CITY OF WILDOMAR

OAK CREEK CANYON DEVELOPMENT

FINAL ENVIRONMENTAL IMPACT REPORT

SCH No. 2012031064
SPECIFIC PLAN NO. 116, AMENDMENT NO. 4
CHANGE OF ZONE AND TENTATIVE TRACT MAP NO. 36388
(PLANNING APPLICATION NO. 11-0261)

Lead Agency:

CITY OF WILDOMAR
23873 CLINTON KEITH ROAD, SUITE 201
WILDOMAR, CA 92595

MAY 2013

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1.0 INTRODUCTION

This Final Environmental Impact Report (Final EIR) was prepared in accordance with the California Environmental Quality Act (CEQA) and the State CEQA Guidelines (Section 15132). The City of Wildomar (City) is the lead agency for the environmental review of the proposed Oak Creek Canyon Residential Development (project; proposed project). The City has the principal responsibility for approving the project. This Final EIR assesses the expected environmental impacts resulting from approval and implementation of the proposed project, as well as responds to comments received on the Draft EIR.

1.1 BACKGROUND AND PURPOSE OF THE EIR

BACKGROUND OF ENVIRONMENTAL REVIEW PROCESS OF THE PROJECT

The following is an overview of the environmental review process for the proposed Oak Creek Canyon Residential Development that led to the preparation of this Final EIR.

Notice of Preparation

The Notice of Preparation (NOP) for the Draft EIR was submitted for public review on Monday, March 5, 2012, with the review period ending on Friday, April 6, 2012. A scoping meeting was held on March 13, 2012, to solicit input from interested agencies and the public. The City received several comment letters on the NOP and during the public scoping meeting. These comments are summarized and a copy of each letter is provided in **Appendix A** of the DEIR.

Draft EIR

The Draft EIR was released for public and agency review on November 19, 2012, with the 45-day review period ending on Friday, January 4, 2013. The Draft EIR contains a description of the project, description of the environmental setting, identification of project impacts, and mitigation measures for impacts found to be significant, as well as an analysis of project alternatives. The Draft EIR was provided to interested public agencies and the public and was made available for review at City offices, at the library, and on the City's website.

Final EIR

The City received comment letters from public agencies, interest groups, and the public regarding the Draft EIR. This document responds to the comments received by the City on the proposed project, as required by CEQA. This document also contains minor edits to the Draft EIR, which are included in Section 3.0, Minor Revisions to the Draft EIR. This document constitutes the Final EIR.

Certification of the Final EIR/Project Consideration

The City will review and consider the Final EIR. If the City finds that the Final EIR is "adequate and complete," the City may certify the Final EIR. The rule of adequacy generally holds that the EIR can be certified if it: (1) shows a good faith effort at full disclosure of environmental information; and (2) provides sufficient analysis to allow decisions to be made regarding the project in contemplation of its environmental consequences.

Upon review and consideration of the Final EIR, the City may take action to adopt, revise, or reject the proposed project. A decision to approve the proposed project would be accompanied by written findings in accordance with State CEQA Guidelines Sections 15091 and 15093. Public Resources Code Section 21081.6 also requires lead agencies to adopt a

mitigation monitoring and reporting program to describe measures that have been adopted or made a condition of project approval in order to mitigate or avoid significant effects on the environment.

1.2 INTENDED USES OF THE EIR

The EIR is intended to evaluate the environmental impacts of the project to the greatest extent possible. This EIR, in accordance with CEQA Guidelines Section 15126, should be used as the primary environmental document to evaluate all planning and permitting actions associated with the project. Please refer to Section 2.0, Project Description, of the Draft EIR for a detailed discussion of the proposed project.

1.3 ORGANIZATION AND SCOPE OF THE FINAL EIR

This document is organized in the following manner:

SECTION 1.0 – INTRODUCTION

Section 1.0 provides an overview of the EIR process to date and what the Final EIR is required to contain.

Section 2.0 – COMMENTS AND RESPONSES TO COMMENTS ON THE DRAFT EIR

Section 2.0 provides a list of commenters, copies of written comments (coded for reference), and the responses to those comments made on the Draft EIR.

Section 3.0 – MINOR REVISIONS TO THE DRAFT EIR

Section 3.0 provides a list of minor edits made to the Draft EIR as a result of comments received and other staff-initiated changes.

2.0 Comments and Responses to Comments on the Draft EIR

2.1 LIST OF COMMENTERS

The following individuals and representatives of organizations and agencies submitted written comments on the Draft EIR. Comment Letters A through G and 1 through 4 were received during the Draft EIR comment period of November 19, 2012, through January 4, 2013; responses to those comments were provided in the proposed Final EIR that was part of the staff report for the meeting held March 27, 2013. During and since that public hearing, the City received additional comments that are included here as Letters 5 through 18. The City Council hearing was continued to April 23, 2013, at which the additional comments were received. The April 23 meeting was subsequently continued to the City Council meeting of May 22, 2013, with the public comment period remaining open. On April 25, 2013, comments were received from the Santa Ana Regional Water Quality Board. All comments and responses and the documentation supporting them, along with the DEIR and all supporting documents, have been provided in this Final EIR and in the administrative record.

Letter	Agency, Organization, or Individual	Date
A	Pechanga Cultural Resources	January 2, 2013
B	Governor's Office of Planning and Research	January 3, 2013
C	Regional Conservation Authority	January 7, 2013
D	City of Menifee	January 7, 2013
E	US Fish and Wildlife Service/California Department of Fish and Wildlife	January 7, 2013
F	County of Riverside, Transportation Department	January 7, 2013
G	California Department of Transportation (Caltrans)	January 16, 2013
1	Gerard Ste. Marie	January 7, 2013
2	Martha Bridges	January 7, 2013
3	Thompson & Associates	January 7, 2013
4	Robert Cashman	January 7, 2013

The following letters were received during or after the City Council meeting of March 27, 2013:

Letter	Agency, Organization, or Individual	Date
5	City of Menifee, Carmen Cave	March 21, 2013
6	Gary Andre	March 26 2013
7	Gayl Taylor	March 26, 2013
8	George Taylor	March 26, 2013
9	Santa Ana Regional Water Quality Control Board	March 26, 2013
10	Sheryl Ade	March 27, 2013
11	Martha Bridges, John Burkett, Gerard Ste. Marie	March 27, 2013
12	Johnson & Sedlack Attorneys at Law	March 27, 2013
13	Santa Ana Regional Water Quality Control Board	March 27, 2013
14	Thompson & Associates Attorneys at Law	March 27, 2013

The following letters were received during or after the City Council meeting of April 23, 2013:

Letter	Agency, Organization, or Individual	Date
15	Sierra Club – San Gorgonio Chapter	April 23, 2013
16	Johnson & Sedlack Attorneys at Law	April 23, 2013
17	Gayl Taylor	April 23, 2013
18	Santa Ana Regional Water Quality Control Board	April 25, 2013

ORAL COMMENTS

During the public hearing on March 27, 2013, the City Council also heard from six public speakers as well as from the project applicant and staff. A number of the speakers also provided written comments that are included in this Final EIR. The six public speakers included:

1. Gayl Taylor – Commenter summarized the letter provided to the Council at this meeting. See response to Letter 7.

2. George Taylor – Commenter summarized the letter provided to the Council at this meeting. See response to Letter 8.

3. Christopher Nelson representing the Umbrell family – Commenter summarized the letter provided to the Council at this meeting. See response to Letter 14.

4. Charles O'Neal – Commenter summarized the letter provided to the Council at this meeting. See Letter 14.

5. Lou Arboleta – The commenter noted that rain events had flooded his teaching farm south of Bundy Canyon Road and requested that stormwater runoff be addressed in the EIR for the "lower side of the road." See response to Letter 14.

6. Jan McKenzie – The commenter wanted to ensure that the 10-inch sewer line in Bundy Canyon Road was of sufficient size to accommodate The Farm. See response to Letter 6, comment 3.

As a result of the comments received, additional explanation and supporting documentation have been added to the FEIR. However, none of this information requires recirculation of the EIR. Recirculation is required when significant new information is added to an EIR after circulation but before final certification. This new information must include significant changes to the project or environmental setting, or a substantial new adverse impact, or a feasible project alternative or mitigation measure that would clearly reduce the impact but will not be implemented on which the public and other agencies must have an opportunity to evaluate and comment (see Public Resources Code (PRC) Section 21091.1; 14 California Code of Regulations (CCR or Guidelines) Section 15088.5; *Vineyard Area Citizens for Responsible Growth v. City of Rancho Cordova* (2007) 40 Cal. 4th 412, 447). The information here only adds to that already discussed in the EIR for purposes of clarification. Conflicting information, including that submitted by experts, does not require recirculation (*Cadiz Land Co. v. Rail Cycle* (2000) 83 Cal. App. 4th 74, 97). Recirculation is not required when changes merely clarify, amplify, or make small modifications (see 14 CCR Section 150833.5(b)). The agency's determination on recirculation is presumed to be correct unless the challenger can show that determination is not supported by substantial evidence

(*Western Placer Citizens for an Agricultural & Rural Environment v. County of Placer* (2006) 144 Cal. App. 4th 890, 903).

2.2 COMMENTS AND RESPONSES

REQUIREMENTS FOR RESPONDING TO COMMENTS ON A DRAFT EIR

State CEQA Guidelines Section 15088 requires that lead agencies evaluate all comments on environmental issues received on the Draft EIR and prepare a written response. The written response must address the significant environmental issue raised and must be detailed, especially when specific comments or suggestions (e.g., additional mitigation measures) are not accepted. In addition, there must be a good faith and reasoned analysis in the written response. However, lead agencies need only respond to significant environmental issues associated with the project and do not need to provide all the information requested by commenters, as long as a good faith effort at full disclosure is made in the EIR (State CEQA Guidelines Section 15204).

State CEQA Guidelines Section 15204 recommends that commenters provide detailed comments that focus on the sufficiency of the Draft EIR in identifying and analyzing the possible impacts on the environment and ways in which the significant effects of the project might be avoided or mitigated. State CEQA Guidelines Section 15204 also notes that commenters should provide an explanation and evidence supporting their comments. Pursuant to State CEQA Guidelines Section 15064, an effect shall not be considered significant in the absence of substantial evidence supporting such a conclusion.

State CEQA Guidelines Section 15088 also recommends that where a response to comments results in revisions to the Draft EIR, those revisions be incorporated as a revision to the Draft EIR or as a separate section of the Final EIR.

RESPONSES TO COMMENT LETTERS

Written comments on the Draft EIR are reproduced on the following pages, along with responses to those comments.

Where changes to the Draft EIR text result from responding to comments, those changes are included in the response and demarcated with revision marks (<u>underline</u> for new text, ~~strikeout~~ for deleted text). The responses to comments were prepared by City staff and PMC.

Letter A

PECHANGA CULTURAL RESOURCES
Temecula Band of Luiseño Mission Indians

Post Office. Box 2183 • Temecula, CA 92593
Telephone (951) 308-9295 • Fax (951) 506-9491

Chairperson:
Germaine Arenas

Vice Chairperson:
Mary Bear Magee

Committee Members:
Evie Gerber
Darlene Miranda
Bridgett Barcello Maxwell
Aurelia Marruffo
Richard B. Scearce, III

Director:
Gary DuBois

Coordinator:
Paul Macarro

Cultural Analyst:
Anna Hoover

January 2, 2013

RECEIVED
JAN 02 2013
CITY OF WILDOMAR

VIA E-MAIL and USPS

Mr. Matthew Bassi
Planning Director
City of Wildomar Planning Dept
23873 Clinton Keith Road, Ste 201
Wildomar, CA 92595

Re: Pechanga Tribe Comments on the Draft Environmental Impact Report for the Oak Creek Canyon Development, Specific Plan 116 Amendment 4, Change of Zone and Tentative Tract Map 36388, Planning Application 11-0261

Dear Mr. Bassi:

This comment letter is written on behalf of the Pechanga Band of Luiseño Indians (hereinafter, "the Tribe"), a federally recognized Indian tribe and sovereign government in response to a Notice of Availability for the above reference Project. The Tribe formally requests, pursuant to Public Resources Code §21092.2, to be notified and involved in the entire CEQA environmental review process for the duration of the above referenced project (the "Project"). Please add the Tribe to your distribution list(s) for public notices and circulation of all documents, including environmental review documents, archeological reports, and all documents pertaining to this Project. The Tribe further requests to be directly notified of all public hearings and scheduled approvals concerning this Project. Please also incorporate these comments into the record of approval for this Project.

A-1

The Tribe submits these comments concerning the Project's potential impacts to cultural resources in conjunction with the environmental review of the Project and to assist the City in developing appropriate avoidance and preservation standards for the cultural sites that the Project will be impacting. The Tribe has met with the City on several occasions to discuss the importance of the activity areas within the Project boundaries and the Village Complex in which it sits. The Tribe has requested avoidance of both CA-RIV-8282 and CA-RIV-1256. However, because of design restrictions, CA-RIV-1256 will be directly impacted. The Tribe also requested a small redesign of the Project to accommodate the avoidance of CA-RIV-1256 but did not receive confirmation of whether this was feasible or not. The Tribe still maintains that the slick can be avoided and requests to discuss this further with the Developer and the City. The Tribe also believes that the proposed mitigation measures are not sufficient to provide for adequate protection of cultural resources. Further information has been provided below.

Sacred Is The Duty Trusted Unto Our Care And With Honor We Rise To The Need

Letter A Continued

THE CITY OF WILDOMAR MUST INCLUDE INVOLVEMENT OF AND CONSULTATION WITH THE PECHANGA TRIBE IN ITS ENVIRONMENTAL REVIEW PROCESS

It has been the intent of the Federal Government[1] and the State of California[2] that Indian tribes be consulted with regard to issues which impact cultural and spiritual resources, as well as other governmental concerns. The responsibility to consult with Indian tribes stems from the unique government-to-government relationship between the United States and Indian tribes. This arises when tribal interests are affected by the actions of governmental agencies and departments. In this case, it is undisputed that the project lies within the Pechanga Tribe's traditional territory. Therefore, in order to comply with CEQA and other applicable Federal and California law, it is imperative that the City of Wildomar consult with the Tribe in order to guarantee an adequate knowledge base for an appropriate evaluation of the Project's effects, as well as generating adequate mitigation measures.

A-2

LEAD AGENCY CONSULTATION WITH THE PECHANGA TRIBE REQUIRED PURSUANT TO CAL. GOVT. C. §§ 65351, 65352, 65352.3, AND 65352.4 (SENATE BILL 18 – TRADITIONAL TRIBAL CULTURAL PLACES LAW)

As a Specific Plan is required for this Project, the Lead Agency initiated and pursued tribal consultation pursuant to a State law entitled Traditional Tribal Cultural Places (also known as SB 18; Cal. Govt. C. § 65352.3). The purpose of consultation is to identify any Native American sacred places and any geographical areas which could potentially yield sacred places, identify proper means of treatment and management of such places, and to ensure the protection and preservation of such places through agreed upon mitigation (Cal. Govt. C. 65352.3; SB18, Chapter 905, Section 1(4)(b)(3)). Consultation must be government-to-government, meaning directly between the Tribe and the Lead Agency, seeking agreement where feasible (Cal. Govt. C. § 65352.4; SB18, Chapter 905, Section 1(4)(b)(3)). Lastly, any information conveyed to the Lead Agency concerning Native American sacred places shall be confidential in terms of the specific identity, location, character and use of those places and associated features and objects. This information is not subject to public disclosure pursuant the California Public Records Act (Cal. Govt. C. 6254(r)).

A-3

The Pechanga Tribe met with the City of Wildomar on June 29, 2012. The Tribe and City representatives met and discussed the Project and potential avoidance measures related to the cultural sites on the Project. At that time, we requested avoidance of CA-RIV-1256 and were told that a discussion with the Project Applicant would occur to discuss this possibility. The Tribe also directly participated in the Phase II excavation activities. Further, the Pechanga Tribe

[1] See e.g., Executive Memorandum of April 29, 1994 on Government-to-Government Relations with Native American Tribal Governments, Executive Order of November 6, 2000 on Consultation and Coordination with Indian Tribal Governments, Executive Memorandum of September 23, 2004 on Government-to-Government Relationships with Tribal Governments, and Executive Memorandum of November 5, 2009 on Tribal Consultation.
[2] See California Public Resource Code §5097.9 et seq.; California Government Code §§65351, 65352.3 and 65352.4

Letter A Continued

is the only tribe that has formally consulted with the City and provided sensitive cultural information and suggested actions related to the cultural sites. As the SB18 process is ongoing and only ends upon formal approval of the Project, the Tribe will continue to work with the City throughout this Project and during earthmoving and final development.

A-3 cont.

PECHANGA CULTURAL AFFILIATION TO PROJECT AREA

The Pechanga Tribe asserts that the Project area is part of *Payómkawichum* (Luiseño), and therefore the Tribe's, aboriginal territory as evidenced by the existence of *Payómkawichum* place names, *tóota yixélval* (rock art, pictographs, petroglyphs), and an extensive artifact record in the vicinity of the Project. This culturally sensitive area is affiliated with the Pechanga Band of Luiseño Indians because of the Tribe's cultural ties to this area as well as extensive history with the City of Wildomar and projects in the surrounding area.

The Pechanga Tribe's knowledge of our ancestral boundaries is based on reliable information passed down to us from our elders; published academic works in the areas of anthropology, history and ethno-history; and through recorded ethnographic and linguistic accounts. Of the many anthropologists and historians who have presented boundaries of the *Payómkawichum* (Luiseño) traditional territory, none have excluded the Wildomar area from their descriptions (Sparkman 1908; Kroeber 1925; White 1963; Harvey 1974; Oxendine 1983; Smith and Freers 1994), and such territory descriptions correspond almost identically with that communicated to the Pechanga people by our elders. While historic accounts and anthropological and linguistic theories are important in determining traditional Luiseño territory, the most critical sources of information used to define our traditional territories are our songs, creation accounts, and oral traditions.

A-4

Luiseño history originates with the creation of all things at *'éxva Teméeku*, in the present day City of Temecula, and dispersing out to all corners of creation (what is today known as Luiseño territory). It was at Temecula that the Luiseño deity *Wuyóot* lived and taught the people, and here that he became sick, finally expiring at Lake Elsinore. Many of our songs relate the tale of the people taking the dying *Wuyóot* to the many hot springs in the area and finally to the hot springs at Elsinore, where he died (DuBois 1908). He was cremated at *'éxva Teméeku*. It is the Luiseño creation account that connects Elsinore to Temecula, and thus to the Temecula people who were evicted and moved to the Pechanga Reservation, and now known as the Pechanga Band of Luiseño Mission Indians (the Pechanga Tribe). From Elsinore, the people spread out, establishing villages and marking their territories. The first people also became the mountains, plants, animals and heavenly bodies.

Many traditions and stories are passed from generation to generation by songs. One of the Luiseño songs recounts the travels of the people to Elsinore after a great flood (DuBois 1908). From here, they again spread out to the north, south, east and west. Three songs, called *Monívol*, are songs of the places and landmarks that were destinations of the Luiseño ancestors, several of which are located near the Project area. They describe the exact route of the Temecula

Letter A Continued

(Pechanga) people and the landmarks made by each to claim title to places in their migrations (DuBois 1908:110). In addition, Pechanga elders state that the Temecula/Pechanga people had usage/gathering rights to an area extending from Rawson Canyon on the east, over to Lake Mathews on the northwest, down Temescal Canyon to Temecula, eastward to Aguanga, and then along the crest of the Cahuilla range back to Rawson Canyon. The Project area is located within the south central area of this culturally affiliated territory. The Native American Heritage Commission (NAHC) Most Likely Descendent (MLD) files substantiate this habitation and migration record from oral tradition. These examples illustrate a direct correlation between the oral tradition and the physical place; proving the importance of songs and stories as a valid source of information outside of the published anthropological data.

Tóota yixélval (rock art) is also an important element in the determination of Luiseño territorial boundaries. *Tóota yixélval* can consist of petroglyphs (incised) elements, or pictographs (painted) elements. The science of archaeology tells us that places can be described through these elements. Riverside and Northern San Diego Counties are home to red-pigmented pictograph panels. Archaeologists have adopted the name for these pictograph-versions, as defined by Ken Hedges of the Museum of Man, as the San Luis Rey style. The San Luis Rey style incorporates elements which include chevrons, zig-zags, dot patterns, sunbursts, handprints, net/chain, anthropomorphic (human-like) and zoomorphic (animal-like) designs. Tribal historians and photographs inform us that some design elements are reminiscent of Luiseño ground paintings. A few of these design elements, particularly the flower motifs, the net/chain and zig-zags, were sometimes depicted in Luiseño basket designs and can be observed in remaining baskets and textiles today.

A-4 cont.

An additional type of *tóota yixélval*, identified by archaeologists also as rock art or petroglyphs, are cupules. Throughout Luiseño territory, there are certain types of large boulders, taking the shape of mushrooms or waves, which contain numerous small pecked and ground indentations, or cupules. Many of these cupule boulders have been identified within a few miles of the Project. Additionally, according to historian Constance DuBois:

> When the people scattered from Ekvo Temeko, Temecula, they were very powerful. When they got to a place, they would sing a song to make water come there, and would call that place theirs; or they would scoop out a hollow in a rock with their hands to have that for their mark as a claim upon the land. The different parties of people had their own marks. For instance, Albañas's ancestors had theirs, and Lucario's people had theirs, and their own songs of Munival to tell how they traveled from Temecula, of the spots where they stopped and about the different places they claimed (1908:158).

Thus, our songs and stories, our indigenous place names, as well as academic works, demonstrate that the Luiseño people who occupied what we know today as Murrieta, Temecula, and the areas in between are ancestors of the present-day *Payómkawichum*/Pechanga people, and as such, Pechanga is culturally affiliated to this geographic area.

Letter A Continued

The Tribe welcomes the opportunity to meet with the City of Wildomar to further explain and provide documentation concerning our specific cultural affiliation to lands within your jurisdiction if necessary. A-4 cont.

PROJECT IMPACTS TO CULTURAL RESOURCES

The proposed Project is located in a highly sensitive region of Luiseño territory and the Tribe believes that the possibility for recovering subsurface resources during ground-disturbing activities is high. The Tribe has over thirty-five (35) years of experience in working with various types of construction projects throughout its territory. The combination of this knowledge and experience, along with the knowledge of the culturally-sensitive areas and oral tradition, is what the Tribe relies on to make fairly accurate predictions regarding the likelihood of subsurface resources in a particular location.

The Pechanga Band is not opposed to this Project; however, we are opposed to any direct, indirect and cumulative impacts this Project may have to tribal cultural resources. The Tribe's primary concerns stem from the Project's proposed impacts on Native American cultural resources. The Tribe is concerned about both the protection of unique and irreplaceable cultural resources, such as Luiseño village sites, sacred sites and archaeological items which would be displaced by ground disturbing work on the Project, and on the proper and lawful treatment of cultural items, Native American human remains and sacred items likely to be discovered in the course of the work. A-5

The Tribe is in receipt of the Archaeological Reports and the Draft Environmental Impact Report for this Project. The Tribe does not believe that the cultural sites identified within the Project boundaries should be characterized as "not significant." We know that these sites are associated with the Audie Murphy Village. Native American village sites often encompassed several square miles (upwards of 5 miles for larger villages) so that community inhabitants could take advantage of multiple resource opportunities. Further, family groups were spread out in order to provide privacy to the residents. By way of analogy, this is similar to a city structure where there are boundaries that associate families with a particular area but within those boundaries are different communities.

Luiseño settlement patterns have been described ethnographically by Sparkman[3] and Strong[4] as sedentary and territorial, with the extended families residing in villages with individual living areas separated anywhere from ¼ of a mile to ½ a mile apart. The proposal that a village footprint covers an expansive area, with each family having its own milling feature(s) is

[3] Sparkman, Philip Stedman, *The Culture of the Luiseño Indians*. University of California Publications in American Archaeology and Ethnology 1908, 8(4).
[4] Strong, William D. *Aboriginal Society in Southern California*. University of California Publications in American Archaeology and Ethnology 26, 1929

Letter A Continued

supported by Bean when he argues that "homes were located some distance apart to provide privacy for families, if terrain permitted."[5] Bean and Smith also suggest "a village might occupy three to five square miles."[6]

The 'sites' located on the Project are intrinsically bound to the landscape and to California's history and cultural heritage because they help tell us the story of the first peoples of this land who not only have their history to contribute to California's unique cultural landscape and rich history, but who also continue to thrive and live here in contemporary times. Although the sites analyzed individually may not be considered significant per the California Register of Historic Resources (CRHR), when taken as a whole – science, ethnographic and academic works, linguistic evidence and tribal knowledge – the evidence clearly shows that this area is indeed significant and with the data we have at the present moment, we believe these sites would be eligible for listing on both California and the National Registers.

The Tribe strives first and foremost to assist the Lead Agency and the Developer with designing a project so that it can be as culturally sensitive as possible. The Tribe also knows that designating cultural sites as unique and significant does not necessarily allow for complete preservation. The Tribe argues that regardless of what preservation or avoidance efforts occur on a given project, archaeological reports must include as much data as is available so that future archaeologists and Lead Agencies can understand the degree of importance of a region which will assist with future development in the area. Thusly, the Tribe requests that the archaeological study and the EIR be updated to indicate that the sites located on this Project are indeed related to the Audie Murphy Village and that when viewed as part of the cultural landscape, they are significant.

A-5 cont.

Additionally, the Tribe has concerns about the proposed mitigation measures. They are not detailed enough to ensure adequate protection of cultural resources during earthmoving activities. These are addressed below.

Finally, the Tribe would like the City to know that no mitigation will ever reduce the impacts to cultural resources to a below significant level. The Tribe's ancestors, their places and things are non-renewable resources. Once they are impacted, whether in their entirety or any portion thereof, is a cumulative impact to the cultural landscape and the Tribe's cultural heritage. The DEIR states that the surrounding property has already disturbed soils which likely disturbed cultural resources during development. Therefore, as a result of the surrounding development, any impacts this Project might make to cultural resources is less than cumulatively considerable. The Tribe disagrees and believes that <u>because</u> the adjacent property has likely impacted cultural resources, this Project should make every attempt at preserving the resources within its

[5] Bean, Lowell J. *Mukat's People: The Cahuilla Indians of Southern California*. University of California Press, Berkeley, 1972, p. 71
[6] Bean, Lowell J. and Charles R. Smith. Serrano: In *Handbook of North American Indians, Volume, 8, California*, edited by Robert Heizer, Smithsonian Institution, Washington D.C., p. 43.

Letter A Continued

boundaries specifically so that cultural resources will not be cumulatively impacted further. Because the surrounding property impacted cultural resources, this does not make it acceptable to continue to impact them on future developments. In fact, this argues even more strenuously for avoidance so that no further resources are lost to development. The Tribe requests to continue to work closely with the City and future Applicants to work towards avoidance of all cultural sites, not just areas that have subjectively been deemed significant per the CRHR or CEQA.

A-5 cont.

PROJECT MITIGATION MEASURES

The Tribe appreciates being included in the Project mitigation measures regarding monitoring; however, there is no direction regarding the disposition of the existing cultural sites or clear direction on inadvertent finds. These are essential components to an environmental document and as currently drafted, the DEIR is in inadequate under the law because it the mitigation measures are vague and thus, unenforceable. This must be revised so that there is a degree of certainty among the parties to ensure that the Developer knows what is required for the known resources and those we know will be encountered during earth moving activities. The Tribe has provided suggested revisions and additions to the existing mitigation measures below (strikeouts are deletions and underlines are additions).

Impact 3.9.2 At least 30 days Prior to the issuance of the first grading permit, the project applicant shall enter into a ~~Tribal~~ Cultural Resources Treatment and Monitoring Agreement with the Pechanga Band of Luiseño Indians . The agreement shall include, but not be limited to, outlining provisions and requirements for addressing the treatment of cultural resources, project grading and development scheduling; terms of compensation for the monitors; and treatment, final disposition of any cultural resources, sacred sites, and human remains discovered on the site, and establishing on-site monitoring provisions and/or requirements for professional Pechanga Tribal monitors during all ground-disturbing activities. A copy of this signed agreement shall be provided to the Planning Director and Building Official prior to the issuance of the first grading permit.
Timing/Implementation: At least 30 days prior to ground-disturbing activities and grading permit issuance

A-6

Impact 3.9.2b Should any culturally ~~significant~~ resources be uncovered during the grading and construction phases of the proposed project, work shall be halted or relocated to an area outside of the area in which the resource was found while ~~a qualified archeologist and tribal representative~~ the Project archaeologist and the Pechanga representative identify the resource and reassess the area. If the resource found is determined to be an historical or unique archeological resource, a time allotment sufficient to allow for the implementation of avoidance measures or appropriate mitigation shall be made available. Work on the proposed project may continue in

Letter A Continued

other areas of the project site while any historical or unique archeological resource mitigation takes place.

Timing/Implementation: During all grading and construction activities

Impact 3.9.2c Prior to beginning project construction, the Project Applicant shall retain a Riverside County qualified archaeological monitor to monitor all ground-disturbing activities in an effort to identify any unknown archaeological resources. Any newly discovered cultural resource deposits shall be subject to a cultural resources evaluation in consultation with the Pechanga Tribe. The Project archaeologist shall be responsible for updating the State DPR forms and completing an Archaeological Monitoring Report detailing the results of the monitoring program including the final disposition of CA-RIV-8282 and CA-RIV-1256, updated DPR forms, a complete catalog list of resources collected during monitoring activities and any other pertinent information related to the Project. A final copy of the study shall be sent to the Project Applicant, the City of Wildomar, the Eastern Information Center and the Pechanga Tribe.

Impact 3.9.2d Prior to beginning project construction, the Project Archaeologist shall file an archaeological monitoring report with the City to document the proposed methodology for grading activity observation which will be determined in consultation with the Pechanga Tribe. Said methodology shall include the requirement for a qualified archaeological monitor to be present and to have the authority to stop and redirect grading activities. In accordance with the agreement required in Impact 3.9.2, the archaeological monitor's authority to stop and redirect grading will be exercised in consultation with the Pechanga Tribe in order to evaluate the significance of any archaeological resources discovered on the property. Tribal and archaeological monitors shall be allowed to monitor all grading, excavation and groundbreaking activities, and shall also have the authority to temporarily stop and redirect grading activities.

A-6 cont.

Impact 3.9.2e The landowner shall relinquish ownership of all cultural resources, including sacred items, burial goods and all archaeological artifacts that are found on the project area to the Pechanga Tribe for proper treatment and disposition. The Tribe maintains a 36 CFR part 79 standard facility and requests that all artifacts, not including human remains, sacred/ceremonial items or grave goods, be curated at that facility. Further, all sacred sites, should they be encountered within the project area, shall be avoided and preserved as the preferred mitigation, if feasible.

Impact 3.9.2f Significant site CA-RIV-8282 cannot be avoided as the preferred option per CEQA. As there are no large boulder outcrops or other predominant features

Letter A Continued

located within this site, no measures are necessary for relocation. However, because the archaeological testing plan identified cultural resources on the surface and at least 35 centimeters in depth, controlled grading will occur within the boundaries of RIV-8282 in order to observe any buried features, artifacts or human remains that were not identified during testing. A plan detailing the controlled grading will be prepared in consultation with the Pechanga Tribe describing the process and duration of the grading in this area prior to grading in the RIV-8282 area.

A-6 cont.

Impact 3.9.2g Significant site CA-RIV-1256 will be avoided through design of the Project. Prior to development in the area, the Project archaeologist and the Pechanga Tribe will fence the area to be protected. No impacts to the area should occur during grading. Upon completion of the grading in this area, the fencing will be removed. The Pechanga Tribe and the Project Applicant will develop a long-term management plan for CA-RIV-1256.

The Tribe reserves the right to fully participate in the environmental review process, as well as to provide further comment on the Project's impacts to cultural resources and potential mitigation for such impacts.

The Pechanga Tribe looks forward to working together with the City of Wildomar in protecting the invaluable Pechanga cultural resources found in the Project area. Please contact me at 951-770-8104 or at ahoover@pechanga-nsn.gov once you have had a chance to review these comments so that we might address the issues concerning the mitigation language. Thank you.

Sincerely,

Anna Hoover
Cultural Analyst

Cc Pechanga Office of the General Counsel

Pechanga Cultural Resources • Temecula Band of Luiseño Mission Indians
Post Office Box 2183 • Temecula, CA 92592

Sacred Is The Duty Trusted Unto Our Care And With Honor We Rise To The Need

Letter A: Pechanga Cultural Resources

Responses

A-1 The commenter asks that CA-RIV-1256 and CA-RIV-8282 be avoided through modification of the project design. The EIR determined that the impacts to both CA-RIV-1256 (see page 3.9-7 of the Draft EIR) and CA-RIV-8282 (see page 3.9-16 of the Draft EIR) are less than significant and therefore do not require mitigation. However, the City has the ability to condition the project to avoid the resource as part of the project approval process. This information will be presented to the Planning Commission and City Council as part of the staff materials to consider the project. The commenter has also requested that the Tribe be notified of all documents pertaining to the project. The Pechanga Tribe is on the distribution list for all CEQA documents prepared by the City of Wildomar and will continue to receive notifications for this project.

A-2 The commenter states that the City must consult with the Tribe during the environmental review process. The City has complied with the provisions of Senate Bill (SB) 18 mandating that prior to the adoption or amendment of the City's General Plan, the City conduct consultations with California Native American Tribes for the purpose of preserving specified places, features, and objects that are located within the City's jurisdiction. The City's consultation process is described on page 3.9-9 of the Draft EIR, with copies of the correspondence included as Appendix 3.9-1 of the Draft EIR.

A-3 The commenter notes that the consultation process was initiated and that it will continue. The commenter also states that the request to avoid CA-RIV-1256 was made during one of the consultation meetings. As noted in response A-1, impacts to both CA-RIV-1256 and CA-RIV-8282 were considered less than significant for purposes of the California Environmental Quality Act. Because of the less than significant impacts, the EIR does not require mitigation of impacts to these sites. However, the Planning Commission and City Council have the ability to condition the project to avoid one or both of the sites as part of the subdivision review and approval process. This information will be presented to the Planning Commission and City Council as part of the staff materials to consider the project.

A-4 The commenter explains the affiliation of the Pechanga Tribe to the project area. The comment does not raise an environmental issue; therefore, no changes to the EIR are necessary.

A-5 The commenter disagrees with the determination in the Draft EIR that the cultural sites are less than significant and requests revisions to the technical studies and the Draft EIR (see discussion under Impact 3.9.1 beginning on page 3.9-16 of the Draft EIR). The request for an updated archaeological study and EIR is unreasonable and unacceptable. Project scoping letters for the project were sent to Anna Hoover, Paul Macarro, and Mark Macarro of the Pechanga Tribe on December 26, 2011, apprising them of the fact that the Sacred Lands File search conducted by the Native American Heritage Commission did not indicate the presence of any cultural resources within the project's Area of Potential Effect (APE). The project scoping letters further asked that any comments or information regarding the subject property be communicated to the project archaeologist as soon as possible. This was the appropriate time to contribute information regarding the potential connection of archaeological sites CA-RIV-1256 and CA-RIV-8282 to the Audie Murphy Village. If such information had been received from the Pechanga Tribe at that time, it would have been included in the Phase I Cultural Resources Assessment and would have been a contributing factor in the evaluation of

site significance, per CEQA criteria. However, in her January 26, 2012, response to the project scoping letter, Ms. Hoover did not provide any information other than stating that the area was extremely sensitive and further stating, "Because we have been working in this area for many years, we are familiar with this particular cultural landscape and have additional information we would like to share with the City." This information should also have been shared with cultural resources consultant Jean A. Keller, PhD, who was in the process of conducting the archaeological study for the proposed project. Providing the additional information one year after the Phase I Cultural Resources Assessment's completion instead of at the time the study was being conducted makes little sense, since this precluded the information's inclusion in the report. As noted in response A-1 above, the analysis conducted for the EIR determined that impacts to both CA-RIV-1256 (see page 3.9-7 of the Draft EIR) and CA-RIV-8282 (see page 3.9-16 of the Draft EIR) are less than significant and therefore do not require mitigation. No additional information has been provided to the City to indicate that either of the sites constitutes a unique archaeological resource which requires mitigation. However, as noted in response A-3, the Planning Commission and City Council have the ability to condition the project to avoid one or both of the sites as part of the subdivision review and approval process. This information will be presented to the Planning Commission and City Council as part of the staff materials to consider the project.

A-6 The commenter requests modifications to the mitigation measures to provide clear direction on the disposition of inadvertent finds. These amendments to the mitigation measures are reasonable and have been made to the Draft EIR. See Section 3.0, Minor Revisions to the Draft EIR, of this Final EIR.

Letter B

STATE OF CALIFORNIA
Governor's Office of Planning and Research
State Clearinghouse and Planning Unit

Edmund G. Brown Jr.
Governor

Ken Alex
Director

January 3, 2013

Matthew C. Bassi
City of Wildomar
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

Subject: Oak Creek Canyon Residential Project (Planning Application No. 11-0261)
SCH#: 2012031064

Dear Matthew C. Bassi:

The State Clearinghouse submitted the above named Draft EIR to selected state agencies for review. On the enclosed Document Details Report please note that the Clearinghouse has listed the state agencies that reviewed your document. The review period closed on January 2, 2013, and the comments from the responding agency (ies) is (are) enclosed. If this comment package is not in order, please notify the State Clearinghouse immediately. Please refer to the project's ten-digit State Clearinghouse number in future correspondence so that we may respond promptly.

Please note that Section 21104(c) of the California Public Resources Code states that:

> "A responsible or other public agency shall only make substantive comments regarding those activities involved in a project which are within an area of expertise of the agency or which are required to be carried out or approved by the agency. Those comments shall be supported by specific documentation."

B-1

These comments are forwarded for use in preparing your final environmental document. Should you need more information or clarification of the enclosed comments, we recommend that you contact the commenting agency directly.

This letter acknowledges that you have complied with the State Clearinghouse review requirements for draft environmental documents, pursuant to the California Environmental Quality Act. Please contact the State Clearinghouse at (916) 445-0613 if you have any questions regarding the environmental review process.

Sincerely,

Scott Morgan
Director, State Clearinghouse

Enclosures
cc: Resources Agency

1400 TENTH STREET P.O. BOX 3044 SACRAMENTO, CALIFORNIA 95812-3044
TEL (916) 445-0613 FAX (916) 323-3018 www.opr.ca.gov

Letter B Continued

Document Details Report
State Clearinghouse Data Base

SCH#	2012031064
Project Title	Oak Creek Canyon Residential Project (Planning Application No. 11-0261)
Lead Agency	Wildomar, City of
Type	EIR Draft EIR
Description	While a single proposal for processing by the City, the proposed project requires three (3) distinct development actions more specifically described as follows: Specific Plan Amendment (SPA) - An amendment to the Farm Specific Plan No. 116 to create special development standards, architectural design guidelines, landscape design guidelines, etc., for a 315-lot single family residential subdivision project (with private parks), including a 3.5 acre commercial retail component; and Change of Zone (CZ) - An amendment to the City's Zoning Map from R-1 (One-Family Dwelling) to R-4 (Planned Residential Zone) and C/1-C/P (General Commercial) to accommodate the development of a 315-lot single family residential subdivision project (with private parks), including a 3.5 acre commercial retail component; and, Tentative Tract Map No. 36388 - A proposed subdivision of 151.23 acres into 315 lots (including a 3.5 acre commercial site - Lot L) for the development of 315 single family residential dwelling units with lot sizes ranging from 4,000 sf to 7,200 sf with private parks.

Lead Agency Contact

Name	Matthew C. Bassi
Agency	City of Wildomar
Phone	951 677-7751 x213 *Fax*
email	
Address	23873 Clinton Keith Road, Suite 201
City	Wildomar *State* CA *Zip* 92595

Project Location

County	Riverside
City	Wildomar
Region	
Lat / Long	
Cross Streets	Bundy Canyon Road between Oak Canyon Drive and Sunset Ave
Parcel No.	362-070-001, 003, 006, 010, 013, 018, 021, 023, 024; 362-080-004, 005, 007, 008, 009, 012; 362-0
Township	6S *Range* 3W *Section* 19N *Base* SBB&M

Proximity to:

Highways	I-15, 215
Airports	No
Railways	No
Waterways	No
Schools	David A. Brown MS, Wildomar Es, Elsinore HS,Donald GrahamES,
Land Use	The proposed project is part of the Farm Specific Plan No. 116. Current zoning for the project site is R-1, Single Family Residential.
Project Issues	Air Quality; Archaeologic-Historic; Drainage/Absorption; Geologic/Seismic; Noise; Population/Housing Balance; Public Services; Recreation/Parks; Schools/Universities; Soil Erosion/Compaction/Grading; Solid Waste; Traffic/Circulation; Vegetation; Water Quality; Water Supply; Wildlife; Growth Inducing; Landuse; Cumulative Effects
Reviewing Agencies	Resources Agency; Department of Conservation; Department of Fish and Game, Region 6; Office of Historic Preservation; Department of Parks and Recreation; Department of Water Resources; California Highway Patrol; Caltrans, District 8; Department of Housing and Community Development; Regional Water Quality Control Board, Region 9; Native American Heritage Commission

Letter B Continued

Document Details Report
State Clearinghouse Data Base

Date Received 11/19/2012 *Start of Review* 11/19/2012 *End of Review* 01/02/2013

Letter B Continued

STATE OF CALIFORNIA — Edmund G. Brown, Jr., Governor

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-6251
Fax (916) 657-5390
Web Site www.nahc.ca.gov
ds_nahc@pacbell.net

Clear 1/02/13 e

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NOV 27 2012
STATE CLEARING HOUSE

November 21, 2012

Mr. Matthew C. Bassi, Planning Director
City of Wildomar
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

Re: SCH#2012031064; CEQA Notice of Completion; draft Environmental Impact Report (DEIR) for the **"Oak Creek Canyon Residential Project (Planning Application No. 11-0261) Project;"** located in the City of Wildomar; Riverside County, California

Dear Mr. Bassi:

The NAHC is the State of California 'Trustee Agency' for the protection and preservation of Native American cultural resources pursuant to California Public Resources Code §21070 and affirmed by the Third Appellate Court in the case of EPIC v. Johnson (1985: 170 Cal App. 3rd 604).

This letter includes state and federal statutes relating to Native American historic properties or resources of religious and cultural significance to American Indian tribes and interested Native American individuals as 'consulting parties' under both state and federal law. State law also addresses the freedom of Native American Religious Expression in Public Resources Code §5097.9. This project is also subject to California Government Code Section 65352.3 *et seq.*

The California Environmental Quality Act (CEQA – CA Public Resources Code 21000-21177, amendment s effective 3/18/2010) requires that any project that causes a substantial adverse change in the significance of an historical resource, that includes archaeological resources, is a 'significant effect' requiring the preparation of an Environmental Impact Report (EIR) per the CEQA Guidelines defines a significant impact on the environment as 'a substantial, or potentially substantial, adverse change in any of physical conditions within an area affected by the proposed project, including ...objects of historic or aesthetic significance." In order to comply with this provision, the lead agency is required to assess whether the project will have an adverse impact on these resources within the 'area of potential effect (APE), and if so, to mitigate that effect. The NAHC advises the Lead Agency to request a Sacred Lands File search of the NAHC if one has not been done for the 'area of potential effect' or APE previously. **B-2**

The NAHC "Sacred Sites,' as defined by the Native American Heritage Commission and the California Legislature in California Public Resources Code §§5097.94(a) and 5097.96. Items in the NAHC Sacred Lands Inventory are confidential and exempt from the Public Records Act pursuant to California Government Code §6254 (r).

Early consultation with Native American tribes in your area is the best way to avoid unanticipated discoveries of cultural resources or burial sites once a project is underway.

Letter B Continued

Culturally affiliated tribes and individuals may have knowledge of the religious and cultural significance of the historic properties in the project area (e.g. APE). We strongly urge that you make contact with the list of Native American Contacts on the attached list of Native American contacts, to see if your proposed project might impact Native American cultural resources and to obtain their recommendations concerning the proposed project. Pursuant to CA Public Resources Code § 5097.95, the NAHC requests cooperation from other public agencies in order that the Native American consulting parties be provided pertinent project information. Consultation with Native American communities is also a matter of environmental justice as defined by California Government Code §65040.12(e). Pursuant to CA Public Resources Code §5097.95, the NAHC requests that pertinent project information be provided consulting tribal parties, including archaeological studies. The NAHC recommends *avoidance* as defined by CEQA Guidelines §15370(a) to pursuing a project that would damage or destroy Native American cultural resources and California Public Resources Code Section 21083.2 (Archaeological Resources) that requires documentation, data recovery of cultural resources, construction to avoid sites and the possible use of covenant easements to protect sites.

Furthermore, the NAHC if the proposed project is under the jurisdiction of the statutes and regulations of the National Environmental Policy Act (e.g. NEPA; 42 U.S.C. 4321-43351). Consultation with tribes and interested Native American consulting parties, on the NAHC list, should be conducted in compliance with the requirements of federal NEPA and Section 106 and 4(f) of federal NHPA (16 U.S.C. 470 *et seq*), 36 CFR Part 800.3 (f) (2) & .5, the President's Council on Environmental Quality (CSQ, 42 U.S.C 4371 *et seq.* and NAGPRA (25 U.S.C. 3001-3013) as appropriate. The 1992 *Secretary of the Interiors Standards for the Treatment of Historic Properties* were revised so that they could be applied to all historic resource types included in the National Register of Historic Places and including cultural landscapes. Also, federal Executive Orders Nos. 11593 (preservation of cultural environment), 13175 (coordination & consultation) and 13007 (Sacred Sites) are helpful, supportive guides for Section 106 consultation. The aforementioned Secretary of the Interior's *Standards* include recommendations for all 'lead agencies' to consider the historic context of proposed projects and to "research" the cultural landscape that might include the 'area of potential effect.'

B-2 cont.

Confidentiality of "historic properties of religious and cultural significance" should also be considered as protected by California Government Code §6254(r) and may also be protected under Section 304 of he NHPA or at the Secretary of the Interior discretion if not eligible for listing on the National Register of Historic Places. The Secretary may also be advised by the federal Indian Religious Freedom Act (cf. 42 U.S.C., 1996) in issuing a decision on whether or not to disclose items of religious and/or cultural significance identified in or near the APEs and possibility threatened by proposed project activity.

Furthermore, Public Resources Code Section 5097.98, California Government Code §27491 and Health & Safety Code Section 7050.5 provide for provisions for inadvertent discovery of human remains mandate the processes to be followed in the event of a discovery of human remains in a project location other than a 'dedicated cemetery'.

To be effective, consultation on specific projects must be the result of an ongoing relationship between Native American tribes and lead agencies, project proponents and their contractors, in the opinion of the NAHC. Regarding tribal consultation, a relationship built around regular meetings and informal involvement with local tribes will lead to more qualitative consultation tribal input on specific projects.

2

Letter B Continued

Finally, when Native American cultural sites and/or Native American burial sites are prevalent within the project site, the NAHC recommends 'avoidance' of the site as referenced by CEQA Guidelines Section 15370(a).

B-2 cont.

If you have any questions about this response to your request, please do not hesitate to contact me at (916) 653-6251.

Sincerely,

Dave Singleton
Program Analyst

Cc: State Clearinghouse

Attachment: Native American Contact List

Letter B: Governor's Office of Planning and Research

Responses

B-1 The Governor's Office of Planning and Research comments that the City of Wildomar has fulfilled the notification requirements for the project. No revisions to the EIR are necessary.

B-2 The Native American Heritage Commission (NAHC) was contacted during circulation of the NOP and responded with a letter dated April 9, 2012, included in Appendix 1.0-2 of the Draft EIR. The letter from the NAHC states that Native American cultural resources were not identified within the project area. The City is also required to contact the NAHC during any General Plan Amendment. This contact, known as SB 18, is to determine if any of the Tribes wish to consult directly with the City regarding sacred lands or sites. The City complied with the provisions of SB 18 by contacting the Native American Heritage Commission and on June 21, 2012, received a list of 14 Tribes from the Commission. The City contacted all 14 Tribes. As of the time of completion of the Phase I Cultural Resources Assessment for the proposed project, two of the tribal representatives contacted the City: the Cahuilla Band of Indians and the Temecula Band of Luiseño Mission Indians. Both representatives stated that while the project site is outside of their present reservation's boundaries, the area of the proposed project is within their ancestral territory. In consideration of the Temecula Band of Luiseño Mission Indians requested to be in direct consultation with the City of Wildomar during the development of the proposed project (see page 3.9-9 of the Draft EIR). The City is in direct consultation with the Temecula Band of Luiseño Mission Indians.

While both Phase I and Phase II Cultural Resource Assessments were conducted for the proposed project, both of the documents contain potentially sensitive information. As a result, while the analysis in Section 3.9, Cultural and Paleontological Resources, of the Draft EIR relied on these reports, only brief summaries are included as Appendices 3.9-1 and 3.9-2 of the Draft EIR. The City provided summary statements from the reports in order to protect confidentiality of the sites (see page 3.9-1 of the Draft EIR).

The proposed project is a private subdivision and subject to the California Environmental Quality Act. The project is not subject to the National Environmental Policy Act (NEPA).

The City's consultation process for this project is described on page 3.9-9 of the Draft EIR, with copies of the correspondence included as Draft EIR Appendix 3.9-1. The City regularly consults with the Pechanga Tribe for all development projects. The consultation for this project will continue, up to and including the City Council meeting.

Mitigation measures MM 3.9.2, 3.9.3, and 3.9.4 address the potential for inadvertent discovery of cultural resources during grading or trenching. The measures, beginning on page 3.9-19 of the Draft EIR, also require on-site monitoring by a representative of the tribe and an agreement regarding ownership of any cultural resources discovered. See Section 3.0 of this Final EIR for the improvements made to the mitigation measures by the Pechanga Tribe in response to Letter A.

Letter C

Regional Conservation Authority
Western Riverside County

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January 7, 2013

Mr. Matthew Bassi
Planning Director
City of Wildomar
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

RE: DRAFT ENVIRONMENTAL IMPACT REPORT FOR OAK CREEK CANYON SCH 2012031064

Dear Mr. Bassi:

The Regional Conservation Authority (RCA) received the Draft Environmental Impact Report (EIR) for Specific Plan No. 116, Amendment No. 4, General Plan Amendment, Change of Zone and Tentative Tract Map No. 36388, Planning Application No. 11-0261 (Project) on November 20, 2012. The RCA is submitting these comments on the Project EIR pertaining to the implementation and consistency of the Project with the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP). The City of Wildomar is a Permittee under the MSHCP and pursuant to the Implementing Agreement is responsible for ensuring all project approvals are consistent with the MSHCP goals and policies.

The RCA offers the following comments:

1. The EIR and the MSHCP Consistency Analysis contained in Appendix 3.8-1 indicate that only approximately 0.26 acres of the 163.25 acre project site is located within a Criteria Cell. The RCA views the 0.26 acre area within a Criteria Cell as insignificant, not warranting a Joint Project Review for the Project, nor would any conservation need to be set aside for the Project. **C-1**

2. DEIR, Ch. 3, Figure 3.8-1 and 3.8.-2 depict only existing conditions of biological and Riparian/Riverine resources on site. Analysis and figures of the proposed project impacts on those resources should be included. MSHCP Riparian/Riverine resources, based on the definitions defined in MSHCP Section 6.1.2, should be depicted and assessed separate from jurisdictional areas of the California Department of Fish and Wildlife and the U.S. Army Corps of Engineers. The EIR Biological Resources section should be revised to include both depiction and impact analysis of MSHCP-defined riparian and riverine areas. **C-2**

Letter C Continued

3. Page 3.8-24 of the EIR states that "Implementation of the MSHCP as part of the project development review process fully mitigates for impacts for these covered species." To clarify, the project must complete the analysis, prepare the appropriate mitigation and conditions for compliance as a result of Section 3 and 6 of the MSHCP imposed by the City in order for the project to be found to be consistent with the MSHCP. Mitigation for species related impacts can then be provided by the MSHCP Permits. **C-3**

4. Page 3.8-26 of the EIR includes discussion of Impact 3.8.3 and mitigation associated with impacts to birds, such as the burrowing owl. Actual impact analysis should be included prior to the mitigation measure that discusses habitat assessments and focused breeding season surveys conducted for the burrowing owl in compliance with Section 6.3.2 of the MSHCP. Wintering bird surveys are not accepted as part of MSHCP burrowing owl survey protocol and should not be utilized as stated in Mitigation Measure 3.8.3a. Additionally, the City should be aware that the RCA and Wildlife Agencies (CDFW and US Fish and Wildlife Service) don't support passive relocation of burrowing owls except in narrow circumstances where there is suitable adjacent conserved land available. There is currently no suitable conservation land adjacent to the project. **C-4**

5. MM 3.8.3a and 3.8.3b should be modified to require immediate notification to the RCA if owls are found during pre-construction surveys. Since passive relocation isn't appropriate for this project t the applicant will need to prepare a relocation plan if owls are found during pre-construction surveys. **C-5**

6. Page 3.8-27 of the EIR includes discussion of Impact 3.8.4 and mitigation associated with riparian resources. The EIR discusses "no net loss" of riparian resources; however, no clear or definitive method of ensuring no net loss has been presented. The MSHCP Consistency Analysis in Appendix 3.8-2 indicates no impacts are expected however, the EIR appears to assume there will be and, based on the site plan included, impacts will occur. The EIR does not provide adequate analysis about the potential impacts to Section 6.1.2-defined riparian and riverine resources. The EIR should be revised to include: **C-6**
   - Analysis of expected impacts to riparian and riverine resources.
   - Mapping of the riparian and riverine impacts.
   - Focused surveys for riparian birds where impacts are expected and suitable habitat occurs.
   - Conservation of avoided riparian/riverine areas.

Letter C Continued

- Determination of Biologically Equivalent or Superior Preservation (DBESP) that includes creation, restoration and/or enhancement to meet biological equivalency standards of the MSHCP.

C-6 cont.

Without the above, the project cannot demonstrate consistency with Section 6.1.2 of the MSHCP and therefore cannot rely on the MSHCP to mitigate impacts to biological resources.

7. Page 3.8-30 contains the following statement: "These fees are utilized to fund the minimization to certain endemic species." This is an inaccurate statement; the MSHCP Fees are for land acquisition for the fulfillment of the MSHCP Conservation Area. This section of the EIR also goes on to state: "Given the proposed project's impacts to the overlying habitat conservation plan area, implementation of the following mitigation measures is required." This statement is also not accurate; all projects within the MSHCP Plan Area are required to pay MSHCP Fees, regardless of biological impacts. The project is not consistent with the MSHCP until the issues raised in this letter are addressed and the fees have been remitted to the RCA. The EIR should be revised so that it portrays an accurate representation of MSHCP compliance.

C-7

8. Page 3.8-31 of the EIR includes MM 3.8.8a. Deferral of a DBESP is not adequate and does not demonstrate consistency with the MSHCP. Please refer to Comment #8.

C-8

9. Page 3.8-32 states that the MSHCP covers over 150 species; this is not an accurate statement. The MSHCP has coverage for 146 species. The EIR should be corrected. The discussion about cumulative impacts and the project's compliance with the MSHCP should be revised. The project has not demonstrated compliance with the MSHCP through the proposed mitigation measures; instead the Project has deferred compliance with the MSHCP. MSHCP consistency as requested in previous comments is required for species "take" to be conferred. The EIR should be revised and the required consistency analyses and compliance provided.

C-9

Sincerely,

Charles Landry
Executive Director

Letter C: Regional Conservation Authority

Reponses

C-1 The commenter affirms that the 0.26 acre of the 151.23-acre proposed project site which is within a criteria cell is insignificant and does not warrant a Joint Project Review or conservation. No changes to the EIR are necessary.

C-2 The commenter requests that the Biological Resources section of the EIR be amended to analyze the impacts on the riparian/riverine resources affected by the project. A Determination of Biologically Equivalent or Superior Preservation (DBESP) has been prepared and submitted to the City of Wildomar Planning Department, then forwarded to the Riverside County Planning Department, Environmental Programs Division. The DBESP is included as Attachment A to this Final EIR and includes both depiction and impact analysis of MSHCP-defined riparian and riverine areas.

C-3 The commenter explains the MSHCP process. The Draft EIR requires completion of the MSHCP process as shown in mitigation measures MM 3.8.3a and MM 3.8.3b on page 3.8-26 of the Draft EIR. The riparian and riverine impacts must also be mitigated per the MSHCP as noted in mitigation measures MM 3.8.5a, MM 3.8.5b, 3.8.8a through 3.8.8c of the Draft EIR (see pages 3.8-27 through -31 of the Draft EIR). Preconstruction surveys for burrowing owls are required by mitigation measures MM 3.8.3a and MM 3.8.3b, per Objective 6 of the MSHCP (see page 3.8-26 of the Draft EIR).

C-4 The commenter requests additional analysis concerning burrowing owls. The Draft EIR reports that the site is located within the Burrowing Owl Survey Area (Figure 6-4 of the MSHCP). A nesting season survey following the Burrowing Owl Survey Instructions for Western Riverside Multiple Species Habitat Conservation Plan Area was prepared by Principe and Associates and is included in the Draft EIR as Appendix 3.8-3. During the owl survey in 2010, neither owls nor evidence of owls having used the site in the previous three years was observed (page 4 of Appendix 3.8.3). Mitigation measures MM 3.8.3a and MM 3.8.3b require a survey of the site prior to any ground-disturbing activities no more than 30 days before disturbance. As noted in mitigation measure MM 3.8.3b, any owl relocation plan must be approved by the CDFW. The City notes that the CDFW only approves relocation under narrow circumstances that may not apply to the proposed project. Mitigation measure MM 3.8.3b is modified to reflect the position of the CDFW (see Section 3.0 of this Final EIR).

C-5 The commenter requests modification of mitigation measures MM 3.8.3a and MM 3.8.3b to require notification to the Regional Conservation Authority if burrowing owls are found. The modification to the mitigation measures also removes passive relocation from consideration. The modifications can be found in Section 3.0, Minor Revisions to the Draft EIR, of this Final EIR.

C-6 The commenter requests additional information regarding how the project will assure no net loss of riparian resources. A DBESP has been prepared and submitted to the City of Wildomar Planning Department and forwarded to the Riverside County Planning Department, Environmental Programs Division. The Final EIR includes as Attachment A the DBESP, which provides the mapping, descriptions, discussions, and findings required to demonstrate consistency with Section 6.1.2 of the MSHCP.

C-7 The commenter requests changes to how compliance with the MSHCP is attained and states that all projects within the MSHCP are required to pay fees regardless of impacts to habitat. Payment of MSHCP fees is required by Riverside County Ordinance 810.2 that is implemented by the City of Wildomar (see mitigation measure MM 3.8.8c on page 3.8-31 of the Draft EIR). The DBESP has been submitted for review, and it must be completed prior to any ground-disturbing activities for the project (see mitigation measures MM 3.8.8a through MM 3.8.8c on page 3.8-31 of the Draft EIR).

C-8 The commenter notes that deferral of a DBESP is not adequate mitigation. A DBESP has been prepared and submitted to the City of Wildomar Planning Department and forwarded to the Riverside County Planning Department, Environmental Programs Division. The Final EIR includes as Attachment A the DBESP, which provides the mapping, descriptions, discussions, and findings required to demonstrate consistency with Section 6.1.2 of the MSHCP.

C-9 The commenter requests a wording change regarding the number of species covered by the MSHCP. The 150-species figure is taken from the home page of the MSHCP website (http://www.rcip.org/conservation.htm) accessed again on February 6, 2013. The statement is informational and the number of species referenced does not impact the analysis. Cumulative impacts associated with the proposed project are addressed on page 3.8-32 of the Draft EIR. The City understands that MSHCP compliance is necessary for the impacts associated with riparian and riverine habitats to be fully mitigated (see also response C-8 above). As noted in comment C-1 above, the 0.26 acres of the project site that is within a criteria cell is considered insignificant and the provisions of the Joint Project Review are not required. Mitigation measure MM 3.8.8c requires payment of the MSHCP fees, and preconstruction surveys for burrowing owls are required as modified in Section 3.0 of this Final EIR. The DBESP has been submitted for review and is also included as Attachment A to this Final EIR. The MSCHP process must be completed prior to approval of any ground-disturbing activity as noted in all of the mitigation measures. The City notes that complete MSHCP findings must be made prior to project approval per Section 4.7 of the *Western Riverside County Multiple Species Habitat Conservation Plan: Permittee Implementation Guidance Manual* (August 2007).

Letter D

Scott A. Mann
Mayor

Wallace W. Edgerton
Deputy Mayor

John V. Denver
Councilmember

Thomas Fuhrman
Councilmember

Greg August
Councilmember

January 7, 2013

RECEIVED
JAN 07 2013
CITY OF WILDOMAR

Matthew Bassi
Planning Director
City of Wildomar
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

RE: Draft Environmental Impact Report for Oak Creek Canyon with a Specific Plan Amendment to the Farm Specific Plan, Change of Zone from R-1 to R-4 and from C-P-S to C-1/C-P, and Tentative Tract No. 36388, a 292-lot subdivision.

Dear Mr. Bassi:

Thank you for the opportunity for the City of Menifee to review the Oak Creek Canyon Environmental Impact Report for the afore-referenced project in the City of Wildomar. Menifee's Community Development Department has the following comments on the Draft Environmental Impact Report:

Page

ES-7: Measure MM 3.3.4, Correct timing to filing of a final map instead of fling.

1.0-1: 1.2 Regional Location, the City of Menifee should be identified.

1.0-3: Figure 1.0-1: Identify the City of Menifee.

1.0-4: Figure 1.0-2: Label the City of Menifee easterly of Sunset Avenue.

1.0-9: 1.4 Known Trustee and Responsible Agencies, correct California Department of Fish and Game to California Department of Fish and Wildlife (the change became effective January 2013). Add the City of Menifee as a responsible agency for the permits that will be needed along Sunset Avenue and potentially Murrieta Road, and Scott Road.

D-1

1.0-9: 1.5 Type of Document, although no specific uses are known for the 5.21-acre commercial area, the impacts from that designated land should be addressed and mitigation measures proposed as appropriate since this project includes the adoption of supporting zoning. The City of Menifee is concerned that the potential impacts to the small lot estate residential lots adjacent to Sunset Avenue are fully evaluated.

1.0-13: 1.9, correct California Department of Fish and Game to California Department of Fish and Wildlife. Change all subsequent references.

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Letter D Continued

2.0-26: Figure 2.0-7, The O-Neil Regional Trail should be noted on the west side of Sunset Avenue.

2.0-29: On-site Roadway Facilities, add that the construction of Sunset Avenue must be coordinated with the City of Menifee.

3.1-1: General Plan Designations, the designation in the City of Menifee should be expressed as RC:LDR to denote Low Density Residential under the Rural Community Foundation.

Figure 2.0-1, 3.1-1: the General Plan designation in the City of Menifee should be express as RC:LDR to denote Low Density Residential under the Rural Community Foundation.

3.1-5, 3.1.2, Regulatory Framework, Table 3.1-1, the R-A designation should be footnoted that the adjacent parcels have a required minimum lot size of 2 ½ acres hence the R-A-2 ½ zoning classification. Add the rear setback as noted in Zoning Ordinance No. 348 as 10 feet and side setbacks are 5 feet. Delete existing asterisk note.

3.1-6 to 8, as stated in the December 27, 2011 Notice of Preparation letter, please address the compatibility with the City of Menifee's existing residential adjacent to the site along Sunset Avenue.

3.3-9, Local, note the City of Menifee under this section as regulatory permits will be necessary on Sunset Avenue.

D-1 cont.

3.3-55: Add to MM 3.3.1 that Sunset Avenue should be constructed to ensure a northbound and southbound lane of traffic along the frontage of the commercial parcel in addition to the installation of a traffic signal.

3.3-61: Measure MM 3.3.4, Correct timing to filing of a final map instead of fling.

3.3-65: Mitigation Measure MM 3.3.5, the statement that TUMF is adequate mitigation is not correct. There are no guarantees that the monies collected for this project under TUMF will go toward improvements at the Scott Road interchange. The project should establish an alternate mechanism to fund and or construct the improvements should they not be in place for opening year and/or build-out year especially since this project is increasing the amount of commercial acreage under the Specific Plan Amendment.

3.4-17: The project's increase in commercial acreage along Bundy Canyon Road needs to be specifically addressed since the additional acres were not included in previous modeling.

3.10-28: This section should include a discussion of trails. Specifically address the O'Neil Regional Trail running south on Sunset Avenue, crossing Bundy Canyon Road and continuing south to Keller Road.

3.11-5: Include a discussion to address the interface along Sunset Avenue in terms of grading and viewshed.

4.0-3: Mitigation Measure MM 3.3.5, the statement that TUMF is adequate mitigation is not correct. There are no guarantees that the monies collected for this project under TUMF will go toward improvements at the Scott Road interchange. The project should establish an alternate

Letter D Continued

mechanism to fund and or construct the improvements should they not be in place for opening year and/or build-out year especially since this project is increasing the amount of commercial acreage under the Specific Plan Amendment. **D-1 cont.**

Please note that the City of Menifee would like to continue to coordinate with the City of Wildomar on mitigation measures and future improvements on Bundy Canyon Road and Sunset Avenue and the future commercial area and would like a condition of approval that memorialized the coordination. **D-2**

Thank you again for the opportunity to provide comments. Please forward any hearing notice regarding this project to my attention.

Sincerely,

Lisa Gordon
Senior Planner
Community Development Department

Letter D: City of Menifee

Responses

D-1 The commenter requests several changes to the Draft EIR to correct typographical errors or provide information on figures within the document. These changes are reflected in Section 3.0 of this Final EIR and below as noted. Figures 1.0-1 and 1.0-2 are amended to show the City of Menifee, and the regional location information on page 1.2 of the Draft EIR is also amended to include the City of Menifee. Section 3.0 also includes the change to the Department of Fish and Game to the Department of Fish and Wildlife and the inclusion of the City of Menifee as a responsible agency. Note that the Draft EIR is not amended to change the name of the California Department of Fish and Game on the Notice of Preparation comments as this was the name of the agency at that time.

Table 3.1-1 is modified per the comment to remove the asterisk and corresponding note in the table. Figure 2.0-1 is also amended to reflect the RC:LDR designation.

The commenter requests additional information regarding the compatibility of the project on the adjacent residential lots along Sunset Avenue. The proposed project has approximately 361 feet of frontage on Sunset Avenue, which is approximately one parcel as shown today. The western boundary of Sunset Avenue will contain the Sunset Trail easement area, followed by grading leading to a commercial pad. The main driveways for the commercial property are on Bundy Canyon Road, with a secondary access onto Sunset Avenue. While no specific commercial development is proposed with this application, possible commercial uses were assumed in the Traffic Analysis (see Table 3.3-5 on page 3.3-17 of the Draft EIR). Because the traffic model outputs are used to determine noise, air quality, and greenhouse gas impacts, the commercial potential is reflected in these sections of the Draft EIR as well. The City of Wildomar requires plot plan approval before any commercial project can be developed. During review of the plot plan, the City will review landscape plans, building elevations, signage, color, and roadway improvements along Sunset Avenue. The City also has a lighting ordinance that restricts the amount of light pollution.

The commenter requests that mitigation measure MM 3.3.1 on page 3.3-55 of the Draft EIR be modified to require a northbound and southbound lane in addition to the traffic signal. See Section 3.0 of this Final EIR for the modification. This modification also requires coordination of improvements with the City of Menifee. The typographical error in MM 3.3.4 has been corrected.

The commenter also states that payment of the Transportation Uniform Mitigation Fee (TUMF) does not guarantee that fees will go toward the improvements at the Scott Road interchange and requests that the proposed project establish a separate funding mechanism for the interchange. The Bundy Canyon Road realignment is a project by the Riverside County Transportation Department in conjunction with the cities of Wildomar and Menifee. A Draft EIR for the Bundy Canyon Road improvements was circulated for public review in January 2013 (SCH 2007051156). The Bundy Canyon Road improvements will extend from I-15 in the west to I-215 in the east. Further, I-215 roadway improvements are under way as a Riverside County Transportation Commission project. The Riverside County Transportation Commission (RCTC) is making improvements to I-215 from the Scott Road interchange to the Nuevo Road interchange, adding one general purpose travel lane in each direction. The improvements follow the previous project that added a travel lane from the Scott Road interchange to the Murrieta Hot Springs Road interchange.

The Scott Road interchange improvements are funded in part by a community facilities district (CF 05-08) and the TUMF. While subject to the TUMF, the proposed project is not within the boundaries of CF 05-08, which was established to pay for a portion of the interchange. The traffic study demonstrates that the project does not directly impact the Scott Road/I-215 interchange (see the Existing Plus Project Scenario shown in Table 3.3-9 on page 3.3-46). This table shows that the Existing Plus Project Scenario results in level of service (LOS) C at the interchange of Scott Road and I-215. The project is part of the overall cumulative background growth conservatively assumed for Opening Year 2015 conditions. It is this conservative cumulative growth forecast that causes the existing interchange at Scott Road to fail as shown in Table 3.3-10 on page 3.3-48 of the Draft EIR. Table 3.3-10 shows the opening year level of service if all of the projects shown in Table 3.3-8 on page 3.3-23 of the Draft EIR are constructed and occupied. As shown, 7 of the projects listed in Table 3.3-8 of the Draft EIR are located within the City of Wildomar and the remaining 24 projects are in the City of Menifee.

The future interchange design for Scott Road/I-215 is approved and in process with the County, Caltrans, and the City of Menifee and is designed to accommodate the anticipated traffic growth. This project, along with others assumed to be constructed and contributing traffic to the Scott Road interchange as part of the Opening Year 2015 scenario, will each mitigate their proportionate share of this cumulative impact through their payment of fees—whether it be to TUMF (regional component), DIF, CFD, or other fees as determined to match the pro-rata share requirements indicated in mitigation measure MM 3.3.5 on page 3.3-65 of the Draft EIR. With the collection of these fees, the funds would be in place to complete construction of the Scott Road/I-215 interchange. As the short-term impacts of the project do not result in a significant impact at this interchange, and only the full buildout of the cumulative projects results in a significant impact at the interchange, payment of a pro-rata share of the cost of improvements is considered appropriate mitigation.

D-2 The City of Wildomar will continue to coordinate with the City of Menifee.

Letter E

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California Department of Fish and Wildlife
Inland Deserts Region
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In Reply Refer To:
FWS/CDFW-WRIV-12B0169-13CPA0040

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JAN 07 2013
CITY OF WILDOMAR

JAN - 7 2013

Mr. Matthew C. Bassi
Planning Director
City of Wildomar
23873 Clinton Keith Road, Suite 201
Wildomar, California 92595

Subject: Oak Creek Canyon Residential Project Draft Environmental Impact Report, City of Wildomar, Riverside County, California (SCH# 2012031064)

Dear Mr. Bassi:

The U.S. Fish and Wildlife Service (Service) and the California Department of Fish and Wildlife (Department), hereafter collectively referred to as the Wildlife Agencies, have reviewed the subject Draft Environmental Impact Report (DEIR) for the proposed Oak Creek Canyon Residential Project (project) received on November 23, 2012. The DEIR has been prepared to identify the proposed project's direct, indirect, and cumulative environmental impacts, to discuss alternatives, and to propose mitigation measures that avoid, minimize, or offset significant environmental impacts.

The primary concern and mandate of the Service is the protection of public fish and wildlife resources and their habitats. The Service has legal responsibility for the welfare of migratory birds, anadromous fish, and endangered animals and plants occurring in the United States. The Service is also responsible for administering the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*). The Department is a trustee agency under the California Environmental Quality Act (CEQA) and is responsible for ensuring appropriate conservation of fish and wildlife resources including rare, threatened, and endangered plant and animal species, pursuant to the California Endangered Species Act, and administers the Natural Community Conservation Planning Program. The Wildlife Agencies are providing the following comments as they relate to the project's consistency with the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP) and the CEQA. Concerns and recommendations specific to the Department are also provided.

On June 22, 2004, the Service issued a section 10(a)(1)(B) permit for the MSHCP. The MSHCP established a multiple species conservation program to minimize and mitigate habitat loss and the incidental take of covered species in association with activities covered under the permit. The Department also issued Natural Community Conservation Plan Approval and Take Authorization for the MSHCP as per section 2800 *et seq.*, of the California Fish and Game Code. The MSHCP Plan Area covers western Riverside County including the city of Wildomar (City). The City is a MSHCP permittee.

E-1

Letter E Continued

One of the requirements of CEQA is that any inconsistencies between a proposed project and applicable general plans and regional plans, including habitat conservation plans and natural community conservation plans, such as the MSHCP, be addressed. We have comments regarding the analysis of impacts to biological resources provided in the DEIR relative to CEQA and the analysis of the project impacts on MSHCP implementation.

The project is the division of 151.23 acres into residential, commercial and open space lots (Tentative Tract Map [TTM] No. 36388). As proposed, TTM 36388 divides the property into five development units, with units 1–4 providing for residential uses, and unit 5 allowing for commercial development. There would be 17 open space lots. The project also requires a general plan amendment; Specific Plan Amendment No. 116 (Amendment 4) to The Farm Specific Plan; zoning changes; construction of two 500,000-gallon water tanks and an access road; and realignment of a portion of Bundy Canyon Road. **E-1 cont.**

The project is located within the Sedco Hills Subunit (SU4) of the Elsinore Area Plan in the vicinity of MSHCP Proposed Linkage 8. A small portion (0.26 acres) of the project is located within MSHCP Criteria Cell 5046 of Cell Group J. MSHCP policies and procedures that apply to the proposed project include the Riparian/Riverine Policy (MSHCP, section 6.1.2), the Additional Survey Needs and Procedures for burrowing owl (MSHCP, section 6.3.2), and the Guidelines Pertaining to the Urban Wildlands Interface (MSHCP, section 6.1.4).

Wildlife Agency Concerns Pertaining to the MSHCP

The DEIR does not clearly define the project or its impacts. The DEIR is deficient in describing how project activities will impact riparian and/or riverine areas, and impacts associated with construction of detention basins, and access roads to these facilities.

The project is located within a MSHCP Criteria Cell and therefore is subject to the Joint Project Review (JPR) process, described in section 6.6.2 of the MSHCP. The MSHCP Consistency Analysis report (dated December 10, 2010), which was included with the DEIR, discusses the project's acreage within the Criteria Cell and the Criteria Cell conservation requirements but the DEIR does not address the need for a JPR. We recognize that the acreage within the Criteria Cell represents a small portion of the entire project however; consistency with the MSCHP requires that the project be submitted to the Regional Conservation Authority (RCA) for the JPR process. **E-2**

The project is located within the MSHCP burrowing owl additional survey area. Suitable burrowing owl habitat was identified on the project site and, focused breeding season surveys were conducted on August 10, 17, 23, and 31, 2010, (*Nesting Season Survey Burrowing Owl [Athene cunicularia hypugaea] Report*, dated September 1, 2010). No burrowing owls were found onsite during the focused surveys. We appreciate that focused burrowing owl surveys have been conducted; however, please note that the 2010 surveys are outdated. There is suitable burrowing owl habitat present onsite and recent records of burrowing owls within approximately 2.5 miles of the project site (Carlsbad Fish and Wildlife Office GIS 2013). Therefore we **E-3**

Letter E Continued

recommend that updated focused breeding season surveys be conducted and the results included in the JPR discussed above. **E-3 cont.**

The DEIR describes proposed mitigation for burrowing owls (MM 3.8.3a and MM 3.8.3b). A pre-construction presence/absence survey would be conducted within 30 days prior to ground disturbing activities. If owls are present, they would be excluded from their burrows during the non-breeding season using either passive relocation or active translocation. The Wildlife Agencies do not recommend excluding the owls from the site using passive relocation unless there are suitable burrows available within 100 meters of the closed burrows (Trulio 1995; CDFG 2012), and the relocation area is protected through a long-term conservation mechanism (e.g., conservation easement). We recommend that you notify the Wildlife Agencies if owls are found to be present onsite and develop a conservation strategy in cooperation with the Service, the Department, and RCA in accordance with the Department's *Staff Report on Burrowing Owl Mitigation* (CDFG 2012). **E-4**

Based on the information provided in the DEIR, it appears that impacts would occur to riparian and/or riverine areas defined by the MSHCP Protection of Species Associated with Riparian/Riverine Areas and Vernal Pools Policy (MSHCP, section 6.1.2). We recommend that alternatives that would avoid impacts to riparian/riverine areas be thoroughly assessed for the project. For unavoidable impacts to riparian and/or riverine areas, a Determination of Biologically Equivalent or Superior Preservation (DBESP) is required to address unavoidable impacts. The DBESP needs to be submitted by the City to both the Department and the Service concurrently for review as provided for in the MSHCP (section 6.1.2). **E-5**

Department Concerns

Although the proposed project is subject to the MSHCP, a Notification of Lake or Streambed Alteration is still required by the Department. Additionally, the Department's criteria for determining the presence of jurisdictional waters are more comprehensive than the MSHCP criteria in section 6.1.2 (Protection of Species Associated with Riparian/Riverine Areas and Vernal Pools). The Department is responsible for assessing and evaluating impacts to jurisdictional waters; typically accomplished through reviewing jurisdictional delineation (JD) reports, supporting information, and conducting site visits. Following review of a JD, the Department may request changes to the JD. The Department may also recommend that additional project avoidance and/or minimization measures be incorporated, or request additional mitigation for project-related impacts to jurisdictional areas. The Department recommends submitting a notification early in project planning, since modification of the proposed project may be required to avoid or reduce impacts to fish and wildlife resources. To obtain a Lake or Streambed Alteration notification package, please go to: http://www.dfg.ca.gov/habcon/1600/forms.html. **E-6**

A JD was submitted with the DEIR, but it fails to identify impacts to Department jurisdictional areas associated with the proposed project. Mitigation measure 3.8.5.a, of the DEIR, proposes that JD shall be verified by the U.S. Army Corps of Engineers and submitted to the City for

Letter E Continued

review. Please note that section 1602 of the California Fish and Game Code requires an entity or person to notify the Department and obtain an agreement prior to conducting a project that may impact a lake, river, stream, drainage, or other watercourse and associated riparian vegetation (please note that the presence of water does not determine the Department's jurisdiction). The Department is a trustee agency for fish, wildlife, and habitats, and has different jurisdictional and notification requirements compared to the U.S. Army Corps of Engineers. A person or entity needs to notify the Department for any work that occurs within a streambed. Whether or not an impact will be substantial or if an agreement is required will be determined by the Department upon review of the JD and notification.

The Department opposes the elimination of ephemeral, intermittent, and perennial streams, channels, lakes, and their associated habitats. The Department recommends avoiding stream and riparian habitat to the greatest extent possible. Any unavoidable impacts need to be compensated with the creation and/or restoration of in-kind habitat either on-site or off-site at a minimum 3:1 replacement-to-impact ratio, depending on the impacts and proposed mitigation. Additional mitigation requirements through the Department's Lake and Streambed Alteration Agreement process may be required, depending on the quality of habitat impacted, proposed mitigation, project design, and other factors.

The following information will be required for the processing of a Notification of Lake or Streambed Alteration and the Department recommends incorporating this information into the DEIR to avoid subsequent CEQA documentation and project delays:

E-6 cont.

1. Delineation of lakes, streams, and associated habitat that will be temporarily and/or permanently impacted by the proposed project (include an estimate of impact to each habitat type);

2. Discussion of avoidance and minimization measures to reduce project impacts; and

3. Discussion of potential mitigation measures required to reduce the project impacts to a level of insignificance.

Please refer to section 15370 of the CEQA guidelines for the definition of mitigation.

In the absence of specific mitigation measures in the CEQA document, the Department believes that it cannot fulfill its obligations as a Trustee and Responsible Agency for fish and wildlife resources. Permit negotiations conducted after and outside of the CEQA process are not CEQA-compliant because they deprive the public and agencies of their right to know what project impacts are and how they are being mitigated (CEQA, section 15002).

The project includes the construction of detention basins. Stormwater treatment control best management practices and low impact design features can increase potential mosquito/vector control breeding habitat. It is in the interest of the City and the Department to offer the public the highest level of protection from vectors while also protecting natural resources and reducing

E-7

Letter E Continued

the use of pesticides. The Department encourages the City to use preventative planning, compatible design, and effective long-term maintenance to avoid or reduce vectors. The City should refer to the California Health & Safety Code § 2000-2093 for definitions and liabilities associated with the creation of habitat conductive to vector production and to guidance provided by the local mosquito and vector control districts/agencies. Please be aware that some vector control measures may have associated environmental impacts and require notification pursuant to the Department's Lake and Streambed Alteration Program.

E-7 cont.

Summary of Wildlife Agency Concerns

The Wildlife Agencies have the following concerns about the project, and request that these concerns be addressed in a subsequent CEQA document:

1. The subsequent CEQA document should clearly define all aspects of the project, including the detention basins and any infrastructure improvements associated with the project;

2. The subsequent CEQA document needs to identify project impacts to riparian/riverine resources as defined by the MSHCP and document project compliance pursuant to section 6.1.2 of the MSHCP for impacts that cannot be avoided;

3. The subsequent CEQA document needs to include updated focused burrowing owl surveys and a description of agency coordination actions if owls are present onsite;

4. The subsequent CEQA document needs to address MSHCP consistency with the JPR process;

E-8

5. The subsequent CEQA document should include a JD of State Waters, an impact analysis, and mitigation measures for the loss of streambed and riparian habitat;

6. The analysis in the subsequent CEQA document should satisfy the requirements of the Department's Lake and Streambed Alteration Program; and

7. The subsequent CEQA document should address potential increases in mosquito/vector breeding habitat through construction and operation of the project, define adequate vector control measures, and analyze the potential environmental impacts of implementing vector control measures.

Based on our review, the subject DEIR is inadequate in describing project related impacts, particularly in regards to: (1) consistency with the MSHCP (riparian/riverine resources, burrowing owl, JPR process); (2) State jurisdictional streambed resources; (3) analysis of mosquito/vector habitat; and (4) identifying appropriate mitigation for purposes of CEQA (CEQA, section 15125 (d)). We recommend that the CEQA document be revised to address these deficiencies.

Letter E Continued

Mr. Matthew C. Bassi (FWS/CDFW-12B0169-13CPA0040) 6

We appreciate the opportunity to provide comments on the proposed action. If you have any questions regarding these comments, please contact Noelle Ronan of the Service at 760-431-9440, extension 215 or Heather Pert of the Department at 858-395-9692.

Sincerely,

Kennon A. Corey
Assistant Field Supervisor
U.S. Fish and Wildlife Service

Heather A. Pert
Staff Environmental Scientist
California Department of Fish and Wildlife

cc:
Charles Landry, RCA
Jeff Brandt, CDFW
Joanna Gibson, CDFW

Literature Cited:

California Department of Fish and Game (CDFG). 2012. Staff report on burrowing owl mitigation. State of California, Natural Resources Agency. Available at: http://www.dfg.ca.gov/wildlife/nongame/docs/BUOWStaffReport.pdf.

Trulio, L.A. 1995. Passive relocation: A method to preserve burrowing owls on disturbed sites. Journal of Field Ornithology 66(1):99-106.

Letter E: US Fish and Wildlife Service/California Department of Fish and Wildlife

Responses

E-1 The commenters explain the requirement for the project to comply with the MSHCP permit process and identify the 0.26-acre portion of the project site that is within a criteria cell. The Regional Conservation Authority (RCA) has determined that the 0.26-acre portion of the project within the criteria cell is insignificant and that neither a Joint Project Review nor conservation is necessary (see Letter C in this Final EIR). The comment also notes the requirement to complete the MSHCP process regarding impacts to burrowing owl habitat and to riverine and riparian habitat. These issues are addressed on pages 3.8-26 through -31 of the Draft EIR.

E-2 The commenters request that the project description address all aspects of the project, including the detention basins and any infrastructure improvements associated with the project. Figure 2.0-7 of Section 2.0, Project Description, in the Draft EIR identifies the location of the storm drainage basin on a single summary sheet. The improvements, including the drainage basin, are also shown on Figures 2.0-4a through 2.0-4d of the Draft EIR. Numerous other figures in the Draft EIR also show the extent of improvements. The operation of the stormwater system is discussed in detail in Section 3.7, Hydrology and Water Quality, of the Draft EIR and illustrated on Figure 3.7-3 in that section. Full detail of the proposed project storm drainage system is included in Draft EIR Appendices 3.7-1 through 3.7-4. The other utilities are discussed in Section 3.10, Public Services and Utilities, of the Draft EIR.

The proposed project will connect to the Farm Mutual Water Company water system, which will deliver the EVMWD water to the proposed project. The proposed project will extend the existing 10-inch water line in Bundy Canyon Road from Harvest Way West to Harvest Way East. A 16-inch water line will extend from the water storage tanks to the proposed commercial area to the east along Beverly Street to J Street then south to Bundy Canyon Road to the east end of lot 313, as shown on Figure 2.0-4e of the Draft EIR. The 16-inch water line is needed for the 3,000 gallon per minute fire flow required for commercial development. In the residential areas of the proposed project, 8- or 12-inch water lines may be used, as residential development has a lower fire flow requirement per the California Fire Code. From the water lines in each street or utility easement, a smaller water lateral or "service" will be extended to each house from a meter box typically located at the edge of the right-of-way. A water booster pump connected to a new 10-inch water line parallel to the new 16-inch water line discussed above will be used to pump water from the existing 10-inch line in Bundy Canyon Road into the two new 500,000-gallon water storage tanks.

Final water line sizing is dependent on a number of factors, including length of street, number of hydrants, anticipated water pressure, and fire flow requirements. The exact size of the water line is determined during preparation of subdivision improvement plans for construction of the facility and is reviewed and approved by The Farm as part of their review of the construction documents. As part of the response to this comment, the City contacted the Farm Mutual Water Company to verify whether any additional water improvements were needed to serve the project.

The Farm Mutual Water Company (FMWC) provided a letter in response that is included as Attachment D to this Final EIR. In their letter, the FMWC states that there is a 2003 agreement to provide service for 350 homes called the Garrett Tract (Artisan Homes/The Harvest) and Fiesta Homes. The FWMC notes that the 275 homes of the proposed project

are less than the 350 homes of the original agreement and that they have sufficient water for the proposed project.

With the exception of the new water storage tanks, all of the water system improvements will be underground and within road rights-of-way or within utility easements shown on the proposed subdivision map (see Figures 2.0-4a through 2.0-4e of the Draft EIR). The water system will be looped within the proposed project, enabling portions of the system to be turned off as needed for maintenance.

From a construction standpoint, the physical difference in water pipe size between 8-, 10-, or 12-inch water line does not affect the width or depth of the trench and therefore the environmental impacts of construction are identical. The project roadways will be graded as part of the overall grading plan (see Figures 2.0-4c through 2.0-4e in the Draft EIR). Construction impacts associated with the installation of water system improvements are the same as impacts from project roadway construction impacts and are similarly addressed through application of mitigation measures MM 3.3.4 (traffic management plan, page 3.3-60), MM 3.4.2a and MM 3.4.2b (air quality, page 3.4-19), MM 3.5.4a through MM 3.5.4c (noise, page 3.5-27), and MM 3.9.2a through MM 3.9.2g (cultural resources, page 3.9-19), as discussed in the Draft EIR.

In regard to sewer service, the proposed project will construct an 8,600-foot portion of the EVMWD's planned gravity system that extends from The Farm Road west in Bundy Canyon Road to a point near Valley Vista Circle. The 10-inch sewer line is identified as Gravity Sewer Improvement RP-23 in the EVMWD Wastewater Master Plan and included in the EVMWD EIR certified for the master plan. The sewer line will be located entirely within the road prism of Bundy Canyon Road, which means that the sewer line will either be under the existing road pavement or along the graded shoulder immediately adjacent to the existing pavement.

Sewer laterals extend from each home to sewer lines contained in the public streets or utility easements as shown on Figures 2.0-4c through 2.0-4e. The sewer laterals leading from each home are 4 inches in diameter and will lead to sewer lines that are 6 inches in diameter. The 6-inch sewer lines will then extend either to the 10-inch sewer main proposed for Bundy Canyon Road or to a lift station located on lot 314 shown on Figure 2.0-4d of the Draft EIR. The sewer lift station would then lift the sewage to the sewer main in Bundy Canyon Road where it flows by gravity to the EVWMD regional wastewater treatment plant located on Chaney Street in the City of Lake Elsinore.

Construction impacts associated with all the sewer construction would be limited to the discovery of cultural resources during trenching, traffic control, noise, and dust control during construction. These impacts are addressed through application of mitigation measures MM 3.3.4 (traffic management plan, page 3.3-60), MM 3.4.2a and MM 3.4.2b (air quality, page 3.4-19), MM 3.5.4a through MM 3.5.4c (noise, page 3.5-27), and MM 3.9.2a through MM 3.9.2g (cultural resources, page 3.9-19), as discussed in the Draft EIR.

The commenters also request that the EIR identify project impacts to riparian/riverine resources as defined by the MSHCP and document project compliance pursuant to Section 6.1.2 of the MSHCP for impacts that cannot be avoided. A DBESP has been prepared identifying all impacts to riparian/riverine areas, submitted to the City of Wildomar Planning Department, forwarded to the Riverside County Planning Department, Environmental Programs Division, and is included in this Final EIR as Attachment A. See also

Figure 3.8-4 included in this Final EIR. See also response E-1 regarding the requirement for a Joint Project Review for the 0.26 acre of the project that is within a criteria cell.

E-3 The commenters request that the EIR include updated focused burrowing owl surveys and a description of agency coordination actions if owls are present on site. Principe and Associates will update the original Nesting Season Survey completed at the site (September 1, 2010) beginning on March 1, 2013, weather permitting. In addition, presence/absence surveys will be conducted within 30 days prior to when ground disturbances are anticipated to commence at the site. The surveys will be conducted in compliance with the MSHCP 30-Day Pre-Construction Burrowing Owl Survey Report Format. If owls are identified on the site during any of the surveys, the wildlife agencies will be notified. A conservation strategy will then be developed by the wildlife agencies and the RCA in accordance with the CDFW's "Staff Report on Burrowing Owl Mitigation."

E-4 The commenters request modifications to mitigation measures regarding how burrowing owls should be treated if presence is discovered during the survey. These comments have been used to modify mitigation measure MM 3.8.3b on page 3.8-26 of the Draft EIR. See Section 3.0 of this Final EIR for the modified language.

E-5 The commenters request that the DBESP be submitted to the USFWS and the CDFW. The DBESP was originally submitted to the Riverside County Planning Department, Environmental Programs Division on December 19, 2012. Comments on the DBESP were received from the County on February 6, 2013. The County will forward the DBESP to USFWS and CDFW for review and comment. Attachment A to this Final EIR includes revisions made in response to the comments received on the original submittal to the County. The City will also send the revised DBESP to both the USFWS and the CDFW.

E-6 The commenters state that the project is required to satisfy the requirements of the California Department of Fish and Wildlife's Lake and Streambed Alteration Program. This requirement is noted on page 3.8-28 of the Draft EIR. The commenters request a jurisdictional delineation of waters of the State, as well as an impact analysis, and mitigation for the loss of streambed and riparian habitat. A wetland delineation has been prepared documenting jurisdictional waters of the State and is included in the Draft EIR as Appendix 3.8-1. Figure 3.8-2 of the Draft EIR provides a jurisdictional assessment of the features found within the proposed project. The proposed project is designed to avoid wetlands and riparian areas, as discussed on page 3.8-28 of the Draft EIR. However, the relocation of Bundy Canyon Road in order to reduce the amount of curve will require the installation of culverts at existing drainage points within the project boundaries. A map has been prepared that quantifies the impacts resulting from the proposed project separately from the impacts resulting from the Bundy Canyon Road/Scott Road Improvement Project. The map has been added to the Draft EIR as Figure 3.8-4. A DBESP has been prepared identifying all impacts to riparian/riverine areas, submitted to the City of Wildomar Planning Department, forwarded to the Riverside County Planning Department, Environmental Programs Division, and is included in this Final EIR as Attachment A. Mitigation measure MM 3.8.5a is modified to require submittal of the jurisdictional delineation to the California Department of Fish and Wildlife (CDFW) as well as to the US Army Corps of Engineers. This amendment is included in Section 3.0 of this Final EIR and reflects the requirement that the project result in "no net loss" to waters of the United States and waters of the State required by mitigation measure MM 3.8.5b on page 3.8-29 of the Draft EIR. The DBESP identifies 0.82 acres of riparian/riverine areas that will be permanently impacted by the project and 0.11 acres of unvegetated riverine areas temporarily impacted. The DBESP also indicates locations where 1.64 acres of native riparian forest habitat along one of the existing

intermittent blueline streams or ephemeral watercourses that is currently sparsely vegetated or unvegetated can be used for mitigation. Other potential mitigation sites are shown as a figure in the DBESP (see page 16 of Attachment A to this Final EIR). The location of the mitigation sites within the property will be determined as a result of the consultation process with both the RCA and the wildlife agencies per the MSHCP requirements and mitigation measure MM 3.8.4 on page 3.8-28 of the Draft EIR. See also response E-7.

E-7 The commenters request that the EIR address potential increases in mosquito/vector breeding habitat through construction and operation of the project, define adequate vector control measures, and analyze the potential environmental impacts of implementing vector control measures. The City of Wildomar requires that storm drainage improvements conform to Riverside County Ordinance 754 requiring that the design of storm drainage basins meets the standards expressed in the *Riverside County Stormwater Quality Best Management Practice Design Handbook, July 2006*. Page 11 of the design handbook states that "in order to avoid vector breeding problems, the design volume should always empty within 72 hours." The design handbook also requires that the pools empty completely and that there be no "micro-pool" in order to deny viable mosquito/vector breeding habitat. Mitigation measure MM 3.7.1 was modified to be clear that the design of the improvements must conform to the *Riverside County Stormwater Quality Best Management Practice Design Handbook* and to ensure that the basins drain within 72 hours of a storm event (see Section 3.0 of this Final EIR).

E-8 This comment summarizes the content of the letter and the expectations of the wildlife agencies. See above for responses to specific items.

Letter F

COUNTY OF RIVERSIDE
TRANSPORTATION AND
LAND MANAGEMENT AGENCY
Transportation Department

Juan C. Perez, P.E., T.E.
Director of Transportation

January 7, 2013

RECEIVED
JAN 07 2013
CITY OF WILDOMAR

Mr. Matthew C. Bassi, Planning Director
City of Wildomar, Planning Department
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

RE: Notice of Availability (NOA) for Draft Environmental Impact Report (DEIR) for the Oak Creek Canyon Residential Project - Specific Plan No. 116 Amendment No. 4, General Plan Amendment, Change of Zone, and Tentative Tract Map No. 36388

Dear Mr. Bassi:

Thank you for the opportunity to review the NOA for the DEIR for the Oak Creek Canyon Residential Project in the City of Wildomar. The project proposes 275 lots for residential development and a 5.21-acre neighborhood commercial site located along Bundy Canyon Road east of Interstate 15.

The Riverside County Transportation Department (RCTD) is working with the City of Wildomar on the planned Bundy Canyon Road widening project. Previously during the Notice of Preparation public review period for the project, RCTD requested that the City coordinate with the County during the development of the Oak Creek Canyon Residential Project to address road alignments, environmental document content, etc. to reduce duplication of effort and avoid any inconsistencies that may arise from the two projects. Coordination has been established and RCTD requests that the City continue its coordination efforts with the County on the planned widening of Bundy Canyon Road.

F-1

In the DEIR, the recommended mitigation for "I" Street and Bundy Canyon Road (intersection #7 in Figure 3.3-10) would have right-in/right-out and left-in access for the cross street, however based on the site plan is unclear how the left-out and through movements would be restricted. Given this intersection is located on a curve, careful considerations should be made during the design of the street and median.

4080 Lemon Street, 8th Floor • Riverside, California 92501 • (951) 955-6740
P.O. Box 1090 • Riverside, California 92502-1090 • FAX (951) 955-3198

Letter F Continued

Thank you again for the opportunity to review the NOA. We look forward to receiving the Final Environmental Impact Report for the development.

F-1 cont.

Sincerely,

Farah Khorashadi

Farah Khorashadi
Engineering Division Manager

FK:KT:rg

Attachment

cc: Juan C. Perez, Director of Transportation
Patricia Romo, Deputy Director of Transportation
Cindi Wachi, Project Manager

Letter F Continued

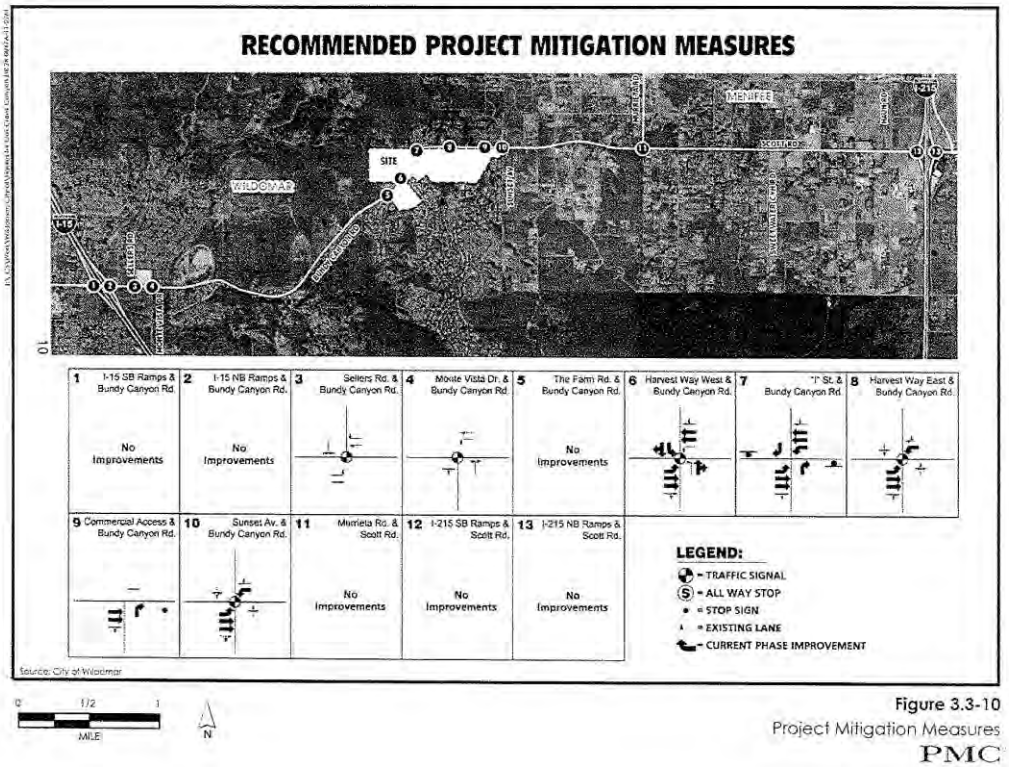

Figure 3.3-10
Project Mitigation Measures
PMC

Letter F: County of Riverside, Transportation Department

Response

F-1 The commenter notes the need for continued cooperation between the Riverside County Transportation Department and the City of Wildomar. No changes to the Draft EIR are necessary. The commenter also suggests that recommended mitigation for the intersection of I Street and Bundy Canyon Road be clarified regarding how through movements would be restricted. The intersection of Bundy Canyon Road and I Street will be improved to control and prevent left-out and through movements with a raised concrete median. This note has been made to the revised Figure 3.3-10 (see Section 3.0, Minor Revisions to the Draft EIR).

Letter G

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY EDMUND G. BROWN Jr. Governor

DEPARTMENT OF TRANSPORTATION
DISTRICT 8
PLANNING
464 WEST 4th STREET, 6th Floor MS 725
SAN BERNARDINO, CA 92401-1400
PHONE (909) 383-4557
FAX (909) 383-5936
TTY (909) 383-6300

Flex your power!
Be energy efficient!

January 16, 2013

Matthew C. Bassi
Planning Director
City of Wildomar
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

Oak Creek Canyon Development Notice of Completion & Environmental Document Transmittal
(Riv-15 PM 15.84)

Mr. Bassi,

We have completed our review for the above mentioned proposal of a subdivision of 151.23 acres into 275 residential lots, one 5.21 acre commercial site and 24 additional parcels for open space, parks, and storm drainage basin.

As the owner and operator of the State Highway System (SHS), it is our responsibility to coordinate and consult with local jurisdictions when proposed development may impact our facilities. As the responsible agency under the California Environmental Quality Act (CEQA), it is also our responsibility to make recommendations to offset associated impacts with the proposed project. Although the project is under the jurisdiction of the City of Perris due to the Project's potential impact to State facilities it is also subject to the policies and regulations that govern the SHS.

We recommend the following to be provided:

Traffic Study

- Please include ramp merge/diverge analysis at the I-15 northbound and southbound direction at Bundy Canyon Rd/I-15 Interchange and the I-215 northbound and southbound direction at I-215/Scott Road Interchange to determine impacts of the development at these locations, if any. **G-1**

- Section 6.6, Cumulative Impacts and Mitigation Measures, At the I-215 southbound and northbound ramp to Scott Road on page 78. The existing interchange is a diamond type configuration. For clarity, it is recommended to describe the proposed improvements as part of a modified loop interchange with both loops on the same side of the street as shown in Exhibit 7-3. Some improvements are in conflict with existing conditions. **G-2**

"Caltrans improves mobility across California"

Letter G Continued

- Please provide the Synchro output for review. **G-3**

- The responsible lead agency must ensure that appropriate fare share contribution is obtained from the developer for the improvement of the I-215 and Scott Road interchange. As opening year 2015 cumulative with project shows significant impact, the I-215/Scott Road interchange modification must be completed before project opening. **G-4**

The California Department of Transportation reserves the right to comment on this project at any future time.

We appreciate the opportunity to offer comments concerning this project. If you have any questions regarding this letter, please contact Talvin Dennis at (909) 383-6908 or myself at (909) 383-4557 for assistance.

Sincerely,

Original signed by Daniel Kopulsky

DANIEL KOPULSKY
Office Chief
Community and Regional Planning

Letter G: California Department of Transportation (Caltrans)

Responses

G-1 The commenter requests that a ramp merge/diverge analysis at the I-15 northbound and southbound direction at the Bundy Canyon Road/I-15 interchange and the I-215 northbound and southbound direction at the I-215/Scott Road interchange be completed to determine impacts of the development at these locations. A supplemental analysis has been conducted to evaluate the performance of freeway ramp junctions (merge/diverge) at the I-15/Bundy Canyon Road and I-215/Scott Road interchanges for both Existing and Existing plus Project (E+P) traffic conditions. The supplemental analysis is included as Attachment B to this Final EIR. As shown in the supplemental analysis, the project is not anticipated to cause any deficiencies to the freeway ramp junctions at either the I-15/Bundy Canyon Road interchange or the I-215/Scott Road interchange (i.e., ramp junctions anticipated to operate at LOS D or better). The project's impact to the I-15/Bundy Canyon Road and I-215/Scott Road ramp junctions is less than significant.

G-2 The commenter states that in Section 6.6, Cumulative Impacts and Mitigation Measures [of the Traffic Impact Analysis], at the I-215 southbound and northbound ramp to Scott Road on page 78, the existing interchange is a diamond-type configuration. For clarity, it is recommended to describe the proposed improvements as part of a modified loop interchange with both loops on the same side of the street as shown in Exhibit 7-3. Some improvements are in conflict with existing conditions. The text has been revised on page 78 of the traffic study to indicate that the recommended improvements are consistent with the proposed modified loop interchange design shown on Exhibit 7-3. Although there were no changes to Section 6.7 of the report, page 80 has also been included as the changes to text in Section 6.6 resulted in a page shift. The modified pages of text are included as an erratum to the traffic study. The modifications to the text do not result in changes to the report's findings or conclusions. See Attachment C to this Final EIR.

G-3 The commenter requests the traffic model information. The peak-hour intersection operations analysis worksheets for the I-15/Bundy Canyon Road and I-215/Scott Road ramps are included in Attachment B of this Final EIR for each analysis scenario.

G-4 The commenter states that the City must ensure that the appropriate fair share contribution is obtained from the developer for the improvement of the I-215 and Scott Road interchange. The interchange improvements are funded in part by a community facilities district (CF 05-08) and the TUMF. While subject to the TUMF, the proposed project is not within the boundaries of CF 05-08, which was established to pay for a portion of the interchange. The traffic study demonstrates that the project does not directly impact the Scott Road/I-215 interchange (see the Existing Plus Project Scenario shown in Table 3.3-9 on page 3.3-46). This table shows that the Existing Plus Project Scenario results in LOS C at the interchange of Scott Road and I-215. The project is part of the overall cumulative background growth conservatively assumed for Opening Year 2015 conditions. It is this conservative cumulative growth forecast that causes the existing interchange at Scott Road to fail as shown in Table 3.3-10 on page 3.3-48 of the Draft EIR. Table 3.3-10 shows the resulting levels of service if all of the projects shown in Table 3.3-8 on page 3.3-23 of the Draft EIR are constructed and occupied by 2015. As shown in the table, 7 of the projects are in the City of Wildomar and the remaining 24 projects are in the City of Menifee.

The future interchange design for Scott Road/I-215 is approved with the County, Caltrans and the City of Menifee, and is designed to accommodate the anticipated traffic growth. This project, along with others assumed to be constructed and contributing traffic to the Scott Road interchange as part of the Opening Year 2015 scenario, will each mitigate their proportionate share of this cumulative impact through their payment of fees—whether it be to TUMF (regional component), DIF, CFD, or other mitigation fees as might be determined to match the pro-rata share requirements required by mitigation measure MM 3.3.5 on page 3.3-65 of the Draft EIR. With the collection of the fees from all of the projects listed in Table 3.3-8 of the Draft EIR, the funds would be in place to complete construction of the Scott Road/I-215 interchange. As the short-term impacts of the proposed project do not result in a significant impact at this interchange, and only the full buildout of the cumulative projects results in a significant impact at the interchange, payment of a pro-rata share of the cost of improvements is considered appropriate mitigation. (See also response D-1.)

Letter 1

January 7, 2013

From: Gerard Ste. Marie
P.O. Box 486
Wildomar, CA 92595

To: City of Wildomar
Attn: Mathew C. Bassi, Planning Director
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

Re: **Written comments to the Oak Creek Canyon Draft Environmental Impact Report (SCH No. 2012031064; Specific Plan No. 116, Amendment No. 4; Change of Zone and Tentative tract Map No. 36388; Planning Application No. 11-0261)**

To Director of Planning - Mathew C. Bassi: Please consider the following comments to the Oak Creek Canyon Draft Environmental Impact Report:

I. Because the City of Wildomar has Never Formally Adopted a General Plan Since Becoming a Newly Incorporated City, General Plan Consistency is Not Possible

Despite numerous representations throughout the Oak Creek Canyon Draft Environmental Impact Report ("DEIR") to the contrary, because the City of Wildomar has never formally adopted a general plan since becoming a newly incorporated city, no aspect of the proposed project can possibly be consistent with the general plan.

1-1

In Section 3.1.2 of the DEIR, the following statement is made:

> "Upon incorporation in 2008, the City of Wildomar adopted the Riverside County General Plan. The adopted General Plan, which was drafted in 2003, is a unit of the Riverside County Integrated Project and aims to manage the overall pattern of development in the county. In 2012, the City updated the Housing Element of the General Plan by identifying and establishing Wildomar's policies with respect to meeting the needs of existing and future residents in the city."

Letter 1 Continued

However, Wildomar's presumptive adoption of a general plan is fallacious. No formal action has ever been undertaken by the Wildomar City Council to adopt the 2003 Riverside County General Plan since inauguration of the new city on July 1, 2008. Moreover, Wildomar took no official action to update any housing element during the year 2012 either.

In fact, Wildomar has never conducted any of the substantive or procedural requirements to general plan adoption as contained under Article 6 of Chapter 3 of Division 1 of Title 7 of the Government Code (sections 65350 – 65352), either upon incorporation or at any time thereafter. This fact places the City of Wildomar is in violation of section 65360 of the Government Code requiring the adoption of a general plan within 30 months after incorporation. This violation of law renders any finding made in the DEIR as to general plan conformity void of any valid legal effect.

1-1 cont.

II. Because the City of Wildomar has Never Formally Adopted a General Plan Since Becoming Incorporated, the City Cannot Possibly Amend a General Plan that has Never been Adopted

One of the actions contemplated in the project is an amendment of the general plan landuse designation, indicated under section 2.3 of the DEIR as follows:

> "**General Plan Amendment** – A proposal to amend the General Plan land use designation for 20.11 acres within Phase/Planning Area No. 18 from Medium Density Residential (MDR) to Medium High Density Residential (MHDR) to accommodate single-family lots with a minimum lot size of 4,500 square feet and to increase the size of the Phase/Planning Area 19 land use designation of Commercial Retail (CR) from 1.0 acres to 5.21 acres, including relocation of the phase/planning area to the southwest corner of the intersection of Bundy Canyon Road and Sunset Avenue."

1-2

However, as previously discussed herein, Wildomar has never formally adopted any general plan since inauguration of the city in July of 2008. Because section 65358 of the Government Code limits general plan amendments to an adopted general plan, and Wildomar has to date failed to formally adopt any general plan, the City is without statutory authority to amend a general plan that has never been adopted.

Letter 1 Continued

III Because the City of Wildomar has Never Formally Adopted a General Plan Since Becoming Incorporated, the City is Without Authority to Prepare or Amend any Specific Plan Either

One of the actions contemplated in the project is an amendment of The Farm Specific plan No. 116, indicated under section 2.3 of the DEIR as follows:

> "**Specific Plan Amendment No. 116 (Amendment 4) to The Farm Specific Plan** – The Farm Specific Plan (Specific Plan No. 116-C/W), which was originally approved on September 24, 1974, and subsequently amended on July 28, 1981 (Resolution No. 81-269) and on January 29, 2002 (Resolution 2002-27), is a master planned community consisting of approximately 1,520 acres with residential uses assigned to occupy 776.7 acres. The remaining 576.7 acres are dedicated to open space and recreation areas consisting of a clubhouse/swimming pool, private park, and lake. Additionally, there are 37.7 acres set aside for school uses, 4.1 acres for a sewage treatment plant, 21.6 acres for commercial use, and 10.3 acres for street purposes. The proposed modification to the Specific Plan (Amendment No. 4) seeks to change the existing approved land uses shown in **Figure 2.0-1**, for the planning areas identified as Phases 9, 17A, 18, and 19. These changes include the conversion of 1.1 acres from commercial use to residential/open space use, establishment of lot sizes for each residential unit of the subdivision, and creation of a 5.21-acre commercial site. (See **Appendix 2.0-2.**"

1-3

However, as previously discussed herein, Wildomar has never formally adopted any general plan since inauguration of the city in July of 2008. Because section 65454 of the Government Code limits specific plan amendments to conformity with an adopted general plan, and Wildomar has to date failed to formally adopt any general plan, the City is without statutory authority to amend any specific plan either. Moreover, because section 65450 of the Government Code specifies that specific plans are for systematic implementation of the general plan, the City is likewise without statutory authority to prepare any specific plan.

3

Comments by Gerard Ste. Marie to Oak Creek Canyon Draft EIR

Letter 1 Continued

IV. The DEIR is Uncertain as to what Pipeline Infrastructure will be Constructed to Accommodate Water and Sewer Services for the Project and what the Environmental Impacts of Infrastructure Construction will be

The DEIR states under section 2.3, "Public Utilities" on p. 2.0-29 that "[b]oth water and sewer lines, currently in Bundy Canyon Road, will be extended through the site along the realigned Bundy Canyon Road and will be located boath in new roadways and utility easements as shown in Figure 2.0-4a through 2.0-4f." However, the DEIR makes no discussion as to the lengths, widths, depths or routes of these required pipelines, the additions of booster pumps or sewer lift stations, or the environmental impacts associated with construction of this new infrastructure. 1-4

On September 9, 2012 EVMWD conducted a Study Session on the Oak Creek Development which discussed all of these water and sewer pipeline infrastructure matters, and which Study Session is attached hereto as "Exhibit A." Please incorporate the findings of this Study Session as well as the associated environmental impacts of pipeline infrastructure construction into any Final EIR

DATED: January 7, 2013

By: Gerard Ste. Marie
P.O. Box 486
Wildomar, CA 92595

Letter 1 Continued

Exhibit "A" Separator

Exhibit "A" Separator

Exhibit "A" Separator

Letter 1 Continued

Elsinore Valley Municipal Water District

STUDY SESSION
DISCUSSION OUTLINE

Date: September 19, 2012

Originator: Paul Carver / Imad Baiyasi

Subject: Oak Creek Canyon Development

Sunbelt Communities, the developer proposing Oak Creek Canyon, 163 acres in which approximately 275 single-family homes and 3 acres of commercial usage are proposed, contacted the Engineering Department on February 18, 2011 to discuss this project. The project is located on the north and south sides of Bundy Canyon Road, east of Sunset Road and west of Beverly Street. As requested by Sunbelt Communities, the District issued a Service Commitment Letter on March 18, 2011 (copy attached).

VSL Engineering and the developer met with Engineering staff on August 5, 2011 to discuss requirements to serve the project with water and sewer. Conceptual analysis revealed that water and sewer line extensions along Bundy Canyon Road and a new storage tank(s) must be constructed.

Subsequent to the meeting, staff reviewed The Farm's Specific Plan 2002 Amendment No. 3 that also includes this development within its boundaries, identified as Phases 9, 17A and 18 (copy attached).

The proposed Oak Creek Canyon development will take its source of water from the existing 2 MG Bundy Canyon water tank. This development will require design and construction of water master plan pipeline and pumping facilities in the 1746 Zone. These water system improvements will include:

- Upgrading/adding to the existing Bundy Canyon Booster Pump Station located on Bundy Canyon Road and Almond Street
- Construction of 3,025 feet of 20-inch DIP in Bundy Canyon Road from the west side of Interstate 15 easterly to Canyon Ranch Road
- Construction of 8,700 feet of 20-inch DIP in Bundy Canyon Road near Valley Vista Circle to the entrance into the development
- Construction of approximately 4,000 feet of 16-inch DIP in the development from Bundy Canyon Road to the development's water tank(s)
- Construction of an 850,000 gallon water tank (or two 425,000 gallon tanks for operational flexibility)
- Construction of a booster pump station at the Bundy Canyon Tank that will exclusively serve the Oak Creek Canyon Development

Item #3.

-3-

Letter 1 Continued

For the sewer system, the Oak Creek Canyon Development will require construction of the following sewer master planned pipeline and pump facilities:

- Construction of 8,000 feet of 10-inch sewer from the high point of Bundy Canyon Road near The Farm Road westerly to Valley Vista Circle
- Construction of 2,100 feet of 8-inch gravity sewer from the Farm Road easterly to the end of the development
- Construction of 2,100 feet of 4-inch force main in Bundy Canyon Road westerly from the proposed lift station to the high point in Bundy Canyon Road
- Construction of a sewer lift station at the far easterly end of the development

Final grading and design of the streets inside the development will influence the quantities of the proposed water and sewer system improvements.

The Farm Mutual Water Company has indicated they want the Oak Creek Development to be a part of their water and sewer system. However, given that the Farm Mutual Water Company buys all of its water from EVMWD, there does not seem to be any advantage for that to happen and in the end, it could cost the developer more money to meet both EVMWD requirements and any additional requirements the Farm MWC may also place on the development.

As for the sewer collection and treatment system, currently the Farm MWC uses a sewage lagoon system and disposes of the effluent by spraying it onto the surrounding hills. It seems unlikely that the Regional Water Quality Control Board (RWQCB) will allow this system to be expanded to accommodate 275 new homes and three acres of commercial area of the proposed Oak Creek Canyon Development.

Therefore, staff strongly recommends that this project be served by EVMWD and utilize EVMWD water and sewer facilities.

Attachments: Will Serve Letter 2370-0
Specific Plan No. 116-C/W
Illustrative Site Plan

-4-

Item #3.

Letter 1: Gerard Ste. Marie

Responses

1-1 to 1-3

Comments 1-1 through 1-3 pertain to the City's legal ability to approve the project. The commenter alleges that the City never validly adopted its General Plan and therefore cannot make findings of General Plan consistency, take action to amend the General Plan, or take action to adopt or amend a Specific Plan. The comment letter does not allege that approval of the project conflicts with the contents of the General Plan (Initial Study Checklist Item X.b); rather, the commenter simply alleges that the City did not follow the proper procedures to adopt the General Plan. Therefore, the comments do not raise environmental or land use impact concerns, per se. Nonetheless, the City will respond to these comments, as they fundamentally relate to the City's ability to approve the project analyzed in this EIR.

Government Code Section 65301(a) allows an agency to adopt another agency's general plan as its general plan, as quoted below.

> *The legislative body may adopt all or part of a plan of another public agency in satisfaction of all or part of the requirements of Section 65302 if the plan of the other public agency is sufficiently detailed and its contents are appropriate, as determined by the legislative body, for the adopting city or county.*

Section 65302 lists the elements required to be present in a general plan. Therefore, Section 65301(a) authorizes a legislative body to adopt as its agency's general plan a general plan adopted by another public agency. As the commenter notes, Government Code Section 65360 requires a newly incorporated city to adopt a general plan within 30 months of incorporation. The State may extend this 30-month period for up to an additional 24 months (Government Code Section 65361). Prior to city incorporation, the City of Wildomar Council-Elect held numerous publicly noticed and agendized meetings in preparation for incorporation. At their April 30, 2008, meeting, a staff report was presented informing the Council-Elect of their options with respect to the adoption of a General Plan. Specifically, staff sought direction from the Council-Elect as to whether the documents that were being prepared for their first meeting on July 1, 2008, should incorporate the County General Plan. The outcome from that meeting was to adopt the County General Plan as the City General Plan upon incorporation, and any decision to prepare a new City General Plan or amend portions of the City General Plan would be deferred to a later date after the Council had time to study the issue.

Accordingly, upon incorporation the City Council adopted the 2002 Riverside County General Plan as the City's General Plan, through Resolution No. 08-01. Section 2 of Resolution No. 08-01 provides:

> *All existing County Resolutions adopted by the Riverside County Board of Supervisors or the Riverside County Planning Commission in effect upon the City's date of incorporation shall remain in full force and effect until any such County Resolution is repealed or superseded by the actions of the City Council.*

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Because the City does have a valid General Plan, the City is able to make findings of General Plan consistency and may take formal action to amend the General Plan and amend The Farm Specific Plan. The commenter has not raised any arguments that approval of the project is inconsistent with the City's General Plan.

Finally, the commenter notes that the DEIR states that in 2012 the City updated the Housing Element in the General Plan, but that the City never took any such action. This comment is correct, and this statement will be struck from the EIR. At the time the DEIR was prepared, the City was intending to take formal action on an updated Housing Element in 2012, but now it is anticipated that the action will take place in 2013. Section 3.0 of the Final EIR makes this change to page 3.1-2 of the Draft EIR.

1-4 The commenter states that the EIR is uncertain as to the extent of sewer and water improvements needed to serve the proposed project. The City of Wildomar does not provide wastewater collection, treatment, or water supply services, but instead relies on the EVMWD and the Farm Mutual Water Company (FMWC) for those services. For this project, water service will be provided by the Farm Mutual Water Company, which purchases its water from the EVMWD (see page 3.10-14 of the Draft EIR). The EVMWD has an adopted *Water Distribution Master Plan, 2008,* and *Wastewater Master Plan, 2008,* that are designed to meet the service needs of future growth. The EVMWD considered the impacts of the master water and sewer plans in the Draft Program Environmental Impact Report for the Water Distribution Master Plan and Wastewater Master Plan (SCH 2008111100). The EIR was circulated for public review and certified by the EVMWD in July 2010.

The proposed project will connect to the Farm Mutual Water Company water system, which will deliver the EVMWD water to the proposed project. The proposed project will extend the existing 10-inch water line in Bundy Canyon Road from Harvest Way West to Harvest Way East. A 16-inch water line will extend from the water storage tanks to the proposed commercial area to the east along Beverly Street to J Street then south to Bundy Canyon Road to the east end of lot 313, as shown on Figure 2.0-4e of the Draft EIR. The 16-inch water line is needed for the 3,000 gallon per minute fire flow required for commercial development. In the residential areas of the proposed project, 8- or 12-inch water lines may be used, as residential development has a lower fire flow requirement per the California Fire Code. From the water lines in each street or utility easement, a smaller water lateral or "service" will be extended to each house from a meter box

typically located at the edge of the right-of-way. A water booster pump connected to a new 10-inch water line parallel to the new 16 inch water line discussed above will be used to pump water from the existing 10-inch line in Bundy Canyon Road into the two new 500,000-gallon water storage tanks.

Final water line sizing is dependent on a number of factors, including length of street, number of hydrants, anticipated water pressure, and fire flow requirements. The exact size of the water line is determined during preparation of subdivision improvement plans for construction of the facility and is reviewed and approved by The Farm as part of their review of the construction documents. As part of the response to this comment, the City contacted the Farm Mutual Water Company to verify whether any additional water improvements were needed to serve the project.

The Farm Mutual Water Company (FMWC) provided a letter in response that is included as Attachment D to this Final EIR. In their letter, the FMWC states that there is a 2003 agreement to provide service for 350 homes called the Garrett Tract (Artisan Homes/The Harvest) and Fiesta Homes. The FWMC notes that the 275 homes of the proposed project are less than the 350 homes of the original agreement and that they have sufficient water for the proposed project.

With the exception of the new water storage tanks, all of the water system improvements will be underground and within road rights-of-way or within utility easements shown on the proposed subdivision map (see Figures 2.0-4a through 2.0-4e of the Draft EIR). The water system will be looped within the proposed project, enabling portions of the system to be turned off as needed for maintenance.

From a construction standpoint, the physical difference in water pipe size between 8-, 10-, or 12-inch water line does not affect the width or depth of the trench and therefore the environmental impacts of construction are identical. The project roadways will be graded as part of the overall grading plan (see Figures 2.0-4c through 2.0-4e in the Draft EIR). Construction impacts associated with the installation of water system improvements are the same as impacts from project roadway construction impacts and are similarly addressed through application of mitigation measures MM 3.3.4 (traffic management plan, page 3.3-60), MM 3.4.2a and MM 3.4.2b (air quality, page 3.4-19), MM 3.5.4a through MM 3.5.4c (noise, page 3.5-27), and MM 3.9.2a through MM 3.9.2g (cultural resources, page 3.9-19), as discussed in the Draft EIR.

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Sewer laterals extend from each home to sewer lines contained in the public streets or utility easements as shown on Figures 2.0-4c through 2.0-4e. The sewer laterals leading from each home are 4 inches in diameter and will lead to sewer lines that are 6 inches in diameter. The 6-inch sewer lines will then extend either to the 10-inch sewer main proposed for Bundy Canyon Road or to a lift station located on lot 314 shown on Figure 2.0-4d of the Draft EIR. The sewer lift station would then lift the sewage to the sewer main

in Bundy Canyon Road where it flows by gravity to the EVWMD regional wastewater treatment plant located on Chaney Street in the City of Lake Elsinore.

Construction impacts associated with all the sewer construction would be limited to the discovery of cultural resources during trenching, traffic control, noise, and dust control during construction. These impacts are addressed through application of mitigation measures MM 3.3.4 (traffic management plan, page 3.3-60), MM 3.4.2a and MM 3.4.2b (air quality, page 3.4-19), MM 3.5.4a through MM 3.5.4c (noise, page 3.5-27), and MM 3.9.2a through MM 3.9.2g (cultural resources, page 3.9-19), as discussed in the Draft EIR.

The commenter includes an incomplete study session discussion outline (associated agenda and other attachments were not provided) from the Elsinore Valley Municipal Water District (EVMWD) that was apparently discussed with the EVMWD Board. While the memorandum includes information about the proposed project, it was not provided to the City during preparation of the Draft EIR or review of the project and to the City's knowledge was not acted upon by the EVMWD Board. The only correspondence received by the City from the EVMWD was a will-serve letter EVMWD provided for the sewer service for the proposed project, which was included in the Draft EIR as Appendix 3.10-1. The Farm Mutual Water Company also provided a will-serve letter that was included as Appendix 3.10-3 of the Draft EIR for the water service associated with the proposed project.

Letter 2

January 7, 2013

From: Martha Bridges
35465 Woshka Lane
Wildomar, CA 92595

To: City of Wildomar
Attn: Mathew C. Bassi, Planning Director
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

Re: **Written comments to the Oak Creek Canyon Draft Environmental Impact Report (SCH No. 2012031064; Specific Plan No. 116, Amendment No. 4; Change of Zone and Tentative tract Map No. 36388; Planning Application No. 11-0261)**

To Director of Planning - Mathew C. Bassi: Please consider the following comments to the Oak Creek Canyon Draft Environmental Impact Report:

I. Because the City of Wildomar has Never Formally Adopted a General Plan Since Becoming a Newly Incorporated City, General Plan Consistency is Not Possible

Despite numerous representations throughout the Oak Creek Canyon Draft Environmental Impact Report ("DEIR") to the contrary, because the City of Wildomar has never formally adopted a general plan since becoming a newly incorporated city, no aspect of the proposed project can possibly be consistent with the general plan.

2-1

In Section 3.1.2 of the DEIR, the following statement is made:

> "Upon incorporation in 2008, the City of Wildomar adopted the Riverside County General Plan. The adopted General Plan, which was drafted in 2003, is a unit of the Riverside County Integrated Project and aims to manage the overall pattern of development in the county. In 2012, the City updated the Housing Element of the General Plan by identifying and establishing Wildomar's policies with respect to meeting the needs of existing and future residents in the city."

Letter 2 Continued

However, Wildomar's presumptive adoption of a general plan is fallacious. No formal action has ever been undertaken by the Wildomar City Council to adopt the 2003 Riverside County General Plan since inauguration of the new city on July 1, 2008. Moreover, Wildomar took no official action to update any housing element during the year 2012 either.

In fact, Wildomar has never conducted any of the substantive or procedural requirements to general plan adoption as contained under Article 6 of Chapter 3 of Division 1 of Title 7 of the Government Code (sections 65350 – 65352), either upon incorporation or at any time thereafter. This fact places the City of Wildomar is in violation of section 65360 of the Government Code requiring the adoption of a general plan within 30 months after incorporation. This violation of law renders any finding made in the DEIR as to general plan conformity void of any valid legal effect.

2-1 cont.

II. Because the City of Wildomar has Never Formally Adopted a General Plan Since Becoming Incorporated, the City Cannot Possibly Amend a General Plan that has Never been Adopted

One of the actions contemplated in the project is an amendment of the general plan landuse designation, indicated under section 2.3 of the DEIR as follows:

> "**General Plan Amendment** – A proposal to amend the General Plan land use designation for 20.11 acres within Phase/Planning Area No. 18 from Medium Density Residential (MDR) to Medium High Density Residential (MHDR) to accommodate single-family lots with a minimum lot size of 4,500 square feet and to increase the size of the Phase/Planning Area 19 land use designation of Commercial Retail (CR) from 1.0 acres to 5.21 acres, including relocation of the phase/planning area to the southwest corner of the intersection of Bundy Canyon Road and Sunset Avenue."

2-2

However, as previously discussed herein, Wildomar has never formally adopted any general plan since inauguration of the city in July of 2008. Because section 65358 of the Government Code limits general plan amendments to an adopted general plan, and Wildomar has to date failed to formally adopt any general plan, the City is without statutory authority to amend a general plan that has never been adopted.

Letter 2 Continued

III Because the City of Wildomar has Never Formally Adopted a General Plan Since Becoming Incorporated, the City is Without Authority to Prepare or Amend any Specific Plan Either

One of the actions contemplated in the project is an amendment of The Farm Specific plan No. 116, indicated under section 2.3 of the DEIR as follows:

> "**Specific Plan Amendment No. 116 (Amendment 4) to The Farm Specific Plan** – The Farm Specific Plan (Specific Plan No. 116-C/W), which was originally approved on September 24, 1974, and subsequently amended on July 28, 1981 (Resolution No. 81-269) and on January 29, 2002 (Resolution 2002-27), is a master planned community consisting of approximately 1,520 acres with residential uses assigned to occupy 776.7 acres. The remaining 576.7 acres are dedicated to open space and recreation areas consisting of a clubhouse/swimming pool, private park, and lake. Additionally, there are 37.7 acres set aside for school uses, 4.1 acres for a sewage treatment plant, 21.6 acres for commercial use, and 10.3 acres for street purposes. The proposed modification to the Specific Plan (Amendment No. 4) seeks to change the existing approved land uses shown in **Figure 2.0-1**, for the planning areas identified as Phases 9, 17A, 18, and 19. These changes include the conversion of 1.1 acres from commercial use to residential/open space use, establishment of lot sizes for each residential unit of the subdivision, and creation of a 5.21-acre commercial site. (See **Appendix 2.0-2.**"

2-3

However, as previously discussed herein, Wildomar has never formally adopted any general plan since inauguration of the city in July of 2008. Because section 65454 of the Government Code limits specific plan amendments to conformity with an adopted general plan, and Wildomar has to date failed to formally adopt any general plan, the City is without statutory authority to amend any specific plan either. Moreover, because section 65450 of the Government Code specifies that specific plans are for systematic implementation of the general plan, the City is likewise without statutory authority to prepare any specific plan.

Letter 2 Continued

IV. The DEIR is Uncertain as to what Pipeline Infrastructure will be Constructed to Accommodate Water and Sewer Services for the Project and what the Environmental Impacts of Infrastructure Construction will be

The DEIR states under section 2.3, "Public Utilities" on p. 2.0-29 that "[b]oth water and sewer lines, currently in Bundy Canyon Road, will be extended through the site along the realigned Bundy Canyon Road and will be located boath in new roadways and utility easements as shown in Figure 2.0-4a through 2.0-4f." However, the DEIR makes no discussion as to the lengths, widths, depths or routes of these required pipelines, the additions of booster pumps or sewer lift stations, or the environmental impacts associated with construction of this new infrastructure.

On September 9, 2012 EVMWD conducted a Study Session on the Oak Creek Development which discussed all of these water and sewer pipeline infrastructure matters, and which Study Session is attached hereto as "Exhibit A." Please incorporate the findings of this Study Session as well as the associated environmental impacts of pipeline infrastructure construction into any Final EIR

2-4 cont.

DATED: January 7, 2013

By: Martha Bridges
35465 Woshka Lane
Wildomar, CA 92595

Letter 2 Continued

Exhibit "A" Separator

Exhibit "A" Separator

Exhibit "A" Separator

Letter 2 Continued

Elsinore Valley Municipal Water District

STUDY SESSION
DISCUSSION OUTLINE

Date: September 19, 2012

Originator: Paul Carver / Imad Baiyasi

Subject: Oak Creek Canyon Development

Sunbelt Communities, the developer proposing Oak Creek Canyon, 163 acres in which approximately 275 single-family homes and 3 acres of commercial usage are proposed, contacted the Engineering Department on February 18, 2011 to discuss this project. The project is located on the north and south sides of Bundy Canyon Road, east of Sunset Road and west of Beverly Street. As requested by Sunbelt Communities, the District issued a Service Commitment Letter on March 18, 2011 (copy attached).

VSL Engineering and the developer met with Engineering staff on August 5, 2011 to discuss requirements to serve the project with water and sewer. Conceptual analysis revealed that water and sewer line extensions along Bundy Canyon Road and a new storage tank(s) must be constructed.

Subsequent to the meeting, staff reviewed The Farm's Specific Plan 2002 Amendment No. 3 that also includes this development within its boundaries, identified as Phases 9, 17A and 18 (copy attached).

The proposed Oak Creek Canyon development will take its source of water from the existing 2 MG Bundy Canyon water tank. This development will require design and construction of water master plan pipeline and pumping facilities in the 1746 Zone. These water system improvements will include:

- Upgrading/adding to the existing Bundy Canyon Booster Pump Station located on Bundy Canyon Road and Almond Street
- Construction of 3,025 feet of 20-inch DIP in Bundy Canyon Road from the west side of Interstate 15 easterly to Canyon Ranch Road
- Construction of 8,700 feet of 20-inch DIP in Bundy Canyon Road near Valley Vista Circle to the entrance into the development
- Construction of approximately 4,000 feet of 16-inch DIP in the development from Bundy Canyon Road to the development's water tank(s)
- Construction of an 850,000 gallon water tank (or two 425,000 gallon tanks for operational flexibility)
- Construction of a booster pump station at the Bundy Canyon Tank that will exclusively serve the Oak Creek Canyon Development

Item #3.

-3-

Letter 2 Continued

For the sewer system, the Oak Creek Canyon Development will require construction of the following sewer master planned pipeline and pump facilities:

- Construction of 8,000 feet of 10-inch sewer from the high point of Bundy Canyon Road near The Farm Road westerly to Valley Vista Circle
- Construction of 2,100 feet of 8-inch gravity sewer from the Farm Road easterly to the end of the development
- Construction of 2,100 feet of 4-inch force main in Bundy Canyon Road westerly from the proposed lift station to the high point in Bundy Canyon Road
- Construction of a sewer lift station at the far easterly end of the development

Final grading and design of the streets inside the development will influence the quantities of the proposed water and sewer system improvements.

The Farm Mutual Water Company has indicated they want the Oak Creek Development to be a part of their water and sewer system. However, given that the Farm Mutual Water Company buys all of its water from EVMWD, there does not seem to be any advantage for that to happen and in the end, it could cost the developer more money to meet both EVMWD requirements and any additional requirements the Farm MWC may also place on the development.

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-4-

Item #3.

Letter 2: Martha Bridges

Responses

2-1 to 2-3

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in Bundy Canyon Road where it flows by gravity to the EVWMD regional wastewater treatment plant located on Chaney Street in the City of Lake Elsinore.

Construction impacts associated with all the sewer construction would be limited to the discovery of cultural resources during trenching, traffic control, noise, and dust control during construction. These impacts are addressed through application of mitigation measures MM 3.3.4 (traffic management plan, page 3.3-60), MM 3.4.2a and MM 3.4.2b (air quality, page 3.4-19), MM 3.5.4a through MM 3.5.4c (noise, page 3.5-27), and MM 3.9.2a through MM 3.9.2g (cultural resources, page 3.9-19), as discussed in the Draft EIR.

The commenter includes an incomplete study session discussion outline (associated agenda and other attachments were not provided) from the Elsinore Valley Municipal Water District (EVMWD) that was apparently discussed with the EVMWD Board. While the memorandum includes information about the proposed project, it was not provided to the City during preparation of the Draft EIR or review of the project and to the City's knowledge was not acted upon by the EVMWD Board. The only correspondence received by the City from the EVMWD was a will-serve letter EVMWD provided for the sewer service for the proposed project, which was included in the Draft EIR as Appendix 3.10-1. The Farm Mutual Water Company also provided a will-serve letter that was included as Appendix 3.10-3 of the Draft EIR for the water service associated with the proposed project.

Letter 3

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VIA US MAIL & ELECTRONIC MAIL

January 7, 2013

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CITY OF WILDOMAR

Mr. Matthew Bassi, Planning Director
City of Wildomar, Planning Department
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595
mbassi@cityofwildomar.org

Re: Comments Concerning the Environmental Impact Report (EIR) for Planning Application No. 11-0261 – Oak Creek Canyon Residential Project

Dear Mr. Bassi, et al.:

Previously we submitted to your office the general concerns expressed by the Umbrell family in relation to the proposed development and with the recent publication of the EIR we cannot help but note that the EIR seems slanted in favor of approval and for that reason submit these additional comments. With that said, we hope the City will take seriously the concerns expressed herein, which are directed at the EIR and specifically the items the EIR fails to address.

As I understand it, the EIR is designed to inform the relevant public agencies, and the public body (those residents affected), of the environmental consequences of a proposed action. With the spirit of the process in mind, as a whole, the EIR fails to address all of the elements that would be of concern to those affected; notably those just outside the immediate project cite. The EIR is verbose for sure, but mostly due to restating the existing rules and regulations and the impact to the development site itself.

First, the EIR improperly categorizes the Oak Creek Canyon Residential Project as an "Infill Project." An "Infill Project" is traditionally known as a project that is applicable to property being developed commensurate with the properties surrounding the project. As you know, none of the surrounding or nearby properties have development to the level of the proposed project and therefore should not be categorized as such.

3-1

This miscategorization allows the developer to effectively ignore the environmental impact shouldered by the surrounding properties. That is because, generally speaking, "Infill Projects" typically do not affect surrounding properties as they are already developed, which is not the case in this project. This disparity in developed properties will result in a significant impact which has been totally ignored by the EIR. For example, unaddressed is the fact that sewer and

Umbrell, Penny 041912-043

Letter 3 Continued

water utilities are more than one mile away from the project and there are no storm drain facilities in areas near the proposed project.

3-1 cont.

In addition, Bundy Canyon Road, if it is being used as a foundation for categorizing the project as an "Infill Project", such usage would be improper. This is because Bundy Canyon Road is going to be re-graded, its alignment re-worked and its lanes widened. As a result, the changes to Bundy Canyon Road itself will have a significant impact on the residents, businesses and all users of the road.

It cannot be ignored either that in the relatively near future Bundy Canyon Road at the 215 interchange will be rebuilt and therein will result in additional impact to the residents, which is not addressed. In addition, from the EIR, it appears that project may include realignments that change or deny access rights from properties adjacent to the road, just outside of the project boundaries, and deny the possibility of zoning change applications for commercial use on the new highway.

3-2

At a minimum, the future project should be discussed in detail and the possible impacts of that future project on persons and property owners thoroughly discusses in the light of the great possibility that this project renders approval of the future project as a "Fiat Accompli."

Because much of the surrounding area is not developed commensurate with the project, the issue of sewage has not been adequately addressed. Although it is understood that Elsinore Municipal Water District has stated it will serve this project, there is no discussion as to how that will be accomplished, where pumping stations would be situated, or the cost likely incurred by the residents.

3-3

Currently many residents are on wells. The realignment of Bundy Canyon Road, and the proposed over fill sites, will dramatically change where water percolation will occur. This will likely result in residents just outside the immediate project boundaries losing valuable water sources, result in new wells having to be dug, and ultimately increase costs to the residents, which should be addressed.

3-4

Further, currently the nearby area development called "The Farm" has a community owned sewage disposal system that partially treats water and then disposes the same into the air at a designated spray field. Generally speaking, such a method is usually only available in rural areas where there is little possibility of mist or odors reaching the residents.

3-5

Given that the project intends to make the area substantially less "rural", it seems logical that the Elsinore Municipal Water District may someday attach to and/or serve the Farm System lest there be two different water services in the same vicinity. This eventuality/possibility, and the attendant cost thereof, should be discussed in the EIR and, if possible, a statement as to probable timeline to such a conversion.

Likewise, the lack of visible fire hydrants give testimony of a relatively low level of fire protection currently available. New water lines and/or tanks will undoubtedly have to be installed

3-6

Letter 3 Continued

to adequately protect the community. The costs, impact on traffic, and time line associated with this eventuality should be discussed in the EIR. **3-6 cont.**

Secondly, the EIR fails to adequately address hydrology, rainfall and storm water facilities. Although the report is verbose in regards to hydrology, it is so only because the complicated rules and regulations are restated. In other words, verbosity is not a substitute for substance.

The EIR acknowledges that "the project site is not currently developed with any storm drain improvements". It is also noteworthy that the surrounding areas are not developed with any storm drain improvements either. Consequently, the flows, and any increases or decreases, necessarily will affect the drainage left unimproved after the project – including those properties immediately outside of the project.

For that reason, CEQA requirements, stated in the report in section 3.7.3, require that a finding of significant impact be made if the project will "create or contribute water which would exceed the capacity of existing storm drains". Since no apparent investigation or comment in regard to the capacity of the existing (unimproved offsite storm drains) is provided, it is logically impossible for the EIR to address the matter; hence it doesn't. As a result, the report is significantly flawed in its failure to indicate significant impact from storm drain flows. **3-7**

This conclusion cannot be overlooked simply because the report claims that onsite systems will mitigate flows from the project so that they would be less than pre project flows. Under the exact wording the finding must be based only on contribution. Failure to determine or examine the areas to determine probable capacity, cannot be mitigated by imagined onsite mitigations of total amount.[1]

Any cursory observation or investigation as to condition or capacity of the existing storm drains would show that such drainage systems have been largely left unattended and neglected resulting in a dumping ground littered with trash/debris and overgrowth. This of course has resulted in impeded flow and capacity and such conditions need to be addressed as the storm water flow capacity of the downstream area should be a calculated zero.

In regards to the existing unattended storm drains, the report identifies eight storm water treatment and detention basins within the project. Each basin is partially interconnected so that there are at least three locations where the storm water could discharge from the basins into pipes or structures crossing under (the original alignment of) Bundy Canyon Road toward any such offsite storm drain flow ways. **3-8**

Only one of those crossings is in a location indicated on the current on-line Riverside County Land Information System (GIS) as a Hydrologic flow-way. As noted in prior comments, the City of Wildomar has a different printout that would identify two of the three locations as flow ways, but no effort has been made to reconcile the two maps, which should be official and would be expected to be identical.

[1] As discussed in greater detail infra, the project states that it may decrease the water flows. This means that California Department of Fish and Game will undoubtedly get involved and homeowners operating on wells will be adversely affected.

Letter 3 Continued

The line identified in the report as area B is located about 200 feet east of the Hydrologic line indicated on the currently available online GIS map. It seems somehow that this line has been moved but not documented; perhaps as the result of area flooding due to an exceptional rainfall event and then lots in the area of the original hydrologic line being gradually filled in. It would seem elementary that the EIR should provide and discuss the impact of this change and then provide input to proper authorities to document the changes.

In addition, the line identified in the report as area C is not shown on either one of the Riverside GIS maps as a hydrologic line. There is, however, currently a small culvert installed under Bundy Canyon Road at that point presumably to eliminate casual flooding during a rainfall. In fact, the roadway elevation of Harvest Way East has been raised over the years so it now matches that of Bundy Canyon Road. On the north side of Bundy Canyon Road there is no defined flow line for storm water, however. The water discharging from the pipe sits on a small low lot at the corner of Bundy Canyon Road and Club drive and then if the water surface rises enough the water flows down Club Drive. This is not a defined hydrologic line and is not a defined or imagined storm drainage course. The developer should not be allowed to utilize this location as a discharge for any amount of storm water unless or until it studies the impact and/or rectifies the issue.

3-8 cont.

In that regard, the line identified at point D is the only one of the three lines that appears as an apparent location identified on the county GIS as a hydrologic line. This is the only one of the three indicated road crossing points that seems to have proper legal status for use as a storm drain discharge point.

In regards to the culvert pipes, many changes are made in the report, none of which are explained, are logical if the statements made in the report are true. For example, the line identified as Area B crosses under Bundy Canyon Road in a 42" concrete pipe. The project plans, and the EIR alternatively show, this pipe as a 54" pipe or a 72" pipe. It is not clearly shown however if the intent is to increase the size of this pipe to match the pipe called for in the plans or to accommodate the actual flows from the project.

As the flow would continue to the north there is about 150 feet of an open "v" shaped depression which, with varying degrees of flooding on private property, apparently accommodates significant flows. Beyond that point, which is about 150 feet north of Bundy Canyon Road, the area becomes unmaintained and frankly unnavigable.

3-9

For that reason, as we have repeatedly proposed, the City should investigate and at a minimum perform a walk-thru of the adjacent properties to see first-hand the issues being raised. In spring rains, the area becomes a breeding ground for mosquitoes and further down at the point where the flow area crosses Carl Street, the property owner has provided access to his property by pushing in a road crossing through the flow area, effective a dam across the flow path. The makeshift dam does have a 12" to 18" pipe protruding from one side to the other, but naturally it is not in any way calculated to manage proper calculable flows – rather it is backyard engineering.

Letter 3 Continued

As a result, water backs up against this road crossing until it seeps into the ground or passes through the loose permeable soil of the road. The soil used on the road crossing is filled with broken concrete and other junk so there is reasonable possibility of flow through the fill.

In regards to Area C, the line identified in the report as area C is not shown on either one of the Riverside GIS maps as a hydrologic line. The pipeline under the road appears to be an 18" culvert, whereas the EIR and the project plans indicate the requirement for a 36" pipe. This pipe apparently carries only a casual flow from one side of Bundy Canyon Road to the other. But again, there is no defined flow line to the north for any storm water nor any reason provided to justify the increased diameter of the pipe. **3-9 cont.**

In addition, the water discharging from the pipe will sit on a very small low lot at the corner of Bundy Canyon Road and Club drive and at some point the water will flow down Club Drive, which is unpaved with no curb or gutter resulting in overflows and prevents usage of the roadway.

In regards to Area D, the line from Area D crosses under Bundy Canyon Road and discharges into a relatively steep sided shallow canyon. The canyon flows to the north until approximately Wheeler Street and then turns to the west to join with the flows from Point B. It appears that this flow area could carry some calculated amount of flow, notwithstanding the heavy brush and trash in the flow area, however, Club Drive will again be affected. As noted earlier, there is a 12" or 18" pipe through the makeshift dam and therefore same concerns noted are present if not aggravated.

Not explained either by the report is the fact that the project plans indicate that the pipe crossing under Bundy Canyon Road is required to be a 72", but yet the pipe currently in place is half that size. If the report is correct, and there is not supposed to be any additional increase in flow, it stands to reason that an increased pipe size would be unnecessary. Why then the increased size?

Likely, the increased size is in the plan because the EIR does not study the actual flow and it appears to be a "rather be safe than sorry" ad hoc pipe diameter placement. Again, if the report assumes that if peak flows are mitigated to be no greater that that would have been calculated for the pre-project flows, then no flooding would occur; hence no need for increased diameter. **3-10**

Lastly, it is understood that the California Department of Fish and Game (CDFG) exerts at least some jurisdiction over the water courses/ways in this area and almost no mention, other than a casual statement that permit may be required, is addressed. It would seem prudent, if not a matter of course, that during the preparation of the EIR the project plans and data should have been submitted to the CDFG and their comments included as part of the report because the possibility of significant changes or special requirements by the CDFG could change configuration of drainage courses, ponds, and capacities into the flow areas.

This is especially true due to the fact that the EIR rainfall and resulting storm drain runoff considerations are based on the typical area rainfall recurrences as opposed to intensity data. In California, it is generally known that the heaviest, longest and most intense rainfall events are those occasioned by exceptional climatic events such as El Niño or Pineapple Express. The

Letter 3 Continued

intensity of rainfall, the length of the rain events, and the flooding and property damage caused in these cases and the potential for short term recurrence likely exceeds anything that has been tabulated on standard rainfall charts and therefore should be addressed. **3-10 cont.**

In sum, it is disappointing that the EIR fails to address any impact whatsoever to properties immediately outside of the project site. The EIR goes out of its way to make unsupportable assumptions all to the risk of the adjacent homeowners. As a result, the report is deficient and another look at the issues addressed herein should be had. We look forward to working with the City on this matter **3-11**

Respectfully,

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Letter 3: Thompson & Associates

Responses

3-1 The commenter opines that the Draft EIR incorrectly characterizes the project as an "infill project." The Draft EIR uses this term in the discussion of Impact 3.1.1 that deals with whether the proposed project will divide an established community (see page 3.1-6 of the Draft EIR). In this context, the City evaluated the surrounding development, which includes The Farm, ranchette development to the east in Menifee, county development to the north, and existing development along Bundy Canyon Road to the west. Of these, The Farm has the closest density range to the proposed project, while the other development ranges in density from similar to the proposed project to very low density associated with very large parcels of land. The proposed project does not divide a community, but rather represents development consistent with plans adopted for the area in 1974 with The Farm Specific Plan. Sewer and water lines extended to the site along Bundy Canyon Road are included in Figures 2.0-4a through 2.0-4d of the Draft EIR and are also included in the Elsinore Valley Municipal Water District (EVMWD) *Water Distribution Master Plan, 2008,* and *Wastewater Master Plan, 2008.* (See also response to 1-4 of this Final EIR.) Storm drainage systems are planned throughout the project and shown on Figure 2.0-7 of the Draft EIR and discussed in Section 3.7, Hydrology and Water Quality. Detailed calculations of anticipated runoff associated with the project are included in Appendices 3.7-1 through 3.7-4 in the Draft EIR.

3-2 The commenter expresses concern about the potential for the Bundy Canyon Road/Scott Road Improvement Project to affect surrounding properties outside of the proposed project boundaries. The proposed project is implementing part of the Bundy Canyon Road project as shown in Figures 2.0-4c through 2.0-4d of the Draft EIR. Impacts of the road realignment are analyzed throughout the Draft EIR and in particular in Section 3.3, Traffic and Circulation, Section 3.8 Biological and Natural Resources, and Natural Resources, and Section 3.5, Noise. The proposed project will not make changes to Bundy Canyon Road outside of the boundaries shown in Section 2.0, Project Description, of the Draft EIR. Bundy Canyon Road is scheduled for additional improvements outside of the project boundaries as described in the Bundy Canyon Road/Scott Road Improvement Project, Draft Environmental Impact Report, January 2013 (SCH 2007051156). The Bundy Canyon Road/Scott Road Improvement Project EIR was prepared by the Riverside County Transportation Department and the cities of Menifee and Wildomar.

3-3 The commenter has a concern over how sewer service will be provided to the project and how much it might cost the residents. The proposed project will connect to a sewer line in Bundy Canyon Road. The connection will require extension of the line along Bundy Canyon Road toward I-15 (see responses 1-4 and 2-4 of this Final EIR). All costs associated with the sewer line extension are the responsibility of the developer. The service fees for customers of the EVMWD are set by the district. The EVMWD published its *Water Distribution Master Plan* in February 2008 and *Wastewater Master Plan* in November 2008. Both documents address the future needs of the Bundy Canyon/Farm area. Costs incurred are based on the demand of the project and paid by the project.

3-4 The commenter is concerned that the proposed project grading would affect where water percolation would occur, thereby affecting area wells. The comment is not substantiated with evidence supplied to the City as part of the letter. The current topographic condition and Bundy Canyon Road alignment indicate that a total of three

major streams cross the existing and proposed roadways. The existing roadway alignment is within soil designated as Soil Type D, which has the least amount of infiltration (water percolation) capabilities. The proposed roadway alignment is also within Soil Type D. As a result, it is not anticipated that the Bundy Canyon Road project will impact or drastically alter the percolation of water into the ground. Moreover, the runoff from the off-site area currently flows through the roadway culverts for small storms and overtops the roadway for larger storm events. Upon the completion of the project and Bundy Canyon Road, the proposed detention basins required as part of the project will store runoff volume emanating from the project site. The runoff volume will be stored for 24–72 hours or allowed to infiltrate, as required as part of the Regional Water Quality Control Board Municipal Separate Storm Sewer System (MS4) Permit, which is for a longer period of time than what currently occurs. Therefore, it can be concluded that runoff volume will be given more time to percolate into the existing soils adjacent to the project and Bundy Canyon Road.

3-5 The commenter questions whether development in the area would eventually need to connect to the EVMWD wastewater treatment system, thereby replacing the Farm Mutual Water Company sewage treatment facility. The proposed project will receive wastewater services from the EVMWD, and there are no plans for the project to connect to The Farm wastewater treatment system or to connect The Farm to the EVMWD. The boundary of sewer service areas is governed by the Local Agency Formation Commission and is based on the ability of the agency to provide services. Neither the City of Wildomar nor the project applicant can change the service area boundaries. The Farm's existing water and sewer infrastructure is wholly the responsibility of the Farm Mutual Water Company and its Board of Directors.

3-6 The commenter expresses concern that the proposed project will result in the need for more fire protection. The proposed project includes an urban water system including two 500,000-gallon water storage tanks and fire hydrants along all roadways. Water lines and hydrants are shown on Figures 2.0-4c through 2.0-4e of the Draft EIR. There is no requirement to retrofit existing areas near the project with similar systems even though these areas will benefit from closer proximity to fire hydrants and water storage. The impacts of construction associated with the proposed project are addressed in the Draft EIR. Construction impacts associated with the installation of utilities are addressed through application of mitigation measures MM 3.3.4 (traffic management plan, page 3.3-60), MM 3.4.2a and MM 3.4.2b (air quality, page 3.4-19), MM 3.5.4a through MM 3.5.4c (noise, page 3.5-27), and MM 3.9.2a through MM 3.9.2g (cultural resources, page 3.9-19), as discussed in the Draft EIR.

3-7 The commenter is concerned that the storm drainage analysis overstates the ability of the existing system to accept new stormwater runoff. Based on 1-foot topographic mapping and field reconnaissance, the existing terrain discharges runoff at three points along the existing Bundy Canyon Road alignment. The three points are as follows:

1. Point #1 consists of a 36-inch culvert approximately 2,500 feet west of Sunset Avenue along Bundy Canyon Road. Point #1 has a total area of 285 acres.

2. At Point #2, an 18-inch culvert exists approximately 2,000 feet west of Sunset Avenue along Bundy Canyon Road. Point #2 has a total area of 27.4 acres.

3. At Point #3, a 48-inch culvert exists approximately 990 feet west of Sunset Avenue along Bundy Canyon Road. Point #3 has a total area of 427 acres.

The current culverts at Points #1 through #3 were not analyzed as part of the Hydrology and Hydraulic Report, which did not evaluate the systems. These systems are undersized, and flows in excess of the existing capacity will overtop the existing Bundy Canyon Road. The proposed project is proposing to construct drainage facilities to convey storm flows emanating from the project based on City of Wildomar street design criteria. The City of Wildomar street design criteria allow the following:

- The runoff within the street will not be allowed to exceed top of curb for the 10-year storm event.

- The runoff within the street will not be allowed to exceed right-of-way for the 100-year storm event.

The proposed systems at Point #1 and #2 will discharge upstream of the existing storm drain culvert. However, the Line D system will replace the existing 48-inch storm drain culvert in order to ensure that Bundy Canyon Road is a 100-year all-weather crossing. The proposed storm drain system reflects the current flow patterns.

As requested by of the City of Wildomar, a supplemental Preliminary Hydrology and Hydraulic Study was prepared to perform basin routing calculations for the proposed detention basins (see Appendix 3.7-4 of the Draft EIR). Tables 15–17 of the supplemental analysis were prepared to provide the total flow rate at the downstream Points #1, #2, and #3 and shows that the pre-project flow rates are more than the post-project flow rates. Tables 15–17 were the primary determinants in concluding that the project would not have a significant impact.

In regard to the physical condition of the downstream drainage system, the alleged negligence of downstream owners or public agencies failing to maintain debris, litter, or brush is not a justifiable reason to prevent upstream property owners from discharging or perpetuating existing flow patterns. The following are common general principles established by the courts:

a. The downstream property owners are obligated to accept and make provisions for runoff that are natural flows from the land above.

b. The upstream property owner shall not concentrate runoff in areas that have not experienced concentrated runoff without making provisions for disposing the runoff in a manner that prevents damage to the downstream owner.

c. The upstream property owner may reasonably increase runoff by paving or construction of other impervious surfaces, including buildings, without liability. The upstream owner may not increase runoff by diversion of runoff from an area that was redirected.

d. No property owner shall block, or permit to be blocked, any that drainage channel, ditch, or pipe.

The proposed project has no control over the downstream property owners. As noted on page 3.7-18 of the Draft EIR, the stormwater would eventually flow into Canyon Lake and Lake Elsinore, consistent with the Drainage Area Management Plan for the Santa Ana Watershed. As stated on page 3.7-24 of the Draft EIR, "The project proposes to collect all on-site stormwater flows via four major subsurface storm drain systems that will convey the flows to one of eight detention basins. The basins are

intended to protect the project site from flood, treat on-site flows for water quality purposes by removing sediment and debris, and mitigate flows for increased runoff due to development." The stormwater is not concentrated and will not increase runoff by diversion. The proposed project's storm drain system will intercept runoff from an off-site area comprising approximately 578 acres. The accepted runoff flows from off site will be conveyed via a subsurface storm drain system to the downstream discharge points within the watershed boundaries. As the project's stormwater can only enter the stormwater system after passing through the basins, the off-site flows will remain separate from the on-site flows until the on-site flows have been treated for water quality purposes. The detention basins were engineered and sized using the *Riverside County Stormwater Quality Best Management Practice Design Handbook* (Riverside County Flood Control and Water Conservation District 2006), Worksheet 1, for volume-based best management practices. In addition, the Drainage Area Management Plan, Santa Ana Region (Riverside County 2011) recommends that stormwater volume not be infiltrated and rather allowed to be conveyed downstream to Canyon Lake and Lake Elsinore because those lakes are impacted by insufficient volume. As the proposed project will convey stormwater to underground pipes that are not designed for infiltration, this criterion would be implemented in the proposed project (see page 3.8-24 of the Draft EIR).

3-8 The commenter states that in regard to the existing unattended storm drains, the report identifies eight stormwater treatment and detention basins within the project. Each basin is partially interconnected so that there are at least three locations where the stormwater could discharge from the basins into pipes or structures crossing under (the original alignment of) Bundy Canyon Road toward any such off-site storm drain flow-ways. Only one of those crossings is in a location indicated on the current online Riverside County Land Information System (GIS) as a hydrologic flow-way. The City of Wildomar has a different printout that would identify two of the three locations as flow-ways, but no effort has been made to reconcile the two maps, which should be official and would be expected to be identical.

The Riverside County Land Information System (GIS) is based on 20-foot contours and mapping prepared by the US Geological Survey. These maps are not as detailed or accurate as the 1-foot contour maps and the biological survey and watercourse delineation prepared by the environmental consultant. The Riverside County Land Information System also states the following:

> *Maps and data are to be used for reference purposes only map features are approximate, and are not necessarily accurate to surveying or engineering standards. The County of Riverside makes no warranty or guarantee as to the content (the source is often third party), accuracy, timeliness, or completeness of any of the data provided, and assumes no legal responsibility for the information contained on this map. Any use of this product with respect to accuracy and precision shall be the sole responsibility of the user.*

As a result, as required by the County of Riverside and the City of Wildomar, the project has the best information available for the area.

3-9 The commenter requests an explanation of the storm drainage system and sizing as proposed with the project, and states that the information in the EIR and the Riverside County GIS appear to be different. Drainage systems shown in the EIR are required in order to meet City of Wildomar flooding criteria to provide flood protection for the

community and the proposed streets. The drainage system varies in size in order to convey the 100-year peak flow rate. Culvert sizes also vary to meet physical constraints of system construction such as depth of the channel on either side of the culvert, top cover, slope, etc. See also response 3-8 regarding information shown in the Riverside County Land Information System. All of the culverts are below other development features of the proposed project such as roadways, trails, and utility easements and are addressed in the Draft EIR. Construction impacts associated with the installation of utilities are addressed through application of mitigation measures MM 3.3.4 (traffic management plan, page 3.3-60), MM 3.4.2a and MM 3.4.2b (air quality, page 3.4-19), MM 3.5.4a through MM 3.5.4c (noise, page 3.5-27), and MM 3.9.2a through MM 3.9.2g (cultural resources, page 3.9-19), as discussed in the Draft EIR.

3-10 The commenter opines that the design of the stormwater system is haphazard rather than based on actual flow based on "…the fact that the project plans indicate that the pipe crossing under Bundy Canyon Road is required to be a 72", but yet the pipe currently in place is half that size. If the report is correct, and there is not supposed to be any additional increase in flow, it stands to reason that an increased pipe size would be unnecessary. Why then the increased size?" Further, the commenter asserts that the California Department of Fish and Game should comment on the system, as they could change the configuration of the drainage courses, ponds, and capacities into the flow areas. Finally, the commenter questions whether the design of the system takes into account the intensity of storm events.

Based on research conducted at the City of Wildomar, the County of Riverside, and Riverside County Flood Control and Water Conservation District, technical data related to the design of the culvert could not be found. Based on an additional study for the area, it has been determined that the existing culverts are undersized and runoff greater than the capacity of the existing culverts will overtop Bundy Canyon Road. The existing culverts do not provide for an all-weather roadway that will function during the 100-year storm event as required by the City of Wildomar. As a result, the storm drain systems were sized to meet the City of Wildomar flooding criteria. Moreover, a supplemental Preliminary Hydrology and Hydraulic Study (see Appendix 3.7-4 of the Draft EIR) was prepared to perform basin routing calculations for the proposed detention basins. Tables 15–17 were prepared to provide the total flow rate at the downstream Points #1, #2, and #3, which show that the pre-project flow rates are less than the post-project flow rates. Tables 15–17 were the primary determinants in concluding that the project would not have a significant impact.

The California Department of Fish and Wildlife (CDFW; formerly the California Department of Fish and Game) has commented on the document and will need to issue a permit for any work within its jurisdiction. Biological impacts associated with the project are addressed in Section 3.8, Biological and Natural Resources, of the Draft EIR and also include input from the CDFW, the Regional Conservation Authority, and the US Army Corps of Engineers. Detailed biological analyses have been prepared, including a Determination of Biologically Equivalent or Superior Preservation (DBESP) that is included as Attachment A to this Final EIR.

Finally, the Hydrology and Hydraulic Report prepared runoff models to understand the flows associated with long-term storms (24-hour durations) and short-term storms based on intensity. Storm drain systems were based on hydrology models that are a function of rainfall intensity. As required by the City of Wildomar and the Regional Water Quality Control Board, the following storms were analyzed: 100-year, 1-hour, 10-year, 24-hour,

and 2-year, 24-hour storm event. The supplemental Preliminary Hydrology and Hydraulic Study prepared for the project performed basin routing calculations for the proposed detention basins and storm drain systems (see Appendix 3.7-4 of the Draft EIR). Tables 15–17 were prepared to provide the total flow rate at the downstream Points #1, #2, and #3, which show that the pre-project flow rates are more than the post-project flow rates. Tables 15–17 were the primary determinants in concluding that the project would not have a significant impact.

3-11 Comment noted. The City disagrees with the assertion that the proposed project fails to address impacts to properties outside of the project boundaries. The commenter is unclear as to which impacts to properties "immediately off site" are not analyzed in the Draft EIR. As noted above, the storm drainage system proposed for the project is sized and designed to reduce the peak stormwater flow from the current condition. Water and wastewater systems are designed to serve the proposed project specifically, and any outside connection would require additional action by the City, the EVMWD, the Farm Mutual Water Company, and possibly LAFCo. The proposed project does not alter Bundy Canyon Road outside of the project boundaries; therefore, the road remains unchanged by the proposed project. Construction impacts associated with the installation of utilities are addressed through application of mitigation measures MM 3.3.4 (traffic management plan, page 3.3-60), MM 3.4.2a and MM 3.4.2b (air quality, page 3.4-19), MM 3.5.4a through MM 3.5.4c (noise, page 3.5-27), and MM 3.9.2a through MM 3.9.2g (cultural resources, page 3.9-19), as discussed in the Draft EIR.

Letter 4

Matthew Bassi

From: Robert Cashman [cashman@linkline.com]
Sent: Monday, January 07, 2013 5:23 PM
To: Matthew Bassi
Cc: Gary Nordquist
Subject: Fwd: Oak Creek Canyon Development - comments on draft EIR

RECEIVED
JAN 07 2013
CITY OF WILDOMAR

This is the final submittal

From: Robert Cashman <cashman@linkline.com>
Subject: Oak Creek Canyon Development - comments on draft EIR
Date: January 6, 2013 11:05:46 PM PST
To: Gary Nordquist <gnordquist@cityofwildomar.org>, Matthew Bassi <mbassi@cityofwildomar.org>

1. The location and connection to regional and local trails that are part of the county and Wildomar trails network are not included in the analysis. **4-1**
2. Section 3.1.1 comments "new development trends in the area have led to higher density…" What projects are being referred to with that comment? The land use designations represented by Figurer 2.0-1 do not reflect this claim. **4-2**
3. The project as described will lead to a significant and noticeably change in the appearance of the area. How Is this mitigated in the draft EIR? **4-3**
4. Mitigation of the traffic impact depends on the widening and re-alignment of Bundy Canyon Road. What is the basis for assuming that the widening of Bundy Canyon Road is expected to be completed by 2015 (section 3.3-11)? **4-4**
5. Please identify and label the location of the Cottonwood Canyon "stream" on the area map. **4-5**
6. Housing element? Is this adopted. **4-6**
7. There should be a detail list of the flora and fauna that were evaluated for the project. A biologist should comment on this list and the note the studies necessary to determine impact. One section of the project may require more attention since it is in a multi species cell. **4-7**
8. Please comment on the proximity to the Cottonwood canyon creek and the habitat zones . **4-8**

Robert Cashman
Resident

1

Letter 4: Robert Cashman

Responses

4-1 The commenter has requested that additional trails information be included in the EIR. During preparation of the Draft EIR, the City Council adopted the Multi-Use Trail System Adopt a Trail Map, which is added as Figure 3.3-11 to Section 3.3 of the Draft EIR (see Section 3.0 of this Final EIR). The trails map shows the Sunset Avenue Regional Trail N-S-14 along the west right-of-way of Sunset Avenue. The trail follows the roadway to the south, connecting to the Hampton-Hirst (HT-E-50) and Keller Road Regional Trail (W-E-20). The proposed project will construct the trail within the 14-foot trail easement as part of right-of-way improvements on Sunset Avenue as shown in Figure 2.0-4b in Section 2.0, Project Description, of the Draft EIR.

4-2 The commenter questions the location of higher-density development projects. Table 3.3-15 on page 3.3-61 of the Draft EIR lists projects considered in the cumulative traffic analysis. As noted in the table, several of the area projects include townhouse and/or condominium development associated with higher density.

4-3 The commenter questions how the visual impact associated with the proposed project would be mitigated. The proposed project will result in grading of the areas planned for development. Much of the project area will be left unchanged as a result of the project and kept in open space. By clustering the homes in development areas, the visual impact of the project will be reduced. Further, compliance with the City's light pollution ordinance will ensure that the nighttime sky will be protected from unnecessary light. Aesthetics are discussed in Section 3.11 of the Draft EIR. The Draft EIR also includes mitigation measures for oak tree mitigation associated with changes to Bundy Canyon Road.

4-4 The commenter questions how the EIR can assume that Bundy Canyon Road will be widened by 2015. The EIR does not assume that the roadway will be widened by 2015. For purposes of the traffic analysis, the proposed Oak Creek Canyon Residential Development Project will be constructed and operated by 2015. The only portion of Bundy Canyon Road that would be completed by 2015 is the portion within the project boundaries. The wording on page 3.3-11 has been revised to help clarify the assumption (see Section 3.0 of this Final EIR).

4-5 The commenter requests that the Cottonwood Canyon "stream" be identified on the area map. Please see Figure 3.8-4 in Section 3.0 of this Final EIR.

4-6 The commenter asks if the 2006–2014 Housing Element was adopted. The Housing Element was not adopted as originally expected during drafting of the EIR. Section 3.0 of this Final EIR corrects the wording on page 3.1-1 of the Draft EIR.

4-7 The commenter requests that a detailed list of flora and fauna be included in the Draft EIR. Table 3.8-3 of the Draft EIR includes a list of special-status species considered in the impact analysis. Figures 3.8-2 and 3.8-3 identify the location of resources found within and near the proposed project site.

4-8 The commenter requests clarification of the proximity of the project to the Cottonwood Canyon creek and habitat zones. Figure 3.8-4 shows the project footprint in relation to the riverine and riparian habitat identified in Figure 3.8-2, and in Appendix 3.8-1, Jurisdictional Delineation of Waters and Wetlands, in the Draft EIR. Section 3.0 of this Final EIR adds Figure 3.8-4 to the Draft EIR.

Letter 5

Matthew Bassi

From: Carmen Cave <ccave@cityofmenifee.us>
Sent: Thursday, March 21, 2013 10:12 AM
To: Matthew Bassi
Subject: RE: MENIFEE MEETING

Actually, this is a much better response and it makes us feel better.

We don't need to meet now that we have this enhanced response.

Would that be ok with you?

And...can we get a copy of the March 6 PC minutes when they are approved?

Thanks!

From: Matthew Bassi [mailto:mbassi@cityofwildomar.org]
Sent: Thursday, March 21, 2013 9:08 AM
To: Carmen Cave
Cc: mteague@pmcworld.com; lrm@markhamdmg.com; bl@billloconsulting.com; TJex@bwslaw.com; salhadeff@lbbslaw.com
Subject: MENIFEE MEETING

Carmen,

You should have received our final response this morning to your March 6, 2013 letter. We have reiterated our original responses to the DEIR comments as well as expanded on a few of them. We have involved our city attorney, and the applicant's attorney in crafting the responses.

As we are scheduled to meet this afternoon, I would like to know what your thoughts are in terms of the goal of the meeting. This would certainly help us prepare for our discussion. I appreciate your time and reply.

MATT

Matthew C. Bassi
Planning Director

City of Wildomar
23873 Clinton Keith Road
Suite 201
Wildomar CA 92595

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City Hall Hours:
Monday - Thursday
8:00 a.m. - 5:00 p.m.
Closed Fridays

www.cityofwildomar.org

Letter 5 Continued

Scott A. Mann
Mayor

Wallace W. Edgerton
Deputy Mayor

John V. Denver
Councilmember

Thomas Fuhrman
Councilmember

Greg August
Councilmember

March 6, 2013

Matthew Bassi
Planning Director
City of Wildomar
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

RE: Responses to Comments on Draft Environmental Impact Report for Oak Creek Canyon with a Specific Plan Amendment to the Farm Specific Plan, Change of Zone from R-1 to R-4 and from C-P-S to C-1/C-P, and Tentative Tract No. 36388, a 292-lot subdivision.

Dear Mr. Bassi:

Thank you for the opportunity for the City of Menifee to review the Responses to Comments for the Oak Creek Canyon Environmental Impact Report in the City of Wildomar. Unfortunately, responses to the City of Menifee's comments were not adequately addressed in the D-1 Response prepared. From a formatting standpoint, it would have been more appropriate to provide a separate answer to each comment that the City of Menifee had cited in their January 7, 2013 letter on the Draft Environmental Impact Report instead on lumping the responses into one large answer that did not address a number of the City's concerns.

For your benefit, Menifee's Community Development Department has the reiterated the comments on the Draft Environmental Impact Report that did not receive a response in the Final EIR. The pages from the Draft EIR are as follows:

Page

1.0-9: 1.5 Type of Document, although no specific uses as known for the 5.21-acre commercial area, the impacts from that designated land should be addressed and mitigation measures proposed as appropriate since this project includes the adoption of supporting zoning. The City of Menifee is concerned that the potential impacts to the small lot estate residential lots adjacent to Sunset Avenue are fully evaluated. **5-1**

Insufficient detail provided to address the impacts associated with the increased commercial acreage adjacent to the City of Menifee. Merely including the acreage in model runs does not address aesthetic/visual impacts, hazardous materials impacts, or land use impacts.

Figure 2.0-1, 3.1-1: the General Plan designation in the City of Menifee should be expressed as RC-LDR to denote Low Density Residential under the Rural Community Foundation. **5-2**

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Menifee, CA 92586
Phone 951.672.6777
Fax 951.679.3843
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Letter 5 Continued

No amended Figure.

3.1-6 to 8, as stated in the December 27, 2001 Notice of Preparation letter, please address the compatibility with the City of Menifee's existing residential adjacent to the site along Sunset Avenue. **5-3**

Insufficient discussion provided with no changes made.

3.3-9, Local, note the City of Menifee under this section as regulatory permits will be necessary on Sunset Avenue. **5-4**

No changes made.

3.3-65: Mitigation Measure MM 3.3.5, the statement that TUMF is adequate mitigation is not correct. There are no guarantees that the monies collected for this project under TUMF will go toward improvements at the Scott Road interchange. The project should establish an alternate mechanism to fund and or construct the improvements should they not be in place for opening year and/or build-out year especially since this project is increasing the amount of commercial acreage under the Specific Plan Amendment.

Insufficient detail provided to address the significant impacts associated with the full buildout at Murrieta Road/Scott Road and the Scott Road Interchange. Payment of the pro-rata share of the cost of improvements is cited as being considered appropriate mitigation, but no monetary expression of what that amount is has been provided. This Specific Plan Amendment with its increase in commercial acreage was not modeled as part of regional plans. The Amendment should provide improvements as needed in the event that projects such as the Bundy Canyon Road/Scott Road improvements or the Interstate 215/Scott Road interchange improvements are not in place. The response that the project does not directly impact the Scott Road/Interstate 215 interchange seems unlikely unless project traffic is being restricted from proceeding eastward to Interstate 215. **5-5**

3.4-17: The project's increase in commercial acreage along Bundy Canyon Road needs to be specifically addressed since the additional acres were not included in previous modeling. **5-6**

No changes made and no discussion.

3.10-28: This section should include a discussion of trails. Specifically address the O'Neil Regional Trail running south on Sunset Avenue, crossing Bundy Canyon Road and continuing south to Keller Road. **5-7**

No changes made and no discussion.

3.11-5: Include a discussion to address the interface along Sunset Avenue in terms of grading and viewshed. **5-8**

No changes made and no discussion.

4.0-3: Mitigation Measure MM 3.3.5, the statement that TUMF is adequate mitigation is not correct. There are no guarantees that the monies collected for this project under TUMF will go toward improvements at the Scott Road interchange. The project should establish an alternate mechanism to fund and or construct the improvements should they not be in place for opening **5-9**

Letter 5 Continued

year and/or build-out year especially since this project is increasing the amount of commercial acreage under the Specific Plan Amendment.

See response above.

Thank you again for the opportunity to provide comments.

Sincerely,

Carmen Cave, Ph.D.
Community Development Director

Letter 5 Continued 5 ✓

Timothy Walker, Mayor
Marsha Swanson, Mayor Pro Tem
Bob Cashman, Council Member
Bridgette Moore, Council Member
Ben J. Benoit, Council Member

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March 20, 2013

Carmen Cave
Community Development Director
City of Menifee
29714 Haun Rd.
Menifee, CA 92586

Re: Responses to March 6, 2013, Letter from the City of Menifee on the Oak Creek Canyon Project

Thank you for the additional comment on the Oak Creek Canyon Project Environmental Impact Report. Staff presented your letter to the Planning Commission at their meeting of March 6, 2013, as part of the public hearing on the project. . The following are responses to your letter of March 6, 2013.For the benefit of the public and the City Council, and as a courtesy to a neighboring city,the City of Wildomar reiterates here the responses it already has provided to the City of Menifee's comments in the Final EIR delivered to the City of Menifee on February 25, 2013. The responses to Menifee were included within overall responses as allowed by CEQA.

1. The commenter states that there is insufficient detail provided by the EIR to determine whether the impacts of the 5.21-acre commercial site on the adjacent small-lot estate residential lots on Sunset Avenue have been fully evaluated. In response to the commenter's letter of January 7, 2013 (see Letter D of the Final EIR), the following is found under Response D-1 on page 2.0-29:

   The commenter requests additional information regarding the compatibility of the project on the adjacent residential lots along Sunset Avenue. The proposed project has approximately 361 feet of frontage on Sunset Avenue, which is approximately one parcel as shown today. The western boundary of Sunset Avenue will contain the Sunset Trail easement area, followed by grading leading to a commercial pad. The main driveways for the commercial property are on Bundy Canyon Road, with a secondary access onto Sunset Avenue. While no specific commercial development is proposed with this application, possible commercial uses were assumed in the Traffic Analysis (see Table 3.3-5 on page 3.3-17 of the Draft EIR). Because the traffic model outputs are used to determine noise, air quality, and greenhouse gas impacts, the commercial potential is reflected in these sections of the

Letter 5 Continued

Draft EIR as well. The City of Wildomar requires plot plan approval before any commercial project can be developed. During review of the plot plan, the City will review landscape plans, building elevations, signage, color, and roadway improvements along Sunset Avenue. The City also has a lighting ordinance that restricts the amount of light pollution.

Without a specific commercial use proposed for the site, it is too speculative to determine what impacts, if any, might occur. The C-P-S zoning is regulated by Section 17.76 of the Wildomar Municipal Code (see page 3.1-4 of the Draft EIR). All uses in this zoning district must have plot plan approval pursuant to Section 17.216 of the Wildomar Municipal Code. Findings for plot plan approval are set in Section 17.216.040 of the Municipal Code and state:

17.216.040 Requirements for approval.

No plot plan shall be approved unless it complies with the following standards:

A. The proposed use must conform to all the requirements of the General Plan and with all applicable requirements of state law and City ordinances.

B. The overall development of the land shall be designed for the protection of the public health, safety and general welfare; to conform to the logical development of the land and to be compatible with the present and future logical development of the surrounding property. The plan shall consider the location and need for dedication and improvement of necessary streets and sidewalks, including the avoidance of traffic congestion; and shall take into account topographical and drainage conditions, including the need for dedication and improvements of necessary structures as a part thereof.

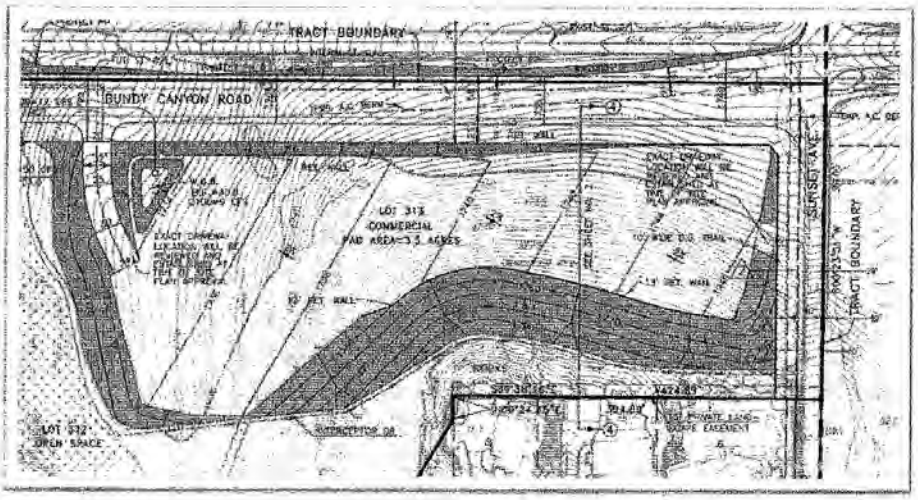
C. All plot plans which permit the construction of more than one structure on a single legally divided parcel shall, in addition to all other requirements, be subject to a condition which prohibits the sale of any existing or subsequently constructed structures on the parcel until the parcel is divided and a final map recorded in accordance with Title 16 in such a manner that each building is located on a separate legally divided parcel. (Ord. 18 § 2, 2008, RCC § 17.216.040)

As shown in B above, a finding of a plot plan is that the design of the project be "...compatible with the present and future logical development of the surrounding property."

The commercial property is also separated from Sunset Avenue by the Sunset Trail right-of-way as shown in Figure 2.0-4e of the Draft EIR. The commercial site itself will be physically lower than the adjacent property to the east, as shown in this enlargement of Parcel 313 from Figure 2.0-4e of the Draft EIR.

Letter 5 Continued

Section 21159 of the Public Resources Code provides guidance to lead agencies on the level of environmental analysis for projects as follows: "In preparation of this analysis, the lead agency may utilize numerical ranges or averages where specific data is not available; however, the agency shall not be required to engage in speculation or conjecture" (PRC 21159(a)).



In this instance, land use traffic generation assumptions were made to enable evaluation of the traffic, air quality, greenhouse gas, and noise analysis. Building style, landscaping, signage, and other features associated with a commercial site plan were not available for the analysis. CEQA does not require an analysis of buildings or types of use for a parcel which have not yet been planned or proposed. The level of specificity of any such discussion is reduced, and cannot include project-specific analysis (as of aesthetics) where such discussion would be purely speculative. The *Tracy First v. City of Tracy* (2009) 177 Cal. App. 4th 912, presents a somewhat similar factual situation. There, the proposal for the WinCo foods development on the southern parcel as analyzed in depth; in contrast, because there was no development plan which had been submitted for the northern parcel, the EIR discussed a "hypothetical" development but could not discuss project specific impacts, such as aesthetics. Thus the level of discuss requested by the City of Menifee is neither possible nor required. CEQA discourages speculative discussion. An EIR is not required to speculate about the environmental consequences of future development that is unspecified and such an analysis would be premature. (*Environmental Council of Sacramento v City of Sacramento* (2006) 142 Cal. App. 4th 1018).

Letter 5 Continued

As the City of Wildomar has a required plot plan approval process, and the plot plan must meet findings that relate to compatibility with surrounding development, the details of the future commercial aesthetic of the commercial land were appropriately left to the plot plan approval process.

With regard to parcel size and the adjacent properties, Parcel 313 has approximately 361 feet of frontage on Sunset Avenue and is approximately 5.1 acres in size; however, only 3.5 acres is suitable for development due to slope constraints. The size of the parcel is similar to, or larger than, other adjacent parcels in the vicinity of the proposed project and is much larger than the existing Farm residential parcels to the south along Sunset Avenue. Parcels to the north are separated from the commercial property by Bundy Canyon Road, which is planned to be a four-lane roadway with a right-of-way of approximately 134 feet (Bundy Canyon Road/Scott Road Improvement Project Draft EIR, SCH 2007051156).

Mitigation measure MM 3.3.1 requires the proposed project to install a traffic signal at the intersection of Sunset Avenue and Bundy Canyon Road. While this will be a change from the existing stop-controlled intersection, there are existing signals on Bundy Canyon Road and additional signals planned as part of the Bundy Canyon Road/Scott Road Improvement Project. As the current intersection is one of an unimproved dirt roadway intersecting a paved roadway, the full intersection improvements are considered a visual enhancement to the area.

Note that mitigation measure MM 3.3.1 already has been modified on page 3.0-4 of the Final EIR by request of the City of Menifee to read as follows; the text modification is underlined below:

Sunset Avenue/Bundy Canyon Road

- Install a traffic signal.
- Construct an eastbound left turn lane and two additional through lanes.
- Construct a westbound left turn lane.
- <u>Ensure a northbound and southbound lane of traffic along the frontage of the commercial parcel. Coordinate improvements with the City of Menifee.</u>

2. The commenter requests that Figure 2.0-1, on page 3.1-1 of the Draft EIR, be amended to show RC-LDR to denote Low Density Residential under the Rural Community Foundation. Figure 2.0-1 has been amended. It was determined that this change was not germane to any analysis in the EIR, so it was not made in the Final EIR. It is added only at the request of the City of Menifee and not as additional information.

3. The commenter requests that the EIR address the compatibility with the City of Menifee's existing residential zoning along Sunset Avenue. See Response 1.

4. The commenter requests a change on page 3.3-9 of the Draft EIR noting that the City of Menifee will require regulatory permits for construction on Sunset Avenue. This section of the Draft EIR explains the regulatory process for the development of roadways affected by the proposed project. One half of Sunset Avenue is within the jurisdiction of the City of Menifee, and an encroachment permit will be needed for

Letter 5 Continued

any construction along this roadway. This correction already was made to the Draft EIR on page 3.0-2 of the Final EIR, which reads as follows:

> Under subsection 2.4, Regulatory Requirements, Permits, and Approvals Potentially Required from Other Public Agencies, the following changes are incorporated:
> - *California Department of Fish and ~~Game (CDFG)~~ Wildlife (CDFW):* A 1603 Streambed Alteration Agreement may be required.
> - *City of Menifee:* Encroachment permit and coordination for improvements on the east side of Sunset Avenue.

The City of Menifee will grant a ministerial permit (the encroachment permit) for such improvements. Therefore, the City of Menifee is not a responsible agency.

As shown in Figure 2.0-4e of the Draft EIR, the only improvements proposed for Sunset Avenue are along the approximately 361-foot frontage of the roadway on the east side of Parcel 313. The proposed street section is shown in Figure 2.0-4a of the Draft EIR. As discussed in Response 1 above, mitigation measure MM 3.3.1 requires that the proposed project install a traffic signal at the intersection of Sunset Avenue and Bundy Canyon Road.

In response to the commenter, the text of the Draft EIR as considered by the Planning Commission is amended as follows to clarify but not to add additional information:

> City of Menifee General Plan
>
> As of the date of publication of this EIR, the City of Menifee General Plan is the Riverside County General Plan, which is the same as City of Wildomar's General Plan. The Riverside County General Plan establishes LOS C as a target for all City-maintained roadways and conventional state highways, except that LOS D could be allowed in urban areas at intersections of any combination of major streets, arterials, expressways, or conventional state highways within 1 mile of a freeway interchange and also at freeway ramp intersections. Current policy requires development projects to mitigate impacts on roadways based on the LOS C standard. Current General Plan policy also permits allowing development projects to mitigate to LOS D, subject to City Council approval, in those instances where mitigation to LOS C is deemed to be impractical. The City of Menifee will require an encroachment permit for any construction within their right-of-way.

As shown in Table 3.3-13 of the Draft EIR, the installation of traffic signals as required by mitigation measure MM 3.3.1 will result in LOS B for the intersection. This level of service is consistent with both the City of Wildomar's and the City of Menifee's adopted level of service standards.

5. The commenter is requesting that the proposed project establish an independent funding mechanism to ensure full funding for the Murrieta Road/Scott Road interchange. The commenter's assumption of inadequate mitigation is not supported by the facts or CEQA statutes or case law. As noted in Response D-1 on page 2.0-29 of the Final EIR:

Letter 5 Continued

Bundy Canyon Road realignment is a project by the Riverside County Transportation Department in conjunction with the cities of Wildomar and Menifee. A Draft EIR for the Bundy Canyon Road improvements was circulated for public review in January 2013 (SCH 2007051156). The Bundy Canyon Road improvements will extend from I-15 in the west to I-215 in the east. Further, I-215 roadway improvements are under way as a Riverside County Transportation Commission project. The Riverside County Transportation Commission (RCTC) is making improvements to I-215 from the Scott Road interchange to the Nuevo Road interchange, adding one general purpose travel lane in each direction. The improvements follow the previous project that added a travel lane from the Scott Road interchange to the Murrieta Hot Springs Road interchange.

The Scott Road interchange improvements are funded in part by a community facilities district (CF 05-08) and the TUMF. While subject to the TUMF, the proposed project is not within the boundaries of CF 05-08, which was established to pay for a portion of the interchange. The traffic study demonstrates that the project does not directly impact the Scott Road/I-215 interchange (see the Existing Plus Project Scenario shown in Table 3.3-9 on page 3.3-46). This table shows that the Existing Plus Project Scenario results in level of service (LOS) C at the interchange of Scott Road and I-215. The project is part of the overall cumulative background growth conservatively assumed for Opening Year 2015 conditions. It is this conservative cumulative growth forecast that causes the existing interchange at Scott Road to fail as shown in Table 3.3-10 on page 3.3-48 of the Draft EIR. Table 3.3-10 shows the opening year level of service if all of the projects shown in Table 3.3-8 on page 3.3-23 of the Draft EIR are constructed and occupied. As shown, 7 of the projects listed in Table 3.3-8 of the Draft EIR are located within the City of Wildomar and the remaining 24 projects are in the City of Menifee.

The future interchange design for Scott Road/I-215 is approved and in process with the County, Caltrans, and the City of Menifee and is designed to accommodate the anticipated traffic growth. This project, along with others assumed to be constructed and contributing traffic to the Scott Road interchange as part of the Opening Year 2015 scenario, will each mitigate their proportionate share of this cumulative impact through their payment of fees—whether it be to TUMF (regional component), DIF, CFD, or other fees as determined to match the pro-rata share requirements indicated in mitigation measure MM 3.3.5 on page 3.3-65 of the Draft EIR. With the collection of these fees, the funds would be in place to complete construction of the Scott Road/I-215 interchange. As the short-term impacts of the project do not result in a significant impact at this interchange, and only the full buildout of the cumulative projects results in a significant impact at the interchange, payment of a pro-rata share of the cost of improvements is considered appropriate mitigation.

Letter 5 Continued

The California Environmental Quality Act (CEQA) provides guidance on the authority to mitigate in Section 15041 of the CEQA Guidelines:

15041. AUTHORITY TO MITIGATE

Within the limitations described in Section 15040:

(a) A lead agency for a project has authority to require feasible changes in any or all activities involved in the project in order to substantially lessen or avoid significant effects on the environment, consistent with applicable constitutional requirements such as the "nexus" and "rough proportionality" standards established by case law (*Nollan v. California Coastal Commission* (1987) 483 U.S. 825, *Dolan v. City of Tigard*, (1994) 512 U.S. 374, *Ehrlich v. City of Culver City*, (1996) 12 Cal. 4th 854.).

As reported in Table 3.3-9 on page 3.3-46 of the Draft EIR, the proposed project will contribute some trips to the I-215 southbound and northbound ramps at the Scott Road ramps at I-215 (see intersection numbers 12 and 13, respectively). The following excerpt from Table 3.3-9 shows that under Existing Plus Project Conditions, the proposed project would result in the following:

#	Intersection	Jurisdiction	Existing				Existing + Project					
			Delay[1] (secs.)		Level of Service		Delay[1] (secs.)			Level of Service		
			AM	PM	AM	PM	AM	Δ	PM	AM	Δ	PM
12	I-215 SB Ramps/Scott Rd.	Caltrans	24.6	30.8	C	C	26.6	2	32.7	C	1.9	C
13	I-215 NB Ramps/Scott Rd.	Caltrans	26.6	32.3	C	C	29.3	2.7	33.9	C	1.6	C

The change (Δ) for both ramps is less than 3.0 seconds under the scenario, and the resulting level of service remains consistent with the LOS threshold of C and D established by Caltrans. The Traffic Impact Analysis and the Draft EIR show that while the proposed project will contribute to existing traffic at the Scott Road/I-215 southbound and northbound ramps, the contribution does not exceed the adopted level of service threshold and is therefore less than significant.

The proposed project will contribute to the cumulative growth in the region and therefore is required to contribute to a regionally adopted mitigation strategy. The project contributes proportionally to the impacts at the interchange; requiring this project to develop an independent funding mechanism would be disproportionate to the impact as reported in the Draft EIR.

6. The commenter is further concerned about the commercial site, suggesting that it was not modeled as part of regional plans. That statement is not correct. The commenter requests that the increase in commercial area be specifically addressed since the additional acres were not included in previous modeling. As noted in Response 1 above and as shown on page 3.3-17 of the Draft EIR, potential land uses

Letter 5 Continued

were assumed and included in the traffic analysis for the project. As a result, all impacts in the Draft EIR, including those for the Scott Road/I-215 interchange, include the commercial development assumptions.

7. The commenter requests a discussion of trails and believes no changes were made to the EIR based on the previous comment. Again, however, that comment is not accurate. On page 3.0-4 of the Final EIR, the following text was included:

> The second paragraph under Impact 3.3.2 on page 59 of the Draft EIR is amended as follows:
> The City of Wildomar has neither a developed bicycle trail system nor a plan for a bicycle system. Although the proposed project has open space and is likely to have trails, these will be recreation oriented ~~and are not anticipated to~~ and will connect to other trail systems. The City adopted the Multi-Use Trail System Adopt a Trail Map that shows the Sunset Avenue Regional Trail N-S-14 along the west right-of-way of Sunset Avenue. The Sunset Avenue Trail follows Sunset Avenue roadway to the south, eventually connecting to the Hampton-Hirst (HT-E-50) and Keller Road Regional Trail (W-E-20). The proposed project incorporates the 14-foot Sunset Trail easement as part of right-of-way improvements on Sunset Avenue as shown in Figure 2.0-4b and will be constructed as part of the proposed project. The Bundy Canyon Road improvements will be designed to accommodate bicycle traffic, which will ensure eventual connectivity to other roadways in the community. This impact is considered **less than significant**.

As noted in the above text, the only portion of the trail system affected by the project is the 361-foot piece on the east side of Parcel 313, which is part of the Sunset Trail system. Note that this is the only portion of the trail that exists within the proposed project boundary.

8. Commenter has requested a discussion on page 3.11-5 to address the interface along Sunset Avenue in terms of grading and viewshed. This issue was discussed on page 3.11-5 of the Draft EIR. The Draft EIR states:

> The proposed project will include a small commercial area approximately 5.2 acres in size (3.5 acres developable). Construction of this commercial property will result in a development that is different in scale and type from the surrounding residential areas. As part of the development review process, the City of Wildomar will evaluate the design of the commercial land as part of plot plan review procedures. The Oak Creek Specific Plan includes commercial design guidelines so aesthetics and design will be part of the review process. As the commercial area fronts on Bundy Canyon Road and will be oriented toward this large arterial, and the design will be reviewed to ensure compatibility with the commercial design guidelines during the plot plan review process, this impact is considered **less than significant**.

9. The commenter states that payment of the TUMF is not adequate mitigation. See Response 5 above. First, the City of Wildomar is not required to mitigate extraterritorial impacts. (*Tracy First, supra*, at 937). Factually, this situation is similar to the facts in *Tracy First* in that the project there, a proposed new grocery store, resulted in potential traffic impacts in an unincorporated area of San Joaquin County, outside of the boundaries and thus jurisdiction of the City of Tracy. In that case, the court held that the

Letter 5 Continued

City was not required to impose a mitigation requirement for such an extraterritorial traffic impact where it has no ability to enforce the measure or ensure the mitigation would actually be implemented given that the County was the agency that would be responsible for construction of the traffic improvement needed to mitigate the impact. The City of Wildomar is similarly situated here in that the improvements necessary to mitigate the cumulative impacts to the Murrieta Road/Scott Road Interchange are outside of the boundaries and thus jurisdiction of the City of Wildomar. Second, to the extent the project may contribute to cumulative impacts, those impacts adequately are addressed by the TUMF fees, as discussed above. See, for example, *Save Our Peninsula*, cited with approval by the California Supreme Court in *City of Marina v. Board of Trustees of California State University* (2006) 39 Cal. 4th 341.

Thank you again for your comments on the project, please call me if you have additional questions.

Sincerely,

Matthew C. Bassi
Planning Director

C: Thomas Jax
Bill Lo
Larry Markham
Mark Teague

1845-5688-7315.1

Letter 5: City of Menifee (Carmen Cave)

Response

5-1 The commenter accepts the City of Wildomar's response, dated March 20, 2013, to the initial comment letters from the City of Menifee, dated March 6, 2013 and March 21, 2013.

No additional response is necessary, please see the letter Matt sent to Menifee dated March 20, 2013 below.

Timothy Walker, Mayor
Marsha Swanson, Mayor Pro Tem
Bob Cashman, Council Member
Bridgette Moore, Council Member
Ben J. Benoit, Council Member

23873 Clinton Keith Rd, Ste. 201
Wildomar, CA 92595
951.677.7751 Phone
951.698.1463 Fax
www.CityofWildomar.org

March 20, 2013

Carmen Cave
Community Development Director
City of Menifee
29714 Haun Rd.
Menifee, CA 92586

Re: Responses to March 6, 2013, Letter from the City of Menifee on the Oak Creek Canyon Project

Thank you for the additional comment on the Oak Creek Canyon Project Environmental Impact Report. Staff presented your letter to the Planning Commission at their meeting of March 6, 2013, as part of the public hearing on the project. . The following are responses to your letter of March 6, 2013.For the benefit of the public and the City Council, and as a courtesy to a neighboring city,the City of Wildomar reiterates here the responses it already has provided to the City of Menifee's comments in the Final EIR delivered to the City of Menifee on February 25, 2013. The responses to Menifee were included within overall responses as allowed by CEQA.

1. The commenter states that there is insufficient detail provided by the EIR to determine whether the impacts of the 5.21-acre commercial site on the adjacent small-lot estate residential lots on Sunset Avenue have been fully evaluated. In response to the commenter's letter of January 7, 2013 (see Letter D of the Final EIR), the following is found under Response D-1 on page 2.0-29:

   The commenter requests additional information regarding the compatibility of the project on the adjacent residential lots along Sunset Avenue. The proposed project has approximately 361 feet of frontage on Sunset Avenue, which is approximately one parcel as shown today. The western boundary of Sunset Avenue will contain the Sunset Trail easement area, followed by grading leading to a commercial pad. The main driveways for the commercial property are on Bundy Canyon Road, with a secondary access onto Sunset Avenue. While no specific commercial development is proposed with this application, possible commercial uses were assumed in the Traffic Analysis (see Table 3.3-5 on page 3.3-17 of the Draft EIR). Because the traffic model outputs are used to determine noise, air quality, and greenhouse gas impacts, the commercial potential is reflected in these sections of the

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Draft EIR as well. The City of Wildomar requires plot plan approval before any commercial project can be developed. During review of the plot plan, the City will review landscape plans, building elevations, signage, color, and roadway improvements along Sunset Avenue. The City also has a lighting ordinance that restricts the amount of light pollution.

Without a specific commercial use proposed for the site, it is too speculative to determine what impacts, if any, might occur. The C-P-S zoning is regulated by Section 17.76 of the Wildomar Municipal Code (see page 3.1-4 of the Draft EIR). All uses in this zoning district must have plot plan approval pursuant to Section 17.216 of the Wildomar Municipal Code. Findings for plot plan approval are set in Section 17.216.040 of the Municipal Code and state:

17.216.040 Requirements for approval.

No plot plan shall be approved unless it complies with the following standards:

A. The proposed use must conform to all the requirements of the General Plan and with all applicable requirements of state law and City ordinances.

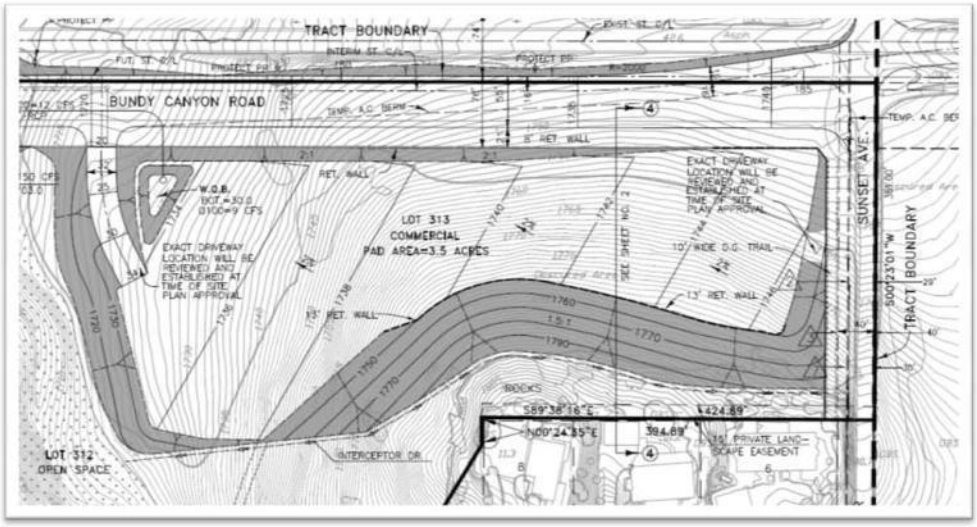
B. The overall development of the land shall be designed for the protection of the public health, safety and general welfare, to conform to the logical development of the land and to be compatible with the present and future logical development of the surrounding property. The plan shall consider the location and need for dedication and improvement of necessary streets and sidewalks, including the avoidance of traffic congestion; and shall take into account topographical and drainage conditions, including the need for dedication and improvements of necessary structures as a part thereof.

C. All plot plans which permit the construction of more than one structure on a single legally divided parcel shall, in addition to all other requirements, be subject to a condition which prohibits the sale of any existing or subsequently constructed structures on the parcel until the parcel is divided and a final map recorded in accordance with Title 16 in such a manner that each building is located on a separate legally divided parcel. (Ord. 18 § 2, 2008; RCC § 17.216.040)

As shown in B above, a finding of a plot plan is that the design of the project be "...compatible with the present and future logical development of the surrounding property."

The commercial property is also separated from Sunset Avenue by the Sunset Trail right-of-way as shown in Figure 2.0-4e of the Draft EIR. The commercial site itself will be physically lower than the adjacent property to the east, as shown in this enlargement of Parcel 313 from Figure 2.0-4e of the Draft EIR.

Section 21159 of the Public Resources Code provides guidance to lead agencies on the level of environmental analysis for projects as follows: "In preparation of this analysis, the lead agency may utilize numerical ranges or averages where specific data is not available; however, the agency shall not be required to engage in speculation or conjecture" (PRC 21159(a)).



In this instance, land use traffic generation assumptions were made to enable evaluation of the traffic, air quality, greenhouse gas, and noise analysis. Building style, landscaping, signage, and other features associated with a commercial site plan were not available for the analysis. CEQA does not require an analysis of buildings or types of use for a parcel which have not yet been planned or proposed. The level of specificity of any such discussion is reduced, and cannot include project-specific analysis (as of aesthetics) where such discussion would be purely speculative. The *Tracy First v. City of Tracy* (2009) 177 Cal. App. 4th 912, presents a somewhat similar factual situation. There, the proposal for the WinCo foods development on the southern parcel as analyzed in depth; in contrast, because there was no development plan which had been submitted for the northern parcel, the EIR discussed a "hypothetical" development but could not discuss project specific impacts, such as aesthetics. Thus the level of discuss requested by the City of Menifee is neither possible nor required. CEQA discourages speculative discussion. An EIR is not required to speculate about the environmental consequences of future development that is unspecified and such an analysis would be premature. (*Environmental Council of Sacramento v City of Sacramento* (2006) 142 Cal. App. 4th 1018).

As the City of Wildomar has a required plot plan approval process, and the plot plan must meet findings that relate to compatibility with surrounding development, the details of the future commercial aesthetic of the commercial land were appropriately left to the plot plan approval process.

With regard to parcel size and the adjacent properties, Parcel 313 has approximately 361 feet of frontage on Sunset Avenue and is approximately 5.1 acres in size; however, only 3.5 acres is suitable for development due to slope constraints. The size of the parcel is similar to, or larger than, other adjacent parcels in the vicinity of the proposed project and is much larger than the existing Farm residential parcels to the south along Sunset Avenue. Parcels to the north are separated from the commercial property by Bundy Canyon Road, which is planned to be a four-lane roadway with a right-of-way of approximately 134 feet (Bundy Canyon Road/Scott Road Improvement Project Draft EIR, SCH 2007051156).

Mitigation measure MM 3.3.1 requires the proposed project to install a traffic signal at the intersection of Sunset Avenue and Bundy Canyon Road. While this will be a change from the existing stop-controlled intersection, there are existing signals on Bundy Canyon Road and additional signals planned as part of the Bundy Canyon Road/Scott Road Improvement Project. As the current intersection is one of an unimproved dirt roadway intersecting a paved roadway, the full intersection improvements are considered a visual enhancement to the area.

Note that mitigation measure MM 3.3.1 already has been modified on page 3.0-4 of the Final EIR by request of the City of Menifee to read as follows; the text modification is underlined below:

Sunset Avenue/Bundy Canyon Road

- Install a traffic signal.
- Construct an eastbound left turn lane and two additional through lanes.
- Construct a westbound left turn lane.
- <u>Ensure a northbound and southbound lane of traffic along the frontage of the commercial parcel. Coordinate improvements with the City of Menifee.</u>

2. The commenter requests that Figure 2.0-1, on page 3.1-1 of the Draft EIR, be amended to show RC-LDR to denote Low Density Residential under the Rural Community Foundation. Figure 2.0-1 has been amended. It was determined that this change was not germane to any analysis in the EIR, so it was not made in the Final EIR. It is added only at the request of the City of Menifee and not as additional information.

3. The commenter requests that the EIR address the compatibility with the City of Menifee's existing residential zoning along Sunset Avenue. See Response 1.

4. The commenter requests a change on page 3.3-9 of the Draft EIR noting that the City of Menifee will require regulatory permits for construction on Sunset Avenue. This section of the Draft EIR explains the regulatory process for the development of roadways affected by the proposed project. One half of Sunset Avenue is within the jurisdiction of the City of Menifee, and an encroachment permit will be needed for

any construction along this roadway. This correction already was made to the Draft EIR on page 3.0-2 of the Final EIR, which reads as follows:

> Under subsection 2.4, Regulatory Requirements, Permits, and Approvals Potentially Required from Other Public Agencies, the following changes are incorporated:
>
> - *California Department of Fish and ~~Game (CDFG)~~ Wildlife (CDFW)*: A 1603 Streambed Alteration Agreement may be required.
>
> - *City of Menifee*: Encroachment permit and coordination for improvements on the east side of Sunset Avenue.

The City of Menifee will grant a ministerial permit (the encroachment permit) for such improvements. Therefore, the City of Menifee is not a responsible agency.

As shown in Figure 2.0-4e of the Draft EIR, the only improvements proposed for Sunset Avenue are along the approximately 361-foot frontage of the roadway on the east side of Parcel 313. The proposed street section is shown in Figure 2.0-4a of the Draft EIR. As discussed in Response 1 above, mitigation measure MM 3.3.1 requires that the proposed project install a traffic signal at the intersection of Sunset Avenue and Bundy Canyon Road.

In response to the commenter, the text of the Draft EIR as considered by the Planning Commission is amended as follows to clarify but not to add additional information:

> City of Menifee General Plan
>
> As of the date of publication of this EIR, the City of Menifee General Plan is the Riverside County General Plan, which is the same as City of Wildomar's General Plan. The Riverside County General Plan establishes LOS C as a target for all City-maintained roadways and conventional state highways, except that LOS D could be allowed in urban areas at intersections of any combination of major streets, arterials, expressways, or conventional state highways within 1 mile of a freeway interchange and also at freeway ramp intersections. Current policy requires development projects to mitigate impacts on roadways based on the LOS C standard. Current General Plan policy also permits allowing development projects to mitigate to LOS D, subject to City Council approval, in those instances where mitigation to LOS C is deemed to be impractical. The City of Menifee will require an encroachment permit for any construction within their right-of-way.

As shown in Table 3.3-13 of the Draft EIR, the installation of traffic signals as required by mitigation measure MM 3.3.1 will result in LOS B for the intersection. This level of service is consistent with both the City of Wildomar's and the City of Menifee's adopted level of service standards.

5. The commenter is requesting that the proposed project establish an independent funding mechanism to ensure full funding for the Murrieta Road/Scott Road Interchange. The commenter's assumption of inadequate mitigation is not supported by the facts or CEQA statutes or case law. As noted in Response D-1 on page 2.0-29 of the Final EIR:

Bundy Canyon Road realignment is a project by the Riverside County Transportation Department in conjunction with the cities of Wildomar and Menifee. A Draft EIR for the Bundy Canyon Road improvements was circulated for public review in January 2013 (SCH 2007051156). The Bundy Canyon Road improvements will extend from I-15 in the west to I-215 in the east. Further, I-215 roadway improvements are under way as a Riverside County Transportation Commission project. The Riverside County Transportation Commission (RCTC) is making improvements to I-215 from the Scott Road interchange to the Nuevo Road interchange, adding one general purpose travel lane in each direction. The improvements follow the previous project that added a travel lane from the Scott Road interchange to the Murrieta Hot Springs Road interchange.

The Scott Road interchange improvements are funded in part by a community facilities district (CF 05-08) and the TUMF. While subject to the TUMF, the proposed project is not within the boundaries of CF 05-08, which was established to pay for a portion of the interchange. The traffic study demonstrates that the project does not directly impact the Scott Road/I-215 interchange (see the Existing Plus Project Scenario shown in Table 3.3-9 on page 3.3-46). This table shows that the Existing Plus Project Scenario results in level of service (LOS) C at the interchange of Scott Road and I-215. The project is part of the overall cumulative background growth conservatively assumed for Opening Year 2015 conditions. It is this conservative cumulative growth forecast that causes the existing interchange at Scott Road to fail as shown in Table 3.3-10 on page 3.3-48 of the Draft EIR. Table 3.3-10 shows the opening year level of service if all of the projects shown in Table 3.3-8 on page 3.3-23 of the Draft EIR are constructed and occupied. As shown, 7 of the projects listed in Table 3.3-8 of the Draft EIR are located within the City of Wildomar and the remaining 24 projects are in the City of Menifee.

The future interchange design for Scott Road/I-215 is approved and in process with the County, Caltrans, and the City of Menifee and is designed to accommodate the anticipated traffic growth. This project, along with others assumed to be constructed and contributing traffic to the Scott Road interchange as part of the Opening Year 2015 scenario, will each mitigate their proportionate share of this cumulative impact through their payment of fees—whether it be to TUMF (regional component), DIF, CFD, or other fees as determined to match the pro-rata share requirements indicated in mitigation measure MM 3.3.5 on page 3.3-65 of the Draft EIR. With the collection of these fees, the funds would be in place to complete construction of the Scott Road/I-215 interchange. As the short-term impacts of the project do not result in a significant impact at this interchange, and only the full buildout of the cumulative projects results in a significant impact at the interchange, payment of a pro-rata share of the cost of improvements is considered appropriate mitigation.

1845-5688-7315.1

The California Environmental Quality Act (CEQA) provides guidance on the authority to mitigate in Section 15041 of the CEQA Guidelines:

15041. AUTHORITY TO MITIGATE

Within the limitations described in Section 15040:

(a) A lead agency for a project has authority to require feasible changes in any or all activities involved in the project in order to substantially lessen or avoid significant effects on the environment, consistent with applicable constitutional requirements such as the "nexus" and "rough proportionality" standards established by case law (*Nollan v. California Coastal Commission* (1987) 483 U.S. 825, *Dolan v. City of Tigard*, (1994) 512 U.S. 374, *Ehrlich v. City of Culver City*, (1996) 12 Cal. 4th 854.).

As reported in Table 3.3-9 on page 3.3-46 of the Draft EIR, the proposed project will contribute some trips to the I-215 southbound and northbound ramps at the Scott Road ramps at I-215 (see intersection numbers 12 and 13, respectively). The following excerpt from Table 3.3-9 shows that under Existing Plus Project Conditions, the proposed project would result in the following:

#	Intersection	Jurisdiction	Existing				Existing + Project					
			Delay[1] (secs.)		Level of Service		Delay[1] (secs.)			Level of Service		
			AM	PM	AM	PM	AM	Δ	PM	AM	Δ	PM
12	I-215 SB Ramps/Scott Rd.	Caltrans	24.6	30.8	C	C	26.6	2	32.7	C	1.9	C
13	I-215 NB Ramps/Scott Rd.	Caltrans	26.6	32.3	C	C	29.3	2.7	33.9	C	1.6	C

The change (Δ) for both ramps is less than 3.0 seconds under the scenario, and the resulting level of service remains consistent with the LOS threshold of C and D established by Caltrans. The Traffic Impact Analysis and the Draft EIR show that while the proposed project will contribute to existing traffic at the Scott Road/I-215 southbound and northbound ramps, the contribution does not exceed the adopted level of service threshold and is therefore less than significant.

The proposed project will contribute to the cumulative growth in the region and therefore is required to contribute to a regionally adopted mitigation strategy. The project contributes proportionally to the impacts at the interchange; requiring this project to develop an independent funding mechanism would be disproportionate to the impact as reported in the Draft EIR.

6. The commenter is further concerned about the commercial site, suggesting that it was not modeled as part of regional plans. That statement is not correct. The commenter requests that the increase in commercial area be specifically addressed since the additional acres were not included in previous modeling. As noted in Response 1 above and as shown on page 3.3-17 of the Draft EIR, potential land uses

were assumed and included in the traffic analysis for the project. As a result, all impacts in the Draft EIR, including those for the Scott Road/I-215 interchange, include the commercial development assumptions.

7. The commenter requests a discussion of trails and believes no changes were made to the EIR based on the previous comment. Again, however, that comment is not accurate. On page 3.0-4 of the Final EIR, the following text was included:

> The second paragraph under Impact 3.3.2 on page 59 of the Draft EIR is amended as follows:
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As noted in the above text, the only portion of the trail system affected by the project is the 361-foot piece on the east side of Parcel 313, which is part of the Sunset Trail system. Note that this is the only portion of the trail that exists within the proposed project boundary.

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Thank you again for your comments on the project, please call me if you have additional questions.

Sincerely,

Matthew C. Bassi
Planning Director

C: Thomas Jax
Bill Lo
Larry Markham
Mark Teague

4845-5688-7315.1

Letter 6

Gary Andre

Resident of Wildomar

3-26-2013

Tentative Tract 36388 Oak Creek Cyn.

Please include this document in the formal CEQA record for Oak Creek Cyn.

Finding of Fact: Transition Zoning

1. Tract map 23111 in Wildomar, there will be transition zoning between the lower density and higher density. = .75% of the lower density. 21,780 x .75 = 16,335SF.
2. I quote "R-R lots adjacent = ½ acre gross (21,780 SF.) then the subdivision lots = 16,335 SF. (.37 acres) It is the intent of the last provision to allow flexibility in design and to create transition areas between lower & higher density projects."
   Please note: One of our council members lives in this tract.
3. At the last council meeting I stated tract map 32206 off of Palomar Road. Transition zoning was used to be in compliance with the lower density zoning northwest of Ione Ln. Matt Bassi confirmed my argument about transition zoning. He stated the homes along Ione Ln. were ½ acre then inside the tract were ¼ acre and stepped up to 7,200. SF. lots heading southeast toward Cert St. Please note: This was a Larry Markham Project. 6-1
4. These two tracts using transition zoning clearly show Oak Creek needs to comply with transition zoning on the northerly side of Bundy Cyn. To be compliant and compatible with the surrounding lower density. There are more developments in Wildomar that have complied with Transition zoning.

Finding of Fact: High levels of Nitrates

The Farm has been in existence about 40 years, they have a sewage system where they spray sewage water over a hillside that is within 187' of the proposed development.

(See attached photos)

1. Test studies in the area have shown high levels of Trihalomethanes and Nitrates.
2. Part of Cottonwood creek on the southside of Bundy Cyn. runs next and to the sewage spray area and thru the proposed development, it then travels under Bundy Cyn. in a northerly direction. Then creek turns northwesterly toward the San Jacinto River. 6-2
3. Please note: Top of the mountain where sewage is sprayed has an elevation of 1923 Ft. Aprox. Sewage ponds have an elevation 1831 Ft. Aprox. Thru the proposed development at the creek we have elevations of 1738 Ft., 1727 Ft. Aprox. Where the creek goes under Bundy Cyn. has an elevation of 1690 Ft. Aprox. All of the proposed development in this area is lower than the spray area.
4. Nitrates and nitrites can enter drinking water from nitrate-containing fertilizers, sewage

Letter 6 Continued

and septic tanks, and **decaying natural material such as human waste**, livestock manure, and decaying plants. **Nitrate is very soluble in water and moves easily through the soil**. Nitrates and nitrites are likely to remain in water/soil until taken up by plants or consumed by other organisms.

5. Trihalomethanes: has industrial applications and is used to produce refrigerants and feedstock. It may be released into the environment where chlorine-based chemicals are used for bleaching and disinfecting processes or disposed at **hazardous waste sites/sewage disposal.**
6. Since the EIR doesn't mention this potential hazardous condition, I believe testing of this area needs to be done to assure the City council, the Community and Perspective buyers that the home their buying is not within a hazardous region. We need to learn from the contaminated housing tract, Autumwood off of Palomar Rd. where three people have died.
7. Testing needs to be done by a independent agency so the results are correct and not tainted by ether party.
8. I believe the blame needs to be put directly on the County of Riverside for letting this problem continue on for years without resolution. Also by approving a completed housing tract towards the back of the Farm, which only adds to the sewage problem.
9. The answer to the problem is not running a undersized sewer line down Bundy Cyn. The correct answer is to remove the existing outdated sewage plant and install a new sewage treatment plant. Thru Federal & State grants and County assistance.

6-2 cont.

Finding of Fact: Sewage Line

1. About a week ago, I talked Lake Elsinore Municipal Water District, Engineer, Larry Rein. The question was, what is capacity of a 10" sewer line?
2. Larry stated: there in the process of revising sewage map because it's out dated.
3. I explained the concern for the Bundy Cyn. sewage plan. I asked Larry Rein what is the capacity of a 10" Dia. Sewer pipe. Larry Rein stated with with a minimum fall of 5% no commercial hookups and no pumps stations. He said 1900 homes.
4. By adding a commercial component in the area and pump stations, Larry Rein said housing service would drop to 700 to 800 homes. Larry stated: it's the volume of water the commercial component uses. He stated: the larger the commercial development is, the higher the commercial sewage use will be. The house numbers could drop even lower 300-400. The Farm is conditioned for 21 acres of commercial.

6-3

Failure to comply with the sewage issues above, takes the burden off of the County of Riverside and puts the whole burden squarely on the City of Wildomar. It also puts the burden on the backs of the Council members who vote yes without further testing.

Letter 6 Continued

Gary Andre,

Resident of Wildomar

Letter 6 Continued

RIVERSIDE COUNTY
PLANNING DEPARTMENT

DATE: December 23, 1987

RECEIVED
JAN 14 1988
RIVERSIDE COUNTY
PLANNING DEPARTMENT

RECEIVED
JAN 8 1988
Planning Dept.

TRACT NO.
23111

TO: Assessor
Building and Safety
Surveyor - Dave Duda
Road Department
Health - Ralph Luchs
Fire Protection
Flood Control District
Fish & Game
LAFCO, S Paisley
U.S. Postal Service - Ruth E. Davidson

Elsinore Valley Water
So. Calif. Edison
So. Calif. Gas
General Telephone
CALTRANS #8
City of Lake Elsinore
Elsinore Union School Dist.
Elsinore Union High School
Wildomar Interest League
Lake Elsinore Park & Recreation
Sierra Club
Commissioner Bresson

VESTING TRACT 23111/CHANGE OF ZONE 5085 (Tm 4) - E.A. 32265 - Kaufman & Broad Barrios & Anderson - South Elsinore District - First Supervisorial District Between Grand & Palomar, E. of Corydon Street - R-R Zone - 57 Acres into 214 lots - Schedule A - No Waiver - CONCURRENT CASE CZ 5085) CZ from R-R to R-1 - Mod 112 - A.P. 370-131-001,002; 370-171-020

Please review the case described above, along with the attached case map. A Land Division Committee meeting has been tentatively scheduled for February 11, 1988. If it clears, it will then go to public hearing.

Your comments and recommendations are requested prior to January 28, 1988 in order that may include them in the staff report for this particular case.

Should you have any questions regarding this item, please do not hesitate to contact Dan Catron at 787-1363
Planner

COMMENTS: (1) Environmental Impacts to site need careful attention.
a. Alquist Priolo Special Study Zone for Wildomar Fault
b. Flooding / inundation hazard
c. Noise attenuation adjacent to major streets (Grand / Palomar)
d. airport influence area
(2) Circulation:
a. Palomar shown as 110' Arterial on General Plan
b. Grand shown as 100' Arterial on General Plan
(3) Lot 1-12 show dual frontage. Access should be prohibited on Grand and noise attenuation walls / screening be provided along 1-12 and 157.

DATE: 1/12/88 SIGNATURE John L. Libiez (Over)

PLEASE print name and title John Libiez, Sr. Planner

4080 LEMON STREET, 9TH FLOOR
RIVERSIDE, CALIFORNIA 92501
(714) 787-6181

46-209 OASIS STREET, ROOM 304
INDIO, CALIFORNIA 92201
(619) 342-8277

City of Lake Elsinore **Letter 6 Continued**

(4) Lots adjacent to Grand & Palomar should be larger

(5) Structure or facility/easement located between lot 94-99 & 100, 108-111 needs identified/explained

(6) R-1 standards would require the following

a. all corner lots to be 7200 SF each
b. average lot size in subdivision be not less than 7260 SF
c. interior lots all be at least 6000 SF each
d. subdivision lots should be 75% the size of the largest adjacent developed lot, but not less than as shown in a, b, or c above.

ie ample
R-R lot adjacent = ½ acre gross (21780 SF)
then subdivision lots = 16,335 (.37 acres)

It is the intent of this last provision to allow flexibility in design and to create transition areas between lower & higher density projects.

Letter 6 Continued

Letter 6 Continued

Letter 6: Gary Andre, resident of Wildomar

Responses

6-1 The commenter requests that the proposed project comply with transition zoning on the northerly side of Bundy Canyon Road. The commenter uses tract maps 23111 and 32206 as examples of two tracts that have complied with transition zoning.

The commenter suggests that the City General Plan and Zoning Ordinance require transitional zoning along the northern boundary of the proposed project. However, neither state law nor the Zoning Ordinance (also known as the Zoning Code) contains any laws that specifically require transitional zoning. However, there are policies in the General Plan regarding a buffer between land uses in the Land Use Element as listed below. These policies have been met, as explained below.

> LU 6.1 Require land uses to develop in accordance with the General Plan and area plans to ensure compatibility and minimize impacts. (AI 3)
>
> LU 6.5 Require buffering *to the extent possible* [emphasis added] between urban uses and adjacent rural/equestrian oriented land uses. (AI 3)
>
> LU 6.6 Require buffering between urban uses and adjacent rural/equestrian oriented land uses. (AI 3)
>
> LU 6.7 Buffer and/or maintain a natural edge for proposed development directly adjacent to national forests. (AI 3)

LU 6.1: The adjacent zoning across Beverly Street to the north of the proposed project (within Phase 17A) is Rural Residential (R-R) as shown in Figure 2.0-2 of the Draft EIR. The permitted uses in the R-R zone are established in Section 17.16.010 of the Wildomar Municipal Code, which is part of the Zoning Code. The first permitted use in the R-R zone district is one-family dwellings.

It is also the intent of the current Farm Specific Plan, as originally adopted and as amended by the proposed Oak Creek Canyon project, to provide one-family dwellings (see page III-1 of Appendix 2.0-2 of the Draft EIR). Phase 17A provides for single-family residential uses with a minimum lot size of 7,200 square feet across a public roadway (Beverly Street) from the existing residential lots/uses that are legally subdivided on 4,500-square-foot parcels. Given that the lots in Phase 17A are larger and homes will be separated by at least 60–80 feet and will have street and property landscaping, buffering as encouraged in the above policies has been achieved and is considered to have no impact on compatibility.

LU 6.5 and 6.6: As shown in Figure 2.0-4a of the Draft EIR, the parcels across Beverly Street north of Phase 17A (see Figure 2.0-4f of the Draft EIR) have a minimum lot size of 4,500 square feet, considerably smaller than the proposed parcels in Phase 17A that are a minimum of 7,200 square feet. Although R-R zoning exists, the 4,500-square-foot parcel size is not large enough to permit the keeping of a horse. Section 17.16.010 Rural Residential (R-R) of the City of Wildomar Municipal Code establishes that "the grazing of cattle, horses, sheep, goats or other farm stock or animals…shall not exceed five animals per acre of all land available." While the Zoning Code allows for the combination of parcels, a single parcel would need to be a minimum of 8,712 square feet in size to

support a horse based on the code interpretation (43,560 square feet divided by 5 = 8,712 square feet).

As the proposed project is not adjacent to any national forest, Policy LU 6.7 does not apply.

In summary, neither the General Plan nor The Farm Specific Plan has policies that require transitional zoning, but the project provides for buffering as set out in the policies cited above.

Similarly, Title 17 Zoning of the Wildomar Municipal Code neither defines nor requires transitional zoning or the increasing of parcel sizes toward the city limits. The proposed project's parcel sizes are governed by The Farm Specific Plan that currently establishes a 7,200-square-foot minimum parcel size for Unit 2 (see page 3.1-6 of the Draft EIR). The proposed parcels south of Beverly Street are a minimum of 7,200 square feet in size, which is unchanged from The Farm Specific Plan (see Figure 2.0-4d of the Draft EIR).

The City evaluates each project individually and can establish parcel sizes as part of legislative action. As explained in this response, there is no environmental impact associated with the differences in parcel size on either side of Beverly Street, as both uses are residential and the proposed project parcels are larger than the existing parcels north of Beverly Street and remain consistent with the current version of The Farm Specific Plan.

The commenter also suggests that transitional zoning was adopted by the City for previous projects. As described in this response, there is no specific statutory or policy requirement to provide for transitional zoning as suggested by the commenter. The EIR is not required to comment on legislative actions taken by the City on projects not included in this EIR. An EIR that provides a reasonable analysis of an impact is not required to address all variations of the issues presented *(National Parks & Conserv. Assn. v. County of Riverside* (1999) 71 Cal. App. 4th 1341).

6-2 The commenter requests that the area proposed for development be tested to determine if there are high levels of trihalomethanes and nitrates because previous tests have shown that high levels of these chemicals exist in the area.

The City is unaware of any "previous tests" as mentioned by the commenter that would apply to the proposed project site, and the commenter has provided no documentation to support the assertion. The commenter refers to an existing spray field for treated wastewater that is located adjacent to but not part of the project site (see Figure 2.0-4e of the Draft EIR). The spray field is owned and operated by the Farm Mutual Water Company and is regulated by the South Coast Air Quality Management District.

Trihalomethanes are associated with the chlorination of drinking water, and nitrates are associated with fertilizers, wastewater, and sewage. The proposed project will obtain drinking water from the Farm Mutual Water Company, which in turn receives water from the Elsinore Valley Municipal Water District (EVMWD). The EVMWD 2011 Water Quality Report includes test results for both nitrates and trihalomethanes. The acceptable level for nitrates is 10 parts per million (ppm), with testing averaging 0.5 ppm to 3.2 ppm. The acceptable level for trihalomethanes is 80 parts per billion (ppb), with water tests averaging between 4.5 ppb and 5.9 ppb. There is nothing associated with the proposed project or the water system that would suggest these numbers would increase. As the

lead agency, the City has the discretion to determine that further studies are not needed to adequately evaluate an impact (see *Gilroy Citizens for Responsible Planning v. City of Gilroy* (2006) 140 Cal. App. 4th 911). As the spray fields are not associated with the proposed project located on the project site and are regulated by the Air Quality Management District, and the water is tested and shows acceptable levels of both nitrates and trihalomethanes, there is no reason to require additional testing. That determination has been made here.

Additionally, the commenter implies that a "reverse CEQA" analysis disapproved by the courts is required. The impact is of the project on the environment, not of the environment on the project. CEQA does not work "in reverse" to require environmental review where an existing condition would have an impact on a new project (*South Orange County Wastewater Authority v. City of Dana Point* (2011) 196 Cal. App. 4th 1604 [holding that CEQA does not require an EIR where it is proposed that the environment needs to be cleaned up for a project instead of vice versa where an existing sewage treatment plant allegedly impacting an adjacent mixed-use development project with its bad smells and noise]; see also *Ballona Wetlands Land Trust v. City of Los Angeles* (2011) 201 Cal. App. 4th 455, 474).

6-3 The commenter alleges that a 10-inch sewage line is not big enough to adequately address capacity needs of future residents associated with the proposed project.

The commenter's information if not correct. The following information is from page 2.0-38 of the Final EIR:

> The 10-inch sewer main is identified as project Gravity Sewer Improvement RP-23 in the EVMWD Wastewater Master Plan. The impacts of the Wastewater Master Plan were evaluated in the Elsinore Valley Municipal Water District Program Environment Impact Report: Water Distribution Master Plan and Wastewater Master Plan (SCH 2008111100). The sewer line will be located entirely within the existing road prism of Bundy Canyon Road. Sewer laterals extend from each home to sewer lines contained in the public streets or utility easements. The sewer laterals leading from each home are 4 inches in diameter and will lead to the sewer lines that are 6 inches in diameter. The sewer lines will extend either to the 10-inch sewer main proposed for Bundy Canyon Road or to a lift station located on lot 314, shown on Figure 2.04-d of the FEIR.

Sewer flow analysis was prepared for the proposed off-site 10-inch sewer main and provided to Norris Brandt, EVMWD Assistant General Manager, and Paul Carver, EVMWD Director of Engineering. These computations included 275 dwelling units and the commercial area proposed by the Oak Creek Canyon project, plus an additional 1,200 dwelling units from The Farm. The resulting sewer peak flow rate was computed utilizing the EVMWD's published design standards and concludes that the total predicted sewer peak flow rate can be accommodated with a 10-inch-diameter pipe at a minimum slope of 1.5 percent.

Upon EVMWD review of these computations, Mr. Carver verified on April 9, 2013, that the 10-inch sewer line is sufficient to convey the required design flow of the proposed project. As noted on page 3.03 of the Final EIR, the 10-inch sewer line is identified as Gravity Sewer Improvement RP-23 in the EVMWD Wastewater Master Plan and included in the EVMWD EIR (SCH#2008111100) certified for the master plan. The proposed project

is constructing the facility as proposed and adopted in the EVMWD Wastewater Master Plan.

While the proposed project is installing a sewer line that is expected to have capacity to serve the proposed project and the existing Farm development, the physical connection of the existing Farm residents to the new sewer line is not part of the proposed project. Sewer service is already provided by the Farm Mutual Water Company to the existing Farm units, and the City is not aware of any plans to discontinue service.

Letter 7

March 26, 2013

To: **City of Wildomar**

From: **Gayl A Taylor**

RE: **Sewer Connection**

My name is Gayl Taylor and I am a resident of The Farm. At the last meeting of the Planning Commission I found out that The Farm Mutual Water Company will serve The Oak Creek Canyon Development with water and the Elisnore Valley Municipal Water Company will service the sewer. This was a surprise because until the Planning Commission meeting this was not known to the residents of The Farm.

But the question that I was asking was regarding The Farm being able to connect to the sewer. There has been several opinions on whether a 10" pipe would be adequate to service Oak Creek and The Farm because The Farm would be adding almost 1200 homes to the 275 homes to be built by Oak Creek. 7-1

For almost 40 years the sewage from The Farm has been processed in pools and then the treated sewage is sprayed onto fields in The Farm. This to me is like having an OUT HOUSE in my back yard. Come to The Farm below the spray fields on a hot day and you will be able to smell the results. Is it not about time that The Farm comes into the 21st Century?

I am not against the development I just want what is best for The Farm and that would be the ability to be connected to the new sewer pipe.

Letter 7: Gayl Taylor

Response

7-1 The commenter, a resident of The Farm, is concerned whether the proposed 10-inch sewer pipe would adequately meet the needs of residents at both The Farm and the proposed project.

The purpose of the sewer improvement is not to serve residents of The Farm but to serve the project. Sewer flow analysis was prepared for the proposed off-site 10-inch sewer main and provided to Norris Brandt, EVMWD Assistant General Manager, and Paul Carver, EVMWD Director of Engineering. These computations included 275 dwelling units and the commercial area proposed by the Oak Creek Canyon project, plus the existing dwelling units in The Farm. The inclusion of such units from The Farm was done by EVMWD and is not part of this project. Any connection of Farm properties is outside the scope of this project and would require further and separate CEQA analysis. The Farm already has a separate sewer and permitted sewer treatment system. The resulting sewer peak flow rate was computed utilizing EVMWD's published design standards and concludes that the total predicted sewer peak flow rate can be accommodated with a 10-inch-diameter pipe at a minimum slope of 1.5 percent.

Upon EVMWD review of these computations, Mr. Carver verified on April 9, 2013, that the 10-inch sewer line is sufficient to convey the required design flow of the proposed project. As noted on page 3.03 of the Final EIR, the 10-inch sewer line is identified as Gravity Sewer Improvement RP-23 in the EVMWD Wastewater Master Plan and included in the EVMWD EIR (SCH#2008111100) certified for the master plan. The proposed project is constructing the facility as proposed and adopted in the EVMWD Wastewater Master Plan (see response 6-3).

Letter 8

FROM: GEORGE W. TAYLOR
34041 HARROW HILL RD.
WILDOMAR, CA. 92595

26 MARCH 2013

TO: WILDOMAR CITY COUNCIL
23873 CLINTON KEITH RD.
WILDOMAR, CA. 92595

SUBJECT: RESIDENT INPUT REGARDING THE OAK CREEK CANYON DEVELOPMENT.

Honorable Mayor, Council Members & Staff.

1. My name is George W. Taylor, a resident of Wildomar since 1986. I am here tonight as a **private resident of the Farm Development** to lend my support in favor of the Oak Creek Canyon Proposed Development, with a condition, and also in support of the Farm Mutual Water Company as the potable water provider as is indicated on page 66 of the Final EIR. and that the developer is paying to put in 8,600 feet of sewer pipe in Bundy Canyon Road.

2. Since I have been a long time resident in this area and in the Farm Development, and retired, I became interested in our local affairs in The Farm and around the valley. At the onset of this project, when it was first brought to the city, and since it is planned to be at my front door, I have had a vested interest to find out all about it.

3. For all of these years I have acted as an unofficial historian of the Farm, Development, and have been involved in much research for my own satisfaction and for my former wife who was a past FPOA board member on our board of directors. I have documentation, audio tapes, and video recordings of most all events that have occurred in the farm over the years.

8-1

4. Having the historical knowledge of The Farm as it was developed and being very familiar with the make-up of each of the original planned phases in SP 116/CW of The Farm, I set out to advise the city, that because of the original plan for recreation, there was none designed in the original Farm Specific Plan phases where this proposal is now founded as the Oak Creek Canyon Proposal. Having this insight, I wrote several input letters to the city with a copy to the Markham Development company. My input caused much needed active recreation amenities to be considered, along with others, as in the development you see before you this evening. I will tell you that Mr. Lo, and Mr. Markham have addressed The Farm concerns, as we were all told and shown, between three our open resident meetings.

PAGE 1 OF 3 PAGES

Letter 8 Continued

5. So, long before this project was brought here, I already was aware of our County Specific Plan and why things were as they are, and all of the conditions of approval that were involved in amendment 3 for the previous proposal.
In fact, I provided the planning department with an overflow of input in the way of current language to replace now outdated language that no longer applied to the developer in amendment # 4.

6. Further, I obtained a copy of the Draft EIR and down loaded much of it as pertained to The Farm. As you are aware, the DEIR was a very broad brushed document.

7. I also obtained a copy of the final EIR which was more specific in detail. I have also down loaded that document and examined all of the conditions of approval that were attached. I had a few questions and made an appointment with the Planning Director to discuss my concerns, he advised that he would look into my input. One in specific that I mentioned was my concern about the 10 inch sewer Pipe as RP-23 identified in the final EIR.

8. Some background explained that in 2005 and 2006 there were discussions with our water company about The Farm connecting to what is presently referred to as RP-23 in the EVMWD Master Wastewater Improvement Plan as updated in 2008. **As a resident of The Farm my one and only concern is that if and when at some time in the future it would be necessary for the Farm Community to connect to it, is a 10 inch pipe of sufficient size to service The Farm community, given new development between I-15 and the Farm, also having a right to connect ?**

8-1 cont.

9. **With all due respect**, not being privileged to know of any discussions between our water board and EVMWD, I have to assume that this subject has had to have been discussed. It may be that this issue has been resolved. Because I have not been made aware of any such discussion, or that there is an engineering report, and not being a mind reader, **I for one, would request some assurance in the record that the size of this 10 inch sewer pipe coming up Bundy Canyon would be large enough to support future development along Bundy Canyon Road as well as the Farm community, should it ever become necessary for all of us to connect. I believe that this is a reasonable and responsible question to ask.**

10. You should know that I have attended the two open FPOA meetings that our board of directors sponsored and one additional that was sponsored by the developer for the general public of Wildomar. All three of these open sessions were well attended by our residents. The last open session that our board sponsored was just for farm Residents with invited guests only as the developer, his staff and consultant, along with members of the Farm Mutual Water Board. All of us in attendance were given opportunity, and encouraged to ask questions of the developer, his staff, the consultant and the Farm Mutual Water board.

PAGE 2 OF 3 PAGES

Letter 8 Continued

11. Based on the three open meetings that I attended, My research through both the DEIR and the Final EIR, my accumulated farm documents and tapes, my previous input to the City, and my appointment with our planning director,
As I stated above, I am here to offer my personal support for the Oak Creek Canyon Development with condition, and also in support of our Farm Mutual water company providing the potable water source. to the project.

8-1 cont.

Respectfully submitted,

George W. Taylor,
A private resident of the Farm.

PAGE 3 OF 3 PAGES.

Letter 8: George Taylor

Response

8-1 The commenter is concerned whether the proposed 10-inch sewer pipe (RP-23) would adequately meet the needs of the proposed project and the residents at The Farm.

See also responses to Letters 6 and 7 from Gary Andre and Gayl Taylor, which make the same comment. Sewer flow analysis was prepared for the proposed off-site 10-inch sewer main and provided to Norris Brandt, EVMWD Assistant General Manager, and Paul Carver, EVMWD Director of Engineering. These computations included 275 dwelling units and the commercial area proposed by the Oak Creek Canyon project, plus an additional 1,200 dwelling units from The Farm. The resulting sewer peak flow rate was computed utilizing EVMWD's published design standards and concludes that the total predicted sewer peak flow rate can be accommodated with a 10-inch-diameter pipe at a minimum slope of 1.5 percent.

Upon EVMWD review of these computations, Mr. Carver verified on April 9, 2013, that the 10-inch sewer line is sufficient to convey the required design flow of the proposed project. As noted on page 3.03 of the Final EIR, the 10-inch sewer line is identified as Gravity Sewer Improvement RP-23 in the EVMWD Wastewater Master Plan and included in the EVMWD EIR (SCH#2008111100) certified for the master plan. The proposed project is constructing the facility as proposed and adopted in the EVMWD Wastewater Master Plan (see response 6-3).

Letter 9

CALIFORNIA Water Boards

EDMUND G. BROWN JR. GOVERNOR

MATTHEW RODRIQUEZ SECRETARY FOR ENVIRONMENTAL PROTECTION

Santa Ana Regional Water Quality Control Board

March 26, 2013

Matt Bassi, Planning Director
City of Wildomar
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

REGIONAL BOARD QUESTION REGARDING DRAFT ENVIRONMENTAL IMPACT REPORT FOR OAK CREEK CANYON PROJECT, CITY OF WILDOMAR

Dear Mr. Bassi:

Staff of the Regional Water Quality Control Board, Santa Ana Region (Regional Board) has recently become aware of a large residential development, which we understand is referred to as the "Oak Creek Canyon" development (Project), planned for the area of Bundy Canyon Road between Farm Road and Sunset Avenue, in Wildomar. Although we understand that a Draft Environmental Impact Report (DEIR) has been issued for this Project in accordance with the California Environmental Quality Act (CEQA), we have not received a copy of the DEIR and we request the opportunity to review it and comment on it. 9-1

Further, we understand that since the issuance of the DEIR, new information has been made public in the form of an "Oak Tree Inventory Map" for the Project, including Tentative Tract Map No. 36388. This map indicates that at least four drainages would be partially filled by the proposed Project, particularly by a potential realignment of Bundy Canyon Road that was referred to, but not yet a definite proposal (Future Development Project), in the Bundy Canyon Road/Scott Road Improvement DEIR (Riverside County Transportation Department, January 2013). These combined projects will have cumulative impacts on the beneficial uses of waters of the state that may not have been adequately disclosed or analyzed. Therefore, we request that a revised DEIR with the Oak Tree Inventory Map and Tentative Tract Map No. 36388 be recirculated for review, in compliance with CEQA.

If you have any questions, please contact Glenn Robertson at (951) 782-3259, or Glenn.Robertson@waterboards.ca.gov, or me at (951) 782-3234, or Mark.Adelson@waterboards.ca.gov

Sincerely,

Mark G. Adelson, Chief
Regional Planning Programs Section

Cc: State Clearinghouse
Riverside County Transportation Department, Riverside – Mary Zambon
California Dept. of Fish and Game, Ontario- Juan J. Lopez-Torres

CAROLE H. BEGWICH, CHAIR | KURT V. BERCHTOLD, EXECUTIVE OFFICER
3737 Main St., Suite 500, Riverside, CA 92501 | www.waterboards.ca.gov/santaana

California Regional Water Quality Control Board
Santa Ana Region
3737 Main Street, Suite 500, Riverside, California 92501-3348
Phone (951) 782-4130 • FAX (951) 781-6288
www.waterboards.ca.gov/santaana

Matthew Rodriquez
Secretary for
Environmental Protection

Edmund G. Brown, Jr.
Governor

FACSIMILE TRANSMITTAL

DATE: March 26, 2013

TO: Mr. Matt Bassi, Planning Director

FAX NO: 951-698-1463

FROM: Glenn Robertson, RWQCB

SENDER'S DIRECT TELEPHONE NUMBER: (951) 782-3259

NUMBER OF PAGES, INCLUDING TRANSMITTAL MEMO: 2

SUBJECT: Oak Creek Canyon Project and Bundy Canyon Road Realignment

MESSAGE:

I understand that the City may meet tonight regarding this Project. Please incorporate the enclosed letter into all comments in the Project record. Thank you.

Glenn Robertson

9-1 cont.

Letter 9: Santa Ana Regional Water Quality Control Board

Responses

9-1 The commenter states that the Oak Tree Inventory Map for the proposed project, including Tentative Tract Map 36388, indicates there are at least four drainages that would be partially affected by the proposed project. Because the Oak Tree Inventory Map was made public subsequent to the release of the DEIR, the commenter is requesting it be included in the EIR for analysis and then recirculated for review.

While appreciated, the commenter is not correct. The Oak Tree Inventory Map is not significant new information; instead, it gathers together and supplements information already provided in Section 3.8, Biological and Natural Resources, on page 3.8-6 of the Draft EIR and illustrated on Figure 3.8-1. Further, the potential impact on oaks is discussed on page 3.11-7 in Section 3.11, Aesthetics and Visual Resources, of the Draft EIR, resulting in mitigation measure MM 3.11.4, which requires a detailed "survey showing the location of oak trees 5 inches in diameter at breast height, as defined by Public Resources Code Section 21083.4(a)."

The additional explanation and supporting documentation that was added to the FEIR refines the information discussed in the Draft EIR. None of this information requires recirculation of the Draft EIR prior to certification. Recirculation is required when significant new information is added to an EIR after circulation but before final certification. This new information must be significant changes to the project or environmental setting, or a substantial new adverse impact, or a feasible project alternative or mitigation measure that would clearly reduce the impact but will not be implemented on which the public and other agencies must have an opportunity to evaluate and comment (see Public Resources Code Section 21091.1; 14 California Code of Regulations (CCR or Guidelines) Section 15088.5); *Vineyard Area Citizens for Responsible Growth v. City of Rancho Cordova* (2007) 40 Cal. 4th 412, 447). The information here only adds to that already discussed in the EIR for purposes of clarification.

Conflicting information, including that submitted by experts, does not require recirculation (*Cadiz Land Co. v. Rail Cycle* (2000) 83 Cal. App. 4th 74, 97). Recirculation is not required when changes merely clarify, amplify, or make small modifications (see 14 CCR Section 150833.5(b)). The agency's determination on recirculation is presumed to be correct unless the challenger can show that determination is not supported by substantial evidence (*Western Placer Citizens for an Agricultural & Rural Environment v. County of Placer* (2006) 144 Cal. App. 4th 890, 903).

In this instance, the oak tree survey was prepared in response to and in compliance with mitigation measure MM 3.11.4 and does not require recirculation of the Draft EIR.

Additionally, the commenter states that the potential realignment of Bundy Canyon Road, analyzed in the Bundy Canyon Road/Scott Road Improvement DEIR (Riverside County Transportation Department, January 2013), combined with the proposed project, could result in cumulative impacts that were not analyzed in the EIR.

As described on page 2.0-24 of the Draft EIR, the proposed project implements a small portion of the larger Bundy Canyon Road/Scott Road Improvement Project as shown in Figure 2.0-4d. The proposed project realigns the existing curve in Bundy Canyon Road

consistent with the Bundy Canyon Road/Scott Road Improvement Project. Because the realignment of the curve is integral to the design of the project and constitutes the primary access, the impact of the curve realignment is analyzed throughout the Draft EIR. The City does not have jurisdiction over the remainder of the Bundy Canyon Road/Scott Road Improvement Project, and the proposed change in the curve can occur independent of the rest of the Bundy Canyon Road project because Bundy Canyon Road is unchanged east and west of the proposed project site.

A cumulative impact is an impact created by the combination of the project reviewed in the EIR together with other projects causing related impacts. The cumulative impact attributable to the project in the EIR is based on an assessment of the project's incremental effects when viewed in connection with the effects of past projects, other current projects, and probable future projects (14 CCR Section15065(a)(3); see also 14 CCR Section15355(b)). A cumulative impact must be discussed in an EIR when it is "cumulatively considerable." In other words, it must be analyzed when the combined impact itself is significant and when the project's incremental contribution to that impact is considerable (14 CCR Section 15130(a)). Cumulative impacts which are insignificant need only be discussed briefly in an EIR (*City of Long Beach v. Los Angeles Unified Sch. Dist.* (2009) 176 Cal. App. 4th 889, 909). Cumulative impacts associated with the proposed project are discussed in each section of the Draft EIR and summarized in Section 4.0. The potential widening of Bundy Canyon Road is discussed in the Draft EIR on page 3.3-59, which also states that the Bundy Canyon Road/Scott Road Improvement Project EIR (SCH 2007051156), January 2013, was prepared by the Riverside County Transportation Commission and addresses the remainder of the Bundy Canyon Road project. As noted above, the realignment of the curve in Bundy Canyon Road is consistent with the larger roadway improvement project.

Letter 10

Sheryl L. Ade
22912 Pavla Court
Wildomar, CA 92595

RECEIVED
MAR 27 2013
CITY OF WILDOMAR

Via Hand-delivered to City Clerk for stamp and certification

March 27, 2013

Matthew Bassi
Director of Planning
City of Wildomar
23873 Clinton Keith Rd., Ste. 201
Wildomar, CA 92595

Ref: Oak Creek Canyon Development, DEIR/EIR, SCH No. 2012031064, Specific Plan No. 116, Amend. No. 4, Change of Zone and Tentative Tract Map. No. 36388 (Planning Application No. 11-0261

Dear Mr. Bassey,

I'm submitting this cover letter and my comments with attachments in regard to the above noted project.

I expect this information to be entered in its entirety into the formal CEQA record.

Thank you for your assistance in this matter.

Regards,

Sheryl L. Ade
Wildomar Resident and Former Council Member

cc: Thomas Jex Esq., City Attorney

Enclosures (11 pages):
1) Ade Comments and related attachments for March 27, 2013 City Council Mtg. re above-referenced project (9 pages)
2) Ade Comments to Planning Commission at March 12, 2013 Hearing re above-referenced project (2 pages)

Letter 10 Continued

Sheryl L. Ade
22912 Pavla Court
Wildomar, CA 92595

Comments submitted for
Special City Council Mtg.
March 26, 2013
Pg. 1

Ref: Oak Creek Canyon Development, DEIR/EIR, SCH No. 2012031064, Specific Plan No. 116, Amend. No. 4, Change of Zone and Tentative Tract Map. No. 36388 (Planning Application No. 11-0261

My concerns regarding the above referenced project are noted below.

1) The Draft EIR was not sent to the Santa Ana Regional Water Quality Control Board. The creeks noted throughout the EIR flow to the northwest and are under the jurisdiction of the Santa Ana Regional Water Quality Control Board.

   This is not the first time the City of Wildomar has failed to send this agency notification of projects under their jurisdiction. Because of this I believe this was done "with prejudice." Therefore, I would ask that the Draft EIR be recirculated so the above-noted agency can review and comment on the proposed project. Glenn Robertson, Engineering Geologist (CEQA Coordinator) emailed a letter to Matthew Bassi, Planning Director, City of Wildomar noting that his agency had not received a Notice of Preparation nor Notice of the Draft EIR and has requested that the Draft EIR be recirculated. Matthew Bassi confirmed to Mr. Robertson that he had received his email request. . **10-1**

2) Reading through the introduction to the EIR, it was noted that in the Specific Plan Amendment No. 116 to the Farm Specific Plan that the Master Planned Farm Community is to have:
   - 37.7 ac. set aside for school use
   - 21.6 ac for commercial use

   There is no mention in the EIR of where this acreage is to be located. The proposed project acreage only mentions 5t acres for commercial and 0 acreage for school use. The school is a public resource and thus should be addressed. **10-2**

3) Existing properties that are located to the north of Bundy Canyon Road are designated as noted below:
   Foundation Element: Rural Community Mountainous
   Area Plan Designation:: 10 ac. minimum
   Foundation Element: Rural Community
   Area Plan Designation: 5 ac minimum **10-3**

   (see Attachment 1 for an aerial view of the Properties North of Bundy Canyon Road(see Attachment 1 for an aerial view of the Properties North of Bundy Canyon Road

Letter 10 Continued
6/7/2012
Carl St
Bundy Canyon Rd
Leicester St
Homestead Ln
© 2013 Google
Google
Date 6/7/2012
1996
33°38'28.92" N 117°18'52.26" W elev 1695 ft
Eye alt 45

Letter 10 Continued

Sheryl L. Ade
22912 Pavla Court
Wildomar, CA 92595

Comments submitted for
Special City Council Mtg.
March 26, 2013
Pg. 3

The proposed project intends to abut these Rural Community properties with 7,200 square foot lots surrounded by block walls. This does not follow the Land Use Policies of the General Plan, in particular):

LU 2.1 (d) Concentrate growth near community centers that provide a mixture of commercial, employment, entertainment, recreation, civic and cultural uses to the greatest extent possible.

LU 2.1 (e) Concentrate growth near or within existing urban or suburban areas to maintain the rural and open space character of Riverside County to the greatest possible extent.

10-3 cont.

LU 2.1 (f) Site development to capitalize upon multi-modal transportation opportunities and promote compatible land use arrangements that reduce reliance on the automobile.

LU 2.1 (g) Prevent in appropriate development in area that are environmentally sensitive or subject to severe natural hazards.

The proposed project also does not fit the RCIP Vision which states:
"Our communities maintain their individual distinctive qualities and character, surrounded in most cases by open space or non-intensive uses to contribute to their sense of unique identity. Community centers, gathering places, and special focal points unique to each community also aid this identity."

The Farm is unique to the community of Wildomar. It is, as its name implies, rural and bucolic in nature. Although there are over 900 homes within the Farm, they are of varied acreages from one-quarter acre up to 10 acres and many of the properties abut orchards, open space or trail areas. There are no sidewalks to tall streetlilghts in the Farm and when one walks through the Farm there is a feeling of utter tranquility. (**See Attachment 2 showing an aerial view of the existing Farm development south of Bundy Canyon Road for confirmation of the above statement**).

10-4

To put a suburban style development with 4,000, 5,000 and 7,200 square foot lots at the entrance to the Farm flies in the face of the RCIP Vision.

Further Policies not adhered to in the proposed project are:

LU6.3 Consider the positive characteristics and unique features of the project site and surrounding community during the design and development process (AI 3).

10-5

Letter 10 Continued
P.4-Ade
6/7/2012
2012
The Farm
Pitchfork Ct
Windmill Rd
Harvest Way
Citrus Hill Rd
© 2013 Google
Google

Letter 10 Continued

Sheryl L. Ade
22912 Pavla Court
Wildomar, CA 92595

Comments submitted for
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LU 6.4 Retain and enhance the integrity of existing residential, employment, agricultural and open space areas by protecting them from encroachment of land uses that would result in impacts from noise, noxious fumes, glare, shadowing and traffic. (A1 3).

LU 6.5 Require buffering to the extent possible between urban uses and adjacent rural/equestrian oriented land uses. (Al 3)

For further consideration on this issue and how a similar situation was handled in Menifee by the Riverside County Planning Commission, I've attached a four-page *County of Riverside Planning Department Staff Report* - .

Please note the similarities between the proposed project and the one noted in this staff report. ***The ultimate outcome for the community of Menifee was quite different from what is being proposed in Wildomar to their benefit and to our community's detriment***.

10-6

The project was in review for five years and had been amended ten times throughout the review process. ***The Tentative Map began with 262 lots aand had been reducted to 67 lots. Applicant worked with staff in an effort to make this case compatible with the surrounding land uses.***

Concerns raised by residents regarding the proposed project are similar to those raised by Wildomar residents.

It should be noted that Staff did not want there to be any block walls as part of the project because iot distracts from the rural integrity.

Letter 10 Continued

Agenda Item No.: 3.13
Area Plan: Southwest
Zoning Area: Rancho California
Supervisorial District: Third
Project Planner: Rebecca Boschee
Planning Commission: November 03, 2004

GENERAL PLAN AMENDMENT NO. 00503
CHANGE OF ZONE NO. 06473
TENTATIVE TRACT MAP NO. 29098
E.A. Number: 37747
Applicant: J&A Investments
Engineer/Rep.: David Jeffers

COUNTY OF RIVERSIDE PLANNING DEPARTMENT
STAFF REPORT

PROJECT DESCRIPTION AND LOCATION:

This project proposes a general plan amendment from Estate Density Residential-Rural Community Foundation (2 acre minimum) to Low Density Residential-Rural Community Foundation (1/2 acre minimum) on 50 gross acres. On the remainder 31.5 acres of the project, there is a proposal to change the open-space portion from Estate Density Residential-Rural Community to Open Space Conservation (OS-C). The project also proposes to be removed from the Leon/Keller Road Policy Area which requires a 2 ½ acre minimum. The change of zone on this project is for the northerly 31.5 acres from Rural Residential (R-R) to Open Area Combining Zone (R-5). The remaining 50 acres would change from Rural Residential (R-R) to Residential Agriculture (R-A). Tentative Tract Map No. 29098 is a Schedule B subdivision of 81.4 gross acres into 67 residential lots with a minimum lot size of 20,000 square feet. This project has perserved the northerly 31.5 acres as a open-space easment per the Multiple Species Habitat Conservation Plan. This project site is located on the westerly side of Winchester Road (Hwy 79), easterly of Leon Road, southerly of Scott Road, and northerly of Keller Road.

ISSUES OF POTENTIAL CONCERN:

This case has been in development review for five years. The case has been amended ten times throughout the review process and the applicant has worked with staff in an effort to make this case compatible with the surrounding land uses. The Tentative Tract Map began as 262 lots and has been reduced to the current number of 67 lots. It should also be noted that the old general plan designation for this subject property was RES- 2 ½ acre minimum. This proposed project is within the Highway 79 and Leon/Keller Road Policy Areas. The number of lots in this project exceed what would be allowed when in compliance with the Highway 79 Policy Area which states that there needs to be a 9% reduction in the total number of lots.

The properties that are north of Keller Road are Rural Residential and Estate Density Residential and thus are of a rural nature. Generally, the properties that are southerly of Keller Road have a land use designation that calls for higher densities and are thus more urbanized. Staff believes that the high density that this project proposes would be incompatible with the integrity of this rural area established in the new general plan.

Staff has received 46 letters and a petition against this project. The concerns that have been raised are all concerning the high density in such a rural area. The surrounding neighbors are also concerned with the increased traffic volume in the area and the overcrowding of the nearby schools. There is also a concern about property values in the area if such a high density moves in. The neighbors also stated that they want a lower density project with horse trails.

Letter 10 Continued

This project is within the sphere of influence of the City of Murrieta. According to the letter that was sent to the county, there are concerns with the high density that is proposed for this project.

Metropolitan Water District maintains ownership of a 145 feet wide easement that runs along Leon Road. Metropolitan Water District will allow grass, shrubs and shallow rooting trees (25 feet maximum) to be planted within the easement. The project has been conditioned for a trail along Leon and Keller Roads.

Staff wants a park for this project and there are several possible locations with one of them being lot #67, due to the high frequency of neighbors. Also it may be possible to develop a park utilizing the detention basin and having a community stable adjacent to that.

It should also be noted that staff does not want there to be any block walls as a part of this project because it distracts from the rural integrity. Also, it is noted on the exhibit that Eastern Municipal Water District is going to be proving sewer services for this tract but that the nearest facilities are 2 miles south at the intersection of Leon and Winchester Road. Staff does not want curbs, gutters or sidewalks for this case but paved private narrow streets instead.

Staff would also like to point out a few lots on the map that do not follow the exact setbacks in the Residential Agricultural (R-A) zoning classification. Lots # 66, 65,24,18 and 46 are less than 100 feet wide. Lot # 28 is not at least 150 feet in depth. Also, the cross-section of Leon Road needs to be revised to show the proposed 20 foot wide trail on the east side of the street.

SUMMARY OF FINDINGS:

1. Existing Land Use (Ex. #1):	Vacant
2. Surrounding Land Use (Ex. #1):	Single-family residences, vacant property and equestrian uses.
3. Existing Zoning (Ex. #3):	Rural Residential (R-R)
4. Surrounding Zoning (Ex. #3):	Rural Residential (R-R), Light Agriculture 2 ½ acre minimum (A-1-2 ½), Rural Residential 2 ½ acre minimum (R-R-2 ½) and Specific Plan (SP).
5. General Plan:	Land Use: Estate Density Residential-Rural Community (2 acre minimum).
6. Project Data:	Total Acreage: 81.4 Gross Acres Total Proposed Lots: 67 Total Lots Proposed Min. Lot Size: 20,000 Sq Ft. Schedule: B
7. Environmental Concerns:	See attached environmental assessment

RECOMMENDATIONS:

DISCUSS AND CONTINUE of **GENERAL PLAN AMENDMENT NO. 00503, CHANGE OF ZONE NO. 06473** and **TENTATIVE TRACT MAP NO. 29098**, subject to the attached conditions of approval, and based upon the findings and conclusions incorporated in the staff report.

Letter 10 Continued

CONCLUSIONS:

1. The proposed project is not in conformance with the Riverside County General Plan. The current general plan designation of Estate Density Residential-Rural Community (2 acre minimum) is too low for the density that is proposed with this project.
2. The proposed project not consistent with the Rural Residential (R-R) zoning classification of Ordinance No. 348.The proposed project would change the existing zoning from R-R to R-A and R-5 and shall conform to all other applicable provisions of Ordinance No. 348.
3. The proposed project is consistent with the Schedule B map requirements of Ordinance No. 460, and with other applicable provisions of Ordinance No. 460.
4. The public's health, safety and general welfare are not protected through project design.
5. The proposed project is not compatible with the present and future logical development of the area.
6. The proposed project will not have a significant effect on the environment.
7. The proposed project will not preclude reserve design for the Multi-Species Habitat Conservation Plan (MSCHP).

FINDINGS: The following findings are in addition to those incorporated in the summary of findings, and in the attached environmental assessment, which is incorporated herein by reference.

1. The project site is designated Estate Density Residential-Rural Community (2 acre min) on the Southwest Area Plan.
2. The proposed use, residential parcels with a minimum size of 20,000 Square Feet, is not permitted use in the Estate Density Residential designation. This is why a General Plan Amendment has been filed to Low Density Residential-Rural Community. The proposed density is also not permitted within the Leon Keller Road Policy area (2 ½ acre min).
3. The proposed use, a subdivision of 20,000 square foot minimum lot sizes is a permitted use in the Low Density Residential designation.
4. The project site is surrounded by properties, which are designated Estate Density Residential-Rural Community, Low Density Residential, Medium Density Residential and Rural Residential.
5. The zoning for the subject site is Rural Residential (R-R).
6. The proposed 50 acre subdivision into 67 residential lots is a permitted use, subject to approval of a General Plan Amendment, Change of Zone and a Tentative Tract Map.
7. The proposed subdivision is consistent with the development standards set forth in the proposed Residential Agricultural zone (R-A).

Letter 10 Continued

Pg 9 - Ltr

GENERAL PLAN AMENDMENT NO. 00503
CHANGE OF ZONE NO. 06473
TENTATIVE TRACT MAP NO. 29098
PC Staff Report: November 03, 2004
Page 4 of 4

8. The project site is surrounded by properties which are zoned Rural Residential (R-R),Rural Residential 2 ½ acre minimum-(R-R-2 ½), Light Agriculture 2 ½ acre minimum (A-1-2 ½) and Specific Plan (SP).

9. This project is located within Criteria Area #5073 and #5174 of the Multi-Species Habitat Conservation Plan, and as such is required to conserve 32.9 acres. This project fulfills those requirements.

10. This project contributes to the overall conservation acreages.

11. This project is needed for inclusion in the Multi-Species Habitat Conservation Area.

12. This project is within the City Sphere of Influence of Murrieta. As such, it is required to conform to the County's Memorandum of Understanding (MOU) with that city. This project does conform to the MOU.

13. Environmental Assessment No. 37747 identified the following potentially significant impacts:

a. Aesthetics
b. Biological Resources
c. Cultural Resources
d. Geology/Soils
e. Hydrology/Water Quality
f. Land Use/Planning
g. Noise
h. Public Services
i. Recreation
j. Transportation/Traffic
k. Utilities/Service Systems

These listed impacts will be fully mitigated by the measures indicated in the environmental assessment, conditions of approval, and attached letters. No other significant impacts were identified.

INFORMATIONAL ITEMS:

1. As of this writing, staff has received 46 letters and a petition, in opposition to this project.

2. The project site is not located within:
   a. A 100-year flood plain an area drainage plan, or dam inundation area.
   b. A fault zone or a liquefaction area.

3. The project site is located within:
   a. The boundaries of the Menifee Union School District and Perris Union High School District.
   b. The Southwest Area Plan.
   c. The City of Murrieta, Sphere of Influence.
   d. The Santa Margarita Watershed.
   e. The Steven's Kangaroo Rat Fee Area.
   f. Cell Criteria Areas #5073 and #5174 of the Multiple Species Habitat Conservation Plan.

4. The subject site is currently designated as Assessor's Parcel Number 467-050-036.

Letter 10 Continued

Sheryl Ade
22912 Pavia Ct.
Wildomar, CA 92595

Ref. Agenda Item 2.1 – Oak Creek Cyn. Devel.
City of Wildomar Planning Commission
March 6, 2013

Good evening again Commissioners and Staff:

For the record, I gave you a copy of my comments this evening.

I'm Sheryl Ade, former City Council Member and resident of Wildomar. I have a number of concerns in regard to this proposed project, but I will only address two of those this evening.

First and foremost I would like to request the Commissioners make a Condition of Approval that this project not move forward until the completion of the Bundy Canyon/Scott Rd. widening from the I-15 to the 215. A letter from the Riverside County Department of Transportation and CalTrans on the phasing of Bundy Canyon and expected completion date should be obtained as part of this condition and become part of the record.

The issue is safety, if the road is only widened for the length of the project, which I believe is approximately.100 feet, I may be off on that. I believe it would be negligent and short-sighted to allow this project to move forward without this vital condition.

The people who live in this area can then know what to expect in terms of the whole of Bundy Canyon road being widened. All they know right now is that they are halfway between heaven and hell – it's just not a good place to be in peak am and pm hours.

The EIR indicates putting more people in this area helps fill our housing quota, but it doesn't solve the problem for me or anyone else that commutes on Bundy Canyon Road on a daily basis and I do. There are other areas in our community that are more suited for the higher density housing that this project provides

Yes, it's a nice project, but it's going into an area that, in respect to circulation, is very undesirable. The EIR traffic studies done in the early 2000s for the master planned communities in Menifee, between Scott and Newport Roads, indicated that traffic from those projects would take Scott or Newport Road to the 215. They never took into consideration that traffic might head west on Bundy Canyon to get to the I-15. I know because I read some of those EIRS. . .I thought it was bizarre. Thus, we have the very untenable situation we are in today. Please don't add to this unfortunate mess by allowing this project to move forward without the completion of the widening of Bundy Canyon/Scott Road.

My second concern is higher density without appropriate buffering. I know that Larry Markham tried to address that. . .but during the late 1980s, vested tract maps were required to include a Fiscal Impact Analysis (relating to levels of service) as part of the staff report. I have a copy of TTM 23111 in which the staff report includes this analysis along with an appendix that summarizes the basic assumptions used in the analysis.

Letter 10 Continued

The Planner's comments (handwritten at that time) also included the following:

Subdivision lots should be 75% the size of the LARGEST adjacent developed lot, but not less than as shown in a, b, or c above.

Example:
R-R lot adjacent = 1/2 acre gross (21,780 SF)
then subdivision lots = 16,335 SF (.37 acres)
It is the intent of this last provision to allow flexibility in design and to create transition areas between lower and higher density projects.

(Reference: John Libiez, Sr. Planner 1/12/88)

By the way, it's also addressed in the Riverside County Integrated Plan (RCIP, 2003). So what has happened to the idea of transition areas? It's been ignored for the most part, that is what's happened. It seems all that's required now is a block wall and some trees.

I was appalled, angry and sickened to see 10 acre custom view homes (horse properties) along Loring Rd. north of Clinton Keith with 7,200 SF tract lots towering over them. These 10-acre homesites were not rezoned to higher density in the RCIP, so there is absolutely no compatibility.

I would ask that the Commissioners consider following the guidelines established by the RCIP and that the City of Wildomar adopted. If you are not familiar with this, perhaps before completing your deliberations on this project, you should research it and the implications if you do not consider this requirement.

Just a couple more things that I jotted down while watching the presentation.

- The Colonial style for the homes? You can delete that as far as I'm concerned.
- Set backs should be staggered. The Design Guidelines that we adopted from the County. . .you're to show your streetscape and the homes should be staggered. If you put them all straight across which I saw in what you were showing up there – it's going to look like the barracks and if you want to see what that looks like, go look at Hidden Creek across from David A. Brown Middle School. They did not stagger those homes and they're all two-story almost. . .so when you drive in there you get this very claustrophobic feel.
- There is an Oak Tree Ordinance Mr. . . .uhm, I can't remember your name (Teague), Ord 559 on Removal and Retention of Trees. There's also the Riverside County Oak Tree Management Guidelines which was passed by the Board of Supervisors on March 2, 1993. The TLMA webpage has links to these.

And that's it, thank you.

Letter 10: Sheryl L. Ade

Responses

10-1 The commenter explains that the creeks discussed throughout the DEIR are within the jurisdiction of the Santa Ana Regional Water Quality Control Board (SARWQCB). However, the SARWQCB was never notified during the NOP process nor were they notified when the DEIR was released.

The proposed project is within the jurisdiction of both the San Diego Regional Water Quality Control Board (SDRWQCB) and the Santa Ana Regional Water Quality Control Board (SARWQCB). However, project impacts to streambeds on the site are limited to those regulated solely by the SARWQCB with regard to issuance of a Clean Water Act Section 401 water quality certification. The City of Wildomar has an agreement with the SDRWQCB dictating that the SDRWQCB has sole responsibility for ensuring compliance with the municipal storm drain (MS4) permit. SARWQCB inadvertently was not notified by the State Clearinghouse despite its responsibility to provide notice to all responsible agencies. Since being made aware of this oversight, all project information was immediately transmitted to SQRWQCB staff by the applicant and the City on March 27, 2013, and adequate time to review and comment on the project was extended to the SARWQCB, including continuance of the City Council meeting and public hearing for the project. The SARWQCB letter is provided in the FEIR as letter 18 and includes responses by the lead agency, provided to the SARWQCB on Monday, May 6, 2013. It should be noted that although the SDRWQCB received a copy of the Draft EIR on November 20, 2012, they did not comment on the document.

10-2 The commenter states that in the Introduction of the DEIR, it was noted that in Specific Plan Amendment No. 116 to The Farm Specific Plan, the Master Planned Farm Community is to have 37.7 acres set aside for school use and 21.6 acres set aside for commercial use. The commenter states that the DEIR does not distinguish where these acreages are to be located and the proposed project only discusses 5 acres to be developed for commercial use and 0 acres for school use.

The commenter is incorrect on the proposed location of a school or larger commercial property within The Farm Specific Plan. To further clarify the project description, the proposed project does not replace The Farm Specific Plan. The Specific Plan identifies Phase 11 as the location of the school site but does not provide a precise location for the larger commercial area. Because the proposed project does not affect Phase 11, and there is no large commercial area proposed in the project area, there was no cause to analyze these uses in the EIR. Responses to comments that do not raise a significant environmental question are not required (*Citizens for E. Shore Parks v. State Lands Comm'n* (2011) 202 Cal. App. 4th 549, 568). In providing these responses, the City has provided specific responses to detailed comments. However, the City is not required to accept a commenter's assumptions, especially when such assumptions factually are incorrect (*Greenebaum v. City of LA* (1984) 153 Cal. App. 3d 391). The City is not required to conduct every test or perform all research, studies, or experimentation requested (PRC Section 21091(d)(2)(B); 14 CCR Section 15204(a)). CEQA discourages speculative discussion. An EIR is not required to speculate about the environmental consequences of future development that is unspecified, and such an analysis would be premature (*Environmental Council of Sacramento v. City of Sacramento* (2006) 142 Cal. App. 4th 1018).

10-3 The commenter explains that the properties north of Bundy Canyon Road are designated either Rural Community Mountainous (10-acre minimum lot size per Area Plan designation) or Rural Community (5-acre minimum lot size per Area Plan designation) according to the Foundation Element. Additionally, because the proposed project intends to abut those Rural Community properties, the commenter states that the proposed 7,200-square-foot lot surrounded by block walls does not follow these policies outlined in the General Plan Land Use Element: LU 2.1(d), (e), (f), and (g).

To put the commenter's quotation of only a few of the policies contained in LU 2.1 in context, the entire policy is shown below.

LU 2.1 Accommodate land use development in accordance with the patterns and distribution of use and density depicted on the General Plan Land Use Map (Figure LU-1) and the Area Plan Land Use Maps, in accordance with the following: (AI 1, 3, 5, 9, 27, 29, 30, 41, 60, 91)

a. Provide a land use mix at the countywide and area plan levels based on projected need and supported by evaluation of impacts to the environment, economy, infrastructure, and services.

b. Accommodate a range of community types and character, from agricultural and rural enclaves to urban and suburban communities.

c. Provide for a broad range of land uses, intensities, and densities, including a range of residential, commercial, business, industry, open space, recreation, and public facilities uses.

d. Concentrate growth near community centers that provide a mixture of commercial, employment, entertainment, recreation, civic, and cultural uses to the greatest extent possible.

e. Concentrate growth near or within existing urban and suburban areas to maintain the rural and open space character of Riverside County to the greatest extent possible.

f. Site development to capitalize upon multi-modal transportation opportunities and promote compatible land use arrangements that reduce reliance on the automobile.

g. Prevent inappropriate development in areas that are environmentally sensitive or subject to severe natural hazards

The proposed project provides a mix of parcel sizes that would allow a variety of home types and values. Design features of the project include open space that accounts for approximately 76 acres within the proposed project site, as well as a trail system and landscaping along the roadways. Included in the project is a commercial site that is intended to provide local-serving services and reduce the number of vehicle trips needed by residents of the proposed project and the area in general. Because the project is located within The Farm Specific Plan and also within the city boundaries of the City of Wildomar, the property is within a community center as defined in LU 2.1. The proposed project includes a widening of Bundy Canyon Road, which also includes bus turnout and shelter areas (see Figures 2.0-4d and 2.0-4e of the Draft EIR). As noted above

and as shown in Figure 2.0-7 of the Draft EIR, the proposed project also includes trails linking all of the residential areas to the parks, open space, commercial area, and ultimately to the bus turnouts on Bundy Canyon Road. When reviewed in the context of all of the policies provided in LU 2.1, the proposed project is consistent with the City's General Plan.

In regard to the retaining walls included in the proposed project, the commenter provides a personal opinion that does not affect the EIR. The comment is noted and will be provided to the City Council for consideration.

10-4 The commenter states that the proposed project does not fit with the RCIP vision (Land Use Element – Community Design) to provide a community with "distinct qualities and character, surrounded in most cases by open space or non-intensive uses."

The commenter provides a personal opinion that does not allege any deficiency in the EIR. The comment is noted and will be provided to the City Council for consideration. However, the project is consistent with the General Plan Land Use Element policies for many reasons. For example, with both residential and commercial components, as well as planned open space, the project will provide a "balanced mix of land uses, including employment, recreation, shopping, and housing" (RCIP, Policy LU 3.1(a)). It is the City's role to assess whether the project is consistent with the applicable General Plan, and the City is uniquely qualified to interpret consistency with the document it has adopted as its own General Plan (*Save Our Peninsula Comm. v Monterey County Bd. of Supervisors* (2001) 87 Cal. App. 4th 99, 142; *Friends of Lagoon Valley v, City of Vacaville* (2007) 154 Cal. App. 4th 807, 815.)

10-5 The commenter states that the proposed project does not adhere to these additional General Plan Land Use Element policies: LU 6.3, 6.4, and 6.5.

A determination of consistency with the General Plan is a legislative determination. The policies raised by the commenter from the General Plan read as follows:

LU 6.3 Consider the positive characteristics and unique features of the project site and surrounding community during the design and development process. (AI 3)

LU 6.4 Retain and enhance the integrity of existing residential, employment, agricultural, and open space areas by protecting them from encroachment of land uses that would result in impacts from noise, noxious fumes, glare, shadowing, and traffic. (AI 3)

LU 6.5 Require buffering to the extent possible between urban uses and adjacent rural/equestrian oriented land uses. (AI 3)

The determination of aesthetic compatibility (LU 6.3) is a legislative decision to be made by the City Council as part of their deliberations on the project. The proposed project was found to have a less than significant impact on aesthetics and visual resources as discussed in Section 3.11 of the Draft EIR. Because the proposed project will be affecting oak trees as part of the grading plan, mitigation measures were developed to replace the oaks with oak or other native species (see Impact 3.11.4 on page 3.11-7 of the Draft EIR). See also the discussion related to the Oak Tree Inventory Map in response 9-1. Additionally, as explained in the response 10-4, the City has great discretion in

determining whether a project is compatible with the applicable General Plan (*Save Our Peninsula Comm. v Monterey County Bd. of Supervisors* (2001) 87 Cal. App. 4th 99, 142).

Policy LU 6.4 speaks to the issue of encroachment of land uses or activities that would be a nuisance by virtue of noxious fumes, traffic, noise, etc. In this context, no new uses are proposed that fit this description and that would affect the surrounding homes. The existing and future traffic on Bundy Canyon Road could affect residents of the project, and noise impacts are discussed in Section 3.5 of the Draft EIR. The Draft EIR includes noise attenuation for properties that abut the Bundy Canyon right-of-way as well as mitigation measures that will apply to homes designed for the project on these parcels (see page 3.5-26 of the Draft EIR).

With regard to buffering (LU 6.5), the adjacent zoning across Beverly Street to the north of the proposed project (within Phase 17A) is Rural Residential (R-R) as shown in Figure 2.0-2 of the Draft EIR. The permitted uses in the R-R zone district are established in Section 17.16.010 of the Wildomar Municipal Code. The first permitted use in the R-R zone district is one-family dwellings. It is also the intent of the current Farm Specific Plan, as originally adopted and as amended by the proposed Oak Creek Canyon project, to provide one-family dwellings (see page III-1 of Appendix 2.0-2 of the Draft EIR). Phase 17A provides for single-family residential uses with a minimum lot size of 7,200 square feet across a public roadway (Beverly Street) from the existing residential lots/uses that are legally subdivided on 4,500-square-foot parcels. Given that the lots in Phase 17A are larger and homes will be separated by at least 60–80 feet and will have street and property landscaping, buffering as encouraged in the above policies has been achieved and is considered to have no impact on compatibility.

10-6 The commenter suggests that the proposed project be compared with a project in the adjacent City of Menifee (General Plan Amendment No. 00503; Change of Zone No. 06473; and Tentative Tract No. 29098) that had some similar features (including block walls) as the proposed project (see attached staff report presented at the November 3, 2004, Planning Commission at the County of Riverside).

The comment does not allege any deficiencies in the EIR but is transmitted to the City Council for consideration.

Letter 11

March 27, 2013

From: Gerard Ste. Marie
P.O. Box 486
Wildomar, CA 92595

Martha Bridges
35465 Woshka Lane
Wildomar, CA 92595

John Burkett
32721 Mesa Drive
Lake Elsinore, CA 92530

To: City of Wildomar
Attn: City Council
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

Re: **Written Comments to Various Sub-Approvals Involving Overall Approval of the Oak Creek Canyon Project (Planning Application No. 11-0261), Including: Final Environmental Impact Report (SCH No. 2012031064); General Plan Amendment No. 11-0261; Change of Zone No. 11-0261; Farm Specific Plan No. 116-C/W, Amendment No. 4; Tentative Tract Map No. 36388**

To the Wildomar City Council: Please consider the following comments to the various sub-approvals involving overall approval of the Oak Creek Canyon Project as a whole (Planning Application No. 11-0261):

I. The Final EIR is Deficient Because it Fails to Discuss General Plan Inconsistency, Fails to Discuss Impacts Associated with Sewer Infrastructure Requirements, Fails to Discuss Impacts Associated with Project Location in a Very High Fire Hazard Severity Zone, Improperly Defers Analysis of Impacts to Future Use of the Commercial Area of the Project, Improperly Defers Analysis and Mitigation of Impacts Associated with Loss of Riparian Habitat and Oak Trees, and Fails to Discuss Unavoidable Impacts and Statement of Overriding Considerations Regarding Loss of Riparian Habitat and Oak Trees; Furthermore, the Introduction of Significant New Information After Circulation of the Draft EIR Relative to the DBESP, Oak Tree Inventory and EVMWD Wastewater Master Plan Require Recirculation of the EIR

11-1

A. The Final EIR is Deficient Because it Fails to Discuss General Plan Inconsistency with the Project

In response to comments made to the Draft EIR regarding absence of a formally adopted general plan by the city of Wildomar, it was stated that

Letter 11 Continued

Wildomar adopted the Riverside County general plan on the first day of incorporation by approving Resolution 08-01 continuing all existing of Riverside County resolutions in the new city, and by so doing the council had automatically determined under Government Code section 65301 that it was adopting the general plan of another public agency that "is sufficiently detailed and its contents are appropriate" to satisfy the legal requirements of a general plan. This is nonsense.

Resolution No. 08-01 mentions nothing regarding adoption of any general plan. Attached hereto as Exhibit "A" is a copy of the Affidavit of Posting of the July 1, 2008 agenda, Resolution No. 08-01 as agendized, and the minutes for approval of Resolution No. 08-01. From these it is readily discernable that adoption of the Riverside County general plan was neither noticed, agendized, nor approved through passage of Resolution No. 08-01. No reference to adoption of a general plan exists in the text of Resolution No. 08-01, no determination as to legal sufficiency of the general plan of another public agency required under Government Code section 65301 is indicated either in the Resolution itself or in the official minutes, and the lack of the legally required 10-day notice by publication for adoption of a general plan is made evident by the Affidavit of Posting 72 hours prior to the meeting. Wildomar simply never indicated an intention to adopt a general plan through approval of Resolution No. 08-01. Due to the fact that Wildomar has no legally defensible general plan, the EIR must include a discussion of project inconsistency with the general plan.

11-1 cont.

But even assuming for the sake of discussion that Wildomar has validly adopted the Riverside County general plan, the fact that Wildomar has not updated its housing element in conjunction with the current cycle Regional Housing Needs Allocation, contrary to what was stated in the Draft EIR but corrected in the Final EIR in response to comments, the Final EIR must discuss inconsistency with Policy H-1 of the Riverside County general plan, which is: "*Policy H-1: Ensure there is a sufficient supply of multi-family and single-family zoned land to meet the housing needs identified in the Regional Housing Needs Allocation (RHNA).*"

B. The Final EIR is Deficient Because it Fails to Discuss Impacts Associated with Sewer Infrastructure Requirements

In response to comments made to the Draft EIR regarding inadequate discussion of the environmental effects of necessary sewer infrastructure improvements to serve the project, the Final EIR refers for the first time to the EVMWD Wastewater Master Plan and its accompanying Program EIR discussion of Improvement RP-23, an 8,600 foot (1.6 mile) gravity sewer extension of the

11-2

Letter 11 Continued

Bundy Canyon Road Trunk needed in order to allow project sewer connection with the EVMWD wastewater collection and treatment system. However, the problem with project reliance upon EVMWD Improvement RP-23 is that the pipeline is not slated for installation by EVMWD until sometime between the years 2021 and 2025 (see Exhibit"B" attached hereto consisting of Table 3-14 of the Wastewater Master Plan Program EIR, Table 9.3 of the Wastewater Master Plan and Figure 13 of the Wastewater Master Plan). Because the EIR assumes construction on the project to begin in 2013, and anticipates the "Opening Year" of the project as 2015, the gorilla in the room is: How will wastewater collection and treatment be accomplished in the 6-10 year window where no sewer pipeline will be available to connect the project with EVMWD wastewater facilities? The Final EIR must explain this little oversight.

Meanwhile, Amendment No. 4 to The Farm Specific Plan No. 116-C/W contains no planning for project connection to EVMWD wastewater facilities at all, but instead refers only to the archaic Farm Mutual Water Company on-site, open-pit, effluent-spewing sewer system currently in use. Moreover, due to delay in completion of the EVMWD RP-23 sewer pipeline until sometime between the years 2021 and 2025, it will be the only sewer system available for the first six-to-ten years of project operation. Because the Final EIR has neglected to undertake environmental review of the only sewer system detailed in The Farm Specific Plan No. 116-C/W Amendment No. 4, and the only sewer system available for project use until the year 2021 at the earliest, it fails compliance under CEQA as an informational document.

11-2 cont.

C. The Final EIR is Deficient Because it Fails to Discuss Impacts Associated with Project Location in a Very High Fire Hazard Severity Zone

The Final EIR rightfully acknowledges that the project is located within a Very High Fire Hazard Severity Zone as determined by the California Department of Forestry and Fire Protection. Under established CEQA thresholds of significance the project would have adverse fire safety impacts because it exposes people or structures to a significant risk of loss, injury or death involving wildfires. However, rather than committing to analysis of these impacts the EIR summarily concludes without discussion that project site proximity to a fire station and the considerable development currently surrounding the site reduces impacts to less than significant. This is a bare conclusion based on insufficient evidence and should be reevaluated so that adequate mitigation measures may be implemented to reduce wildfire threats.

11-3

Letter 11 Continued

D. The Final EIR is Deficient Because it Improperly Defers Analysis of Impacts to Future Use of the Commercial Area of the Project

Commercial development on the site is contemplated in Phase 19 of the Oak Creek Canyon Project. The EIR itself acknowledges that "*[t]his document will not analyze the potential impacts of any future use of the 5.21-acre commercial area of the proposed project due to a lack of specific plans for the area. A subsequent programmatic environmental analysis will be performed once the future use of the commercial area of the proposed project has been developed and proposed.*" However, because CEQA requires that all phases of a project must be considered when evaluating its impact on the environment, the EIR is deficient. 11-4

E. The Final EIR is Deficient Because it Improperly Defers Analysis and Mitigation of Impacts Associated with Loss of Riparian Habitat and Oak Trees

Although the Draft EIR acknowledges that loss of riparian habitat and oak trees could possibly occur through project implementation (and based on site plans included, do occur), no discussion of theses potential impacts or measures to mitigate them was made. Rather, any necessary analysis and mitigation measures were pushed off into future permit applications, negotiations with trustee and responsible agencies and third party surveys and reports prepared after and outside of CEQA review. Upon comments from the Regional Conservation Authority, the California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service, the lead agency for the first time in the Final EIR has published a Determination of Biologically Equivalent or Superior Preservation (DBESP) which does quantify the loss to riparian habitats and proposes alternative mitigation scenarios, but the Final EIR nonetheless fails to discuss such habitat loss or to implement any of the suggested mitigation measures. Also released for pubic review for the first time after close of the comment period on the Draft EIR was an Oak Tree Inventory Map indicating the loss of 63 mature oak trees 5 or more inches diameter at breast height. However, the Final EIR once again fails to discuss this loss of mature oak trees or implement any definitive mitigation, but defers consideration of actual mitigation measures until after and outside of the CEQA process. 11-5

F. The Final EIR is Deficient Because it Fails to Discuss Unavoidable Impacts and Statement of Overriding Considerations Regarding Loss of Riparian Habitat and Oak Trees

Upon public release of the DBESP and Oak Tree Inventory Map after close of the comment period on the Draft EIR, it became obvious that there are unavoidable adverse environmental impacts relative to loss of riparian habitat and 11-6

Letter 11 Continued

mature oak trees that would occur on site as a result of the project. However, the Final EIR fails to discuss these unavoidable impacts or to make a statement of overriding considerations as required by CEQA

11-6 cont.

G. The Introduction of Significant New Information After Circulation of the Draft EIR Relative to the DBESP, Oak Tree Inventory and EVMWD Wastewater Master Plan Require Recirculation of the EIR

Upon public release of the DBESP and Oak Tree Inventory Map, and disclosure of lead agency reliance on the EVMWD RP-23 sewer trunk extension pipeline discussed in its Wastewater Master Plan for provision of sewer service to the project, all done after close of the comment period on the Draft EIR, significant new information that deprives the public of a meaningful opportunity to comment upon substantial adverse environmental effects of the project or a feasible way to mitigate or avoid such effects has been disclosed regarding loss of riparian habitat and mature oak trees as well as the unavailability of adequate sewer facilities until the year 2021 at the earliest, a minimum 6 years after stated project completion in 2015. Based on this significant new information, CEQA requires recirculation of the EIR for further public comment.

11-7

II. General Plan Amendment No. 11-0261 is Not Authorized by Law Because the City of Wildomar has Never Formally Adopted a General Plan Since Becoming Incorporated

One of the actions contemplated in the project is an amendment to general plan landuse designations within the project. However, as previously discussed herein, Wildomar has never formally adopted any general plan since inauguration of the city in July of 2008. Because section 65358 of the Government Code limits general plan amendments to an adopted general plan, and Wildomar has to date failed to formally adopt any general plan, the City is without statutory authority to amend a general plan that has never been adopted.

11-8

III. The Farm Specific Plan No. 116-C/W, Amendment No. 4 is Not Authorized by Law Due to General Plan Inconsistency, Failure to Detail Major Infrastructure and Failure to Include a Program of Implementation and Financing Measures for Provision of Major Infrastructure

One of the actions contemplated in the project is Amendment No. 4 to The Farm Specific plan No. 116-C/W. However, as previously discussed herein, Wildomar has never formally adopted any general plan since inauguration of the city in July of 2008. Because section 65454 of the Government Code limits specific plan

11-9

Letter 11 Continued

amendments to conformity with an adopted general plan, and Wildomar has to date failed to formally adopt any general plan, the City is without statutory authority to amend any specific plan either. Moreover, because section 65450 of the Government Code specifies that specific plans are for systematic implementation of the general plan, the City is likewise without statutory authority to prepare any specific plan.

But even assuming for the sake of discussion that Wildomar has validly adopted the Riverside County general plan, a specific plan must include a statement of the relationship of the specific plan to the general plan, and that has not been done. Moreover, the fact that the specific plan amendment requires a concurrent general plan amendment in order to achieve general plan consistency is proof in itself that the specific plan amendment cannot possibly be consistent with the existing general plan. Also, because a general plan amendment is not legally effective until at least 30 days after adoption, the specific plan amendment cannot possibly be consistent with the general plan as amended either.

11-9 cont.

A specific plan must by law include text and diagrams which specify in detail the proposed distribution, location, and extent and intensity of major components of public and private transportation, sewage, water, drainage, solid waste disposal, energy, and other essential facilities proposed to be located within the area covered by the plan and needed to support the land uses described in the plan. The specific plan in question here has provided no such text and diagrams. Furthermore, a specific plan must also include a program of implementation and financing measures to provide these essential infrastructure facilities. The specific plan in question here does not contain any program of implementation or financing measures for any of the major infrastructure facilities, which in this case would include Bundy Canyon Road realignment, neighborhood streets, electricity, natural gas, communications such as telephone, cable television and internet, water service including the two new 500,000 gallon tanks, sewer service, drainage infrastructure and solid waste disposal.

IV. Tentative Tract Map No. 36388 is Not Authorized by Law Because the City of Wildomar has Never Formally Adopted a General Plan or a Specific Plan Since Becoming Incorporated

One of the actions contemplated in the project is the approval of Tentative Tract Map No. 36388. Government Code section 66473.5 requires a finding of general plan and specific plan consistency of the subdivision in relation to approval of a tentative map. However, the same statute provides that general and/or specific

11-10

Letter 11 Continued

plan consistency is only possible if the local agency has officially adopted such a plan. Here, as noted above, because the city of Wildomar has never officially adopted a general plan or specific plan since becoming incorporated, Tentative Tract Map No. 36388 cannot possibly achieve plan consistency and as such cannot lawfully be approved

11-10 cont.

DATED: March 27, 2013

By: Gerard Ste. Marie
P.O. Box 486
Wildomar, CA 92595

Martha Bridges
35465 Woshka Lane
Wildomar, CA 92595

John Burkett
32721 Mesa Drive
Lake Elsinore, CA 92530

Letter 11 Continued

Exhibit "A" Separator

Exhibit "A" Separator

Exhibit "A" Separator

Letter 11 Continued

NOTICE OF A SPECIAL FIRST MEETING OF THE WILDOMAR CITY COUNCIL

NOTICE IS HEREBY GIVEN that a special first meeting of the City Council will be held on July 1, 2008 at 6:00 P.M.

Elsinore High School
21800 Canyon Drive
Wildomar, CA 92595

The special first meeting shall be for the purpose of conducting business in accordance with the attached agenda.

NO OTHER BUSINESS WILL BE DISCUSSED

AFFIDAVIT OF POSTING

I, Cher VanLancker, do hereby certify, under penalty of perjury under the laws of the State of California, that the foregoing notice of special first meeting was delivered personally or by mail to each councilmember of the City of Wildomar and to each local newspaper of general circulation, radio or television station requesting notice in writing, and was posted at the following locations at least 72 hours in advance of the special first meeting:

Elsinore High School
21800 Canyon Drive
Wildomar, CA 92595

U.S. Post Office
21392 Palomar St
Wildomar, CA. 92595

Mission Trail Library
34303 Mission Trail Blvd.
Wildomar CA. 92595

Cher VanLancker
Cher VanLancker

RIV #4822-1812-9410 v1

Letter 11 Continued

RESOLUTION NO. 08-01

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF WILDOMAR, CALIFORNIA, ADOPTING BY REFERENCE ALL APPLICABLE COUNTY OF RIVERSIDE RESOLUTIONS AS CITY OF WILDOMAR RESOLUTIONS

THE CITY COUNCIL OF THE CITY OF WILDOMAR DOES RESOLVE AS FOLLOWS:

SECTION 1. Recitals.

(a) The City of Wildomar is newly incorporated and desires to continue the existing regulatory and management scheme in providing services to City residents as were previously provided to them by the County of Riverside during this transitional period.

(b) The County of Riverside has adopted numerous resolutions which, among other matters, set fee levels for services for building, planning, safety, and has also approved by resolution Specific Plans and related matters for projects located in whole or in part within the incorporated area of the City (collectively, the "County Resolutions").

(c) The City Council believes it is in the City's best interest to continue such County Resolutions in full force and effect until such time as they are superseded by City policies.

SECTION 2. Adoption of County Resolutions. All existing County Resolutions adopted by the Riverside County Board of Supervisors or the Riverside County Planning Commission in effect upon the City's date of incorporation shall remain in full force and effect until any such County Resolution is repealed or superseded by the actions of the City Council.

PASSED, APPROVED, AND ADOPTED this 1st day of July, 2008.

_____, Mayor

RIV #4834-7509-0946 v1

-1-

Letter 11 Continued

6.1.24 RESOLUTION NO. 08-24

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF WILDOMAR, CALIFORNIA, PROVIDING FOR THE ENFORCEMENT OF STATE LAWS AND REGULATIONS RELATING TO PUBLIC HEALTH BY THE COUNTY HEALTH OFFICER

Councilmember Moore moved that the City adopt Resolution Nos. 08-01 through 08-24 Related to Administrative Matters. Seconded by Councilmember Farnam.

Motion carried, the following vote resulted:

AYES:	Sheryl Ade Bob Cashman Scott Farnam Bridgette Moore Marsha Swanson
NOES:	NONE
ABSENT:	NONE
ABSTAIN:	NONE

6.2 Adopt Organizational Resolutions 08-25 through 08-36 Related to Financial Matters:

6.2.1 RESOLUTION NO. 08-25

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF WILDOMAR, CALIFORNIA, AUTHORIZING REIMBURSEMENTS FOR PRE-INCORPORATION AND POST-INCORPORATION EXPENSES

6.2.2 RESOLUTION NO. 08-26

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF WILDOMAR, CALIFORNIA, AUTHORIZING THE INTERIM CITY MANAGER TO FILE THE STATEMENT OF FACTS FOR THE ROSTER OF PUBLIC AGENCIES WITH THE CALIFORNIA SECRETARY OF STATE AND TO FILE FOR A FEDERAL TAXPAYER IDENTIFICATION NUMBER

6.2.3 RESOLUTION NO. 08-27

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF WILDOMAR, CALIFORNIA, AUTHORIZING THE MAYOR TO

RIV #4826-1704-9346 v1

11

Letter 11 Continued

Exhibit "B" Separator

Exhibit "B" Separator

Exhibit "B" Separator

Letter 11 Continued

Table 3-14
Proposed Gravity Sewer Improvements

Project No.	Sewershed	Pipe Diameter (inches)	Pipe Length (feet)	Year of Occurrence
RP-1	Regional	15	1,300	2008-2010*
RP-2	Regional	15	2,000	2008-2010*
RP-3	Regional	33	4,700	2008-2010*
RP-4	Regional	15	2,300	2008-2010*
RP-5	Regional	42	3,700	2008-2010*
RP-6	Regional	48	3,500	2008-2010*
RP-7	Regional	48	2,400	2008-2010*
RP-8	Regional	21	2,700	2008-2010*
RP-9	Regional	54	17,500	2008-2010*
RP-10	Regional	15	900	2008-2010*
RP-11	Regional	10	2,700	2011-2015
RP-12	Regional	12	3,200	2011-2015
RP-13	Regional	24	3,300	2011-2015
RP-14	Regional	8	1,000	2011-2015
RP-15	Regional	10	7,500	2026-2030
RP-16	Regional	15	2,800	2011-2015
RP-17	Regional	15	1,900	2011-2015
RP-18	Regional	15	4,700	2011-2015
RP-19	Regional	12	2,300	2016-2020
RP-20	Regional	10	1,400	2016-2020
RP-21	Regional	10	3,500	2021-2025
RP-22	Regional	15	7,000	2021-2025
RP-23	Regional	10	8,600	2021-2025
RP-24	Regional	10	6,500	2016-2020
RP-25	Regional	27	808	2011-2015
RP-26	Regional	24	1,500	2011-2015
RP-27	Regional	12	7,400	2021-2025
RP-28	Regional	10	3,700	2016-2020
RP-29	Regional	10	1,400	2016-2020
RP-30	Regional	12	6,200	2011-2015
RP-31	Regional	12	10,000	2011-2015
RP-32A	Regional	12	4,100	2011-2015
RP-332B	Regional	15	4,200	2011-2015
RP-33	Regional	12	7,800	2011-2015
RP-34	Regional	12	5,300	2011-2015
RP-35	Regional	10	2,000	2016-2020
RP-36	Regional	10	1,300	2025-2029
RP-37	Regional	24	2,000	Post 2030
CLP-1	Canyon Lake	12	500	2008-2010
CLP-2	Canyon Lake	21	300	2011-2015
CLP-3	Canyon Lake	10	300	2011-2015
CLP-4	Canyon Lake	10	300	2011-2015
AP-1	Alberhill	15	3,600	2016-2020
AP-2	Alberhill	15	3,900	2021-2025

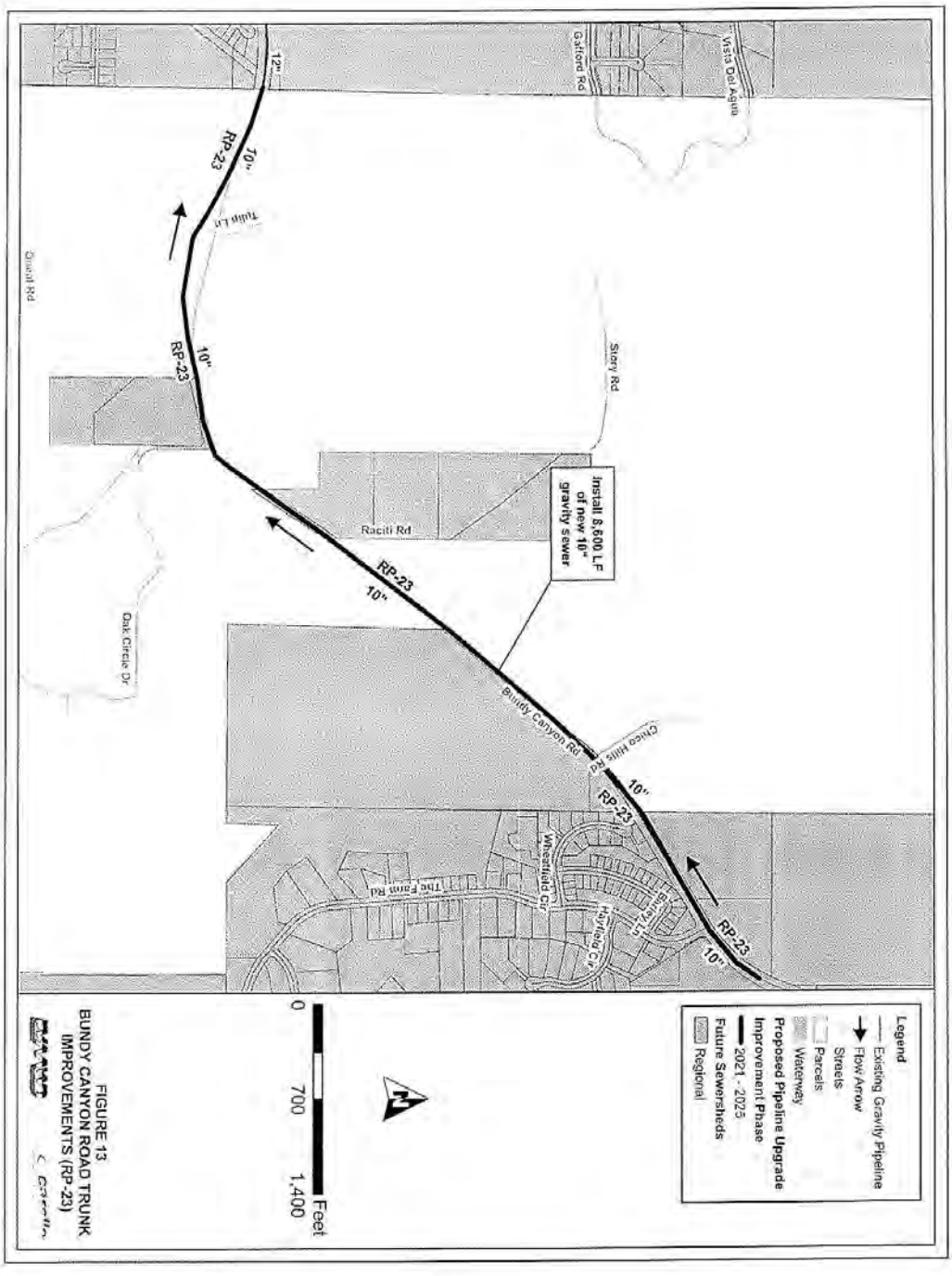
Letter 11 Continued

Table 9.3 Capital Improvement Program
Wastewater Master Plan
Elsinore Valley Municipal Water District

Project No.	Project Sheet No.	Type of Project	Description/ Sized	Description of CIP Item Description Limits	Sewer Trunk: Planned Trunk Name	CIP Item Description of CIP Item Detail Figure See Appendix	Existing (Lake Access)	CIP Sizes: Ec. Sized Diam. (In)	CIP Sizes: New Sized Diam. (In)	CIP Sizes: Parallel/ Replace	CIP Sizes: New	Length (ft)	Unit Cost (Based)	CIP Costs: Backfill+ Construction Cost ($)	CIP Costs: Capital Improvement Cost (Rounded) ($)	CIP by Phases: Phase 1 2010-2015 ($)	CIP by Phases: Phase 2 2015-2020 ($)	CIP by Phases: Phase 3 2020-2025 ($)	CIP by Phases: Phase 4 2025-2030 ($)	CIP by Phases: Phase 5 2030-2035 ($)	CIP by Phases: Phase 6 Post 2035 ($)	CIP Financing Split (Existing vs. Future Users): Future Users Benefit (%)	CIP Financing Split (Existing vs. Future Users): Existing Users Cost ($)	CIP Financing Split (Existing vs. Future Users): Future Users Cost ($)	Total Capital Cost ($)
Regional Sewershed																									
Gravity Main Improvements																									
1	SD-1	Pipe	Riverside Dr.	Grand Ave. to 1,300' nwly (Grand Ave.	A Trunk	Figure 1	X	10	15	Replace	New	1,300	339	$442,800	$487,000	$487,000					30%	$146,100	$341,700	$487,800
2	SD-2	Pipe	Riverside Dr.	1,300' nwly Grand Ave. to SCE w/o A-4-LS	A Trunk	Figure 1	X	10	15	Replace	New	2,800	339	$953,400	$1,050,000	$1,050,000					30%	$315,000	$735,000	$1,050,000
3	SD-3	Pipe	Mission Trail	Mallow Forest Main Discharge to Sandy Canyon Rd.	Lakeshore South	Figure 4A	X	12/15	33	Parallel	New	4,700	N/A	N/A	$0	$0					72%	$0	$0	$0
4	SD-4	Pipe	Mission Trail	Sandy Canyon Rd. to Drayton St.	Lakeshore South	Figure 4A	X	18	33	Parallel	New	2,200	N/A	N/A	$0	$0					72%	$0	$0	$0
5	SD-5	Pipe	Mission Trail	Drayton St. to 820' sw Bella Bird.	Lakeshore South	Figure 5A	X	21	42	Parallel	New	2,700	N/A	N/A	$0	$0					72%	$0	$0	$0
6	SD-6	Pipe	Mission Trail	820' nwly Sedco Blvd. to Malaga Rd.	Lakeshore South	Figure 5	X	21	42	Parallel	New	3,900	N/A	N/A	$0	$0					71%	$0	$0	$0
7	SD-7	Pipe	Malaga Rd.	Mission Trail to alignment Lakeshore Dr.	Lakeshore Malaga	Figure 5	X	15	18	New	New	2,400	N/A	$0	$0	$0					71%	$0	$0	$0
8	SD-8	Pipe	Lakeshore Dr. to Malaga Rd.	Lakeshore Dr. to Malaga Rd.	Regional Lakeshore South	Figure 5	X	-	21	New	New	2,200	475	$1,364,000	$1,592,000	$1,592,000					0%	$1,592,000	$0	$1,592,000
9	SD-9	Pipe	Various Streets	Sta 0 Force Main Discharge to Sta 0	Lakeshore North	Figure 6	X	24	54	Parallel	New	17,500	N/A	$0	$0	$0					82%	$0	$0	$0
10	SD-10	Pipe	Malaga	Regional Rte. 1-5 Force Main Crossing East to Canyon Hills Rd.	Canyon Hills	Figure 3	X	10	15	Replace	New	900	339	$305,000	$410,000	$410,000					10%	$427,000	$41,000	$410,000
11	SD-11	Pipe	Canal Ave.	Hills Ridge Rd. to Horse Cross Rd.	Nichols Road	Figure 3	X	-	12	New	New	2,700	264	$591,000	$649,000	$649,000					100%	$649,000	$0	$649,000
12	SD-12	Pipe	Canal Ave.	Tenth Street to Nichols Rd.	Nichols Road	Figure 3	X	-	12	New	New	3,500	272	$858,000	$1,348,000	$1,348,000					100%	$0	$1,348,000	$1,348,000
13	SD-13	Pipe	Tuscany Ave. and Summerton St.	Sunset St. to Hwy 74	Nichols Road	Figure 9	X	-	24	New	New	3,300	387	$1,521,000	$2,590,000	$2,590,000					100%	$2,590,000	$0	$2,590,000
14	SD-14	Pipe	Nichols Dr.	Nichols Dr. to Rosetta Dr.	A Trunk	Figure 1	X	-	8	New	New	1,000	151	$166,000	$203,000	$203,000					100%	$203,000	$0	$203,000
15	SD-15	Pipe	Hartnett Ave.	Telford Ave. to Mission St.	Sixth Street Trunk Extension	Figure 11	X	-	10	New	New	2,200	226	$1,098,000	$2,530,000	$2,530,000					100%	$0	$2,530,000	$2,530,000
16	SD-16	Pipe	No Existing Street	840' sw Grindelwald Ave. to New Tuscany Hills Ln.	North Tuscany Hills	Figure 6	X	-	15	New	New	2,400	316	$1,172,000	$2,748,000	$2,748,000					100%	$0	$2,748,000	$2,748,000
17	SD-17	Pipe	Summerhill Drive Extension	Existing Temporary Tuscany Hills Ln. to Tuscany Hills Ln.	North Tuscany Hills	Figure 8	X	-	15	New	New	1,900	339	$595,000	$1,091,000	$1,091,000					100%	$0	$1,091,000	$1,091,000
18	SD-18	Pipe	Greenwald Ave.	Scenic Crest Dr. to 840' sw Greenwald Ave.	North Tuscany Hills	Figure 8	X	-	15	New	New	4,700	339	$1,598,000	$2,475,000	$2,475,000					100%	$0	$2,475,000	$2,475,000
19	SD-19	Pipe	Greenwald Ave.	Ashmeyer Rd. to Scenic Crest Dr.	North Tuscany Hills	Figure 8	X	-	12	New	New	2,300	272	$525,000	$930,000	$930,000					100%	$0	$930,000	$930,000
20	SD-20	Pipe	Mountain St.	Proctor Place to Greenwald Ave.	North Tuscany Hills	Figure 8	X	-	10	New	New	1,400	226	$347,000	$493,000	$493,000					100%	$0	$493,000	$493,000
21	SD-21	Pipe	Quail Rd.	Seneca Ave. to Riverside Dr.	North Tuscany Hills	Figure 6	X	-	10	New	New	3,900	226	$883,000	$1,370,000	$1,370,000					100%	$0	$1,370,000	$1,370,000
22	SD-22	Pipe	Mt Lebanon Dr. and Summit Knoll	Mt Lebanon Dr. to Riverside Dr.	East Lake Sub-trunk	Figure 10	X	-	15	New	New	17,600	339	$2,377,000	$3,685,000	$3,685,000					100%	$0	$3,685,000	$3,685,000
23	SD-23	Pipe	Sandy Canyon Rd.	Mid Trail Farm Rd. to end Trail Ln.	Sandy Canyon Road Trunk Extension	Figure 13	X	-	10	New	New	8,000	326	$1,947,000	$3,600,000				$3,600,000		100%	$0	$3,600,000	$3,600,000
24	SD-24	Pipe	Lost Rd.	Crooked Arrow Dr. to Lemon St.	Lemon Street Trunk Extension	Figure 14	X	-	10	New	New	6,500	226	$1,471,000	$2,282,000		$2,282,000				100%	$0	$2,282,000	$2,282,000
25	SD-25	Pipe	Drayton St.	Crowell Street to Mission Trail	B Trunk	Figure 2A	X	18	27	Replace	New	1,500	655	$1,244,000	$1,510,000	$1,510,000					30%	$1,510,000	$0	$1,510,000
26	SD-26	Pipe	Drayton St.	to Melinda Ln. to Crystal St.	B Trunk	Figure 2A	X	18	24	Replace	New	1,500	587	$879,000	$1,354,000	$1,354,000					100%	$0	$1,354,000	$1,354,000
27	SD-27	Pipe	Possible Interceptor #3	Palomino St. to Calvon Lake Rd.	Interceptor #3 Subtrunk	Figure 15			12	New	New	7,400	250/754	$1,524,000	$5,433,000	$1,524,000			$1,264,000	$4,433,000	100%	$0	$5,433,000	$5,433,000

November 2008

Letter 11 Continued



Letter 11: Martha Bridges, John Burkett, and Gerard Saint Marie

Responses

11-1 The commenters continue to discuss the City of Wildomar's adoption of the Riverside County General Plan as the City's General Plan by adopting Resolution 08-01. They go on to state that due to the City's failure to adopt a General Plan, the FEIR must include a discussion of the project's "inconsistency with the general plan" and a discussion of the project's inconsistency with Policy H-1 of the Riverside County General Plan.

The commenters previously submitted a comment letter on January 7, 2013, asserting, among other things, that the City has not adopted a General Plan and that therefore the EIR cannot contain findings of General Plan consistency. The City responded to this comment by explaining that the City adopted the Riverside County General Plan as the City's General Plan via Resolution 08-01, which continued all County resolutions that were in effect as of July 1, 2008, in the City. The commenters refute the City's explanation and disagree that the City adopted a General Plan.

As stated in the response to the commenters' January 7 letter, the commenters' arguments that the City has not followed the proper procedures to adopt the City's General Plan do not raise environmental or land use impact concerns, per se. Responses to comments that do not raise significant environmental questions are not required (see *Citizens for East Shore Parks v. State Lands Com.*, 202 Cal. App. 4th 549, 568 (2011)). Therefore, the City was not required to respond to the commenters' January 7 comments and is not required to respond to the commenters' rebuttal arguments, regarding whether the proper procedures were followed for the adoption of the General Plan. Nonetheless, the City has chosen to respond to these comments.

The commenters' rebuttal arguments do not change the City's explanation as to how it adopted its General Plan. As previously explained, the City's decision to adopt the General Plan was pursuant to Government Code Section 65301(a), which authorizes a public agency to adopt all or part of the general plan of another public agency. Upon city incorporation, the City Council adopted the 2002 Riverside County General Plan as the City's General Plan, through Resolution No. 08-01. Resolution No. 08-01 continued in effect in the City of Wildomar all County resolutions existing as of July 1, 2008. The County Board of Supervisors adopted the 2002 Riverside County General Plan on October 2, 2003, by Resolution No. 2003-487. Therefore, the City has a valid General Plan.

The commenters further assert that the FEIR must include a discussion of the project's inconsistency with the General Plan because the City "has no legally defensible general plan." As discussed above, the City does have a valid General Plan.

The commenters further argue that even if the City does have a valid General Plan (which it does), the FEIR must discuss the project's inconsistency with General Plan Policy H-1: "Ensure there is a sufficient supply of multi-family and single-family zoned land to meet the housing needs identified in the Regional Housing Needs Allocation (RHNA)." The proposed project would result in the construction of 275 single-family homes on a range of parcel sizes. One of the project objectives is to "provide a residential development that would assist the City in meeting its existing and future housing needs" (see page 2.0-1 of the Draft EIR). The proposed project does not change the land use designation or zoning of any land intended for multiple-family residential use, but does include changes that allow a smaller lot pattern and housing product. The Draft EIR

determined on page 3.1-7 that the proposed project was consistent with the General Plan policies.

Finally, the commenters note that the DEIR states that in 2012 the City updated the Housing Element in the General Plan, but that the City never took any such action. This comment is correct, and this statement was struck from the EIR. At the time the DEIR was prepared, the City was intending to take formal action on an updated Housing Element in 2012, but now it is anticipated that the action will take place in 2013. Section 3.0 of the Final EIR makes this change to page 3.1-2 of the Draft EIR. As the proposed project is not a project proposed in the Housing Element, the fact that the City has not adopted the element does not affect the analysis in this EIR.

11-2 The commenters state that the FEIR is deficient because it fails to discuss impacts associated with sewer infrastructure requirements. The commenters state that according to the EVMWD Wastewater Master Plan and its accompanying program EIR discussion of Improvement R-23, improvements made to RP-23 (an 8,600-foot gravity sewer extension of the Bundy Canyon Road Trunk) would not occur until sometime between 2021 and 2025. The commenters request that the FEIR discuss how wastewater collection and treatment will be accomplished if the proposed project is anticipated to be completed in 2015 using the RP-23 sewer extension.

As stated in the Final EIR, the developer of the proposed project will construct an 8,600-foot portion of the EVMWD's planned gravity system that extends from The Farm Road west in Bundy Canyon Road to a point near Valley Vista Circle. The 10-inch sewer line is identified as Gravity Sewer Improvement RP-23 in the EVMWD Wastewater Master Plan and included in the EVMWD EIR certified for the master plan. The sewer line will be located entirely within the road prism of Bundy Canyon Road, which means that the sewer line will either be under the existing road pavement or along the graded shoulder immediately adjacent to the existing pavement. The timing shown in the EVMWD Wastewater Master Plan is for the EVMWD to construct the improvement; since the developer will be constructing the improvement, it may occur at any time and will be constructed as part of this project.

11-3 The commenters state that the FEIR is deficient because it fails to discuss impacts associated with the project location in a Very High Fire Hazard Severity Zone. The commenters request that impacts be reevaluated so adequate mitigation measures are implemented to reduce wildfire threats.

Significant risk of wildfire is discussed in Impact 3.10.1b of the Draft EIR beginning on page 3.10-5. The EIR concludes that proximity to a fire station and the considerable development that already exists around the proposed project reduces the threat of wildfire to less than significant. Other project features, including the installation of fire hydrants as part of the City's subdivision design standards, paved roadways designed for fire vehicles (see Figure 2.0-4 of the Draft EIR), fire breaks associated with all new construction, landscaping of individual lawns and areas, and residential fire sprinklers required due to changes in the California Building Code in 2011, all reduce the potential impacts for wildland fire to less than significant.

11-4 The commenters state that the FEIR is deficient because it improperly defers analysis of impacts to future use of the commercial area of the project. The commenters explain CEQA requirements for evaluating impacts for all phases of a project and therefore request that the FEIR discuss and analyze future commercial development.

While no specific commercial development is proposed with this application, possible commercial uses were assumed in the Traffic Analysis (see Table 3.3-5 on page 3.3-17 of the Draft EIR). Because the traffic model outputs are used to determine noise, air quality, and greenhouse gas impacts, the commercial potential is reflected in these sections of the Draft EIR as well. The City of Wildomar requires plot plan approval before any commercial project can be developed. During review of the plot plan, the City will review landscape plans, building elevations, signage, color, and roadway improvements along Sunset Avenue. The City also has a lighting ordinance that restricts the amount of light pollution.

Without a specific commercial use proposed for the site, it is too speculative to determine what impacts, if any, might occur. The C-P-S zoning is regulated by Section 17.76 of the Wildomar Municipal Code (see page 3.1-4 of the Draft EIR). All uses in this zoning district must have plot plan approval pursuant to Section 17.216 of the Wildomar Municipal Code. Findings for plot plan approval are set in Section 17.216.040 of the Municipal Code and state:

17.216.040 Requirements for approval.

No plot plan shall be approved unless it complies with the following standards:

A. The proposed use must conform to all the requirements of the General Plan and with all applicable requirements of state law and City ordinances.

B. The overall development of the land shall be designed for the protection of the public health, safety and general welfare; to conform to the logical development of the land and to be compatible with the present and future logical development of the surrounding property. The plan shall consider the location and need for dedication and improvement of necessary streets and sidewalks, including the avoidance of traffic congestion; and shall take into account topographical and drainage conditions, including the need for dedication and improvements of necessary structures as a part thereof.

C. All plot plans which permit the construction of more than one structure on a single legally divided parcel shall, in addition to all other requirements, be subject to a condition which prohibits the sale of any existing or subsequently constructed structures on the parcel until the parcel is divided and a final map recorded in accordance with Title 16 in such a manner that each building is located on a separate legally divided parcel. (Ord. 18 § 2, 2008, RCC § 17.216.040)

As shown in 17.216.040.B above, a finding of a plot plan is that the design of the project be "compatible with the present and future logical development of the surrounding property."

Section 21159(a) of the Public Resources Code provides guidance to lead agencies on the level of environmental analysis for projects as follows: "In preparation of this analysis, the lead agency may utilize numerical ranges or averages where specific data is not available; however, the agency shall not be required to engage in speculation or conjecture."

When environmental impacts cannot be assessed yet, as if the case here, those impacts may be deferred for study to a time when the severity of the impacts and their likelihood of occurrence will be known more specifically (*Rio Vista Farm Bureau v. County of Solano* (1992) 5 Cal. App. 351).

In this instance, land use traffic generation assumptions were made to enable evaluation of the traffic, air quality, greenhouse gas, and noise impact analyses. Building style, landscaping, signage, and other features associated with a commercial site plan were not available for the analysis. CEQA does not require an analysis of buildings or types of use for a parcel that have not yet been planned or proposed. The level of specificity of any such discussion is reduced and cannot include project-specific analysis (as of aesthetics) where such discussion would be purely speculative. The *Tracy First v. City of Tracy* (2009) 177 Cal. App. 4th 912 case presents a somewhat similar factual situation. There, the proposal for the WinCo foods development on the southern parcel was analyzed in depth; in contrast, because there was no development plan that had been submitted for the northern parcel, the EIR discussed a "hypothetical" development but could not discuss project-specific impacts, such as aesthetics. Thus, the level of discussion requested by the commenters is neither possible nor required. CEQA discourages speculative discussion. An EIR is not required to speculate about the environmental consequences of future development that is unspecified and such an analysis would be premature (*Environmental Council of Sacramento v. City of Sacramento* (2006) 142 Cal. App. 4th 1018).

As the City of Wildomar has a required plot plan approval process, and the plot plan must meet findings that relate to compatibility with surrounding development, the project-specific details of the future development of the commercial land were appropriately left to the plot plan approval process.

11-5 The commenters state that the FEIR is deficient because it improperly defers analysis and mitigation of impacts associated with the loss of riparian habitat and oak trees. Additionally, the commenters state that a Determination of Biologically Equivalent or Superior Preservation (DBESP), published by the US Fish and Wildlife Service, which quantified the loss to riparian habitats and proposed mitigation scenarios, was not incorporated into the FEIR.

The commenter is not correct that the DBESP was published by the US Fish and Wildlife Service. The City published the DBESP and the Oak Tree Inventory Map in the FEIR. As explained in response 9-1, no recirculation is required simply because of the compilation of the Oak Tree Inventory Map. Because the final design of the project and the realigned Bundy Canyon Road is not complete, the proposed mitigation measure must necessarily be flexible to ensure that all impacts are addressed. In this instance, the Draft EIR reports that there will be impacts to the riparian area, identifies the process whereby the rough estimate of impact will be made precise through final engineering plans, and also provides a metric for mitigation. In the case of the loss of riparian habitat, mitigation measure MM 3.8.4 on page 3.8-28 of the Draft EIR establishes no net loss as the performance standard. Therefore, the project must provide mitigation acceptable to the resource agencies that ensures there is no loss of the 0.719 acre of riparian area identified in the DBESP. Similarly, mitigation measure MM 3.11.4 both requires replacement of oak trees at a 3:1 ratio and establishes a performance standard for survival of the replaced trees (see page 3.11-8 of the Draft EIR). Section 15126(1)(B) of the State CEQA guidelines permits a mitigation measure to include a performance standard (*Gentry v. City of Murrieta* (1995) 36 Cal. App. 4th 1359, 1395). Such a mitigation standard

used by a trustee agency is not deferred mitigation, but a practical approach to the underlying requirement that there be compliance with the requirements of the trustee agency (*Gentry v. City of Murrieta* (1995) 36 Cal. App. 4th 1359, 1395). Also see response 11-2.

CEQA does not require an applicant to bear unnecessary investigation burdens; impacts may be mitigated once a precise design is established. Public Resources Code Section 21081.6(b) provides that when a trustee agency provides mitigation measures, it must provide performance standards for mitigation measures; those performance standards are included in the FEIR before public review. Additionally, when mitigation could be accomplished in more than one way, it is appropriate for the agency to identify performance standards that would fulfill the ultimate goal of the mitigation. In this instance, the project is required to demonstrate no net loss of riparian habitat that must be verified by the California Department of Fish and Wildlife (see mitigation measure MM 3.8.8a on page 3.8-31 of the Draft EIR). The DBESP was prepared concurrent with the circulation of the Draft EIR and is included as Appendix A to the Final EIR.

11-6 The commenters state that the FEIR is deficient because it fails to discuss unavoidable impacts and a Statement of Overriding Considerations, as required by CEQA, regarding the loss of riparian habitat and oak trees.

Mitigation measure MM 3.8.8a requires that the applicant "ensure that the project will result in no net loss of riparian/riverine habitats by providing mitigation through impact avoidance, impact minimization, and/or compensatory mitigation for the impact, as determined in the DBESP" (see page 3.8-27 of the Draft EIR). Compliance with the mitigation measure results in a less than significant impact, and no finding of significant and unavoidable impact or statement of overriding considerations is necessary.

11-7 The commenters state that the release of the DBESP, Oak Tree Inventory, and new information in the EVMWD Wastewater Master Plan (RP-23 sewer trunk extension pipeline) subsequent to the release of the DEIR require additional analysis and the recirculation of the EIR for further public comment.

The issues of habitat loss, mitigation, and construction are discussed in Section 3.8, Biological and Natural Resources, of the DEIR. The section contains a biological resources map (see Figure 3.8-1) as well as a jurisdictional assessment for wetlands (see Figure 3.8-2). The section is supported by the biological appendices 3.8-1 Jurisdictional Delineation of Waters and Wetlands, 3.8-2 Western Riverside County MSHCP Consistency Analysis, and 3.8-3 Nesting Season Survey for Burrowing Owl. The DBESP included in the Final EIR provides refinement of these documents but does not provide new information that was not previously disclosed in the EIR.

The proposed project will construct an 8,600-foot portion of the EVMWD's planned gravity system that extends from The Farm Road west in Bundy Canyon Road to a point near Valley Vista Circle. The 10-inch sewer line is identified as Gravity Sewer Improvement RP-23 in the EVMWD Wastewater Master Plan and included in the EVMWD EIR certified for the master plan. The sewer line will be located entirely within the road prism of Bundy Canyon Road, which means that the sewer line will either be under the existing road pavement or along the graded shoulder immediately adjacent to the existing pavement. The location and size of the sewer line has been public information since 2010 and therefore no recirculation is necessary.

11-8 The commenters state that General Plan Amendment No.11-0261 is not authorized by law because the City of Wildomar has never formally adopted a General Plan since becoming an incorporated city in July of 2008.

See response 11-1. Responses to comments that do not raise a significant environmental question are not required (*Citizens for E. Shore Parks v. State Lands Comm'n* (2011) 202 Cal. App. 4th 549).

11-9 The commenters state that Farm Specific Plan No. 116-C/W, Amendment No. 4 is not authorized by law due to General Plan inconsistency, failure to detail major infrastructure, and failure to include a program of implementation and financing measures for provision of major infrastructure.

The commenters assert that the City cannot amend The Farm Specific Plan because the City never formally adopted a General Plan. See response 11-1 for the City's response to this allegation.

In addition, the commenters argue that the Specific Plan does not include "a statement of the relationship of the specific plan to the general plan" and that the fact that both a Specific Plan amendment and General Plan amendment are required for this project is proof that the Specific Plan amendment is not consistent with the General Plan. The commenters raise a personal opinion that does not affect the analysis in the EIR.

Furthermore, the commenters assert that the Specific Plan is missing text and diagrams showing in detail proposed infrastructure and a program of implementation and financing measures for the infrastructure. The proposed project amends an existing Specific Plan that was adopted in 1974. The amendment allows for the construction of the project as defined in Section 2.0 of the Draft EIR. Utilities are discussed in Section 3.10 and as amended in the Final EIR. All utilities needed to serve the project will be constructed by the developer. Operation and maintenance of the facilities will either be by the Farm Mutual Water Company for water and wastewater or by the homeowners association for stormwater, open space, and trails. The utility plan for the existing Farm development is discussed beginning on page I-4 of The Farm Specific Plan (see Attachment 2.0-2 of the Draft EIR).

11-10 The commenters state that Tentative Tract Map No. 36388 is not authorized by law because the City of Wildomar has never formally adopted a General Plan or a Specific Plan since becoming an incorporated city in July 2008.

See response 11-1.

Letter 12

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March 27, 2013

VIA FAX AND EMAIL

City of Wildomar
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

RE: EIR for the Oak Creek Canyon Residential Project, Specific Plan No. 116, Amendment No. 4, General Plan Amendment, Change of Zone and Tentative Tract Map No. 36388 (Planning Application No. 11-0261) (SCH No. 2012031064)

Greetings:

On behalf of concerned residents, I hereby submit these comments on the Environmental Impact Report ("EIR") for, and in opposition to, the Oak Creek Canyon Residential Project. As a preliminary note, my firm notified the City of its desire to receive all notifications regarding this Project in a letter dated July 2, 2012. The City failed to provide any such notifications.

General Comments:

The California Environmental Quality Act ("CEQA") was adopted as a disclosure and transparency document. The theory is that by providing a document that adequately describes the environmental consequences of a project to decision makers and the public, the decision makers will make a rational decision based upon the true environmental consequences of the project and if they do not, the electorate can hold them accountable for their decisions. The core of this statutory structure is the adequacy of the document as an informational document.

12-1

The EIR completely fails as an informational document. The EIR does not adequately describe the proposed changes, particularly to traffic, temporary construction noise, drainage, water supply, and sewage disposal. For example, the EIR contains no discussion of the water and sewage lines which will be installed on- or off-site. The U.S. Fish and Wildlife Service and the California Department of Fish and Wildlife both found that the EIR was inadequate in describing Project-related impacts.

Letter 12 Continued

In general, the EIR is conclusory and is not based on substantial evidence in the record. Also, the Responses to Comments also often allege facts which are not supported by any evidence in the record.

CEQA requires that all proposed mitigation measures be fully enforceable and certain to occur. This Project fails to ensure that mitigation will occur with this Project and instead provides vague, uncertain, and unenforceable mitigation measures. Many mitigation measures are improperly deferred.

12-1 cont.

CEQA also requires that where feasible mitigation exists which can substantially lessen the environmental impacts of a project, ***all feasible mitigation*** must be adopted. In this way CEQA goes beyond its informational role to require that projects substantively lessen their negative effects on the environment. It is critical to proper drafting of an EIR that all feasible mitigation measures be required of a project. This has not been done with this Project.

Air Quality

The EIR's air quality analysis assumes a maximum disturbance of five acres, but nothing in the EIR limits the amount of disturbance. If more than five acres are disturbed, and this is permitted under the EIR, then impacts to air quality will be significant.

The EIR includes sign postage requirements for the Project to mitigate impacts. But the EIR does require the applicant to enforce the posted requirements.

For example, MM 3.4.2b states that "the grading plans shall reference that a sign will be posed on-site stating that construction workers need to shut off engines after 5 minutes of idling." First, this measure only requires incorporation of a sign into grading plans. It does not require that a sign be posted. But even if it actually required postage, the measure is still uncertain because there is no associated enforcement measure. This mitigation measure is highly indicative of the measures required by the EIR and demonstrates the overall deficiency of the document.

12-2

The EIR fails to incorporate all feasible mitigation for air quality emissions.

The following additional mitigation measures should be incorporated:

Construction Impacts

1. Gravel pads must be installed at all access points to prevent tracking of mud onto public roads.

2. Install and maintain trackout control devices in effective condition at all access points where paved and unpaved access or travel routes intersect (eg. Install wheel shakers, wheel washers, and limit site access.)

Letter 12 Continued

3. All roadways, driveways, sidewalks, etc., should be completed as soon as possible. In addition, building pads should be laid as soon as possible after grading unless seeding or soil binders are used.

4. Pave all construction roads.

5. Pave all construction access roads at least 100 feet on to the site from the main road.

6. Limit fugitive dust sources to 20 percent opacity.

7. Require a dust control plan for earthmoving operations.

8. When materials are transported off-site, all material shall be covered, effectively wetted to limit visible dust emissions, and at least six inches of freeboard space from the top of the container shall be maintained.

9. All streets shall be swept at least once a day using SCAQMD Rule 1186 certified street sweepers utilizing reclaimed water trucks if visible soil materials are carried to adjacent streets.

10. The contractor or builder shall designate a person or persons to monitor the dust control program and to order increased watering, as necessary, to prevent transport of dust offsite.

11. Post a publicly visible sign with the telephone number and person to contact regarding dust complaints. This person shall respond and take corrective action within 24 hours.

12. Extend grading period sufficiently to reduce air quality impacts below a level of significance.

13. The simultaneous disturbance of the site shall be limited to five acres per day.

14. Any vegetative cover to be utilized onsite shall be planted as soon as possible to reduce the disturbed area subject to wind erosion. Irrigation systems required for these plants shall be installed as soon as possible to maintain good ground cover and to minimize wind erosion of the soil.

15. Any on-site stockpiles of debris, dirt or other dusty material shall be covered or watered three times daily.

16. Any site access points within 30 minutes of any visible dirt deposition on any public roadway shall be swept or washed.

17. A high wind response plan shall be formulated for enhanced dust control if winds are forecast to exceed 25 mph in any upcoming 24-hour period.

12-2 cont.

Letter 12 Continued

18. Implement activity management techniques including a) development of a comprehensive construction management plan designed to minimize the number of large construction equipment operating during any given time period; b) scheduling of construction truck trips during non-peak hours to reduce peak hour emissions; c) limitation of the length of construction work-day period; and d) phasing of construction activities.*

19. Develop a trip reduction plan to achieve a 1.5 AVR for construction employees

20. Require high pressure injectors on diesel construction equipment.*

21. Restrict truck operation to "clean" trucks, such as a 2007 or newer model year or 2010 compliant vehicles.*

22. Require the use of CARB certified particulate traps that meet level 3 requirements on all construction equipment.*

23. Utilize only CARB certified equipment for construction activities.*

24. The developer shall require all contractors to turn off all construction equipment and delivery vehicles when not in use and/or idling in excess of 3 minutes.*

25. Restrict engine size of construction equipment to the minimum practical size.*

26. Use electric construction equipment where technically feasible.*

27. Substitute gasoline-powered for diesel-powered construction equipment.*

28. Require use of alternatively fueled construction equipment, using, e.g., compressed natural gas, liquefied natural gas, propane, or biodiesel.*

29. Use methanol-fueled pile drivers.*

30. Install catalytic converters on gasoline-powered equipment.*

31. Require the use of Alternative Diesel Fuels on diesel equipment used. Alternative diesel fuels exist that achieve PM10 and NOx reductions. PuriNOx is an alternative diesel formulation that was verified by CARB on January 31, 2001 as achieving a 14% reduction in NOx and a 63% reduction in PM10 compared to CARB diesel. It can be used in any direct-injection, heavy-duty compression ignition engine and is compatible with existing engines and existing storage, distribution, and vehicle fueling facilities. Operational experience indicates little or no difference in performance and startup time, no discernable operational differences, no increased engine noise, and significantly reduced visible smoke.

12-2 cont.

Letter 12 Continued

32. Electrical powered equipment shall be utilized in-lieu of gasoline-powered engines where technically feasible.*

33. All forklifts shall be electric or natural gas powered.*

34. Suspend use of all construction equipment operations during second stage smog alerts.*

35. Provide temporary traffic controls such as a flag person, during all phases of construction to maintain smooth traffic flow.*

36. Provide dedicated turn lanes for movement of construction trucks and equipment on- and off-site.*

37. Reroute construction trucks away from congested streets and sensitive receptor areas.*

38. Configure construction parking to minimize traffic interference.*

39. Prior to the issuance of a grading and building permit, the applicant shall submit verification that a ridesharing program for the construction crew has been encouraged and will be supported by the contractor via incentives or other inducements.*

40. Minimize construction worker trips by requiring carpooling and providing for lunch onsite. *

41. Provide shuttle service to food service establishments/commercial areas for the construction crew.*

42. Provide shuttle service to transit stations/multimodal centers for the construction crew.*

43. Require the use of Zero-VOC paints, coatings, and solvents.

(* Would reduce impacts to GHGs as well)

12-2 cont.

Operational Emissions

1. The operator of the primary facilities shall become SmartWay Partner.*

2. The Project shall meet SmartWay 1.25 ratings.*

3. The project shall use only freight companies that meet SmartWay 1.25 ratings.*

4. (ALTERNATIVELY from 2,3 above) The operator of the primary facilities shall incorporate requirements or incentives sufficient to achieve at least 20% per year (as a percentage of previous percentage, not total trips) increase in percentage of long haul trips carried by SmartWay carriers until it reaches a minimum of 90% of all long haul trips carried by SmartWay 1.0 or greater carriers. Results, including backup data shall be

Letter 12 Continued

reported to the Planning Department semi-annually.*

5. The operator of the primary facilities shall incorporate requirements or incentives sufficient to achieve a 15% per year (as a percentage of previous percentage, not total trips) increase in percentage of consolidator trips carried by SmartWay carriers until it reaches a minimum of 85% of all consolidator trips carried by SmartWay 1.0 or greater carriers. Results, including backup data shall be reported to the Planning Department semi-annually.*

6. All fleet vehicles shall conform to 2010 air quality standards or better. Results, including backup data shall be reported to the Planning Department semi-annually.*

7. All spaces utilizing refrigerated storage, including restaurants and food or beverage stores, shall provide an electrical hookup for refrigeration units on delivery trucks. Trucks incapable of utilizing the electrical hookup for powering refrigeration units shall be prohibited from accessing the site. All leasing documents shall include these requirements and provide that violation of those provisions will constitute a material breach of the lease that will result in the termination of the lease. Because of the fact that these terms of the lease are designed to benefit the public, the public shall be considered to be a third party beneficiary with standing to enforce the requirements of the lease.* **12-2 cont.**

8. Install catalytic converters on gasoline-powered equipment.*

9. Where diesel powered vehicles are necessary, require the use of alternative diesel fuels. Alternative diesel fuels exist that achieve PM10 and NOx reductions. PuriNOx is an alternative diesel formulation that was verified by CARB on January 31, 2001 as achieving a 14% reduction in NOx and a 63% reduction in PM10 compared to CARB diesel. It can be used in any direct-injection, heavy-duty compression ignition engine and is compatible with existing engines and existing storage, distribution, and vehicle fueling facilities. Operational experience indicates little or no difference in performance and startup time, no discernable operational differences, no increased engine noise, and significantly reduced visible smoke.

10. Electrical powered equipment should be utilized in-lieu of gasoline-powered engines where technically feasible.*

11. Utilize electrical equipment for landscape maintenance.*

12. All forklifts shall be electric or natural gas powered.*

13. Utilize electric yard trucks.*

14. Prohibit idling of trucks for periods exceeding three minutes.*

Letter 12 Continued

15. Provide electrical vehicle ("EV") and compressed natural gas ("CNG") vehicles in vehicle fleets.*

16. Charge reduced or no parking fee for EVs and CNG vehicles.*

17. Install EV charging facilities for a minimum of 10% of all parking spaces.*

18. Install a CNG fueling facility.*

19. Provide preferential parking locations for EVs and CNG vehicles.*

20. Implement parking fee for single-occupancy vehicle commuters.*

21. Plant shade trees in parking lots to provide minimum 50% cover to reduce evaporative emissions from parked vehicles.*

22. Plant at least 50 percent low-ozone forming potential (Low-OFP) trees and shrubs, preferably native, drought-resistant species, to meet city/county landscaping requirements.*

23. Plant Low-OFP, native, drought-resistant, tree and shrub species, 20% in excess of that already required by city or county ordinance. Consider roadside, sidewalk, and driveway shading.*

12-2 cont.

24. Orient 75 percent or more of homes and buildings to face either north or south (within 30 degrees of N/S) and plant trees and shrubs that shed their leaves in winter nearer to these structures to maximize shade to the building during the summer and allow sunlight to strike the building during the winter months.*

25. Provide grass paving, tree shading, or reflective surface for unshaded parking lot areas, driveways, or fire lanes that reduce standard black asphalt paving by 10% or more.*

26. Electrical outlets shall be installed on the exterior walls of all residential and commercial buildings (and perhaps parking lots) to promote the use of electric landscape maintenance equipment.*

27. Prohibit gas powered landscape maintenance equipment within residential, commercial, and mixed-use developments. Require landscape maintenance companies to use battery powered or electric equipment **or** contract only with commercial landscapers who operate with equipment that complies with the most recent California Air Resources Board certification standards, or standards adopted no more than three years prior to date of use or any combination of these two themes.*

28. Provide a complimentary cordless electric lawnmower to each residential buyer.

Letter 12 Continued

29. Implement parking cash-out program for non-driving employees.*
30. Require each user to establish a carpool/vanpool program.*
31. Create a car sharing program within the planned community.*
32. Create a light vehicle network, such as a neighborhood electric vehicle (NEV) system.*
33. Provide preferential parking for carpool/vanpool vehicles.*
34. Provide subsidies or incentives to employees who use public transit or carpooling, including preferential parking.*
35. Provide secure, weather-protected bicycle parking for employees.*
36. Provide direct, safe, attractive pedestrian access from project to transit stops and adjacent development.*
37. Provide direct safe, direct bicycle access to adjacent bicycle routes.*
38. Provide showers and lockers for employees bicycling or walking to work.*
39. Short-term bicycle parking for retail customers and other non-commute trips.*
40. Connect bicycle lanes/paths to city-wide network.*
41. Design and locate buildings to facilitate transit access, e.g., locate building entrances near transit stops, eliminate building setbacks, etc.*
42. Construct transit facilities such as bus turnouts/bus bulbs, benches, shelters, etc.*
43. Provide a display case or kiosk displaying transportation information in a prominent area accessible to employees or residents.
44. Provide shuttle service to food service establishments/commercial areas.*
45. Provide shuttle service to transit stations/multimodal centers.*
46. Provide on-site child care or contribute to off-site child care within walking distance.*
47. Implement a compressed workweek schedule.*
48. Implement home-based telecommunicating program, alternate work schedules, and satellite work centers.*
49. All buildings shall be constructed to LEED Platinum standards.*
50. Design buildings for passive heating and cooling and natural light, including building orientation, proper orientation and placement of windows, overhangs, skylights, etc.*

12-2 cont.

Letter 12 Continued

51. Construct photovoltaic solar or alternative renewable energy sources sufficient to provide 100% of all electrical usage for the entire Project.*
52. Install an ozone destruction catalyst on all air conditioning systems.*
53. Construct renewable energy sources sufficient to offset the equivalent of 100% of all greenhouse gas emissions from mobile sources (internal combustion engines) for the entire Project. *
54. Purchase only green/ renewable power from the electric company.*
55. Install solar water heating systems to generate all hot water requirements.*

(* Would reduce impacts to GHGs as well)

12-2 cont.

Noise

The EIR improperly finds that noise impacts are not significant because the impacts are temporary. The fact that an impact is temporary does not mean the impact is insignificant.

The EIR states that noise impacts are considered significant if (1) the Project increases noise levels by 3 dBA CNEL, and either (2) existing noise levels already exceed the 65 dBA CNEL residential standard, or (3) the Project increases noise levels from below 65 dBA CNEL to above 65 dBA CNEL. The EIR then wrongly concludes that "[a]lthough construction noise would result in a short-term increase greater than 5 dBA over ambient noise levels, construction noise is of short-term duration and will not present any long-term impacts."

Noise impacts are grossly underestimated. Limiting the hours of construction does not mitigate against significant impacts; limited hours merely reduces the number of hours people are exposed to significant impacts. Also, notifying adjacent homeowners of construction does not mitigate impacts (see MM 3.5.4d). At the very minimum, the EIR must require temporary sound barriers to reduce significant impacts.

12-3

The EIR assumes that vehicles will be equipped with mufflers, but does not require mufflers on vehicles.

In making its findings, the EIR falsely states that there are no structures on site and no structures within 25 feet of any area being developed as part of the Project.

Construction noise impacts should be found significant and the EIR must be amended and recirculated.

Noise mitigation is improperly deferred. For instance, MM 3.5.1f states that "[a] final noise study shall be prepared prior to obtaining building permits."

The following mitigation measures must be adopted:

1. Temporary noise barriers must be installed during project construction.

Letter 12 Continued

2. Where technically feasible, utilize only electrical construction equipment
3. During construction, the developer shall require that all contractors turn off all construction equipment and delivery vehicles when not in use and prohibit idling in excess of 3 minutes.
4. Provide a "windows closed" condition requiring a means of mechanical ventilation (e.g. air conditioning) for all buildings.
5. Provide upgraded windows with a minimum Sound Transmission Class (STC) rating of 34 for all buildings, and/or require the installation of double-paned windows.
6. Keep new transportation facilities away from vibration sensitive areas.
7. When dealing with existing transportation facilities, obvious vibration causes, such as pot holes, pavement cracks, differential settlement in bridge approaches or individual pavement slabs, etc., may be eliminated by resurfacing.
8. Require the use of rubberized asphalt for construction of all roadways and parking areas.
9. Maintain quality pavement conditions that are free of bumps, pot holes, pavement cracks, differential settlement in bridge approaches or individual pavement slabs, etc.
10. Require resurfacing of roads.
11. Ban heavy trucks near vibration sensitive uses.
12. Use alternate construction methods and tools to reduce construction vibrations. Examples are predrilling of pile holes, avoiding cracking and seating methods for resurfacing concrete pavements near vibration sensitive areas, using rubber tired as opposed to tracked vehicles, placing haul roads away from vibration sensitive areas.
13. Scheduling construction activities (particularly pile driving) for times when it does not interfere with vibration sensitive operations (e.g. night time).
14. To reduce train vibrations, require the use of continuous, welded rails, vibration damping pads between rails and ties, and extra ballast.

12-3 cont.

Hydrology and Water Quality

The EIR finds that the Project will alter the existing drainage pattern of the site and may impact stormwater runoff rates and volumes compared to existing conditions, yet finds this impact to be less than significant. This is indicative of the conclusory nature of the EIR's findings in general and the lack of support for its findings.

12-4

Letter 12 Continued

Biological Impacts

The EIR admits that the Project could result in the direct mortality or loss of habitat for raptors, but does not provide any mitigation for this potential loss.

MM 3.8.2 states that "[t]he project applicant shall conduct construction and clearing activities outside of the avian nesting season (January 15-August 31), ***where feasible***" [emphasis added]. This measure provides no assurance that impacts to migratory birds will be mitigated.

MM 3.8.4 improperly defers mitigation, as do most of the measures associated with biological impacts. This measure states that "[m]itigation can include on-site restoration or purchase of mitigation credits." MM 3.8.8b allows the applicant to submit plans that illustrate how disturbance to sensitive portions of the site will be avoided.

12-5

The Project must require off-site mitigation within the County in order to preserve similar type and amount of habitat.

Traffic/ Transportation

The traffic impacts analysis establishes that "C" is an acceptable level of service and is the threshold for significance determinations. However, the analysis itself uses level of service "D" to make impact findings. In so doing, the EIR grossly underestimates traffic impacts and fails as an informational document.

Traffic mitigation is uncertain and unenforceable. For instance, MM 3.3.1 states that "[a]ll improvements shall be in place prior to full buildout of the project." This measure improperly defers all improvements which would purportedly reduce significant Project impacts. Traffic impacts remain significant in the interim.

MM 3.3.5 requires the applicant "pay a fair share of the costs" of traffic improvements, but does not identify any fair share program. In fact, a fair share program for these particular improvements may not exist at all. Traffic impacts thus remain significant.

12-6

The following mitigation measures must be incorporated:

1. Improve traffic flow by signal synchronization.
2. Provide preferential parking for carpool/vanpool vehicles.
3. Provide secure, weather-protected bicycle parking for employees.
4. Provide direct, safe bicycle access to adjacent bicycle routes.
5. Provide showers and lockers for employees bicycling or walking to work.
6. Provide shuttle service to food service establishments/commercial areas.

Letter 12 Continued

7. Provide shuttle service to transit stations/multimodal centers.
8. Implement parking fee for single-occupancy vehicle commuters.
9. Implement parking cash-out program for non-driving employees.

12-6 cont.

Public Services and Utilities

The EIR finds that the provision of facilities could cause environmental impacts, yet inexplicably finds these impacts to be less than significant.

The EIR states that "[u]pon review and the necessary permit processing by the Riverside County Fire Department and the Elsinore Valley Municipal Water District, this impact will be less than significant." This is yet another example of improperly deferred mitigation and the conclusory nature of the EIR. There is absolutely no discussion in the EIR of potential problems.

12-7

Cumulative Impacts

The EIR misleads decision makers and the public as to the extent and severity of the Project's cumulative environmental impacts.

The EIR claims the Project will not result in ***any*** significant cumulative impacts, but fails to provide substantial evidence to support this determination. Moreover, the analysis itself is flawed in that it does not identify which, if any, other projects were considered in the cumulative analysis.

12-8

The EIR finds that the Project will result in a 2.7 percent increase in the population of Wildomar and a 2.5 percent increase in the number of homes with the City. This impact is not considered cumulatively.

Alternatives

The EIR fails to consider a reasonable range of Project alternatives and is severely flawed in this respect.

The EIR ***only considers two alternatives***, both of which are essentially "no Project" alternatives. There is no reduced Project alternative. This is extremely concerning because the Project will result in significant impacts.

12-9

The EIR does not consider an environmental superior alternative to the Project. Where there is an environmentally superior alternative that significantly decreases the significant impacts of the Project, then that alternative must be approved rather than the Project if that alternative is feasible, even if the alternative would impede to some degree the attainment of the project objectives, or would be more costly. (PRC§ 21002; *Uphold Our Heritage v. Town of Woodside* (2007) 147 Cal.App.4th 587, 597; CEQA Guidelines § 15126.6(b).)

Letter 12 Continued

Findings

The findings required under CEQA cannot be made with respect to this Project. The findings of fact are conclusory and are not supported by substantial evidence.

Not all significant effects of the Project have been eliminated or substantially lessened, additional mitigation is feasible, and the Project fails to adopt an environmentally superior and feasible alternative.

12-10

Statement of Overriding Considerations

CEQA Guidelines § 15093(b) provides that when the agency approves a project which will result in the occurrence of significant effects which are identified in the final EIR, but are not avoided or substantially lessened, the agency shall state in writing the specific reasons to support its action based on the final EIR and/or other information in the record. The decision to approve a project in spite of significant environment impacts requires the decision-making agency to balance the economic, legal, social, technological, or other benefits of a proposed project against its unavoidable environmental risks. (Guidelines § 15093(a).) However, the Statement of Overriding Considerations shall be supported by ***substantial evidence*** in the record. (*Id.*) In *Sierra Club v. Contra Costa County* (1992) 10 Cal.App.4th 1212, 1222, the court said: "Whereas the [mitigation and feasibility] findings … typically focus on the feasibility of specific proposed alternatives and mitigation measures, the statement of overriding considerations focuses on the larger, more general reasons for approving the project, such as the need to create new jobs, provide housing, generate taxes, and the like."

12-11

Substantial evidence in the record does not support the adoption of a statement of overriding considerations given the immense environmental harm expected with the Project balanced with minimal economic benefits.

A Statement of Overriding Considerations cannot be supported for this Project on the basis of these minimal benefits compared to the Project's enormous environmental effects.

Conclusion

Thank you for your consideration of these comments and the attached material.

Sincerely,

Raymond W. Johnson
JOHNSON & SEDLACK

Letter 12 Continued

Attachments

1. California Air Resources Board. (October 24, 2008) *Preliminary Draft Staff Proposal, Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the California Environmental Quality Act.*

2. California Air Pollution Control Officers Association. (January 2008) *CEQA & Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act.*

3. Bay Area Air Quality Management District. (December 7, 2009) *California Environmental Quality Act Guidelines Update, Proposed Thresholds of Significance.*

4. U.S. Department of Transportation, Federal Highway Administration. (August 2006) *Construction Noise Handbook, Chapter 4.0 Construction Noise Criteria and Descriptors.*

5. U.S. Department of Transportation, Federal Highway Administration. (August 2006) *Construction Noise Handbook, Chapter 9.0 Construction Equipment Noise Levels and Ranges.*

6. U.S. Department of Housing and Urban Development. (March 1985) *The Noise Guidebook.*

7. Suter, Dr. Alice H., Administrative Conference of the United States. (November 1991) *Noise and Its Effects.*

8. Federal Interagency Committee on Urban Noise. (June 1980) *Guidelines for Considering Noise in Land Use Planning and Control.*

Letter 12 Continued

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26785 Camino Seco
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(951) 775-1912 Cellular

Johnson & Sedlack, an Environmental Law firm representing plaintiff environmental groups in environmental law litigation, primarily CEQA.

City Planning:

Current Planning

- Two years principal planner, Lenexa, Kansas (consulting)
- Two and one half years principal planner, Lee's Summit, Missouri
- One year North Desert Regional Team, San Bernardino County
- Thirty years subdivision design: residential, commercial and industrial
- Thirty years as applicants representative in various jurisdictions in: Missouri, Texas, Florida, Georgia, Illinois, Wisconsin, Kansas and California
- Twelve years as applicants representative in the telecommunications field

General Plan

- Developed a policy oriented Comprehensive Plan for the City of Lenexa, Kansas.
- Updated Comprehensive Plan for the City of Lee's Summit, Missouri.
- Created innovative zoning ordinance for Lenexa, Kansas.
- Developed Draft Hillside Development Standards, San Bernardino County, CA.
- Developed Draft Grading Standards, San Bernardino County.
- Developed Draft Fiscal Impact Analysis, San Bernardino County

Environmental Analysis

- Two years, Environmental Team, San Bernardino County
  - Review and supervision of preparation of EIR's and joint EIR/EIS's
  - Preparation of Negative Declarations
  - Environmental review of proposed projects
- Eighteen years as an environmental consultant reviewing environmental documentation for plaintiffs in CEQA and NEPA litigation

Letter 12 Continued

Representation:

- Represented various clients in litigation primarily in the fields of Environmental and Election law. Clients include:
  - Sierra Club
  - San Bernardino Valley Audubon Society
  - Sea & Sage Audubon Society
  - San Bernardino County Audubon Society
  - Center for Community Action and Environmental Justice
  - Endangered Habitats League
  - Rural Canyons Conservation Fund
  - California Native Plant Society
  - California Oak Foundation
  - Citizens for Responsible Growth in San Marcos
  - Union for a River Greenbelt Environment
  - Citizens to Enforce CEQA
  - Friends of Riverside's Hills
  - De Luz 2000
  - Save Walker Basin
  - Elsinore Murrieta Anza Resource Conservation District

Education:

- B. A. Economics and Political Science, Kansas State University 1970
- Masters of Community and Regional Planning, Kansas State University, 1974
- Additional graduate studies in Economics at the University of Missouri at Kansas City
- J.D. University of La Verne. 1997 Member, Law Review, Deans List, Class Valedictorian, Member Law Review, Published, Journal of Juvenile Law

Professional Associations:

- Member, American Planning Association
- Member, American Institute of Certified Planners
- Member, Association of Environmental Professionals
- Member, U.S. Green Building Council, LEED GA

Letter 12 Continued

Johnson & Sedlack, Attorneys at Law
26785 Camino Seco
Temecula, CA 92590
(951) 506-9925
12/97- Present

Principal in the environmental law firm of Johnson & Sedlack. Primary areas of practice are environmental and election law. Have provided representation to the Sierra Club, Audubon Society, AT&T Wireless, Endangered Habitats League, Center for Community Action and Environmental Justice, California Native Plant Society and numerous local environmental groups. Primary practice is writ of mandate under the California Environmental Quality Act.

Planning-Environmental Solutions
26785 Camino Seco
Temecula, CA 92590
(909) 506-9825
8/94- Present

Served as applicant's representative for planning issues to the telecommunications industry. Secured government entitlements for cell sites. Provided applicant's representative services to private developers of residential projects. Provided design services for private residential development projects. Provided project management of all technical consultants on private developments including traffic, geotechnical, survey, engineering, environmental, hydrogeological, hydrologic, landscape architectural, golf course design and fire consultants.

San Bernardino County Planning Department
Environmental Team
385 N. Arrowhead
San Bernardino, CA 92415
(909) 387-4099
6/91-8/94

Responsible for coordination of production of EIR's and joint EIR/EIS's for numerous projects in the county. Prepared environmental documents for numerous projects within the county. Prepared environmental determinations and environmental review for projects within the county.

San Bernardino County Planning Department
General Plan Team
385 N. Arrowhead
San Bernardino, CA 92415
(909) 387-4099
6/91-6/92

Created draft grading ordinance, hillside development standards, water efficient landscaping ordinance, multi-family development standards, revised planned development section and fiscal impact analysis. Completed land use plans and general plan amendment for approximately 250 square miles. Prepared proposal for specific plan for the Oak Hills community.

Letter 12 Continued

San Bernardino County Planning Department
North Desert Regional Planning Team
15505 Civic 6/90-6/91
Victorville, CA
(619) 243-8245

Worked on regional team. Reviewed general plan amendments, tentative tracts, parcel maps and conditional use permits. Prepared CEQA documents for projects.

Broadmoor Associates/Johnson Consulting
229 NW Blue Parkway
Lee's Summit, MO 64063
(816) 525-6640 2/86-6/90

Sold and leased commercial and industrial properties. Designed and developed an executive office park and an industrial park in Lee's Summit, Mo. Designed two additional industrial parks and residential subdivisions. Prepared study to determine target industries for the industrial parks. Prepared applications for tax increment financing district and grants under Economic Development Action Grant program. Prepared input/output analysis of proposed race track Provided conceptual design of 800 acre mixed use development.

Shepherd Realty Co.
Lee's Summit, MO 6/84-2-86

Sold and leased commercial and industrial properties. Performed investment analysis on properties. Provided planning consulting in subdivision design and rezoning.

Contemporary Concepts Inc.
Lee's Summit, MO 9/78-5/84
Owner

Designed and developed residential subdivision in Lee's Summit, Mo. Supervised all construction trades involved in the development process and the building of homes.

Environmental Design Association
Lee's Summit, Mo.
Project Coordinator 6/77-9/78

Was responsible for site design and preliminary building design for retirement villages in Missouri, Texas and Florida. Was responsible for preparing feasibility studies of possible conversion projects. Was in charge of working with local governments on zoning issues and any problems that might arise with projects. Coordinated work of local architects on projects. Worked with marketing staff regarding design changes needed or contemplated.

Letter 12 Continued

City of Lee's Summit, MO
220 SW Main
Lee's Summit, MO 64063
Community Development Director 4/75-6/77

Supervised Community Development Dept. staff. Responsible for preparation of departmental budget and C.D.B.G. budget. Administered Community Development Block Grant program. Developed initial Downtown redevelopment plan with funding from block grant funds. Served as a member of the Lee's Summit Economic Development Committee and provided staff support to them. Prepared study of available industrial sites within the City of Lee's Summit. In charge of all planning and zoning matters for the city including comprehensive plan.

Howard Needles Tammen & Bergendoff
9200 Ward Parkway
Kansas City, MO 64114
(816) 333-4800 5/73-4/75
Economist/Planner

Responsible for conducting economic and planning studies for Public and private sector clients. Consulting City Planner for Lenexa, KS.

Conducted environmental impact study on maintaining varying channel depth of the Columbia River including an input/output analysis. Environmental impact studies of dredging the Mississippi River. Worked on the Johnson County Industrial Airport industrial park master plan including a study on the demand for industrial land and the development of target industries based upon location analysis. Worked on various airport master plans. Developed policy oriented comprehensive plan for the City of Lenexa, KS. Developed innovative zoning ordinance heavily dependent upon performance standards for the City of Lenexa, KS.

*** Please refer to Attachment E for Letter 12 Attachments.**

Letter 12: Raymond Johnson, Johnson & Sedlack, Attorneys at Law

Responses

12-1 The commenter opines on the purpose of CEQA and states that the EIR fails as an informational document because it does not adequately describe the changes to various issue areas (i.e., traffic, temporary construction noise, drainage, water supply, and sewage disposal) associated with the proposed project. Additionally, the commenter states that the proposed project includes vague, uncertain, and unenforceable mitigation measures and some mitigation measures are improperly deferred. The commenter also states that all feasible mitigation that can substantially lessen the environmental impacts of a project must be adopted.

The commenter has received constructive notice of this DEIR and has submitted two timely and detailed responses. (See Letter 16 as well, submitted at the continued hearing.)

The commenter lists requirements of CEQA without specific application to this project. A response is legally adequate if it provides a good faith analysis and contains a level of detail that matches the level of detail in the comment (*Pfeiffer v. City of Sunnyvale* (2011) 200 Cal. App. 4th 1552, 1568). Responses to comments need not address a list of general suggestions for mitigating an environmental impact that are not concrete or specific to the project (*Santa Clarita Org. for Planning the Env't v. City of Santa Clarita* (2011) 197 Cal. App. 4th 1042).

The CEQA Guidelines do not limit the lead agency's ability to reject comments that are not focused as recommended, especially duplicative comments and those which lack substance because they are transmissions of technical articles with little or no connection to the project (14 CCR Section 15204(e); *Environmental Protection Info. Ctr. v. CA Dept. of Forestry & Fire Protection* (2008) 44 Cal. 4th 459).

In an attempt to prove his point, the commenter has listed a large number of general mitigation measures that are not specifically related to this project. In general, mitigation measures must be designed to minimize significant environmental impacts, but need not necessarily eliminate them (PRC Section 21100(b)(3); 14 CCR Section 15126.4(a)(1)).

An agency need not respond to all comments on a draft EIR, but only to the significant environmental issues presented (14 CCR Sections 15088(c), 15132(d), 15204(a); *Citizens for E. Shore Parks v. State Lands Comm'n* (2011) 202 Cal. App. 4th 549). A lead agency is not required to conduct every test or perform all research, studies, or experimentation at the commenter's request (PRC Section 21091(d)(2)(B); 14 CCR Section 15204(a)). An EIR need not provide all information reviewers request, as long as the report, when looked at as a whole, reflects a good faith effort at full disclosure (14 CCR Section 15204(a)). Furthermore, a last-minute submission of voluminous documents accompanied by more general objections to a project does not adequately serve to "fairly present" issues to an agency that should be addressed in an EIR (*Citizens for Responsible Equitable Environmental Development v. City of San Diego* (2011) 196 Cal. App. 4th 515, 521–522). Nor have mitigation measures been improperly deferred here. See also the response to Letter 11, comments 4 and 5.

Finally, as explained in the response to Letter 6, comment 2, courts have held that an EIR is required to analyze only the project's impacts on the environment, not the environment's impacts on the project.

12-2 The commenter states that although a maximum disturbance area of 5 acres is assumed during construction grading, the EIR air quality analysis does not put a limitation on the amount of disturbance, thereby resulting in significant air quality effects under CEQA. The commenter also states that mitigation measure MM 3.4.2b does not require the applicant to enforce the sign postage requirements. The commenter requests that the mitigation measures listed in the letter for air quality (construction and operational phases) to be incorporated into the EIR.

Including enforcement mechanisms in a mitigation measure is not required. Since such mitigation measures are conditions of project approval, they are monitored through City processes which monitor development, such as inspections. Failure to implement mitigation measures may result in denial of approvals or permits or permit revocation. Ongoing enforcement occurs through normal City processes such as administrative penalties and procedures and coordination with other agencies that have their own statutory and regulatory enforcement powers.

As set out in Section 3.4, Air Quality, of the DEIR, there is a limitation that no more than 5 acres per day will be graded. This limitation arises from the air quality impact modeling process that differentiates between active grading, which involves equipment moving soil, and exposed area. While it is possible to have more than 5 acres of disturbed area, for a development project, the 5 acres of active grading activity for any given day is used as the model default for analysis and is a direct function of how much soil movement can occur based on the equipment inventory populated by the model defaults for grading activity. Lastly, the purpose of the 5-acre disturbance area for purposes of localized significant thresholds in the air quality analysis focuses primarily on grading activity. Despite the commenter's list of possible mitigations, the air quality discussion and mitigations in Section 3.4, Air Quality, of the DEIR will reduce impacts to insignificance. No additional mitigation is required and no statement of overriding considerations is necessary.

12-3 The commenter states that temporary construction noise impacts were identified; however, they were improperly identified as less than significant. The commenter also states that the noise impacts are grossly underestimated. For example, limiting the hours of exposure and notifying adjacent homeowners do not properly mitigate significant impacts. Additionally, the commenter states the EIR falsely states that there are no structures on-site and no structures within 25 feet of any area being developed. Further, the commenter states that noise mitigation (i.e., MM 3.5.1f) is improperly deferred. The commenter requests that the aforementioned noise impacts be found significant and the noise mitigation measures listed in the letter be incorporated into the EIR.

The City of Wildomar Noise Ordinance specifically exempts construction activity that occurs consistent with Section 9.48.020 of the Municipal Code. Section 9.48.020(I) reads:

I. Private construction projects located within one-quarter of a mile from an inhabited dwelling, provided that:

1. Construction does not occur between the hours of 6:00 p.m. and 6:00 a.m. during the months of June through September, and

2. Construction does not occur between the hours of 6:00 p.m. and 7:00 a.m. during the months of October through May.

Mitigation measure MM 3.5.4a on page 3.5-30 of the Draft EIR requires that construction only occur consistent with the City's Noise Ordinance. As construction is temporary and the noise levels associated with the Noise Ordinance do not apply provided the activity occurs at the times in the ordinance, this impact is considered less than significant and requires no mitigation.

Mitigation measure MM 3.5.1f, on page 3.5-28 of the Draft EIR, requires that a final noise study be provided for some of the lots identified in the Draft EIR. The intent of the final noise study is to ensure that the noise mitigation provided in mitigation measures MM 3.5.1a through 3.5.1e meet the attenuation assumed in the noise analysis included as Appendix 3.5-1 and 3.5-2 of the Draft EIR. The mitigation measures included in the EIR are based on mathematical modeling of the project. Mitigation measure MM 3.5.1f will provide evidence that the measures met the assumptions in the model and if they do not, will ensure proper attenuation is achieved. As mitigation is required in the EIR for noise attenuation, this is not deferral of mitigation.

The commenter has expressed an opinion that noise impacts be considered significant and unavoidable, but provides no evidence to support this assertion. As described in the EIR, this impact is less than significant with implementation of mitigation measures.

12-4 The commenter states that the proposed project will alter the existing drainage pattern of the site and may impact stormwater runoff rates and volumes. As such, the commenter states that impact determination should not be "less than significant."

See response to Letter 14.

12-5 The commenter states the EIR does not properly identify mitigation measures if the proposed project results in the direct mortality of or loss of habitat for raptors. The commenter also states mitigation measure MM 3.8.2 provides no assurance that impacts to migratory birds will be mitigated and mitigation measure MM 3.8.4 improperly defers mitigation. The commenter requests that the proposed project require off-site mitigation with the County in order to preserve similar type and amount of habitat associated with biological resources.

On page 3.8-25 of the Draft EIR mitigation measure 3.8.2 requires the project to conduct a pre-construction survey for raptors. In response to the comment, the mitigation measure can be made more explicit as shown below:

MM 3.8.2: The project applicant shall conduct construction and/or clearing activities outside of the avian nesting season (February 15–August 31), where feasible. <u>However, if project construction and/or clearing activities are necessary within, or within proximity to, vegetated areas during the nesting bird season (February 15–August 31), the following is required:</u>

<u>Prior to construction activities during the avian nesting season (February 15–August 31), a qualified biologist shall conduct pre-construction nesting bird surveys pursuant to the Migratory Bird Treaty Act (MBTA) in the adjacent off-site and/or on-site vegetated areas for nesting birds and/or raptors. The survey shall begin not more than three days prior to the</u>

beginning of grading activities. No activities which would result in the take of active nests or any other violation of the MBTA shall be allowed. If project construction and/or clearing activities are not completed prior to the nesting bird season, and any nesting birds are determined present, appropriate avoidance buffers (generally 100–300 feet from an active nest, and up to 500 feet for raptors) will be imposed and monitored by a qualified biologist to ensure no violation of the MBTA occurs, and the appropriate resource agencies will be contacted if deemed necessary by the project biologist. Project activities may commence within avoidance buffers based only on recommendations by the project biologist to ensure compliance with the MBTA.~~f clearing and/or construction activities occur during nesting season, then preconstruction surveys for nesting raptors and migratory birds shall be conducted by a qualified biologist, up to 14 days before initiation of construction activities. The qualified biologist shall survey the construction zone and a 250-foot radius surrounding the construction zone to determine whether the activities taking place have the potential to disturb or otherwise harm nesting birds.~~

To address mitigation measure MM 3.8.4, subsequent to the release of the DEIR, a Determination of Biologically Equivalent or Superior Preservation (DBESP) was prepared for the project submitted by the City to the Riverside County Planning Department, Environmental Programs Division and in turn was circulated to federal and state resource agencies. The DBESP is included as Attachment A to this Final EIR and includes both depiction and impact analysis of MSHCP-defined riparian and riverine areas. The Final EIR includes as Attachment A the DBESP, which provides the mapping, descriptions, discussions, and findings required to demonstrate consistency with Section 6.1.2 of the MSHCP. The DBESP does not defer mitigation as explained in response 11-5.

12-6 The commenter states that in the Traffic/Transportation chapter, LOS C is considered the threshold for determining impacts to traffic. However, the analysis uses LOS D as the threshold to determine impacts and therefore traffic impacts are underestimated. Additionally, the commenter states that traffic mitigation is uncertain and unenforceable (e.g., MM 3.3.1 improperly defers all improvements and impacts remain significant; MM 3.3.5 does not identify a fair share program and thus impacts remain significant). The commenter requests that the mitigation measures for traffic/transportation listed in the letter be incorporated into the EIR.

As each jurisdiction adopts its own levels of service, different levels of service are used to determine traffic impacts, depending on the jurisdiction of the intersection being analyzed. The Draft EIR explains the different levels of service beginning on page 3.3-14. Traffic impacts are therefore assessed appropriately for each jurisdiction. Mitigation measure MM 3.3.1 requires that all improvements be installed prior to filing of a final map (see page 3.3-55 of the Draft EIR). Because a final map is required before the properties can be sold individually, all of the improvements listed in the mitigation measure will be in place prior to the realization of the traffic impact associated with the proposed project.

The Scott Road interchange improvements are funded in part by a community facilities district (CF 05-08) and the Transportation Uniform Mitigation Fee (TUMF). While subject to the TUMF, the proposed project is not within the boundaries of CF 05-08, which was established to pay for a portion of the interchange. The traffic study demonstrates that the project does not directly impact the Scott Road/I-215 interchange (see the Existing Plus Project Scenario shown in Table 3.3-9 on page 3.3-46 of the DEIR). This table shows that the

Existing Plus Project Scenario results in level of service (LOS) C at the interchange of Scott Road and I-215. The project is part of the overall cumulative background growth conservatively assumed for Opening Year 2015 conditions. It is this conservative cumulative growth forecast that causes the existing interchange at Scott Road to fail as shown in Table 3.3-10 on page 3.3-48 of the Draft EIR. Table 3.3-10 shows the opening year level of service if all of the projects shown in Table 3.3-8 on page 3.3-23 of the Draft EIR are constructed and occupied. As shown, 7 of the projects listed in Table 3.3-8 of the Draft EIR are located within the City of Wildomar and the remaining 24 projects are in the City of Menifee.

The future interchange design for Scott Road/I-215 is approved and in process with the County, Caltrans, and the City of Menifee and is designed to accommodate the anticipated traffic growth. This project, along with others assumed to be constructed and contributing traffic to the Scott Road interchange as part of the Opening Year 2015 scenario, will mitigate their proportionate share of this cumulative impact through their payment of fees—whether it be to TUMF (regional component), DIF, CFD, or other fees as determined to match the pro-rata share requirements indicated in mitigation measure MM 3.3.5 on page 3.3-65 of the Draft EIR. Mitigation measure MM 3.3.5 states, "The project applicant shall be required to implement, or pay a fair share of costs of the implementation of…" The intent of the mitigation is either to ensure that the improvements occur or to ensure contributions to an existing fee program. The project itself does not trigger the need for construction of the improvements listed in mitigation measure MM 3.3.5.

With the collection of these fees, the funds would be in place to complete construction of the Scott Road/I-215 interchange (see response Letter 5). As the short-term impacts of the project do not result in a significant impact at this interchange, and only the full buildout of the cumulative projects results in a significant impact at the interchange, payment of a pro-rata share of the cost of improvements is considered appropriate mitigation.

In regard to assurance of mitigation, the required roadway improvements must be constructed concurrent with the improvements for the Final Map. As noted in the EIR, the realignment of Bundy Canyon Road will be in the first phase of development. The other improvements will occur as portions of the project are constructed. As it is the project itself that is generating the impacts leading to the improvement, it is appropriate that the timing of the improvements be consistent with construction.

The commenter is incorrect that the listed mitigation measures must be included in the EIR or as conditions of approval of the project. The mitigation measures listed in the Draft EIR beginning on page 3.3-55, and based on the Traffic Impact Analysis for the project included as Appendices 3.3-1 and 3.3-2, have reduced the traffic impacts to a less than significant level. The commenter has provided no additional analysis or evidence to suggest that further mitigation is necessary.

12-7 The commenter alleges the EIR determined that provision of facilities could cause environmental impacts; however, associated impacts to public services and utilities were found to be less than significant. Additionally, the commenter states that a mitigation measure to review necessary permits by the Riverside County Fire Department (RCFD) and the EVMWD improperly defers mitigation.

The commenter is referring to two different impact analyses criteria where neither discussion resulted in required mitigation. A less than significant impact determination

was concluded for the discussion related to an increase in demand for fire protection and emergency medical services (Impact 3.10.1a – Standard of Significance 1). This determination was based on compliance with the safety requirements outlined in General Plan Policy S-5-1 in addition to the resultant incremental changes in population and housing the project would generate.

Impact 3.10.1c analyzed adequate fire flow; based on analysis, a less than significant determination was made. Part of compliance includes review of necessary permits by the RCFD and the EVMWD during the building permit and site review processes to determine fire hydrant sizing and placement. Approval of the proposed project site plan for fire hydrant sizing and placement is contingent upon review by the RCFD and the EVMWD. In the analysis, it was determined that the additional need for water supply generated by the proposed project would not result in the creation of additional water supply infrastructure. Therefore, a less than significant determination was made and did not require any mitigation.

12-8 The commenter states that the EIR concludes the proposed project would not contribute to cumulative impacts and the EIR fails to provide evidence to support this determination. The commenter also states that the EIR fails to evaluate the potential increase in population and housing units.

The cumulative impacts section summarizes the cumulative discussions in each of the EIR sections. See response 9-1. The increase in housing units and population associated with the proposed project is discussed in Section 3.2, Population/Housing/Employment, of the Draft EIR. As noted in Table 3.2-8 on page 3.2-7 of the Draft EIR, approximately 895 residents could be anticipated in the city at full buildout and occupancy of the proposed project. Table 3.2-8 also shows the existing land use designation for The Farm Specific Plan would allow a population of 801 new residents, resulting in a net change of 94 residents between the existing permitted condition and the proposed project. While the 895 new residents represent a 2.78 percent increase in the current population of 32,719, the percentage change between the existing Farm Specific Plan and the proposed project is 0.29 percent. This figure is compared to the existing Farm Specific Plan that is part of the City of Wildomar General Plan. These figures also assume that the entire project was constructed and occupied as a single phase and that all residents were new to Wildomar and so therefore constitute the greatest increase in current population. Even with this assumption, the potential of a 2.78 percent increase in the population was not considered a significant impact in the Draft EIR.

While the population increase is linked directly to the increase in the number of housing units, this change is similarly minimal when compared to The Farm Specific Plan. The existing Specific Plan would allow the construction of 246 housing units, while the proposed project allows for 275. The difference of 29 housing units represents less than the average annual growth for the city over the previous three years as shown in Table 3.2-3 on page 3.2-3 of the Draft EIR.

12-9 The commenter states that the EIR fails to consider a reasonable range of project alternatives and the ones considered in the EIR are both essentially "no project" alternatives. The commenter requests a reasonable range of alternatives be analyzed.

The alternatives analysis in an EIR must be need discuss only a reasonable range of feasible alternatives (14 CCR Section 15126.6(a), (c)). An EIR that discusses a reasonable range of alternatives is not deficient simply because it excludes other potential

alternatives from its analysis (*City of Maywood v. Los Angeles Unified Sch. Dist.* (2012) 208 Cal. App. 4th 362). The City has determined that the EIR presents a reasonable range of alternatives and has explained the reasoning for its selection of alternatives on pages 5.0-1 through 5.0-2 of the DEIR.

12-10 The commenter explains that the findings of fact are conclusory and are not supported by substantial evidence. Additionally, the commenter states that not all significant effects associated with the proposed project have been eliminated or substantially lessened, additional mitigation is feasible, and the proposed project fails to adopt an environmentally superior alternative.

This comment expresses the opinion of the commenter without citation of specific evidence and repeats earlier comments.

12-11 The commenter explains that a Statement of Overriding Considerations cannot be supported for this project based on the minimal economic benefits in comparison with the project's enormous environmental effects.

There is no Statement of Overriding Considerations in the Draft EIR.

Letter 13

Matthew Bassi

From: Adelson, Mark@Waterboards <Mark.Adelson@waterboards.ca.gov>
Sent: Wednesday, March 27, 2013 4:27 PM
To: Matthew Bassi
Cc: Robertson, Glenn@Waterboards; Amir Morales; 'James R. Bach'; Larry R. Markham
Subject: Oak Creek Canyon development – City Council Special Meeting Agenda 03-27-13

Matthew –

Today, Glenn Robertson of this office and I met with and James Bach, with MDMG, and Amir Morales, with PCR, both representatives of the Oak Creek Canyon development project. Mr. Bach requested the meeting so that project representatives could discuss the project's DEIR with Santa Ana Regional Board staff. As a result of an oversight, apparently the City's, the DEIR had not been circulated to this office for review and comments, a fact that Staff became aware of yesterday.

The meeting also provided Mr. Bach with the opportunity to request that Board staff consider withdrawing the letter that we had sent to the City yesterday, in which we requested recirculation of the DEIR for the project so that we, and presumably others, would have an opportunity to comment on it. Staff made this request because we had only just been made aware of the project and its potentially significant impact on aquatic resources that are within the Santa Ana RWQCB's jurisdiction, and because we had been advised that important information necessary to fully consider the project's environmental impacts was available but had not been included in the DEIR. **13-1**

Mr. Bach offered to make a request of the Wildomar City Council to continue consideration of the project's DEIR, to give Board staff, and any other interested parties, an opportunity to review and comment on the DEIR. We now understand that Mr. Bach discussed this matter with you, and that the City Council's consideration of the project's DEIR will likely be rescheduled for April 24, 2013. Therefore, our request for recirculation of the DEIR is withdrawn.

Regards,

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Letter 13: Santa Ana Regional Water Quality Control Board

Response

13-1 The commenter states that the initial request by the Santa Ana Regional Water Quality Control Board to recirculate the DEIR has been withdrawn.

Letter 14

Trent Thompson
Christopher Nelson
Linda DeVore
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VIA PERSONAL DELIVERY

March 27, 2013

City of Wildomar, City Council
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

Re: Objection to the Environmental Impact Report (EIR) for
Planning Application No. 11-0261 – Oak Creek Canyon Residential Project

Dear Council Members:

This firm represents Penny, Danny, & Andrea Umbrell who own property adjacent to the north boundary of the Oak Creek Canyon Project. While the Umbrells are not opposed to the Project in and of itself, they strenuously object to the plan for handling storm water outflows from the Project.

Specifically, the Project proposes to increase the sizes of the culverts under Bundy Canyon Road. In times of heavy rains, this increase will cause intensified flooding of the properties in the immediate downstream vicinity of the Project, including the Umbrell's. Both the Draft EIR and the Final EIR seem unable to grasp (or intentionally conceal) the concept that larger flows in one location will cause flooding in downstream locations that lack the capacity to handle the higher flows. **14-1**

In order to provide you with some perspective, I'm attaching as Exhibit A an aerial photo of the area surrounding the Umbrell's property, showing its relation to the Project land. You will notice on the photo the following items:

Cottonwood Canyon Creek is the blue line at the right (east) of the map.
The unnamed drainage way crossing the Umbrell's property is the blue line in the approximate middle of the map.

Point 1: 42-inch culvert under Bundy Canyon Rd. (noted in EIR as 36")
See Exhibits B & C **14-2**

Point 2: 18-inch clogged culvert under Bundy Canyon Rd.
See Exhibit D

Point 3: 42- inch culvert under Bundy Canyon Rd. at the crossing of Cottonwood Canyon Creek. See Exhibits E (north side) & F (south side)

Letter 14 Continued

Point 4: Collapsed 42" culvert where Cottonwood Canyon Creek has been filled in to allow passage of Club Drive
See Exhibits G, H (upstream side), I (roadway view), & J (downstream side)

Point 5: 42" culvert (just off the map) where Cottonwood Canyon Creek has been filled in to allow passage of Walker Street
See Exhibit K

Point 6: Choke point where rough fill is topped with plywood "footbridge"
See Exhibits L & M ("roadway" view)

The flow pattern is from south to north, or from the bottom to the top of the map. Of course, the Oak Creek Project property is to the bottom (south) of Bundy Canyon Rd.

The photos attached as exhibits B-M were taken on March 25, 2013.

14-2 cont.

In assessing the potential storm water runoff from the Project, the Environmental Impact Report (EIR) focuses only on the outflow rates at the Project boundary. In doing so, the EIR seems to assume that the runoff will somehow magically disappear as it crosses under Bundy Canyon Road. Of course, that won't happen. Therefore, to fully assess the environmental impact of the Project, the City must also consider the impact of the Project downstream of the Project boundary.

14-3

As will be explained below, even if the supposed mitigation factors are considered, the Project as planned will actually result in an increase in storm runoff across the Umbrell's and other downstream residents' property, as well as in the Cottonwood Canyon Creek bed itself. These increases could have catastrophic or even fatal consequences. Therefore, I and the Umbrells strongly urge the Council to reject the plan until proper storm runoff capacity is established – not only for the Project's land, but also for the downstream owners and residents.

14-4

The key factor is the planned larger culverts under Bundy Canyon Road. The culverts will increase the storm flow rates from the Project by over 700%.

Current Actual Flow Rates From the Project Property

The Council should first understand the current actual flow rates of water exiting the Project land – not merely the hypothetical rates posed by the developer in a 100-year flood situation within the Project boundaries.

As seen on **Exhibit A**, there are currently three relevant drainage culverts running under Bundy Canyon Road at points 1, 2, and 3. Their respective diameters of 42" (not 36" as stated in the EIR), 18", and 42" set the current flow rates for all properties downstream of the Project. The impact of any change in the sizes of the culverts and the attendant flow rates must be addressed in the EIR. They are not, and so will be discussed here.

14-5

Letter 14 Continued

Point 1: Unnamed Drainage Way Across Umbrell Property

The culvert at Point 1 on **Exhibit A**, is a 42-inch culvert that is currently ¾ filled with accumulated dirt and debris. See **Exhibits B&C**. The Project's own engineer Joe Castaneda stated in his testimony to the Planning Board on March 7, 2013 that a 36-inch culvert (based on the EIR) has a carrying capacity of approximately 100 cubic feet per second (cfs). This is assuming an empty, clear culvert, which this is not. When one considers that this particular culvert is ¾ clogged, it can be readily seen that the actual flow rate can be nowhere near the100 cfs cited by Mr. Castaneda, but more likely 25 cfs.[1]

14-6

The 683 cfs pre-project flow stated by the Project engineer is the rate only before the Bundy Canyon Road crossing, not the rate exiting the crossing and affecting the downstream properties. Thus, as far as the downstream property owners are impacted, this 25 cfs is the real storm flow rate from the Project property. This rate must therefore be the starting figure to determine the Project's impact.

Point 2: 18" Culvert on to Umbrell's Property

There is currently an 18" culvert under Bundy Canyon Road. That culvert also is heavily clogged, as is evidenced by **Exhibit D**. This culvert has an approximate flow capacity of 15 cfs.

14-7

Point 3: Cottonwood Canyon Creek

Currently at Cottonwood Canyon Creek, there is a 42" culvert under Bundy Canyon Road. See **Exhibits E & F.** Such a culvert would allow an approximate storm flow of 150 cfs or possibly less.

14-8

Total Runoff Flow Rates.

The combined current flow rates at Points 1, 2, and 3 total approximately 190 cfs. This of course varies with the amount of storm runoff, with lesser storms producing a lower flow rate. However, it is a reasonably accurate figure in terms of maximum carrying capacity.

It should also be noted that, to the Umbrell's knowledge, no storm waters have overtopped Bundy Canyon road at Points 1 and 2 in at least 30 years. Therefore, Bundy Canyon Road is acting as a levee, and the Project land as a retention and settlement basin which releases the storm waters at a maximum rate of 190 cfs for all three outlets combined.

14-9

These approximate rates of 25, 15, and150 cfs are the flow rates that the downstream property owners would currently experience in a significant storm event. Therefore they are the proper starting points for the calculus in determining the environmental impact of the Project, not the flow rates immediately upstream of Bundy Canyon Road.

[1] Thanks and recognition are given to Charles, O'Neil, Registered Civil Engineer #14923, for providing the flow rates (based on the EIR information) referenced in this letter. Mr. O'Neal has a Master's of Science Degree from U.C. Berkley and has over 55 years' experience in public works engineering and construction.

Letter 14 Continued

Current Downstream Conditions

A full impact report of storm runoff must not merely start at the proper place (the current flow rates coming out from under Bundy Canyon Road), but it must also determine whether or not there is sufficient downstream capacity to handle the increased runoff. As explained below, that capacity does not exist for the Project.

Downstream From Point 1: Drainage Way Across Umbrell's Property

If the developer, his engineer, or anyone from the Planning department had taken even a little time to examine drainage way downstream of the Project and the Umbrell's property, he or she would not see a clear, free-flowing streambed, ready to handle a 500 cfs floodwater flow, as the EIR seems to blindly assume. Instead, any person inspecting the drainage way would find a tangled, clogged junkyard. See **Exhibits K, L, M, N.**

The majority of this drainage area is filled with thick, natural vegetation which severely restricts its carrying capacity. The drainage way has been used for decades as a dumping ground for every conceivable sort of refuse, from soda bottles to cars, tires, and large appliances. Some persons have constructed retaining walls along the drainage way, restricting flow by narrowing its width. Other persons have used various debris, junk, and dirt to essentially fill in the drainage and construct a plywood foot bridge over the drainage way (Point 6 and **Exhibits L & M**) effectively damming the flow. **14-10**

While the Umbrells have cleared out their section of the drainage area, providing a clear, unobstructed path for any storm runoff, the remainder is still a "jungle junkyard" completely incapable of handling the proposed increased flows from the Project.

The EIR says that the 36" culvert at Point A on the map is currently insufficient to adequately manage the storm waters. This is a culvert under an engineered, well-built road. How much less could a small, clogged culvert in a haphazard, dirt-filled road (Point 6) handle the runoff? It already causes flooding at a 25 cfs flow, so there's no way it can handle the 500 cfs that the Project intends.

Downstream From Point 2: Unchannelled Drainage Across Umbrell's Property

At Point 2 of the map, there is no substantial reason to increase the culvert size because the water literally has nowhere to go. It appears chosen as a Project discharge point only because of the existing culvert under Bundy Canyon Road. It is not on a hydrologic line, nor is there any discernible streambed to channel the water or basin to catch it. Instead, after crossing under Bundy Canyon Road, it enters the Umbrell's property and simply spreads out as it flows towards Club Drive. The water then flows down Club Drive until it flows into the unnamed drainage way at approximately Point 6 of the map. See dark blue line on **Exhibit P**. **14-11**

Increased unchanneled flow from this culvert will result in gully erosion, not only across the Umbrell's and adjoining property but also down Club Drive, a public road. Club Drive is unpaved and has no curbs or gutters to channel the flood waters. This erosion of Club Drive will

Letter 14 Continued

then create costs for the City in terms of repeated road repair for Club Drive, as well as periodically denying emergency fire and police services prompt access to the residents in the vicinity.

Downstream From Point 3: Cottonwood Canyon Creek

Downstream of Bundy Canyon Road, Cottonwood Canyon Creek has been filled in and raised for the Club Drive roadway crossing, but was provided a 42" culvert to facilitate water flow. See Map Point 4 and **Exhibits G-J**. This 42" culvert, if it were open, is equal to the 42" culvert upstream at Bundy Canyon Road and thus restricts the creek's flow to the 150 cfs allowed by the Bundy Canyon Road crossing. However, the culvert is clogged, rendering the Club Street crossing an effective dam on Cottonwood Canyon Creek.

The Project plans call for dramatically increasing the flow capacity at the Bundy Canyon Road Crossing via replacing the single 42" pipe with at triple 5' x 8' box culvert. In planning the new culverts, it appears that no one has considered that this creek has far less capacity less than ½ mile downstream. This must considered before authorizing the Project.

14-12

The Council should also consider the Walker Street crossing at Point 5 on the map. This is another earth-fill roadway blocking Cottonwood Canyon Creek except for a collapsed 42" culvert through the fill. (See **Exhibit K**). Please note that this is downstream of the confluence of Cottonwood Canyon Creek and the unnamed drainage way across the Umbrell's property. Thus, this crossing must carry the storm waters from three drainage ways, currently fed by a 42", an 18", and another 42" culvert, for a total inflow rate of 190 cfs. There is no way the clogged 42" can be expected to manage the 190 cfs current flow, much less the highly-increased flow of 1,500 cfs contemplated by the Project.

It is clear that, under current conditions, the downstream flow capacity at either map Points 4 or 5 is significantly less than the capacity at the current Bundy Canyon Road Crossings. When these crossings are expanded to handle substantially more storm runoff, there must inevitably be serious flooding in the downstream areas. See **Exhibit O** for a diagram of this. The EIR is completely remiss in failing to consider the implications of the increased flow. This increased flow amounts to a "significant impact" as defined by the EIR, and requires further discussion of mitigation measures.

Project Changes and Increased Runoff Downstream from Bundy Canyon Road

14-13

For simplicity and clarity, the current and planned storm water flow rates coming out of Bundy Canyon Road at the various points on the map are as follows:

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Letter 14 Continued

Map Location	Current Culvert size, Cross Section Area, and Flow Rate	Post-Project Culvert size, Cross Section Area, and Flow Rate
Point 1	42", clogged 5,542 sq. in. (unclogged) 25 cfs	72" 16,286 sq. in. 500 cfs
Point 2	18" clogged 1,017 sq. in. (unclogged) 15 cfs	36" 4,071 sq. in. 100 cfs
Point 3	42" 5,542 sq. in. 150 cfs	5'x8' (three each) 17,280 sq. in. 900 cfs total
TOTAL RATES	**190 cfs**	**1,500 cfs**

Thus, despite the EIR and Developer's talk about mitigated storm water runoff, the actual runoff rates flowing out from Bundy Canyon Road are nearly tripled, **a calculated increase of 789%**. 14-13 cont.

The Umbrells do not dispute that the Developer has mitigated the storm flows from the Project at points immediately upstream (south) of Bundy Canyon Road. The Umbrells also understand that, as the Project is currently designed, the drainage culvert under Bundy Canyon Road will have to be enlarged to handle the storm water flows from the Project.

However, by enlarging the culverts under Bundy Canyon Road, the Developer will literally open the floodgates on all downstream property owners, as clearly shown on **Exhibit O** (using figures for Point 1, a line diagram showing the effect of the widening of the Bundy Canyon Road culverts. This will essentially serve to move any water backup from the Project property on to the Umbrell and other downstream properties.

This is not mitigation. Unless the downstream drainage conditions are improved, serious problems will almost certainly arise in almost any substantial rain event.

Probable Effects of Increased Runoff Rates from the Project Under Current Downstream Conditions

The City must consider what would happen in a 100-year (or even lesser) flood event with the flows as increased by the Project. The storm waters, with a flow increased by 789%, would back up against the earth- and junk-fill road crossings (Points 4, 5, and 6), piling up thousands of tons of runoff. 14-14

The first result is that the properties on either side of Cottonwood Canyon Creek and the unnamed drainage way across the Umbrell's property will flood. Indeed, there is currently frequent minor flooding. But when the combined flows out from Bundy Canyon Road are

Letter 14 Continued

increased by 789%, there can only be exponentially more flooding. Such flooding will likely cut a swath of 200 feet wide or wider, as shown on **Exhibit P**, a map of the estimated flooding impact of the increased flows.

But the flooding in the immediate vicinity is only part of the picture. The current crossings at Points 4, 5, and 6 on the map are simple, dirt- and debris-filled embankments over 10 feet high which will act as dams. These crossings can not be expected to withstand the pressure of the increased flood waters. Under the increased load of an expected significant flood, these crossings could experience catastrophic failure, releasing a torrent of floodwaters downstream. These released floodwaters would in turn cause serious flooding throughout the Cottonwood Canyon Creek area between Wildomar and Canyon Lake. Flooding of this scale would surely cause significant property damage and could even result in the loss of life. **14-14 cont.**

This potential harm is clearly a significant environmental impact and should have been addressed in the EIR. Its failure to do so requires that it be rejected and the Project be put on hold until a satisfactory resolution of the flooding issue found.

Responses to Statements in Final EIR

We have reviewed the Draft EIR for the Project as well as the Final EIR's responses to our comments on the Draft. Those responses do not fully address the comments and concerns we have raised. Instead, they basically reply "The storm water runoff at the Project boundary is less post-project than pre-project. Therefore it has been mitigated and there is no negative environmental impact. The downstream conditions are completely irrelevant and beyond our control."

The Final EIR assumes that the upstream (Project) flow patterns are merely being perpetuated when it states:

> In regard to the physical condition of the downstream drainage system, the alleged negligence of downstream owners or public agencies failing to maintain debris, litter, or brush is not a justifiable reason to prevent upstream property owners from discharging or perpetuating existing flow patterns.
> Final EIR, Page 2.0-79, 4th full paragraph. **14-15**

But the current flow patterns and rates are not being perpetuated.

The current flow rates to properties north of Bundy Canyon Road are restricted by the 36", 18", and 42" culverts under the road, a condition which has existed for over 20 years. The Project calls for the enlargement of those culverts to allow a greatly increased (approximately 789%) flow of runoff onto the properties downstream of the road. The EIR fails to show how increasing flood runoff is merely "perpetuating existing flow patterns." They have not because they can not; those flow patterns are being intensified, not merely perpetuated.

Instead, the EIR simply states that "the existing culverts are too small anyway." But this misses the point. The essence of the EIR is how the Project will affect both the Project lands and the

Letter 14 Continued

surrounding areas. Since the Project calls for increasing the size of the Bundy Canyon Road culverts, the environmental impact of that increase must be addressed and found in compliance with the law. The EIR fails to do so, is therefore flawed, and can not be accepted.

The responses in the final EIR claim that the law regarding floodwaters is, *inter alia,* as follows:

> b. . . . The upstream property owner shall not concentrate runoff in areas that have not experienced concentrated runoff without making provisions for disposing the runoff in a manner that *prevents damage to the downstream owner*.
>
> c. The upstream property owner may *reasonably* increase runoff by paving or construction of other impervious surfaces, including buildings . . .
>
> Final EIR, Page 2.0-79 (emphasis added)

Please note that the EIR admits there is a duty to ensure the Project "prevents damage to the downstream owner," and that any increased runoff is limited to what is "reasonable".

As stated above, by enlarging the culverts under Bundy Canyon Road, the Project will increase downstream flows by approximately 789%. This amount can not be considered reasonable, and for reasons stated above, will cause damage to the downstream property owners through flooding. Thus, by the very standards espoused in the final EIR, the Project runs afoul of the law by unreasonably increasing the storm runoff through the enlarged culverts, thus causing damage to the downstream owners. **14-15 cont.**

The Final EIR's response to our comments further states: "The proposed project has no control over the downstream property owners", as though that excuses the Project from any impacts it may cause to the downstream owners. It is given that the Developer can not control the downstream owners, however, the Project must be evaluated on the impact to the area environment *as it now stands*, not in an idealistic fictional world. The Developer is required to mitigate the storm flows – as those flows impact downstream owners.

If the City is unwilling to make the Developer mitigate the actual increase in downstream flows, the question must be asked, "*Is the City prepared to spend the money to ensure that the increased downstream flows are properly managed?*" There are multiple road crossings downstream of the Project that need upgrading to handle the proposed increased flow from the Project. There are also numerous Municipal and Fish & Game code violations that need to be remedied in the drainage way downstream of the Umbrell's property and in Cottonwood Canyon Creek. All of these items must be discussed in the EIR and the City's plan to properly remedy these issues must be stated.

Conclusion

An EIR is supposed to inform the relevant public agencies and the public body (those residents affected) of the environmental consequences of a proposed action. This must include not only **14-16**

Letter 14 Continued

the environment as contained within the Project boundaries, but also the adjacent and downstream residents and property owners. The EIR grossly fails in this regard.
As written, the EIR appears to "hide the ball" when it comes to the storm water runoff by focusing on the runoff figures on the upstream side of Bundy Canyon Road, and ignoring the actual flow under the road and its impact on downstream residents. As stated previously, that analysis simply assumes that there will be no impact to downstream property owners. The EIR authors thus appear to play magician, making the runoff simply disappear when in passes under Bundy Canyon Road.

The focus on the upstream side of the road makes the Developer look good: reducing runoff from 686 cfs to 534 cfs above Bundy Canyon Road at point 1 is indeed a good thing. But enlarging the culverts in Bundy Canyon Road as part of the Project will actually increase the actual runoff to downstream residents by approximately 789%. This is not mitigation, and can not be allowed unless downstream conditions are shown capable of handling the increase, which is impossible in their current condition.

Therefore, as we have repeatedly proposed, the City at a minimum should require the appropriate staff members perform a walk-thru of the downstream properties to see first-hand the flood water issues posed by the Project. The City will then more readily see that the area downstream of the Project is in no way able to manage any increased runoff. Therefore, the Project, with its proposed increase in downstream flow, poses a serious environmental impact – an impact which can not be ignored by the City, and must be properly addressed in the EIR.

14-16 cont.

To adopt the EIR and the Project as it currently stands is to literally open the floodgates onto the Umbrells, their neighbors, and a numerous other property owners. It is the City's job to ensure this does not happen.

While the Umbrells and I are not opposed to the development of the Project's real property, we are opposed to the manner in which the storm runoff effects on downstream properties is ignored. We therefore urge the City to reject the EIR as written and require an updated EIR that fully addresses the impacts of storm runoff and how to protect downstream property owners and residents.

We of course remain available to work with the City in this matter.

Respectfully,

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*** Please refer to Attachment E for Letter 14 Attachments.**

Letter 14: Trent Thompson, Thompson & Associates, Attorneys at Law

Responses

14-1 The commenter alleges that the project proposes to increase the sizes of the culverts under Bundy Canyon Road, which would intensify flooding associated with heavy rains to properties in the immediate downstream vicinity of the project. The commenter states that the DEIR and FEIR do not discuss the associated increase in downstream stormwater associated with an increase in upstream flows.

As stated on page 3.7-18 of the DEIR, the project proposes to collect all on-site stormwater flows via four major subsurface storm drain systems that will convey the flows to one of eight on-site extended detention basins. The basins are intended to protect the project site from flood, treat on-site flows for water quality purposes by removing sediment and debris, and mitigate flows for increased runoff due to development of the project. The stormwater basins will slow the speed of the stormwater runoff and allow debris and sediment to settle to the bottom of the basin or to be trapped and later removed during routine maintenance.

Upon the completion of the project and Bundy Canyon Road, the proposed detention basins required as part of the project will store runoff volume emanating from the project site. The runoff volume will be stored for 24–72 hours or allowed to infiltrate, as required as part of the Regional Water Quality Control Board Municipal Separate Storm Sewer System (MS4) Permit, which is for a longer period of time than what currently occurs.

Stormwater from the basins will be allowed to flow into a public storm drain line located in Bundy Canyon Road. The stormwater would eventually flow into Canyon Lake and Lake Elsinore consistent with the Drainage Area Management Plan for the Santa Ana Watershed (JLC 2011b, p. A 20). All on-site pre-project flow rates for the eight detention basins will either be equivalent to or greater than the estimated flow rates post-project. As such, the proposed storm drain system is designed to adequately reduce stormwater flows for the required water quality volume and mitigate flows to pre-project levels.

14-2 The commenter states that an attached Exhibit A is aerial photography of the area surrounding Penny, Danny, and Andrea Umbrell's property, located downstream of the proposed project. Existing drainage conditions (points 1 through 6) surrounding the Umbrell's property are highlighted in the Exhibit A aerial imagery.

Commenter provides information. No response is necessary.

14-3 The commenter alleges that the EIR assesses outflow rates from associated stormwater runoff from the proposed project at the project boundary but does not consider impacts beyond the project boundary.

As previously noted and as discussed in Section 3.7, Hydrology and Water Quality, of the DEIR, the storm drainage system proposed for the project is sized and designed to reduce the peak stormwater flow from the current condition (see DEIR page 3.7-24). Water and wastewater systems are designed to serve the proposed project specifically.

14-4 The commenter states that even with proposed mitigation, the proposed project would result in an increase in stormwater runoff to the Umbrell's property, the Cottonwood Canyon Creek bed, and other properties downstream. The commenter states that the associated increase in stormwater runoff could result in potentially catastrophic or fatal consequences due to the increase in culvert sizes, which will result in an increase in stormwater flow rates of over 700 percent generated by the proposed project.

As noted on page 3.7-18 of the Draft EIR, the stormwater would eventually flow into Canyon Lake and Lake Elsinore, consistent with the Drainage Area Management Plan for the Santa Ana Watershed. As stated on page 3.7-24 of the Draft EIR, "The project proposes to collect all on-site stormwater flows via four major subsurface storm drain systems that will convey the flows to one of eight detention basins. The basins are intended to protect the project site from flood, treat on-site flows for water quality purposes by removing sediment and debris, and mitigate flows for increased runoff due to development." The stormwater is not concentrated and will not increase runoff by diversion. The reduction in flow is shown in Table 3.7-4 on page 3.7-25 of the Draft EIR and supported by the drainage study prepared for the project and included as Appendix 3.7-1 of the Draft EIR.

The proposed project's storm drain system will intercept runoff from an off-site area comprising approximately 578 acres. The accepted runoff flows from off-site will be conveyed via a subsurface storm drain system to the downstream discharge points within the watershed boundaries. As the project's stormwater can only enter the stormwater system after passing through the basins, the off-site flows will remain separate from the on-site flows until the on-site flows have been treated for water quality purposes. The detention basins were engineered and sized using the *Riverside County Stormwater Quality Best Management Practice Design Handbook* (Riverside County Flood Control and Water Conservation District 2006), Worksheet 1, for volume-based best management practices. In addition, the *Drainage Area Management Plan, Santa Ana Region* (Riverside County 2011) recommends that stormwater volume not be infiltrated and rather allowed to be conveyed downstream to Canyon Lake and Lake Elsinore because those lakes are impacted by insufficient volume. As the proposed project will convey stormwater to underground pipes that are not designed for infiltration, this criterion would be implemented in the proposed project (see page 3.8-24 of the Draft EIR).

14-5 The commenter states that the impacts associated with increase in the size of the drainage culverts at points 1, 2, and 3 (in the attached Exhibit A) from their respective diameters of 42 inches, 18 inches, and 42 inches (EIR states they are 36 inches) and the attendant flow rates were not analyzed in the EIR.

These points were analyzed in the EIR as noted below.

1. Point #1 consists of a 36-inch culvert approximately 2,500 feet west of Sunset Avenue along Bundy Canyon Road. Point #1 has a total area of 285 acres.

2. At Point #2, an 18-inch culvert exists approximately 2,000 feet west of Sunset Avenue along Bundy Canyon Road. Point #2 has a total area of 27.4 acres.

3. At Point #3, a 48-inch culvert exists approximately 990 feet west of Sunset Avenue along Bundy Canyon Road. Point #3 has a total area of 427 acres.

The sizes and flow of the existing culverts are known to be undersized, and flows in excess of the existing capacity will overtop the existing Bundy Canyon Road. The proposed project is proposing to construct drainage facilities to convey storm flows emanating from the project based on City of Wildomar street design criteria. The City of Wildomar street design criteria allow the following:

- The runoff within the street will not be allowed to exceed top of curb for the 10-year storm event.

- The runoff within the street will not be allowed to exceed right-of-way for the 100-year storm event.

The proposed storm drainage system at Points #1 and #2 as identified by the commenter will discharge upstream of the existing storm drain culvert (see Lines B and C on Figure 3.7-3 of the Draft EIR). However, the line at Point #3, Cottonwood Creek (see Line D on Figure 3.7-3 of the Draft EIR) will replace the existing 48-inch storm drain culvert in order to ensure that Bundy Canyon Road does not flood during a 100-year storm event.

As requested by the City of Wildomar, a supplemental Preliminary Hydrology and Hydraulic Study was prepared to perform basin routing calculations for the proposed detention basins (see Appendix 3.7-4 of the Draft EIR). Tables 15 through 17 of the supplemental analysis were prepared to provide the total flow rate at the downstream Points #1, #2, and #3 and show that the pre-project flow rates are more than the post-project flow rates. Tables 15 through 17 were the primary determinants in concluding that the project would not have a significant impact.

In regard to the physical condition of the downstream drainage system, the alleged negligence of downstream owners or public agencies failing to maintain debris, litter, or brush is not a justifiable reason to prevent upstream property owners from discharging or perpetuating existing flow patterns.

There is no increase in downstream runoff outside the property boundaries (see response 14-6 below). Furthermore, since downstream runoff is not being increased by the project, there is no environmental impact to analyze there. Simply being downhill from the project does not result in an environmental impact as the commenter seems to imply (*Association for Protection etc. Values v. City of Ukiah* (1992) 2 Cal. App. 4th 720, 736). [A downstream property owner challenged approvals for construction of a residence uphill from him, citing surface runoff, among other things. The court noted that there was no evidence presented that the actual construction would make runoff and erosion worse than normal on the sloped property, and held that "surface and groundwater runoff are common and typical concerns with sloping lots and in this context on the evidence presented cannot be considered unusual circumstances."]

14-6 The commenter discusses the actual carrying capacity of storm flow of the culvert at Point 1 and explains it is 25 cubic feet per second (cfs) (due to the culvert being three-quarters clogged) and not 100 cfs, as stated by the project engineer. Additionally, the commenter states that the 683 cfs pre-project flow stated by the project engineer is the rate only before the Bundy Canyon Road crossing, not the rate exiting the crossing and affecting the downstream properties. Therefore, the commenter recommends that 25 cfs be the starting flow rate to determine project impacts.

Based on research conducted at the City of Wildomar, the County of Riverside, and the Riverside County Flood Control and Water Conservation District, it has been determined that the existing culverts are undersized and runoff greater than the capacity of the existing culverts will overtop Bundy Canyon Road. The existing culverts do not provide for an all-weather roadway that will function during the 100-year storm event as required by the City of Wildomar. As a result, the proposed project's storm drain systems were sized to meet the City of Wildomar flooding criteria.

Additionally, the Hydrology and Hydraulic Report prepared runoff models to understand the flows associated with long-term storms (24-hour durations) and short-term storms based on intensity. Storm drain systems were based on hydrology models that are a function of rainfall intensity. As required by the City of Wildomar and the Regional Water Quality Control Board, the following storms were analyzed: 100-year, 1-hour, 10-year, 24-hour, and 2-year, 24-hour storm event. The supplemental Preliminary Hydrology and Hydraulic Study prepared for the project performed basin routing calculations for the proposed detention basins and storm drain systems (see Appendix 3.7-4 of the Draft EIR). Tables 15 through 17 were prepared to provide the total flow rate at the downstream Points #1, #2, and #3, which show that the pre-project flow rates are more than the post-project flow rates. Tables 15 through 17 were the primary determinants in concluding that the project would not have a significant impact.

The commenter states that the existing clogged culverts and Bundy Canyon Road form a barrier to natural storm flow and create an informal stormwater basin south of Bundy Canyon Road. The commenter believes that the proposed project will eliminate this informal basin and result in downstream flooding. As noted above, the Draft EIR concludes that the post-development stormwater runoff will not exceed preconstruction rates and therefore the project will not result in downstream flooding.

14-7 The commenter explains that the 18-inch culvert (Point 2) under Bundy Canyon Road is also heavily clogged and has an approximate flow capacity of 15 cfs.

See response 14-6.

14-8 The commenter notes that the storm flow capacity at Point 3 (Cottonwood Canyon Creek) has an approximate flow of 150 cfs or possibly less.

See response 14-6.

14-9 The commenter explains how the combined stormwater flow rate for Points 1, 2, and 3 is only approximately 190 cfs, much less than what was identified in the EIR. As such, the commenter suggests that the starting point for calculating project-related environmental impacts for downstream locations at Points 1, 2, and 3 be 25, 15, and 150 cfs, respectively.

See response 14-6.

14-10 The commenter explains current downstream conditions and questions how a small, clogged culvert at Point 6 could handle project associated stormwater runoff.

See response 14-6.

14-11 The commenter explains why there is no substantial reason to increase the culvert size at Point 2. The commenter states that increased unchanneled flow from this culvert will result in gully erosion across the Umbrell's and other adjoining properties.

See response 14-6.

14-12 The commenter explains that Cottonwood Canyon Creek at Point 3 has far less capacity to accommodate stormwater flows than half a mile downstream. The commenter explains his rationale for making this determination and requests that further discussion of mitigation measures be included in the EIR to address how the currently clogged culverts will handle the increased stormwater flow associated with the proposed project.

See response 14-6.

14-13 The commenter disagrees with the mitigation measures associated with stormwater runoff in the EIR because he states that unless downstream drainage conditions are improved, serious problems will arise in almost any substantial rain event. The commenter explains that by enlarging the culverts under Bundy Canyon Road, properties downstream would inevitably get flooded due to an increase of 789 percent stormwater runoff flows.

See response 14-6.

14-14 The commenter requests that the City consider what would happen in a 100-year (or even less) flood event with the flow rate increase associated with the proposed project. The commenter suggests that the 789 percent increase in flows could result in thousands of tons of runoff at Points 4, 5, and 6 and flooding at the properties located on either side of Cottonwood Canyon Creek and at the Umbrell's property. The commenter states that the potential flooding downstream is clearly an environmental impact and should be addressed as such in the EIR.

See response 14-6.

14-15 The commenter states that the responses in the FEIR to their comments to the DEIR were not fully addressed. The commenter reiterates that an increase of 789 percent stormwater flow downstream of the proposed project, due to increasing the size of the culverts under Bundy Canyon Road, would cause damage to home and property owners downstream. Additionally, the commenter requests that the EIR include discussion of the associated impacts to home and property owners downstream. Further, the commenter states that multiple road crossings downstream of the project need to be upgraded to handle the proposed increased flows associated with the proposed project.

See response 14-6.

14-16 The commenter requests that City staff perform a field visit to the properties downstream of the project to visually see the potential issues associated with stormwater runoff generated by the proposed project. The commenter also requests that these potential impacts be properly addressed in the EIR.

On April 15, 2013, representatives of the applicant and the City met with the commenter and his representatives at the commenter's property, which is north of Bundy Canyon

Road. They examined the culverts leading to the property and confirmed that they have silt in them, which would restrict water flow. Maintenance of the culverts was the responsibility of Riverside County as verified in the 2008 *County Maintained Road Book*. After city incorporation, the responsibility for maintenance of the roadway shifted to the City of Wildomar. The City has a regular maintenance program and has scheduled removal of silt from these culverts. As the City has had responsibility for maintenance of the culverts for only the previous four years, it is unknown how long the culverts have been in this partially blocked condition.

As shown on Figure 3.7-3 of the Draft EIR, the proposed project has eight extended detention basins, six of which are south of Bundy Canyon Road upstream of the commenter's property. Based on an examination by the applicant and City representatives, and the studies and reports included as Appendices 3.7-1 through 3.7-3 in the Draft EIR, and discussed in Section 3.7, Hydrology and Water Quality, in the Draft EIR, the proposed project would result in less stormwater than is currently experienced at the culvert locations during peak storm events (see Draft EIR page 3.7-24). The commenter has not performed any studies or gathered specific information in that regard to support comments to the contrary (see also response 14-6).

In regard to maintenance of culverts and roadways north of Bundy Canyon Road, these roadways were offered for dedication via a 1925 map, but never accepted by Riverside County. Since the roadways were not part of the *County Maintained Road Book*, the City of Wildomar did not become responsible for maintenance upon city incorporation. As such, the roadways and culverts are the responsibility of the private property owners and not of the City of Wildomar. The City also observes that the adjacent property owners have modified the drainages and in some cases have received violation citations from resource agencies.

With regard to notification of property owners, both the City of Wildomar and the project applicant have provided numerous opportunities for landowners in the vicinity of the proposed project to receive information and make comment. The Notice of Preparation (NOP) for the Draft EIR was submitted for public review on Monday, March 5, 2012, with the review period ending on Friday, April 6, 2012. A scoping meeting was held on March 13, 2012, to solicit input from interested agencies and the public. The City received several comment letters on the NOP and during the public scoping meeting. These comments are summarized and a copy of each letter is provided in Appendix A of the DEIR. The Draft EIR was released for public and agency review on November 19, 2012, with the 45-day review period ending on Friday, January 4, 2013. The Draft EIR contains a description of the project, description of the environmental setting, identification of project impacts, and mitigation measures for impacts found to be significant, as well as an analysis of project alternatives. The Draft EIR was provided to interested public agencies and the public and was made available for review at City offices, at the library, and on the City's website. The Final EIR was released for public review on February 22, 2013. In addition to the published notices, the City's website includes all of the environmental documents prepared for the project.

The following is a summary of notices and meetings conducted for this project.

2/11/2011	Initial meeting with City of Wildomar to discuss conceptual project
3/16/2011	Initial meeting with Farm POA to present conceptual project
4/6/2011	Planning Commission workshop to present conceptual project
11/30/2011	Initial submittal of project
3/3/2012	Notice of Preparation of DEIR
3/13/2012	NOP Draft EIR scoping meeting
3/16/2012	Meeting with Farm POA Board
4/20/2012	Meeting with Farm POA Board
5/17/2012	Community meeting at Elsinore High School
7/2/2012	Second submittal of project to City of Wildomar
9/19/2012	Third submittal of project to City of Wildomar
11/19/2012	Draft EIR available for comment
1/2/2013	DEIR comment period ends
1/10/2013	Presentation of project to Farm POA
2/24/2013	Notice of Planning Commission public hearing published
3/16/2013	Notice of City Council Meeting public hearing published
3/26/2013	City Council meeting

As explained more fully in response 6-2, an EIR assesses the impacts of the project on the environment, not of the environment on the project. Therefore, the baseline here is the existing hydrology and stormwater discharge associated with existing conditions. As discussed in the Draft EIR and in response 14-6, the proposed project's impacts on storm drainage are fully addressed.

Letter 15

SAN GORGONIO CHAPTER

SIERRA CLUB
FOUNDED 1892

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(951) 684-6203 Fax (951) 684-6172

Regional Groups Serving Riverside and San Bernardino Counties: Big Bear, Los Serranos, Mojave, Moreno Valley, Mountains, Tahquitz., Santa Margaarita

City of Wildomar Planning Department
Wildomar, Ca.

Re: Oak Creek Canyon Project (Planning Application No. 11-0261)

Attn: Mr. Matt Bassi

After reviewing the staff report describing the EIR, we offer the following comments:

1. The Farm's sewage treatment plant, spraying system and receiving area are also of concern to us. The adjacent tract areas should have the soils tested for accumulated contaminants. There should be monitoring of the air for chlorine, ammonia and other significant gases during spraying periods. To avoid future liability, the Farm should make arrangements to connect to the new sewer line being brought to the area due to the new development. Full disclosure to prospective home-buyers will be necessary. **15-1**

2. Oak tree removal may be unavoidable, but open space and natural areas for the trees should be reserved. Existing creeks and tributaries are the most likely places they can survive so all efforts should go to providing habitat for them and conserving riparian areas at the same time. This will make the tract more valuable, as well. There is an opportunity to keep one of the major watercourses open and save some of the oak trees in the process. The developer is looking into this as a possibility. **15-2**

3. A connected and interesting trail system will add value to the development. Making the area suitable for families to spend time strolling, jogging and hiking outdoors will add market-value. Developments such as Harveston in Temecula are very desirable because of the user-friendly trail system. A loop design that winds through natural areas and near the parks would create interest and draw families outdoors. Extending to the commercial area will be of benefit and 2 pedestrian bridges or underpasses will make the trail safe since Bundy Canyon will become a large thorough-fare. It appears that the development is going to work towards this concept. **15-3**

4. Cul-de-sac design should include pedestrian connection to adjacent streets, open space, parks and the trail system. Pedestrian access between these areas and streets makes more friendly and walkable neighborhoods. There are several places this occurs in the design and a few more opportunities that can be explored. **15-4**

5. Wildlife movement will be greatly impacted. Better placement of open space and preservation of riparian and native habitats should be considered. Appropriately sized culverts and bridges can help preserve wildlife corridors. Possible clustering of housing **15-5**

Letter 15 Continued

could alleviate this concern. **15-5 cont.**

6. Energy efficiency and greenhouse gas emissions: Photovoltaic panels should be on every roof-top. The Sierra Club will see if there could be a partnership opportunity to promote this type of alternative energy. **15-6 cont.**

Pam Nelson
Conservation Chair
Santa Margarita group of the Sierra Club

Letter 15: Sierra Club

Responses

15-1 The commenter states that, due to The Farm's sewage treatment plant, spraying system, and receiving area, the adjacent tract areas should have the soils tested for accumulated contaminants. The commenter proposes air quality monitoring for chlorine, ammonia, and other gases during spraying periods, and also proposes that The Farm connect to the new sewer line being brought to the area due to the new development and make full disclosures to prospective homebuyers in the area.

There is no evidence to suggest that the operation of the spray field exceeds regulatory requirements. The proposed project is not part of the spray field and there is nothing in the record that would require additional soil sampling. Sewer connection to the existing Farm residences is not part of the proposed project (see responses 6-2 and 6-3).

15-2 The commenter states that open space and natural areas for the trees should be reserved, ideally along existing creeks and tributaries.

As shown in Figures 3.8-2 and 3.8-4 of the Draft EIR, there are 3.82 acres of riparian/riverine areas within the project boundaries and 0.37 acres of unvegetated riverine area. The proposed project will result in permanent impacts to 0.82 acres of riverine area and 0.11 acres of unvegetated riverine area. The remainder of the riparian/riverine areas and unvegetated riverine area is located in the open space portions of the proposed project and will remain undeveloped. The project was designed to meet the objective shown on page 2.0-1 of the Draft EIR to "provide a project that minimizes its impact on site resources and existing residents through site design." See also Figure 2.0-7 in the Draft EIR that shows the proposed parks and trails proposed with the project.

15-3 The commenter encourages exploring and implementing an interconnected and looped recreational trail system which also incorporates pedestrian bridges and extends to the commercial area.

Through a combination of trails and sidewalks, the entire site is linked internally and to the future Sunset Avenue Regional Trail (see Figure 2.0-4b of the Draft EIR) along the west side of Sunset Avenue (see Figure 2.0-7 of the Draft EIR).

15-4 The commenter notes that there are some places in the project where cul-de-sac design includes pedestrian connection to adjacent streets, open space, parks, and the trail system and states there are other places in the project where these features could be incorporated.

The commenter expresses a personal opinion concerning the design of the project but does not raise a question regarding the EIR. The comment will be provided to the City Council for consideration.

15-5 The comment states that wildlife movement will be greatly impacted, and the project should incorporate better placement of open space, preservation of riparian and native habitats, and appropriately sized culverts and bridges. The commenter also suggests that clustering of housing could alleviate this concern.

It is anticipated that wildlife would move along the riparian corridors that will be largely avoided by the proposed project. The riparian corridor is currently impacted by Bundy Canyon Road and this will continue with the realignment proposed as part of the project. The existing Bundy Canyon Road crossing of Cottonwood Creek uses culverts that could allow some wildlife movement under the road. The plans for the new Bundy Canyon Road crossing provide for larger box culverts that are larger in both width and height and are square rather than round. This change in culvert size will increase the wildlife movement potential under Bundy Canyon Road.

15-6 The commenter states that photovoltaic panels should be on every rooftop and that it will explore the possibility of a partnership opportunity to promote this type of alternative energy.

Access to solar energy is addressed in California Civil Code Sections 714 and 714.1, California Civil Code Sections 801 and 801.5, California Government Code Section 65850.5, California Health and Safety Code Section 17959.1, and California Government Code Sections 66473.1 and 66475.3. These sections put a limit on the ability of public agencies and homeowners associations (HOA) to prevent the installation of solar systems and require that cities use an administrative, nondiscretionary review process for on-site solar systems. The City is also limited in enforcing conditions that address visual or aesthetic concerns.

California Government Code Section 65850.5(b) requires cities to administratively approve applications to install solar energy systems by issuing building permits, unless there is a specific threat to public health and safety for which the public agency has prepared and adopted written findings based on substantial evidence that there would be a specific, adverse impact to public health and safety. Section 21080.35 of the Public Resources Code exempts certain solar energy systems. To qualify under this statutory exemption, a solar energy project must be located on the roof of either an existing building or on an existing parking lot.

With the above legal requirements, the City must allow all of the buildings within the proposed project to install solar panels if requested by the owner. Section 3.12 of the Draft EIR analyzes the proposed project's impact on energy use.

Letter 16

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April 23, 2013

VIA PERSONAL DELIVERY

Wildomar City Council
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

RE: Environmental Impact Report (SCH No. 2012031064) for the Oak Creek Canyon Project, including General Plan Amendment No. 11-0261, Change of Zone No. 11-0261, Farm Specific Plan No. 116-C/W, Amendment No. 4 (Planning Application No. 11-0261), Tentative Tract Map No. 36388

Greetings:

On behalf of concerned residents, I hereby submit these comments on the Environmental Impact Report ("EIR") for, and in opposition to, the Oak Creek Canyon Project (the "Project"). As a preliminary note, my firm notified the City of its desire to receive all notifications regarding this Project in a letter dated July 2, 2012. The City failed to provide such notifications.

The Oak Creek Canyon Project includes several development applications, including: (1) General Plan Amendment No. 11-0261; (2) Change of Zone No. 11-0261; (3) Farm Specific Plan No. 116-C/W, Amendment No. 4 (Planning Application No. 11-0261); and (4) Tentative Tract Map No. 36388. The General Plan Amendment would change the land use designation for 20.11 acres from Medium Density Residential to Medium High Density Residential. The Change of Zone would change the zoning designations for three phasing/planning areas in the following manner: rezone Phase 9 Planning Area from R-1 (One-Family Dwelling) to R-4 (Planned Residential Zone to allow 4,000 square-foot minimum lots); rezone Phase 18 Planning Area from R-1 to R-4 (to allow 6,000 square-foot minimum lots); and rezone Phase 19 Planning Area from C-P-S (Scenic Highway Commercial) to C-1/C-P (General Commercial). The Specific Plan Amendment would create special development standards and guidelines for a 275-lot single-family subdivision project, including a 5.21-acre commercial retail component. Finally, the Tentative Tract Map includes a proposed subdivision of 151.23 acres into 275 residential lots, a 5.21-acre commercial site, and 24 parcels for open space, parks, and storm drainage basins.

Letter 16 Continued

The Project site encompasses 151.23 acres within the Farm Specific Plan community in the City of Wildomar. The site is bisected by Bundy Canyon Road and extends east from Farm Road/Harvest Way to Sunset Avenue. The Project site is surrounded by existing residential uses.

General Comments

The California Environmental Quality Act ("CEQA") was adopted as a disclosure and transparency document. The theory is that by providing a document that adequately describes the environmental consequences of a project to decision makers and the public, the decision makers will make a rational decision based upon the true environmental consequences of the project and if they do not, the electorate can hold them accountable for their decisions. The core of this statutory structure is the adequacy of the document as an informational document.

Unfortunately, the EIR for this Project completely fails as an informational document, both in describing the Project itself and in describing Project impacts. The EIR does not adequately describe the proposed changes, particularly with respect to traffic, temporary construction noise, drainage, water supply, and sewage disposal. For example, the EIR contains no discussion of the water and sewage lines which will be installed on- or off-site.

Many areas of analysis in the EIR are fatally flawed. To illustrate, the EIR's air quality analysis assumes a maximum disturbance of five acres, but nothing in the EIR limits the amount of disturbance. If more than five acres are disturbed, and this is permitted under the EIR, then impacts to air quality will be significant. Traffic impacts are therefore underestimated. This is representative of the EIR's analysis of Project impacts generally. Indeed, the U.S. Fish and Wildlife Service and the California Department of Fish and Wildlife, among others, found that the EIR was inadequate in describing Project-related impacts. **16-1**

In general, the EIR is conclusory and is not based on substantial evidence in the record. Also, the Responses to Comments also often allege facts which are not supported by any evidence in the record.

CEQA requires that all mitigation measures in an EIR be fully enforceable, certain to occur, and not deferred. (Public Resources Code § 21081.6; Cal. Code of Regulations, Tit. 14 §§ 15074.1, 15097.) This Project fails to ensure that all feasible mitigation will occur with this Project and instead provides vague, uncertain, and unenforceable mitigation measures. Many mitigation measures are improperly deferred. As a result, mitigation of Project impacts will not actually occur, even if all of the proposed measures are adopted and implemented.

The EIR fails to incorporate mitigation measures which commit the City to actually reduce the effects of this Project. CEQA requires that where feasible mitigation exists which can substantially lessen the environmental impacts of a project, ***all feasible mitigation*** must be adopted. In this way CEQA goes beyond its informational role to require that projects

Letter 16 Continued

substantively lessen their negative effects on the environment. It is critical to proper drafting of an EIR that all feasible mitigation measures be required of a project. This has not been done with this Project. Additional feasible mitigation is available, as set forth herein. **16-1 cont.**

Air Quality

The EIR's air quality analysis assumes a maximum disturbance of five acres, but nothing in the EIR limits the amount of disturbance. If more than five acres are disturbed, and this is permitted under the EIR, then impacts to air quality will be significant. The EIR must include a mitigation measure which prohibits disturbance of more than five acres per day.

The EIR finds that the Project "will not result in exposure of sensitive receptors to substantial odorous emissions." This finding is completely unsupported, as the Project places new residents near a sewage treatment plant.

The EIR includes sign postage requirements for the Project to mitigate impacts, but does not require enforcement of the posted requirements. Without a provision for enforcement, all signage mitigation is meaningless.

For example, MM 3.4.2b states that "the grading plans shall reference that a sign will be posed on-site stating that construction workers need to shut off engines after 5 minutes of idling." First, this measure only requires incorporation of a sign into grading plans. It does not require that a sign be posted. But even if it actually required postage, the measure is still uncertain because there is no associated enforcement measure. This mitigation measure is highly indicative of the measures required by the EIR and demonstrates the overall deficiency of the document. **16-2**

The EIR fails to incorporate all feasible mitigation for air quality emissions.

The following additional mitigation measures should be incorporated:

Construction Emissions

1. Gravel pads must be installed at all access points to prevent tracking of mud onto public roads.

2. Install and maintain trackout control devices in effective condition at all access points where paved and unpaved access or travel routes intersect (e.g., install wheel shakers, wheel washers, and limit site access).

3. All roadways, driveways, sidewalks, etc., should be completed as soon as possible. In addition, building pads should be laid as soon as possible after grading unless seeding or soil binders are used.

4. Pave all construction roads.

Letter 16 Continued

5. Pave all construction access roads at least 100 feet on to the site from the main road.

6. Limit fugitive dust sources to 20 percent opacity.

7. Require a dust control plan for earthmoving operations.

8. When materials are transported off-site, all material shall be covered, effectively wetted to limit visible dust emissions, and at least six inches of freeboard space from the top of the container shall be maintained.

9. All streets shall be swept at least once a day using SCAQMD Rule 1186 certified street sweepers utilizing reclaimed water trucks if visible soil materials are carried to adjacent streets.

10. The contractor or builder shall designate a person or persons to monitor the dust control program and to order increased watering, as necessary, to prevent transport of dust off-site.

11. Post a publicly visible sign with the telephone number and person to contact regarding dust complaints. This person shall respond and take corrective action within 24 hours.

12. Extend grading period sufficiently to reduce air quality impacts below a level of significance.

13. The simultaneous disturbance of the site shall be limited to five acres per day.

16-2 cont.

14. Any vegetative cover to be utilized on-site shall be planted as soon as possible to reduce the disturbed area subject to wind erosion. Irrigation systems required for these plants shall be installed as soon as possible to maintain good ground cover and to minimize wind erosion of the soil.

15. Any on-site stockpiles of debris, dirt or other dusty material shall be covered or watered three times daily.

16. Any site access points within 30 minutes of any visible dirt deposition on any public roadway shall be swept or washed.

17. A high wind response plan shall be formulated for enhanced dust control if winds are forecast to exceed 25 mph in any upcoming 24-hour period.

18. Implement activity management techniques, including: (a) development of a comprehensive construction management plan designed to minimize the number of large construction equipment operating during any given time period; (b) scheduling of construction truck trips during non-peak hours to reduce peak hour emissions; (c) limitation of the length of construction work-day period; and (d) phasing of construction

Letter 16 Continued

activities.*

19. Require high pressure injectors on diesel construction equipment.*

20. Restrict truck operation to "clean" trucks, such as a 2007 or newer model year or 2010 compliant vehicles.*

21. Require the use of CARB certified particulate traps that meet level 3 requirements on all construction equipment.*

22. Utilize only CARB certified equipment for construction activities.*

23. The developer shall require all contractors to turn off all construction equipment and delivery vehicles when not in use and/or idling in excess of three minutes.*

24. Restrict engine size of construction equipment to the minimum practical size.*

25. Use electric construction equipment where technically feasible.*

26. Require use of alternatively fueled construction equipment, using, e.g., compressed natural gas, liquefied natural gas, propane, or biodiesel.*

27. Use methanol-fueled pile drivers.*

28. Install catalytic converters on gasoline-powered equipment.*

16-2 cont.

29. Require the use of Alternative Diesel Fuels on diesel equipment used. Alternative diesel fuels exist that achieve PM10 and NOx reductions. PuriNOx is an alternative diesel formulation that was verified by CARB on January 31, 2001 as achieving a 14% reduction in NOx and a 63% reduction in PM10 compared to CARB diesel. It can be used in any direct-injection, heavy-duty compression ignition engine and is compatible with existing engines and existing storage, distribution, and vehicle fueling facilities. Operational experience indicates little or no difference in performance and startup time, no discernible operational differences, no increased engine noise, and significantly reduced visible smoke.

30. Electrical powered equipment shall be utilized in-lieu of gasoline-powered engines where technically feasible.*

31. All forklifts shall be electric or natural gas powered.*

32. Suspend use of all construction equipment operations during second stage smog alerts.*

33. Provide temporary traffic controls such as a flag person, during all phases of construction to maintain smooth traffic flow.*

Letter 16 Continued

34. Provide dedicated turn lanes for movement of construction trucks and equipment on- and off-site.*

35. Reroute construction trucks away from congested streets and sensitive receptor areas.*

36. Configure construction parking to minimize traffic interference.*

37. Minimize construction worker trips by requiring carpooling and providing for lunch on-site. *

38. Require the use of Zero-VOC paints, coatings, and solvents.

(* Would reduce impacts to GHGs as well.)

Operational Emissions

1. Plant at least 50 percent low-ozone forming potential (Low-OFP) trees and shrubs, preferably native, drought-resistant species, to meet city/county landscaping requirements.*

2. Plant Low-OFP, native, drought-resistant, tree and shrub species, 20 percent in excess of that already required by city or county ordinance. Consider roadside, sidewalk, and driveway shading.*

16-2 cont.

3. Orient 75 percent or more of homes to face either north or south (within 30 degrees of N/S) and plant trees and shrubs that shed their leaves in winter nearer to these structures to maximize shade during the summer and allow sunlight to strike the building during the winter months.*

4. Electrical outlets shall be installed on the exterior walls of homes to promote the use of electric landscape maintenance equipment.*

5. Create a car sharing program within the planned community.*

6. Create a light vehicle network, such as a neighborhood electric vehicle (NEV) system.*

7. Provide bicycle routes.*

8. All buildings shall be constructed to LEED Platinum standards.*

9. Design buildings for passive heating and cooling and natural light, including building orientation, proper orientation and placement of windows, overhangs, skylights, etc.*

10. Construct photovoltaic solar or alternative renewable energy sources sufficient to provide 100 percent of all electrical usage for the entire Project.*

Letter 16 Conintued

11. Install an ozone destruction catalyst on all air conditioning systems.*

12. Construct renewable energy sources sufficient to offset the equivalent of 100 percent of all greenhouse gas emissions from mobile sources for the entire Project. *

13. Purchase only green/renewable power from the electric company.*

14. Install solar water heating systems.*

(* Would reduce impacts to GHGs as well)

16-2 cont.

Noise

The EIR improperly finds that noise impacts are not significant because the impacts are temporary. The fact that an impact is temporary does not mean the impact is insignificant. Construction noise impacts should be found significant and the EIR must be amended and recirculated.

The EIR states that noise impacts are considered significant if (1) the Project increases noise levels by 3 dBA CNEL, and either (2) existing noise levels already exceed the 65 dBA CNEL residential standard, or (3) the Project increases noise levels from below 65 dBA CNEL to above 65 dBA CNEL. The EIR then wrongly concludes that "[a]lthough construction noise would result in a short-term increase greater than 5 dBA over ambient noise levels, construction noise is of short-term duration and will not present any long-term impacts."

Noise impacts are grossly underestimated. Limiting the hours of construction does not mitigate significant impacts. Limiting hours merely reduces the number of hours people are exposed to significant impacts. Also, notifying adjacent homeowners of construction does not mitigate impacts (see, e.g., MM 3.5.4d). At the very minimum, the EIR must require temporary sound barriers to reduce significant impacts.

16-3

The EIR assumes that vehicles will be equipped with mufflers, but does not require mufflers on vehicles.

In making its findings, the EIR falsely states that there are no structures on-site and no structures within 25 feet of any area being developed as part of the Project.

Noise mitigation is improperly deferred. For instance, MM 3.5.1f states that "[a] final noise study shall be prepared prior to obtaining building permits."

The following mitigation measures must be adopted:

1. **Temporary noise barriers must be installed during project construction.**

2. Where technically feasible, utilize only electrical construction equipment.

Letter 16 Continued

3. During construction, the developer shall require that all contractors turn off all construction equipment and delivery vehicles when not in use and prohibit idling in excess of 3 minutes.
4. **All construction vehicles shall be equipped with mufflers.**
5. Require the use of rubberized asphalt for construction of all roadways and parking areas.
6. Maintain quality pavement conditions that are free of bumps, pot holes, pavement cracks, differential settlement in bridge approaches or individual pavement slabs, etc.
7. Require resurfacing of roads.
8. Ban heavy trucks near vibration sensitive uses.
9. Use alternate construction methods and tools to reduce construction vibrations. Examples include predrilling of pile holes, avoiding cracking and seating methods for resurfacing concrete pavements near vibration sensitive areas, using rubber tired as opposed to tracked vehicles, placing haul roads away from vibration sensitive areas.
10. Schedule construction activities (particularly pile driving) for times when it does not interfere with vibration sensitive operations (e.g., night time).

16-3 cont.

Additionally, cumulative noise impacts are not adequately considered. The cumulative analysis does not evaluate noise impacts from proposed or future planned projects. The cumulative impact analysis must be re-prepared and the EIR recirculated to take into account projects which, when combined with this Project, may have a significant impact on noise.

Geology and Soils

MM 3.6.3 is uncertain and unenforceable. This measure only recommends over-excavation; it does not actually require anything. Thus, areas of the Project site may remain unstable.

16-4

Hydrology and Water Quality

The EIR finds that the Project will alter the existing drainage pattern of the site and may impact stormwater runoff rates and volumes compared to existing conditions, yet finds this impact to be less than significant. This is indicative of the conclusory nature of the EIR's findings in general and the lack of support for its findings.

16-5

Biological Impacts

Despite the fact that the Project is located within the Western Riverside County Multiple Species Habitat Conservation Plan, which is intended to serve as a habitat conservation plan, the EIR fails to provide adequate mitigation for the significant impacts of the Project.

16-6

Letter 16 Continued

The EIR admits that the Project could result in the direct mortality or loss of habitat for raptors, but does not provide any mitigation for this potential loss.

MM 3.8.2 states that "[t]he project applicant shall conduct construction and clearing activities outside of the avian nesting season (January 15-August 31), ***where feasible***" [emphasis added]. This measure provides no assurance that impacts to migratory birds will be mitigated.

MM 3.8.4 improperly defers mitigation, as do most of the measures associated with biological impacts. This measure states that "[m]itigation can include on-site restoration or purchase of mitigation credits." MM 3.8.8b allows the applicant to submit plans that illustrate how disturbance to sensitive portions of the site will be avoided.

16-6 cont.

The Project must require off-site mitigation within the County in order to preserve similar type and amount of habitat. This mitigation measure is feasible and necessary.

Traffic/ Transportation

The traffic impacts analysis establishes that "C" is an acceptable level of service (LOS) and "D" is only permissible under certain circumstances "as an exception." However, the EIR uses "D" as the threshold for significance determinations, without discussing why this LOS is permissible. By using "D" as the threshold level of service, the EIR grossly underestimates traffic impacts and fails as an informational document.

Even using an unacceptable LOS of "D," the EIR found that 8 of the 13 intersections analyzed will operate at LOS "F" with the Project in 2015. Another two intersections will operate at LOS "D." Of particular concern, **the EIR finds that traffic will operate an unacceptable level of service of "F" at two intersections even with mitigation.** Despite this finding, the EIR manages to find that traffic impacts are less than significant.

16-7

Traffic mitigation is uncertain and unenforceable. For instance, MM 3.3.1 states that "[a]ll improvements shall be in place prior to full buildout of the project." This measure improperly defers all improvements which would purportedly reduce significant Project impacts. Traffic impacts remain significant in the interim.

MM 3.3.4 requires the preparation and implementation of a Traffic Management Plan (TMP). This measure is deficient and ineffective, though, as it only requires two small provisions to be included in the TMP: (1) adequate access for emergency vehicles; and (2) two-way traffic through the construction zone. This measure does not mitigate the Project's significant impacts.

MM 3.3.5 requires the applicant "pay a fair share of the costs" of traffic improvements, but does not identify any fair share program. In fact, a fair share program for these particular improvements may not exist at all. Noting "consistency" with planned improvements by other entities which are funded by TUMF does not make this measure enforceable or certain. Indeed, it

Letter 16 Continued

is not clear that the planned improvements funded by TUMF will occur in the foreseeable future. There is no evidence of actual plans in place for construction of the necessary traffic improvements. Moreover, TUMF improvements can take up to 9 years to become a reality from a local jurisdiction developing a project to completion of construction. (*2011 Annual Report, Transportation Uniform Mitigation Fee Program*, Western Riverside Council of Governments, "Five Year Transportation Improvement Program," <http://www.wrcog.cog.ca.us/downloads/AnnualReport_for_web.pdf>, p. 7.) Traffic impacts thus remain significant.

16-7 cont.

The following mitigation measures must be incorporated and actually required:

1. Improve traffic flow by signal synchronization.
2. Provide bicycle routes.

Public Services and Utilities

The EIR finds that the provision of facilities could cause environmental impacts, yet inexplicably finds these impacts to be less than significant.

The EIR fails to adequately address the issue of sewage. As pointed out in the Comments on the Draft EIR, there is no discussion of *how* the Elsinore Valley Municipal Water District will serve the Project, where pumping stations will be located, or the cost to residents.

16-8

The EIR states that "[u]pon review and the necessary permit processing by the Riverside County Fire Department and the Elsinore Valley Municipal Water District, this impact will be less than significant." This is yet another example of improperly deferred mitigation and the conclusory nature of the EIR. There is absolutely no discussion in the EIR of potential problems.

The EIR finds that the risk of loss due to a wildfire is less than significant because the Project is located in close proximity to a fire station. In the case of a wildfire, the Project's proximity to a single fire station is not enough to mitigate impacts.

Cumulative Impacts

One of the biggest deficiencies in the EIR relates to the cumulative effects of the Project for each and every impact considered. An effect is cumulatively considerable if the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, other current projects, and the effects of probable future projects. (Guidelines § 15064 (h)(1).) The EIR gives short shrift to the consideration of cumulative impacts.

16-9

First, the analysis itself is flawed in that it does not identify which, *if any*, other projects were considered in the cumulative analysis.

Letter 16 Continued

The EIR claims the Project will not result in ***any*** significant cumulative impacts, but fails to provide substantial evidence to support this determination. For example, the EIR finds that the Project will result in a 2.7 percent increase in the population of Wildomar and a 2.5 percent increase in the number of homes with the City. This impact is not considered cumulatively.

The EIR also often finds impacts not cumulatively considerable on the basis that such impacts were found not individually significant. This completely disregards the purpose of CEQA requiring that an EIR consider whether impacts may be cumulatively considerable, even if they are not individually significant. The EIR fails as an informational document by failing to sufficiently evaluate the cumulative impacts of this Project. **16-9 cont.**

Project Alternatives

The EIR fails to consider a reasonable range of Project alternatives and is severely flawed in this respect.

The EIR only considers two alternatives, both of which are essentially "no Project" alternatives. Alternative 1 represents no development on the site, and Alternative 2 represents the current zoning of the site. No alternative is considered which would actually reduce the impacts associated with this Project. This is extremely concerning because the Project will result in significant impacts. **16-10**

The EIR does not consider an environmental superior alternative to the Project. Where there is an environmentally superior alternative that significantly decreases the significant impacts of the Project, then that alternative must be approved rather than the Project if that alternative is feasible, even if the alternative would impede to some degree the attainment of the project objectives, or would be more costly. (PRC§ 21002; *Uphold Our Heritage v. Town of Woodside* (2007) 147 Cal.App.4th 587, 597; CEQA Guidelines § 15126.6(b).)

Findings

The findings required under CEQA cannot be made with respect to this Project. The findings of fact are conclusory and are not supported by substantial evidence.

Not all significant effects of the Project have been eliminated or substantially lessened, additional mitigation is feasible, and the Project fails to adopt an environmentally superior and feasible alternative. **16-11**

Conclusion

Thank you for your consideration of these comments and the attached material.

Sincerely,

Letter 16 Continued

Raymond W. Johnson
JOHNSON & SEDLACK

Letter 16 Continued

Attachments

1. California Air Resources Board. (October 24, 2008) *Preliminary Draft Staff Proposal, Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the California Environmental Quality Act.*

2. California Air Pollution Control Officers Association. (January 2008) *CEQA & Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act*.

3. Bay Area Air Quality Management District. (December 7, 2009) *California Environmental Quality Act Guidelines Update, Proposed Thresholds of Significance*.

4. U.S. Department of Transportation, Federal Highway Administration. (August 2006) *Construction Noise Handbook, Chapter 4.0 Construction Noise Criteria and Descriptors.*

5. U.S. Department of Transportation, Federal Highway Administration. (August 2006) *Construction Noise Handbook, Chapter 9.0 Construction Equipment Noise Levels and Ranges.*

6. U.S. Department of Housing and Urban Development. (March 1985) *The Noise Guidebook.*

7. Suter, Dr. Alice H., Administrative Conference of the United States. (November 1991) *Noise and Its Effects*.

8. Federal Interagency Committee on Urban Noise. (June 1980) *Guidelines for Considering Noise in Land Use Planning and Control*.

Letter 16 Continued

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(951) 506-9725 Fax
(951) 775-1912 Cellular

Johnson & Sedlack, an Environmental Law firm representing plaintiff environmental groups in environmental law litigation, primarily CEQA.

City Planning:

Current Planning

- Two years principal planner, Lenexa, Kansas (consulting)
- Two and one half years principal planner, Lee's Summit, Missouri
- One year North Desert Regional Team, San Bernardino County
- Thirty years subdivision design: residential, commercial and industrial
- Thirty years as applicants representative in various jurisdictions in: Missouri, Texas, Florida, Georgia, Illinois, Wisconsin, Kansas and California
- Twelve years as applicants representative in the telecommunications field

General Plan

- Developed a policy oriented Comprehensive Plan for the City of Lenexa, Kansas.
- Updated Comprehensive Plan for the City of Lee's Summit, Missouri.
- Created innovative zoning ordinance for Lenexa, Kansas.
- Developed Draft Hillside Development Standards, San Bernardino County, CA.
- Developed Draft Grading Standards, San Bernardino County.
- Developed Draft Fiscal Impact Analysis, San Bernardino County

Environmental Analysis

- Two years, Environmental Team, San Bernardino County
  - Review and supervision of preparation of EIR's and joint EIR/EIS's
  - Preparation of Negative Declarations
  - Environmental review of proposed projects
- Eighteen years as an environmental consultant reviewing environmental documentation for plaintiffs in CEQA and NEPA litigation

Letter 16 Continued

Representation:

- Represented various clients in litigation primarily in the fields of Environmental and Election law. Clients include:
  - Sierra Club
  - San Bernardino Valley Audubon Society
  - Sea & Sage Audubon Society
  - San Bernardino County Audubon Society
  - Center for Community Action and Environmental Justice
  - Endangered Habitats League
  - Rural Canyons Conservation Fund
  - California Native Plant Society
  - California Oak Foundation
  - Citizens for Responsible Growth in San Marcos
  - Union for a River Greenbelt Environment
  - Citizens to Enforce CEQA
  - Friends of Riverside's Hills
  - De Luz 2000
  - Save Walker Basin
  - Elsinore Murrieta Anza Resource Conservation District

Education:

- B. A. Economics and Political Science, Kansas State University 1970
- Masters of Community and Regional Planning, Kansas State University, 1974
- Additional graduate studies in Economics at the University of Missouri at Kansas City
- J.D. University of La Verne. 1997 Member, Law Review, Deans List, Class Valedictorian, Member Law Review, Published, Journal of Juvenile Law

Professional Associations:

- Member, American Planning Association
- Member, American Institute of Certified Planners
- Member, Association of Environmental Professionals
- Member, U.S. Green Building Council, LEED GA

Letter 16 Continued

Johnson & Sedlack, Attorneys at Law
26785 Camino Seco 12/97- Present
Temecula, CA 92590
(951) 506-9925

Principal in the environmental law firm of Johnson & Sedlack. Primary areas of practice are environmental and election law. Have provided representation to the Sierra Club, Audubon Society, AT&T Wireless, Endangered Habitats League, Center for Community Action and Environmental Justice, California Native Plant Society and numerous local environmental groups. Primary practice is writ of mandate under the California Environmental Quality Act.

Planning-Environmental Solutions
26785 Camino Seco 8/94- Present
Temecula, CA 92590
(909) 506-9825

Served as applicant's representative for planning issues to the telecommunications industry. Secured government entitlements for cell sites. Provided applicant's representative services to private developers of residential projects. Provided design services for private residential development projects. Provided project management of all technical consultants on private developments including traffic, geotechnical, survey, engineering, environmental, hydrogeological, hydrologic, landscape architectural, golf course design and fire consultants.

San Bernardino County Planning Department
Environmental Team 6/91-8/94
385 N. Arrowhead
San Bernardino, CA 92415
(909) 387-4099

Responsible for coordination of production of EIR's and joint EIR/EIS's for numerous projects in the county. Prepared environmental documents for numerous projects within the county. Prepared environmental determinations and environmental review for projects within the county.

San Bernardino County Planning Department
General Plan Team 6/91-6/92
385 N. Arrowhead
San Bernardino, CA 92415
(909) 387-4099

Created draft grading ordinance, hillside development standards, water efficient landscaping ordinance, multi-family development standards, revised planned development section and fiscal impact analysis. Completed land use plans and general plan amendment for approximately 250 square miles. Prepared proposal for specific plan for the Oak Hills community.

Letter 16 Continued

San Bernardino County Planning Department
North Desert Regional Planning Team
15505 Civic 6/90-6/91
Victorville, CA
(619) 243-8245

Worked on regional team. Reviewed general plan amendments, tentative tracts, parcel maps and conditional use permits. Prepared CEQA documents for projects.

Broadmoor Associates/Johnson Consulting
229 NW Blue Parkway
Lee's Summit, MO 64063
(816) 525-6640 2/86-6/90

Sold and leased commercial and industrial properties. Designed and developed an executive office park and an industrial park in Lee's Summit, Mo. Designed two additional industrial parks and residential subdivisions. Prepared study to determine target industries for the industrial parks. Prepared applications for tax increment financing district and grants under Economic Development Action Grant program. Prepared input/output analysis of proposed race track Provided conceptual design of 800 acre mixed use development.

Shepherd Realty Co.
Lee's Summit, MO 6/84-2-86

Sold and leased commercial and industrial properties. Performed investment analysis on properties. Provided planning consulting in subdivision design and rezoning.

Contemporary Concepts Inc.
Lee's Summit, MO 9/78-5/84
Owner

Designed and developed residential subdivision in Lee's Summit, Mo. Supervised all construction trades involved in the development process and the building of homes.

Environmental Design Association
Lee's Summit, Mo.
Project Coordinator 6/77-9/78

Was responsible for site design and preliminary building design for retirement villages in Missouri, Texas and Florida. Was responsible for preparing feasibility studies of possible conversion projects. Was in charge of working with local governments on zoning issues and any problems that might arise with projects. Coordinated work of local architects on projects. Worked with marketing staff regarding design changes needed or contemplated.

Letter 16 Continued

City of Lee's Summit, MO
220 SW Main
Lee's Summit, MO 64063
Community Development Director 4/75-6/77

Supervised Community Development Dept. staff. Responsible for preparation of departmental budget and C.D.B.G. budget. Administered Community Development Block Grant program. Developed initial Downtown redevelopment plan with funding from block grant funds. Served as a member of the Lee's Summit Economic Development Committee and provided staff support to them. Prepared study of available industrial sites within the City of Lee's Summit. In charge of all planning and zoning matters for the city including comprehensive plan.

Howard Needles Tammen & Bergendoff
9200 Ward Parkway
Kansas City, MO 64114
(816) 333-4800 5/73-4/75
Economist/Planner

Responsible for conducting economic and planning studies for Public and private sector clients. Consulting City Planner for Lenexa, KS.

Conducted environmental impact study on maintaining varying channel depth of the Columbia River including an input/output analysis. Environmental impact studies of dredging the Mississippi River. Worked on the Johnson County Industrial Airport industrial park master plan including a study on the demand for industrial land and the development of target industries based upon location analysis. Worked on various airport master plans. Developed policy oriented comprehensive plan for the City of Lenexa, KS. Developed innovative zoning ordinance heavily dependent upon performance standards for the City of Lenexa, KS.

*** Please refer to Attachment E for Letter 16 Attachments.**

Letter 16: Raymond Johnson, Johnson & Sedlack, Attorneys at Law

Responses

16-1 The commenter makes similar comments to those made in his prior letter in comment 12-1. In addition, he asserts that certain areas of the EIR are flawed and provides as a single example the air quality analysis. The commenter states that the air quality analysis assumes a maximum disturbance of 5 acres, and extrapolating from this, the traffic impacts are underestimated. The comment reiterates the assertion made in comment 12-1 that the mitigation measures described in the EIR are not enforceable and are improperly deferred and that the EIR does not incorporate mitigation measures which will commit the City to reduce the effects of the project.

Because this comment largely reiterates prior concerns raised in comment 12-1, the response provided to comment 12-1 is also applicable here. As previously stated, mitigation measures have not been improperly deferred. See above in response to Letter 11, comments 4 and 5. The commenter's concern about the air quality study is largely addressed by response 12-2.

16-2 The commenter largely reiterates comments made previously in comment 12-2. The comment also adds that the EIR must include a mitigation measure that prohibits disturbance of more than 5 acres per day. The commenter also adds that there is no support for the EIR's finding that the project will not result in exposure of sensitive receptors to substantial odorous emissions because of the presence of a sewer treatment plant.

See responses to 12-1 and 12-2.

16-3 The commenter reiterates earlier comments made in comment 12-3. The commenter adds, however, that the EIR wrongly concludes that the increase by 5 dBA caused by construction noise is short term and will not present any long-term impacts. The commenter also adds that cumulative noise impacts are not considered.

See prior response 12-3. Additionally, the new portion of the comment (that the EIR conclusion is "wrong") is itself conclusory and is adequately answered by response 12-3. The EIR's analysis of cumulative impacts generally is addressed in responses 9-1 and 12-6. Noise impacts, including construction noise impacts, are analyzed beginning on page 3.5-10 of the Draft EIR. Mitigation measures MM 3.5.4a through 3.5.4d specifically address construction noise associated with the proposed project. These mitigation measures are in addition to Chapter 9.48, Noise Regulation, of the Wildomar Municipal Code. The commenter does not indicate which mitigation measures are inadequate or why compliance with the noise regulations in the Municipal Code is inadequate.

The noise analysis included as Appendix 3.5-1 and as discussed on page 3.5-14 of the Draft EIR is based on the 2035 predicted future traffic generation along Bundy Canyon Road. The proposed single-family development will not generate noise other than traffic, and the traffic noise is accommodated in the 2035 future traffic figures. The cumulative noise increase, as reported on page 3.5-32 of the Draft EIR, is between 0.0 and 1.0 db in 2035, which was considered barely perceptible and therefore less than significant. The future commercial area is also not expected to generate noise; however, during the plot plan

review required for all commercial development, the project will be reviewed by the City to ensure compliance with Chapter 9.48, Noise Regulation.

16-4 The commenter asserts that mitigation MM 3.6.3 is uncertain and unenforceable and that it merely recommends rather than requires the stated excavation and so the area may remain geologically unstable.

The mitigation measure is both measurable and enforced by the City Public Works and Building Departments as indicated in the Draft EIR. The mitigation measures were based on recommendations from the soil engineer in the Preliminary Geotechnical Investigation included as Appendix 3.6-1. As noted in the discussion of impact 3.6.3 on page 3.6-11 of the Draft EIR, the excavation and compaction would take place under the direction of a qualified geotechnical engineer as part of the grading process. The need to review site conditions and make adjustments to grading and engineering plans to reflect actual conditions is a normal part of the development process. The City Engineer is responsible for all inspections associated with grading and compaction.

16-5 The commenter restates, verbatim, the same author's comment made in comment 12-4 concerning hydrology and water quality.

See response 12-4.

16-6 The commenter adds an acknowledgment that the project is within the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP) but goes on to make the same assertions that the commenter made in comment 12-5.

The new introductory assertion that the MSHCP does not serve to provide adequate mitigation for any significant biological impacts is conclusory. Furthermore, compliance with the MSHCP provides adequate mitigation for the project impacts (*Gentry v. City of Murrieta* (1995) 36 Cal. App. 4th 1359).

16-7 The commenter reiterates prior comments made in comment 12-6 regarding traffic. The commenter adds that the EIR does not discuss permissibility of using LOS D. The commenter also adds that eight intersections will operate at LOS F with the project at 2015 even with mitigation. The commenter further alleges that implementation of a Traffic Management Plan is deficient mitigation and that TUMF-funded improvements are uncertain to occur.

See response 12-6, which addresses these comments, including the newly added TUMF-related comment. Also see response 12-1, which addresses the commenter's reiterated allegation concerning "uncertain" mitigation. The commenter is incorrect that the EIR concludes that the traffic impacts result in unacceptable level of service. As shown in Table 3.3-13 on page 3.3-57 of the Draft EIR, the project as mitigated will result in acceptable levels of service at all of the study intersections. Table 3.3-14 on page 3.3-58 of the Draft EIR shows that the proposed project will reduce the delay significantly at those intersections already operating at LOS F. Since delay will be reduced, there is no impact associated with the proposed project. Table 3.3-17 on page 3.3-68 shows that under the cumulative condition, with all improvements and mitigation in place, the study area intersections operate at an acceptable level of service.

16-8 The commenter repeats assertions made in comment 12-7 and also adds that "the issue of sewage" is not adequately addressed because locations of the EVMWD pump

stations are not finalized and cost to residents is not explained. The commenter also asserts that the project's proximity to a fire station is not sufficient to mitigate risk of loss due to wildfire.

See response 12-7. The comment concerning costs of the sewage system is an economic impact of the project, not an environmental one, and the purpose of the EIR is to analyze and address the environmental impacts of the project. See also responses 1-4 and 6-3, which further address the commenter's concerns about sewage. See response 11-3 regarding wildfire.

16-9 The commenter repeats concerns about cumulative impacts that he previously made in comment 12-8 and adds additional general information about the purpose of CEQA and definitions of cumulative impacts.

The commenter's concerns were addressed by response 12-8. New language added to this comment is only a general comment on the purpose of CEQA and the definitions of cumulative impacts, and not new specific comments about the project or the EIR.

16-10 The commenter restates a prior comment made (12-9) and elaborates on the assertion that both alternatives are essentially "no project" alternatives.

This comment was addressed fully by response 12-9.

16-11 This comment restates verbatim the comment made previously in comment 12-10.

See response 12-10.

Letter 17

April 23, 2013

To the Wildomar City Council

RE: Oak Creek Canyon Project (Planning Application #11-0261)

From: Gayl A Taylor, Farm Resident

There are still several question regarding the Oak Creek Development that have still not been answered.

Assuming the 10" sewer pipe is adequate for sewer service for both the Oak Creek Development and The Farm will this sewer line be installed in time for the first houses that are constructed in the Oak Creek Development to be hooked up or are we then going to be told that they will have to be hooked up to the system operated by The Farm Mutual Water Company? **17-1**

Why hasn't a cost analysis been done regarding what the cost would be for the residents of The Farm to hook up to the new sewer pipe? **17-2**

The Farm Mutual Water Company operates a septic system which includes dissemination of wastewater over a vacant field. This system is archaic. When a new and up to date system is available why wouldn't The Farm be allowed to hook up to the new sewer system? **17-3**

Why would the builder even consider building under these spray fields?

I ask the City Council to do their homework regarding the spray fields.

And again I say, **this, to me, is like having an outhouse in my backyard.**

Gayl A Taylor

Letter 17: Gayl Taylor

Responses

17-1 The commenter asks whether the sewer line serving the project will be installed in a time frame that allows the first houses constructed in the Oak Creek Development to hook up to that sewer line rather than the system operated by the Farm Mutual Water Company.

The 10-inch sewer line in Bundy Canyon Road will be installed and operational prior to occupancy of any of the housing units in the proposed project. None of the housing units will be connected to the Farm Mutual Water Company wastewater collection and treatment system.

17-2 The commenter asks why a cost analysis has not been done to ascertain costs to residents of The Farm to hook up to the new sewer pipe. The commenter also states that the Farm Mutual Water Company's septic system is archaic and asks why The Farm would not be permitted to connect with the new system.

This comment addresses an economic impact of the project, not an environmental one. The purpose of the EIR is to analyze and address the environmental impacts of the project. The project does not propose to connect existing Farm residents to the new sewer line.

17-3 The commenter expresses general concern about development in the area of the spray fields.

This comment expresses the opinion of the commenter but does not raise any issues regarding the adequacy of the analysis in the EIR.

Comment Letter 18

California Water Boards

Edmund G. Brown Jr., Governor

Matthew Rodriquez, Secretary for Environmental Protection

Santa Ana Regional Water Quality Control Board

April 25, 2013

Matt Bassi, Planning Director
City of Wildomar
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

COMMENTS ON DRAFT AND FINAL ENVIRONMENTAL IMPACT REPORTS, OAK CREEK CANYON DEVELOPMENT, TENTATIVE TRACT MAP NO. 36388, BUNDY CANYON ROAD AT HARVEST WAY - CITY OF WILDOMAR, SCH# 2012031064

Dear Mr. Bassi:

Staff of the Regional Water Quality Control Board, Santa Ana Region (Santa Ana Regional Board) has reviewed both the November 2012 Draft Environmental Impact Report (DEIR) and the February 2013 Final Environmental Impact Report for the proposed Oak Creek Canyon Development (Project) in the northern portion of the City of Wildomar (City). The Regional Board had not previously received CEQA documents for review, nor was aware of the Project, and therefore on March 27, 2013 Board staff requested that the City allow completion of Responsible Agency review under the California Environmental Quality Act.

18-1

The Project would realign Bundy Canyon Road on hilltop property located between The Farm Road and Sunset Avenue, shifting the road toward the east, decreasing its curve, and increasing lanes in order to match an adjacent widening project to be conducted by the Riverside County Transportation Department (DEIR p. 2.0 -1,29). It is unclear whether the County has already prescribed the exact route of the new roadbed, shoulders and right-of-way. Adjacent to the new alignment, the Project would subdivide the property for the construction of 275 houses and a commercial retail site. The Project size (please clarify) is variously discussed as 137.82 acres (DEIR Introduction p.1.0-1), 168 acres (DEIR p. 2.0-1), 151.23 acres (DEIR p.2.0-2), and 163.25 acres on pgs. 4 and 15 of the MSHCP[1] summary.

We request that the following comments be incorporated into the final EIR, in order to protect water quality standards (i.e., water quality objectives and beneficial uses) identified in the Water Quality Control Plan for the Santa Ana River Basin, 1995, as amended (Region 8 Basin Plan):

1. Water Quality Standards of Site Portion within the Santa Ana Region

18-2

Section 3.7 (Hydrology and Water Quality) notes the division of the City, and the Project site, between watersheds jurisdictional to the Santa Ana Regional Board and the San Diego Regional Board. P. 3.7-11 discusses stormwater runoff regulation by the San Diego Regional Board, as agreed to with the Santa Ana Region, but erroneously extrapolates all other regulatory jurisdiction for

[1] Western Riverside County Multiple Species Habitat Conservation Plan Consistency Analysis for Tentative Tract Map 36388.

Cargle H. Beswick, chair | Kurt V. Berchtold, executive officer
3737 Main St., Suite 500, Riverside, CA 92501 | www.waterboards.ca.gov/santaana

Comment Letter 18 Continued

the site to the San Diego Regional Board. Pgs.3.7-5, 3.7-9, and 3.7-11 should clarify that except for the San Diego Regional Board's regulation of stormwater runoff for all of Wildomar, each Regional Board has jurisdiction for other regulations within its own watershed (i.e., Clean Water Act Section 401 Water Quality Certification, etc.). Figure 3.7-1, Watershed Map, should clarify that the majority of the Project site is within the jurisdiction of the Santa Ana Regional Board.

18-2 cont.

Our remaining comments are relevant to the water quality standards of the site's several intermittent drainages. One of three primary drainages is located in the southwestern portion of the site and is jurisdictional to the San Diego Regional Board (within Santa Margarita River watershed boundary); it will not be impacted by the Project nor discussed further in this letter. The other two primary drainages flow northerly beneath Bundy Canyon Road and converge in the San Jacinto River watershed (jurisdictional to the Santa Ana Regional Board), among the streams that constitute the headwaters of Cottonwood Canyon Creek:

- One drainage flows easterly from the northwestern boundary of the site and would be encroached upon, but essentially avoided, on the northwestern side of the realigned Bundy Canyon Road. In the north-central portion of the site area, Project residences and streets would fill this primary drainage, two of its tributaries, and half of another tributary.

- The drainage in the northeastern portion of the site would also be largely avoided, except beside the south side of Bundy Canyon Road. Here, the road widening would remove a portion of a riparian community (willows, mulefat, cottonwood) dominated by a cluster of oak trees that have recruited where surface drainage and channel underflow have favored them.

18-3

With the focus of DEIR Section 3.7 entirely on compliance with the San Diego Region's stormwater regulations, water quality objectives and beneficial uses within the Santa Ana Region were not addressed and must be included.

The Project's tributaries to Cottonwood Canyon Creek and eventually, the San Jacinto River Reach 1, must have these beneficial uses protected, or mitigated for where impacted:

- Municipal Supply (MUN), Agricultural Supply (AGR), Groundwater Recharge (GWR), Water Contact Recreation (REC1), Non-Contact Water Recreation (REC2), Warm Freshwater Habitat (WARM), and Wildlife Habitat (WILD).

The San Jacinto River, Reach 1, is tributary to the Elsinore Groundwater Management Zone (GMZ) with beneficial uses of MUN, AGR, and Industrial Process Supply (PROC). Further, the water quality objectives to be met by the Project's wet- and dry-weather runoff are footnoted below[2] and must be included in the Final EIR.

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[2] **For Cottonwood Creek**: Total Dissolved Solids (TDS) 150 milligrams/liter (mg/l); Hardness 70 mg/l; Sodium (Na) 10 mg/l; Chloride (Cl)12 mg/l; Total Inorganic Nitrogen (TIN) 1 mg/l; Sulfate (SO4) 15 mg/l; and Chemical Oxygen Demand (COD) 5 mg/l.

For San Jacinto River Reach 1: TDS 450 mg/l; Hardness 260 mg/l; Na 50 mg/l; Cl 65 mg/l; TIN 3 mg/l; and SO4 60 mg/l.

For the Elsinore GMZ: TDS 450 mg/l; Hardness 280 mg/l; Na 50 mg/l; Cl 60 mg/l; SO4 60 mg/l; and Nitrate-Nitrogen (NO3-N) 4 mg/l

Comment Letter 18 Continued

2. Cumulative Impacts

Regional Board staff understands that a new "Oak Tree Inventory Map" (created as grading condition Attachment G, received by electronic mail on March 28, 2013) was not included in either the Draft or Final EIRs. Attachment G constitutes a comprehensive overlay of the proposed configuration of houses beside the Project's proposed realignment of Bundy Canyon Road, upon an aerial view of the site's drainages and numbered maturing oak individuals. Regional Board staff request that this Attachment G be added to the Final EIR as new information under CEQA. Further, all cumulative impacts of this combined road alignment and residential development on beneficial uses (water quality, hydrology, and riparian habitat) would be mitigated to a level of "less than cumulatively considerable" under CEQA, according to Section 4.0 (Cumulative Impacts), using numerous mitigation measures (MM) that include: 18-4

- A series of eight detention basins to prevent the increase of post-Project runoff over pre-Project runoff , and the increase of Hydraulic Conditions of Concern (HCOCs) (DEIR p.4.0-6; Preliminary Water Quality Management Plan (WQMP p.A-3 and Figure 3); and

- A future Oak Tree Mitigation Plan (DEIR p.4.0-10, MM 3.11.4) that would replant a larger number of oak trees than are lost to the houses and the realigned Road.

Regional Board staff still disagrees with Section 4.0 that enough riparian avoidance would be implemented. Permanent impacts to waters of the U.S. and state should be avoided to the maximum extent possible. In order to rejoin Bundy Canyon Road, the path of the widened realignment would be redirected through the concentrated riparian stand referred to in Comment 1 above (35 coast live oak trees clustered on Oak Tree Inventory Map; Jurisdictional Waters Segment No.1 on Jurisdictional Impacts Map). Impact 3.11.4 acknowledges this proposed oak habitat removal as an adverse aesthetic impact, but this should also be added in the "Cumulative Impacts to Biological Resources" in the Cumulative Impacts Summary. From examination of the Oak Tree Inventory Map, it appears that the realignment could be shifted either farther north than indicated, or approximately 150 feet south to a much less critical gap between riparian stands, through the planned site of Lot 312 Detention Basin. Board staff strongly recommends this shift of the realignment, which could be carried by an open bridge over the drainage and still join the current Bundy Canyon Road onsite. We are willing to work with the City toward a re-design of the Project that should not affect Project goals. 18-5 18-1 cont.

3. Certification and Mitigation

The DEIR maps and text (p.3.8-7; Figure 3.8-2 Jurisdictional Assessment; Jurisdictional Delineation p.8) report "potentially jurisdictional waters of the U.S." to be 0.719 acres. No wetlands were identified or delineated, including isolated wetlands such as vernal pools. DEIR p.3.8-28 states that the Jurisdictional Delineation must still obtain agency verification. A proposed total of 4,061 linear feet (LF) and 0.219 acre of onsite impacted waters of the U.S. would be jurisdictional to the U.S. Army Corps of Engineers (Corps) and will require their issuance of a Clean Water Act Section 404 Permit (2,756 LF and 0.126 acre would be impacted by the residential development, and 1,305 LF and 0.093 acre would be impacted by the road realignment). The applicant should be directed to apply for a Clean Water Act Section 401 Water Quality Standards Certification (Certification) from our office as a prerequisite for the 404 Permit, once the Corps has issued notification of this requirement. 18-6

Comment Letter 18 Continued

"Potentially jurisdictional waters of the state," jurisdictional to the California Department of Fish and Wildlife, are reported to be 3.831 acres (including habitat). Onsite impacted waters of the State would be 0.391 acre by the development and 0.430 acre by the realignment, for a total of 0.821 acre (LF not reported). Where this acreage does not overlap the federal acreage, the applicant should so indicate (with the additional acreage and linear feet) in the Certification application (Impact 3.8.5, MM 3.8.5a and 3.8.5b); the Regional Board will take jurisdiction for this additional acreage and linear feet as waters of the state and consider issuance of waste discharge requirements (WDRs) for regulation of excavation and fill impacts. 18-7

A mitigation plan will be required with the Certification application for the loss of beneficial uses to waters of the U.S. and state caused by these impacts. MM 3.8.4 states that there will be no net loss of riparian vegetation and that mitigation through the Certification or WDRs may be applicable to satisfy requirements. MM 3.8.5b is more specific, proposing compensatory mitigation through an in-lieu fee program and/or impact avoidance and minimization. The above-referenced Oak Tree Mitigation Plan (MM 3.11.4) would likely be a major part of these riparian mitigation measures, and it must mitigate for temporal loss of the oak-riparian forest habitat as well as for permanent habitat loss. Also, Regional Board staff considers the possible locations for on-site mitigation indicated on the Potential Mitigation Sites Map (Final EIR, no figure) to be a favorable guide toward final determination of compensatory mitigation. Finally, Final EIR p.14 proposes that 1.64 acres of riparian habitat enhancement be created onsite; Regional Board staff wishes the exact locations of this enhancement to be mapped and reviewed against current conditions of the drainages and any required mitigation ratios from other agencies. 18-8

Mitigation sites must be protected from other uses by conservation easements or other appropriate restrictive land use instruments. A conservator should be found to manage onsite/offsite mitigation sites in perpetuity. 18-9

4. Final EIR

The February 2013 Final EIR should not be certified until it is revised to include the above discussions, particularly: 1) the verified Jurisdictional Delineation, and 2) mapped/described locations for all probable riparian mitigation proposals onsite and/or offsite, including a potential alternative shift of the Bundy Canyon Road alignment to avoid the eastern oak riparian cluster. 18-10 18-8 cont. 18-1 cont.

If you have any questions, please contact Glenn Robertson at (951) 782-3259 or Glenn.Robertson@waterboards.ca.gov, or me at (951) 782-3234 or Mark.Adelson@waterboards.ca.gov

Sincerely,

Glenn Robertson, for

Mark G. Adelson, Chief
Regional Planning Programs Section

Cc: State Clearinghouse
U.S. Army Corps of Engineers, Los Angeles – Mark Durham
California Dept. of Fish and Game, Ontario- Juan J. Lopez-Torres
California Regional Water Quality Control Board, San Diego Region – Christopher Means
Riverside County Transportation Department – Mary Zambon

X:Groberts on Magnolia/Data/CEQA/CEQA Responses/ DEIR- City of Wildomar - Oak Creek Canyon Dev.doc

Letter 18: Santa Ana Regional Water Quality Control Board

Responses

18-1 The commenter states that the project would realign Bundy Canyon Road between The Farm Road and Sunset Avenue. This realignment would shift the road toward the east, decrease its curve, and increase lanes to match an adjacent widening project to be conducted by the Riverside County Transportation Department. The commenter is unclear whether the exact alignment of the roadbed has been set. The commenter also notes several acreages listed as the project size.

The proposed project incorporates a portion of the Bundy Canyon Road/Scott Road Project engineered by the Riverside County Transportation Commission (RCTC). The precise alignment was provided to the applicant prior to design and submittal of Tentative Tract Map 36388, which is part of the proposed project. As the alignment and the entire Bundy Canyon/Scott Road Project is part of the RCTC project, neither the applicant nor the City has the ability to change the alignment.

As requested by the commenter, the City evaluated the potential to move the roadway alignment. The combination of design speed for the roadway, existing development along the route, and the constraints of meeting the existing roadway at the west and east edges of the property restrict the potential roadway alignment. If the road is moved to the south (see **Figure 18-1**), two Farm residences would be impacted and the road would eliminate one of the Farm Mutual Water Company's two water wells. Moreover, the ultimate construction of the road as designed currently overlaps an area of existing impacts to Cottonwood Creek associated with the existing culvert beneath Bundy Canyon Road. Therefore, the southerly shift to the road design would ultimately result in increased impacts to RWQCB "waters of the State" associated with Cottonwood Creek, which supports the highest biological function and value on the site by shifting the entire footprint of the road further upstream where an overlap with existing impact cannot be utilized. If the roadway is shifted north (see **Figure 18-2**), it would eliminate a heritage oak that was avoided by the project, conflict with two large stands of oak trees, impact 36 properties and 12 homes, and result in a wider crossing of Cottonwood Creek. The majority of impacts to the significant stands of oaks north of the existing alignment of Bundy Canyon Road associated with Cottonwood Creek are likely to be considered jurisdictional by the resource agencies, resulting in increased impacts to biological function and value resources compared to the proposed project. A more northerly alignment would also eliminate the existing County Water Company well.

The project size listed in the MSHCP consistency analysis included the initial proposed project size of 151.23 acres and land surrounding the proposed project site. The EIR will be revised to consistently use this 151.23-acre size.

18-2 The commenter requests that this comment and the following comments be incorporated into the FEIR to protect water quality standards identified in the *Water Quality Control Plan for the Santa Ana River Basin* (1995), as amended (Region 8 Basin Plan). The commenter states that Section 3.7, Hydrology and Water Quality, primarily focuses on compliance with the San Diego Regional Board even though a majority of the project falls within the jurisdiction of Santa Ana Regional Board. The commenter requests clarification on Figure 3.7-1 to illustrate that the majority of the project is within the jurisdiction of the Santa Ana Regional Board.

The requested changes to the Draft EIR have been made as shown on page 3.0-5 of this Final EIR. The requested change clarifies that the San Diego Regional Water Quality Control Board (RWQCB) is the regulating entity for stormwater runoff from the proposed project pursuant to the municipal storm drain permit (MS4 Permit), but that regulatory responsibility for impacts to US Army Corps of Engineers (USACE)/RWQCB jurisdictional "waters of the United States," through issuance of a Section 401 Water Quality Certification pursuant to the federal Clean Water Act, and/or impacts to non-federal isolated RWQCB "waters of the State," through issuance of Waste Discharge Requirements pursuant to the Porter-Cologne Water Quality Act, remains within the jurisdiction of the Santa Ana Regional Water Quality Control Board. See also response 18-3.

18-3 The commenter states that one of three primary drainages is located in the southwestern portion of the site and is jurisdictional to the San Diego Regional Board (within the Santa Margarita River watershed boundary) and will not be impacted by the project and therefore not discussed further in this letter. The commenter states that water quality objectives and beneficial uses within the Santa Ana region were not addressed and must be included. The commenter also states that the project's tributaries to Cottonwood Canyon Creek and eventually San Jacinto River Reach 1 must have beneficial uses protected or mitigated for where impacted. The commenter requests that water quality objectives to be met by the project's wet and dry weather runoff be included in the FEIR.

The preliminary Water Quality Management Plan (WQMP) provided as Appendix 3.7-2 of the DEIR references the beneficial uses for San Jacinto River Reach 1 identified in the Region 8 Basin Plan and was prepared with specific consideration of the Drainage Area Management Plan for the Santa Ana Watershed (see page 3.7-18 in the DEIR) based on the fact that all impervious surfaces associated with the proposed development drain to the Santa Ana watershed. As such, the water quality facilities and best management practices (BMPs) for the proposed project were designed in compliance with federal, state, regional, and local guidelines to ensure that impacts to beneficial uses and/or water quality objectives for both the Santa Margarita and the Santa Ana watersheds are mitigated to a level of less than significant under CEQA.

Based on the preliminary WQMP and as supported by mitigation measure MM 3.7.1, beneficial uses and water quality objectives for San Jacinto River Reach 1 will be addressed during grading and construction by preparation and compliance with the forthcoming stormwater pollution and prevention plan (SWPPP) based on guidelines provided in the National Pollutant Discharge Elimination System (NPDES) and the State Water Resources Control Board's (SWRCB) General Construction Permit. Post-construction protection of beneficial uses and water quality objectives for San Jacinto River Reach 1 and the Elsinore Groundwater Management Zone will be accomplished through the implementation of the Site Design Concepts and BMPs presented in the preliminary WQMP, including the construction of eight water quality basins, seven of which also function to mitigate increased runoff and keeping post-project discharge at or below pre-project levels in compliance with the SWRCB's MS4 permit requirements. Pages 3.7-17 and 3.7-18 of the DEIR specifically state, "Expected pollutants for the project site include sediment/turbidity, nutrients, organic compounds (petroleum hydrocarbons), trash and debris, oxygen demanding substances, bacteria, viruses, pesticides, and metals" and that "…the proposed extended detention basins have been designed to adequately treat the on-site flows for water quality purposes as well as to mitigate flows for increased runoff." Thus, the proposed project is designed to meet all of the water quality objectives of the Santa Ana Region Basin Plan. However, the specific wet- and dry-weather runoff

pollutant concentrations have been added to the Final EIR as Table 3.7-3.5 as requested by the commenter. In addition, the preliminary or final WQMP will be provided to the Santa Ana RWQCB as part of the forthcoming Section 401 Water Quality Certification application for the development in order to ensure RWQCB concurrence with methods proposed to (1) protect beneficial uses and (2) provide compliance with water quality objectives as set forth by the Santa Ana Region Basin Plan.

In sum, the DEIR discusses the beneficial uses in Section 3.7 of the Draft EIR beginning on page 3.7-15. The water quality objectives have been specifically articulated in the Final EIR as Table 3.7-3.5 as requested by the commenter.

18-4 The commenter notes that the Oak Tree Inventory Map was not included in the EIR. The commenter requests that accompanying Attachment G, an aerial view of the site's drainages and numbered maturing oak individuals be included in the FEIR.

The Oak Tree Inventory Map was prepared by the applicant and presented to the Planning Commission at the first public hearing on the proposed project on March 6, 2013. The map was also part of the staff report presented at the Planning Commission meeting. The map was prepared to comply with part 1 of mitigation measure MM 3.11.4 as discussed on page 3.11-8 of the Draft EIR. The map provides the precise location of oak trees and further refines the oak trees shown on Figure 3.8-1, Biological Resources Map, of the Draft EIR. While the Oak Tree Inventory Map is already part of the record, the map has been included as Figure 3.8-5 and made part of the Draft EIR. It should be noted that Part 1 of mitigation measure MM 3.11.4 in the DEIR requiring the replacement of oak trees is solely a discretionary requirement by the City of Wildomar. Therefore, the oak tree replacement mitigation areas may or may not be utilized to address impacts to jurisdictional waters by the project as part of subsequent regulatory permits, the feasibility of which will ultimately be determined by resource agencies during processing of regulatory permits for the project.

18-5 The commenter disagrees with Section 4.0 that enough riparian avoidance would be implemented with the mitigation measures proposed. The commenter states that impacts to waters of the United States and State should be avoided to the maximum extent possible. Additionally, the commenter states that Impact 3.11.4 identifies an adverse aesthetic impact and as such, this impact should be added to the "Cumulative Impacts to Biological Resources."

The mitigation measures require that the proposed project result in no net loss of riparian vegetation through the implementation and/or acquisition of on- or off-site compensatory mitigation, which is subject to review and approval by the resource agencies and the County of Riverside Environmental Programs Department as part of the regulatory permitting process. With the exception of the proposed road impacts, the most significant extent of riparian vegetation on the site within Cottonwood Creek is avoided, in addition to an entire ephemeral drainage with riparian vegetation that initiates near the northwest corner of the site. Moreover, the majority of the riparian impacts on the site are associated with the proposed road design, the alignment of which cannot be changed by the applicant or the City as mentioned in response 18-1. The remaining riparian impacts associated with the development have been minimized to the greatest feasible extent by the applicant and are based on engineering logistics and economic feasibility required to implement the proposed development.

The impact on oak trees is discussed as a cumulative impact in Section 3.11, Aesthetic and Visual Resources, of the Draft EIR beginning on page 3.11-7. The biological analysis discusses cumulative impacts on page 3.8-32 of the Draft EIR and lists the mitigation measures included in the DEIR section as reducing the cumulative impacts to a less than significant level. Because mitigation measure MM 3.11.4 on page 3.11-8 of the Draft EIR already requires replacement of oak trees impacted by the proposed project, it is reasonable to simply repeat the mitigation measure and discussion in the Biological and Natural Resources section of the DEIR. See also response 18-4.

18-6 The commenter states that no wetlands were identified or delineated, including isolated wetlands such as vernal pools, and that a Jurisdiction Delineation must still obtain agency verification. However, a proposed total of 4,061 linear feet and 0.219 acre of on-site impacted waters of the United States would be jurisdictional to the US Army Corps of Engineers and will require their issuance of a Clean Water Act Section 404 Permit. The commenter requests that the City apply for a Section 401 Certification as a prerequisite to the 404 Permit, once the Corps has issued notification of this requirement.

The EIR requires mitigation of impacts to both wetlands and waters of the State through compliance with permits discussed in the Draft EIR beginning on page 3.8-27 and mitigation measures MM 3.8.4 and MM 3.8.5a (see also the amendment to mitigation measure MM 3.8.5a on page 3.0-8 of the Final EIR). As such, the extent of USACE, RWQCB, and CDFW (collectively "the resource agencies") jurisdictional waters associated with the site will be confirmed by the resource agencies as part of the Section 404, 401, and 1602 permitting process for the proposed project. Although the USACE provides for formal Jurisdictional Determinations, there is no formal process to obtain resource agency concurrence for a proposed project site by the RWQCB or the CDFW site outside of a permit action. CEQA requires adequate evaluation of impacts to biological resources by a proposed project, which in the case of this project was adequately evaluated by the project biologist and included in the Draft EIR. The applicant is in the process of preparing regulatory permit applications for the project, including a formal Jurisdictional Determination request to the USACE and a Section 401 Water Quality Certification to the Santa Ana RWQCB.

18-7 The commenter states that the EIR identified potentially jurisdictional waters of the State (CDFW) and shows the total acres of impacted state waters. Additionally, the commenter requests clarification for acreages where regional and state waters do not overlap. The commenter states that waste discharge requirements (WDRs) for the regulation of excavation and fill impacts will be issued by the Regional Board where regional and state waters do not overlap.

All of the RWQCB jurisdictional drainage features on the property overlap with the federal jurisdictional waters of the United States, and there are no isolated non-federal waters of the State known to occur on the project site. Therefore, the extent of RWQCB jurisdiction is consistent with the extent of USACE jurisdictional waters of the United States. The City is not aware of any existing regulatory guidance pursuant to the Porter-Cologne Water Quality Act, or otherwise, that requires regulation of CDFW jurisdiction by the RWQCB as waters of the State as seems to be suggested by the commenter. The extent of CDFW jurisdiction is generally defined by the California Fish and Game Code as the limits of a "defined bed and bank and streambed associated riparian vegetation," whereas in the case of isolated waters of the State, the extent of RWQCB jurisdiction is presumed to be consistent with field indicators typically associated with federal

jurisdiction, such as the limits of an ordinary high water mark, and does not extend to the limits of CDFW jurisdiction (which also regulates isolated streambed resources).

18-8 The commenter states that a mitigation plan will be required with the certification application for the loss of beneficial uses to waters of the United States and of the State caused by impacts. Additionally, the commenter states that the Oak Tree Mitigation Plan must mitigate for the temporal loss of the oak-riparian forest habitat as well as for permanent habitat loss. The commenter requests that the exact locations of the proposed on-site riparian habitat be mapped. The commenter also requests all probable riparian mitigation proposed on-site and/or off-site be mapped/described.

Impacts to jurisdictional resources that support oak trees are typically evaluated by the resource agencies as part of riparian vegetation community. In the case of this project, impacts to individual oak trees will likely be mitigated separately within proposed open space areas (see also response 18-4). The applicant will include a proposal of compensatory mitigation for impacts to RWQCB jurisdictional waters with consideration to temporal loss of riparian habitat including oak trees, where applicable, as part of the Section 401 Water Quality Certification application for the proposed project. As stated in the DEIR, the project proposes to mitigate impacts to jurisdictional streambed resources through the implementation and/or purchase of on- or off-site mitigation subject to review and approval by the resource agencies as part of the regulatory permit process. Should on-site mitigation for riparian mitigation be deemed feasible by the applicant in conjunction with the resource agencies, mapping of on-site riparian mitigation areas will be included as part of a Habitat Mitigation and Monitoring Plan to be reviewed and approved during the processing of regulatory permits for the project.

18-9 The commenter requests that a conservator be utilized to manage on/off-site mitigation areas in perpetuity.

On-site mitigation for impacts to jurisdictional resources, if determined feasible by the applicant in conjunction with the resource agencies, will be preserved in perpetuity through the use of an appropriate legal preservation mechanism.

18-10 The commenter requests that the FEIR not be certified until all revisions above are incorporated into the document.

As stated in response 18-6, only the USACE, which is not a trustee agency to CEQA, provides for formal Jurisdictional Determinations. The RWQCB does not have a method to provide a formal jurisdictional determination outside of a Section 401 or WDR permit action, which generally takes several months to over a year to process. CEQA does not require issuance of a formal jurisdictional determination in the presence of an adequate evaluation of biological resources, including streambeds, which has been provided as part of the DEIR.

Compensatory mitigation is subject to review and approval and typically considered to be conceptual in nature as part of regulatory permit applications given the potential for the resource agencies to revise the location, type, and/or extent of such mitigation proposals. The DEIR included a proposal of compensatory mitigation intended to compensate for impacts to USACE, RWQCB, and/or CDFW jurisdictional waters to include on- or off-site mitigation subject to resource agency review and approval. Moreover, the Determination of Biologically Equivalent or Superior Preservation provided at Attachment

A of the FEIR includes an exhibit labeled "Potential Mitigation Sites" that is conceptual in nature and depicts the 1.64 acres of riparian habitat enhancement on the site.

Therefore, based on the fact that an adequate jurisdictional assessment has been performed on the site, a formal jurisdictional delineation will take several months to obtain, a verified jurisdictional delineation is not a CEQA requirement, and areas of conceptual on-site mitigation have already been mapped and included in the FEIR, certification of the FEIR need not be unreasonably withheld.

3.0 Minor Revisions to the Draft EIR

3.1 INTRODUCTION

This section includes minor edits to the Draft EIR. These modifications resulted from responses to comments received during the Draft EIR public review period as well as from staff-initiated changes.

Revisions herein do not result in new significant environmental impacts, do not constitute significant new information, and do not alter the conclusions of the environmental analysis. Changes are provided in revision marks (underline for new text and ~~strikeout~~ for deleted text).

3.2 MINOR CHANGES AND EDITS TO THE DRAFT EIR

The following changes are made to the Draft EIR based on comments received on the project and review of those comments by the City and by the technical experts responsible for the supporting studies.

TABLE OF CONTENTS

The table of contents of the Draft EIR will be amended to reflect changes in appendices through the addition of the one new attachment and two new figures referenced in this Final EIR.

Attachment A will be Appendix 3.8-4	DBESP (NEW)
Figure 1.0-1	Regional Location Map (REVISED)
Figure 1.0-2	Proposed Project Site (REVISED)
Figure 2.0-3	Proposed Zoning (REVISED)
Figure 2.0-7	Proposed Park Trails and Basins (REVISED)
Figure 3.3-10	Project Mitigation Measures (REVISED)
Figure 3.3-11	Approved Trail Map (NEW)
Figure 3.8-4	Project Impact on Riverine and Riparian Habitat (NEW)
Figure 3.8-5	Oak Tree Inventory Map (NEW)

EXECUTIVE SUMMARY

The mitigation measures in the Executive Summary are modified as indicated below.

SECTION 1.0, INTRODUCTION

Subsection 1.2, Regional Location, on page 1.0-1 is amended as follows:

> The City of Wildomar is located in the southwestern portion of Riverside County along Interstate 15 (I-15) southeast of Lake Elsinore and west of the City of Menifee.

Figures 1.0-1 and 1.0-2 are amended to show the location of the City of Menifee.

Subsection 1.4, Known Trustee and Responsible Agencies, on page 1.0-9 is amended as follows:

Under the list of trustee agencies, the following wording change is made:

- California Department of Fish and ~~Game~~ Wildlife, Region 6 ~~(CDFG)~~ (CDFW)

Please note that the change in agency name from the California Department of Fish and Game to the California Department of Fish and Wildlife took effect on January 1, 2013. The change should be considered global throughout the EIR when referring to this agency.

The following agency is added to the list of responsible agencies:

- City of Menifee

The text under Notice of Preparation under 1.8 Environmental Review Process on page 1.0-11 is amended as follows:

> In accordance with Section 15082 of the CEQA Guidelines, the City prepared a Notice of Preparation (NOP) of an EIR for the project on March 5~~19~~, 2012. The City was identified as the lead agency for the proposed project. The notice was circulated to the public, local, state, and federal agencies, and other interested parties to solicit comments on the proposed project.

SECTION 2.0, PROJECT DESCRIPTION

Figure 2.0-1 is amended to reflect the RC:LDR land use designation of the City of Menifee.

Figure 2.0-7 is amended to show the location of the Sunset Avenue Trail on the west side of Sunset Avenue.

Under subsection 2.4, Regulatory Requirements, Permits, and Approvals Potentially Required From Other Public Agencies, the following changes are incorporated:

- *California Department of Fish and ~~Game (CDFG)~~ Wildlife (CDFW):* A 1603 Streambed Alteration Agreement may be required.

- *City of Menifee:* Encroachment permit and coordination for improvements on the east side of Sunset Avenue.

Page 2.0-29, the following shall be added after the second full paragraph under Public Utilities:

> The proposed project will connect to The Farm Mutual Water Company water system. The proposed project will extend the existing 10-inch water line in Bundy Canyon Road from Harvest Way West to Harvest Way East. A 16-inch water line will extend from the water storage tanks to the proposed commercial area to the east along Beverly Street to J Street then south to Bundy Canyon Road to the east end of lot 313, as shown on Figure 2.0-4e. In the residential areas of the proposed project, 8- or 12-inch water lines may be used, as residential development has a lower fire flow requirement per the California Fire Code. From the water lines in each street or utility easement, a smaller water lateral or "service" will be extended to each house from a meter box typically located at the edge of the right-of-way. A water booster pump connected to the 10-inch water line in Bundy Canyon Road will be used to pump water from the existing 10-inch line into the two new 500,000-gallon water storage tanks.
>
> The proposed project will construct an 8,600-foot portion of the EVMWD's planned gravity system that extends from The Farm Road west in Bundy Canyon Road to a point near Valley Vista Circle. The 10-inch sewer line is identified as Gravity Sewer Improvement RP-23 in the EVMWD Wastewater Master Plan and included in the EVMWD EIR certified for the master plan. The sewer line will be located entirely within the road prism of Bundy Canyon Road,

which means that the sewer line will either be under the existing road pavement or along the graded shoulder immediately adjacent to the existing pavement.

Sewer laterals extend from each home to sewer lines contained in the public streets or utility easements as shown on Figures 2.0-4c through 2.0-4e. The sewer laterals leading from each home are 4 inches in diameter and will lead to sewer lines that are 6 inches in diameter. The sewer lines will extend either to the 10-inch sewer main proposed for Bundy Canyon Road or to a lift station located on lot 314 shown on Figure 2.0-4d. The sewer lift station would then lift the sewage to the sewer main in Bundy Canyon Road where it flows by gravity to the EVWMD regional wastewater treatment plant located on Chaney Street in the City of Lake Elsinore.

SECTION 3.1, LAND USE

The last sentence under General Plan Designations on page 3.1-1 is amended as follows:

The portion of land to the east of the proposed project that is in the City of Menifee is designated Low Density Residential under the Rural Community Foundation (RC:LDR).

Subsection 3.1.2, Regulatory Framework, is amended as follows:

City of Wildomar General Plan

Upon incorporation in 2008, the City of Wildomar adopted the Riverside County General Plan. The adopted General Plan, which was drafted in 2003, is a unit of the Riverside County Integrated Project and aims to manage the overall pattern of development in the county. ~~In 2012, the City updated the Housing Element of the General Plan by identifying and establishing Wildomar's policies with respect to meeting the needs of existing and future residents in the city.~~

The first goal of the ~~recently adopted~~ Housing Element of the Wildomar General Plan is to assist in the development of adequate housing to meet the city's fair share of the region's housing needs for all economic segments of the population. The Housing Element identifies the following policies that are relevant to the proposed project:

- Policy 1.2d: Identify areas of the city with adequate infrastructure and limited environmental constraints that are most suited to the construction of housing, particularly housing affordable to low/moderate-income households and high-density product types.

- Policy 1.7c: Continue to provide for greater flexibility in the design of single-family development through the processing of PDs, Specific Plans, and Area Plans, and application of density provisions, when requested, to allow for varying lot sizes and development standards than normally required in residential districts.

- Policy 1.7d: Encourage new large-scale development proposals to provide a range of housing types and densities for all income levels through the use of creative planning concepts such as specific plans and mixed-use development.

- ~~Policy H-1: Ensure there is a sufficient supply of multi-family and single-family zoned land to meet the housing needs identified in the Regional Housing Needs Allocation (RHNA).~~

- ~~Policy H-2: Maintain land use policies that allow residential growth consistent with the availability of adequate infrastructure and public services.~~

The General Plan focuses on community development to concentrate development to achieve community focal points, stimulate a mix of activities, promote economic development, achieve more efficient use of land, create a transit-friendly and walkable environment, and offer a broader mix of housing choices for implementing its vision.

Table 3.1-1 on page 3.1-5 is amended as follows:

TABLE 3.1-1
SUMMARY OF RESIDENTIAL ZONE DISTRICTS

City of Menifee						
Zone	Min. Lot Size	Coverage	Max. Height	Setbacks		
				Front	Rear	Side/Exterior
R-A, 2.5	2.5 acres		40′	20′	*10′	*5

SECTION 3.3, TRAFFIC AND CIRCULATION

Figure 3.3-10 is amended to include the following asterisked note for the I Street and Bundy Canyon Intersection Number 7:

* Raised concrete median to left-out and through movements.

On page 3.3-55, mitigation measure MM 3.3.1 is revised as follows:

Sunset Avenue/Bundy Canyon Road

- Install a traffic signal.
- Construct an eastbound left turn lane and two additional through lanes.
- Construct a westbound left turn lane.
- Ensure a northbound and southbound lane of traffic along the frontage of the commercial parcel.
- Coordinate improvements with the City of Menifee.

The second paragraph under Impact 3.3.2 on page 59 of the Draft EIR is amended as follows:

The City of Wildomar has neither a developed bicycle trail system nor a plan for a bicycle system. Although the proposed project has open space and is likely to have trails, these will be recreation oriented ~~and are not anticipated to~~ and will connect to other trail systems. The City adopted the Multi-Use Trail System Adopt a Trail Map that shows the Sunset Avenue Regional Trail N-S-14 along the west right-of-way of Sunset Avenue. The Sunset Avenue Trail follows Sunset Avenue roadway to the south, eventually connecting to the Hampton-Hirst (HT-E-50) and Keller Road Regional Trail (W-E-20). The proposed project incorporates the 14-foot Sunset Trail easement as part of right-of-way improvements on Sunset Avenue as shown

in Figure 2.0-4b and will be constructed as part of the proposed project. The Bundy Canyon Road improvements will be designed to accommodate bicycle traffic, which will ensure eventual connectivity to other roadways in the community. This impact is considered **less than significant**.

On page 3.3-61 of the Draft EIR, timing/implementation for mitigation measure MM 3.3.4 is amended as follows:

Timing/Implementation: Prior to ~~fling~~ filing of a final map

SECTION 3.7, HYDROLOGY AND WATER QUALITY

The first paragraph on page 3.7-9 shall be amended as follows:

The federal Clean Water Act (CWA) gives states the primary responsibility for protecting and restoring water quality. In California, the State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards (RWQCBs) are the agencies with the primary responsibility for implementing federal CWA requirements, including developing and implementing programs to achieve water quality standards. Water quality standards include designated beneficial uses of water bodies, criteria or objectives (numeric or narrative) which are protective of those beneficial uses, and policies to limit the degradation of water bodies. The project site is located in a portion of the state that is regulated by *both the Santa Ana and* San Diego Regional Water Quality Control Board (SDRWQCB), and the water quality standards for water bodies in the San Diego region are primarily contained in the *Water Quality Control Plan for the San Diego Basin* (Basin Plan) (SDRWQCB 1994), which is discussed in more detail below.

The first paragraph under REGIONAL on page 3.7-11 shall be amended as follows:

The project site is actually within the jurisdictional boundaries of two RWQCBs—the San Diego RWQCB and the Santa Ana RWQCB. However, in 2010 the Santa Ana and San Diego Regional Water Quality Control Boards agreed to a jurisdictional exchange to reduce the complexity of Small Municipal Separate Storm Sewer System (MS4) Permit administration and compliance. Under this exchange, the cities of Wildomar and Murrieta, including the proposed project site, are regulated wholly by the SDRWQCB and are required to comply with the SDRWQCB MS4 Permit (NPDES No. CA S0108766, Order No. R9-2010-0016). *Except for the San Diego Regional Board's regulation of stormwater runoff for all of the City of Wildomar, each Regional Board has jurisdiction for other regulations within its own watershed (i.e. Clean Water Act Section 401 Water Quality Certification, etc.) As shown in Figure 3.7-1, Watershed Map, the majority of the proposed project is within the jurisdiction of the Santa Ana Regional Board.*

The following shall be added following the last paragraph under **Water Quality Control Plan for the San Diego Basin (Basin Plan)** on page 3.7-12.

Water Quality Control Plan for the Santa Ana (Basin Plan)

The Water Quality Control Plan for the Santa Ana Basin is the bases for the Regional Board's regulatory programs. The Basin Plan establishes water quality standards for all the ground and surface waters in the Santa Ana Basin. The standards include both the beneficial uses of specific water bodies and the levels of water quality that must be met and maintained to protect those uses. The Basin Plan includes and implementation plan describing the actions by the Regional Board and others that are necessary to achieve and maintain the adopted water quality standards.

The Santa Ana RWQCB issues permits, called waste discharge requirements and master reclamation permits, which require that waste and reclaimed water not be discharged in a manner that would cause an exceedance of applicable water quality objectives or adversely affect beneficial uses designated in the Basin Plan. The SDRWQCB enforces these permits through a variety of administrative means.

The following shall be added after the second paragraph on page 3.7-22:

The Santa Ana Regional Water Quality Control Board has established the objectives shown in ***Table 3.7-3.5*** *to be met by the project's wet and dry-weather runoff.*

TABLE 3.7-3.5
SANTA ANA REGIONAL WATER QUALITY CONTROL BOARD PROJECT WATER QUALITY OBJECTIVES

	Cottonwood Creek	San Jacinto River Reach 1	Elsinore Groundwater Management Zone
Total Dissolved Solids (TDS)	150 mg/l	450 mg/l	450 mg/l
Hardness	70 mg/l	260 mg/l	280 mg/l
Sodium (Na)	10 mg/l	50 mg/l	50 mg/l
Chloride (CL)	12 mg/l	65 mg/l	60 mg/l
Total Inorganic Nitrogen (TIN)	1 mg/l	3 mg/l	
Sulfate (S04)	15 mg/l	60 mg/l	60 mg/l
Chemical Oxygen Demand (COD)	5 mg/l		
Nitrate Nitrogen (N03-N)			4 mg/l

Source: mg/l = milligrams/liter

Mitigation measure 3.7.1 shall be amended as follows:

MM 3.7.1 Prior to the approval of the grading permit for future development on the project site, the project applicant(s) shall be required to prepare a stormwater pollution and prevention plan (SWPPP) consistent with the NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Order No. 2010-0014-DWQ), which is to be administered through all phases of grading and project construction. The SWPPP shall incorporate best management practices (BMPs) and be consistent with the *Riverside County Stormwater Quality Best Management Practice Design Handbook* to ensure that potential water quality impacts during construction phases are minimized. The SWPPP shall be submitted to the Regional Water Quality Control Board and to the City of Wildomar for review. A copy of the SWPPP must be kept accessible on the project site at all times. In addition, the project applicant(s) will be required to submit, and obtain City approval of, a Water Quality Management Plan prior to the issuance of any building or grading permit for future development on the project site in order to comply with the Areawide Urban Runoff Management Program. The project shall implement site design BMPs, source control BMPs, and treatment control BMPs as identified in the Water Quality Management Plan. Site design BMPs shall include, but are not limited to, landscape buffer areas, on-site ponding areas, roof and paved area runoff directed to

vegetated areas, and vegetated swales. Source control BMPs shall include, but are not limited to, education, landscape maintenance, litter control, parking lot sweeping, irrigation design to prevent overspray, and covered trash storage. Treatment control BMPs shall include vegetated swales and a detention basin, or an infiltration device. The project will be responsible for maintenance of the basins to ensure they drain within 72 hours of a storm event.

SECTION 3.8, BIOLOGICAL AND NATURAL RESOURCES

Mitigation measure 3.8.2 on page 3.8-25 of the Draft EIR shall be amended as follows:

MM 3.8.2: The project applicant shall conduct construction and/or clearing activities outside of the avian nesting season (February 15–August 31), where feasible. However, if project construction and/or clearing activities are necessary within, or within proximity to, vegetated areas during the nesting bird season (February 15–August 31), the following is required:

Prior to construction activities during the avian nesting season (February 15–August 31), a qualified biologist shall conduct pre-construction nesting bird surveys pursuant to the Migratory Bird Treaty Act (MBTA) in the adjacent off-site and/or on-site vegetated areas for nesting birds and/or raptors. The survey shall begin not more than three days prior to the beginning of grading activities. No activities which would result in the take of active nests or any other violation of the MBTA shall be allowed. If project construction and/or clearing activities are not completed prior to the nesting bird season, and any nesting birds are determined present, appropriate avoidance buffers (generally 100–300 feet from an active nest, and up to 500 feet for raptors) will be imposed and monitored by a qualified biologist to ensure no violation of the MBTA occurs, and the appropriate resource agencies will be contacted if deemed necessary by the project biologist. Project activities may commence within avoidance buffers based only on recommendations by the project biologist to ensure compliance with the MBTA.~~f clearing and/or construction activities occur during nesting season, then preconstruction surveys for nesting raptors and migratory birds shall be conducted by a qualified biologist, up to 14 days before initiation of construction activities. The qualified biologist shall survey the construction zone and a 250-foot radius surrounding the construction zone to determine whether the activities taking place have the potential to disturb or otherwise harm nesting birds.~~

Mitigation measures MM 3.8.3a on page 3.8-26 and MM 3.8.3b on page 3.8-27 of the Draft EIR are amended as follows:

MM 3.8.3a Per MSHCP Species-Specific Objective 6, pre-construction presence/absence surveys for burrowing owl within the survey area where suitable habitat is present will be conducted for all covered activities through the life of the permit. Surveys will be conducted within 30 days prior to disturbance. ~~Take of active nests will be avoided. Passive relocation (use of one-way doors and collapse of burrows) will occur when owls are present outside the nesting season.~~ If owls are found on site during the pre-ground-disturbance survey, the City shall immediately notify both the Regional Conservation Authority (RCA) and the wildlife agencies. A conservation strategy will then be

developed by the wildlife agencies and the RCA in accordance with the CDFW's "Staff Report on Burrowing Owl Mitigation."

The breeding period for burrowing owls is February 1 through August 31, with the peak being April 15 to July 15, the recommended survey window. Winter surveys may be conducted between December 1 and January 31. If construction is delayed or suspended for more than 30 days after the survey, the area shall be resurveyed.

Surveys shall be completed for occupied burrowing owl burrows within all construction areas and within 150 meters (500 feet) out from the project work areas (where possible and appropriate based on habitat). All occupied burrows will be mapped on an aerial photo.

Timing/Implementation: *30 days prior to any vegetation removal or ground-disturbing activities*

Enforcement/Monitoring: *City of Wildomar Planning Department*

MM 3.8.3b Based on the burrowing owl survey results, the City shall require the project applicant to take the following actions to offset impacts prior to ground disturbance if owls are found to be present:

- If paired owls are nesting in areas scheduled for disturbance or degradation, nest(s) shall be avoided from February 1 through August 31 by a minimum of a 75-meter (250 feet) buffer or until fledging has occurred. Following fledging, owls may be passively relocated by a qualified biologist.

- If impacts on occupied burrows in the non-nesting period are unavoidable, on-site passive relocation techniques may be used if approved by the CDFG to encourage owls to move to alternative burrows outside of the impact area. However, no occupied burrows shall be disturbed during the nesting season unless a qualified biologist verifies through noninvasive methods that the burrow is no longer occupied. Foraging habitat for relocated pairs shall be provided in accordance with guidelines provided by the CDFG (2012).

- The RCA and wildlife agencies do not support passive relocation of burrowing owls except in narrow circumstances where there is suitable adjacent conserved land available. There is currently no suitable land adjacent to the project site. If relocation of the owls is approved for the site by the wildlife agencies, ~~CDFG,~~ the City shall require the developer to hire a qualified biologist to prepare a plan for relocating the owls to a suitable site. The relocation plan must include all of the following:

Mitigation measure MM 3.8.5a on page 3.8-29 of the Draft EIR is amended as follows:

MM 3.8.5a *To the extent required by applicable law or regulation, the* jurisdictional delineation shall be verified by the USACE and submitted to the City and the California Department of Fish and Wildlife for the appropriate action.~~, and submitted to the City for review.~~

The second paragraph under Cumulative Impacts and Mitigation Measures shall be amended as follows:

Implementation of mitigation measures **MM 3.8.8.a** through **MM 3.8.8c** ensures the project will be compliant with the MSHCP. As identified previously, implementation of mitigation measures **MM 3.8.4**, **MM 3.8.5a**, and **MM 3.8.5b** ensures no net loss of wetlands or waters of the State or waters of the United States. Implementation of mitigation measures **MM 3.8.2, MM 3.8.3a,** and **MM 3.8.3b** ensures that effects to nesting birds are minimized. *Implementation of **MM 3.11.4** in section 3.11 Aesthetic and Visual Resources ensures that the impact to oak trees is fully mitigated.* Though the development of the proposed project will continue the urbanization of the area that began long before incorporation of the city, mitigation measures associated with the proposed project will reduce the project's contribution to cumulative impacts to a **less than cumulatively considerable** level.

SECTION 3.9, CULTURAL RESOURCES

Mitigation measures for Impact 3.9.2 that begin on page 3.9-19 of the Draft EIR are amended as follows:

MM 3.9.2a At least 30 days prior ~~Prior~~ to the issuance of the first grading permit, the project applicant shall enter into a Cultural Resources Treatment and ~~Tribal~~ Monitoring Agreement with the Pechanga Band of Luiseno Indians and/or the Cahuilla Band of Indians. The agreement shall include, but not be limited to, outlining provisions and requirements for addressing the treatment of cultural resources; project grading and development scheduling; terms of compensation for the monitors; and treatment and final disposition of any cultural resources, sacred sites, and human remains discovered on the site; and establishing on-site monitoring provisions and/or requirements for professional Pechanga Tribal monitors during all ground-disturbing activities. A copy of this signed agreement shall be provided to the Planning Director and Building Official prior to the issuance of the first grading permit.

Timing/Implementation: *At least 30 days prior ~~Prior~~ to ground-disturbing activities and grading permit issuance*

Enforcement/Monitoring: *City of Wildomar Planning and Building Department*

MM 3.9.2b Should any culturall~~y~~ ~~significant~~ resources be uncovered during the grading and construction phases of the proposed project, work shall be halted or relocated to an area outside of the area in which the resource was found while ~~a qualified archeologist and tribal representative~~ the project archaeologist and the Pechanga representative identify the resource and reassess the area. If the resource found is determined to be an historical or unique archeological resource, a time allotment sufficient to allow for the implementation of avoidance measures or appropriate mitigation shall be made available. Work on the proposed project may continue in other areas of the project site while any historical or unique archeological resource mitigation takes place.

MM 3.9.2c Prior to beginning project construction, the project applicant shall retain a Riverside County qualified archaeological monitor to monitor all ground-

disturbing activities in an effort to identify any unknown archaeological resources. Any newly discovered cultural resource deposits shall be subject to a cultural resources evaluation in consultation with the Pechanga Tribe. The project archaeologist shall be responsible for updating the State DPR forms and completing an Archaeological Monitoring Report detailing the results of the monitoring program, including the final disposition of CA-RIV-8282 and CA-RIV-1256, updated DPR forms, a complete catalog list of resources collected during monitoring activities, and any other pertinent information related to the project. A final copy of the study shall be sent to the project applicant, the City of Wildomar, the Eastern Information Center, and the Pechanga Tribe.

Timing/Implementation: *During all grading and construction activities*

Enforcement/Monitoring: *City of Wildomar Planning Department* and *Public Works Department*

MM 3.9.2d Prior to beginning project construction, the project applicant shall file an archaeological monitoring report with the City to document the proposed methodology for grading activity observation, which will be determined in consultation with the Pechanga Tribe. Said methodology shall include the requirement for a qualified archaeological monitor to be present and to have the authority to stop and redirect grading activities. In accordance with the agreement required in mitigation measure MM 3.9.2, the archaeological monitor's authority to stop and redirect grading will be exercised in consultation with the Pechanga Tribe in order to evaluate the significance of any archaeological resource discovered on the property. Tribal and archaeological monitors shall be allowed to monitor all grading, excavation, and groundbreaking activities, and shall also have the authority to temporarily stop and redirect grading activities.

Timing/Implementation: *During all grading and construction activities*

Enforcement/Monitoring: *City of Wildomar Planning Department* and *Public Works Department*

MM 3.9.2e The landowner shall relinquish ownership of all cultural resources, including sacred items, burial goods, and all archaeological artifacts that are found on the project area to the Pechanga Tribe for proper treatment and disposition. The Tribe maintains a 36 CFR Part 79 standard facility and requests that all artifacts, not including human remains, sacred/ceremonial items, or grave goods, be curated at that facility. Further, all sacred sites, should they be encountered within the project area, shall be avoided and preserved as the preferred mitigation, if feasible.

Timing/Implementation: *During all grading and construction activities*

Enforcement/Monitoring: *City of Wildomar Planning Department and Public Works Department*

MM 3.9.2f Significant site CA-RIV-8282 cannot be avoided as the preferred option per CEQA. As there are no large boulder outcrops or other predominant features

located within this site, no measures are necessary for relocation. However, because the archaeological testing plan identified cultural resources on the surface and at least 35 centimeters in depth, controlled grading will occur within the boundaries of CA-RIV-8282 in order to observe any buried features, artifacts, or human remains that were not identified during testing. A plan detailing the controlled grading will be prepared in consultation with the Pechanga Tribe describing the process and duration of the grading in this area prior to grading in the CA-RIV-8282 area.

Timing/Implementation: *During all grading and construction activities*

Enforcement/Monitoring: *City of Wildomar Planning Department and Public Works Department*

MM 3.9.2g Significant site CA-RIV-1256 will be avoided through design of the project. Prior to development in the area, the project archaeologist and the Pechanga Tribe will fence the area to be protected. No impacts to the area should occur during grading. Upon completion of the grading in this area, the fencing will be removed. The Pechanga Tribe and the project applicant will develop a long-term management plan for CA-RIV-1256.

Timing/Implementation: *During all grading and construction activities*

Enforcement/Monitoring: *City of Wildomar Planning Department and Public Works Department*

3.10 PUBLIC SERVICES AND UTILITIES

The following shall be added under the paragraph in Impact 3.10.4b on page 3.10-17:

The proposed project will connect to the Farm Mutual Water Company water system, which will deliver EVMWD water to the proposed project. The proposed project will extend the existing 10-inch water line in Bundy Canyon Road from Harvest Way West to Harvest Way East. A 16-inch water line will extend from the water storage tanks to the proposed commercial area to the east end of lot 313, as shown on Figure 2.0-4e. The 16-inch water line is needed for the 3,000 gallon per minute fire flow required for commercial development. In the residential areas of the proposed project, 8- or 12-inch water lines may be used, as residential development has a lower fire flow requirement per the California Fire Code. A water booster pump connected to the 10-inch water line in Bundy Canyon Road will be used to pump water from the existing 10-inch line into the two new 500,000-gallon water storage tanks.

Final water line sizing is dependent on a number of factors, including length of street, number of hydrants, anticipated water pressure, and fire flow requirements. The exact size of the water line is determined during preparation of subdivision improvement plans for construction of the facility and is reviewed and approved by The Farm as part of their review of the construction documents.

With the exception of the new water storage tanks, all of the water system improvements will be underground and within road rights-of-way or within utility easements shown on the proposed subdivision map (see Figures 2.0-4a through 2.0-4e). The water system will be

looped within the proposed project, enabling portions of the system to be turned off as needed for maintenance.

From a construction standpoint, the physical difference in water pipe size between 8-, 10-, or 12-inch water line does not affect the width or depth of the trench and therefore the environmental impacts of construction are identical. The project roadways will be graded as part of the overall grading plan (see Figures 2.0-4c through 2.0-4e). Construction impacts associated with the installation of water system improvements are addressed through application of mitigation measures MM 3.3.4 (traffic management plan, page 3.3-60), MM 3.4.2a and MM 3.4.2b (air quality, page 3.4-19), MM 3.5.4a through MM 3.5.4c (noise, page 3.5-27), and MM 3.9.2a through MM 3.9.2g (cultural resources, page 3.9-19).

Mitigation Measures

~~None required.~~ Impacts are mitigated through application of mitigation measures required by other sections of this EIR: MM 3.3.4 (traffic management plan, page 3.3-60), MM 3.4.2a and MM 3.4.2b (air quality, page 3.4-19), MM 3.5.4a through MM 3.5.4c (noise, page 3.5-27), and MM 3.9.2a through MM 3.9.2g (cultural resources, page 3.9-19.)

Application of mitigation measures contained in this EIR will ensure that impacts involving cultural resources, dust, noise and traffic control during construction of water lines to serve the proposed project are **less than significant**.

The Wastewater Master Plan paragraph on page 3.10-21 of the Draft EIR is amended as follows:

Wastewater Master Plan

The EVMWD's Wastewater Master Plan (2003) evaluates the capacity of its wastewater collection system during peak wet weather flows and describes current services and plans to connect currently unserved areas and future development areas to the district's sanitary sewer system. The plan provides a detailed capital improvement program (CIP) for the necessary improvements to the existing wastewater collection system facilities and improvements needed for future growth, as well as a detailed cost summary and implementation plan. The master plan identifies a gravity sewer line in Bundy Canyon Road (RP-23) that will provide the connection from the existing line near Valley Vista Circle to the proposed project site. The EVMWD considered the impacts of the master water and sewer plans in the Draft Program Environmental Impact Report for the Water Distribution Master Plan and Wastewater Master Plan (SCH 2008111100). The EIR was circulated for public review from and certified by the EVMWD in July 2010.

Impact statement 3.10.5b on page 3.10-23 of the Draft EIR is modified as follows:

Impact 3.10.5b The proposed project will slightly increase wastewater flows. However, the increase represented by the proposed project will not require any additional infrastructure or treatment capacity beyond what is planned in the EVMWD master sewer and water plans. This impact is considered **less than significant**.

Under the second paragraph in Impact 3.10.5b on page 3.10-23 of the Draft EIR, the following is added as a new paragraph:

The proposed project will construct an 8,600-foot portion of the EVMWD's planned gravity system improvement that extends from The Farm Road west in Bundy Canyon Road to a point near Valley Vista Circle. The 10-inch sewer main is identified as project Gravity Sewer Improvement RP-23 in the EVMWD Wastewater Master Plan. The impacts of the Wastewater Master Plan were evaluated in the Elsinore Valley Municipal Water District Program Environmental Impact Report: Water Distribution Master Plan and Wastewater Master Plan (SCH 2008111100). The sewer line will be located entirely within the existing road prism of Bundy Canyon Road. The 10-inch line is shown on Figure 2.0-4c in Section 2.0, Project Description, of this Draft EIR. The sewer main represents a 0.45 percent increase in the approximate 348 miles of sewer mains operated by the EVMWD. Management for construction of the sewer connection is the responsibility of the EVMWD, consistent with the district's construction standards.

Sewer laterals extend from each home to sewer lines contained in the public streets or utility easements as shown on Figures 2.0-4c through 2.0-4e. The sewer laterals leading from each home are 4 inches in diameter and will lead to sewer lines that are 6 inches in diameter. The sewer lines will extend either to the 10-inch sewer main proposed for Bundy Canyon Road or to a lift station located on lot 314 shown on Figure 2.04-d. The sewer lift station would then lift the sewage to the sewer main in Bundy Canyon Road where it flows by gravity to the EVWMD regional wastewater treatment plant located on Chaney Street in the City of Lake Elsinore.

Construction impacts associated with all the sewer construction would be limited to the discovery of cultural resources during trenching, traffic control, noise, and dust control during construction. These impacts are addressed through application of mitigation measures MM 3.3.4 (traffic management plan, page 3.3-60), MM 3.4.2a and MM 3.4.2b (air quality, page 3.4-19), MM 3.5.4a through MM 3.5.4c (noise, page 3.5-27), and MM 3.9.2a through MM 3.9.2g (cultural resources, page 3.9-19).

Mitigation Measures

~~None required.~~ Impacts are mitigated through application of mitigation measures required by other sections of this EIR: (See also mitigation measures MM 3.3.4 (traffic management plan, page 3.3-60), MM 3.4.2a and MM 3.4.2b (air quality, page 3.4-19), MM 3.5.4a through MM 3.5.4c (noise, page 3.5-27), and MM 3.9.2a through MM 3.9.2g (cultural resources, page 3.9-19).

Application of mitigation measures contained in this EIR will ensure that impacts involving cultural resources, dust, noise and traffic control during construction of sewer lines to serve the proposed project are **less than significant**.

ATTACHMENTS

ATTACHMENT A – DETERMINATION OF BIOLOGICALLY EQUIVALENT OR SUPERIOR PRESERVATION (DBESP)

OCTOBER 2012

DETERMINATION OF BIOLOGICALLY EQUIVALENT OR SUPERIOR PRESERVATION

RIPARIAN/RIVERINE AREAS

TENTATIVE TRACT MAP 36388

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I. INTRODUCTION

Principe and Associates was hired by Bill Lo Consulting to prepare a Determination of Biologically Equivalent or Superior Preservation (DBESP) report on Riparian/Riverine Areas in compliance with the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP).

Tentative Tract Map 36388 is not part of the Bundy Canyon/Scott Road Improvement Project per se, except that the Tentative Tract Map 36388 project has been designed and engineered in response to the widening and realigning of Bundy Canyon Road, and the associated realigning of intersecting roads to maintain existing access.

This DBESP report will evaluate:

- Unavoidable permanent impacts to 0.82 acres of Riparian/Riverine Areas.
- Temporary impacts to 0.11 acres of unvegetated Riverine Areas.

The purpose of this DBESP report is to ensure replacement of any lost functions and values of Riparian/Riverine Areas as it relates to covered species.

II. DEFINITION OF THE PROJECT AREA

A. Project Area

The project area is located in the northeast corner of the City of Wildomar, Riverside County, California. It shares its east boundary line with the City of Menifee along Sunset Avenue, and is located approximately 0.5 miles south of the City of Lake Elsinore. The local area is referred to as The Farm. The Farm was originally developed in the 1970s as a 1,600-acre self-sustaining retirement community. It continues to expand and modernize as resident demographics change over time.

B. Site Information

The 163.25-acre site is located north and south of Bundy Canyon Road, approximately midway between Interstate Highways 15 and 215 in the City of Wildomar, Riverside County, California **(Site Vicinity Map)**. The local area is referred to as The Farm. It is mapped in a portion of Section 19, Township 6 South and Range 3 West of the USGS Topographic Map, 7.5 Minute Series, Romoland, California Quadrangle **(USGS Location Map)**.

Scale: 1"= 1000'

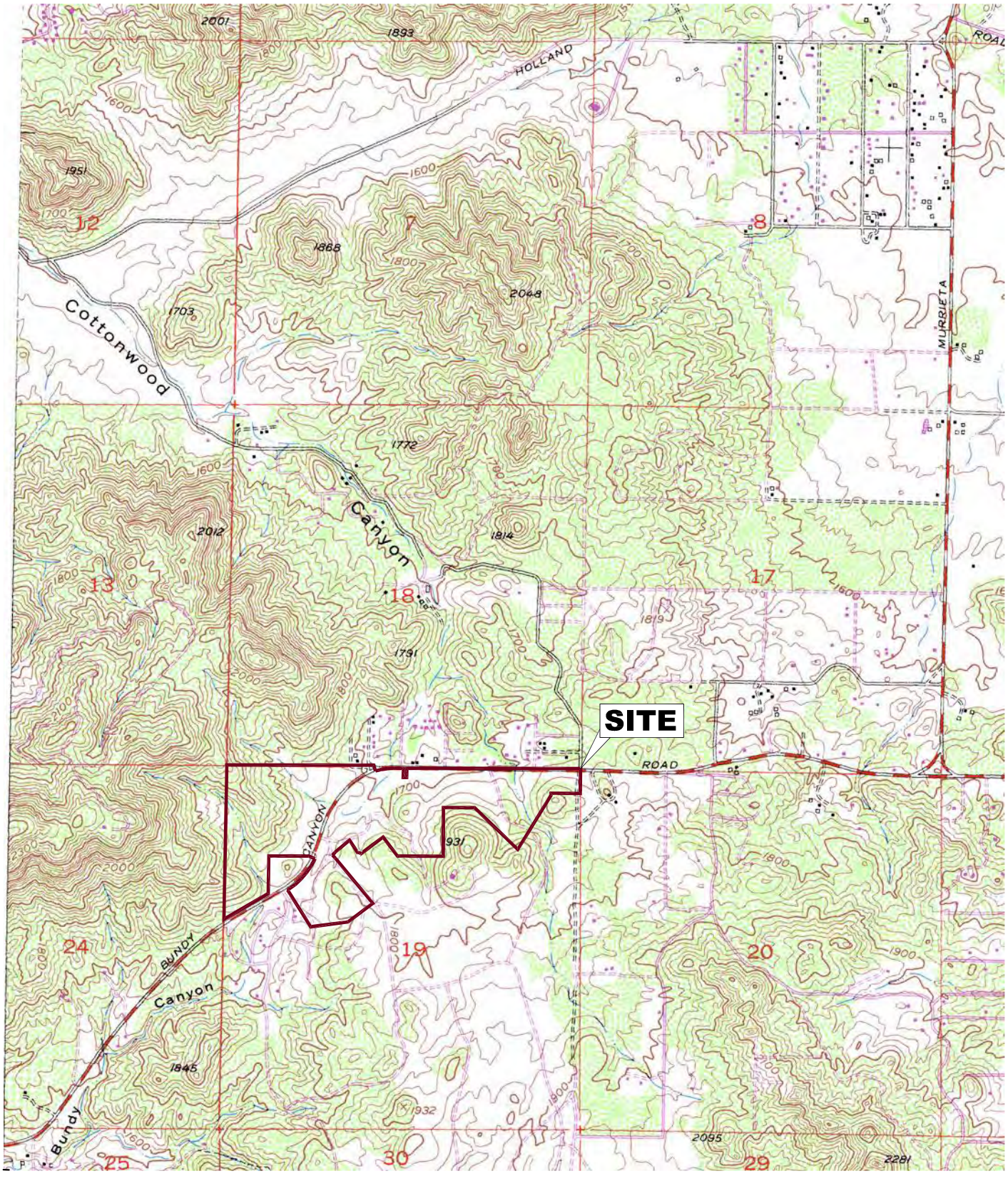
Feet

0 1000 2000

SITE VICINITY MAP

TENTATIVE TRACT MAP 36388

PRINCIPE AND ASSOCIATES



Base Map Source: USGS 7.5 Min.
Romoland, CA Quad.

0 2000 4000 Feet

USGS LOCATION MAP

TENTATIVE TRACT MAP 36388

PRINCIPE AND ASSOCIATES

Two of the 18 parcels of land comprising the site are located within Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP) Conservation Planning Criteria Areas. A total of 0.26 acres of the 163.25-acre site are located within Cell #5046 of Cell Group J' of the Sedco Hills Subunit (SU4) of the Elsinore Area Plan.

The recorded sizes of the 18 lots total 163.25 acres. The Assessor's Parcel Numbers are 362-070-001, 003, 006, 010, 013, 018, 021, 023, and 024; 362-080-004, 005, 007, 008, 009, and 012; 362-090-004, 009, and 015.

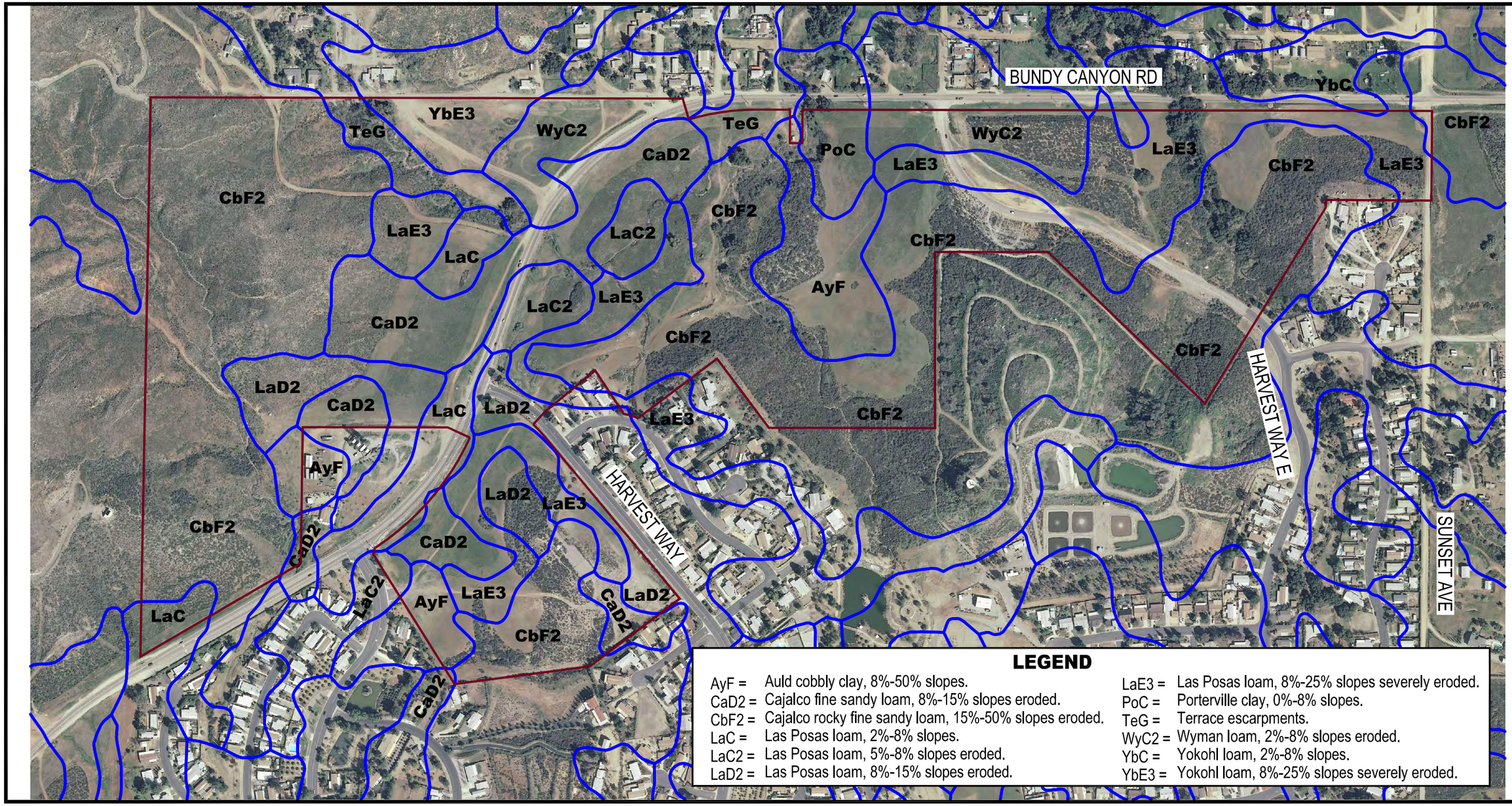
Topography of the site is varied, ranging from relatively flat-lying areas with gentle slopes to moderately sloping foothills to steep sloping hillsides with stream-cut valleys. The relatively flat areas located on the south side of Bundy Canyon Road are the result of agricultural land uses that have taken place for decades. All natural topographic irregularities have long been eliminated by seasonal plowing and discing. Elevation through the majority of the central portion of the site is between the 1720- and 1740-foot contours. Elevations along the base of the foothills is between 1740 and 1760 feet, and is also the result of past agricultural land uses. The highest elevation is present in the rugged northwest corner of the site, 1940 feet. There is a 190-foot change in elevation along the west property line (1940 to 1750). The southern portion of the site slopes downward to the north, and includes three areas with elevations above 1800 feet.

Three reaches of intermittent blueline streams designated on the USGS Romoland Quadrangle are present on the site. These streams are ephemeral in nature. Two of them originate in the relatively undeveloped Sedco Hills located west and northwest of the site. The other, Cottonwood Canyon Creek, originates on the Menifee Hills located south of the site, and passes through a small portion of The Farm. Water flows in the creek most of the year, with urban runoff as its source. Eight more ephemeral watercourses are present on the site. Five originate on the Sedco Hills, and have confluences with the two blueline streams. Two originate on the Menifee Hills, and have confluences with one of the blueline streams. The upstream reaches of these watercourses have been significantly altered by existing development at The Farm. The last one appears to have developed from storm water runoff along Bundy Canyon Road. The channel is not incised through the middle reach of this watercourse, but it does have a confluence with one of the blueline streams.

Due to continuous agricultural uses over decades, other kinds of permanent and/or semi-permanent aquatic features are not present on the site (i.e., wetlands, vernal pools and swales, vernal pool-like ephemeral ponds, stock ponds, etc.).

Review of the "Soil Survey of Western Riverside Area, California" revealed that the surficial soils at the site are included in the Cajalco-Temescal-Las Posas Association (Soils of the Southern California Coastal Plain). Within this association, 12 soil types have been mapped on the site **(Soils Map)**:

- AyF – Auld cobbly clay, 8 to 50 percent slopes.
- CaD2 – Cajalco fine sandy loam, 8 to 15 percent slopes, eroded.
- CbF2 – Cajalco rocky fine sandy loam, 15 to 50 percent slopes, eroded.



LEGEND

AyF =	Auld cobbly clay, 8%-50% slopes.	LaE3 =	Las Posas loam, 8%-25% slopes severely eroded.
CaD2 =	Cajalco fine sandy loam, 8%-15% slopes eroded.	PoC =	Porterville clay, 0%-8% slopes.
CbF2 =	Cajalco rocky fine sandy loam, 15%-50% slopes eroded.	TeG =	Terrace escarpments.
LaC =	Las Posas loam, 2%-8% slopes.	WyC2 =	Wyman loam, 2%-8% slopes eroded.
LaC2 =	Las Posas loam, 5%-8% slopes eroded.	YbC =	Yokohl loam, 2%-8% slopes.
LaD2 =	Las Posas loam, 8%-15% slopes eroded.	YbE3 =	Yokohl loam, 8%-25% slopes severely eroded.

Base Map Source: Soil Survey - Western Riverside Area, California

0 400 800 Feet

SOILS MAP

TENTATIVE TRACT MAP 36388

PRINCIPE AND ASSOCIATES

- LaC – Las Posas loam, 2 to 8 percent slopes.
- LaC2 – Las Posas loam, 5 to 8 percent slopes, eroded.
- LaD2 – Las Posas loam, 8 to 15 percent slopes, eroded.
- LaE3 – Las Posas loam, 8 to 25 percent slopes, severely eroded.
- PoC – Poterville clay, 0 to 8 percent slopes.
- TeG – Terrace escarpments.
- WyC2 – Wyman loam, 2 to 8 percent slopes, eroded.
- YbC – Yokohl loam, 2 to 8 percent slopes.
- YbE3 – Yokohl loam, 8 to 25 percent slopes, severely eroded.

The Riparian/Riverine Areas on the site are found within a variety of soil types, including Auld cobbly clay, Cajalco fine sandy loam, Cajalco rocky fine sandy loam, Las Posas loam, Las Posas loam, Las Posas loam, and Terrace escarpments. Generally, the soils observed in the onsite watercourses were sandy loams, brown in color, with or without gravel and/or cobbles. Typical Riverwash soils were not mapped on this site.

Hydric soils were not identified within any of the Riparian/Riverine Areas. The soils present on the site are mainly sand and silt with no organic streaking or sulfidic odor.

III. PROJECT DESCRIPTION, DEMONSTRATING WHY AN AVOIDANCE ALTERNATIVE IS NOT POSSIBLE

Tentative Tract Map 36388 is the subdivision of 163.25 acres of land into 256 single family residential lots, varying in size from 4500 square feet to 10749 square feet, and a 3.5 acre commercial site. In addition, the project also proposes the construction of two 56' diameter water tanks to serve the water needs of existing and future residents. Amenities include three park sites equaling 4.7 acres, approximately 6,500 linear feet of walkable trails, and approximately 32 acres of open space.

This project also proposes the relocation and realignment of 5,425 feet of Bundy Canyon Road from approximately The Farm Road to Sunset Avenue. The project has been designed and engineered in response to the widening and realigning of Bundy Canyon Road, and the associated realigning of intersecting roads to maintain existing access.

The Bundy Canyon/Scott Road Improvement Project is a circulation improvement project required to accommodate planned future growth in the area by providing additional travel lanes and improving safety through modification of the roadway's horizontal alignment and vertical profile. The improvements project is designated in the 2003 Riverside County General Plan as an "Urban Arterial". The improvement project is a Covered Activity in the MSHCP (Section 7.3 - Covered Activities Inside Criteria Area). Specifically, it is one of the Planned Roads Within the Criteria Area (Section 7.3.5). Planned roadways are defined as either existing facilities that require improvements (i.e., widening) or as new facilities to be constructed.

Proposed project improvement activities include grading activities, paving of existing and new roadbed, adjusting the vertical alignment based on design speed criteria, adjusting the intersection geometry at cross streets to conform to new improvements, relocating utilities, acquiring right-of-way to accommodate the widening of the road, and the extension and/or replacement of existing cross culverts under the current roadway.

The Bundy Canyon/Scott Road Improvement Project minimizes impacts to Riparian/Riverine Areas by following the existing road alignments to the maximum extent feasible. The major exception occurs between Harvest Way and Harvest Way East where the existing vertical and horizontal alignment is not sufficient to meet Riverside County's design standards for an Urban Arterial roadway (or an interim 4-lane arterial). At this location, a necessary shift to the south results in unavoidable impacts to Riparian/Riverine Areas on the Tentative Tract Map 36388 site.

Why an avoidance alternative is not possible

The Bundy Canyon/Scott Road Improvement Project requires that existing Bundy Canyon Road be realigned and widened on the Tentative Tract Map 36388 site. The new road alignment intersects five existing Riparian/Riverine Areas, two intermittent blueline streams and three ephemeral watercourses.

The portion of the existing roadbed that intersects with Cottonwood Canyon Creek is insufficient to accommodate the six lanes necessary to satisfy the County's General Plan requirement for an Urban Arterial roadway (or an interim 4-lane arterial). Therefore, fill is required within the streambed that currently intersects the road, and avoidance of the Riparian/Riverine Areas is not feasible. This improvement alone accounts for the removal of over 30 coast live oaks within an area measuring 0.28 acres, or 34 percent of the total impacts to Riparian/Riverine Areas.

Two alignments were analyzed in the area located between Harvest Way and Harvest Way East. The alignment with the smaller curve radius impacted approximately 78 percent more Riparian/Riverine Areas and upland coast live oaks than the alignment with the longer curve radius. Therefore, the proposed alignment with the longer curve radius reduces impacts to Riparian/Riverine Areas and upland coast live oaks, including a heritage oak (51.6 inch DBH) on the Tentative Tract Map 36388 site.

The Bundy Canyon/Scott Road Improvement Project accounts for 0.43 acres of the total 0.82 acres impacts on Riparian/Riverine Areas, or 52 percent. The remaining 0.39 acres of impacts occur within the Tentative Tract Map 36388 footprint. The project has been designed and engineered in response to the widening and realigning of Bundy Canyon Road, and the associated realigning of intersecting roads to maintain existing access. Because of these constraints, an avoidance alternative is not possible.

IV. DESCRIPTION OF BIOLOGICAL INFORMATION AVAILABLE FOR THE PROJECT SITE, INCLUDING THE RESULTS OF RESOURCE MAPPING

The following reports have been previously prepared on the entire site or portions of the site. Complete biological information on the project site is included in those documents, and is herein incorporated by reference. This section will only reiterate the information on riparian resources.

Glenn Lukos Associates. February 12, 2009. "Results of General Biological Surveys, Focused Surveys and MSHCP Consistency Analysis for the Bundy Canyon/Scott Road Improvement Project".

Glenn Lukos Associates. February 12, 2009. "Jurisdictional Delineation for the Bundy Canyon/Scott Road Improvement Project".

Tom Dobson and Associates. April 2006. "Western Riverside County Multiple Species Habitat Conservation Plan Consistency Analysis for Tentative Tract #28416".

Principe and Associates. September 1, 2010. "Nesting Season Survey for the Burrowing Owl *(Athene cunicularia hypugaea)*, Previous Tract Map 28416".

Principe and Associates. December 10, 0210. "MSHCP Consistency Analysis for Previous Tract Map 28416".

Principe and Associates. March 7, 2011. "Jurisdictional Delineation of Waters and Wetlands, Previous Tract Map 28416".

Vegetation Associations and Species Composition in the Riparian/Riverine Areas

Riparian resources on the 163.25-acre site belong to the Riparian Forest/Woodland/Scrub Vegetation Association (3.82 acres).

Riparian Forest/Woodland/Scrub subtypes are spatially distributed in drainages throughout much of Western Riverside County, and cover approximately 1.1 percent (14,545 acres) of the Plan Area. Southern Cottonwood/Willow Riparian Forest makes up the largest proportion of the riparian vegetation in the Plan Area comprising nearly one-half of the acreage (6,610 acres). Large complexes containing several of the riparian forest, woodland and scrub types are located in several portions in the Plan Area. The stream channels within the San Mateo Canyon watershed and the Cleveland National Forest generally support Riparian Forest, Southern Sycamore/Alder Riparian Woodland and Riparian Scrub in connected stands. The Temecula area supports a diversity of riparian vegetation types among urban and agricultural land uses along Temecula Creek, Sandia Canyon and portions of Wolf Valley.

Based on species composition, the Mapped Subassociation occurring on the site is the **Riparian Forest.** Riparian Forest can include any combination of riparian tree and

shrub species along perennial stream channel banks, including alder, willows, cottonwood, sycamore, oaks, bay laurel, and black walnut. Where the stream channel receives perennial flows in some years but intermittent flows in others, white alder drops out of the vegetation. Where the stream channel receives only intermittent flow, willow species and western cottonwood become less common and the western sycamore, coast live oak and California bay laurel tend to move down into the channel. Along ephemeral stream channels, coast live oak and Southern California black walnut can grow within the channel as a continuum or ecotone from uplands on north-facing slopes.

On the site, coast live oak *(Quercus agrifolia* var. *agrifolia)* dominates the Riparian Forest vegetation. Other associated riparian species include western ragweed *(Ambrosia psilostachya* var. *californica),* mule fat *(Baccharis salicifolia),* giant wildrye *(Elymus condensatus),* California flowering ash *(Fraxinus dipetala),* western sunflower *(Helianthus annuus),* toyon *(Heteromeles arbutifolia),* *sourclover *(Melilotus indicus),* *tree tobacco *(Nicotiana glauca),* western cottonwood *(Populus fremontii* subsp. *fremontii),* California scrub oak *(Quercus berberidifolia),* narrow-leaved willow *(Salix exigua),* red willow *(Salix* laevigata) arroyo willow *(Salix lasiolepis* var. *lasiolepis),* Mexican elderberry *(Sambucus mexicana),* and *Mediterranean tamarisk *(Tamarix ramosissima),* poison oak *(Toxicodendron diversilobum),* hoary nettle *(Urtica dioica* subsp. *holosericea),* and cocklebur *(Xanthium strumarium* var. *canadense)*

Riparian/Riverine Areas Assessment

The onsite Riparian/Riverine Areas vary considerably in length and width, and support scattered scrub, woodland and forest habitat types. Trees of all sizes occur as individuals or in clumps. These Riparian/Riverine Areas provide numerous functions, including nesting and foraging riparian habitats for a variety of wildlife species, dynamic surface water storage, energy dissipation, subsurface storage of water, nutrient cycling, removal of elements and compounds derived from nuisance flow from surrounding development, retention of particulates, export of organic carbon, and maintenance of characteristic detrital biomass.

The Riparian/Riverine Areas that will be impacted by the project exhibit moderate-to-low functions and values. The reach of Cottonwood Canyon Creek exhibits moderate functions and values, and has the densest riparian habitat with the highest species and structural diversity. The other Riparian/Riverine Areas consist of sparsely vegetated channels. Coast live oaks occur in the majority of areas at varying densities. They are currently providing riparian habitat for wildlife species with a low functions and values. Many of the trees in these Riparian/Riverine Areas are drought-stressed, and in poor condition and vigor. It has been shown through numerous focused biological surveys prepared by others that the impacted Riparian/Riverine Areas do not support species listed under the heading “Purpose” in *Section 6.1.2. of the MSHCP, Volume 1, The Plan.*

The onsite Riparian/Riverine Areas exhibit reduced functions and values as a result of altered conveyance of freshwater beneath existing Bundy Canyon Road.

They are also currently subject to varying levels of edge effect based on the existing land uses. Riparian/Riverine Areas that will be impacted are buffered by agricultural, rural residential, and transportation uses, thus reducing the biological functions and values of these areas.

Additionally, the majority of the Riparian/Riverine Areas being impacted are first order streams that exhibit relatively limited functions and values based on their locations relatively high in the watershed, and their locations surrounded by rural and urban land uses.

V. QUANTIFICATION OF UAVOIDABLE IMPACTS TO RIPARIAN/RIVERINE AREAS AND VERNAL POOLS ASSOCIATED WITH THE PROJECT, INCLUDING DIRECT AND INDIRECT EFFECTS

3.82 acres of Riparian/Riverine Areas and 0.45 acres of unvegetated Riverine Areas have been mapped on the 163.25-acre site **(see Riparian/Riverine Areas Map)**.

A. Direct Effects

The project will result in unavoidable permanent impacts to 0.82 acres of Riparian/Riverine Areas growing along two intermittent blueline streams and three ephemeral watercourses **(Riparian/Riverine Areas Impacts Map)**. The impacts are subject to CDFG jurisdiction pursuant to Section 1600 of the California Fish and Game Code.

The Bundy Canyon/Scott Road Improvement Project accounts for 0.43 acres of the impacts, or 52 percent.

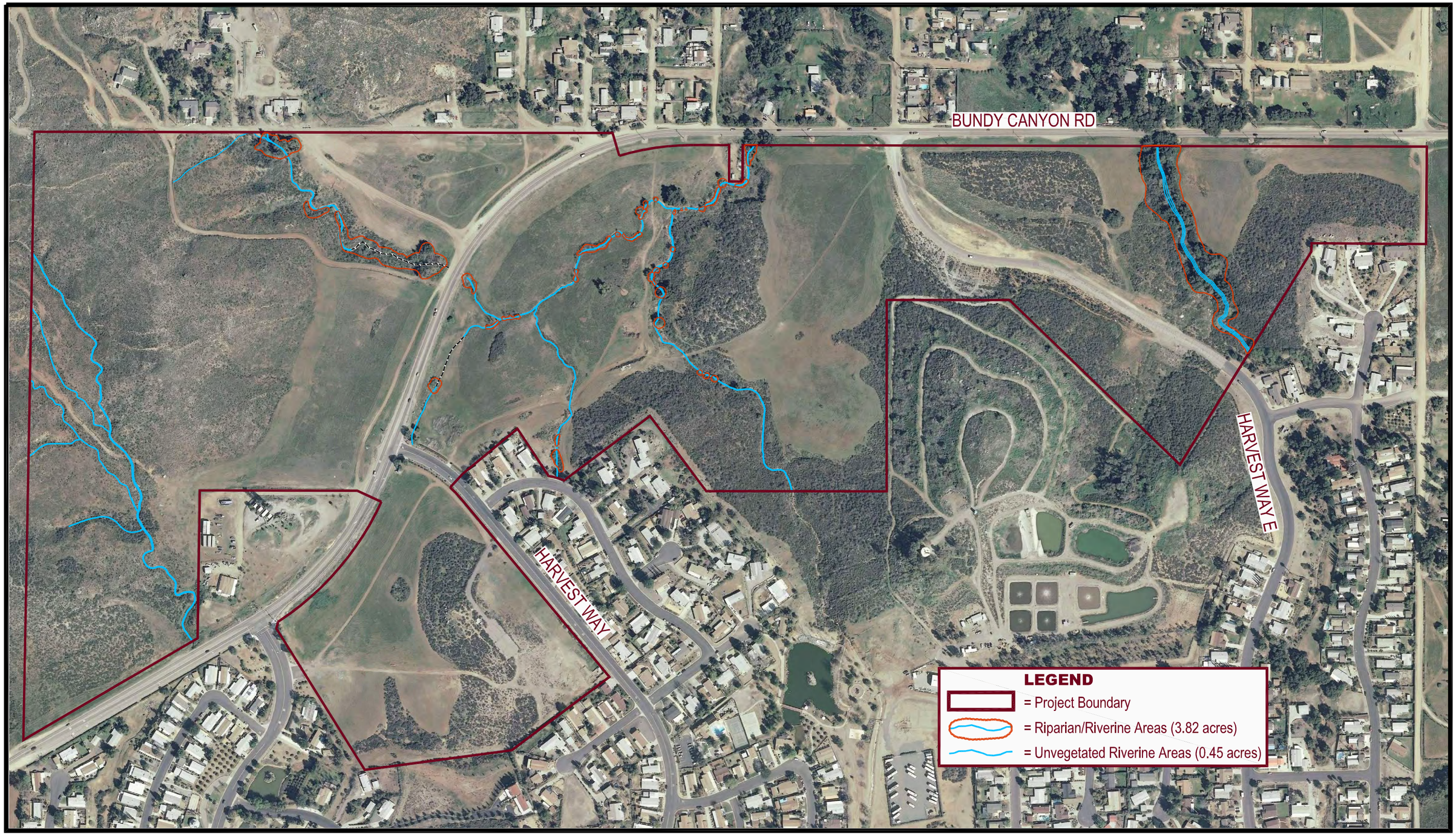
B. Indirect Effects

There will be unavoidable temporary impacts to 0.11 acres of unvegetated Riverine Areas until the project's storm drain system is in place.

VI. DESCRIPTION OF PROJECT DESIGN FEATURES AND MITIGATION MEASURES THAT REDUCE DIRECT AND INDIRECT EFFECTS, SUCH AS EDGE TREATMENTS, LANDSCAPING, ELEVATION DIFFERENCE, MINIMIZATION AND/OR COMPENSATION THROUGH RESTORATION OR ENHANCEMENT

A. Project Design Features and Mitigation Measures that Reduce Direct Effects

To reduce unavoidable permanent impacts on a total of 0.82 acres of Riparian/Riverine Areas, mitigation at a 2:1 ratio is proposed to occur through habitat creation and enhancement within an existing Riparian/Riverine Area on the site **(Potential Mitigation Sites Map)**. The map shows large areas where mitigation could occur in one place or smaller areas where mitigation would have to be done at multiple sites. Under either scenario, mitigation measures will include creating a total of 1.64 acres of



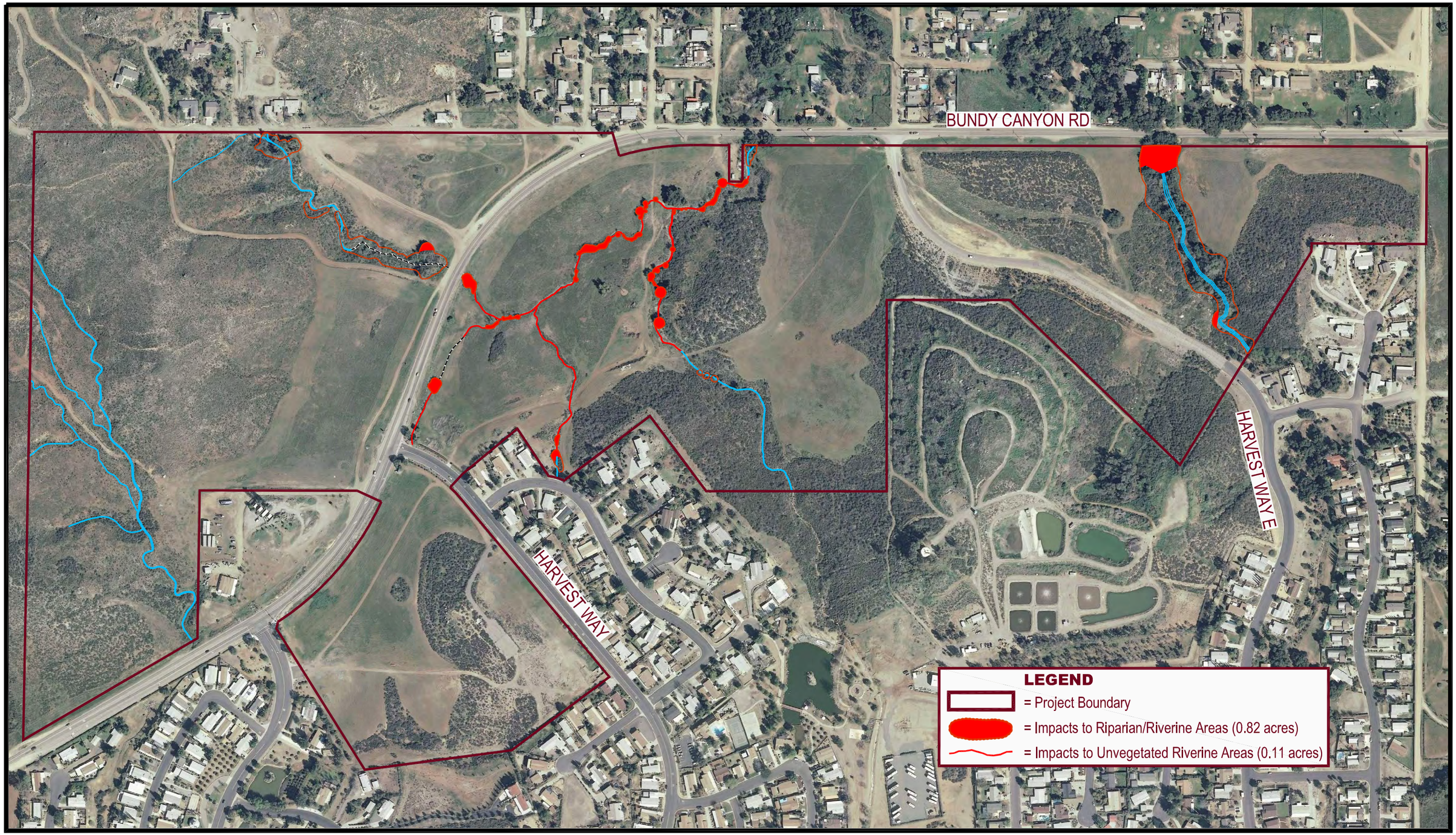
Site area: 163.25 acres

0 340 680 Feet

RIPARIAN/RIVERINE AREAS MAP

TENTATIVE TRACT MAP 36388

PRINCIPE AND ASSOCIATES



Source of Project Footprint: Lot Study (CAD File) from VSL Engineering Dated: 10-15-2012

Site area: 163.25 acres

0 340 680 Feet

RIPARIAN/RIVERINE AREAS IMPACTS MAP

TENTATIVE TRACT MAP 36388

PRINCIPE AND ASSOCIATES

BUNDY CANYON RD

HARVEST WAY

HARVEST WAY E

1

2

3

4

5

6

LEGEND

= Project Boundary

= Impacts to Riparian/Riverine Areas (0.82 acres)

= Impacts to Unvegetated Riverine Areas (0.11 acres)

3 = Potential Mitigation Sites

Source of Project Footprint: Lot Study (CAD File) from VSL Engineering Dated: 10-15-2012

Site area: 163.25 acres

0 340 680 Feet

POTENTIAL MITIGATION SITES MAP

TENTATIVE TRACT MAP 36388

PRINCIPE AND ASSOCIATES

native Riparian Forest habitat along one of the existing intermittent blueline streams or ephemeral watercourses that is currently sparsely vegetated or unvegetated.

Habitat creation will involve planting the same native riparian species that are present in the existing Riparian Forest growing on the site. A dense, continuous forest habitat will more than adequately mitigate the loss of the sparse, intermittent Riparian/Riverine Areas removed. Habitat enhancement will include removal of invasive, non-native species throughout the conservation area. And, the mitigation site will be conserved in-perpetuity using appropriate legal mechanisms such as a Conservation Easement and/or Deed Restriction.

B. Project Design Features and Mitigation Measures that Reduce Indirect Effects

The project has been designed to reduce unavoidable temporary impacts to 0.11 acres of unvegetated Riverine Areas. The site-specific storm drain system will be an improvement to existing conditions, as it has been designed to carry flows generated by a 100-year storm (Q_{100}). Storm water runoff captured by the onsite storm drain system will ultimately flow into extended detention basins that will be constructed for water quality purposes before it is discharged downstream and off the site. Storm water will be treated in the basins, with certain impervious disconnect treatments as required by the new Municipal Separate Storm Sewer Systems (MS4) Permit.

Also, all storm water runoff entering Riparian/Riverine Areas from developed areas will be treated by numerous water quality basins and/or biological swales at the curbs. The project will have no impact on existing water quality along the intermittent blueline streams and ephemeral watercourses.

To avoid diverting storm water runoff around the site during the construction of the onsite storm drain system, existing drainage swales will remain in place during construction of the storm drains.

VII. FINDING DEMONSTRATING THAT ALTHOUGH THE PROPOSED PROJECT WOULD NOT AVOID IMPACTS, WITH PROPOSED DESIGN AND COMPENSATION MEASURES, THE PROJECT WOULD BE BIOLOGICALLY EQUIVALENT OR SUPERIOR TO THAT WHICH WOULD OCCUR UNDER AN AVOIDANCE ALTERNATIVE WITHOUT THESE MEASURES, BASED ON THE FOLLOWING FACTORS

The project will result in 0.82 acres of impacts to Riparian/Riverine Areas occurring along two intermittent blueline streams and three ephemeral watercourses. The Bundy Canyon/Scott Road Improvement Project accounts for 0.43 acres of the total impacts to Riparian/Riverine Areas on the site (or 52 percent). To reduce unavoidable permanent impacts on Riparian/Riverine Areas, mitigation is proposed to occur through habitat creation and enhancement on 1.64 acres located within an existing Riparian/Riverine Area on the site.

As stated in the Riparian/Riverine Areas Assessment starting on Page 6, functions and values of the Riparian/Riverine Areas that will be impacted are moderate-to-low. Focused surveys conducted by others in the onsite Riparian/Riverine Areas for least Bell's vireo, southwestern willow flycatcher and western yellow-billed cuckoo were negative. Habitat creation and enhancement at the selected mitigation site will increase the functions and values of the existing Riparian/Riverine Area by increasing the wildlife habitat, water quality and hydrologic functions and values.

The habitat functions and values at the mitigation site are expected to perform, and in most cases exceed, the functions and values provided by the existing habitat. The created and enhanced habitat is also expected to establish conditions suitable for natural regeneration through seed dispersal and wildlife interactions.

Wildlife habitat functions and values will be increased through the planting of native riparian vegetation in sparsely vegetated or unvegetated areas, and the removal of invasive, non-native species that are currently growing in the mitigation site. The riparian vegetation will provide viable nesting and foraging habitat for a variety of common wildlife species, but could include endangered and threatened species, and any species identified as a candidate, sensitive, or special status species. The dense, continuous Riparian Forest wildlife habitat created and enhanced at the mitigation site will be biologically superior to existing conditions, thus mitigating the lost functions and values of the Riparian/Riverine Areas removed from other portions of the site.

The increase in riparian vegetation within the mitigation site will increase water quality functions and values by removing toxins, nitrogen and other elements and compounds derived from nuisance flow from surrounding developments, retaining particulates, exporting organic carbon, and maintaining characteristic detrital biomass. Improvements in water quality will take place as nutrients, toxins, nitrogen, etc. are cycled through the mitigation site and absorbed into the plant tissue. The increase in water quality functions and values at the mitigation site will be superior to existing conditions, thus mitigating the lost functions and values of the Riparian/Riverine Areas removed from other portions of the site.

In addition, storm water runoff captured by the project's onsite storm drain system will ultimately flow into extended detention basins that will be constructed for water quality purposes before it is discharged downstream and off the site. Storm water will be treated in the basins, with certain impervious disconnect treatments as required by the new Municipal Separate Storm Sewer Systems (MS4) Permit. Also, all storm water runoff entering Riparian/Riverine Areas from developed areas will be treated by numerous water quality basins and/or biological swales at the curbs.

The increase in riparian vegetation within the mitigation site will also improve hydrologic functions and values by increasing flood flow attenuation, energy dissipation and water storage capabilities (i.e., dynamic surface storage during storm events, long-term surface storage, subsurface storage, etc.).

The site-specific storm drain system designed and engineered for the project will continue to provide a hydrologic connection between up- and downstream reaches of the two intermittent blueline streams and three ephemeral watercourses being impacted via culverts. As a result, transmission of organic carbon and related functions will continue with little impact. Overall, the improved hydrology functions and values throughout the site will be superior to existing conditions, thus mitigating the lost functions and values of the Riparian/Riverine Areas removed from other portions of the site.

In summary:

- a high quality wildlife habitat will be created and enhanced on the site, and the mitigation site will be conserved in-perpetuity using appropriate legal mechanisms such as a Conservation Easement and/or Deed Restriction. This ensures replacement of any lost functions and values of Riparian/Riverine Areas as it relates to covered species pursuant to *Section 6.1.2 of the MSHCP, Volume 1, The Plan.*

- habitat creation and enhancement will increase water quality functions and values at the mitigation site, while the development of the Tentative Tract Map 36388 storm drain system will capture storm water runoff and divert it into extended detention basins that will be constructed for water quality purposes. Also, all storm water runoff entering Riparian/Riverine Areas from developed areas will be treated by numerous water quality basins and/or biological swales at the curbs.

- habitat creation and enhancement improve hydrologic functions and values at the mitigation site, while the development of the Tentative Tract Map 36388 storm drain system will continue to provide a hydrologic connection between up- and downstream reaches of impacted areas via culverts.

In conclusion, the findings demonstrate that although the Tentative Tract Map 36388 project would not avoid impacts, with the proposed project design features and mitigation measures, the project would be biologically superior to that which would occur under an avoidance alternative without these measures.

VIII. CERTIFICATION STATEMENT

Date: October 11, 2012

I hereby certify that the statements furnished herein and in the attached exhibits present the data and information required for this Determination of Biologically Equivalent or Superior Preservation report to the best of my ability, and that the facts, statements and information presented are true and correct to the best of my knowledge and belief.

_____

Paul A. Principe, Principal
PRINCIPE AND ASSOCIATES

ATTACHMENT B - SUPPLEMENTAL TRAFFIC ANALYSIS

URBAN CROSSROADS

41 Corporate Park | Suite 300 | Irvine, CA 92606 | (949) 660-1994
www.urbanXroads.com

January 31, 2013

Mr. Matthew Bassi
CITY OF WILDOMAR
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

Subject: Traffic Study Review Comments for Oak Creek (Tentative Tract Map No. 36388) (PA 11-0261) Traffic Impact Analysis (Revised) – Response to Comments

Dear Mr. Bassi:

The firm of Urban Crossroads, Inc. is pleased to submit the following responses to comments provided by the California Department of Transportation (Caltrans) on January 16, 2013 for the *Oak Creek (Tentative Tract Map No. 36388) (PA 11-0261) Traffic Impact Analysis (Revised)* (May 21, 2012). The Caltrans comment letter is included in Attachment "A" of this letter.

Comment 1
Please include ramp merge/diverge analysis at the I-15 northbound and southbound direction at Bundy Canyon Rd/I-15 Interchange and the I-215 northbound and southbound direction at I-215/Scott Road Interchange to determine impacts of the development at these locations, if any.

Response 1
A supplemental analysis has been conducted to evaluate the performance of freeway ramp junctions (merge/diverge) at the I-15/Bundy Canyon Road and I-215/Scott Road interchanges for both Existing and Existing plus Project (E+P) traffic conditions. The supplemental analysis is included as Attachment "B" of this letter. As shown in the supplemental analysis, the Project is not anticipated to cause any deficiencies to the freeway ramp junctions at either the I-15/Bundy Canyon Road interchange or the I-215/Scott Road interchange (i.e., ramp junctions anticipated to operate at LOS "D" or better). In other words, the Project's impact to the I-15/Bundy Canyon Road and I-215/Scott Road ramp junctions is less-than-significant.

Comment 2
Section 6.6, Cumulative Impacts and Mitigation Measures, At the I-215 southbound and northbound ramp to Scott Road on page 78. The existing interchange is a diamond type configuration. For clarity, it is recommended to describe the proposed improvements as part of a modified loop interchange with both loops on the same side of the street as shown in Exhibit 7-3. Some improvements are in conflict with existing conditions.

Response 2
The text has been revised on page 78 of the traffic study to indicate that the recommended improvements are consistent with the proposed modified loop interchange design shown on Exhibit 7-3. Although there

were no changes to Section 6.7 of the report, page 80 has also been included as the changes to text in Section 6.6 resulted in a page shift. The modified pages of text have been provided to the EIR preparer to be included as an erratum to the traffic study. The modifications to the text do not result in changes to the report's findings or conclusions.

Comment 3
Please provide the Synchro output for review.

Response 3
The peak hour intersection operations analysis worksheets for the I-15/Bundy Canyon Road and I-215/Scott Road ramps are included in Attachment "C" of this letter for each analysis scenario.

Comment 4
The responsible lead agency must ensure that appropriate fair share contribution is obtained from the developer for the improvement of the I-215 and Scott Road interchange. As opening year 2015 cumulative with project shows significant impact, the I-215/Scott Road interchange modification must be completed before project opening.

Response 4
Comment noted.

If you have any questions or require any additional information regarding this response to comments, please give me a call at (949) 660-1994 ext. 204.

Respectfully submitted,

URBAN CROSSROADS, INC.

Aric Evatt, PTP
Principal

Charlene Hwang, PE
Senior Transportation Engineer

AE:CH

JN:08055-10 Response

Attachments

ATTACHMENT "A"

Caltrans Comment Letter, dated January 16, 2013

DEPARTMENT OF TRANSPORTATION
DISTRICT 8
PLANNING
464 WEST 4th STREET, 6th Floor MS 725
SAN BERNARDINO, CA 92401-1400
PHONE (909) 383-4557
FAX (909) 383-5936
TTY (909) 383-6300

Flex your power!
Be energy efficient!

January 16, 2013

Matthew C. Bassi
Planning Director
City of Wildomar
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

Oak Creek Canyon Development Notice of Completion & Environmental Document Transmittal (Riv-15 PM 15.84)

Mr. Bassi,

We have completed our review for the above mentioned proposal of a subdivision of 151.23 acres into 275 residential lots, one 5.21 acre commercial site and 24 additional parcels for open space, parks, and storm drainage basin.

As the owner and operator of the State Highway System (SHS), it is our responsibility to coordinate and consult with local jurisdictions when proposed development may impact our facilities. As the responsible agency under the California Environmental Quality Act (CEQA), it is also our responsibility to make recommendations to offset associated impacts with the proposed project. Although the project is under the jurisdiction of the City of Perris due to the Project's potential impact to State facilities it is also subject to the policies and regulations that govern the SHS.

We recommend the following to be provided:

Traffic Study

- Please include ramp merge/diverge analysis at the I-15 northbound and southbound direction at Bundy Canyon Rd/I-15 Interchange and the I-215 northbound and southbound direction at I-215/Scott Road Interchange to determine impacts of the development at these locations, if any.

- Section 6.6, Cumulative Impacts and Mitigation Measures, At the I-215 southbound and northbound ramp to Scott Road on page 78. The existing interchange is a diamond type configuration. For clarity, it is recommended to describe the proposed improvements as part of a modified loop interchange with both loops on the same side of the street as shown in Exhibit 7-3. Some improvements are in conflict with existing conditions.

- Please provide the Synchro output for review.

- The responsible lead agency must ensure that appropriate fare share contribution is obtained from the developer for the improvement of the I-215 and Scott Road interchange. As opening year 2015 cumulative with project shows significant impact, the I-215/Scott Road interchange modification must be completed before project opening.

The California Department of Transportation reserves the right to comment on this project at any future time.

We appreciate the opportunity to offer comments concerning this project. If you have any questions regarding this letter, please contact Talvin Dennis at (909) 383-6908 or myself at (909) 383-4557 for assistance.

Sincerely,

Original signed by Daniel Kopulsky

DANIEL KOPULSKY
Office Chief
Community and Regional Planning

ATTACHMENT "B"

Freeway Ramp Junction Analysis

URBAN CROSSROADS

41 Corporate Park | Suite 300 | Irvine, CA 92606 | (949) 660-1994
www.urbanXroads.com

January 31, 2013

Mr. Matthew Bassi
CITY OF WILDOMAR
23873 Clinton Keith Road, Suite 201
Wildomar, CA 92595

Subject: Freeway Ramp Junction Analysis for the Oak Creek (Tentative Tract Map No. 36388) (PA 11-0261) Project

Dear Mr. Bassi:

Urban Crossroads, Inc. is pleased to submit this assessment of the freeway ramp junction (merge/diverge) operations for the proposed Oak Creek (Tentative Tract Map No. 36388) (PA 11-0261) residential project. The freeway ramp junction operations have been evaluated at two (2) interchanges as part of this assessment: the I-15 Freeway at Bundy Canyon Road interchange and the I-215 Freeway at Scott Road interchange. For the purposes of this analysis, the freeway ramp junction peak hour operations have been evaluated for each of the analysis scenarios below:

- Existing Conditions
- Existing Plus Project (E+P) Conditions

INTRODUCTION

The I-15 Freeway is a north-south oriented interstate highway that connects Southern California to Las Vegas. There are currently three (3) mixed-flow lanes in each direction of travel along the I-15 Freeway near Bundy Canyon Road. There are currently no high-occupancy vehicle (HOV) lanes on the I-15 Freeway in the vicinity of Bundy Canyon Road. The I-215 Freeway is also a north-south oriented state highway that runs parallel to the I-15 Freeway through Riverside County and San Bernardino County. Specifically, the I-215 Freeway diverges from the I-15 Freeway in Murrieta and converges with the I-15 Freeway near Devore. The I-215 Freeway is currently two (2) mixed-flow lanes in each direction of travel north of Scott Road and three (3) mixed-flow lanes south of Scott Road (recently completed I-215 South Project). There are currently no HOV lanes on the I-215 Freeway in the vicinity of Scott Road.

Freeway ramp junction operations (i.e., merge/diverge junctions and off-ramp queuing) have been evaluated for both the weekday AM and PM peak hours for each of the analysis scenarios listed above.

METHODOLOGY

The merge/diverge ramp junction analysis evaluates the performance of the on and off ramp junctions at the I-15/Bundy Canyon Road and I-215/Scott Road interchanges.

The freeway system in the study area has been broken into segments defined by freeway-to-arterial interchange locations resulting in eight (8) existing on and off ramp locations (four on and off ramp locations at each interchange). Although the HCM indicates the influence area for a merge/diverge junction is 1,500 feet, this analysis has been performed at all ramp locations with respect to the nearest on or off ramp at each interchange in an effort to be consistent with Caltrans guidance/comments on other projects Urban Crossroads has worked on in Riverside County.

The merge/diverge analysis is based on the HCM Ramps and Ramp Junctions analysis method and performed using HCS+ software. The measure of effectiveness (reported in passenger car/mile/lane) are calculated based on the existing number of travel lanes, number of lanes at the on and off ramps at the analysis junction and acceleration/deceleration lengths at each merge/diverge point. The merge/diverge area level of service thresholds for each density range utilized are as follows:

Level of Service	Density Range (pc/mi/ln)[1]
A	0.0 – 10.0
B	10.1 – 20.0
C	20.1 – 28.0
D	28.1 – 35.0
E	>35.0
F	Demand Exceeds Capacity

[1] *pc/mi/ln = passenger cars per mile per lane. Source: HCM 2000, Chapter 25*

LEVEL OF SERVICE CRITERIA

Caltrans has determined that freeway segments and ramp junctions that operate below LOS "D" should be identified and improved to an acceptable LOS, however, specific criteria to identify project-related impacts is not specified in the Caltrans Traffic Impact Study guidelines (December 2002).

For the purposes of this traffic impact analysis and in accordance with Caltrans traffic study guidelines, if a freeway segment is projected to operate at an acceptable level of service (i.e., LOS "D" or better) without the project and the project is expected to cause the facility to operate at an unacceptable level of service (i.e., LOS "E" or worse), the impact is considered significant.

VOLUME DEVELOPMENT

The I-15 Freeway and I-215 Freeway mainline volume data (total vehicle flow only) were obtained from the Caltrans Performance Measurement System (PeMS) website for the dates coinciding with the dates from the peak hour freeway-to-arterial ramp data from the traffic study. In an effort to conduct a conservative analysis, the maximum value observed within the three (3) day period was utilized for the morning (AM) and evening (PM) peak hours. In addition, truck traffic, represented as a percentage of total traffic, has been utilized for the purposes of this analysis in an effort to not overstate traffic volumes and potential impacts. As such, actual vehicles (as opposed to passenger-car-equivalent volumes) have been utilized for the purposes of the basic freeway segment analysis. The truck percentages on the freeway segments have been obtained from historical data published on the Caltrans Traffic Data Branch website. The existing ramp data from the *Oak Creek (Tentative Tract Map No. 36388) (PA 11-0261) Traffic Impact Analysis (Revised)* (dated May 21, 2012) were utilized to maintain flow of the mainline volumes (i.e., no unexplained loss of vehicles/trucks).

Project only volumes on the freeway mainline and ramps have also been obtained from the *Oak Creek (Tentative Tract Map No. 36388) (PA 11-0261)* revised traffic study. The methodology in which the volumes were developed for the E+P traffic conditions is also consistent with that utilized in the traffic study.

ANALYSIS

The results of the freeway ramp junction (merge/diverge) operations analysis for both Existing and E+P traffic conditions are presented in Table 1. It should be noted that construction of the I-215 Central Project is anticipated to begin in early 2013 and will be completed by Year 2015. The I-215 Central Project includes the widening of the I-215 Freeway in both directions of travel to include an additional mixed-flow lane, for a total of three (3) mixed-flow lanes between Nuevo Road in the City of Perris and Scott Road in the City of Menifee. As noted previously, the I-215 South Project which included the widening of the I-215 Freeway to three (3) mixed-flow lanes between Scott Road and the I-15 Freeway was recently completed in 2012.

As shown in Table 1, the ramp junction merge and diverge areas are anticipated to operate at acceptable LOS (i.e., LOS "D" or better) during the peak hour for Existing and E+P traffic conditions. Freeway ramp junctions (merge/diverge) analysis worksheets are provided in Attachment "1" for Existing conditions and in Attachment "2" for E+P conditions.

SUMMARY OF FINDINGS

This analysis concludes that the freeway ramp junctions at the I-15 Freeway/Bundy Canyon Road interchange and the I-215 Freeway/Scott Road interchange are anticipated to operate at LOS "D" or better during the peak hours for both Existing and E+P traffic conditions. In other words, the Project's impact to the I-15/Bundy Canyon Road and I-215/Scott Road ramp junctions is less-than-significant.

If you have any questions regarding this analysis, please give me a call at (949) 660-1994 ext. 204.

Respectfully submitted,

URBAN CROSSROADS, INC.

Aric Evatt, PTP
Principal

Charlene Hwang, PE
Senior Transportation Engineer

REGISTERED PROFESSIONAL ENGINEER
CHARLENE SOOK HWANG
No. TR 2414
Exp. 6/30/2013
TRAFFIC
STATE OF CALIFORNIA

AE:CH

JN:08055-09 Letter

Attachments

Table 1

Freeway Ramp Junction Merge/Diverge Analysis

Freeway	Direction	Ramp or Segment	Lanes on Freeway[1]	Existing				Existing Plus Project			
				AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
				Density[2]	LOS	Density[2]	LOS	Density[2]	LOS	Density[2]	LOS
I-15 Freeway	SB	Off-Ramp at Bundy Canyon Road	3	19.6	B	27.4	C	19.8	B	27.8	C
		On-Ramp at Bundy Canyon Road	3	18.9	B	23.3	C	19.2	B	23.5	C
	NB	On-Ramp at Bundy Canyon Road	3	26.6	C	27.2	C	27.0	C	27.5	C
		Off-Ramp at Bundy Canyon Road	3	29.7	D	34.3	D	29.7	D	34.5	D
I-215 Freeway	SB	Off-Ramp at Scott Road	2	21.1	C	20.0	B	21.3	C	20.4	C
		On-Ramp at Scott Road	2	21.6	C	19.2	B	21.8	C	19.3	B
	NB	On-Ramp at Scott Road	2	21.5	C	22.3	C	21.9	C	22.5	C
		Off-Ramp at Scott Road	3	17.2	B	20.7	C	17.3	B	20.9	C

[1] Number of lanes are in the specified direction and is based on existing conditions.

[2] Density is measured by passenger cars per mile per lane (pc/mi/ln).

* **BOLD** = Unacceptable Level of Service

ATTACHMENT "1"

FREEWAY RAMP JUNCTION HCS+ ANALYSIS WORKSHEETS
EXISTING CONDITIONS

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 2125 ft
V_D = 715 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2405	0.92	Level	9	0	0.957	1.00	2732
Ramp	357	0.92	Level	5	0	0.976	1.00	398
UpStream								
DownStream	715	0.92	Level	5	0	0.976	1.00	797

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.673 using Equation (Exhibit 25-12)
V_{12} = 1970 pc/h
V_3 or V_{av34} 762 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2732	Exhibit 25-14	7050	No
$V_{FO} = V_F - V_R$	2334	Exhibit 25-14	7050	No
V_R	398	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1970	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 19.6 (pc/mi/ln)
LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.334 (Exhibit 25-19)
S_R= 57.3 mph (Exhibit 25-19)
S_0= 71.3 mph (Exhibit 25-19)
S = 60.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp: ☑ Yes ☐ On ☐ No ☑ Off

L_{up} = 2125 ft

V_u = 357 veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2048	0.92	Level	9	0	0.957	1.00	2326
Ramp	715	0.92	Level	5	0	0.976	1.00	797
UpStream	357	0.92	Level	5	0	0.976	1.00	398
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 841.72 (Equation 25-2 or 25-3)

P_{FM} = 0.591 using Equation (Exhibit 25-5)

V_{12} = 1376 pc/h

V_3 or V_{av34} 950 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3123	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2173	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 18.9 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.310 (Exibit 25-19)

S_R = 57.9 mph (Exhibit 25-19)

S_0 = 63.4 mph (Exhibit 25-19)

S = 59.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R = mph (Exhibit 25-19)

S_0 = mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 1830 ft
V_u = 343 veh/h

Terrain: Level
S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3936	0.92	Level	9	0	0.957	1.00	4471
Ramp	493	0.92	Level	5	0	0.976	1.00	549
UpStream	343	0.92	Level	5	0	0.976	1.00	382
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = 1283.20 (Equation 25-2 or 25-3)
P_{FM} = 0.594 using Equation (Exhibit 25-5)
V_{12} = 2655 pc/h
V_3 or V_{av34} 1816 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5020	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3204	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 26.6 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.365 (Exibit 25-19)
S_R = 56.6 mph (Exhibit 25-19)
S_0 = 60.3 mph (Exhibit 25-19)
S = 57.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 1830 ft
V_D = 493 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	4279	0.92	Level	9	0	0.957	1.00	4860
Ramp	343	0.92	Level	5	0	0.976	1.00	382
UpStream								
DownStream	493	0.92	Level	5	0	0.976	1.00	549

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.621 using Equation (Exhibit 25-12)
V_{12} = 3163 pc/h
V_3 or V_{av34} 1697 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4860	Exhibit 25-14	7050	No
$V_{FO} = V_F - V_R$	4478	Exhibit 25-14	7050	No
V_R	382	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3163	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 29.7 (pc/mi/ln)
LOS = D (Exhibit 25-4)

Speed Determination

D_s = 0.332 (Exhibit 25-19)
S_R = 57.4 mph (Exhibit 25-19)
S_0 = 68.6 mph (Exhibit 25-19)
S = 60.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 1985 ft
V_D = 674 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1928	0.92	Level	7	0	0.966	1.00	2169
Ramp	322	0.92	Level	5	0	0.976	1.00	359
UpStream								
DownStream	674	0.92	Level	5	0	0.976	1.00	751

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 1.000 using Equation (Exhibit 25-12)
V_{12} = 2169 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2169	Exhibit 25-14	4700	No
$V_{FO} = V_F - V_R$	1810	Exhibit 25-14	4700	No
V_R	359	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2169	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 21.1 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.330 (Exhibit 25-19)
S_R= 57.4 mph (Exhibit 25-19)
S_0= N/A mph (Exhibit 25-19)
S = 57.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp: ☑ Yes ☐ On ☐ No ☑ Off

L_{up} = 1985 ft

V_u = 322 veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1606	0.92	Level	8	0	0.962	1.00	1815
Ramp	674	0.92	Level	5	0	0.976	1.00	751
UpStream	322	0.92	Level	5	0	0.976	1.00	359
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 853.92 (Equation 25-2 or 25-3)

P_{FM} = 1.000 using Equation (Exhibit 25-5)

V_{12} = 1815 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2566	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2566	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 21.6 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.321 (Exibit 25-19)

S_R = 57.6 mph (Exhibit 25-19)

S_0 = N/A mph (Exhibit 25-19)

S = 57.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R = mph (Exhibit 25-19)

S_0 = mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 2025 ft
V_u = 442 veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1597	0.92	Level	8	0	0.962	1.00	1805
Ramp	658	0.92	Level	5	0	0.976	1.00	733
UpStream	442	0.92	Level	5	0	0.976	1.00	492
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = 1265.44 (Equation 25-2 or 25-3)
P_{FM} = 1.000 using Equation (Exhibit 25-5)
V_{12} = 1805 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2538	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2538	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 21.5 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.322 (Exibit 25-19)
S_R = 57.6 mph (Exhibit 25-19)
S_0 = N/A mph (Exhibit 25-19)
S = 57.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 2025 ft
V_D = 658 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2039	0.92	Level	7	0	0.966	1.00	2294
Ramp	442	0.92	Level	5	0	0.976	1.00	492
UpStream								
DownStream	658	0.92	Level	5	0	0.976	1.00	733

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.680 using Equation (Exhibit 25-12)
V_{12} = 1717 pc/h
V_3 or V_{av34} 577 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2294	Exhibit 25-14	7050	No
$V_{FO} = V_F - V_R$	1802	Exhibit 25-14	7050	No
V_R	492	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1717	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 17.2 (pc/mi/ln)
LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.342 (Exhibit 25-19)
S_R = 57.1 mph (Exhibit 25-19)
S_0 = 71.3 mph (Exhibit 25-19)
S = 60.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 2125 ft
V_D = 495 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3736	0.92	Level	9	0	0.957	1.00	4244
Ramp	516	0.92	Level	5	0	0.976	1.00	575
UpStream								
DownStream	495	0.92	Level	5	0	0.976	1.00	551

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.627 using Equation (Exhibit 25-12)
V_{12} = 2877 pc/h
V_3 or V_{av34} 1367 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4244	Exhibit 25-14	7050	No
$V_{FO} = V_F - V_R$	3669	Exhibit 25-14	7050	No
V_R	575	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2877	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 27.4 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.350 (Exhibit 25-19)
S_R= 57.0 mph (Exhibit 25-19)
S_0= 69.9 mph (Exhibit 25-19)
S = 60.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 2125 ft
V_u = 516 veh/h

Terrain: Level
S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3220	0.92	Level	9	0	0.957	1.00	3657
Ramp	495	0.92	Level	5	0	0.976	1.00	551
UpStream	516	0.92	Level	5	0	0.976	1.00	575
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = 1073.91 (Equation 25-2 or 25-3)
P_{FM} = 0.591 using Equation (Exhibit 25-5)
V_{12} = 2163 pc/h
V_3 or V_{av34} 1494 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4208	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2714	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 23.3 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.335 (Exibit 25-19)
S_R = 57.3 mph (Exhibit 25-19)
S_0 = 61.4 mph (Exhibit 25-19)
S = 58.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 1830 ft
V_u = 758 veh/h

Terrain: Level
S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	4377	0.92	Level	9	0	0.957	1.00	4972
Ramp	289	0.92	Level	5	0	0.976	1.00	322
UpStream	758	0.92	Level	5	0	0.976	1.00	845
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 1341.84 (Equation 25-2 or 25-3)
P_{FM} = 0.594 using Equation (Exhibit 25-5)
V_{12} = 2952 pc/h
V_3 or V_{av34} 2020 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5294	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3274	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 27.2 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.372 (Exibit 25-19)
S_R = 56.4 mph (Exhibit 25-19)
S_0 = 59.5 mph (Exhibit 25-19)
S = 57.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$

D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 1830 ft
V_D = 289 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	5135	0.92	Level	8	0	0.962	1.00	5805
Ramp	758	0.92	Level	5	0	0.976	1.00	845
UpStream								
DownStream	289	0.92	Level	5	0	0.976	1.00	322

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.576 using Equation (Exhibit 25-12)
V_{12} = 3702 pc/h
V_3 or V_{av34} 2103 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5805	Exhibit 25-14	7050	No
$V_{FO} = V_F - V_R$	4960	Exhibit 25-14	7050	No
V_R	845	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3702	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 34.3 (pc/mi/ln)
LOS = D (Exhibit 25-4)

Speed Determination

D_s = 0.374 (Exhibit 25-19)
S_R= 56.4 mph (Exhibit 25-19)
S_0= 67.0 mph (Exhibit 25-19)
S = 59.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 1985 ft
V_D = 598 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1812	0.92	Level	7	0	0.966	1.00	2038
Ramp	416	0.92	Level	5	0	0.976	1.00	463
UpStream								
DownStream	598	0.92	Level	5	0	0.976	1.00	666

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 1.000 using Equation (Exhibit 25-12)
V_{12} = 2038 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2038	Exhibit 25-14	4700	No
$V_{FO} = V_F - V_R$	1575	Exhibit 25-14	4700	No
V_R	463	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2038	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 20.0 (pc/mi/ln)
LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.340 (Exhibit 25-19)
S_R = 57.2 mph (Exhibit 25-19)
S_0 = N/A mph (Exhibit 25-19)
S = 57.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 1985 ft
V_u = 416 veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1396	0.92	Level	8	0	0.962	1.00	1578
Ramp	598	0.92	Level	5	0	0.976	1.00	666
UpStream	416	0.92	Level	5	0	0.976	1.00	463
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 1.000 using Equation (Exhibit 25-5)
V_{12} = 1578 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2244	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2244	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 19.2 (pc/mi/ln)
LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.307 (Exibit 25-19)
S_R= 57.9 mph (Exhibit 25-19)
S_0= N/A mph (Exhibit 25-19)
S = 57.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 2025 ft
V_u = 738 veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1765	0.92	Level	8	0	0.962	1.00	1995
Ramp	569	0.92	Level	5	0	0.976	1.00	634
UpStream	738	0.92	Level	5	0	0.976	1.00	822
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 1.000 using Equation (Exhibit 25-5)
V_{12} = 1995 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2629	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2629	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 22.3 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.326 (Exibit 25-19)
S_R = 57.5 mph (Exhibit 25-19)
S_0 = N/A mph (Exhibit 25-19)
S = 57.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 2025 ft
V_D = 569 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2503	0.92	Level	7	0	0.966	1.00	2816
Ramp	738	0.92	Level	5	0	0.976	1.00	822
UpStream								
DownStream	569	0.92	Level	5	0	0.976	1.00	634

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.652 using Equation (Exhibit 25-12)
V_{12} = 2122 pc/h
V_3 or V_{av34} 694 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2816	Exhibit 25-14	7050	No
$V_{FO} = V_F - V_R$	1994	Exhibit 25-14	7050	No
V_R	822	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2122	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 20.7 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.372 (Exhibit 25-19)
S_R= 56.4 mph (Exhibit 25-19)
S_0= 71.3 mph (Exhibit 25-19)
S = 59.5 mph (Exhibit 25-15)

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ATTACHMENT "2"

FREEWAY RAMP JUNCTION HCS+ ANALYSIS WORKSHEETS
EXISTING PLUS PROJECT CONDITIONS

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 2125 ft
V_D = 749 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2425	0.92	Level	9	0	0.957	1.00	2754
Ramp	377	0.92	Level	5	0	0.976	1.00	420
UpStream								
DownStream	749	0.92	Level	5	0	0.976	1.00	834

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.672 using Equation (Exhibit 25-12)
V_{12} = 1988 pc/h
V_3 or V_{av34} 766 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2754	Exhibit 25-14	7050	No
$V_{FO} = V_F - V_R$	2334	Exhibit 25-14	7050	No
V_R	420	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1988	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 19.8 (pc/mi/ln)
LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.336 (Exhibit 25-19)
S_R= 57.3 mph (Exhibit 25-19)
S_0= 71.3 mph (Exhibit 25-19)
S = 60.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 2125 ft
V_u = 377 veh/h

Terrain: Level
S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2048	0.92	Level	9	0	0.957	1.00	2326
Ramp	749	0.92	Level	5	0	0.976	1.00	834
UpStream	377	0.92	Level	5	0	0.976	1.00	420
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = 849.64 (Equation 25-2 or 25-3)
P_{FM} = 0.591 using Equation (Exhibit 25-5)
V_{12} = 1376 pc/h
V_3 or V_{av34} 950 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3160	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2210	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 19.2 (pc/mi/ln)
LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.312 (Exibit 25-19)
S_R = 57.8 mph (Exhibit 25-19)
S_0 = 63.4 mph (Exhibit 25-19)
S = 59.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 1830 ft
V_u = 358 veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3936	0.92	Level	9	0	0.957	1.00	4471
Ramp	543	0.92	Level	5	0	0.976	1.00	605
UpStream	358	0.92	Level	5	0	0.976	1.00	399
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = 1295.18 (Equation 25-2 or 25-3)
P_{FM} = 0.594 using Equation (Exhibit 25-5)
V_{12} = 2655 pc/h
V_3 or V_{av34} 1816 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5076	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3260	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 27.0 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.370 (Exibit 25-19)
S_R = 56.5 mph (Exhibit 25-19)
S_0 = 60.3 mph (Exhibit 25-19)
S = 57.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 1830 ft
V_D = 543 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	4294	0.92	Level	9	0	0.957	1.00	4877
Ramp	358	0.92	Level	5	0	0.976	1.00	399
UpStream								
DownStream	543	0.92	Level	5	0	0.976	1.00	605

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.620 using Equation (Exhibit 25-12)
V_{12} = 3174 pc/h
V_3 or V_{av34} 1703 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4877	Exhibit 25-14	7050	No
$V_{FO} = V_F - V_R$	4478	Exhibit 25-14	7050	No
V_R	399	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3174	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 29.7 (pc/mi/ln)
LOS = D (Exhibit 25-4)

Speed Determination

D_s = 0.334 (Exhibit 25-19)
S_R= 57.3 mph (Exhibit 25-19)
S_0= 68.6 mph (Exhibit 25-19)
S = 60.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 1985 ft
V_D = 691 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1943	0.92	Level	7	0	0.966	1.00	2186
Ramp	337	0.92	Level	5	0	0.976	1.00	375
UpStream								
DownStream	691	0.92	Level	5	0	0.976	1.00	770

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 1.000 using Equation (Exhibit 25-12)
V_{12} = 2186 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2186	Exhibit 25-14	4700	No
$V_{FO} = V_F - V_R$	1811	Exhibit 25-14	4700	No
V_R	375	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2186	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 21.3 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.332 (Exhibit 25-19)
S_R= 57.4 mph (Exhibit 25-19)
S_0= N/A mph (Exhibit 25-19)
S = 57.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 1985 ft
V_u = 337 veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1606	0.92	Level	8	0	0.962	1.00	1815
Ramp	691	0.92	Level	5	0	0.976	1.00	770
UpStream	337	0.92	Level	5	0	0.976	1.00	375
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 1.000 using Equation (Exhibit 25-5)
V_{12} = 1815 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2585	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2585	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 21.8 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.322 (Exibit 25-19)
S_R = 57.6 mph (Exhibit 25-19)
S_0 = N/A mph (Exhibit 25-19)
S = 57.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 2025 ft
V_u = 449 veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1597	0.92	Level	8	0	0.962	1.00	1805
Ramp	698	0.92	Level	5	0	0.976	1.00	778
UpStream	449	0.92	Level	5	0	0.976	1.00	500
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 1.000 using Equation (Exhibit 25-5)
V_{12} = 1805 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2583	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2583	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 21.9 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.324 (Exibit 25-19)
S_R = 57.5 mph (Exhibit 25-19)
S_0 = N/A mph (Exhibit 25-19)
S = 57.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 2025 ft
V_D = 698 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2046	0.92	Level	7	0	0.966	1.00	2302
Ramp	449	0.92	Level	5	0	0.976	1.00	500
UpStream								
DownStream	698	0.92	Level	5	0	0.976	1.00	778

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.679 using Equation (Exhibit 25-12)
V_{12} = 1724 pc/h
V_3 or V_{av34} 578 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2302	Exhibit 25-14	7050	No
$V_{FO} = V_F - V_R$	1802	Exhibit 25-14	7050	No
V_R	500	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1724	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 17.3 (pc/mi/ln)
LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.343 (Exhibit 25-19)
S_R= 57.1 mph (Exhibit 25-19)
S_0= 71.3 mph (Exhibit 25-19)
S = 60.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 2125 ft
V_D = 522 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3795	0.92	Level	9	0	0.957	1.00	4311
Ramp	575	0.92	Level	4	0	0.980	1.00	637
UpStream								
DownStream	522	0.92	Level	5	0	0.976	1.00	582

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.623 using Equation (Exhibit 25-12)
V_{12} = 2926 pc/h
V_3 or V_{av34} 1385 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4311	Exhibit 25-14	7050	No
$V_{FO} = V_F - V_R$	3674	Exhibit 25-14	7050	No
V_R	637	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2926	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 27.8 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.355 (Exhibit 25-19)
S_R= 56.8 mph (Exhibit 25-19)
S_0= 69.8 mph (Exhibit 25-19)
S = 60.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 2125 ft
V_u = 575 veh/h

Terrain: Level
S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3220	0.92	Level	9	0	0.957	1.00	3657
Ramp	522	0.92	Level	5	0	0.976	1.00	582
UpStream	575	0.92	Level	4	0	0.980	1.00	637
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = 1080.55 (Equation 25-2 or 25-3)
P_{FM} = 0.591 using Equation (Exhibit 25-5)
V_{12} = 2163 pc/h
V_3 or V_{av34} 1494 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4239	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2745	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 23.5 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.337 (Exibit 25-19)
S_R = 57.3 mph (Exhibit 25-19)
S_0 = 61.4 mph (Exhibit 25-19)
S = 58.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 1830 ft
V_u = 800 veh/h

Terrain: Level
S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	4377	0.92	Level	9	0	0.957	1.00	4972
Ramp	326	0.92	Level	4	0	0.980	1.00	361
UpStream	800	0.92	Level	5	0	0.976	1.00	891
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = 1350.18 (Equation 25-2 or 25-3)
P_{FM} = 0.594 using Equation (Exhibit 25-5)
V_{12} = 2952 pc/h
V_3 or V_{av34} 2020 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5333	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3313	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 27.5 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.376 (Exibit 25-19)
S_R = 56.4 mph (Exhibit 25-19)
S_0 = 59.5 mph (Exhibit 25-19)
S = 57.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-15 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Bundy Canyon
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 1830 ft
V_D = 326 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	5177	0.92	Level	8	0	0.962	1.00	5852
Ramp	800	0.92	Level	5	0	0.976	1.00	891
UpStream								
DownStream	326	0.92	Level	4	0	0.980	1.00	361

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.573 using Equation (Exhibit 25-12)
V_{12} = 3732 pc/h
V_3 or V_{av34} 2120 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5852	Exhibit 25-14	7050	No
$V_{FO} = V_F - V_R$	4961	Exhibit 25-14	7050	No
V_R	891	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3732	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 34.5 (pc/mi/ln)
LOS = D (Exhibit 25-4)

Speed Determination

D_s = 0.378 (Exhibit 25-19)
S_R= 56.3 mph (Exhibit 25-19)
S_0= 66.9 mph (Exhibit 25-19)
S = 59.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 1985 ft
V_D = 612 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1859	0.92	Level	7	0	0.966	1.00	2091
Ramp	463	0.92	Level	4	0	0.980	1.00	513
UpStream								
DownStream	612	0.92	Level	5	0	0.976	1.00	682

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 1.000 using Equation (Exhibit 25-12)
V_{12} = 2091 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2091	Exhibit 25-14	4700	No
$V_{FO} = V_F - V_R$	1578	Exhibit 25-14	4700	No
V_R	513	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2091	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 20.4 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.344 (Exhibit 25-19)
S_R = 57.1 mph (Exhibit 25-19)
S_0 = N/A mph (Exhibit 25-19)
S = 57.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Southbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 1985 ft
V_u = 463 veh/h

Terrain: Level
S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1396	0.92	Level	8	0	0.962	1.00	1578
Ramp	612	0.92	Level	5	0	0.976	1.00	682
UpStream	463	0.92	Level	4	0	0.980	1.00	513
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 1.000 using Equation (Exhibit 25-5)
V_{12} = 1578 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2260	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2260	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 19.3 (pc/mi/ln)
LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.308 (Exibit 25-19)
S_R = 57.9 mph (Exhibit 25-19)
S_0 = N/A mph (Exhibit 25-19)
S = 57.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	On-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 2025 ft
V_u = 759 veh/h

Terrain: Level
S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1765	0.92	Level	8	0	0.962	1.00	1995
Ramp	598	0.92	Level	5	0	0.976	1.00	666
UpStream	759	0.92	Level	5	0	0.976	1.00	846
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 1.000 using Equation (Exhibit 25-5)
V_{12} = 1995 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2661	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2661	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = 22.5 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.328 (Exibit 25-19)
S_R = 57.5 mph (Exhibit 25-19)
S_0 = N/A mph (Exhibit 25-19)
S = 57.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	CH	Freeway/Dir of Travel	I-215 Northbound
Agency or Company	Urban Crossroads, Inc.	Junction	Off-Ramp at Scott
Date Performed	1/30/2013	Jurisdiction	Caltrans
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Plus Project

Project Description Oak Creek (Tenative Tract Map No. 36388) (JN 08055)

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 65.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 2025 ft
V_D = 598 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2524	0.92	Level	7	0	0.966	1.00	2839
Ramp	759	0.92	Level	5	0	0.976	1.00	846
UpStream								
DownStream	598	0.92	Level	5	0	0.976	1.00	666

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.650 using Equation (Exhibit 25-12)
V_{12} = 2142 pc/h
V_3 or V_{av34} 697 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2839	Exhibit 25-14	7050	No
$V_{FO} = V_F - V_R$	1993	Exhibit 25-14	7050	No
V_R	846	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2142	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 20.9 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.374 (Exhibit 25-19)
S_R= 56.4 mph (Exhibit 25-19)
S_0= 71.3 mph (Exhibit 25-19)
S = 59.4 mph (Exhibit 25-15)

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ATTACHMENT "C"

HCM Peak Hour Intersection Analysis Worksheets

Existing (2011) Conditions

Oak Creek (TTM No. 36388) Traffic Impact Analysis
Existing (2011) Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 I-15 Southbound Ramps / Bundy Canyon Road

Cycle (sec):	65	Critical Vol./Cap.(X):	0.842
Loss Time (sec):	12	Average Delay (sec/veh):	23.0
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	23	23	10	23	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0	0	0	1	0	0	0	0	1	1	0	1	0	2	0	0
Volume Module:												
Base Vol:	0	0	0	146	1	210	0	470	415	299	554	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	146	1	210	0	470	415	299	554	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
PHF Volume:	0	0	0	179	1	258	0	577	509	367	680	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	179	1	258	0	577	509	367	680	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	179	1	258	0	577	509	367	680	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.85	0.85	0.85	1.00	0.88	0.88	0.95	0.95	1.00
Lanes:	0.00	0.00	0.00	1.00	0.01	0.99	0.00	1.06	0.94	1.00	2.00	0.00
Final Sat.:	0	0	0	1615	8	1609	0	1783	1574	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.11	0.16	0.16	0.00	0.32	0.32	0.20	0.19	0.00
Crit Moves:						****		****		****		
Green/Cycle:	0.00	0.00	0.00	0.19	0.19	0.19	0.00	0.38	0.38	0.24	0.63	0.00
Volume/Cap:	0.00	0.00	0.00	0.58	0.84	0.84	0.00	0.84	0.84	0.84	0.30	0.00
Delay/Veh:	0.0	0.0	0.0	26.8	43.9	43.9	0.0	23.4	23.4	37.3	5.7	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	26.8	43.9	43.9	0.0	23.4	23.4	37.3	5.7	0.0
LOS by Move:	A	A	A	C	D	D	A	C	C	D	A	A
HCM2kAvgQ:	0	0	0	4	8	8	0	13	13	7	3	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Existing (2011) Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 I-15 Northbound Ramps / Bundy Canyon Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.743
Loss Time (sec):	12	Average Delay (sec/veh):	18.9
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	23	0	0	23	23
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	0	1 0	0 0	0	0 0	1 0	2	0 0	0 0	1	1 0
Volume Module:												
Base Vol:	215	1	127	0	0	0	243	373	0	0	638	249
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	215	1	127	0	0	0	243	373	0	0	638	249
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PHF Volume:	244	1	144	0	0	0	276	423	0	0	723	282
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	244	1	144	0	0	0	276	423	0	0	723	282
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	244	1	144	0	0	0	276	423	0	0	723	282
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.85	0.85	0.85	1.00	1.00	1.00	0.95	0.95	1.00	1.00	0.91	0.91
Lanes:	1.00	0.01	0.99	0.00	0.00	0.00	1.00	2.00	0.00	0.00	1.44	0.56
Final Sat.:	1615	13	1604	0	0	0	1805	3610	0	0	2488	971
Capacity Analysis Module:												
Vol/Sat:	0.15	0.09	0.09	0.00	0.00	0.00	0.15	0.12	0.00	0.00	0.29	0.29
Crit Moves:	****						****				****	
Green/Cycle:	0.20	0.20	0.20	0.00	0.00	0.00	0.21	0.60	0.00	0.00	0.39	0.39
Volume/Cap:	0.74	0.44	0.44	0.00	0.00	0.00	0.74	0.20	0.00	0.00	0.74	0.74
Delay/Veh:	31.3	21.9	21.9	0.0	0.0	0.0	30.2	5.6	0.0	0.0	17.9	17.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	31.3	21.9	21.9	0.0	0.0	0.0	30.2	5.6	0.0	0.0	17.9	17.9
LOS by Move:	C	C	C	A	A	A	C	A	A	A	B	B
HCM2kAvgQ:	6	3	3	0	0	0	5	2	0	0	10	10

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Existing (2011) Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.854
Loss Time (sec):	12	Average Delay (sec/veh):	24.6
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	19	19	10	19	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0	0	0	0	1	0	0	1	0	0	1	0	1	0	1	0	0
Volume Module:												
Base Vol:	0	0	0	238	0	84	0	512	235	439	451	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	238	0	84	0	512	235	439	451	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
PHF Volume:	0	0	0	252	0	89	0	543	249	466	478	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	252	0	89	0	543	249	466	478	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	252	0	89	0	543	249	466	478	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.95	1.00	0.85	1.00	1.00	0.85	0.95	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Final Sat.:	0	0	0	1809	0	1615	0	1900	1615	1805	1900	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.14	0.00	0.06	0.00	0.29	0.15	0.26	0.25	0.00
Crit Moves:				****				****		****		
Green/Cycle:	0.00	0.00	0.00	0.17	0.00	0.17	0.00	0.33	0.33	0.30	0.63	0.00
Volume/Cap:	0.00	0.00	0.00	0.84	0.00	0.33	0.00	0.86	0.46	0.86	0.40	0.00
Delay/Veh:	0.0	0.0	0.0	42.4	0.0	22.8	0.0	30.0	16.4	32.7	5.6	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	42.4	0.0	22.8	0.0	30.0	16.4	32.7	5.6	0.0
LOS by Move:	A	A	A	D	A	C	A	C	B	C	A	A
HCM2kAvgQ:	0	0	0	7	0	2	0	13	4	8	4	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Existing (2011) Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	90	Critical Vol./Cap.(X):	0.864
Loss Time (sec):	12	Average Delay (sec/veh):	26.6
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	16	0	0	16	16
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 1	0	0 1	0 0	0	0 0	1 0	1	0 0	0 0	1 0	1
Volume Module:												
Base Vol:	143	7	292	0	0	0	135	615	0	0	747	516
Growth Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
Initial Bse:	143	7	292	0	0	0	135	615	0	0	747	516
User Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
PHF Adj:	0.87 0.87	0.87		0.87 0.87	0.87		0.87 0.87	0.87		0.87 0.87	0.87	
PHF Volume:	165	8	337	0	0	0	156	710	0	0	863	596
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	165	8	337	0	0	0	156	710	0	0	863	596
PCE Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
MLF Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
FinalVolume:	165	8	337	0	0	0	156	710	0	0	863	596
Saturation Flow Module:												
Sat/Lane:	1900 1900	1900		1900 1900	1900		1900 1900	1900		1900 1900	1900	
Adjustment:	0.95 0.95	0.85		1.00 1.00	1.00		0.95 1.00	1.00		1.00 1.00	0.85	
Lanes:	0.95 0.05	1.00		0.00 0.00	0.00		1.00 1.00	0.00		0.00 1.00	1.00	
Final Sat.:	1723	84	1615	0	0	0	1805 1900		0	0 1900		1615
Capacity Analysis Module:												
Vol/Sat:	0.10 0.10	0.21		0.00 0.00	0.00		0.09 0.37	0.00		0.00 0.45	0.37	
Crit Moves:		****					****				****	
Green/Cycle:	0.24 0.24	0.24		0.00 0.00	0.00		0.11 0.63	0.00		0.00 0.52	0.52	
Volume/Cap:	0.40 0.40	0.88		0.00 0.00	0.00		0.78 0.59	0.00		0.00 0.88	0.71	
Delay/Veh:	29.5 29.5	52.8		0.0 0.0	0.0		56.2 10.7	0.0		0.0 28.2	19.5	
User DelAdj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
AdjDel/Veh:	29.5 29.5	52.8		0.0 0.0	0.0		56.2 10.7	0.0		0.0 28.2	19.5	
LOS by Move:	C	C	D	A	A	A	E	B	A	A	C	B
HCM2kAvgQ:	4	4	12	0	0	0	4	11	0	0	24	14

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Existing (2011) Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 I-15 Southbound Ramps / Bundy Canyon Road

Cycle (sec):	65	Critical Vol./Cap.(X):	0.648
Loss Time (sec):	12	Average Delay (sec/veh):	18.9
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	23	23	10	23	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0	1 0	0	1 0	0 0	1	1 0	1 0	2	0 0
Volume Module:												
Base Vol:	0	0	0	310	2	204	0	333	262	231	501	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	310	2	204	0	333	262	231	501	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
PHF Volume:	0	0	0	330	2	217	0	354	279	246	533	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	330	2	217	0	354	279	246	533	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	330	2	217	0	354	279	246	533	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.85	0.85	0.85	1.00	0.89	0.89	0.95	0.95	1.00
Lanes:	0.00	0.00	0.00	1.00	0.01	0.99	0.00	1.12	0.88	1.00	2.00	0.00
Final Sat.:	0	0	0	1615	16	1603	0	1887	1485	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.20	0.14	0.14	0.00	0.19	0.19	0.14	0.15	0.00
Crit Moves:				****				****		****		
Green/Cycle:	0.00	0.00	0.00	0.28	0.28	0.28	0.00	0.35	0.35	0.18	0.54	0.00
Volume/Cap:	0.00	0.00	0.00	0.74	0.49	0.49	0.00	0.53	0.53	0.74	0.27	0.00
Delay/Veh:	0.0	0.0	0.0	27.7	20.5	20.5	0.0	17.2	17.2	33.4	8.2	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	27.7	20.5	20.5	0.0	17.2	17.2	33.4	8.2	0.0
LOS by Move:	A	A	A	C	C	C	A	B	B	C	A	A
HCM2kAvgQ:	0	0	0	8	4	4	0	6	6	5	3	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Existing (2011) Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 I-15 Northbound Ramps / Bundy Canyon Road

Cycle (sec):	70	Critical Vol./Cap.(X):	0.622
Loss Time (sec):	12	Average Delay (sec/veh):	19.3
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	23	0	0	23	23
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	0	1 0	0 0	0	0 0	1 0	2	0 0	0 0	1	1 0
Volume Module:												
Base Vol:	325	0	433	0	0	0	120	523	0	0	407	169
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	325	0	433	0	0	0	120	523	0	0	407	169
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
PHF Volume:	334	0	445	0	0	0	123	538	0	0	418	174
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	334	0	445	0	0	0	123	538	0	0	418	174
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	334	0	445	0	0	0	123	538	0	0	418	174
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	1.00	1.00	1.00	0.95	0.95	1.00	1.00	0.91	0.91
Lanes:	1.00	0.00	1.00	0.00	0.00	0.00	1.00	2.00	0.00	0.00	1.41	0.59
Final Sat.:	1805	0	1615	0	0	0	1805	3610	0	0	2439	1013
Capacity Analysis Module:												
Vol/Sat:	0.19	0.00	0.28	0.00	0.00	0.00	0.07	0.15	0.00	0.00	0.17	0.17
Crit Moves:			****				****				****	
Green/Cycle:	0.36	0.00	0.36	0.00	0.00	0.00	0.14	0.47	0.00	0.00	0.33	0.33
Volume/Cap:	0.52	0.00	0.77	0.00	0.00	0.00	0.48	0.32	0.00	0.00	0.52	0.52
Delay/Veh:	18.5	0.0	26.3	0.0	0.0	0.0	29.0	11.6	0.0	0.0	19.5	19.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	18.5	0.0	26.3	0.0	0.0	0.0	29.0	11.6	0.0	0.0	19.5	19.5
LOS by Move:	B	A	C	A	A	A	C	B	A	A	B	B
HCM2kAvgQ:	6	0	11	0	0	0	2	4	0	0	6	6

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Existing (2011) Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	75	Critical Vol./Cap.(X):	0.891
Loss Time (sec):	12	Average Delay (sec/veh):	30.8
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	19	19	10	19	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0	0	0	0	1	0	0	1	0	0	1	0	1	0	1	0	0
Volume Module:												
Base Vol:	0	0	0	396	0	120	0	537	205	393	664	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	396	0	120	0	537	205	393	664	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
PHF Volume:	0	0	0	412	0	125	0	559	213	409	691	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	412	0	125	0	559	213	409	691	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	412	0	125	0	559	213	409	691	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.95	1.00	0.85	1.00	1.00	0.85	0.95	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Final Sat.:	0	0	0	1809	0	1615	0	1900	1615	1805	1900	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.23	0.00	0.08	0.00	0.29	0.13	0.23	0.36	0.00
Crit Moves:				****				****		****		
Green/Cycle:	0.00	0.00	0.00	0.26	0.00	0.26	0.00	0.33	0.33	0.25	0.58	0.00
Volume/Cap:	0.00	0.00	0.00	0.89	0.00	0.30	0.00	0.89	0.40	0.89	0.62	0.00
Delay/Veh:	0.0	0.0	0.0	45.8	0.0	22.9	0.0	38.7	19.9	46.0	11.3	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	45.8	0.0	22.9	0.0	38.7	19.9	46.0	11.3	0.0
LOS by Move:	A	A	A	D	A	C	A	D	B	D	B	A
HCM2kAvgQ:	0	0	0	13	0	3	0	16	4	9	10	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Existing (2011) Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	95	Critical Vol./Cap.(X):	0.886
Loss Time (sec):	12	Average Delay (sec/veh):	32.3
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	16	0	0	16	16
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 1	0	0 1	0 0	0	0 0	1 0	1	0 0	0 0	1 0	1
Volume Module:												
Base Vol:	278	8	452	0	0	0	122	811	0	0	779	439
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	278	8	452	0	0	0	122	811	0	0	779	439
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PHF Volume:	284	8	462	0	0	0	125	829	0	0	797	449
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	284	8	462	0	0	0	125	829	0	0	797	449
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	284	8	462	0	0	0	125	829	0	0	797	449
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.94	0.94	0.85	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.85
Lanes:	0.97	0.03	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00
Final Sat.:	1742	50	1615	0	0	0	1805	1900	0	0	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.16	0.16	0.29	0.00	0.00	0.00	0.07	0.44	0.00	0.00	0.42	0.28
Crit Moves:			****				****				****	
Green/Cycle:	0.31	0.31	0.31	0.00	0.00	0.00	0.11	0.56	0.00	0.00	0.46	0.46
Volume/Cap:	0.52	0.52	0.92	0.00	0.00	0.00	0.66	0.78	0.00	0.00	0.92	0.61
Delay/Veh:	27.8	27.8	53.4	0.0	0.0	0.0	48.9	19.8	0.0	0.0	38.6	20.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	27.8	27.8	53.4	0.0	0.0	0.0	48.9	19.8	0.0	0.0	38.6	20.9
LOS by Move:	C	C	D	A	A	A	D	B	A	A	D	C
HCM2kAvgQ:	7	7	17	0	0	0	3	18	0	0	26	10

Note: Queue reported is the number of cars per lane.

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Existing Plus Project Conditions

Oak Creek (TTM No. 36388) Traffic Impact Analysis
Existing Plus Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #1 I-15 Southbound Ramps / Bundy Canyon Road

Cycle (sec):	65	Critical Vol./Cap.(X):	0.875
Loss Time (sec):	12	Average Delay (sec/veh):	25.5
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	23	23	10	23	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	1 0	0	1 0	0 0	1	1 0	1 0	2	0 0
Volume Module:												
Base Vol:	0	0	0	146	1	210	0	470	415	299	554	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	146	1	210	0	470	415	299	554	0
Added Vol:	0	0	0	20	0	0	0	9	0	34	13	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	166	1	210	0	479	415	333	567	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
PHF Volume:	0	0	0	204	1	258	0	588	509	409	696	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	204	1	258	0	588	509	409	696	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	204	1	258	0	588	509	409	696	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.85	0.85	0.85	1.00	0.88	0.88	0.95	0.95	1.00
Lanes:	0.00	0.00	0.00	1.00	0.01	0.99	0.00	1.07	0.93	1.00	2.00	0.00
Final Sat.:	0	0	0	1615	8	1609	0	1799	1558	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.13	0.16	0.16	0.00	0.33	0.33	0.23	0.19	0.00
Crit Moves:						****		****		****		
Green/Cycle:	0.00	0.00	0.00	0.18	0.18	0.18	0.00	0.37	0.37	0.26	0.63	0.00
Volume/Cap:	0.00	0.00	0.00	0.69	0.87	0.87	0.00	0.87	0.87	0.87	0.30	0.00
Delay/Veh:	0.0	0.0	0.0	31.5	49.6	49.6	0.0	26.1	26.1	39.7	5.5	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	31.5	49.6	49.6	0.0	26.1	26.1	39.7	5.5	0.0
LOS by Move:	A	A	A	C	D	D	A	C	C	D	A	A
HCM2kAvgQ:	0	0	0	5	8	8	0	14	14	8	3	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Existing Plus Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #2 I-15 Northbound Ramps / Bundy Canyon Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.784
Loss Time (sec):	12	Average Delay (sec/veh):	19.8
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	23	0	0	23	23
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	0	1 0	0	0	0 0 0	1 0	2	0 0	0	0 1	1 0
Volume Module:												
Base Vol:	215	1	127	0	0	0	243	373	0	0	638	249
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	215	1	127	0	0	0	243	373	0	0	638	249
Added Vol:	0	0	15	0	0	0	0	29	0	0	47	50
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	215	1	142	0	0	0	243	402	0	0	685	299
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PHF Volume:	244	1	161	0	0	0	276	456	0	0	777	339
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	244	1	161	0	0	0	276	456	0	0	777	339
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	244	1	161	0	0	0	276	456	0	0	777	339
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.85	0.85	0.85	1.00	1.00	1.00	0.95	0.95	1.00	1.00	0.91	0.91
Lanes:	1.00	0.01	0.99	0.00	0.00	0.00	1.00	2.00	0.00	0.00	1.39	0.61
Final Sat.:	1615	11	1606	0	0	0	1805	3610	0	0	2397	1046
Capacity Analysis Module:												
Vol/Sat:	0.15	0.10	0.10	0.00	0.00	0.00	0.15	0.13	0.00	0.00	0.32	0.32
Crit Moves:	****						****				****	
Green/Cycle:	0.19	0.19	0.19	0.00	0.00	0.00	0.19	0.61	0.00	0.00	0.41	0.41
Volume/Cap:	0.78	0.52	0.52	0.00	0.00	0.00	0.78	0.21	0.00	0.00	0.78	0.78
Delay/Veh:	35.4	23.3	23.3	0.0	0.0	0.0	34.0	5.3	0.0	0.0	18.2	18.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	35.4	23.3	23.3	0.0	0.0	0.0	34.0	5.3	0.0	0.0	18.2	18.2
LOS by Move:	D	C	C	A	A	A	C	A	A	A	B	B
HCM2kAvgQ:	7	3	3	0	0	0	5	2	0	0	12	12

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
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Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	70	Critical Vol./Cap.(X):	0.858
Loss Time (sec):	12	Average Delay (sec/veh):	26.6
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	19	19	10	19	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	0 1	0	0 1	0 0	1	0 1	1 0	1	0 0
Volume Module:												
Base Vol:	0	0	0	238	0	84	0	512	235	439	451	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	238	0	84	0	512	235	439	451	0
Added Vol:	0	0	0	0	0	15	0	50	17	0	12	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	238	0	99	0	562	252	439	463	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
PHF Volume:	0	0	0	252	0	105	0	596	267	466	491	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	252	0	105	0	596	267	466	491	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	252	0	105	0	596	267	466	491	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.95	1.00	0.85	1.00	1.00	0.85	0.95	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Final Sat.:	0	0	0	1809	0	1615	0	1900	1615	1805	1900	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.14	0.00	0.07	0.00	0.31	0.17	0.26	0.26	0.00
Crit Moves:				****				****		****		
Green/Cycle:	0.00	0.00	0.00	0.16	0.00	0.16	0.00	0.37	0.37	0.30	0.67	0.00
Volume/Cap:	0.00	0.00	0.00	0.86	0.00	0.40	0.00	0.86	0.45	0.86	0.39	0.00
Delay/Veh:	0.0	0.0	0.0	49.9	0.0	27.3	0.0	31.0	17.4	36.0	5.5	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	49.9	0.0	27.3	0.0	31.0	17.4	36.0	5.5	0.0
LOS by Move:	A	A	A	D	A	C	A	C	B	D	A	A
HCM2kAvgQ:	0	0	0	8	0	2	0	15	5	9	4	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
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2000 HCM Operations Method (Future Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	80	Critical Vol./Cap.(X):	0.915
Loss Time (sec):	12	Average Delay (sec/veh):	29.3
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	16	0	0	16	16
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 1	0	0 1	0 0	0	0 0	1 0	1	0 0	0 0	1	0 1
Volume Module:												
Base Vol:	143	7	292	0	0	0	135	615	0	0	747	516
Growth Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
Initial Bse:	143	7	292	0	0	0	135	615	0	0	747	516
Added Vol:	7	0	0	0	0	0	40	9	0	0	5	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	150	7	292	0	0	0	175	624	0	0	752	516
User Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
PHF Adj:	0.87 0.87	0.87		0.87 0.87	0.87		0.87 0.87	0.87		0.87 0.87	0.87	
PHF Volume:	173	8	337	0	0	0	202	721	0	0	868	596
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	173	8	337	0	0	0	202	721	0	0	868	596
PCE Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
MLF Adj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
FinalVolume:	173	8	337	0	0	0	202	721	0	0	868	596
Saturation Flow Module:												
Sat/Lane:	1900 1900	1900		1900 1900	1900		1900 1900	1900		1900 1900	1900	
Adjustment:	0.95 0.95	0.85		1.00 1.00	1.00		0.95 1.00	1.00		1.00 1.00	0.85	
Lanes:	0.96 0.04	1.00		0.00 0.00	0.00		1.00 1.00	0.00		0.00 1.00	1.00	
Final Sat.:	1725 80	1615		0 0	0		1805 1900	0		0 1900	1615	
Capacity Analysis Module:												
Vol/Sat:	0.10 0.10	0.21		0.00 0.00	0.00		0.11 0.38	0.00		0.00 0.46	0.37	
Crit Moves:		****					****				****	
Green/Cycle:	0.23 0.23	0.23		0.00 0.00	0.00		0.13 0.62	0.00		0.00 0.50	0.50	
Volume/Cap:	0.44 0.44	0.92		0.00 0.00	0.00		0.90 0.61	0.00		0.00 0.92	0.74	
Delay/Veh:	27.3 27.3	57.7		0.0 0.0	0.0		67.8 10.1	0.0		0.0 32.2	19.7	
User DelAdj:	1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00		1.00 1.00	1.00	
AdjDel/Veh:	27.3 27.3	57.7		0.0 0.0	0.0		67.8 10.1	0.0		0.0 32.2	19.7	
LOS by Move:	C C	E		A A	A		E B	A		A C	B	
HCM2kAvgQ:	4 4	12		0 0	0		5 10	0		0 25	13	

Note: Queue reported is the number of cars per lane.

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2000 HCM Operations Method (Future Volume Alternative)

Intersection #1 I-15 Southbound Ramps / Bundy Canyon Road

Cycle (sec):	70	Critical Vol./Cap.(X):	0.710
Loss Time (sec):	12	Average Delay (sec/veh):	21.8
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	23	23	10	23	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	1 0	0	1 0	0 0	1	1 0	1 0	2	0 0
Volume Module:												
Base Vol:	0	0	0	310	2	204	0	333	262	231	501	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	310	2	204	0	333	262	231	501	0
Added Vol:	0	0	0	59	0	0	0	19	0	27	15	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	369	2	204	0	352	262	258	516	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
PHF Volume:	0	0	0	393	2	217	0	374	279	274	549	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	393	2	217	0	374	279	274	549	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	393	2	217	0	374	279	274	549	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.85	0.85	0.85	1.00	0.89	0.89	0.95	0.95	1.00
Lanes:	0.00	0.00	0.00	1.00	0.01	0.99	0.00	1.15	0.85	1.00	2.00	0.00
Final Sat.:	0	0	0	1615	16	1603	0	1937	1442	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.24	0.14	0.14	0.00	0.19	0.19	0.15	0.15	0.00
Crit Moves:				****				****		****		
Green/Cycle:	0.00	0.00	0.00	0.31	0.31	0.31	0.00	0.33	0.33	0.19	0.52	0.00
Volume/Cap:	0.00	0.00	0.00	0.79	0.44	0.44	0.00	0.59	0.59	0.79	0.29	0.00
Delay/Veh:	0.0	0.0	0.0	30.5	20.0	20.0	0.0	20.4	20.4	38.5	9.6	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	30.5	20.0	20.0	0.0	20.4	20.4	38.5	9.6	0.0
LOS by Move:	A	A	A	C	C	C	A	C	C	D	A	A
HCM2kAvgQ:	0	0	0	10	4	4	0	7	7	6	3	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
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2000 HCM Operations Method (Future Volume Alternative)

Intersection #2 I-15 Northbound Ramps / Bundy Canyon Road

Cycle (sec):	75	Critical Vol./Cap.(X):	0.674
Loss Time (sec):	12	Average Delay (sec/veh):	20.8
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	23	0	0	23	23
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	0	1 0	0	0	0 0 0	1 0	2	0 0	0	0	1 1 0
Volume Module:												
Base Vol:	325	0	433	0	0	0	120	523	0	0	407	169
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	325	0	433	0	0	0	120	523	0	0	407	169
Added Vol:	0	0	42	0	0	0	0	78	0	0	42	37
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	325	0	475	0	0	0	120	601	0	0	449	206
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
PHF Volume:	334	0	488	0	0	0	123	618	0	0	461	212
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	334	0	488	0	0	0	123	618	0	0	461	212
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	334	0	488	0	0	0	123	618	0	0	461	212
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	1.00	1.00	1.00	0.95	0.95	1.00	1.00	0.91	0.91
Lanes:	1.00	0.00	1.00	0.00	0.00	0.00	1.00	2.00	0.00	0.00	1.37	0.63
Final Sat.:	1805	0	1615	0	0	0	1805	3610	0	0	2358	1082
Capacity Analysis Module:												
Vol/Sat:	0.19	0.00	0.30	0.00	0.00	0.00	0.07	0.17	0.00	0.00	0.20	0.20
Crit Moves:			****				****				****	
Green/Cycle:	0.40	0.00	0.40	0.00	0.00	0.00	0.13	0.44	0.00	0.00	0.31	0.31
Volume/Cap:	0.46	0.00	0.76	0.00	0.00	0.00	0.51	0.39	0.00	0.00	0.64	0.64
Delay/Veh:	17.0	0.0	24.4	0.0	0.0	0.0	32.1	14.3	0.0	0.0	23.7	23.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	17.0	0.0	24.4	0.0	0.0	0.0	32.1	14.3	0.0	0.0	23.7	23.7
LOS by Move:	B	A	C	A	A	A	C	B	A	A	C	C
HCM2kAvgQ:	6	0	11	0	0	0	3	5	0	0	8	8

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Existing Plus Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	75	Critical Vol./Cap.(X):	0.915
Loss Time (sec):	12	Average Delay (sec/veh):	32.7
Optimal Cycle: OPTIMIZED		Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	19	19	10	19	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	0	1 0	0 1	0	0 1	0 1	1	0 1	0 0
Volume Module:												
Base Vol:	0	0	0	396	0	120	0	537	205	393	664	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	396	0	120	0	537	205	393	664	0
Added Vol:	0	0	0	0	0	47	0	37	14	0	33	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	396	0	167	0	574	219	393	697	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
PHF Volume:	0	0	0	412	0	174	0	597	228	409	725	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	412	0	174	0	597	228	409	725	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	412	0	174	0	597	228	409	725	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.95	1.00	0.85	1.00	1.00	0.85	0.95	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Final Sat.:	0	0	0	1809	0	1615	0	1900	1615	1805	1900	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.23	0.00	0.11	0.00	0.31	0.14	0.23	0.38	0.00
Crit Moves:				****				****		****		
Green/Cycle:	0.00	0.00	0.00	0.25	0.00	0.25	0.00	0.34	0.34	0.25	0.59	0.00
Volume/Cap:	0.00	0.00	0.00	0.92	0.00	0.43	0.00	0.92	0.41	0.92	0.65	0.00
Delay/Veh:	0.0	0.0	0.0	50.6	0.0	24.5	0.0	41.2	19.3	50.7	11.5	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	50.6	0.0	24.5	0.0	41.2	19.3	50.7	11.5	0.0
LOS by Move:	A	A	A	D	A	C	A	D	B	D	B	A
HCM2kAvgQ:	0	0	0	14	0	4	0	18	4	9	10	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Existing Plus Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	95	Critical Vol./Cap.(X):	0.913
Loss Time (sec):	12	Average Delay (sec/veh):	33.9
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	16	0	0	16	16
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 1	0	0 1	0 0	0	0 0	1 0	1	0 0	0 0	1	0 1
Volume Module:												
Base Vol:	278	8	452	0	0	0	122	811	0	0	779	439
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	278	8	452	0	0	0	122	811	0	0	779	439
Added Vol:	21	0	0	0	0	0	29	8	0	0	12	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	299	8	452	0	0	0	151	819	0	0	791	439
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PHF Volume:	306	8	462	0	0	0	154	837	0	0	809	449
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	306	8	462	0	0	0	154	837	0	0	809	449
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	306	8	462	0	0	0	154	837	0	0	809	449
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.94	0.94	0.85	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.85
Lanes:	0.97	0.03	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00
Final Sat.:	1741	47	1615	0	0	0	1805	1900	0	0	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.18	0.18	0.29	0.00	0.00	0.00	0.09	0.44	0.00	0.00	0.43	0.28
Crit Moves:			****				****				****	
Green/Cycle:	0.31	0.31	0.31	0.00	0.00	0.00	0.11	0.56	0.00	0.00	0.46	0.46
Volume/Cap:	0.57	0.57	0.93	0.00	0.00	0.00	0.81	0.78	0.00	0.00	0.93	0.60
Delay/Veh:	28.9	28.9	55.2	0.0	0.0	0.0	64.2	19.8	0.0	0.0	39.7	20.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	28.9	28.9	55.2	0.0	0.0	0.0	64.2	19.8	0.0	0.0	39.7	20.6
LOS by Move:	C	C	E	A	A	A	E	B	A	A	D	C
HCM2kAvgQ:	8	8	17	0	0	0	4	18	0	0	27	10

Note: Queue reported is the number of cars per lane.

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Opening Year (2015) Without Project Conditions

Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) Without Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #1 I-15 Southbound Ramps / Bundy Canyon Road

Cycle (sec):	70	Critical Vol./Cap.(X):	0.891
Loss Time (sec):	12	Average Delay (sec/veh):	26.9
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	23	23	10	23	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0	1 0	0	1 0	0 0	1	1 0	1 0	2	0 0
Volume Module:												
Base Vol:	0	0	0	146	1	210	0	470	415	299	554	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	0	0	158	1	227	0	509	449	324	600	0
Added Vol:	0	0	0	117	0	8	0	150	11	38	248	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	275	1	235	0	659	460	362	848	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	0	0	290	1	248	0	693	484	381	892	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	290	1	248	0	693	484	381	892	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	290	1	248	0	693	484	381	892	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.85	0.85	0.85	1.00	0.89	0.89	0.95	0.95	1.00
Lanes:	0.00	0.00	0.00	1.00	0.01	0.99	0.00	1.18	0.82	1.00	2.00	0.00
Final Sat.:	0	0	0	1615	7	1609	0	1993	1393	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.18	0.15	0.15	0.00	0.35	0.35	0.21	0.25	0.00
Crit Moves:				****				****		****		
Green/Cycle:	0.00	0.00	0.00	0.20	0.20	0.20	0.00	0.39	0.39	0.24	0.63	0.00
Volume/Cap:	0.00	0.00	0.00	0.89	0.76	0.76	0.00	0.89	0.89	0.89	0.39	0.00
Delay/Veh:	0.0	0.0	0.0	51.9	36.7	36.7	0.0	27.8	27.8	45.9	6.6	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	51.9	36.7	36.7	0.0	27.8	27.8	45.9	6.6	0.0
LOS by Move:	A	A	A	D	D	D	A	C	C	D	A	A
HCM2kAvgQ:	0	0	0	10	7	7	0	17	17	8	5	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) Without Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #2 I-15 Northbound Ramps / Bundy Canyon Road

Cycle (sec):	70	Critical Vol./Cap.(X):	0.888
Loss Time (sec):	12	Average Delay (sec/veh):	24.9
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	23	0	0	23	23
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	0 1	0	0 0	0 0	0	1 0	2 0	0	0 0	1 1	0
Volume Module:												
Base Vol:	215	1	127	0	0	0	243	373	0	0	638	249
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	233	1	137	0	0	0	263	404	0	0	691	270
Added Vol:	8	0	10	0	0	0	11	256	0	0	279	136
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	241	1	147	0	0	0	274	660	0	0	970	406
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	253	1	155	0	0	0	288	694	0	0	1021	427
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	253	1	155	0	0	0	288	694	0	0	1021	427
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	253	1	155	0	0	0	288	694	0	0	1021	427
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.85	0.85	0.85	1.00	1.00	1.00	0.95	0.95	1.00	1.00	0.91	0.91
Lanes:	1.00	0.01	0.99	0.00	0.00	0.00	1.00	2.00	0.00	0.00	1.41	0.59
Final Sat.:	1615	12	1605	0	0	0	1805	3610	0	0	2433	1018
Capacity Analysis Module:												
Vol/Sat:	0.16	0.10	0.10	0.00	0.00	0.00	0.16	0.19	0.00	0.00	0.42	0.42
Crit Moves:	****						****				****	
Green/Cycle:	0.18	0.18	0.18	0.00	0.00	0.00	0.18	0.65	0.00	0.00	0.47	0.47
Volume/Cap:	0.89	0.55	0.55	0.00	0.00	0.00	0.89	0.30	0.00	0.00	0.89	0.89
Delay/Veh:	55.0	28.5	28.5	0.0	0.0	0.0	52.4	5.3	0.0	0.0	23.2	23.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	55.0	28.5	28.5	0.0	0.0	0.0	52.4	5.3	0.0	0.0	23.2	23.2
LOS by Move:	E	C	C	A	A	A	D	A	A	A	C	C
HCM2kAvgQ:	9	4	4	0	0	0	6	3	0	0	19	19

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
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Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	120	Critical Vol./Cap.(X):	1.883
Loss Time (sec):	12	Average Delay (sec/veh):	284.4
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	19	19	10	19	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	0 1	0	0 1	0 0	1	0 1	1 0	1	0 0
Volume Module:												
Base Vol:	0	0	0	238	0	84	0	512	235	439	451	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	0	0	258	0	91	0	554	254	475	488	0
Added Vol:	0	0	0	61	0	396	0	1026	404	386	1130	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	319	0	487	0	1580	658	861	1618	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	0	0	335	0	513	0	1663	693	906	1703	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	335	0	513	0	1663	693	906	1703	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	335	0	513	0	1663	693	906	1703	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.95	1.00	0.85	1.00	1.00	0.85	0.95	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Final Sat.:	0	0	0	1809	0	1615	0	1900	1615	1805	1900	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.19	0.00	0.32	0.00	0.88	0.43	0.50	0.90	0.00
Crit Moves:						****		****		****		
Green/Cycle:	0.00	0.00	0.00	0.17	0.00	0.17	0.00	0.46	0.46	0.27	0.73	0.00
Volume/Cap:	0.00	0.00	0.00	1.10	0.00	1.88	0.00	1.88	0.92	1.88	1.23	0.00
Delay/Veh:	0.0	0.0	0.0	131.1	0.0	461.1	0.0	434	47.1	449.2	124	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	131.1	0.0	461.1	0.0	434	47.1	449.2	124	0.0
LOS by Move:	A	A	A	F	A	F	A	F	D	F	F	A
HCM2kAvgQ:	0	0	0	20	0	49	0	155	28	83	96	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) Without Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	120	Critical Vol./Cap.(X):	1.988
Loss Time (sec):	12	Average Delay (sec/veh):	322.3
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	16	0	0	16	16
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 1	0	0 1	0 0	0	0 0	1 0	1 0	0	0 0	1 0	1
Volume Module:												
Base Vol:	143	7	292	0	0	0	135	615	0	0	747	516
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	155	8	316	0	0	0	146	666	0	0	809	559
Added Vol:	341	0	129	0	0	0	519	568	0	0	1175	175
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	496	8	445	0	0	0	665	1234	0	0	1984	734
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	522	8	468	0	0	0	700	1299	0	0	2088	772
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	522	8	468	0	0	0	700	1299	0	0	2088	772
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	522	8	468	0	0	0	700	1299	0	0	2088	772
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.92	0.92	0.85	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.85
Lanes:	0.98	0.02	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00
Final Sat.:	1725	26	1615	0	0	0	1805	1900	0	0	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.30	0.30	0.29	0.00	0.00	0.00	0.39	0.68	0.00	0.00	1.10	0.48
Crit Moves:	****						****				****	
Green/Cycle:	0.15	0.15	0.15	0.00	0.00	0.00	0.20	0.75	0.00	0.00	0.55	0.55
Volume/Cap:	1.99	1.99	1.91	0.00	0.00	0.00	1.99	0.91	0.00	0.00	1.99	0.86
Delay/Veh:	508.9	509	474.0	0.0	0.0	0.0	503.0	21.4	0.0	0.0	475	31.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	508.9	509	474.0	0.0	0.0	0.0	503.0	21.4	0.0	0.0	475	31.8
LOS by Move:	F	F	F	A	A	A	F	C	A	A	F	C
HCM2kAvgQ:	52	52	45	0	0	0	67	35	0	0	201	27

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) Without Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #1 I-15 Southbound Ramps / Bundy Canyon Road

Cycle (sec):	80	Critical Vol./Cap.(X):	0.921
Loss Time (sec):	12	Average Delay (sec/veh):	33.1
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	23	23	10	23	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	1 0	0	1 0	0 0	1	1 0	1 0	2	0 0
Volume Module:												
Base Vol:	0	0	0	310	2	204	0	333	262	231	501	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	0	0	336	2	221	0	360	284	250	542	0
Added Vol:	0	0	0	157	0	26	0	326	23	21	267	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	493	2	247	0	686	307	271	809	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	0	0	518	2	260	0	723	323	285	852	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	518	2	260	0	723	323	285	852	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	518	2	260	0	723	323	285	852	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.85	0.85	0.85	1.00	0.91	0.91	0.95	0.95	1.00
Lanes:	0.00	0.00	0.00	1.00	0.01	0.99	0.00	1.38	0.62	1.00	2.00	0.00
Final Sat.:	0	0	0	1615	14	1603	0	2381	1063	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.32	0.16	0.16	0.00	0.30	0.30	0.16	0.24	0.00
Crit Moves:				****				****		****		
Green/Cycle:	0.00	0.00	0.00	0.35	0.35	0.35	0.00	0.33	0.33	0.17	0.50	0.00
Volume/Cap:	0.00	0.00	0.00	0.92	0.46	0.46	0.00	0.92	0.92	0.92	0.47	0.00
Delay/Veh:	0.0	0.0	0.0	45.5	20.9	20.9	0.0	37.8	37.8	63.9	13.2	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	45.5	20.9	20.9	0.0	37.8	37.8	63.9	13.2	0.0
LOS by Move:	A	A	A	D	C	C	A	D	D	E	B	A
HCM2kAvgQ:	0	0	0	17	5	5	0	18	18	7	7	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) Without Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #2 I-15 Northbound Ramps / Bundy Canyon Road

Cycle (sec):	80	Critical Vol./Cap.(X):	0.854
Loss Time (sec):	12	Average Delay (sec/veh):	26.9
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	23	0	0	23	23
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	0 1	0	0 0	0 0	0	1 0	2 0	0	0 0	1 1	0
Volume Module:												
Base Vol:	325	0	433	0	0	0	120	523	0	0	407	169
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	352	0	469	0	0	0	130	566	0	0	441	183
Added Vol:	26	0	44	0	0	0	23	460	0	0	261	159
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	378	0	513	0	0	0	153	1026	0	0	702	342
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
PHF Volume:	388	0	527	0	0	0	157	1055	0	0	721	351
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	388	0	527	0	0	0	157	1055	0	0	721	351
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	388	0	527	0	0	0	157	1055	0	0	721	351
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	1.00	1.00	1.00	0.95	0.95	1.00	1.00	0.90	0.90
Lanes:	1.00	0.00	1.00	0.00	0.00	0.00	1.00	2.00	0.00	0.00	1.34	0.66
Final Sat.:	1805	0	1615	0	0	0	1805	3610	0	0	2308	1125
Capacity Analysis Module:												
Vol/Sat:	0.22	0.00	0.33	0.00	0.00	0.00	0.09	0.29	0.00	0.00	0.31	0.31
Crit Moves:			****				****				****	
Green/Cycle:	0.37	0.00	0.37	0.00	0.00	0.00	0.13	0.48	0.00	0.00	0.35	0.35
Volume/Cap:	0.58	0.00	0.88	0.00	0.00	0.00	0.70	0.61	0.00	0.00	0.88	0.88
Delay/Veh:	21.5	0.0	37.8	0.0	0.0	0.0	42.7	15.9	0.0	0.0	32.0	32.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	21.5	0.0	37.8	0.0	0.0	0.0	42.7	15.9	0.0	0.0	32.0	32.0
LOS by Move:	C	A	D	A	A	A	D	B	A	A	C	C
HCM2kAvgQ:	8	0	16	0	0	0	4	9	0	0	17	17

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) Without Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	120	Critical Vol./Cap.(X):	2.336
Loss Time (sec):	12	Average Delay (sec/veh):	465.2
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	19	19	10	19	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	0	1 0	0 1	0	0	1 0 1	1	0 1	0 0
Volume Module:												
Base Vol:	0	0	0	396	0	120	0	537	205	393	664	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	0	0	429	0	130	0	581	222	425	719	0
Added Vol:	0	0	0	211	0	674	0	1591	493	260	1367	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	640	0	804	0	2172	715	685	2086	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
PHF Volume:	0	0	0	666	0	837	0	2260	744	713	2170	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	666	0	837	0	2260	744	713	2170	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	666	0	837	0	2260	744	713	2170	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.95	1.00	0.85	1.00	1.00	0.85	0.95	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Final Sat.:	0	0	0	1809	0	1615	0	1900	1615	1805	1900	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.37	0.00	0.52	0.00	1.19	0.46	0.40	1.14	0.00
Crit Moves:						****		****		****		
Green/Cycle:	0.00	0.00	0.00	0.22	0.00	0.22	0.00	0.51	0.51	0.17	0.68	0.00
Volume/Cap:	0.00	0.00	0.00	1.66	0.00	2.34	0.00	2.34	0.90	2.34	1.68	0.00
Delay/Veh:	0.0	0.0	0.0	354.5	0.0	656.7	0.0	634	40.2	661.5	331	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	354.5	0.0	656.7	0.0	634	40.2	661.5	331	0.0
LOS by Move:	A	A	A	F	A	F	A	F	D	F	F	A
HCM2kAvgQ:	0	0	0	58	0	89	0	239	28	75	183	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) Without Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	120	Critical Vol./Cap.(X):	2.274
Loss Time (sec):	12	Average Delay (sec/veh):	474.1
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	16	0	0	16	16
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 1	0	0 1	0 0	0	0 0	1 0	1 0	0	0 0	1 0	1
Volume Module:												
Base Vol:	278	8	452	0	0	0	122	811	0	0	779	439
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	301	9	489	0	0	0	132	878	0	0	843	475
Added Vol:	527	0	445	0	0	0	590	1212	0	0	1100	125
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	828	9	934	0	0	0	722	2090	0	0	1943	600
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PHF Volume:	847	9	955	0	0	0	738	2137	0	0	1987	614
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	847	9	955	0	0	0	738	2137	0	0	1987	614
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	847	9	955	0	0	0	738	2137	0	0	1987	614
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.93	0.85	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.85
Lanes:	0.99	0.01	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00
Final Sat.:	1749	18	1615	0	0	0	1805	1900	0	0	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.48	0.48	0.59	0.00	0.00	0.00	0.41	1.12	0.00	0.00	1.05	0.38
Crit Moves:			****				****				****	
Green/Cycle:	0.26	0.26	0.26	0.00	0.00	0.00	0.18	0.64	0.00	0.00	0.46	0.46
Volume/Cap:	1.86	1.86	2.27	0.00	0.00	0.00	2.27	1.76	0.00	0.00	2.27	0.83
Delay/Veh:	439.9	440	624.9	0.0	0.0	0.0	632.1	366	0.0	0.0	609	35.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	439.9	440	624.9	0.0	0.0	0.0	632.1	366	0.0	0.0	609	35.8
LOS by Move:	F	F	F	A	A	A	F	F	A	A	F	D
HCM2kAvgQ:	80	80	100	0	0	0	76	187	0	0	207	22

Note: Queue reported is the number of cars per lane.

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Opening Year (2015) With Project Conditions

Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) With Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #1 I-15 Southbound Ramps / Bundy Canyon Road

Cycle (sec):	80	Critical Vol./Cap.(X):	0.909
Loss Time (sec):	12	Average Delay (sec/veh):	30.6
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	23	23	10	23	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	1 0	0	1 0	0 0	1	1 0	1 0	2	0 0
Volume Module:												
Base Vol:	0	0	0	146	1	210	0	470	415	299	554	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	0	0	158	1	227	0	509	449	324	600	0
Added Vol:	0	0	0	136	0	8	0	159	11	72	261	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	294	1	235	0	668	460	396	861	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	0	0	310	1	248	0	703	484	416	906	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	310	1	248	0	703	484	416	906	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	310	1	248	0	703	484	416	906	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.85	0.85	0.85	1.00	0.89	0.89	0.95	0.95	1.00
Lanes:	0.00	0.00	0.00	1.00	0.01	0.99	0.00	1.18	0.82	1.00	2.00	0.00
Final Sat.:	0	0	0	1615	7	1609	0	2007	1383	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.19	0.15	0.15	0.00	0.35	0.35	0.23	0.25	0.00
Crit Moves:				****				****		****		
Green/Cycle:	0.00	0.00	0.00	0.21	0.21	0.21	0.00	0.39	0.39	0.25	0.64	0.00
Volume/Cap:	0.00	0.00	0.00	0.91	0.73	0.73	0.00	0.91	0.91	0.91	0.39	0.00
Delay/Veh:	0.0	0.0	0.0	58.0	37.3	37.3	0.0	32.8	32.8	50.8	7.1	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	58.0	37.3	37.3	0.0	32.8	32.8	50.8	7.1	0.0
LOS by Move:	A	A	A	E	D	D	A	C	C	D	A	A
HCM2kAvgQ:	0	0	0	11	7	7	0	19	19	10	5	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) With Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #2 I-15 Northbound Ramps / Bundy Canyon Road

Cycle (sec):	80	Critical Vol./Cap.(X):	0.902
Loss Time (sec):	12	Average Delay (sec/veh):	27.4
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	23	0	0	23	23
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	0	1 0	0 0	0	0 0	1 0	2	0 0	0 0	1	1 0
Volume Module:												
Base Vol:	215	1	127	0	0	0	243	373	0	0	638	249
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	233	1	137	0	0	0	263	404	0	0	691	270
Added Vol:	8	0	25	0	0	0	11	285	0	0	326	186
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	241	1	162	0	0	0	274	689	0	0	1017	456
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	253	1	171	0	0	0	288	725	0	0	1070	479
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	253	1	171	0	0	0	288	725	0	0	1070	479
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	253	1	171	0	0	0	288	725	0	0	1070	479
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.85	0.85	0.85	1.00	1.00	1.00	0.95	0.95	1.00	1.00	0.91	0.91
Lanes:	1.00	0.01	0.99	0.00	0.00	0.00	1.00	2.00	0.00	0.00	1.38	0.62
Final Sat.:	1615	11	1606	0	0	0	1805	3610	0	0	2378	1066
Capacity Analysis Module:												
Vol/Sat:	0.16	0.11	0.11	0.00	0.00	0.00	0.16	0.20	0.00	0.00	0.45	0.45
Crit Moves:	****						****				****	
Green/Cycle:	0.17	0.17	0.17	0.00	0.00	0.00	0.18	0.68	0.00	0.00	0.50	0.50
Volume/Cap:	0.90	0.61	0.61	0.00	0.00	0.00	0.90	0.30	0.00	0.00	0.90	0.90
Delay/Veh:	62.0	34.5	34.5	0.0	0.0	0.0	59.3	5.3	0.0	0.0	25.3	25.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	62.0	34.5	34.5	0.0	0.0	0.0	59.3	5.3	0.0	0.0	25.3	25.3
LOS by Move:	E	C	C	A	A	A	E	A	A	A	C	C
HCM2kAvgQ:	10	5	5	0	0	0	7	4	0	0	22	22

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
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Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	120	Critical Vol./Cap.(X):	1.925
Loss Time (sec):	12	Average Delay (sec/veh):	296.6
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	19	19	10	19	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	0	1 0	0 1	0	0 1	0 1	1	0 1	0 0
Volume Module:												
Base Vol:	0	0	0	238	0	84	0	512	235	439	451	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	0	0	258	0	91	0	554	254	475	488	0
Added Vol:	0	0	0	61	0	411	0	1076	421	386	1142	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	319	0	502	0	1630	675	861	1630	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	0	0	335	0	528	0	1716	711	906	1716	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	335	0	528	0	1716	711	906	1716	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	335	0	528	0	1716	711	906	1716	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.95	1.00	0.85	1.00	1.00	0.85	0.95	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Final Sat.:	0	0	0	1809	0	1615	0	1900	1615	1805	1900	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.19	0.00	0.33	0.00	0.90	0.44	0.50	0.90	0.00
Crit Moves:						****		****		****		
Green/Cycle:	0.00	0.00	0.00	0.17	0.00	0.17	0.00	0.47	0.47	0.26	0.73	0.00
Volume/Cap:	0.00	0.00	0.00	1.09	0.00	1.93	0.00	1.92	0.94	1.92	1.24	0.00
Delay/Veh:	0.0	0.0	0.0	127.8	0.0	479.5	0.0	452	49.4	468.4	129	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	127.8	0.0	479.5	0.0	452	49.4	468.4	129	0.0
LOS by Move:	A	A	A	F	A	F	A	F	D	F	F	A
HCM2kAvgQ:	0	0	0	20	0	51	0	162	29	85	99	0

Note: Queue reported is the number of cars per lane.

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Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.862
Loss Time (sec):	8	Average Delay (sec/veh):	10.7
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	19	19	0	19	19
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	2 0	0	0 2	0 0	4	0 1	0 1	2	0 1
Volume Module:												
Base Vol:	0	0	0	238	0	84	0	512	235	0	451	439
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	0	0	258	0	91	0	554	254	0	488	475
Added Vol:	0	0	0	61	0	411	0	1076	421	386	1142	0
PasserByVol:	0	0	0	0	0	0	0	0	0	-386	0	386
Initial Fut:	0	0	0	319	0	502	0	1630	675	0	1630	861
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	0	0	335	0	528	0	1716	711	0	1716	906
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	335	0	528	0	1716	711	0	1716	906
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	335	0	528	0	1716	711	0	1716	906
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.92	1.00	0.75	1.00	0.91	0.85	0.91	0.91	0.85
Lanes:	0.00	0.00	0.00	2.00	0.00	2.00	0.00	4.00	1.00	0.00	3.00	1.00
Final Sat.:	0	0	0	3502	0	2842	0	6916	1615	0	5187	1615
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.10	0.00	0.19	0.00	0.25	0.44	0.00	0.33	0.56
Crit Moves:						****						****
Green/Cycle:	0.00	0.00	0.00	0.22	0.00	0.22	0.00	0.65	0.65	0.00	0.65	0.65
Volume/Cap:	0.00	0.00	0.00	0.44	0.00	0.86	0.00	0.38	0.68	0.00	0.51	0.86
Delay/Veh:	0.0	0.0	0.0	20.8	0.0	34.7	0.0	4.9	8.3	0.0	5.6	15.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	20.8	0.0	34.7	0.0	4.9	8.3	0.0	5.6	15.8
LOS by Move:	A	A	A	C	A	C	A	A	A	A	A	B
HCM2kAvgQ:	0	0	0	3	0	9	0	4	9	0	6	13

Note: Queue reported is the number of cars per lane.

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2000 HCM Operations Method (Future Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	120	Critical Vol./Cap.(X):	2.022
Loss Time (sec):	12	Average Delay (sec/veh):	332.7
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	16	0	0	16	16
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 1	0	0 1	0	0	0 0 0	1	0 1	0 0	0	0 1	0 1
Volume Module:												
Base Vol:	143	7	292	0	0	0	135	615	0	0	747	516
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	155	8	316	0	0	0	146	666	0	0	809	559
Added Vol:	348	0	129	0	0	0	559	578	0	0	1180	175
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	503	8	445	0	0	0	705	1244	0	0	1989	734
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	529	8	468	0	0	0	742	1309	0	0	2093	772
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	529	8	468	0	0	0	742	1309	0	0	2093	772
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	529	8	468	0	0	0	742	1309	0	0	2093	772
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.92	0.92	0.85	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.85
Lanes:	0.99	0.01	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00
Final Sat.:	1724	26	1615	0	0	0	1805	1900	0	0	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.31	0.31	0.29	0.00	0.00	0.00	0.41	0.69	0.00	0.00	1.10	0.48
Crit Moves:		****					****				****	
Green/Cycle:	0.15	0.15	0.15	0.00	0.00	0.00	0.20	0.75	0.00	0.00	0.54	0.54
Volume/Cap:	2.02	2.02	1.91	0.00	0.00	0.00	2.02	0.92	0.00	0.00	2.02	0.88
Delay/Veh:	524.0	524	475.7	0.0	0.0	0.0	517.1	22.3	0.0	0.0	491	33.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	524.0	524	475.7	0.0	0.0	0.0	517.1	22.3	0.0	0.0	491	33.8
LOS by Move:	F	F	F	A	A	A	F	C	A	A	F	C
HCM2kAvgQ:	54	54	45	0	0	0	72	36	0	0	204	28

Note: Queue reported is the number of cars per lane.

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2000 HCM Operations Method (Future Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	65	Critical Vol./Cap.(X):	0.912
Loss Time (sec):	12	Average Delay (sec/veh):	24.3
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Permitted				Permitted				Protected				Permitted			
Rights:	Include				Include				Include				Include			
Min. Green:	0	10	10		0	0	10		10	16	0		0	16	16	
Y+R:	4.0	4.0	4.0		4.0	4.0	4.0		4.0	4.0	4.0		4.0	4.0	4.0	
Lanes:	0	1 0	0	2	0	0 0	0	2	2	0 4	0	0	0	0 3	1	1
Volume Module:																
Base Vol:	0	7	292		0	0	143		135	615	0		0	747	516	
Growth Adj:	1.08	1.08	1.08		1.08	1.08	1.08		1.08	1.08	1.08		1.08	1.08	1.08	
Initial Bse:	0	8	316		0	0	155		146	666	0		0	809	559	
Added Vol:	348	0	129		0	0	0		559	578	0		0	1180	175	
PasserByVol:	-349	0	0		0	0	349		0	0	0		0	0	0	
Initial Fut:	-1	8	445		0	0	504		705	1244	0		0	1989	734	
User Adj:	0.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	0.00	0.95	0.95		0.95	0.95	0.95		0.95	0.95	0.95		0.95	0.95	0.95	
PHF Volume:	0	8	468		0	0	530		742	1309	0		0	2093	772	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	8	468		0	0	530		742	1309	0		0	2093	772	
PCE Adj:	0.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	0.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
FinalVolume:	0	8	468		0	0	530		742	1309	0		0	2093	772	
Saturation Flow Module:																
Sat/Lane:	1900	1900	1900		1900	1900	1900		1900	1900	1900		1900	1900	1900	
Adjustment:	1.00	1.00	0.75		1.00	1.00	0.75		0.92	0.91	1.00		1.00	0.87	0.87	
Lanes:	0.00	1.00	2.00		0.00	0.00	2.00		2.00	4.00	0.00		0.00	3.65	1.35	
Final Sat.:	0	1900	2842		0	0	2842		3502	6916	0		0	6063	2236	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.00	0.16		0.00	0.00	0.19		0.21	0.19	0.00		0.00	0.35	0.35	
Crit Moves:							****		****					****		
Green/Cycle:	0.00	0.20	0.20		0.00	0.00	0.20		0.23	0.61	0.00		0.00	0.38	0.38	
Volume/Cap:	0.00	0.02	0.81		0.00	0.00	0.91		0.91	0.31	0.00		0.00	0.91	0.91	
Delay/Veh:	0.0	20.7	32.7		0.0	0.0	44.1		38.7	6.1	0.0		0.0	23.8	23.8	
User DelAdj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
AdjDel/Veh:	0.0	20.7	32.7		0.0	0.0	44.1		38.7	6.1	0.0		0.0	23.8	23.8	
LOS by Move:	A	C	C		A	A	D		D	A	A		A	C	C	
HCM2kAvgQ:	0	0	8		0	0	10		9	3	0		0	17	17	

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) With Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

****

Intersection #1 I-15 Southbound Ramps / Bundy Canyon Road

****

Cycle (sec): 90 Critical Vol./Cap.(X): 0.972
Loss Time (sec): 12 Average Delay (sec/veh): 42.5
Optimal Cycle: OPTIMIZED Level Of Service: D

****

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	23	23	10	23	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	1 0	0	1 0	0 0	1	1 0	1 0	2	0 0
Volume Module:												
Base Vol:	0	0	0	310	2	204	0	333	262	231	501	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	0	0	336	2	221	0	360	284	250	542	0
Added Vol:	0	0	0	216	0	26	0	345	23	48	282	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	552	2	247	0	705	307	298	824	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	0	0	0	581	2	260	0	743	323	314	868	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	581	2	260	0	743	323	314	868	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	581	2	260	0	743	323	314	868	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.85	0.85	0.85	1.00	0.91	0.91	0.95	0.95	1.00
Lanes:	0.00	0.00	0.00	1.00	0.01	0.99	0.00	1.39	0.61	1.00	2.00	0.00
Final Sat.:	0	0	0	1615	14	1603	0	2403	1044	1805	3610	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.36	0.16	0.16	0.00	0.31	0.31	0.17	0.24	0.00
Crit Moves:				****				****		****		
Green/Cycle:	0.00	0.00	0.00	0.37	0.37	0.37	0.00	0.32	0.32	0.18	0.50	0.00
Volume/Cap:	0.00	0.00	0.00	0.97	0.44	0.44	0.00	0.97	0.97	0.97	0.48	0.00
Delay/Veh:	0.0	0.0	0.0	57.6	21.8	21.8	0.0	50.9	50.9	79.1	15.2	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	57.6	21.8	21.8	0.0	50.9	50.9	79.1	15.2	0.0
LOS by Move:	A	A	A	E	C	C	A	D	D	E	B	A
HCM2kAvgQ:	0	0	0	22	6	6	0	21	21	9	8	0

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Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) With Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #2 I-15 Northbound Ramps / Bundy Canyon Road

Cycle (sec): 90 Critical Vol./Cap.(X): 0.896
Loss Time (sec): 12 Average Delay (sec/veh): 31.4
Optimal Cycle: OPTIMIZED Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	23	0	0	23	23
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	0	1 0	0	0 0	0 0	1 0	2	0 0	0	0 1	1 0
Volume Module:												
Base Vol:	325	0	433	0	0	0	120	523	0	0	407	169
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	352	0	469	0	0	0	130	566	0	0	441	183
Added Vol:	26	0	86	0	0	0	23	538	0	0	303	196
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	378	0	555	0	0	0	153	1104	0	0	744	379
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
PHF Volume:	388	0	570	0	0	0	157	1135	0	0	764	389
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	388	0	570	0	0	0	157	1135	0	0	764	389
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	388	0	570	0	0	0	157	1135	0	0	764	389
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	1.00	1.00	1.00	0.95	0.95	1.00	1.00	0.90	0.90
Lanes:	1.00	0.00	1.00	0.00	0.00	0.00	1.00	2.00	0.00	0.00	1.32	0.68
Final Sat.:	1805	0	1615	0	0	0	1805	3610	0	0	2269	1157
Capacity Analysis Module:												
Vol/Sat:	0.22	0.00	0.35	0.00	0.00	0.00	0.09	0.31	0.00	0.00	0.34	0.34
Crit Moves:			****				****				****	
Green/Cycle:	0.39	0.00	0.39	0.00	0.00	0.00	0.11	0.48	0.00	0.00	0.37	0.37
Volume/Cap:	0.56	0.00	0.91	0.00	0.00	0.00	0.78	0.65	0.00	0.00	0.91	0.91
Delay/Veh:	22.6	0.0	44.0	0.0	0.0	0.0	57.0	18.7	0.0	0.0	37.2	37.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	22.6	0.0	44.0	0.0	0.0	0.0	57.0	18.7	0.0	0.0	37.2	37.2
LOS by Move:	C	A	D	A	A	A	E	B	A	A	D	D
HCM2kAvgQ:	9	0	19	0	0	0	4	12	0	0	20	20

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) With Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	120	Critical Vol./Cap.(X):	2.393
Loss Time (sec):	12	Average Delay (sec/veh):	483.4
Optimal Cycle:	OPTIMIZED	Level Of Service:	F

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	19	19	10	19	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0	0	0	0	1	0	0	1	0	0	1	0	1	0	0
Volume Module:												
Base Vol:	0	0	0	396	0	120	0	537	205	393	664	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	0	0	429	0	130	0	581	222	425	719	0
Added Vol:	0	0	0	211	0	721	0	1629	507	260	1400	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	640	0	851	0	2210	729	685	2119	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
PHF Volume:	0	0	0	666	0	885	0	2300	758	713	2205	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	666	0	885	0	2300	758	713	2205	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	666	0	885	0	2300	758	713	2205	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.95	1.00	0.85	1.00	1.00	0.85	0.95	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Final Sat.:	0	0	0	1809	0	1615	0	1900	1615	1805	1900	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.37	0.00	0.55	0.00	1.21	0.47	0.40	1.16	0.00
Crit Moves:						****		****		****		
Green/Cycle:	0.00	0.00	0.00	0.23	0.00	0.23	0.00	0.51	0.51	0.17	0.67	0.00
Volume/Cap:	0.00	0.00	0.00	1.61	0.00	2.39	0.00	2.39	0.93	2.39	1.73	0.00
Delay/Veh:	0.0	0.0	0.0	330.1	0.0	681.4	0.0	660	44.3	687.3	351	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	330.1	0.0	681.4	0.0	660	44.3	687.3	351	0.0
LOS by Move:	A	A	A	F	A	F	A	F	D	F	F	A
HCM2kAvgQ:	0	0	0	56	0	96	0	246	30	76	190	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) With Project Conditions WITH IMPROVEMENTS
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.901
Loss Time (sec):	8	Average Delay (sec/veh):	16.9
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	19	19	0	19	19
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0 0	0	2 0	0 0	2	0 0	4 0	1	0 1	2 0	1
Volume Module:												
Base Vol:	0	0	0	396	0	120	0	537	205	0	664	393
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	0	0	429	0	130	0	581	222	0	719	425
Added Vol:	0	0	0	211	0	721	0	1629	507	260	1400	0
PasserByVol:	0	0	0	0	0	0	0	0	0	-260	0	260
Initial Fut:	0	0	0	640	0	851	0	2210	729	0	2119	685
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
PHF Volume:	0	0	0	666	0	885	0	2300	758	0	2205	713
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	666	0	885	0	2300	758	0	2205	713
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	666	0	885	0	2300	758	0	2205	713
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.92	1.00	0.75	1.00	0.91	0.85	0.91	0.91	0.85
Lanes:	0.00	0.00	0.00	2.00	0.00	2.00	0.00	4.00	1.00	0.00	3.00	1.00
Final Sat.:	0	0	0	3502	0	2842	0	6916	1615	0	5187	1615
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.19	0.00	0.31	0.00	0.33	0.47	0.00	0.43	0.44
Crit Moves:						****			****			
Green/Cycle:	0.00	0.00	0.00	0.35	0.00	0.35	0.00	0.52	0.52	0.00	0.52	0.52
Volume/Cap:	0.00	0.00	0.00	0.55	0.00	0.90	0.00	0.64	0.90	0.00	0.82	0.85
Delay/Veh:	0.0	0.0	0.0	16.4	0.0	29.9	0.0	10.7	25.8	0.0	14.0	20.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	16.4	0.0	29.9	0.0	10.7	25.8	0.0	14.0	20.4
LOS by Move:	A	A	A	B	A	C	A	B	C	A	B	C
HCM2kAvgQ:	0	0	0	6	0	13	0	9	17	0	11	10

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) With Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec): 120 Critical Vol./Cap.(X): 2.299
Loss Time (sec): 12 Average Delay (sec/veh): 484.1
Optimal Cycle: OPTIMIZED Level Of Service: F

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	16	0	0	16	16
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 1	0	0 1	0 0	0	0 0	1 0	1	0 0	0 0	1	0 1
Volume Module:												
Base Vol:	278	8	452	0	0	0	122	811	0	0	779	439
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	301	9	489	0	0	0	132	878	0	0	843	475
Added Vol:	548	0	445	0	0	0	619	1220	0	0	1112	125
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	849	9	934	0	0	0	751	2098	0	0	1955	600
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PHF Volume:	868	9	955	0	0	0	768	2145	0	0	1999	614
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	868	9	955	0	0	0	768	2145	0	0	1999	614
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	868	9	955	0	0	0	768	2145	0	0	1999	614
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.93	0.85	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.85
Lanes:	0.99	0.01	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00
Final Sat.:	1747	18	1615	0	0	0	1805	1900	0	0	1900	1615
Capacity Analysis Module:												
Vol/Sat:	0.50	0.50	0.59	0.00	0.00	0.00	0.43	1.13	0.00	0.00	1.05	0.38
Crit Moves:			****				****				****	
Green/Cycle:	0.26	0.26	0.26	0.00	0.00	0.00	0.19	0.64	0.00	0.00	0.46	0.46
Volume/Cap:	1.93	1.93	2.30	0.00	0.00	0.00	2.30	1.76	0.00	0.00	2.30	0.83
Delay/Veh:	471.5	471	636.6	0.0	0.0	0.0	642.6	365	0.0	0.0	621	36.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	471.5	471	636.6	0.0	0.0	0.0	642.6	365	0.0	0.0	621	36.3
LOS by Move:	F	F	F	A	A	A	F	F	A	A	F	D
HCM2kAvgQ:	84	84	101	0	0	0	80	187	0	0	210	22

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Opening Year (2015) With Project Conditions WITH IMPROVEMENTS
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	95	Critical Vol./Cap.(X):	0.994
Loss Time (sec):	12	Average Delay (sec/veh):	41.4
Optimal Cycle:	OPTIMIZED	Level Of Service:	D

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Permitted				Permitted				Protected				Permitted			
Rights:	Include				Include				Include				Include			
Min. Green:	0	10	10		0	0	10		10	16	0		0	16	16	
Y+R:	4.0	4.0	4.0		4.0	4.0	4.0		4.0	4.0	4.0		4.0	4.0	4.0	
Lanes:	0	1 0	0	2	0	0 0	0	2	2	0 4	0	0	0	0 3	1	1
Volume Module:																
Base Vol:	0	8	452		0	0	278		122	811	0		0	779	439	
Growth Adj:	1.08	1.08	1.08		1.08	1.08	1.08		1.08	1.08	1.08		1.08	1.08	1.08	
Initial Bse:	0	9	489		0	0	301		132	878	0		0	843	475	
Added Vol:	548	0	445		0	0	0		619	1220	0		0	1112	125	
PasserByVol:	-550	0	0		0	0	550		0	0	0		0	0	0	
Initial Fut:	-2	9	934		0	0	851		751	2098	0		0	1955	600	
User Adj:	0.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	0.00	0.98	0.98		0.98	0.98	0.98		0.98	0.98	0.98		0.98	0.98	0.98	
PHF Volume:	0	9	955		0	0	870		768	2145	0		0	1999	614	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	9	955		0	0	870		768	2145	0		0	1999	614	
PCE Adj:	0.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	0.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
FinalVolume:	0	9	955		0	0	870		768	2145	0		0	1999	614	
Saturation Flow Module:																
Sat/Lane:	1900	1900	1900		1900	1900	1900		1900	1900	1900		1900	1900	1900	
Adjustment:	1.00	1.00	0.75		1.00	1.00	0.75		0.92	0.91	1.00		1.00	0.88	0.88	
Lanes:	0.00	1.00	2.00		0.00	0.00	2.00		2.00	4.00	0.00		0.00	3.83	1.17	
Final Sat.:	0	1900	2842		0	0	2842		3502	6916	0		0	6383	1959	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.00	0.34		0.00	0.00	0.31		0.22	0.31	0.00		0.00	0.31	0.31	
Crit Moves:			****						****					****		
Green/Cycle:	0.00	0.34	0.34		0.00	0.00	0.34		0.22	0.54	0.00		0.00	0.32	0.32	
Volume/Cap:	0.00	0.01	0.99		0.00	0.00	0.91		0.99	0.58	0.00		0.00	0.99	0.99	
Delay/Veh:	0.0	20.9	58.9		0.0	0.0	41.9		67.8	15.1	0.0		0.0	48.6	48.6	
User DelAdj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
AdjDel/Veh:	0.0	20.9	58.9		0.0	0.0	41.9		67.8	15.1	0.0		0.0	48.6	48.6	
LOS by Move:	A	C	E		A	A	D		E	B	A		A	D	D	
HCM2kAvgQ:	0	0	22		0	0	18		14	11	0		0	23	23	

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to URBAN CROSSROADS, IRVINE

Horizon Year (2035) Without Project Conditions

Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) Without Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 I-15 Southbound Ramps / Bundy Canyon Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.726
Loss Time (sec):	12	Average Delay (sec/veh):	18.1
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	23	23	10	23	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0	1 0	0	1 0	0 0	2	1 0	2 0	3	0 0
Volume Module:												
Base Vol:	0	0	0	305	1	325	0	862	506	402	1043	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	305	1	325	0	862	506	402	1043	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	0	0	305	1	325	0	862	506	402	1043	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	305	1	325	0	862	506	402	1043	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	305	1	325	0	862	506	402	1043	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.85	0.85	0.85	1.00	0.86	0.86	0.92	0.91	1.00
Lanes:	0.00	0.00	0.00	1.00	0.01	0.99	0.00	2.00	1.00	2.00	3.00	0.00
Final Sat.:	0	0	0	1615	5	1610	0	3268	1634	3502	5187	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.19	0.20	0.20	0.00	0.26	0.31	0.11	0.20	0.00
Crit Moves:						****		****		****		
Green/Cycle:	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.38	0.38	0.17	0.55	0.00
Volume/Cap:	0.00	0.00	0.00	0.76	0.81	0.81	0.00	0.69	0.81	0.69	0.37	0.00
Delay/Veh:	0.0	0.0	0.0	28.7	32.6	32.6	0.0	16.5	19.5	27.0	7.7	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	28.7	32.6	32.6	0.0	16.5	19.5	27.0	7.7	0.0
LOS by Move:	A	A	A	C	C	C	A	B	B	C	A	A
HCM2kAvgQ:	0	0	0	7	8	8	0	9	12	4	4	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) Without Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 I-15 Northbound Ramps / Bundy Canyon Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.622
Loss Time (sec):	12	Average Delay (sec/veh):	17.0
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	23	0	0	23	23
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	0	1 0	0 0	0	0 0	2 0	3	0 0	0 0	3	0 1
Volume Module:												
Base Vol:	312	1	298	0	0	0	302	864	0	0	1133	452
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	312	1	298	0	0	0	302	864	0	0	1133	452
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	312	1	298	0	0	0	302	864	0	0	1133	452
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	312	1	298	0	0	0	302	864	0	0	1133	452
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	312	1	298	0	0	0	302	864	0	0	1133	452
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.85	0.85	0.85	1.00	1.00	1.00	0.92	0.91	1.00	1.00	0.91	0.85
Lanes:	1.00	0.01	0.99	0.00	0.00	0.00	2.00	3.00	0.00	0.00	3.00	1.00
Final Sat.:	1615	5	1610	0	0	0	3502	5187	0	0	5187	1615
Capacity Analysis Module:												
Vol/Sat:	0.19	0.19	0.19	0.00	0.00	0.00	0.09	0.17	0.00	0.00	0.22	0.28
Crit Moves:	****						****				****	
Green/Cycle:	0.25	0.25	0.25	0.00	0.00	0.00	0.17	0.55	0.00	0.00	0.38	0.38
Volume/Cap:	0.77	0.74	0.74	0.00	0.00	0.00	0.52	0.30	0.00	0.00	0.57	0.73
Delay/Veh:	29.9	27.9	27.9	0.0	0.0	0.0	23.6	7.3	0.0	0.0	15.0	20.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	29.9	27.9	27.9	0.0	0.0	0.0	23.6	7.3	0.0	0.0	15.0	20.3
LOS by Move:	C	C	C	A	A	A	C	A	A	A	B	C
HCM2kAvgQ:	8	7	7	0	0	0	3	3	0	0	7	9

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) Without Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.650
Loss Time (sec):	8	Average Delay (sec/veh):	10.3
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	10	0	10	0	19	19	0	19	19
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0	0	0	2	0	0	0	2	0	0	4	0	1	0	0	3	0	2
Volume Module:																		
Base Vol:	0	0	0	501	0	537	0	1731	727	0	1942	948
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	501	0	537	0	1731	727	0	1942	948
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	0	0	0	501	0	537	0	1731	0	0	1942	948
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	501	0	537	0	1731	0	0	1942	948
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
FinalVolume:	0	0	0	501	0	537	0	1731	0	0	1942	948
Saturation Flow Module:																		
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.92	1.00	0.75	1.00	0.91	1.00	1.00	0.91	0.75
Lanes:	0.00	0.00	0.00	2.00	0.00	2.00	0.00	4.00	1.00	0.00	3.00	2.00
Final Sat.:	0	0	0	3502	0	2842	0	6916	1900	0	5187	2842
Capacity Analysis Module:																		
Vol/Sat:	0.00	0.00	0.00	0.14	0.00	0.19	0.00	0.25	0.00	0.00	0.37	0.33
Crit Moves:						****					****	
Green/Cycle:	0.00	0.00	0.00	0.29	0.00	0.29	0.00	0.58	0.00	0.00	0.58	0.58
Volume/Cap:	0.00	0.00	0.00	0.49	0.00	0.65	0.00	0.43	0.00	0.00	0.65	0.58
Delay/Veh:	0.0	0.0	0.0	18.0	0.0	20.5	0.0	7.3	0.0	0.0	9.1	8.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	18.0	0.0	20.5	0.0	7.3	0.0	0.0	9.1	8.6
LOS by Move:	A	A	A	B	A	C	A	A	A	A	A	A
HCM2kAvgQ:	0	0	0	5	0	6	0	5	0	0	8	6

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) Without Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	75	Critical Vol./Cap.(X):	0.930
Loss Time (sec):	12	Average Delay (sec/veh):	27.0
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	10	10	0	0	10	10	16	0	0	16	16
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0 1	0	2	0 0 0	0	2	2 0 4	0	0	0 0 3	1	1
Volume Module:												
Base Vol:	0	8	489	0	0	545	737	1494	0	0	2345	807
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	8	489	0	0	545	737	1494	0	0	2345	807
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	8	489	0	0	545	737	1494	0	0	2345	807
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	8	489	0	0	545	737	1494	0	0	2345	807
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	8	489	0	0	545	737	1494	0	0	2345	807
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	0.75	1.00	1.00	0.75	0.92	0.91	1.00	1.00	0.88	0.88
Lanes:	0.00	1.00	2.00	0.00	0.00	2.00	2.00	4.00	0.00	0.00	3.72	1.28
Final Sat.:	0	1900	2842	0	0	2842	3502	6916	0	0	6187	2129
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.17	0.00	0.00	0.19	0.21	0.22	0.00	0.00	0.38	0.38
Crit Moves:						****	****				****	
Green/Cycle:	0.00	0.21	0.21	0.00	0.00	0.21	0.23	0.63	0.00	0.00	0.41	0.41
Volume/Cap:	0.00	0.02	0.83	0.00	0.00	0.93	0.93	0.34	0.00	0.00	0.93	0.93
Delay/Veh:	0.0	23.8	38.6	0.0	0.0	50.7	45.7	6.5	0.0	0.0	26.6	26.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	23.8	38.6	0.0	0.0	50.7	45.7	6.5	0.0	0.0	26.6	26.6
LOS by Move:	A	C	D	A	A	D	D	A	A	A	C	C
HCM2kAvgQ:	0	0	9	0	0	11	10	4	0	0	20	20

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) Without Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 I-15 Southbound Ramps / Bundy Canyon Road

Cycle (sec):	90	Critical Vol./Cap.(X):	0.904
Loss Time (sec):	12	Average Delay (sec/veh):	33.2
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	23	23	10	23	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0	1 0	0	1 0	0 0	2	1 0	2 0	3	0 0
Volume Module:												
Base Vol:	0	0	0	549	2	539	0	1251	524	301	1104	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	549	2	539	0	1251	524	301	1104	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	0	0	549	2	539	0	1251	524	301	1104	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	549	2	539	0	1251	524	301	1104	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	549	2	539	0	1251	524	301	1104	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.85	0.85	0.85	1.00	0.87	0.87	0.92	0.91	1.00
Lanes:	0.00	0.00	0.00	1.00	0.01	0.99	0.00	2.11	0.89	2.00	3.00	0.00
Final Sat.:	0	0	0	1615	6	1611	0	3495	1464	3502	5187	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.34	0.33	0.33	0.00	0.36	0.36	0.09	0.21	0.00
Crit Moves:				****				****		****		
Green/Cycle:	0.00	0.00	0.00	0.37	0.37	0.37	0.00	0.39	0.39	0.11	0.50	0.00
Volume/Cap:	0.00	0.00	0.00	0.92	0.91	0.91	0.00	0.92	0.92	0.77	0.43	0.00
Delay/Veh:	0.0	0.0	0.0	47.5	45.0	45.0	0.0	34.4	34.4	48.2	14.5	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	47.5	45.0	45.0	0.0	34.4	34.4	48.2	14.5	0.0
LOS by Move:	A	A	A	D	D	D	A	C	C	D	B	A
HCM2kAvgQ:	0	0	0	19	18	18	0	22	22	4	7	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) Without Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #2 I-15 Northbound Ramps / Bundy Canyon Road

Cycle (sec):	75	Critical Vol./Cap.(X):	0.777
Loss Time (sec):	12	Average Delay (sec/veh):	24.3
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	23	0	0	23	23
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	0	1 0	0 0	0	0 0	2 0	3	0 0	0 0	3	0 1
Volume Module:												
Base Vol:	399	0	569	0	0	0	373	1427	0	0	1006	380
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	399	0	569	0	0	0	373	1427	0	0	1006	380
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	399	0	569	0	0	0	373	1427	0	0	1006	380
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	399	0	569	0	0	0	373	1427	0	0	1006	380
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	399	0	569	0	0	0	373	1427	0	0	1006	380
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	1.00	1.00	1.00	0.92	0.91	1.00	1.00	0.91	0.85
Lanes:	1.00	0.00	1.00	0.00	0.00	0.00	2.00	3.00	0.00	0.00	3.00	1.00
Final Sat.:	1805	0	1615	0	0	0	3502	5187	0	0	5187	1615
Capacity Analysis Module:												
Vol/Sat:	0.22	0.00	0.35	0.00	0.00	0.00	0.11	0.28	0.00	0.00	0.19	0.24
Crit Moves:			****				****				****	
Green/Cycle:	0.40	0.00	0.40	0.00	0.00	0.00	0.13	0.44	0.00	0.00	0.31	0.31
Volume/Cap:	0.55	0.00	0.88	0.00	0.00	0.00	0.80	0.63	0.00	0.00	0.63	0.77
Delay/Veh:	18.3	0.0	34.2	0.0	0.0	0.0	41.0	16.8	0.0	0.0	23.2	30.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	18.3	0.0	34.2	0.0	0.0	0.0	41.0	16.8	0.0	0.0	23.2	30.7
LOS by Move:	B	A	C	A	A	A	D	B	A	A	C	C
HCM2kAvgQ:	8	0	16	0	0	0	4	9	0	0	8	10

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) Without Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.849
Loss Time (sec):	8	Average Delay (sec/veh):	15.4
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	10	0	10	0	19	19	0	19	19
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	2 0	0	0 2	0 0	4 0	1	0 0	3 0	2
Volume Module:												
Base Vol:	0	0	0	946	0	890	0	2240	788	0	2193	754
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	946	0	890	0	2240	788	0	2193	754
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	0	0	0	946	0	890	0	2240	0	0	2193	754
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	946	0	890	0	2240	0	0	2193	754
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
FinalVolume:	0	0	0	946	0	890	0	2240	0	0	2193	754
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.92	1.00	0.75	1.00	0.91	1.00	1.00	0.91	0.75
Lanes:	0.00	0.00	0.00	2.00	0.00	2.00	0.00	4.00	1.00	0.00	3.00	2.00
Final Sat.:	0	0	0	3502	0	2842	0	6916	1900	0	5187	2842
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.27	0.00	0.31	0.00	0.32	0.00	0.00	0.42	0.27
Crit Moves:						****					****	
Green/Cycle:	0.00	0.00	0.00	0.37	0.00	0.37	0.00	0.50	0.00	0.00	0.50	0.50
Volume/Cap:	0.00	0.00	0.00	0.73	0.00	0.85	0.00	0.65	0.00	0.00	0.85	0.53
Delay/Veh:	0.0	0.0	0.0	18.6	0.0	24.1	0.0	11.6	0.0	0.0	16.0	10.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	18.6	0.0	24.1	0.0	11.6	0.0	0.0	16.0	10.7
LOS by Move:	A	A	A	B	A	C	A	B	A	A	B	B
HCM2kAvgQ:	0	0	0	9	0	12	0	9	0	0	12	5

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) Without Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	120	Critical Vol./Cap.(X):	0.981
Loss Time (sec):	12	Average Delay (sec/veh):	44.8
Optimal Cycle:	OPTIMIZED	Level Of Service:	D

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	10	10	0	0	10	10	16	0	0	16	16
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0 1	0	2	0 0 0	0	2	2 0 4	0	0	0 0 3	1	1
Volume Module:												
Base Vol:	0	10	1028	0	0	885	748	2438	0	0	2062	661
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	10	1028	0	0	885	748	2438	0	0	2062	661
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	10	1028	0	0	885	748	2438	0	0	2062	661
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	10	1028	0	0	885	748	2438	0	0	2062	661
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	10	1028	0	0	885	748	2438	0	0	2062	661
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	0.77	1.00	1.00	0.75	0.92	0.91	1.00	1.00	0.91	0.88
Lanes:	0.00	1.00	2.00	0.00	0.00	2.00	2.00	4.00	0.00	0.00	3.76	1.24
Final Sat.:	0	1900	2936	0	0	2842	3502	6916	0	0	6467	2073
Capacity Analysis Module:												
Vol/Sat:	0.00	0.01	0.35	0.00	0.00	0.31	0.21	0.35	0.00	0.00	0.32	0.32
Crit Moves:			****				****				****	
Green/Cycle:	0.00	0.36	0.36	0.00	0.00	0.36	0.22	0.54	0.00	0.00	0.33	0.33
Volume/Cap:	0.00	0.01	0.98	0.00	0.00	0.87	0.98	0.65	0.00	0.00	0.98	0.98
Delay/Veh:	0.0	24.9	61.3	0.0	0.0	44.4	74.4	19.8	0.0	0.0	53.0	53.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	24.9	61.3	0.0	0.0	44.4	74.4	19.8	0.0	0.0	53.0	53.0
LOS by Move:	A	C	E	A	A	D	E	B	A	A	D	D
HCM2kAvgQ:	0	0	27	0	0	20	16	17	0	0	28	27

Note: Queue reported is the number of cars per lane.

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Horizon Year (2035) With Project Conditions

Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) With Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #1 I-15 Southbound Ramps / Bundy Canyon Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.741
Loss Time (sec):	12	Average Delay (sec/veh):	18.8
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	23	23	10	23	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	1 0	0	1 0	0 0	2	1 0	2 0	3	0 0
Volume Module:												
Base Vol:	0	0	0	305	1	325	0	862	506	402	1043	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	305	1	325	0	862	506	402	1043	0
Added Vol:	0	0	0	20	0	0	0	9	0	34	13	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	325	1	325	0	871	506	436	1056	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	0	0	325	1	325	0	871	506	436	1056	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	325	1	325	0	871	506	436	1056	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	325	1	325	0	871	506	436	1056	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.85	0.85	0.85	1.00	0.86	0.86	0.92	0.91	1.00
Lanes:	0.00	0.00	0.00	1.00	0.01	0.99	0.00	2.00	1.00	2.00	3.00	0.00
Final Sat.:	0	0	0	1615	5	1610	0	3268	1634	3502	5187	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.20	0.20	0.20	0.00	0.27	0.31	0.12	0.20	0.00
Crit Moves:						****		****		****		
Green/Cycle:	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.38	0.38	0.17	0.55	0.00
Volume/Cap:	0.00	0.00	0.00	0.80	0.81	0.81	0.00	0.70	0.81	0.75	0.37	0.00
Delay/Veh:	0.0	0.0	0.0	32.3	32.6	32.6	0.0	16.7	19.5	29.1	7.7	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	32.3	32.6	32.6	0.0	16.7	19.5	29.1	7.7	0.0
LOS by Move:	A	A	A	C	C	C	A	B	B	C	A	A
HCM2kAvgQ:	0	0	0	8	8	8	0	9	12	4	4	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) With Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #2 I-15 Northbound Ramps / Bundy Canyon Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.635
Loss Time (sec):	12	Average Delay (sec/veh):	17.9
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	23	0	0	23	23
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	0	1 0	0	0	0 0 0	2 0	3	0 0	0	0	3 0 1
Volume Module:												
Base Vol:	312	1	298	0	0	0	302	864	0	0	1133	452
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	312	1	298	0	0	0	302	864	0	0	1133	452
Added Vol:	0	0	15	0	0	0	0	29	0	0	47	50
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	312	1	313	0	0	0	302	893	0	0	1180	502
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	312	1	313	0	0	0	302	893	0	0	1180	502
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	312	1	313	0	0	0	302	893	0	0	1180	502
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	312	1	313	0	0	0	302	893	0	0	1180	502
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.85	0.85	0.85	1.00	1.00	1.00	0.92	0.91	1.00	1.00	0.91	0.85
Lanes:	1.00	0.01	0.99	0.00	0.00	0.00	2.00	3.00	0.00	0.00	3.00	1.00
Final Sat.:	1615	5	1610	0	0	0	3502	5187	0	0	5187	1615
Capacity Analysis Module:												
Vol/Sat:	0.19	0.19	0.19	0.00	0.00	0.00	0.09	0.17	0.00	0.00	0.23	0.31
Crit Moves:		****					****				****	
Green/Cycle:	0.25	0.25	0.25	0.00	0.00	0.00	0.17	0.55	0.00	0.00	0.38	0.38
Volume/Cap:	0.77	0.78	0.78	0.00	0.00	0.00	0.52	0.31	0.00	0.00	0.59	0.81
Delay/Veh:	29.9	30.2	30.2	0.0	0.0	0.0	23.6	7.4	0.0	0.0	15.3	24.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	29.9	30.2	30.2	0.0	0.0	0.0	23.6	7.4	0.0	0.0	15.3	24.5
LOS by Move:	C	C	C	A	A	A	C	A	A	A	B	C
HCM2kAvgQ:	8	8	8	0	0	0	3	3	0	0	7	11

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) With Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.659
Loss Time (sec):	8	Average Delay (sec/veh):	10.5
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	10	0	10	0	19	19	0	19	19
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0	0	0	2	0	0	0	2	0	0	4	0	1	0	0	3	0	2
Volume Module:																		
Base Vol:	0	0	0	501	0	537	0	1731	727	0	1942	948
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	501	0	537	0	1731	727	0	1942	948
Added Vol:	0	0	0	0	0	15	0	50	17	0	12	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	501	0	552	0	1781	744	0	1954	948
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	0	0	0	501	0	552	0	1781	0	0	1954	948
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	501	0	552	0	1781	0	0	1954	948
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
FinalVolume:	0	0	0	501	0	552	0	1781	0	0	1954	948
Saturation Flow Module:																		
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.92	1.00	0.75	1.00	0.91	1.00	1.00	0.91	0.75
Lanes:	0.00	0.00	0.00	2.00	0.00	2.00	0.00	4.00	1.00	0.00	3.00	2.00
Final Sat.:	0	0	0	3502	0	2842	0	6916	1900	0	5187	2842
Capacity Analysis Module:																		
Vol/Sat:	0.00	0.00	0.00	0.14	0.00	0.19	0.00	0.26	0.00	0.00	0.38	0.33
Crit Moves:						****					****	
Green/Cycle:	0.00	0.00	0.00	0.29	0.00	0.29	0.00	0.57	0.00	0.00	0.57	0.57
Volume/Cap:	0.00	0.00	0.00	0.49	0.00	0.66	0.00	0.45	0.00	0.00	0.66	0.58
Delay/Veh:	0.0	0.0	0.0	17.8	0.0	20.5	0.0	7.5	0.0	0.0	9.4	8.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	17.8	0.0	20.5	0.0	7.5	0.0	0.0	9.4	8.8
LOS by Move:	A	A	A	B	A	C	A	A	A	A	A	A
HCM2kAvgQ:	0	0	0	4	0	6	0	6	0	0	8	6

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) With Project Conditions
AM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	75	Critical Vol./Cap.(X):	0.937
Loss Time (sec):	12	Average Delay (sec/veh):	27.6
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	10	10	0	0	10	10	16	0	0	16	16
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 1	0 0	2	0 0	0 0	2	2 0	4 0	0	0 0	3 1	1
Volume Module:												
Base Vol:	0	8	489	0	0	545	737	1494	0	0	2345	807
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	8	489	0	0	545	737	1494	0	0	2345	807
Added Vol:	7	0	0	0	0	0	40	9	0	0	5	0
PasserByVol:	-7	0	0	0	0	7	0	0	0	0	0	0
Initial Fut:	0	8	489	0	0	552	777	1503	0	0	2350	807
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	8	489	0	0	552	777	1503	0	0	2350	807
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	8	489	0	0	552	777	1503	0	0	2350	807
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	8	489	0	0	552	777	1503	0	0	2350	807
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	0.77	1.00	1.00	0.75	0.92	0.91	1.00	1.00	0.90	0.88
Lanes:	0.00	1.00	2.00	0.00	0.00	2.00	2.00	4.00	0.00	0.00	3.69	1.31
Final Sat.:	0	1900	2936	0	0	2842	3502	6916	0	0	6341	2178
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.17	0.00	0.00	0.19	0.22	0.22	0.00	0.00	0.37	0.37
Crit Moves:						****	****				****	
Green/Cycle:	0.00	0.21	0.21	0.00	0.00	0.21	0.24	0.63	0.00	0.00	0.40	0.40
Volume/Cap:	0.00	0.02	0.80	0.00	0.00	0.94	0.94	0.34	0.00	0.00	0.94	0.94
Delay/Veh:	0.0	23.7	35.9	0.0	0.0	51.8	45.8	6.5	0.0	0.0	27.6	27.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	23.7	35.9	0.0	0.0	51.8	45.8	6.5	0.0	0.0	27.6	27.6
LOS by Move:	A	C	D	A	A	D	D	A	A	A	C	C
HCM2kAvgQ:	0	0	9	0	0	11	11	4	0	0	21	20

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) With Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #1 I-15 Southbound Ramps / Bundy Canyon Road

Cycle (sec):	95	Critical Vol./Cap.(X):	0.952
Loss Time (sec):	12	Average Delay (sec/veh):	38.2
Optimal Cycle:	OPTIMIZED	Level Of Service:	D

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	10	10	10	0	23	23	10	23	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	1 0	0	1 0	0 0	2	1 0	2 0	3	0 0
Volume Module:												
Base Vol:	0	0	0	549	2	539	0	1251	524	301	1104	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	549	2	539	0	1251	524	301	1104	0
Added Vol:	0	0	0	59	0	0	0	19	0	27	15	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	608	2	539	0	1270	524	328	1119	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	0	0	608	2	539	0	1270	524	328	1119	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	608	2	539	0	1270	524	328	1119	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	0	0	608	2	539	0	1270	524	328	1119	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.85	0.85	0.85	1.00	0.87	0.87	0.92	0.91	1.00
Lanes:	0.00	0.00	0.00	1.00	0.01	0.99	0.00	2.12	0.88	2.00	3.00	0.00
Final Sat.:	0	0	0	1615	6	1611	0	3510	1448	3502	5187	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.38	0.33	0.33	0.00	0.36	0.36	0.09	0.22	0.00
Crit Moves:				****				****		****		
Green/Cycle:	0.00	0.00	0.00	0.39	0.39	0.39	0.00	0.38	0.38	0.11	0.48	0.00
Volume/Cap:	0.00	0.00	0.00	0.96	0.85	0.85	0.00	0.96	0.96	0.89	0.45	0.00
Delay/Veh:	0.0	0.0	0.0	54.4	37.3	37.3	0.0	41.7	41.7	64.3	16.4	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	54.4	37.3	37.3	0.0	41.7	41.7	64.3	16.4	0.0
LOS by Move:	A	A	A	D	D	D	A	D	D	E	B	A
HCM2kAvgQ:	0	0	0	23	17	17	0	24	24	5	8	0

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) With Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #2 I-15 Northbound Ramps / Bundy Canyon Road

Cycle (sec):	75	Critical Vol./Cap.(X):	0.818
Loss Time (sec):	12	Average Delay (sec/veh):	26.6
Optimal Cycle:	OPTIMIZED	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	10	10	10	0	0	0	10	23	0	0	23	23
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	0	1 0	0	0	0 0 0	2 0	3	0 0	0	0	3 0 1
Volume Module:												
Base Vol:	399	0	569	0	0	0	373	1427	0	0	1006	380
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	399	0	569	0	0	0	373	1427	0	0	1006	380
Added Vol:	0	0	42	0	0	0	0	78	0	0	42	37
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	399	0	611	0	0	0	373	1505	0	0	1048	417
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	399	0	611	0	0	0	373	1505	0	0	1048	417
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	399	0	611	0	0	0	373	1505	0	0	1048	417
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	399	0	611	0	0	0	373	1505	0	0	1048	417
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.95	1.00	0.85	1.00	1.00	1.00	0.92	0.91	1.00	1.00	0.91	0.85
Lanes:	1.00	0.00	1.00	0.00	0.00	0.00	2.00	3.00	0.00	0.00	3.00	1.00
Final Sat.:	1805	0	1615	0	0	0	3502	5187	0	0	5187	1615
Capacity Analysis Module:												
Vol/Sat:	0.22	0.00	0.38	0.00	0.00	0.00	0.11	0.29	0.00	0.00	0.20	0.26
Crit Moves:			****				****				****	
Green/Cycle:	0.40	0.00	0.40	0.00	0.00	0.00	0.13	0.44	0.00	0.00	0.31	0.31
Volume/Cap:	0.55	0.00	0.95	0.00	0.00	0.00	0.80	0.66	0.00	0.00	0.66	0.84
Delay/Veh:	18.3	0.0	44.6	0.0	0.0	0.0	41.0	17.3	0.0	0.0	23.6	36.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	18.3	0.0	44.6	0.0	0.0	0.0	41.0	17.3	0.0	0.0	23.6	36.6
LOS by Move:	B	A	D	A	A	A	D	B	A	A	C	D
HCM2kAvgQ:	8	0	19	0	0	0	4	9	0	0	9	12

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) With Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #12 I-215 Southbound Ramps / Scott Road

Cycle (sec):	60	Critical Vol./Cap.(X):	0.876
Loss Time (sec):	8	Average Delay (sec/veh):	16.2
Optimal Cycle:	OPTIMIZED	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	10	0	10	0	19	19	0	19	19
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 0	0	0 0	2 0	0	0 2	0 0	4	0 1	0 0	3	0 2
Volume Module:												
Base Vol:	0	0	0	946	0	890	0	2240	788	0	2193	754
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	946	0	890	0	2240	788	0	2193	754
Added Vol:	0	0	0	0	0	47	0	37	14	0	33	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	946	0	937	0	2277	802	0	2226	754
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	0	0	0	946	0	937	0	2277	0	0	2226	754
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	946	0	937	0	2277	0	0	2226	754
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
FinalVolume:	0	0	0	946	0	937	0	2277	0	0	2226	754
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	1.00	0.92	1.00	0.75	1.00	0.91	1.00	1.00	0.91	0.75
Lanes:	0.00	0.00	0.00	2.00	0.00	2.00	0.00	4.00	1.00	0.00	3.00	2.00
Final Sat.:	0	0	0	3502	0	2842	0	6916	1900	0	5187	2842
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.27	0.00	0.33	0.00	0.33	0.00	0.00	0.43	0.27
Crit Moves:						****					****	
Green/Cycle:	0.00	0.00	0.00	0.38	0.00	0.38	0.00	0.49	0.00	0.00	0.49	0.49
Volume/Cap:	0.00	0.00	0.00	0.72	0.00	0.88	0.00	0.67	0.00	0.00	0.88	0.54
Delay/Veh:	0.0	0.0	0.0	17.9	0.0	25.7	0.0	12.2	0.0	0.0	17.4	11.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	17.9	0.0	25.7	0.0	12.2	0.0	0.0	17.4	11.0
LOS by Move:	A	A	A	B	A	C	A	B	A	A	B	B
HCM2kAvgQ:	0	0	0	9	0	13	0	10	0	0	12	5

Note: Queue reported is the number of cars per lane.

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Oak Creek (TTM No. 36388) Traffic Impact Analysis
Long-Range (2035) With Project Conditions
PM Peak Hour

Level Of Service Computation Report
2000 HCM Operations Method (Future Volume Alternative)

Intersection #13 I-215 Northbound Ramps / Scott Road

Cycle (sec):	115	Critical Vol./Cap.(X):	0.996
Loss Time (sec):	12	Average Delay (sec/veh):	46.2
Optimal Cycle:	OPTIMIZED	Level Of Service:	D

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	10	10	0	0	10	10	16	0	0	16	16
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	0 1	0	0 2	0	0 0	0 2	2	0 4	0 0	0	0 3	1 1
Volume Module:												
Base Vol:	0	10	1028	0	0	885	748	2438	0	0	2062	661
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	10	1028	0	0	885	748	2438	0	0	2062	661
Added Vol:	21	0	0	0	0	0	29	8	0	0	12	0
PasserByVol:	-21	0	0	0	0	21	0	0	0	0	0	0
Initial Fut:	0	10	1028	0	0	906	777	2446	0	0	2074	661
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	10	1028	0	0	906	777	2446	0	0	2074	661
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	10	1028	0	0	906	777	2446	0	0	2074	661
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	0	10	1028	0	0	906	777	2446	0	0	2074	661
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	1.00	0.77	1.00	1.00	0.75	0.92	0.91	1.00	1.00	0.91	0.88
Lanes:	0.00	1.00	2.00	0.00	0.00	2.00	2.00	4.00	0.00	0.00	3.76	1.24
Final Sat.:	0	1900	2936	0	0	2842	3502	6916	0	0	6477	2064
Capacity Analysis Module:												
Vol/Sat:	0.00	0.01	0.35	0.00	0.00	0.32	0.22	0.35	0.00	0.00	0.32	0.32
Crit Moves:			****				****				****	
Green/Cycle:	0.00	0.35	0.35	0.00	0.00	0.35	0.22	0.54	0.00	0.00	0.32	0.32
Volume/Cap:	0.00	0.01	1.00	0.00	0.00	0.91	1.00	0.65	0.00	0.00	1.00	1.00
Delay/Veh:	0.0	24.3	64.2	0.0	0.0	47.2	75.9	18.9	0.0	0.0	55.2	55.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	24.3	64.2	0.0	0.0	47.2	75.9	18.9	0.0	0.0	55.2	55.2
LOS by Move:	A	C	E	A	A	D	E	B	A	A	E	E
HCM2kAvgQ:	0	0	27	0	0	21	17	16	0	0	28	27

Note: Queue reported is the number of cars per lane.

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ATTACHMENT C - MODIFIED PAGES TO APPENDIX 3.3-1 OF THE DRAFT EIR

I-215 Southbound Ramps / Scott Road (#12) – This intersection is anticipated to operate at an unacceptable LOS (LOS "F") during the AM and PM peak hours under Opening Year (2015) without Project condition and is anticipated to continue to operate at LOS "F" during the peak hours with the addition of Project traffic (as measured by 50 or more peak hour trips). As such, this impact is considered **cumulatively significant**. The following improvements are necessary to reduce the cumulative impact to ***"less-than-significant"***:

- Re-stripe the southbound shared left-through lane as a left turn lane and construct a second left turn lane and second right turn lane.
- Construct three additional eastbound through lanes.
- Eliminate the westbound left turn lane and construct two additional through lanes and a right turn lane.
- It should be noted that these improvements are consistent with the planned I-215 Freeway at Scott Road interchange improvements. The existing interchange is currently a diamond-type configuration and would be improved to include two (2) loop-ramps, north of Scott Road (see Exhibit 7-3).

I-215 Northbound Ramps / Scott Road (#13) – This intersection is anticipated to operate at an unacceptable LOS (LOS "F") during the AM and PM peak hours under Opening Year (2015) without Project condition and is anticipated to continue to operate at LOS "F" during the peak hours with the addition of Project traffic (as measured by 50 or more peak hour trips). As such, this impact is considered **cumulatively significant**. The following improvements are necessary to reduce the cumulative impact to ***"less-than-significant"***:

- Construct a second northbound right turn lane and re-stripe the shared left-through lane as a through lane.
- Construct two southbound right turn lanes.
- Construct a second eastbound left turn lane and two additional through lanes.
- Construct two additional westbound through lanes and a shared through-right turn lane.
- It should be noted that these improvements are consistent with the planned I-215 Freeway at Scott Road interchange improvements. The existing interchange is currently a diamond-type configuration and would be improved to include two (2) loop-ramps, north of Scott Road (see Exhibit 7-3).

The effectiveness of the recommended improvements discussed above to address Opening Year (2015) with Project cumulative traffic impacts are presented in Table 6-4. Opening Year (2015) with Project intersection operations analysis worksheets with cumulative mitigation measures are provided in Appendix "6.5".

6.7 TRAFFIC SIGNAL WARRANTS ANALYSIS

Traffic signal warrants for Opening Year (2015) without and with Project traffic conditions are based on Opening Year (2015) without and with Project ADT volumes. For Opening Year (2015) without Project traffic conditions, there are no intersections anticipated to warrant a traffic signal as compared to those previously identified under existing (2011) traffic conditions. Similarly, there are no additional traffic signals that appear to be warranted under Opening Year (2015) with Project traffic conditions in addition to those warranted under Opening Year (2015) without Project traffic conditions.

It should be noted that if access is ultimately restricted at the intersection of Harvest Way-West and Bundy Canyon Road, the installation of a traffic signal is not necessary to achieve acceptable peak hour intersection operations (i.e., LOS "D" or better).

ATTACHMENT D - THE FARM MUTUAL WATER COMPANY, FEBRUARY 12, 2013

THE FARM MUTUAL WATER CO.
33383 Millpond Drive • Wildomar, CA 92595 • (951) 244-4198 • (951) 244-6531

February 12, 2013

Sunbelt Communities, LLC
C/O Larry Markham - MDMG
41635 Enterprise Circle North
Temecula, Ca 92590

Reference: Oak Creek Canyon

Board of Directors

Glenn Neal
President

Kevin Anctil
Vice President

Vickie Jackson
Treasurer

George Wasenius
Secretary

Kathleen Bradley
Director

Dear Larry,

Based on your request of The Farm Mutual Water Company ("FMWC"), we would like to confirm the following:

1. Water service to Oak Creek Canyon residents (275 homes) will come from the existing 10" line on Bundy Canyon Road that currently serves the residents of The Farm. The retail water service will be provided by FMWC.

2. FMWC purchases their water from EVMWD. FMWC has adequate water available thru their bulk water supplier, EVMWD, to provide service to the Oak Creek Canyon development. Water is transmitted from a 10" line on Bundy Canyon Road. FMWC has its own distribution facilities, water tanks and booster stations within The Farm to serve water to all of the residents.

3. As part of the original agreement (2003) for providing water service to 350+ homes called The Garrett tract (Artisan Homes/The Harvest) and Fiesta Homes, there will be no need for offsite improvement to be constructed in order to serve Oak Creek Canyon. The reason for this is that the property Oak Creek Canyon is developing and seeking entitlement is the same as the Fiesta Homes site. The difference in the number of units is 22 (253 for Fiesta versus 275 for Oak Creek Canyon). This additional water requirement can be mitigated within our existing system.

4. Developer will construct all water systems pursuant to FMWC standards.

5. Developer will pay all connection fees to FMWC.

According to our meeting last Tuesday with you, Mr. Lo and Krieger & Stewart engineers, Phil Strom and Pat Watson, we agree that we will work together to design a water system that will serve the needs of both The Farm and Oak Creek Canyon. As you know, Pat Watson is the engineer for FMWC. Should you have any questions, please don't hesitate to call or write us.

Sincerely,

Glenn Neal
President

Attachment E –
Letter 12, 14 and 16 Attachments

Letter 12 Attachments

California Air Resources Board

Preliminary Draft Staff Proposal

Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the California Environmental Quality Act

Released: October 24, 2008

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DOCUMENT AVAILABILITY

Electronic copies of this document and related materials can be found at: http://www.arb.ca.gov/cc/localgov/ceqa/ceqa.htm. Alternatively, paper copies may be obtained from the Board's Public Information Office, 1001 I Street, 1st Floor, Visitors and Environmental Services Center, Sacramento, California, 95814, (916) 322-2990.

For individuals with sensory disabilities, this document is available in Braille, large print, audiocassette or computer disk. Please contact ARB's Disability Coordinator at (916) 323-4916 by voice or through the California Relay Services at 711, to place your request for disability services. If you are a person with limited English and would like to request interpreter services, please contact ARB's Bilingual Manager at (916) 323-7053.

DISCLAIMER

This preliminary draft proposal has been reviewed by the staff of the Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does mention of trade names or commercial products constitute endorsement or recommendation of use.

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Reviewed and approved for distribution by: Lynn M. Terry, Deputy Executive Officer

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ATTACHMENT A: PRELIMINARY DRAFT PROPOSAL FOR INDUSTRIAL PROJECTS

ATTACHMENT B: PRELIMINARY DRAFT PROPOSAL FOR RESIDENTIAL AND COMMERCIAL PROJECTS

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INTRODUCTION

Climate change is one of the most serious environmental problems facing the world, the United States, and California today. In this State, climate change already is impacting our coastlines, water supplies, agriculture, and public health, and putting millions of acres of forested land at increased risk of fire. These adverse effects will only increase in number and intensity if we do not promptly and substantially reduce pollution of the atmosphere with greenhouse gases (GHGs).

California law provides that climate change is an environmental effect subject to the California Environmental Quality Act (CEQA).[1] Lead agencies therefore are obligated to determine whether a project's climate change-related effects may be significant, requiring preparation of an Environmental Impact Report,[2] and to impose feasible mitigation to substantially lessen any significant effects.[3] Determining significance, however, can be a challenging task. Accordingly, the Governor's Office of Planning and Research in its June 2008 Technical Advisory, "CEQA and Climate Change,"[4] asked the Air Resources Board (ARB) to make recommendations for GHG-related thresholds of significance – identifiable benchmarks or standards that assist lead agencies in the significance determination.[5]

With this Staff Proposal, ARB staff is taking the first step toward developing recommended statewide interim thresholds of significance for GHGs that may be adopted by local agencies for their own use. The task that ARB staff is undertaking is, however, a limited one. Staff will not attempt to address every type of project that may be subject to CEQA, but instead will focus on common project types that, collectively, are responsible for substantial GHG emissions – specifically, industrial, residential, and commercial projects.[6] ARB staff believes that thresholds in these important sectors will advance our climate objectives, streamline project review, and encourage consistency and uniformity in the CEQA analysis of GHG emissions throughout the State.

Staff intends to make its final recommendations on thresholds in early 2009, in order to harmonize with OPR's timeline for issuing draft CEQA guidelines addressing GHG emissions[7] and to provide much needed guidance to lead agencies in the near term.

Public, stakeholder, and local lead agency participation is essential to the success of this project. ARB staff believes that the comment and feedback it receives, along with

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[1] Senate Bill 97, Public Resources Code, § 21083.05.
[2] California Code of Regulations, tit. 14, § 15064, subd. (f)(1).
[3] Id., § 15021, subd. (a)(2).
[4] See: http://opr.ca.gov/download.php?dl=ceqa/pdfs/june08-ceqa.pdf
[5] Id., § 15064.7, subd. (a).
[6] The collective greenhouse gas emissions from the industrial, residential and commercial sectors, together with the transportation sector, represent approximately 80% of the statewide greenhouse gas emissions inventory in 2004.
[7] See Senate Bill 97, Public Resources Code § 21083.05 (providing that draft guidelines are due June 1, 2009).

additional data and analyses, can form a body of evidence that lead agencies may rely on in adopting thresholds of significance consistent with ARB staff's recommendations.

Because the schedule is expedited, staff's recommendations must necessarily be interim and subject to review and revision as more information becomes available.[8]

BACKGROUND

Significance Under CEQA

A significant effect on the environment means a substantial, or potentially substantial, change in the environment caused directly or indirectly by the project.[9] The incremental effect of a project can be significant when it is cumulatively considerable – that is, when the effect is added to that of other past, present, and reasonably foreseeable probable future projects that also contribute to the problem.[10]

To streamline and facilitate consistency in the significance determination, the CEQA Guidelines[11] encourage agencies "to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects."[12] A threshold of significance is an identifiable quantitative, qualitative or performance level that marks the division between an impact that is significant and one that is not. A threshold of significance gives rise to a presumption, which can be rebutted by evidence that the threshold should not apply to a particular project.

Thresholds of significance must be supported by "substantial evidence." This does not mean that there is one best threshold. In CEQA, substantial evidence "means enough relevant information and reasonable inferences from this information that a fair argument can be made to support a conclusion, even though other conclusions might also be reached."[13]

Climate Change and GHG Thresholds of Significance

"The capacity of the environment is limited, and it is the intent of the Legislature that the government of the state take immediate steps to identify any critical thresholds for the health and safety of the people of the state and take all coordinated actions necessary to prevent such thresholds being reached."[14] But where should a threshold of significance be set for GHG emissions and climate change? This question can be answered only after considering the nature of the environmental problem.

---

[8] ARB staff intends to monitor the implementation of thresholds that are adopted as a result of this process for effectiveness. In the same time frame as the update of the AB 32 Scoping Plan, staff intends to revisit its recommendations and to modify them if necessary.
[9] California Code of Regulations, title 14, §§ 15064, subd. (d), 15382.
[10] *Id.*, § 15355, subd. (b).
[11] Id., § 15000, et. seq.
[12] *Id.*, § 15064.7, subd. (a).
[13] *Id.*, § 15384, subd. (a).
[14] Public Resources Code, § 21000, subd. (d).

There is a scientific consensus that human activities, chief among them the burning of fossil fuels, profoundly affect the world's climate by increasing the atmospheric concentration of GHG beyond natural levels. Contributing additional GHG pollution to the atmosphere leads to higher global average temperatures, changes to climate, and adverse environmental impacts here in California and around the world.[15] Climate change, caused by "collectively significant projects taking place over a period of time[,]"[16] is a quintessential cumulative impact.

The experts tell us that an additional increase in global average temperatures of just 2 degrees Celsius (3.6 degrees Fahrenheit) is very likely dangerous.[17] With a 2 degree Celsius increase, disastrous effects become likely, including more extreme and more frequent severe weather, more wildfires, greater frequency of droughts and floods, rapid and higher sea level rise, and increased habitat destruction and extinctions.[18] These environmental effects will undoubtedly lead to serious economic, political, and national security disruptions.

In order to reduce the risk of dangerous climate change, we must stabilize atmospheric levels of GHGes at approximately 450 parts per million (ppm) by mid-century.[19] We are fast approaching this limit. Since the beginning of the industrial era, atmospheric concentrations of carbon dioxide, the primary GHG, have climbed to their highest point in the last half-million years, increasing from just under 300 ppm at the turn of the last century, to over 380 ppm today, and rising at about 2 ppm per year.[20]

In response to the challenge of climate change, California has taken a leadership role by committing to reduce its GHG emissions to 1990 levels by 2020 (about a thirty percent reduction in business-as-usual emissions in 2020) and to eighty percent below 1990 levels by 2050.[21] The latter target is consistent with the scientific consensus of the reductions needed to stabilize atmospheric levels of GHGs at 450 ppm by mid-century. Assembly Bill 32, the Global Warming Solutions Act of 2006, codifies the 2020 reduction

---

[15] There is a large body of authoritative sources on the causes and current and projected impacts of climate change. An extended discussion of climate change is beyond the scope of this Staff Proposal. For additional information, ARB recommends the Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) and, in particular, the IPCC's "Frequently Asked Questions," available at: http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-faqs.pdf and the 2006 California Climate Action Team's Report to the Governor and Legislature, available at: http://www.climatechange.ca.gov/climate_action_team/reports/index.html.

[16] See California Code of Regulations, tit. 14, § 15355, subd. (b).

[17] See IPCC 4th Assessment Report, Working Group II, Summary for Policymakers, Figure 2, available at: http://www.ipcc.ch/graphics/graphics/ar4-wg2/jpg/spm2.jpg (chart showing global impacts at various temperature increases); California Climate Change Center, Our Changing Climate: Assessing the Risks to California (2008) at p. 15, available at http://www.energy.ca.gov/2006publications/CEC-500-2006-077/CEC-500-2006-077.PDF (chart showing impacts in California at various temperature increases.)

[18] *Id.*

[19] See IPCC 4th Assessment Report, Working Group III, Summary for Policymakers at p. 17, available at http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf.

[20] IPPC 4th Assessment Report, Working Group I, Figure FAQ 2.1, available at: http://www.ipcc.ch/graphics/graphics/ar4-wg1/jpg/faq-2-1-fig-1.jpg.

[21] Executive Order S-03-05

target and charges ARB with development of a Scoping Plan to map out how the State will achieve this target, including regulatory, voluntary, and market-based mechanisms beginning in 2012.[22]

There is strong need, however, to aggressively address GHG emissions right now. The pollution we contribute to the atmosphere today will continue to have climate impacts for years, decades, and, in some cases, millennia to come. And the longer we delay in addressing the problem, the more we risk being unable to meet our climate objective. CEQA provides a mechanism that is independent of AB 32 through which lead agencies can begin immediately to reduce the climate change-related impacts of the projects that come before them.

What Type of Threshold is Appropriate?

Some have suggested that because of the need for urgent action and the uncertainty of the precise "tipping point" for dangerous climate change, any contribution of GHGs to the atmosphere may be significant – a so-called "zero threshold."

ARB staff believes that for the project types under consideration, non-zero thresholds can be supported by substantial evidence. ARB staff believes that zero thresholds are not mandated in light of the fact that (1) some level of emissions in the near term and at mid-century is still consistent with climate stabilization and (2) current and anticipated regulations and programs apart from CEQA (e.g., AB 32, the Pavley vehicle regulations, the Renewable Portfolio Standard, the California Solar Initiative, and the commitment to net-zero-energy buildings by 2020 (residential) and 2030 (commercial)) will proliferate and increasingly will reduce the GHG contributions of past, present, and future projects.

But any non-zero threshold must be sufficiently stringent to make substantial contributions to reducing the State's GHG emissions peak, to causing that peak to occur sooner, and to putting California on track to meet its interim (2020) and long-term (2050) emissions reduction targets. ARB staff believes that the preliminary interim approaches outlined in this Staff Proposal are consistent with these objectives.

RECOMMENDED THRESHOLDS – CONCEPTUAL APPROACH

ARB staff believes that different GHG thresholds of significance may apply to projects in different sectors. Two primary reasons that sector-specific thresholds are appropriate are: (1) some sectors contribute more substantially to the problem, and therefore should have a greater obligation for emissions reductions, and, (2) looking forward, there are differing levels of emissions reductions expected from different sectors in order to meet California's climate objectives. We also believe that different types of thresholds – quantitative, qualitative, and performance-based – can apply to different sectors under the premise that the sectors can and must be treated separately given the state of the science and data. A sector-specific approach is consistent with ARB's

[22] Health and Safety Code, § 38500, et. seq.

Proposed Scoping Plan. Consequently, the Staff Proposal takes different, although harmonious, approaches to setting thresholds for different sectors.

The attached flowcharts describe ARB staff's preliminary interim threshold concepts for two important sectors: industrial projects (**Attachment A**) and residential and commercial projects (**Attachment B**). The objective is to develop thresholds for projects in these sectors that will result in a substantial portion of the GHG emissions from new projects being subject to CEQA's mitigation requirement, consistent with a lead agency's obligation to "avoid or minimize environmental damage where feasible."[23] ARB staff is working on a proposal for an interim approach for thresholds for transportation projects and large dairies. Electricity generation is another sector where clarity is needed in the near term. The California Energy Commission (CEC) recently began a public process for identifying an approach for assessing the significance of GHG emissions from power plant projects. CEC staff anticipates concluding that work in Spring 2009.[24]

ARB staff's proposed recommendations for GHG thresholds address projects for which local agencies are typically the CEQA lead agency. In addition to the CEC, other State agencies also serve as lead agencies under CEQA. ARB is coordinating with these State agencies on their approaches to thresholds of significance.

[23] California Code of Regulations, title 14, § 15021.
[24] The CEC adopted an Order Instituting Informational Proceeding on October 8, 2008 to address GHG emissions in power plant licensing cases: http://www.energy.ca.gov/ghg_powerplants/notices/2008-10-06_PROPOSED_GHG_CEQA_OII.PDF.

REQUEST FOR PUBLIC COMMENT

ARB staff believes that the concepts in this Staff Proposal can be further developed into interim thresholds of significance. However, staff recognizes that additional analyses and data are needed to fill in some of the blanks, and to understand how the thresholds will operate in the real world.

Comments on all aspects of the Staff Proposal are encouraged. In particular, ARB seeks the active participation of local lead agencies. Staff has identified a few questions to solicit public comment, but this list is not exhaustive.

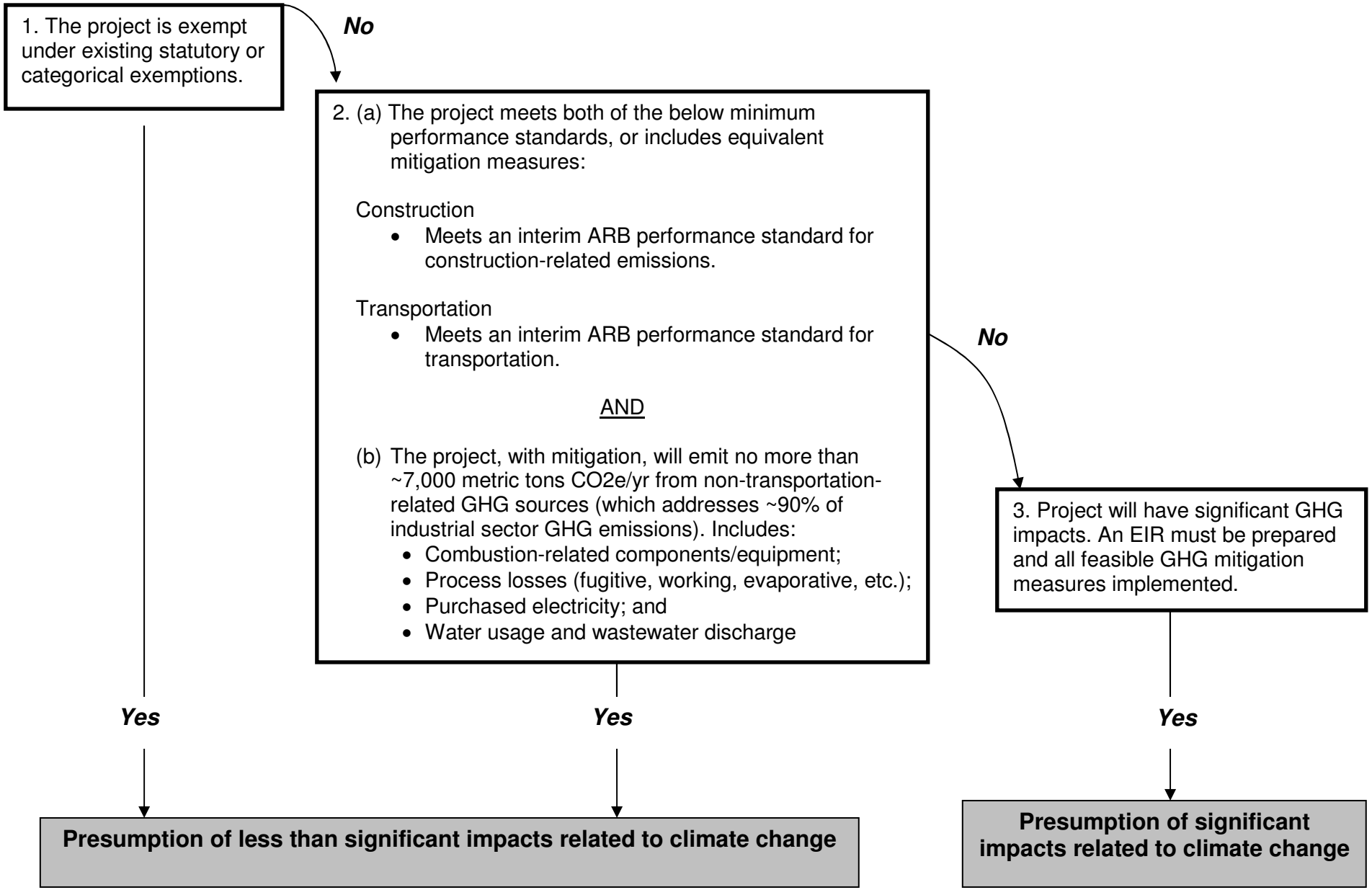
- Will the recommended approaches have any unintended consequences, for example, encouraging the piecemealing of projects?

- As set out in the attachments to the Staff Proposal, staff proposes to define certain performance standards (*e.g.*, for energy efficiency) by referencing or compiling lists from existing local, State or national standards. For some sub-sources of GHG emissions (*e.g.*, construction, transportation, waste), ARB staff has not identified reference standards. How should the performance standards for these sub-sources be defined?

- Are any of the industrial, residential, or commercial project types eligible for categorical exemptions likely to contribute more significantly to climate change than staff's preliminary analysis indicates?

- For residential and commercial projects, staff has proposed that the GHG emissions of some projects that meet GHG performance standards might under some circumstances still be considered cumulatively considerable and therefore significant. What types of projects might still have significant climate change-related impacts?

ATTACHMENT A
Preliminary Draft Proposal for Industrial Projects



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Preliminary Draft Proposal for Industrial Projects

Introduction

CEQA guidelines provide that thresholds of significance can be qualitative, quantitative, or in the form of performance standards. ARB staff's objective is to develop a threshold of significance that will result in the vast majority (~90% statewide) of the greenhouse gas (GHG) emissions from new industrial projects being subject to CEQA's requirement to impose feasible mitigation. ARB staff believes this can be accomplished with a threshold that allows small projects to be considered insignificant. ARB staff used existing data for the industrial sector to derive a proposed hybrid threshold. The threshold consists of a quantitative threshold of 7,000 metric tons of CO2 equivalent per year (MTCO2e/year) for operational emissions (excluding transportation), and performance standards for construction and transportation emissions.

The goal of this effort is to provide for the mitigation of GHG emissions from industrial projects on a statewide level. Over time, implementation of AB 32 will reduce or mitigate GHG emissions from industrial sources. Once such requirements are in place, they could become the performance standard for industrial projects for CEQA purposes. ARB staff intends to pursue this approach in conjunction with development of the regulatory requirements for industrial sources in the Proposed AB 32 Scoping Plan. Staff is proposing the use of a quantitative significance threshold at least until such time that performance standards, such AB 32 regulatory requirements, are in place to ensure mitigation of significant impacts of GHG emissions from projects in the industrial sector.

The performance standards are largely self explanatory and similar to the approaches proposed for residential and commercial projects. The method for deriving the quantitative aspect of the threshold warrants further explanation.

Technical foundation for proposed quantitative aspect of the threshold

Based on the available data, ARB staff found that for the industrial sector, small projects – defined as the portion of new projects that, when viewed collectively, were responsible for only a relatively small amount of emissions – could be allowed to proceed without requiring additional mitigation under CEQA. The question for ARB staff was what line divides these small projects from the rest of the projects that should undergo mitigation to achieve the larger environmental objective.

ARB decided to construct a representative small project and to estimate that project's expected emissions. First, ARB considered the common sub-sources of GHG emissions in the industrial sector. The four main broad emission categories and their approximate statewide contribution to GHG emissions from industrial facilities other than power plants are:

Category	MMTCO2e/year	Percent (%)
Combustion processes	70	63 %
Process Losses (evaporative, fugitive, working, etc.)	15	13 %
Purchased Electricity	18	17 %
Water Use and Wastewater Treatment	7	7 %

As the table indicates, GHG emissions from industrial sources are dominated by combustion emissions. To ensure that significant industrial emissions would be captured by the proposed threshold, ARB staff evaluated industrial boilers because they are a very common piece of equipment, are essential in many energy-intensive industries, and are a top contributor to industrial combustion emissions.

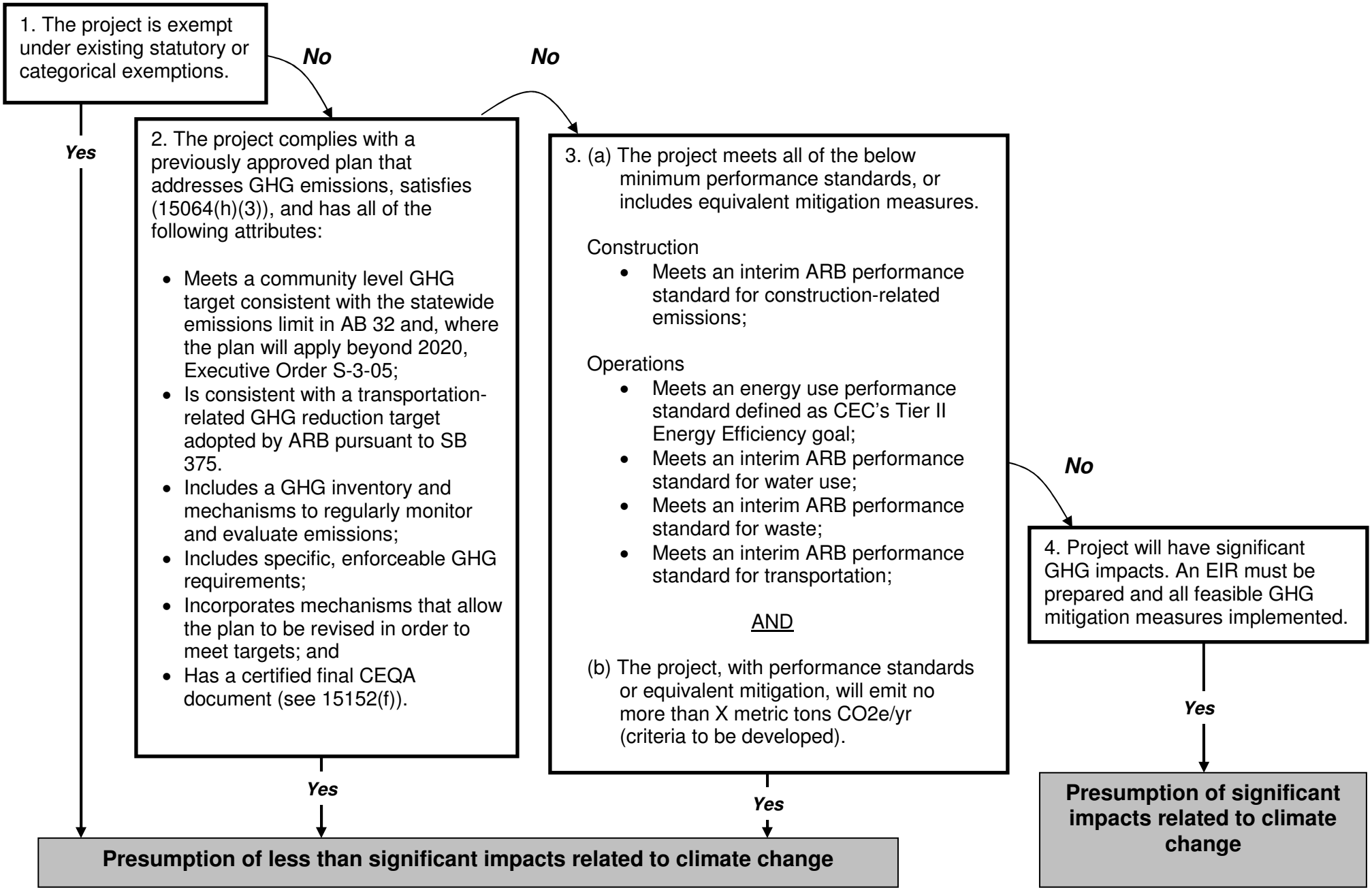
A recent comprehensive survey of industrial boilers by Oak Ridge National Laboratory[25] found that boilers with an input capacity of 10 MMBtu/hr or greater correspond to 93 percent of total industrial boiler input capacity. Based on this data, ARB staff used a natural gas boiler input capacity benchmark of 10 MMBtu/hr which equates to emissions of 4,660 MTCO2e/yr. This capacity benchmark defines a significant combustion source.

As shown in the above table, combustion processes account for 63 percent of the statewide GHG emissions from industrial facilities. Process losses, purchased electricity, and water use and water treatment account for the remaining 27 percent of emissions. Staff applied these proportions to the benchmark combustion emissions estimate (4,660 MTCO2e/yr). The result is an overall emissions estimate of approximately 7,000 MTCO2e/yr for a representative small project that accounts for the four main categories in the table above.

Based on the available data, staff believes that the 7,000 MTCO2e/year benchmark can be used to effectively mitigate industrial projects with significant GHG emissions.

[25] Characterization of the U.S. Industrial/Commercial Boiler Population, Energy, and Environmental Analysis, Inc. submitted to Oak Ridge National Laboratory, available at:: http://ww.eea-inc.com/natgas_reports/BoilersFinal.pdf.

ATTACHMENT B
Preliminary Draft Proposal for Residential and Commercial Projects



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Preliminary Draft Proposal for Residential and Commercial Projects

Introduction

CEQA guidelines provide that thresholds of significance can be qualitative, quantitative, or in the form of performance standards. ARB staff's objective is to develop a threshold for residential and commercial projects that will substantially reduce the greenhouse gas (GHG) emissions from new projects and streamline the permitting of carbon-efficient projects. To achieve this, staff's preliminary recommendation is to develop a threshold based on clear and stringent performance standards.

Performance standards will address the five major emission sub-sources for the sector: energy use, transportation, water use, waste, and construction. For the energy use performance standard, staff recommends reliance on the California Energy Commission's (CEC) Tier II Energy Efficiency standards for solar energy incentive programs. These standards are consistent with what is needed to meet the state's goal of zero net energy buildings and are continuously updated to reflect energy efficiency best practices. For the remaining sub-sources (water, waste, etc.), staff intends to compile benchmark performance standards as part of its final threshold recommendation. Projects may alternatively incorporate mitigation equivalent to these performance standards.

Staff recognizes that a substantial body of measures to address GHG emissions exists through programs like LEED, GreenPoint Rated, and the California Green Building Code. As work on performance standards moves forward, staff intends to make use of these projects.

In addition, staff proposes that a presumption of non-significance apply only to projects whose total net emissions, after meeting the performance standards or equivalent, are below a specified level. Staff proposes to develop this emissions level as part of its final threshold recommendation.

Discussion of Flow Chart

Box 1: In general, categorical exemptions will continue to apply.

Based on its preliminary analysis, ARB staff believes that projects described in CEQA's categorical and statutory exemption provisions (Articles 18 and 19 of the California Code of Regulations, title 14) will not interfere with achieving the objective to minimize emissions from new projects in this sector. GHG emissions from residential and commercial projects that are described in the categorical exemption language appear to be relatively small from a GHG perspective. For example, staff's preliminary analysis indicates that emissions from a project qualifying for the statutory infill project exemption (Cal. Code Regs., tit. 14, § 15195) will emit approximately 1,600 metric tons (MT)CO2e/yr. Staff believes

such infill projects represent some of the largest projects described in the exemption provisions. ARB staff expects to provide additional analyses to support a lead agency's determination that the GHG impact of these project types is less than significant. Staff invites the public and stakeholders to provide further evidence on the application of categorical exemptions to residential and commercial projects.

Box 2: If GHGs are adequately addressed at the programmatic level, the impact of certain individual projects can be found to be insignificant.

As OPR noted in its June 2008 Technical Advisory:

> CEQA can be a more effective tool for greenhouse gas emissions analysis and mitigation if it is supported and supplemented by sound development policies and practices that will reduce greenhouse gas emissions on a broad planning scale and that can provide the basis for a programmatic approach to project-specific CEQA analysis and mitigation…. For local government lead agencies, adoption of general plan policies and certification of general plan EIRs that analyze broad jurisdiction-wide impacts of greenhouse gas emissions can be part of an effective strategy for addressing cumulative impacts and for streamlining later project-specific CEQA reviews.

ARB staff encourages local agencies to take advantage of a programmatic approach to address climate change, consistent with existing law.

If a project complies with the requirements of a previously adopted GHG emission reduction plan or mitigation program that satisfies California Code of Regulations, title 14, section 15064(h)(3), and includes the attributes specified in that provision and Box 2, the lead agency may determine that the project's GHG impacts are less than significant with no further analysis required. Examples of plans that may satisfy this provision include Climate Action Plans incorporated into General Plans that have inventories, an emissions target, suites of specific and enforceable measures to reach that target, monitoring and reporting, and mechanisms to revise the plan to stay on target. Moreover, a prior EIR that "adequately addressed" climate change may be used for tiering purposes. (See Cal. Code Regs. tit. 14, § 15152.)

Box 3: Projects that meet performance standards, or include equivalent mitigation, can be found to be insignificant.

The threshold incorporates performance standards requiring carbon efficiency for each major sub-source of emissions from projects in these sectors. Provided they are set at a sufficiently stringent level, performance standards will dramatically reduce GHG emissions and promote a transition toward zero and low emission projects. In most cases, ARB staff expects that performance

standards will need to reach beyond current State mandates by a substantial amount, given that GHG emission reduction goals have not yet been adequately incorporated into State programs. Staff anticipates that performance standards will become more stringent over time.

ARB staff has identified the California Energy Commission's Tier II Energy Efficiency goals as an appropriate performance standard for energy use. Under State law, the CEC is required to establish eligibility criteria, conditions for incentives, and rating standards to qualify for ratepayer-funded solar energy system incentives in California. As part of this effort, the CEC establishes energy efficiency standards for homes and commercial structures, and requires new buildings to exceed current building standards by meeting Tier Energy Efficiency goals. CEC's Tier II Energy Efficiency goals will continue to be updated to achieve energy efficiency best practices, and are consistent with what is needed to meet the California Public Utilities Commission Strategic Plan goals of zero net energy buildings. Currently, the CEC's proposed guidelines for the solar energy incentive program recommend a Tier II goal for residential and commercial projects of a 30 percent reduction in building combined space heating, cooling, and water heating energy compared to the 2008 Title 24 Standards.[26]

For the remaining sub-sources, staff intends to compile benchmark performance standards as part of its final threshold recommendation. ARB staff believes that existing progressive green building standards provide a starting point for performance standards for transportation, water use, waste, and construction-related emissions. Existing green building rating systems like LEED, GreenPoint Rated, the California Green Building Code, and others, contain examples of measures that are likely to result in substantial GHG emission reductions from residential and commercial projects. The key to this approach will be identifying effective GHG reduction measures within these systems. ARB staff would like input from the public and stakeholders on appropriate performance standards for these sub-sources. Performance standards that already exist and have been proven to be effective – at the local, State, national or international level – are preferable.

Under staff's proposed approach, lead agencies would be allowed to find that a project's mitigation is "equivalent" to identified performance standards, thereby allowing for cost-effective and innovative approaches to reducing GHG emissions.

Staff believes that under some circumstances, projects that meet performance standards or include equivalent mitigation measures will have impacts that may still be cumulatively considerable and therefore significant. For this reason, staff recommends that, in addition to meeting performance standards or including

[26] Guidelines for California's Solar Electric Incentive Program Pursuant to Senate Bill 1 - SECOND EDITION - Draft Guidelines can be found at: http://www.energy.ca.gov/2008publications/CEC-300-2008-007/CEC-300-2008-007-D.PDF

equivalent mitigation measures, a project must also emit no more than “X” MTCO2e/yr. Criteria for determining this emissions level have yet to be defined. ARB requests public and stakeholder input on what types of projects might still have significant climate change-related impacts.

Box 4: Presumption of significant impacts.

If a project cannot meet the requirements in the previous boxes, it should be presumed to have significant impacts related to climate change. The lead agency must then prepare an EIR, or other appropriate document, and implement all feasible GHG mitigation measures.

CAPCOA

CALIFORNIA AIR POLLUTION CONTROL OFFICERS ASSOCIATION

CEQA & Climate Change

Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act

January 2008

Disclaimer

The California Air Pollution Control Officers Association (CAPCOA) has prepared this white paper consideration of evaluating and addressing greenhouse gas emissions under the California Environmental Quality Act (CEQA) to provide a common platform of information and tools to support local governments.

This paper is intended as a resource, not a guidance document. It is not intended, and should not be interpreted, to dictate the manner in which an air district or lead agency chooses to address greenhouse gas emissions in the context of its review of projects under CEQA.

This paper has been prepared at a time when California law has been recently amended by the Global Warming Solutions Act of 2006 (AB 32), and the full programmatic implications of this new law are not yet fully understood. There is also pending litigation in various state and federal courts pertaining to the issue of greenhouse gas emissions. Further, there is active federal legislation on the subject of climate change, and international agreements are being negotiated. Many legal and policy questions remain unsettled, including the requirements of CEQA in the context of greenhouse gas emissions. This paper is provided as a resource for local policy and decision makers to enable them to make the best decisions they can in the face of incomplete information during a period of change.

Finally, this white paper reviews requirements and discusses policy options, but it is not intended to provide legal advice and should not be construed as such. Questions of legal interpretation, particularly in the context of CEQA and other laws, or requests for advice should be directed to the agency's legal counsel.

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List of Acronyms and Abbreviations

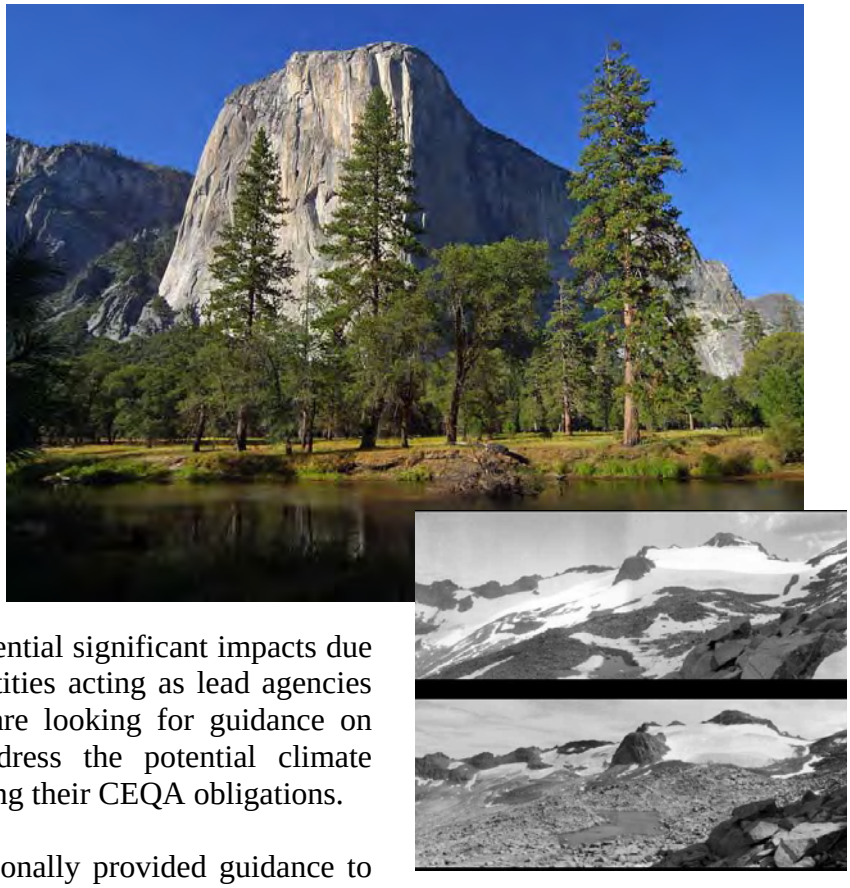
Acronym/ Abbreviation	Meaning
AB 32	Assembly Bill 32 Global Warming Solutions Act of 2006
AG	Attorney General
ARB	Air Resources Board
ASTM	American Society of Testing and Material
BAAQMD	Bay Area Air Quality Management District
BAU	Business as Usual
BEES	Building for Environmental and Economic Sustainability
Calfire	California Fire
Caltrans	California Department of Transportation
CAP	Criteria Air Pollutants
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resource Board
CAT	Climate Action Team
CCAP	Center for Clean Air Policy
CCAR	California Climate Action Registry
CDFA	California Department of Food and Agriculture
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CF	Connectivity Factor
CH_4	Methane
CIWMB	California Integrated Waste Management Board
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CNG	Compressed Natural Gas
CPUC	California Public Utilities Commission
CUFR	California Urban Forestry
DGS	Department of General Services
DOE	U.S. Department of Energy
DOF	Department of Finance
DPF	Diesel Particulate Filter
DWR	Department of Water Resources
E85	85% Ethanol
EEA	Massachusetts Executive Office of Energy and Environmental Affairs
EERE	Energy Efficiency and Renewable Energy
EIR	Environmental Impact Report
EOE	Encyclopedia of Earth
EPA	U.S. Environmental Protection Agency
ETC	Edmonton Trolley Coalition
EV	Electric Vehicles
FAR	Floor Area Ratio

GHG	Greenhouse Gas
GGEP	Greenhouse Gas Emissions Policy
GGRP	Greenhouse Gas Reduction Plan
GP	General Plan
GWP	Global Warming Potential
IGCC	Integrated Gasification Combined Cycle
IOU	Investor Owned Utility
IPCC	International Panel on Climate Change
IT	Information Technology
ITE	Institute of Transportation Engineers
J&S	Jones & Stokes
km	Kilometer
LandGem	Landfill Gas Emissions Model
LEED	Leadership in Energy and Environmental Design
LNG	Liquefied Natural Gas
MBUAPCD	Monterey Bay Unified Air Pollution Control District
MEPA	Massachusetts Environmental Policy Act
MND	Mitigated Negative Declaration
MMT CO_2e	Million Metric Tons Carbon Dioxide Equivalent
MW	Megawatts
N_2O	Nitrous Oxide
NACAA	National Association Clean Air Agencies
ND	Negative Declaration
NEV	Neighborhood Electric Vehicle
NIST	National Institute of Standards and Technology
NO_X	Oxides of Nitrogen
NREL	National Renewable Energy Laboratory
NSCAPCD	Northern Sonoma County Air Pollution Control District
NSR	New Source Review
OPR	State Office of Planning and Research
PFC	Perfluorocarbon
PG&E	Pacific Gas & Electric
POU	Publicly Owned Utility
PM	Particulate Mater
RoadMod	Road Construction Emissions Model
ROG	Reactive Organic Gas
RPS	Renewable Portfolio Standards
RTP	Regional Transportation Plan
S-3-05	Executive Order S-3-05
SB	Senate Bill
SBCAPCD	Santa Barbara County Air Pollution Control District
SCAQMD	South Coast Air Quality Management District
SCM	Sustainable Communities Model
SIP	State Implementation Plan
SJVAPCD	San Joaquin Valley Unified Air Pollution Control District
SLOCAPCD	San Luis Obispo County Air Pollution Control District

SMAQMD	Sacramento Metropolitan Air Quality Management District
SMUD	Sacramento Municipal Utilities District
SO_X	Sulfur Oxides
SP	Service Population
SRI	Solar Reflectance Index
SWP	State Water Project
TAC	Toxic Air Contaminants
TBD	To Be Determined
TDM	Transportation Demand Management
TMA	Transportation Management Association
THC	Total Hydrocarbon
UC	University of California
ULEV	Ultra Low Emission Vehicle
UNFCCC	United Nations Framework Convention on Climate Change
URBEMIS	Urban Emissions Model
USGBC	U.S. Green Building Council
VMT	Vehicle Miles Traveled
VTPI	Victoria Transit Policy
YSAQMD	Yolo-Solano Air Quality Management District

Introduction

The California Environmental Quality Act (CEQA) requires that public agencies refrain from approving projects with significant adverse environmental impacts if there are feasible alternatives or mitigation measures that can substantially reduce or avoid those impacts. There is growing concern about greenhouse gas emissions[1] (GHG) and recognition of their significant adverse impacts on the world's climate and on our environment. In its most recent reports, the International Panel on Climate Change (IPCC) has called the evidence for this "unequivocal." In California, the passage of the Global Warming Solutions Act of 2006 (AB 32) recognizes the serious threat to the "economic well-being, public health, natural resources, and the environment of California" resulting from global warming. In light of our current understanding of these impacts, public agencies approving projects subject to the CEQA are facing increasing pressure to identify and address potential significant impacts due to GHG emissions. Entities acting as lead agencies in the CEQA process are looking for guidance on how to adequately address the potential climate change impacts in meeting their CEQA obligations.



Air districts have traditionally provided guidance to local lead agencies on evaluating and addressing air pollution impacts from projects subject to CEQA. Recognizing the need for a common platform of information and tools to support decision makers as they establish policies and programs for GHG and CEQA, the California Air Pollution Control Officers Association has prepared a white paper reviewing policy choices, analytical tools, and mitigation strategies.

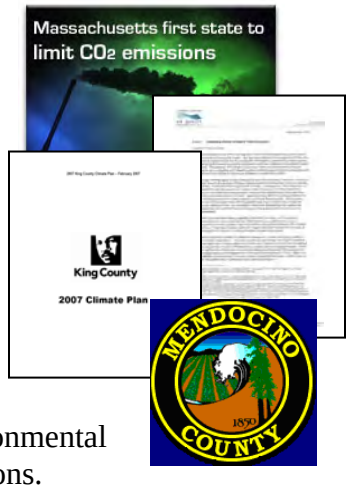
This paper is intended to serve as a resource for public agencies as they establish agency procedures for reviewing GHG emissions from projects under CEQA. It considers the application of thresholds and offers three alternative programmatic approaches toward

[1] Throughout this paper GHG, CO_2, CO_2e, are used interchangeably and refer generally to greenhouse gases but do not necessarily include all greenhouse gases unless otherwise specified.

determining whether GHG emissions are significant. The paper also evaluates tools and methodologies for estimating impacts, and summarizes mitigation measures. It has been prepared with the understanding that the programs, regulations, policies, and procedures established by the California Air Resources Board (CARB) and other agencies to reduce GHG emissions may ultimately result in a different approach under CEQA than the strategies considered here. The paper is intended to provide a common platform for public agencies to ensure that GHG emissions are appropriately considered and addressed under CEQA while those programs are being developed.

Examples of Other Approaches

Many states, counties, and cities have developed policies and regulations concerning greenhouse gas emissions that seek to require or promote reductions in GHG emissions through standards for vehicle emissions, fuels, electricity production/renewables, building efficiency, and other means. A few have developed guidance and are currently considering formally requiring or recommending the analysis of greenhouse gas emissions for development projects during their associated environmental processes. Key work in this area includes:



- Massachusetts Office of Energy and Environmental Affairs Greenhouse Gas Emissions Policy;
- King County, Washington, Executive Order on the Evaluation of Climate Change Impacts through the State Environmental Policy Act;
- Sacramento AQMD interim policy on addressing climate change in CEQA documents; and
- Mendocino AQMD updated guidelines for use during preparation of air quality impacts in Environmental Impact Reports (EIRs) or mitigated negative declarations.

The following paper evaluates options for lead agencies to ensure that GHG emissions are appropriately addressed as part of analyses under CEQA. It considers the use of significance thresholds, tools and methodologies for analyzing GHG emissions, and measures and strategies to avoid, reduce, or mitigate impacts.

Greenhouse Gas Significance Criteria

This white paper discusses three basic options air districts and lead agencies can pursue when contemplating the issues of CEQA thresholds for greenhouse gas emissions. This paper explores each path and discusses the benefits and disbenefits of each. The three basic paths are:

- No significance threshold for GHG emissions;

- GHG emissions threshold set at zero; or
- GHG threshold set at a non-zero level.

Each has inherent advantages and disadvantages. Air districts and lead agencies may believe the state or national government should take the lead in identifying significance thresholds to address this global impact. Alternatively, the agency may believe it is premature or speculative to determine a clear level at which a threshold should be set. On the other hand, air districts or lead agencies may believe that every GHG emission should be scrutinized and mitigated or offset due to the cumulative nature of this impact. Setting the threshold at zero will place all discretionary projects under the CEQA microscope. Finally, an air district or lead agency may believe that some projects will not benefit from a full environmental impact report (EIR), and may believe a threshold at some level above zero is needed.

This paper explores the basis and implications of setting no threshold, setting a threshold at zero and two primary approaches for those who may choose to consider a non-zero threshold. The first approach is grounded in statute (AB 32) and executive order (EO S-3-05) and explores four possible options under this scenario. The options under this approach are variations of ways to achieve the 2020 goals of AB 32 from new development, which is estimated to be about a 30 percent reduction from business as usual.

The second approach explores a tiered threshold option. Within this option, seven variations are discussed. The concepts explored here offer both quantitative and qualitative approaches to setting a threshold as well as different metrics by which tier cut-points can be set. Variations range from setting the first tier cut-point at zero to second-tier cut-points set at defined emission levels or based on the size of a project. It should be noted that some applications of the tiered threshold approach may require inclusion in a General Plan or adoption of enabling regulations or ordinances to render them fully effective and enforceable.

Greenhouse Gas Analytical Methodologies

The white paper evaluates various analytical methods and modeling tools that can be applied to estimate the greenhouse gas emissions from different project types subject to CEQA. In addition, the suitability of the methods and tools to characterize accurately a project's emissions is discussed and the paper provides recommendations for the most appropriate methodologies and tools currently available.

The suggested methodologies are applied to residential, commercial, specific plan and general plan scenarios where GHG emissions are estimated for each example. This chapter also discusses estimating emissions from solid waste facilities, a wastewater treatment plant, construction, and air district rules and plans.

Another methodology, a service population metric, that would measure a project's overall GHG efficiency to determine if a project is more efficient than the existing statewide average for per capita GHG emissions is explored. This methodology may be more directly correlated to a project's ability to help achieve objectives outlined in AB 32, although it relies on establishment of an efficiency-based significance threshold. The subcommittee believes this methodology may eventually be appropriate to evaluate the long-term GHG emissions from a project in the context of meeting AB 32 goals. However, this methodology will need further work and is not considered viable for the interim guidance presented in this white paper.

Greenhouse Gas Mitigation Measures

Common practice in environmental protection is first to avoid, then to minimize, and finally to compensate for impacts. When an impact cannot be mitigated on-site, off-site mitigation can be effectively implemented in several resource areas, either in the form of offsetting the same impact or preserving the resource elsewhere in the region.

This white paper describes and evaluates currently available mitigation measures based on their economic, technological and logistical feasibility, and emission reduction effectiveness. The potential for secondary impacts to air quality are also identified for each measure. A summary of current rules and regulations affecting greenhouse gas emissions and climate change is also provided.

Reductions from transportation related measures (e.g., bicycle, pedestrian, transit, and parking) are explored as a single comprehensive approach to land use. Design measures that focus on enhancing alternative transportation are discussed. Mitigation measures are identified for transportation, land use/building design, mixed-use development, energy efficiency, education/social awareness and construction.

Purpose

CEQA requires the avoidance or mitigation of significant adverse environmental impacts where there are feasible alternatives available. The contribution of GHG to climate change has been documented in the scientific community. The California Global Warming Solutions Act of 2006 (AB 32) mandates significant reductions in greenhouse gases (GHG); passage of that law has highlighted the need to consider the impacts of GHG emissions from projects that fall under the jurisdiction of the California Environmental Quality Act (CEQA). Because we have only recently come to fully recognize the potential for significant environmental impacts from GHG, most public agencies have not yet established policies and procedures to consider them under CEQA. As a result, there is great need for information and other resources to assist public agencies as they develop their programs.

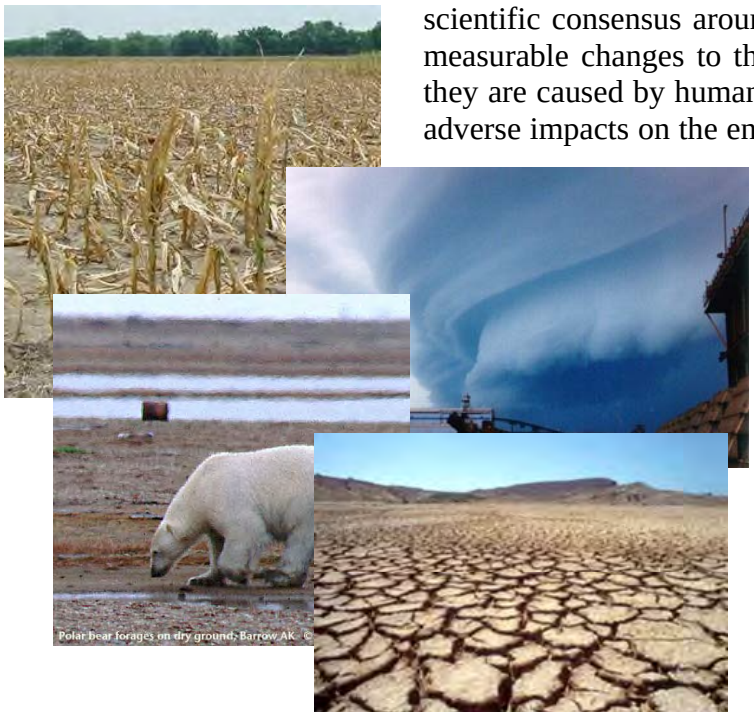
Air districts have historically provided guidance to local governments on the evaluation of air pollutants under CEQA. As local concern about climate change and GHG has increased, local governments have requested guidance on incorporating analysis of these impacts into local CEQA review. The California Air Pollution Control Officers Association (CAPCOA), in coordination with the CARB, the Governor's Office of Planning and Research (OPR) and two environmental consulting firms, has harnessed the collective expertise to evaluate approaches to analyzing GHG in CEQA. The purpose of this white paper is to provide a common platform of information and tools to address climate change in CEQA analyses, including the evaluation and mitigation of GHG emissions from proposed projects and identifying significance threshold options.

CEQA requires public agencies to ensure that potentially significant adverse environmental effects of discretionary projects are fully characterized, and avoided or mitigated where there are feasible alternatives to do so. Lead agencies have struggled with how best to identify and characterize the magnitude of the adverse effects that individual projects have on the global-scale phenomenon of climate change, even more so since Governor Schwarzenegger signed Executive Order S-3-05 and the state Legislature enacted The Global Warming Solutions Act of 2006 (AB 32). There is now a resounding call to establish procedures to analyze and mitigate greenhouse gas (GHG) emissions. The lack of established thresholds does not relieve lead agencies of their responsibility to analyze and mitigate significant impacts, so many of these agencies are seeking guidance from state and local air quality agencies. This white paper addresses issues inherent in establishing CEQA thresholds, evaluates tools, catalogues mitigation measures and provides air districts and lead agencies with options for incorporating climate change into their programs.

Background

National and International Efforts

International and Federal legislation have been enacted to deal with climate change issues. The Montreal Protocol was originally signed in 1987 and substantially amended in 1990 and 1992. In 1988, the United Nations and the World Meteorological Organization established the IPCC to assess the scientific, technical and socioeconomic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts, and options for adaptation and mitigation. The most recent reports of the IPCC have emphasized the scientific consensus around the evidence that real and measurable changes to the climate are occurring, that they are caused by human activity, and that significant adverse impacts on the environment, the economy, and human health and welfare are unavoidable.



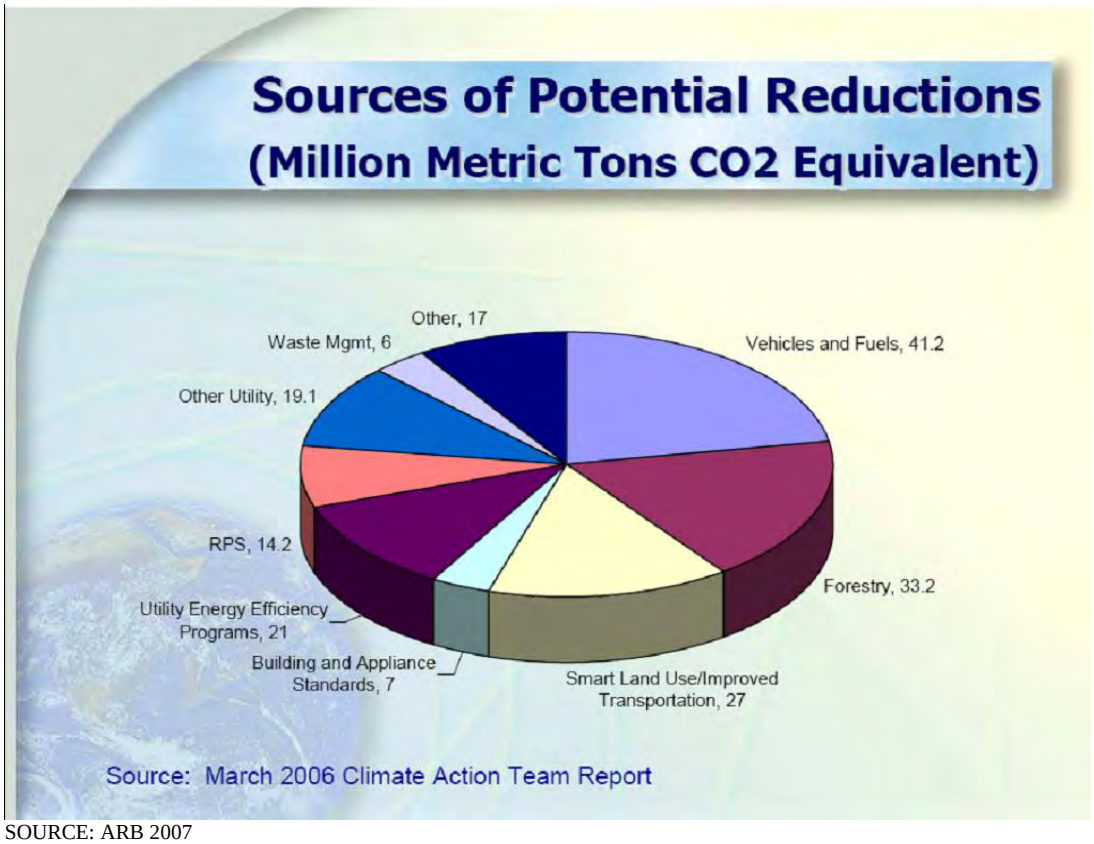
In October 1993, President Clinton announced his Climate Change Action Plan, which had a goal to return greenhouse gas emissions to 1990 levels by the year 2000. This was to be accomplished through 50 initiatives that relied on innovative voluntary partnerships between the private sector and government aimed at producing cost-effective reductions in greenhouse gas emissions. On March 21, 1994, the United States joined a number of countries around the world in signing the United Nations Framework Convention on Climate Change (UNFCCC). Under the Convention, governments agreed to gather and share information on greenhouse gas emissions, national policies, and best practices; launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and cooperate in preparing for adaptation to the impacts of climate change.

These efforts have been largely policy oriented. In addition to the national and international efforts described above, many local jurisdictions have adopted climate change policies and programs. However, thus far little has been done to assess the significance of the affects new development projects may have on climate change.

Executive Order S-3-05

On June 1, 2005, Governor Schwarzenegger issued Executive Order S-3-05 (S-3-05). It included the following GHG emission reduction targets: by 2010, reduce GHG emissions to 2000 levels; by 2020, reduce GHG emissions to 1990 levels; by 2050, reduce GHG emissions to 80 percent below 1990 levels. To meet the targets, the Governor directed the Secretary of the California Environmental Protection Agency to coordinate with the Secretary of the Business, Transportation and Housing Agency, Secretary of the Department of Food and Agriculture, Secretary of the Resources Agency, Chairperson of the CARB, Chairperson of the Energy Commission and President of the Public Utilities Commission on development of a Climate Action Plan.

The Secretary of CalEPA leads a Climate Action Team (CAT) made up of representatives from the agencies listed above to implement global warming emission reduction programs identified in the Climate Action Plan and report on the progress made toward meeting the statewide greenhouse gas targets that were established in the Executive Order.



SOURCE: ARB 2007

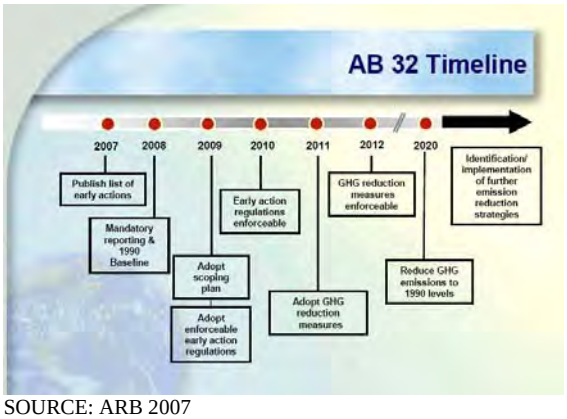
In accord with the requirements of the Executive Order, the first report to the Governor and the Legislature was released in March 2006 and will be issued bi-annually thereafter. The CAT Report to the Governor contains recommendations and strategies to help ensure the targets in Executive Order S-3-05 are met.

California Global Warming Solutions Act of 2006 (AB 32)

In 2006, the California State Legislature adopted the California Global Warming Solutions Act of 2006. AB 32 establishes a cap on statewide greenhouse gas emissions and sets forth the regulatory framework to achieve the corresponding reduction in statewide emissions levels. AB 32 charges the California Air Resources Board (CARB), the state agency charged with regulating statewide air quality, with implementation of the act. Under AB 32, greenhouse gases are defined as: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

The regulatory steps laid out in AB 32 require CARB to: adopt early action measures to reduce GHGs; to establish a statewide greenhouse gas emissions cap for 2020 based on 1990 emissions; to adopt mandatory reporting rules for significant source of greenhouse gases; and to adopt a scoping plan indicating how emission reductions will be achieved via regulations, market mechanisms and other actions; and to adopt the regulations needed to achieve the maximum technologically feasible and cost-effective reductions in greenhouse gases.

AB 32 requires that by January 1, 2008, the State Board shall determine what the statewide greenhouse gas emissions inventory was in 1990, and approve a statewide greenhouse gas emissions limit that is equivalent to that level, to be achieved by 2020. While the level of 1990 GHG emissions has not yet been approved, CARB's most recent emission inventory indicates that California had annual emissions of 436 million metric tons of carbon dioxide equivalent (MMT CO_2e) in 1990 and 497 MMT CO_2e in 2004.



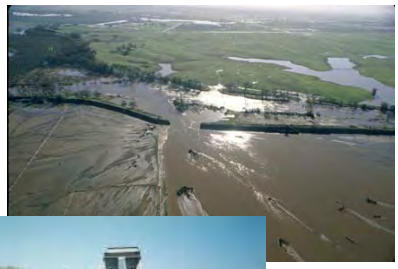
SOURCE: ARB 2007

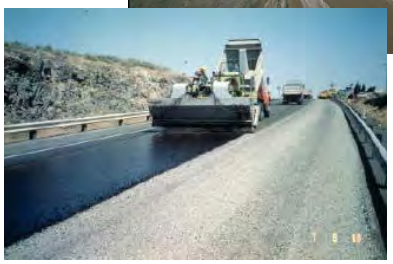
The regulatory timeline laid out in AB 32 requires that by July 1, 2007, CARB adopt a list of discrete early action measures, or regulations, to be adopted and implemented by January 1, 2010. These actions will form part of the State's comprehensive plan for achieving greenhouse gas emission reductions. In June 2007, CARB adopted three discrete early action measures. These three new proposed regulations meet the definition of "discrete early action greenhouse gas reduction measures," which include the following: a low carbon fuel standard; reduction of HFC-134a emissions from non-professional servicing of motor vehicle air conditioning systems; and improved landfill methane capture. CARB estimates that by 2020, the reductions from those three discrete early action measures would be approximately 13-26 MMT CO_2e.

CARB evaluated over 100 possible measures identified by the CAT for inclusion in the list of discrete early action measures. On October 25, 2007 CARB gave final approval to the list of Early Action Measures, which includes nine discrete measures and 35

additional measures, all of which are to be enforceable by January 1, 2010. AB 32 requires that by January 1, 2009, CARB adopt a scoping plan indicating how emission reductions will be achieved via regulations, market mechanisms and other actions.

Senate Bill 97





Senate Bill (SB) 97, signed in August 2007, acknowledges that climate change is an important environmental issue that requires analysis under CEQA. This bill directs the OPR to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions, by July 1, 2009. The Resources Agency is required to certify or adopt those guidelines by January 1, 2010. This bill also protects projects funded by the Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act of 2006, or the Disaster Preparedness and Flood Protection Bond Act of 2006 (Proposition 1B or 1E) from claims of inadequate analysis of GHG as a legitimate cause of action. This latter provision will be repealed on January 1, 2010. Thus, this "protection" is highly limited to a handful of projects and for a short time period.

The Role of Air Districts in the CEQA Process

Air districts assume one of three roles in the CEQA process. They may be lead agencies when they are adopting regulations and air quality plans. In some instances, they can also be a lead agency when approving permits to construct or operate for applicants subject to district rules. However, in many cases where an air district permit is involved, another agency has broader permitting authority over the project and assumes the role of lead agency. In these situations, the air district becomes what is referred to as a responsible agency under CEQA. When CEQA documents are prepared for projects that do not involve discretionary approval of a district regulation, plan or permit, the air district may assume the role of a concerned or commenting agency. In this role, it is typical for air districts to comment on CEQA documents where there may be air quality-related adverse impacts, such as projects that may create significant contributions to existing violations of ambient standards, cause a violation of an ambient standard or create an exposure to toxic air contaminants or odors. In some cases, the air district may also act in an "advisory" capacity to a lead agency early on in its review of an application for a proposed development project.

A few air districts in California began developing significance thresholds for use in CEQA analyses in the late 1980's and early 1990's. By the mid-1990's most air districts had developed CEQA thresholds for air quality analyses. Many of the districts have included in their guidance the analysis of rule development and permits that may be subject to CEQA.

What is Not Addressed in this Paper

Impacts of Climate Change to a Project

The focus of this paper is addressing adverse impacts to climate change and the ability to meet statewide GHG reduction goals caused by proposed new land development projects. CEQA also requires an assessment of significant adverse impacts a project might cause by bringing development and people into an area affected by climate change (CEQA Guidelines §15126.2). For example, an area that experiences higher average temperatures due to climate change may expose new development to more frequent exceedances and higher levels of ozone concentrations. Alternatively, a rise in sea level brought on by climate change may inundate new development locating in a low-lying area. The methodologies, mitigation and threshold approaches discussed in this paper do not specifically address the potential adverse impacts resulting from climate change that may affect a project.

Impacts from Construction Activity

Although construction activity has been addressed in the analytical methodologies and mitigation chapters, this paper does not discuss whether any of the threshold approaches adequately addresses impacts from construction activity. More study is needed to make this assessment or to develop separate thresholds for construction activity. The focus of this paper is the long-term adverse operational impacts of land use development.

Introduction

Any analysis of environmental impacts under CEQA includes an assessment of the nature and extent of each impact expected to result from the project to determine whether the impact will be treated as significant or less than significant. CEQA gives lead agencies discretion whether to classify a particular environmental impact as significant. "The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved," ref: CEQA Guidelines §15064(b) ("Guidelines"). Ultimately, formulation of a standard of significance requires the lead agency to make a policy judgment about where the line should be drawn distinguishing adverse impacts it considers significant from those that are not deemed significant. This judgment must, however, be based on scientific information and other factual data to the extent possible (Guidelines §15064(b)).

CEQA does not require that agencies establish thresholds of significance. Guidelines §15064.7(a) encourages each public agency "…to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which normally means the effect will be determined to be less than significant."

Once such thresholds are established, an impact that complies with the applicable threshold will "normally" be found insignificant and an impact that does not comply with the applicable threshold will "normally" be found significant.

Additionally, Guidelines §15064.7(b) requires that if thresholds of significance are adopted for general use as part of the lead agency's environmental review process they must be adopted by ordinance, resolution, rule or regulation, and developed through a public review process and be supported by substantial evidence.

While many public agencies adopt regulatory standards as thresholds, the standards do not substitute for a public agency's use of careful judgment in determining significance. They also do not replace the legal standard for significance (i.e., if there is a fair argument, based on substantial evidence in light of the whole record that the project may have a significant effect, the effect should be considered significant) (Guidelines §15064(f)(1). Also see *Communities for a Better Environment v. California Resource Agency* 103 Cal. App. 4th 98 (2002)). In other words, the adoption of a regulatory standard does not create an irrebuttable presumption that impacts below the regulatory standard are less than significant.

Summary of CEQA Thresholds at Air Districts

This section briefly summarizes the evolution of air district CEQA significance thresholds. Ventura County APCD, in 1980, was the first air district in California that formally adopted CEQA significance thresholds. Their first CEQA assessment document contained impact thresholds based on project type: residential, nonresidential, and government. Then, as now, the District's primary CEQA thresholds applied only to ROG and NO_x. The 1980 Guidelines did not address other air pollutants.

Santa Barbara County APCD and the Bay Area AQMD adopted thresholds in 1985. The South Coast AQMD recommended regional air quality thresholds in 1987 for CO, SO_2, NO_2, particulates, ROG, and lead. Most of the other California air districts adopted CEQA guidance and thresholds during the 1990's. Air districts have updated their thresholds and guidelines several times since they were first published.

Originally, most districts that established CEQA thresholds focused on criteria pollutants for which the district was nonattainment and the thresholds only addressed project level impacts. Updates during the 1990's began to add additional air quality impacts such as odors, toxic air contaminants and construction. Several air districts also developed thresholds for General Plans that relied on an assessment of the plan consistency with the district's air quality plans. A consistency analysis involves comparing the project's land use to that of the general plan and the population and employment increase to the forecasts underlying the assumptions used to develop the air quality plan.

Most air district thresholds for CEQA are based on the threshold for review under the New Source Review (NSR). The NSR threshold level is set by district rule and is different depending on the nonattainment classification of the air district. Areas with a less severe classification have a higher NSR trigger level while the most polluted areas have the lowest NSR trigger level. Some districts, such as Ventura County APCD, have significantly lower CEQA thresholds that are not tied to the NSR requirements. In Ventura, one set of CEQA thresholds is 25 pounds per day for all regions of Ventura County, except the Ojai Valley. The second set of CEQA thresholds was set at 5 pounds per day for the Ojai Valley.

The Sacramento Metropolitan AQMD bases its thresholds for ozone precursors on the projected land use share of emission reductions needed for attainment. The emission reductions needed to reach attainment are based on commitments made in the state implementation plan (SIP) prepared for the federal clean air act.

CEQA Considerations in Setting Thresholds

Public agencies use significance thresholds to disclose to their constituents how they plan on evaluating and characterizing the severity of various environmental impacts that could be associated with discretionary projects that they review. Significance thresholds are also used to help identify the level of mitigation needed to reduce a potentially significant impact to a less than significant level and to determine what type of an environmental document should be prepared for a project; primarily a negative declaration, mitigated negative declaration or an environmental impact report.

While public agencies are not required to develop significance thresholds, if they decide to develop them, they are required to adopt them by ordinance, resolution, rule or regulation through a public process. A lead agency is not restrained from adopting any significance threshold it sees as appropriate, as long as it is based on substantial evidence. CEQA Guidelines §15064.7 encourages public agencies to develop and publish significance thresholds that are identifiable, quantitative, qualitative or performance level that the agency uses in the determination of the significance of environmental effects. The courts have ruled that a "threshold of significance" for a given environmental effect is simply that level at which the lead agency finds the effects of the project to be significant.

Before an agency determines its course with regard to climate change and CEQA, it must be made clear that a threshold, or the absence of one, will not relieve a lead agency from having to prepare an EIR or legal challenges to the adequacy of an analysis leading to a conclusion, or lack of a conclusion, of significance under CEQA. CEQA has generally favored the preparation of an EIR where there is any substantial evidence to support a fair argument that a significant adverse environmental impact may occur due to a proposed project. This paper explores three alternative approaches to thresholds, including a no threshold option, a zero threshold option and a non-zero threshold option.

Fair Argument Considerations

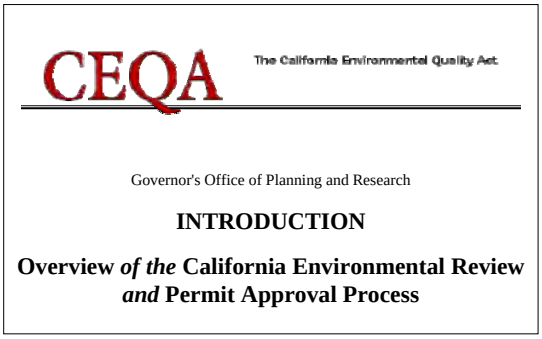
Under the CEQA fair argument standard, an EIR must be prepared whenever it can be fairly argued, based on substantial evidence in the administrative record, that a project may have a significant adverse effect on the environment. "Substantial evidence" comprises "enough relevant information and reasonable inferences from this information that a fair argument can be made to support a conclusion, even though other conclusions might also be reached." (Guidelines §15384) This means that if factual information is presented to the public agency that there is a reasonable possibility the project could have

a significant effect on the environment, an EIR is required even if the public agency has information to the contrary (Guidelines §15064 (f)).

The courts have held that the fair argument standard "establishes a low threshold for initial preparation of an EIR, which reflects a preference for resolving doubts in favor of environmental review." (*Santa Teresa Citizen Action Group v. City of San Jose* [2003] 114 Cal.App.4th 689) Although the determination of whether a fair argument exists is made by the public agency, that determination is subject to judicial scrutiny when challenged in litigation. When the question is whether an EIR should have been prepared, the court will review the administrative record for factual evidence supporting a fair argument.

The fair argument standard essentially empowers project opponents to force preparation of an EIR by introducing factual evidence into the record that asserts that the project may have a significant effect on the environment. This evidence does not need to be conclusive regarding the potential significant effect.

In 1998, the Resources Agency amended the State CEQA Guidelines to encourage the use of thresholds of significance. Guidelines §15064 (h) provided that when a project's impacts did not exceed adopted standards, the impacts were to be considered less than significant. The section went on to describe the types of adopted standards that were to be considered thresholds. Guidelines § 15064.7 provided that agencies may adopt thresholds of significance to guide their determinations of significance. Both of these sections were challenged when environmental groups sued the Resources Agency in 2000 over the amendments. The trial court concluded that §15064.7 was proper, if it was applied in the context of the fair argument standard.


CEQA The California Environmental Quality Act

Governor's Office of Planning and Research

INTRODUCTION

Overview *of the* California Environmental Review *and* Permit Approval Process

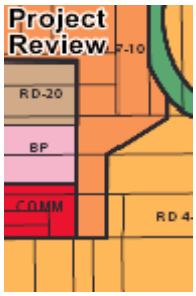
At the appellate court level, §15064(h) was invalidated. [2] Establishing a presumption that meeting an adopted standard would avoid significant impacts was "inconsistent with controlling CEQA law governing the fair argument approach." The Court of Appeal explained that requiring agencies to comply with a regulatory standard "relieves the agency of a duty it would have under the fair argument approach to look at evidence beyond the regulatory standard, or in contravention of the standard, in deciding whether an EIR must be prepared. Under the fair argument approach, any substantial evidence supporting a fair argument that a project may have a significant environmental effect would trigger the preparation of an EIR." (*Communities for a Better Environment v. California Resources Agency* [2002] 103 Cal.App.4th 98)

[2] Prior §15064(h) has been removed from the State CEQA Guidelines. Current §15064(h) discusses cumulative impacts.

In summary, CEQA law does not require a lead agency to establish significance thresholds for GHG. CEQA guidelines encourage the development of thresholds, but the absence of an adopted threshold does not relieve the agency from the obligation to determine significance.

Defensibility of CEQA Analyses

The basic purposes of CEQA, as set out in the State CEQA Guidelines, include: (1) informing decision makers and the public about the significant environmental effects of proposed projects; (2) identifying ways to reduce or avoid those impacts; (3) requiring the implementation of feasible mitigation measures or alternatives that would reduce or avoid those impacts; and (4) requiring public agencies to disclose their reasons for approving any project that would have significant and unavoidable impacts (Guidelines §15002). CEQA is enforced through civil litigation over procedure (i.e., did the public agency follow the correct CEQA procedures?) and adequacy (i.e., has the potential for impacts been disclosed, analyzed, and mitigated to the extent feasible?).



The California Supreme Court has held that CEQA is "to be interpreted in such manner as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language." (*Friends of Mammoth v. Board of Supervisors* [1972] 8 Cal.3d 247, 259) Within that context, the role of the courts is to weigh the facts in each case and apply their judgment. Although the court may rule on the adequacy of the CEQA work, the court is not empowered to act in the place of the public agency to approve or deny the project for which the CEQA document was prepared. Further, the court's review is limited to the evidence contained in the administrative record that was before the public agency when it acted on the project.

Putting aside the issue of CEQA procedure, the defensibility of a CEQA analysis rests on the following concerns:

- whether the public agency has sufficiently analyzed the environmental consequences to enable decision makers to make an intelligent decision;
- whether the conclusions of the public agency are supported by substantial evidence in the administrative record; and
- whether the agency has made a good faith effort at the full disclosure of significant effects.

CEQA analyses need not be perfect or exhaustive -- the depth and breadth of the analysis is limited to what is "reasonably feasible." (Guidelines §15151) At the same time, the analysis "must include detail sufficient to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed

project." (Laurel Heights Improvement Assn. v. Regents of University of California (1988) 47 Cal.3d 376)

By itself, establishment of a GHG threshold will not insulate individual CEQA analyses from challenge. Defensibility depends upon the adequacy of the analysis prepared by the lead agency and the process followed. However, the threshold can help to define the boundaries of what is a reasonable analysis by establishing when an analysis will be required and the basic scope of that analysis. The threshold would attempt to define the point at which an analysis will be required and when a level of impact becomes significant, requiring preparation of an EIR. If the threshold includes recommendations for the method or methods of analysis, it can establish the minimum level of analysis to address this issue.

Considerations in Setting Thresholds for Stationary Source Projects

In many respects, the analysis of GHG emissions from stationary sources is much more straightforward than the analysis of land use patterns, forecasted energy consumption, and emissions from mobile sources. The reason is that, for the most part, the latter analyses depend largely on predictive models with myriad inputs and have a wider range of error. Emissions from stationary sources involve a greater reliance on mass and energy balance calculations and direct measurements of emissions from the same or similar sources. Energy demand is more directly tied to production, and even associated mobile source emissions will likely fall within narrower predictive windows.

Implementing CEQA Without a Threshold

A lead agency is not required to establish significance thresholds for GHG emissions from stationary sources. The lead agency may find that it needs more information or experience evaluating GHG from these types of projects to determine an appropriate significance threshold. As with other project types, the lead agency could conduct a project specific analysis to determine whether an environmental impact report is needed and to determine the level of mitigation that is appropriate. The agency might also rely on thresholds established for criteria pollutants as a screening method, and analyze GHG emissions (and require mitigation) from projects with emissions above the criteria pollutant thresholds. Over time, the agency could amass information and experience with specific project categories that would support establishing explicit thresholds. The lead agency may also choose to base local CEQA thresholds on state guidelines or on the category-specific reduction targets established by ARB in its scoping plan for implementing AB32. Resource constraints and other considerations associated with implementing CEQA without GHG thresholds for stationary sources would be similar to those outlined for other types of projects (see Chapter 5 – No Threshold Option).

Implementing CEQA with Threshold of Zero

A lead agency may find that any increase in GHG emissions is potentially significant under CEQA. The resources and other considerations for implementing a threshold of zero for stationary sources are the same as those outlined for other types of projects (see Chapter 6 – Zero Threshold Option).

Implementing CEQA with a Non-Zero Threshold

A lead agency may identify one or more non-zero thresholds for significance of emissions of GHG from stationary sources. The agency could elect to rely on existing thresholds for reviewing new or modified stationary sources of GHG, if the state or local air district has established any. The agency could also apply the threshold(s) established for non-stationary sources to GHG emissions from stationary sources. Significance thresholds could also be established by ordinance, rule, or policy for a given category of stationary sources; this approach is especially conducive to a tiered threshold approach. For example, the agency could establish significance and mitigation tiers for stationary compression-ignition diesel-fueled generators. Under such an approach, the project proponent could be first required to use a lower GHG-emitting power source if feasible, and if not, to apply mitigation based on the size of the generator and other defined considerations, such as hours of operation. Certain classes of generators could be found to be insignificant under CEQA (e.g., those used for emergency stand-by power only, with a limit on the annual hours of use). As with non-stationary projects, the goal of establishing non-zero thresholds is to maximize environmental protection, while minimizing resources used. Resource and other considerations outlined for non-stationary projects are applicable here (see Chapter 7 – Non-Zero Threshold Options).

Implementing CEQA with Different Thresholds for Stationary and Non-stationary Projects

Although a lead agency may apply the same thresholds to stationary and non-stationary projects, it is not required to do so. There are, in fact, some important distinctions between the two types of projects that could support applying different thresholds. The lead agency should consider the methods used to estimate emissions. Are the estimates a "best/worst reasonable scenario" or are they based on theoretical maximum operation? How accurate are the estimates (are they based on models, simulations, emission factors, source test data, manufacturer specifications, etc.)? To what extent could emissions be reduced through regulations after the project is constructed if they were found to be greater than originally expected (i.e., is it possible to retrofit emissions control technology onto the source(s) of GHG at a later date, how long is the expected project life, etc.)? Are there emission limits or emissions control regulations (such as New Source Review) that provide certainty that emissions will be mitigated? Generally, stationary source emissions are based on maximum emissions (theoretical or allowed under law or regulation), are more accurate, and are more amenable to retrofit at a later time than non-stationary source emissions. It is also more likely that category specific

rules or some form of NSR will apply to stationary sources than non-stationary projects. Notwithstanding, it is almost always more effective and cost-efficient to apply emission reduction technology at the design phase of a project. There are, therefore, a number of considerations that need to be evaluated and weighed before establishing thresholds – and which may support different thresholds for stationary and non-stationary projects. Furthermore, the considerations may change over time as new regulations are established and as emissions estimation techniques and control technology evolves.

Direct GHG Emissions from Stationary Sources

The main focus of this paper has been the consideration of projects that do not, in the main, involve stationary sources of air pollution, because stationary source projects are generally a smaller percentage of the projects seen by most local land use agencies. That said, some discussion of stationary sources is warranted. As the broader program for regulating GHG from these sources is developed, the strategies for addressing them under CEQA will likely become more refined.

The primary focus of analysis of stationary source emissions has traditionally been those pollutants that are directly emitted by the source, whether through a stack or as fugitive releases (such as leaks). CAPCOA conducted a simplified analysis of permitting activity to estimate the number of stationary source projects with potentially significant emissions of greenhouse gases that might be seen over the course of a year. This analysis looked only at stationary combustion sources (such as boilers and generators), and only considered direct emissions. A lead agency under CEQA may see a different profile of projects than the data provided here suggest, depending on what other resources are affected by projects. In addition, air districts review like-kind replacements of equipment to ensure the new equipment meets current standards, but such actions might not constitute a project for many land use agencies or other media regulators. The data does provide a useful benchmark, however, for lead agencies to assess the order of magnitude of potential stationary source projects. A similar analysis is included for non-stationary projects in Chapter 7.

Table 1: Analysis of GHG Emissions from Stationary Combustion Equipment Permits[3]

	BAAQMD	SMAQMD	SJVUAPCD	SCAQMD
Total Applications for Year	1499	778	1535	1179
Affected at threshold of:				
900 metric tons/year	26	43	63	108
10,000 metric tons/year	7	5	26	8
25,000 metric tons/year	3	1	11	4

[3] District data varies based on specific local regulations and methodologies.

Emissions from Energy Use

In addition to the direct emissions of GHG from stationary projects, CEQA will likely need to consider the project's projected energy use. This could include an analysis of opportunities for energy efficiency, onsite clean power generation (e.g., heat/energy recovery, co-generation, geothermal, solar, or wind), and the use of dedicated power contracts as compared to the portfolio of generally available power. In some industries, water use and conservation may provide substantial GHG emissions reductions, so the CEQA analysis should consider alternatives that reduce water consumption and wastewater discharge. The stationary project may also have the opportunity to use raw or feedstock materials that have a smaller GHG footprint; material substitution should be evaluated where information is available to do so.

Emissions from Associated Mobile Sources

The stationary project will also include emissions from associated mobile sources. These will include three basic components: emissions from employee trips, emissions from delivery of raw or feedstock materials, and emissions from product transport. Employee trips can be evaluated using trip estimation as is done for non-stationary projects, and mitigations would include such measures as providing access to and incentives for use of public transportation, accessibility for bicycle and pedestrian modes of transport, employer supported car or vanpools (including policies such as guaranteed rides home, etc). Upstream and downstream emissions related to goods movement can also be estimated with available models. The evaluation will need to determine the extent of the transport chain that should be included (to ensure that all emissions in the chain have been evaluated and mitigated, but to avoid double counting). Mitigations could include direct actions by operators who own their own fleet, or could be implemented through contractual arrangements with independent carriers; again, the evaluation will need to consider how far up and down the chain mitigation is feasible and can be reasonably required.

Comparing Emissions Changes Across Pollutant Categories

The potential exists for certain GHG reduction measures to increase emissions of criteria and toxic pollutants known to cause or aggravate respiratory, cardiovascular, and other health problems. For instance, GHG reduction efforts such as alternative fuels and methane digesters may create significant levels of increased pollutants that are detrimental to the health of the nearby population (e.g.; particulate matter, ozone precursors, toxic air contaminants). Such considerations should be included in any CEQA analysis of a project's environmental impacts. While there are many win-win

strategies that can reduce both GHG and criteria/toxic pollutant emissions, when faced with situations that involve tradeoffs between the two, the more immediate public health concerns that may arise from an increase in criteria or toxic pollutant emissions should take precedence. GHG emission reductions could be achieved offsite through other mitigation programs.

Introduction

Under state law, it is the purview of each lead agency to determine what, if any, significance thresholds will be established to guide its review of projects under CEQA. While the state does provide guidelines for implementing CEQA, the guidelines have left the decision of whether to establish thresholds (and if so, at what level) to individual lead agencies. Frequently, lead agencies consult with resource-specific agencies (such as air districts) for assistance in determining what constitutes a significant impact on that specific resource.

With the passage of AB 32, the ARB has broad authority to regulate GHG emissions as necessary to meet the emission reduction goals of the statute. This may include authority to establish emission reduction requirements for new land use projects, and may also enable them to recommend statewide thresholds for GHG under CEQA.

In developing this white paper, CAPCOA recognizes that, as the GHG reduction program evolves over time, GHG thresholds and other policies and procedures for CEQA may undergo significant revision, and that uniform statewide thresholds and procedures may be established. This paper is intended to serve as a resource for public agencies until such time that statewide guidance is established, recognizing that decisions will need to be made about GHG emissions from projects before such guidance is available. This paper is not, however, uniform statewide guidance. As stated before, it outlines several possible approaches without endorsing any one over the others.

Some air districts may choose to use this paper to support their establishment of guidance for GHG under CEQA, including thresholds. This paper does not, nor should it be construed to require a district to implement any of the approaches evaluated here. Decisions about whether to provide formal local guidance on CEQA for projects with GHG emissions, including the question of thresholds, will be made by individual district boards.

Each of the 35 air districts operates independently and has its own set of regulations and programs to address the emissions from stationary, area and mobile sources, consistent with state and federal laws, regulations, and guidelines. The independence of the districts allows specific air quality problems to be addressed on a local level. In addition, districts have also established local CEQA thresholds of significance for criteria pollutants – also to address the specific air quality problems relative to that particular district.

The overall goal of air district thresholds is to achieve and maintain health based air quality standards within their respective air basins and to reduce transport of emissions to other air basins. In establishing recommended thresholds, air districts consider the existing emission inventory of criteria pollutants and the amount of emission reductions needed to attain and maintain ambient air quality standards.

However, unlike criteria pollutants where individual districts are characterized by varying levels of pollutant concentrations and source types, greenhouse gases (GHG) and their attendant climate change ramifications are a global problem and, therefore, may suggest a uniform approach to solutions that ensure both progress and equity.

Under SB97, the Office of Planning and Research is directed to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions through CEQA by July 1, 2009. Those guidelines may recommend thresholds. As stated, this paper is intended to provide a common platform of information and tools to support local decision makers until such time that statewide guidance or requirements are promulgated.

Local Ability to Promulgate District-Specific GHG Thresholds

One of the primary reasons behind the creation of air districts in California is the recognition that some regions within the state face more critical air pollution problems than others and, as has often been pointed out – one size does not fit all. For example, a "Serious" federal nonattainment district would need greater emission reductions than a district already in attainment – and, therefore, the more "serious" district would set its criteria pollutant CEQA thresholds of significance much lower than the air district already in attainment.

The action of GHGs is global in nature, rather than local or regional (or even statewide or national). Ultimately there may be a program that is global, or at least national in scope. That said, actions taken by a state, region, or local government can contribute to the solution of the global problem. Local governments are not barred from developing and implementing programs to address GHGs. In the context of California and CEQA, lead agencies have the primary responsibility and authority to determine the significance of a project's impacts.

Further, air districts have primary authority under state law for "control of air pollution from all sources, other than emissions from motor vehicles." (H&SC §40000) The term air contaminant or "air pollutant" is defined extremely broadly, to mean "any discharge, release, or other propagation into the atmosphere" and includes, but is not limited to, soot, carbon, fumes, gases, particulate matter, etc. Greenhouse gases and other global warming pollutants such as black carbon would certainly be included in this definition, just as the U.S. Supreme Court held in Massachusetts v. EPA that greenhouse gases were air pollutants under the federal Clean Air Act. Therefore, air districts have the primary authority to regulate global warming pollutants from nonvehicular sources. AB 32 does not change this result. Although it gives wide responsibility to CARB to regulate greenhouse gases from all sources, including nonvehicular sources, it does not preempt the districts. AB 32 specifically states That "nothing in this division shall limit or expand the existing authority of any district..."(H&SC § 38594). Thus, districts and CARB retain concurrent authority over nonvehicular source greenhouse gas emissions.

Introduction

The CEQA statutes do not require an air district or any lead agency to establish significance thresholds under CEQA for any pollutant. While there are considerations that support the establishment of thresholds (which are discussed in other sections of this document), there is no obligation to do so.

An air district or other lead agency may elect not to establish significance thresholds for a number of reasons. The agency may believe that the global nature of the climate change problem necessitates a statewide or national framework for consideration of environmental impacts. SB 97 directs OPR to develop "guidelines for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions by July 1, 2009," and directs the California Resources Agency to certify and adopt the guidelines by June 30, 2010.

An agency may also believe there is insufficient information to support selecting one specific threshold over another. As described earlier, air districts have historically set CEQA thresholds for air pollutants in the context of the local clean air plan, or (in the case of toxic air pollutants) within the framework of a rule or policy that manages risks and exposures due to toxic pollutants. There is no current framework that would similarly manage impacts of greenhouse gas pollutants, although the CARB is directed to establish one by June 30, 2009, pursuant to AB 32. A local agency may decide to defer any consideration of thresholds until this framework is in place.

Finally, an agency may believe that the significance of a given project should be assessed on a case-by-case basis in the context of the project at the time it comes forward.

Implementing CEQA Without Significance Thresholds for GHG

The absence of a threshold does not in any way relieve agencies of their obligations to address GHG emissions from projects under CEQA. The implications of not having a threshold are different depending on the role the agency has under CEQA – whether it is acting in an advisory capacity, as a responsible agency, or as a lead agency.

Implications of No Thresholds for an Agency Acting in an Advisory Capacity

Air districts typically act in an advisory capacity to local governments in establishing the framework for environmental review of air pollution impacts under CEQA. This may include recommendations regarding significance thresholds, analytical tools to assess emissions and impacts, and mitigations for potentially significant impacts. Although districts will also address some of these issues on a project-specific basis as responsible agencies, they may provide general guidance to local governments on these issues that

are program wide, and these are advisory (unless they have been established by regulation).

An air district that has not established significance thresholds for GHG will not provide guidance to local governments on this issue. This does not prevent the local government from establishing thresholds under its own authority. One possible result of this would be the establishment of different thresholds by cities and counties within the air district. Alternatively, the air district could advise local governments not to set thresholds and those jurisdictions may follow the air district's guidance.

It is important to note here (as has been clearly stated by the Attorney General in comments and filings) that lack of a threshold does *not* mean lack of significance. An agency may argue lack of significance for any project, but that argument would have to be carried forth on a case-by-case, project specific basis. By extension then, a decision not to establish thresholds for GHG is likely to result in a greater workload for responsible and lead agencies as they consider individual projects under CEQA.

Implications of No Thresholds for a Responsible Agency

If there are no established thresholds of significance, the significance of each project will have to be determined during the course of review. The responsible agency (e.g., the air district) will review each project referred by the lead agency. The review may be qualitative or quantitative in nature. A qualitative review would discuss the nature of GHG emissions expected and their potential effect on climate change as the district understands it. It could also include a discussion of the relative merits of alternative scenarios. A quantitative analysis would evaluate, to the extent possible, the expected GHG emissions; it would also need to evaluate their potential effect on climate change and might include corresponding analysis of alternatives. The air district, as a responsible agency, may also identify mitigation measures for the project.

The lack of established thresholds will make the determination of significance more resource intensive for each project. The district may defer to the lead agency to make this determination, however the district may be obligated, as a responsible agency, to evaluate the analysis and determination.

Implications of No Thresholds for a Lead Agency

The main impact of not having significance thresholds will be on the primary evaluation of projects by the lead agency. Without significance thresholds, the agency will have to conduct some level of analysis of every project to determine whether an environmental impact report is needed. There are three fundamental approaches to the case-by-case analysis of significance, including presumptions of significance or insignificance, or no presumption:

1. The agency can begin with a presumption of significance and the analysis would be used to support a case-specific finding of no significance. This is similar to establishing a threshold of zero, except that here, the "threshold" is rebuttable. This approach may result in a large number of projects proceeding to preparation of an environmental impact report. Because of the attendant costs, project proponents may challenge the determination of significance, although formal challenge is less likely than attempts to influence the determination.

2. The agency can begin with a presumption of insignificance, and the analysis would be used to support a case-specific finding of significance. A presumption of insignificance could be based on the perspective that it would be speculative to attempt to identify the significance of GHG emissions from a project relative to climate change on a global scale. This approach might reduce the number of projects proceeding to preparation of environmental impact reports. It is likely to have greater success with smaller projects than larger ones, and a presumption of *insignificance* may be more likely to be challenged by project opponents.

3. It is not necessary for the lead agency to have any presumption either way. The agency could approach each project from a *tabula rasa* perspective, and have the determination of significance more broadly tied to the specific context of the project; this approach is likely to be resource intensive, and creates the greatest uncertainty for project proponents. To the extent that it results in a lead agency approving similar projects based on different determinations of significance for GHG emissions, it may be more vulnerable to challenge from either proponents or opponents of the project. Alternatively, in the absence of either thresholds or presumptions, the lead agency could use each determination of significance to build its approach in the same way that subsequent judgments define the law.

Relevant Citations

The full text of relevant citations is in Appendix A.

Public Resources Code – §21082.2, Significant Effect on Environment; Determination; Environmental Impact Report Preparation.

State CEQA Guidelines – §15064, Determining the Significance of the Environmental Effects Caused by a Project.

Introduction

If an air district or lead agency determines that any degree of project-related increase in GHG emissions would contribute considerably to climate change and therefore would be a significant impact, it could adopt a zero-emission threshold to identify projects that would need to reduce their emissions. A lead agency may determine that a zero-emission threshold is justified even if other experts may disagree. A lead agency is not prevented from adopting any significance threshold it sees as appropriate, as long as it is based on substantial evidence.

If the zero threshold option is chosen, all projects subject to CEQA would be required to quantify and mitigate their GHG emissions, regardless of the size of the project or the availability of GHG reduction measures available to reduce the project's emissions. Projects that could not meet the zero-emission threshold would be required to prepare environmental impact reports to disclose the unmitigable significant impact, and develop the justification for a statement of overriding consideration to be adopted by the lead agency.

Implementing CEQA With a Zero Threshold for GHG

The scientific community overwhelmingly agrees that the earth's climate is becoming warmer, and that human activity is playing a role in climate change. Unlike other environmental impacts, climate change is a global phenomenon in that all GHG emissions generated throughout the earth contribute to it. Consequently, both large and small GHG generators cause the impact. While it may be true that many GHG sources are individually too small to make any noticeable difference to climate change, it is also true that the countless small sources around the globe combine to produce a very substantial portion of total GHG emissions.

A zero threshold approach is based on a belief that, 1) all GHG emissions contribute to global climate change and could be considered significant, and 2) not controlling emissions from smaller sources would be neglecting a major portion of the GHG inventory.

CEQA explicitly gives lead agencies the authority to choose thresholds of significance. CEQA defers to lead agency discretion when choosing thresholds. Consequently, a zero-emission threshold has merits.

The CEQA review process for evaluating a project's impact on global climate change under the zero threshold option would involve several components. Air quality sections would be written by lead agencies to include discussions on climate change in CEQA documents, GHG emissions would be calculated, and a determination of significance would be made. The local air districts would review and comment on the climate change discussions in environmental documents. Lead agencies may then revise final EIRs to accommodate air district comments. More than likely, mitigation measures will be specified for the project, and a mitigation monitoring program will need to be put in place to ensure that these measures are being implemented.

Since CEQA requires mitigation to a less than significant level, it is conceivable that many projects subjected to a zero threshold could only be deemed less than significant with offsite reductions or the opportunity to purchase greenhouse gas emission reduction credits. GHG emission reduction credits are becoming more readily available however the quality of the credits varies considerably. High quality credits are generated by actions or projects that have clearly demonstrated emission reductions that are real, permanent, verifiable, enforceable, and not otherwise required by law or regulation. When the pre- or post-project emissions are not well quantified or cannot be independently confirmed, they are considered to be of lesser quality. Similarly, if the reductions are temporary in nature, they are also considered to be poor quality. Adoption of a zero threshold should consider the near-term availability and the quality of potential offsets.

There are also environmental justice concerns about the effects of using offsite mitigations or emission reduction credits to offset, or mitigate, the impacts of a new project. Although GHGs are global pollutants, some of them are emitted with co-pollutants that have significant near-source or regional impacts. Any time that increases in emissions at a specific site will be mitigated at a remote location or using emission reduction credits, the agency evaluating the project should ensure that it does not create disproportionate impacts.

Administrative Considerations

If electing to pursue a zero threshold, an air district or lead agency should consider the administrative costs and the environmental review system capacity. Some projects that previously would have qualified for an exemption could require further substantial analysis, including preparation of a Negative Declaration (ND), a Mitigated Negative Declaration (MND) or an EIR. Moreover, the trade-offs between the volume of projects requiring review and the quality of consideration given to reviews should be considered. It may also be useful to consider whether meaningful mitigation can be achieved from smaller projects.

Consideration of Exemptions from CEQA

A practical concern about identifying GHG emissions as a broad cumulative impact is whether the zero threshold option will preclude a lead agency from approving a large set of otherwise qualified projects utilizing a Categorical Exemption, ND, or MND. The results could be a substantial increase in the number of EIR's. This is a valid and challenging concern, particularly for any threshold approach that is based on a zero threshold for net GHG emission increases.

CEQA has specified exceptions to the use of a categorical exception. Specifically, CEQA Guidelines §15300.2 includes the following exceptions:

"(b) Cumulative Impact. All exemptions for these classes are inapplicable when the cumulative impact of successive projects of the same type in the same place, over time is significant."

(c) Significant Effect. A categorical exemption shall not be used for an activity where there is a reasonable possibility that the activity will have a significant effect on the environment due to unusual circumstances."

These CEQA Guidelines sections could be argued to mean that any net increase in GHG emissions would preclude the use of a categorical exemption. However, as described below, if the following can be shown, then the exceptions above could be argued not to apply:

(1) Cumulative local, regional and/or state GHG emissions are being reduced or will be reduced by adopted, funded, and feasible measures in order to meet broader state targets.

(2) Mandatory state or local GHG reduction measures would apply to the project's emissions such that broader GHG reduction goals would still be met and the project contributions would not be cumulatively considerable.

(3) Project GHG emissions are below an adopted significance threshold designed to take into account the cumulative nature of GHG emissions.

A similar argument could be made relative to the use of a ND (provided no additional mitigation (beyond existing mandates) is required to control GHG emissions) and to the use of a MND instead of an EIR. However, due to the "fair argument" standard, which is discussed in Chapter 3, caution is recommended in use of a ND or MND unless all three elements above can be fully supported through substantial evidence and there is no substantial evidence to the contrary. Establishing a significance threshold of zero is likely to preclude the use of a categorical exemption.

Relevant Citations

The full text of relevant citations is in Appendix A.

Public Resources Code – §21004, Mitigating or Avoiding a Significant Effect; Powers of Public Agency.

State CEQA Guidelines – §15064, Determining the Significance of the Environmental Effects Caused by a Project.

State CEQA Guidelines – §15130, Discussion of Cumulative Impacts.

State CEQA Guidelines – §15064.7, Thresholds of Significance.

Introduction

A non-zero threshold could minimize the resources spent reviewing environmental analyses that do not result in real GHG reductions or to prevent the environmental review system from being overwhelmed. The practical advantages of considering non-zero thresholds for GHG significance determinations can fit into the concept regarding whether the project's GHG emissions represent a "considerable contribution to the cumulative impact" and therefore warrant analysis.

Specifying a non-zero threshold could be construed as setting a *de minimis* value for a cumulative impact. In effect, this would be indicating that there are certain GHG emission sources that are so small that they would not contribute substantially to the global GHG budget. This could be interpreted as allowing public agencies to approve certain projects without requiring any mitigation of their GHG. Any threshold framework should include a proper context to address the *de minimis* issue. However, the CEQA Guidelines recognize that there may be a point where a project's contribution, although above zero, would not be a *considerable contribution* to the cumulative impact and, therefore, not trigger the need for a significance determination.

GHG emissions from all sources are under the purview of CARB and as such may eventually be "regulated" no matter how small. Virtually all projects will result in some direct or indirect release of GHG. However, a decision by CARB to regulate a class of sources does not necessarily mean that an individual source in that class would constitute a project with significant GHG impacts under CEQA. For example, CARB has established criteria pollutant emission standards for automobiles, but the purchase and use of a single new car is not considered a project with significant impacts under CEQA. At the same time, it is important to note that it is likely that all meaningful sources of emissions, no matter how small are likely to be considered for regulation under AB 32. It is expected that projects will have to achieve some level of GHG reduction to comply with CARB's regulations meant to implement AB 32. As such all projects will have to play a part in reducing our GHG emissions budget and no project, however small, is truly being considered *de minimis* under CARB's regulations.

This chapter evaluates a range of conceptual approaches toward developing GHG significance criteria. The air districts retained the services of J&S an environmental consulting, firm to assist with the development of a Statute and Executive Order-based threshold (Approach 1) and a tiered threshold (Approach 2) based on a prescribed list of tasks and deliverables. Time and financial constraints limited the scope and depth of this analysis, however, the work presented here may be useful in developing interim guidance while AB 32 is being implemented. J&S recognized that approaches other than those described here could be used.

As directed, J&S explored some overarching issues, such as:

- what constitutes "new" emissions?

- how should "baseline emissions" be established?
- what is cumulatively "considerable" under CEQA?
- what is "business as usual" ? and
- should an analysis include "life-cycle" emissions?

The answers to these issues were key to evaluating each of the threshold concepts.

Approach 1 – Statute and Executive Order Approach

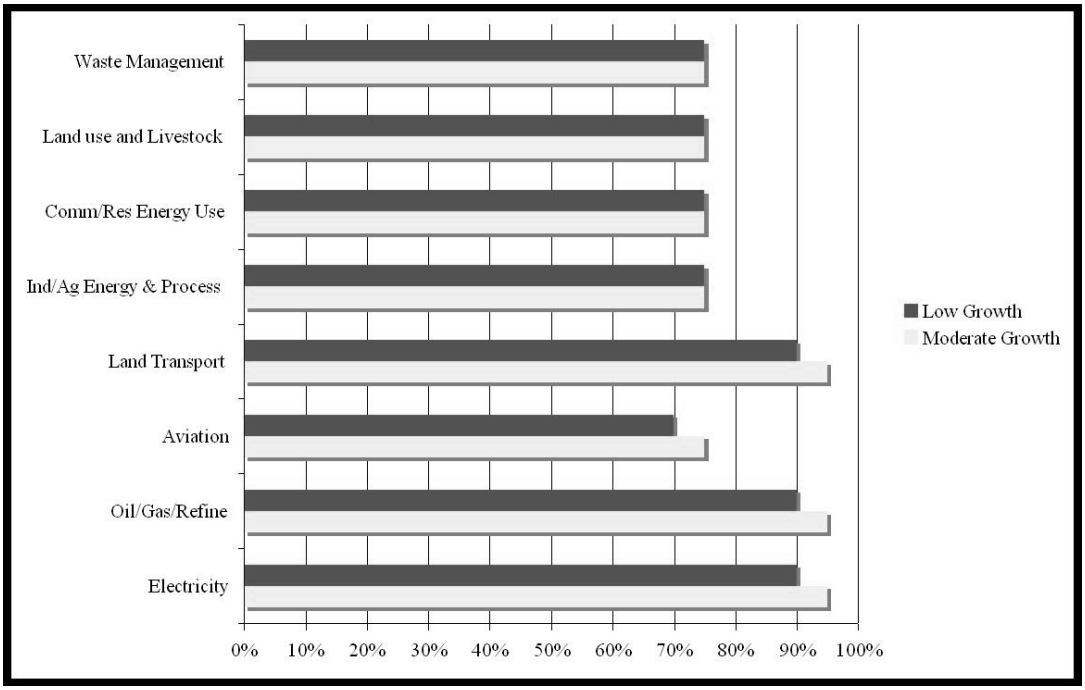
Thresholds could be grounded in existing mandates and their associated GHG emission reduction targets. A project would be required to meet the targets, or reduce GHG emissions to the targets, to be considered less than significant.

AB 32 and S-3-05 target the reduction of statewide emissions. It should be made clear that AB 32 and S-3-05 do not specify that the emissions reductions should be achieved through uniform reduction by geographic location or by emission source characteristics. For example, it is conceivable, although unlikely, that AB 32 goals could be achieved by new regulations that only apply to urban areas or that only apply to the transportation and/or energy sector. However, this approach to evaluating GHG under CEQA is based on the presumption that a new project must at least be consistent with AB 32 GHG emission reduction mandates.

The goal of AB 32 and S-3-05 is the significant reduction of future GHG emissions in a state that is expected to rapidly grow in both population and economic output. As such, there will have to be a significant reduction in the per capita GHG output for these goals to be met. CEQA is generally used to slow or zero the impact of new emissions, leaving the reduction of existing emission sources to be addressed by other regulatory means. With these concepts in mind, four options were identified for statute/executive order-based GHG significance thresholds and are described below.

Threshold 1.1: AB 32/S-3-05 Derived Uniform Percentage-Based Reduction. AB 32 requires the state to reduce California-wide GHG emissions to 1990 levels by 2020. Reducing greenhouse gas emission levels from 2020 to 1990 levels could require a 28 to 33 percent reduction of business-as-usual GHG emissions depending on the methodology used to determine the future emission inventories. The exact percent reduction may change slightly once CARB finalizes its 1990 and 2020 inventory estimates. In this context, business-as-usual means the emissions that would have occurred in the absence of the mandated reductions. The details of the business-as-usual scenario are established by CARB in the assumptions it uses to project what the state's GHG emissions would have been in 2020, and the difference between that level and the level that existed in 1990 constitutes the reductions that must be achieved if the mandated goals are to be met.

This threshold approach would require a project to meet a percent reduction target based on the average reductions needed from the business-as-usual emission from all GHG sources. Using the 2020 target, this approach would require all discretionary projects to achieve a 33 percent reduction from projected business-as-usual emissions in order to be considered less than significant. A more restrictive approach would use the 2050 targets. S-3-05 seeks to reduce GHG emissions to 80 percent below 1990 levels by 2050. To reach the 2050 milestone would require an estimated 90 percent reduction (effective immediately) of business-as-usual emissions. Using this goal as the basis for a significance threshold may be more appropriate to address the long-term adverse impacts associated with global climate change. Note that AB 32 and S-3-05 set emission inventory goals at milestone years; it is unclear how California will progress to these goals in non-milestone years.



SOURCE: ARB 2007

Threshold 1.2: Uniform Percentage-Based (e.g.50%) Reduction for New Development. This threshold is based on a presumption that new development should contribute a greater percent reduction from business-as-usual because greater reductions can be achieved at lower cost from new projects than can be achieved from existing sources. This approach would establish that new development emit 50 percent less GHG emissions than business-as-usual development. This reduction rate is greater than the recommended reduction rate for meeting the Threshold 1.1 2020 target (33 percent) but is significantly less restrictive than the Threshold 1.1 2050 target reduction rate (90 percent). If a 50 percent GHG reduction were achieved from new development, existing emissions would have to be reduced by 25 to 30 percent in order to meet the 2020 emissions goal depending on the year used to determine the baseline inventory. Although this reduction goal is reasonable for achieving the 2020 goal, it would not be possible to

reach the 2050 emissions target with this approach even if existing emissions were 100 percent controlled.

Threshold 1.3: Uniform Percentage-Based Reduction by Economic Sector. This threshold would use a discrete GHG reduction goal specific to the economic sector associated with the project. There would be specific reduction goals for each economic sector, such as residential, commercial, and industrial development. Specifying different reduction thresholds for each market sector allows selection of the best regulatory goal for each sector taking into account available control technology and costs. This approach would avoid over-regulating projects (i.e. requiring emissions to be controlled in excess of existing technology) or under-regulating projects (i.e. discouraging the use of available technology to control emissions in excess of regulations). This approach requires extensive information on the emission inventories and best available control technology for each economic sector. This data will be compiled as CARB develops its scoping plan under AB 32 and its implementing regulations; as a result, this approach will be more viable in the long term.

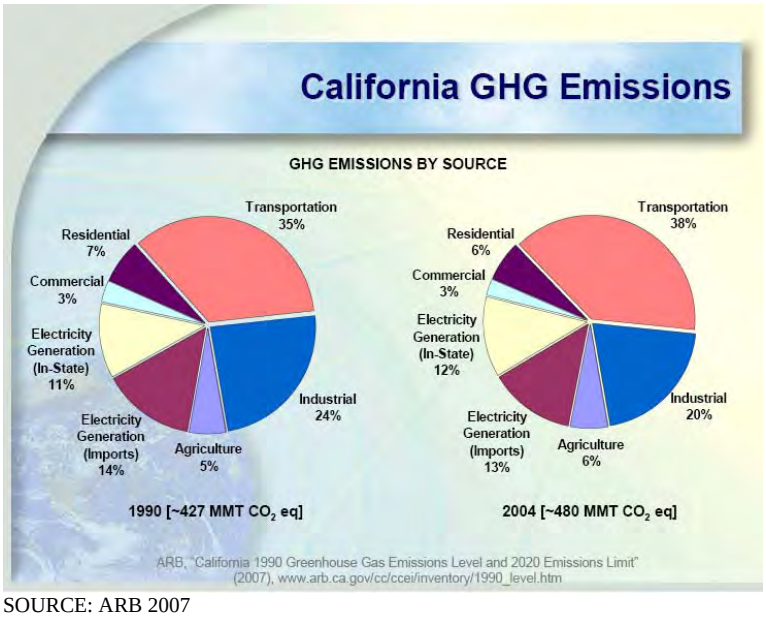
Threshold 1.4: Uniform Percentage-Based Reduction by Region. AB 32 and S-3-05 are written such that they apply to a geographic region (i.e. the entire state of California) rather than on a project or sector level. One could specify regions of the state such as the South Coast Air Basin, Sacramento Valley, or Bay Area which are required to plan (plans could be developed by regional governments, such as councils of governments) and demonstrate compliance with AB 32 and S-3-05 reduction goals at a regional level. To demonstrate that a project has less than significant emissions, one would have to show compliance with the appropriate regional GHG plan. Effectively this approach allows for analysis of GHG emissions at a landscape scale smaller than the state as a whole. Specifying regions in rough correlation to existing air basins or jurisdictional control allows for regional control of emissions and integration with regional emission reduction strategies for criteria and toxic air pollutants. Although differing GHG reduction controls for each region are possible, it is likely that all regions would be

required to achieve 1990 emission inventories by the year 2020 and 80 percent less emissions by 2050. Threshold 1.4 is considered viable long-term significance criteria that is unlikely to be used in the short term.

Implementing CEQA Thresholds Based on Emission Reduction Targets

Characterizing Baseline and Project Emissions

While the population and economy of California is expanding, all new projects can be considered to contribute new emissions. Furthermore, GHG impacts are exclusively cumulative impacts; there are no non-cumulative GHG emission impacts from a climate change perspective. "Business-as-usual" is the projection of GHG emissions at a future date based on current technologies and regulatory requirements in absence of other reductions. For example to determine the future emissions from a power plant for "business-as-usual" one would multiply the projected energy throughput by the current emission factor for that throughput. If adopted regulations (such as those that may be promulgated by CARB for AB 32) dictate that power plant emissions must be reduced at some time in the future, it is appropriate to consider these regulation standards as the new business-as-usual for a future date. In effect, business-as-usual will continue to evolve as regulations manifest. Note that "business-as-usual" defines the CEQA No Project conditions, but does not necessarily form the baseline under CEQA. For instance, it is common to subtract the future traffic with and without a project to determine the future cumulative contribution of a project on traffic conditions. However, existing conditions at the time of issuance of the notice of preparation is normally the baseline.



SOURCE: ARB 2007

Establishing Emission Reduction Targets

One of the obvious drawbacks to using a uniform percent reduction approach to GHG control is that it is difficult to allow for changes in the 1990 and future emission inventories estimates. To determine what emission reductions are required for new projects one would have to know accurately the 1990 budget and efficacy of other GHG promulgated regulations as a function of time. Since CARB will not outline its

regulation strategy for several more years, it is difficult to determine accurately what the new project reductions should be in the short term. Future updates to the 1990 inventory could necessitate changes in thresholds that are based on that inventory. It is important to note that it is difficult to create near term guidance for a uniform reduction threshold strategy since it would require considerable speculation regarding the implementation and effectiveness of forthcoming CARB regulations.

Of greater importance are the assumptions used to make the projected 2020 emission inventories. Projecting future inventories over the next 15-50 years involves substantial uncertainty. Furthermore, there are likely to be federal climate change regulations and possibly additional international GHG emission treaties in the near future. To avoid such speculation, this paper defines all future emission inventories as hypothetical business-as-usual projections.

This white paper is intended to support local decisions about CEQA and GHG in the near term. During this period, it is unlikely that a threshold based on emission reduction targets would need to be changed. However, it is possible that future inventory updates will show that targets developed on the current inventory were not stringent enough, or were more stringent than was actually needed.

Approach 2 – Tiered Approach

The goal of a tiered threshold is to maximize reduction predictability while minimizing administrative burden and costs. This would be accomplished by prescribing feasible mitigation measures based on project size and type, and reserving the detailed review of an EIR for those projects of greater size and complexity. This approach may require inclusion in a General Plan, or adoption of specific rules or ordinances in order to fully and effectively implement it.

A tiered CEQA significance threshold could establish different levels at which to determine if a project would have a significant impact. The tiers could be established based on the gross GHG emission estimates for a project or could be based on the physical size and characteristics of the project. This approach would then prescribe a set of GHG mitigation strategies that would have to be incorporated into the project in order for the project to be considered less than significant.

The framework for a tiered threshold would include the following:

- disclosure of GHG emissions for all projects;
- support for city/county/regional GHG emissions reduction planning;
- creation and use of a “green list” to promote the construction of projects that have desirable GHG emission characteristics;
- a list of mitigation measures;

- a decision tree approach to tiering; and
- quantitative or qualitative thresholds.

Decision-Tree Approach to Tiering

CEQA guidance that allows multiple methodologies to demonstrate GHG significance will facilitate the determination of significance for a broad range of projects/plans that would otherwise be difficult to address with a single non-compound methodology. Even though there could be multiple ways that a project can determine GHG significance using a decision-tree approach, only one methodology need be included in any single CEQA document prepared by the applicant. The presence of multiple methodologies to determine significance is designed to promote flexibility rather than create additional analysis overhead. Figure 1 shows a conceptual approach to significance determination using a tiered approach that shows the multiple routes to significance determination.

Figure 1 Detail Description

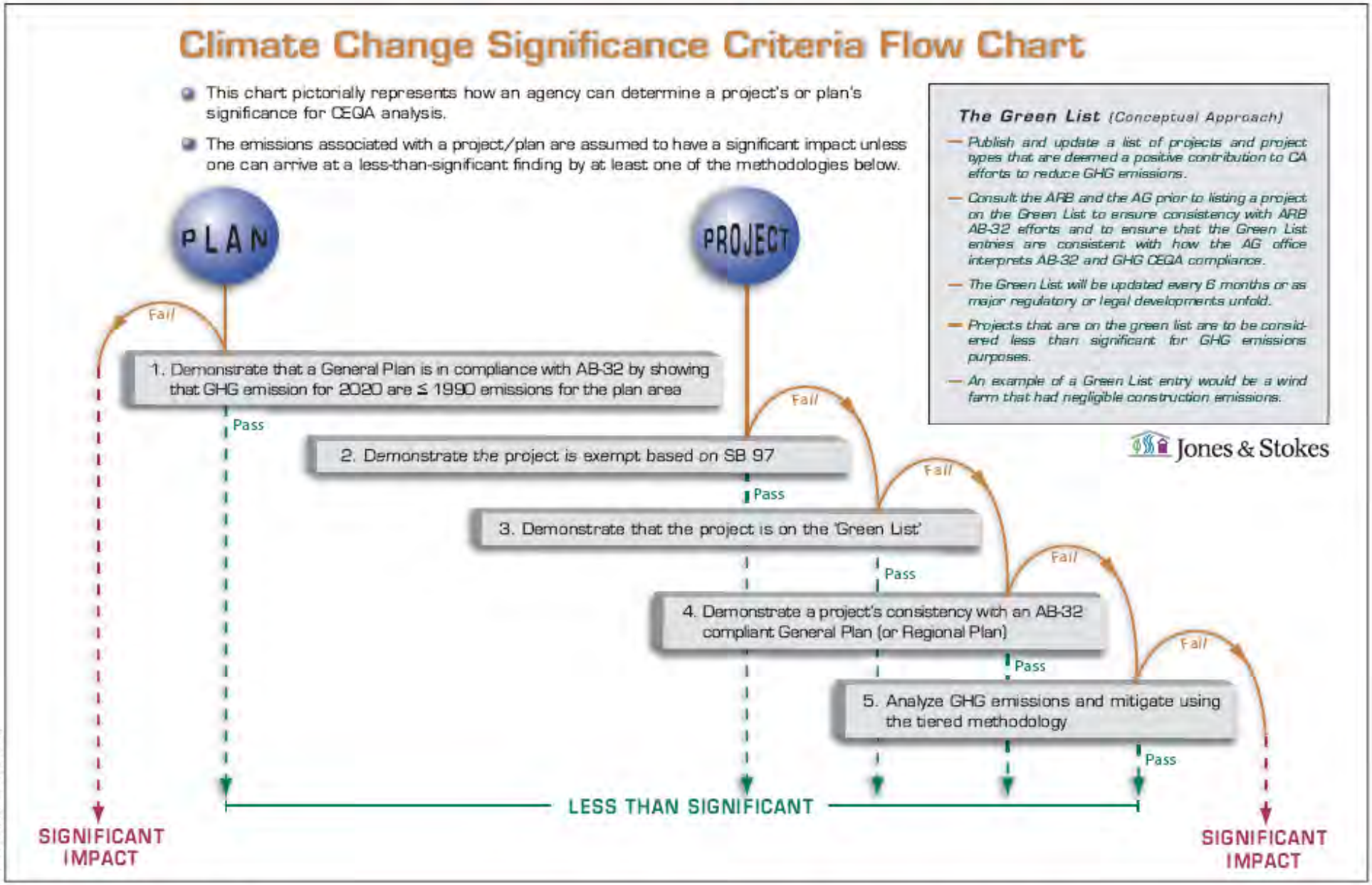
Figure 1 pictorially represents how an agency can determine a project's or plan's significance for CEQA analysis using the non-zero threshold methodology. The emissions associated with a project/plan are assumed to have a significant impact unless one can arrive at a less-than-significant finding by at least one of the methodologies below.

1. Demonstrate that a General Plan (GP) or Regional Plan is in Compliance with AB32

   - For most GPs or RPs this will require demonstration that projected 2020 emissions will be equal to or less than 1990 emissions.
   - GPs or RPs are expected to fully document 1990 and 2020 GHG emission inventories.
   - Projection of 2020 emissions is complicated by the fact that CARB is expected to promulgate emission reductions in the short term. Until explicit CARB regulations are in place, unmitigated GP 2020 emission inventories represent business-as-usual scenarios.
   - EIRs for GPs or RPs which demonstrate 2020 mitigated emissions are less than or equal to 1990 emissions are considered less than significant.

2. Demonstrate the Project is Exempt Based on SB 97

   - As specified in SB 97, projects that are funded under November 2006 Proposition 1B (Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act) and 1C (Disaster Preparedness and Flood Prevention Bond Act) may be exempt from analysis until January 1, 2010.



Jones & Stokes

Figure 1
Climate Change Significance Criteria Flow Chart

- An exemption can be used in an ND, MND, or EIR to support a less than significant finding for GHG impacts.

3. Demonstrate that the Project is on the 'Green List'

- This list would include projects that are deemed a positive contribution to California efforts to reduce GHG emissions. If the project is of the type described on the Green List it is considered less than significant.
- If the Green List entry description requires mitigation for impacts other than GHG, this methodology can be used in MNDs or EIRs; if the Green List entry does not require mitigation this methodology can be used in NDs, MNDs, or EIRs.

4. Demonstrate a Project's Compliance with a General Plan

- If a project is consistent with an appropriate General Plan's Greenhouse Gas Reduction Plan (GGRP), a project can be declared less than significant.
- Note that at this time there are no known jurisdictions that have a GGRP that has been fully subject to CEQA review. While Marin County has adopted a forward-thinking GGRP and it is described in the most recent GP update, the associated EIR does not analyze the secondary environmental impacts of some of the GGRP measures such as tidal energy. While one can reference GGRPs that have not been reviewed fully in CEQA, to attempt to show a project's compliance with such a plan as evidence that the project's GHG emission contributions are less than significant may not be supported by substantial evidence that cumulative emissions are being fully addressed in the particular jurisdiction.
- Compliance with a CEQA-vetted GGRP can be cited as evidence for all CEQA documents (Categorical Exemption, ND, MND, and EIR).

5. Analyze GHG Emissions and Mitigate using the Tiered Methodology

- Guidance and mitigation methodology for various development projects (residential, commercial, industrial) are listed in the form of tiered thresholds. If a project incorporates the mitigation measures specified in the tiered threshold tables the project is considered less than significant.
- All project emissions are considered less than significant if they are less than the threshold(s).
- If the tiered approach requires mitigation, this methodology can be used in MNDs or EIRs; if the tiered approach does not require mitigation this methodology can be used in NDs, MNDs, or EIRs.

The Green List

- The Green List would be a list of projects and project types that are deemed a positive contribution to California's efforts to reduce GHG emissions.
- If this approach is followed, it is suggested that CARB and the Attorney General (AG) are consulted prior to listing a project on the Green List to ensure consistency with CARB AB 32 efforts and to ensure that the Green List entries are consistent with how the AG office interprets AB 32 and GHG CEQA compliance.
- The Green List should be updated every 6 months or as major regulatory or legal developments unfold.
- Projects that are on the Green List are to be considered less than significant for GHG emissions purposes.
- A tentative list of potential Green List entries is presented below. Actual Green List entries should be far more specific and cover a broad range of project types and mitigation approaches. The list below is merely a proof-of-concept for the actual Green List.

    1. Wind farm for the generation of wind-powered electricity
    2. Extension of transit lines to currently developed but underserved communities
    3. Development of high-density infill projects with easily accessible mass transit
    4. Small hydroelectric power plants at existing facilities that generate 5 mw or less (as defined in Class 28 Categorical Exemption)
    5. Cogeneration plants with a capacity of 50 mw or less at existing facilities (as defined in Class 29 Cat Exemption)
    6. Increase in bus service or conversion to bus rapid transit service along an existing bus line
    7. Projects with LEED "Platinum" rating
    8. Expansion of recycling facilities within existing urban areas
    9. Recycled water projects that reduce energy consumption related to water supplies that services existing development
    10. Development of bicycle, pedestrian, or zero emission transportation infrastructure to serve existing regions

There are also several options for tiering and thresholds, as shown in Table 2 below. One could establish strictly numeric emissions thresholds and require mitigation to below the specific threshold to make a finding of less than significant. One could establish narrative emissions threshold that are based on a broader context of multiple approaches to GHG reductions and a presumption that projects of sufficiently low GHG intensity are less than significant.

In Concept 2A, a zero threshold would be applied to projects and thus only projects that result in a reduction of GHG emissions compared to baseline emissions would be less than significant absent mitigation. All projects would require quantified inventories. All projects that result in a net increase of GHG emissions would be required to mitigate their emissions to zero through direct mitigation or through fees or offsets or the impacts

Table 2: Approach 2 Tiering Options

	Concept 2A Zero	Concept 2B Quantitative	Concept 2C Qualitative
Tier 1	Project results in a net reduction of GHG emissions *Less than Significant*	Project in compliance with an AB 32-compliant General/Regional Plan, on the Green List, or below Tier 2 threshold. Level 1 Reductions (Could include such measures as: bike parking, transit stops for planned route, Energy Star roofs, Energy Star appliances, Title 24, water use efficiency, etc.) *Less than Significant*	Project in compliance with an AB 32-compliant General/Regional Plan, on the Green List, or below Tier 2 threshold. Level 1 Reductions (See measures under 2B) *Less than Significant*
Tier 2	Project results in net increase of GHG emissions Mitigation to zero (including offsets) *Mitigated to Less than Significant*	Above Tier 2 threshold Level 2 Mitigation (Could include such measures as: Parking reduction beyond code, solar roofs, LEED Silver or Gold Certification, exceed Title 24 by 20%, TDM measures, etc.) *Mitigated to Less than Significant*	Above Tier 2 threshold Level 2 Mitigation (See measures under 2B) *Mitigated to Less than Significant*
Tier 3	Mitigation infeasible to reduce emissions to zero (e.g., cost of offsets infeasible for project or offsets not available) *Significant and Unavoidable*	Above Tier 2 threshold With Level 1, 2 Mitigation Level 3 Mitigation: (Could include such measures as: On-site renewable energy systems, LEED Platinum certification, Exceed Title 24 by 40%, required recycled water use for irrigation, zero waste/high recycling requirements, mandatory transit passes, offsets/carbon impact fees) *Mitigated to Less than Significant*	Above Tier 3 thresholds Quantify Emissions, Level 3 Mitigation (see measures under 2B), and Offsets for 90% of remainder *Significance and Unavoidable*

would be identified as significant and unavoidable. This could be highly problematic and could eliminate the ability to use categorical exemptions and negative declarations for a wide range of projects.

In Concepts 2B and 2C, the first tier of a tiered threshold includes projects that are within a jurisdiction with an adopted greenhouse gas reduction plan (GGRP) and General Plan/Regional Plan that is consistent with AB 32 (and in line with S-3-05), or are on the Green List, or are below the Tier 2 threshold. All Tier 1 projects would be required to implement mandatory reductions required due to other legal authority (Level 1 reductions) such as AB 32, Title 24, or local policies and ordinances. With Level 1

reduction measures, qualifying Tier 1 projects would be considered less than significant without being required to demonstrate mitigation to zero.

In Concept 2B, the Tier 2 threshold would be quantitative, and quantified inventories would be required. Several quantitative threshold options are discussed below. A more comprehensive set of Level 2 mitigation would be required. If the project's emissions still exceed the Tier 2 threshold, an even more aggressive set of Level 3 mitigation measures would be required including offsets (when feasible) to reduce emissions below the Tier 2 threshold.

In Concept 2C, there would be two thresholds, a lower Tier 2 threshold (the "low bar") and a higher Tier 3 threshold (the "high bar"). The Tier 2 threshold would be the significance threshold for the purposes of CEQA and would be qualitative in terms of units (number of dwelling units, square feet of commercial space, etc.) or a per capita ratio. Projects above the Tier 2 threshold would be required to implement the comprehensive set of Level 2 mitigation. Projects below the Tier 2 threshold would not be required to quantify emissions or reductions. The Tier 3 threshold would be a threshold to distinguish the larger set of projects for which quantification of emissions would be required. Level 3 mitigation would be required and the project would be required to purchase offsets (when feasible) in the amount of 90 percent of the net emissions after application of Level 1 reductions and Level 2 and 3 mitigation. A variant on Concept 2C would be to require mandatory Level 3 mitigation without quantification and offsets.

Approach 2 Threshold Options

Seven threshold options were developed for this approach. The set of options are framed to capture different levels of new development in the CEQA process and thus allow different levels of mitigation. Options range from a zero first-tier threshold (Threshold 2.1) up to a threshold for GHG that would be equivalent to the capture level (i.e., number of units) of the current criteria pollutant thresholds used by some air districts (Threshold 2.4). The decision-based implementation approach discussed above could be used for any of these options. Table 3 below compares the results of each of the approaches discussed here.

Threshold 2.1: Zero First Tier Tiered Threshold.

This option would employ the decision tree concept and set the first tier cut-point at zero. The second tier cut-point could be one of the qualitative or quantitative thresholds discussed below. First-tier projects would be required to implement a list of very feasible and readily available mitigation measures.

Threshold 2.2: Quantitative Threshold Based on Market Capture

A single quantitative threshold was developed in order to ensure capture of 90 percent or more of likely future discretionary developments. The objective was to set the emission

threshold low enough to capture a substantial fraction of future residential and non-residential development that will be constructed to accommodate future statewide population and job growth, while setting the emission threshold high enough to exclude small development projects that will contribute a relatively small fraction of the cumulative statewide GHG emissions.

The quantitative threshold was created by using the following steps:

- Reviewing data from four diverse cities (Los Angeles in southern California and Pleasanton, Dublin, and Livermore in northern California) on pending applications for development.

- Determining the unit (dwelling unit or square feet) threshold that would capture approximately 90 percent of the residential units or office space in the pending application lists.

- Based on the data from the four cities, the thresholds selected were 50 residential units and 30,000 square feet of commercial space.

- The GHG emissions associated with 50 single-family residential units and 30,000 square feet of office were estimated and were found to be 900 metric tons and 800 metric tons, respectively. Given the variance on individual projects, a single threshold of 900 metric tons was selected for residential and office projects.

- A 900 metric ton threshold was also selected for non-office commercial projects and industrial projects to provide equivalency for different projects in other economic sectors.

- If this threshold is preferred, it is suggested that a more robust data set be examined to increase the representativeness of the selected thresholds. At a minimum, a diverse set of at least 20 cities and/or counties from throughout the state should be examined in order to support the market capture goals of this threshold. Further, an investigation of market capture may need to be conducted for different commercial project types and for industrial projects in order to examine whether multiple quantitative emissions thresholds or different thresholds should be developed.

The 900-ton threshold corresponds to 50 residential units, which corresponds to the 84th percentile of projects in the City of Los Angeles, the 79th percentile in the City of Pleasanton, the 50th percentile in the City of Livermore and the 4th percentile in the City of Dublin. This is suggestive that the GHG reduction burden will fall on larger projects that will be a relatively small portion of overall projects within more developed central cities (Los Angeles) and suburban areas of slow growth (Pleasanton) but would be the higher portion of projects within moderately (Livermore) or more rapidly developing areas (Dublin). These conclusions are suggestive but not conclusive due to the small sample size. The proposed threshold would exclude the smallest proposed developments

from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. While this would exclude perhaps 10 percent of new residential development, the capture of 90 percent of new residential development would establish a strong basis for demonstrating that cumulative reductions are being achieved across the state. It can certainly serve as an interim measure and could be revised if subsequent regulatory action by CARB shows that a different level or different approach altogether is called for.

The 900-ton threshold would correspond to office projects of approximately 35,000 square feet, retail projects of approximately 11,000 square feet, or supermarket space of approximately 6,300 square feet. 35,000 square feet would correspond to the 46th percentile of commercial projects in the City of Los Angeles, the 54th percentile in the City of Livermore, and the 35th percentile in the City of Dublin. However, the commercial data was not separated into office, retail, supermarket or other types, and thus the amount of capture for different commercial project types is not known. The proposed threshold would exclude smaller offices, small retail (like auto-parts stores), and small supermarkets (like convenience stores) from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA but would include many medium-scale retail and supermarket projects.

The industrial sector is less amenable to a unit-based approach given the diversity of projects within this sector. One option would be to adopt a quantitative GHG emissions threshold (900 tons) for industrial projects equivalent to that for the residential/commercial thresholds described above. Industrial emissions can result from both stationary and mobile sources. CARB estimates that their suggested reporting threshold for stationary sources of 25,000 metric tons accounts for more than 90 percent of the industrial sector GHG emissions (see Threshold 2.3 for 25,000 metric ton discussion). If the CARB rationale holds, then a 900 metric ton threshold would likely capture at least 90 percent (and likely more) of new industrial and manufacturing sources. If this approach is advanced, we suggest further examination of industrial project data to determine market capture.

This threshold would require the vast majority of new development emission sources to quantify their GHG emissions, apportion the forecast emissions to relevant source categories, and develop GHG mitigation measures to reduce their emissions.

Threshold 2.3: CARB Reporting Threshold

CARB has recently proposed to require mandatory reporting from cement plants, oil refineries, hydrogen plants, electric generating facilities and electric retail providers, cogeneration facilities, and stationary combustion sources emitting $\geq$ 25,000 MT CO_2e/yr. AB 32 requires CARB to adopt a regulation to require the mandatory reporting and verification of emissions. CARB issued a preliminary draft version of its proposed reporting requirements in August 2007 and estimates that it would capture 94 percent of the GHG emissions associated with stationary sources.

This threshold would use 25,000 metric tons per year of GHG as the CEQA significance level. CARB proposed to use the 25,000 metric tons/year value as a reporting threshold, not as a CEQA significance threshold that would be used to define mitigation requirements. CARB is proposing the reporting threshold to begin to compile a statewide emission inventory, applicable only for a limited category of sources (large industrial facilities using fossil fuel combustion).

A 25,000 metric ton significance threshold would correspond to the GHG emissions of approximately 1,400 residential units, 1 million square feet of office space, 300,000 square feet of retail, and 175,000 square feet of supermarket space. This threshold would capture far less than half of new residential or commercial development.

As noted above, CARB estimates the industrial-based criteria would account for greater than 90 percent of GHG emissions emanating from stationary sources. However, industrial and manufacturing projects can also include substantial GHG emissions from mobile sources that are associated with the transportation of materials and delivery of products. When all transportation-related emissions are included, it is unknown what portion of new industrial or manufacturing projects a 25,000-ton threshold would actually capture.

An alternative would be to use a potential threshold of 10,000 metric tons considered by the Market Advisory Committee for inclusion in a Greenhouse Gas Cap and Trade System in California. A 10,000 metric ton significance threshold would correspond to the GHG emissions of approximately 550 residential units, 400,000 square feet of office space, 120,000 square feet of retail, and 70,000 square feet of supermarket space. This threshold would capture roughly half of new residential or commercial development.

Threshold 2.4: Regulated Emissions Inventory Capture

Most California air districts have developed CEQA significance thresholds for NOx and ROG emissions to try to reduce emissions of ozone precursors from proposed sources that are not subject to NSR pre-construction air quality permitting. The historical management of ozone nonattainment issues in urbanized air districts is somewhat analogous to today's concerns with greenhouse gas emissions in that regional ozone concentrations are a cumulative air quality problem caused by relatively small amounts of NOx and ROG emissions from thousands of individual sources, none of which emits enough by themselves to cause elevated ozone concentrations. Those same conditions apply to global climate change where the environmental problem is caused by emissions from a countless number of individual sources, none of which is large enough by itself to cause the problem. Because establishment of NOx/ROG emissions CEQA significance thresholds has been a well-tested mechanism to ensure that individual projects address cumulative impacts and to force individual projects to reduce emissions under CEQA, this threshold presumes the analogy of NOx/ROG emission thresholds could be used to develop similar GHG thresholds.

The steps to develop a GHG emission threshold based on the NOx/ROG analogy were as follows:

- For each agency, define its NOx/ROG CEQA thresholds.
- For each agency, define the regional NOx/ROG emission inventory the agency is trying to regulate with its NOx/ROG thresholds.
- For each agency, calculate the percentage of the total emission inventory for NOx represented by that agency's CEQA emission threshold. That value represents the "minimum percentage of regulated inventory" for NOx.
- The current (2004) California-wide GHG emission inventory is 499 million metric tons per year of CO_2 equivalent (MMT CO_2e). Apply the typical "minimum percentage of regulated inventory" value to the statewide GHG inventory, to develop a range of analogous GHG CEQA thresholds.

The preceding methodology was applied to two different air quality districts: the Bay Area Air Quality Management District (BAAQMD), a mostly-urbanized agency within which most emissions are generated from urban areas; and the San Joaquin Valley Air Pollution Control District (SJVAPCD), which oversees emissions emanating in part from rural areas that are generated at dispersed agricultural sources and area sources. For example, in the Bay Area the NOx threshold is 15 tons/year. The total NOx inventory for 2006 was 192,000 tons/year (525 tons/day). The threshold represents 0.008 percent of the total NOx inventory. Applying that ratio to the total statewide GHG emissions inventory of 499 MMT CO_2e (2004) yields an equivalent GHG threshold of 39,000 MMT CO_2e.

The range of analogous CEQA GHG thresholds derived from those two agencies is tightly clustered, ranging from 39,000 to 46,000 tons/year. A 39,000 to 46,000 metric ton threshold would correspond to the GHG emissions of approximately 2,200 to 2,600 residential units, 1.5 to 1.8 million square feet of office space, 470,000 to 560,000 square feet of retail, and 275,000 to 320,000 square feet of supermarket space. This threshold would capture far less than half of new residential or commercial development. Similarly, this threshold would capture less of new industrial/manufacturing GHG emissions inventory than Thresholds 2.2 or 2.3.

Threshold 2.5: Unit-Based Thresholds Based on Market Capture

Unit thresholds were developed for residential and commercial developments in order to capture approximately 90 percent of future development. The objective was to set the unit thresholds low enough to capture a substantial fraction of future housing and commercial developments that will be constructed to accommodate future statewide population and job growth, while setting the unit thresholds high enough to exclude small development projects that will contribute a relatively small fraction of the cumulative statewide GHG emissions. Sector-based thresholds were created by using the same steps

and data used to create Threshold 2.2- Quantitative Threshold Based on Market Capture above.

The distribution of pending application data suggests that the GHG reduction burden will fall on larger projects that will be a relatively small portion of overall projects within more developed central cities and suburban areas of slow growth but would be the higher portion of projects within moderately or rapidly developing areas. The proposed threshold would exclude the smallest proposed developments from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. While this would exclude perhaps 10 percent of new residential development, the capture of 90 percent of new residential development would establish a strong basis for demonstrating that cumulative reductions are being achieved across the state. It can certainly serve as an interim measure and could be revised if subsequent regulatory action by CARB shows that a different level or different approach altogether is called for.

A similar rationale can be applied to the development of a commercial threshold. Threshold 2.5 would exclude many smaller businesses from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. It should be noted that the GHG emissions of commercial projects vary substantially. For example, the carbon dioxide emissions associated with different commercial types were estimated as follows:

- 30,000 square-foot (SF) office = 800 metric tons/year CO_2
- 30,000 SF retail = 2,500 metric tons/year CO_2
- 30,000 SF supermarket = 4,300 metric tons/year CO_2

Thus, in order to assure appropriate market capture on an emissions inventory basis, it will be important to examine commercial project size by type, instead of in the aggregate (which has been done in this paper).

The industrial sector is less amenable to a unit-based approach given the diversity of projects within this sector. One option would be to use a quantitative threshold of 900 tons for industrial projects in order to provide for rough equivalency between different sectors. Industrial emissions can result from both stationary and mobile sources. However, if the CARB rationale for > 90 percent stationary source capture with a threshold of 25,000 metric tons holds, then a 900 metric ton threshold would likely capture at least 90 percent (and likely more) of new industrial sources. Further examination of unit-based industrial thresholds, such as the number of employees or manufacturing floor space or facility size, may provide support for a unit-based threshold based on market capture.

This threshold would require the vast majority of new development emission sources to quantify their GHG emissions, apportion the forecast emissions to relevant source categories, and develop GHG mitigation measures to reduce their emissions.

Threshold 2.6. Projects of Statewide, Regional, or Areawide Significance

For this threshold, a set of qualitative, tiered CEQA thresholds would be adopted based on the definitions of "projects with statewide, regional or areawide significance" under the Guidelines for California Environmental Quality Act, CCR Title 14, Division 6, Section 15206(b).

Project sizes defined under this guideline include the following:

- Proposed residential development of more than 500 dwelling units.
- Proposed shopping center or business establishment employing more than 1,000 persons or encompassing more than 500,000 square feet of floor space.
- Proposed commercial office building employing more than 1,000 persons or encompassing more than 250,000 square feet of floor space.
- Proposed hotel/motel development of more than 500 rooms.
- Proposed industrial, manufacturing or processing plant or industrial park planned to house more than 1,000 persons, or encompassing more than 600,000 square feet of floor space.

These thresholds would correspond to the GHG emissions of approximately 9,000 metric tons for residential projects, 13,000 metric tons for office projects, and 41,000 metric tons for retail projects. These thresholds would capture approximately half of new residential development and substantially less than half of new commercial development. It is unknown what portion of the new industrial or manufacturing GHG inventory would be captured by this approach.

Threshold 2.7 Efficiency-Based Thresholds

For this approach, thresholds would be based on measurements of efficiency. For planning efforts, the metric could be GHG emissions per capita or per job or some combination thereof. For projects, the metric could be GHG emission per housing unit or per square foot of commercial space. In theory, one could also develop metrics for GHG emissions per dollar of gross product to measure the efficiency of the economy.

This approach is attractive because it seeks to benchmark project GHG intensity against target levels of efficiency. The thresholds would need to be set such that there is reasonably foreseeable and sufficient reductions compared to business as usual to support meeting AB 32 and S-3-05 goals in time (in combination with command and control regulations). Because this approach would require substantial data and modeling to fully develop, this is a concept considered as a potential future threshold and not appropriate

for interim guidance in the short term. Thus, it is not evaluated in the screening evaluation in the next section.

Table 3 compares the results for each of the approaches.

Table 3: Comparison of Approach 2 Tiered Threshold Options

Threshold	GHG Emission Threshold (metric tons/year)	Future Development Captured by GHG Threshold
2.1: Zero Threshold	0 tons/year	All
2.2: Quantitative Threshold Based on Market Capture	~900 tons/year	Residential development > 50 dwelling units Office space > 36,000 ft^2 Retail space >11,000 ft^2 Supermarkets >6.300 ft^2 small, medium, large industrial
2.3: CARB GHG Mandatory Reporting Threshold OR Potential Cap and Trade Entry Level	25,000 metric tons/year OR 10,000 metric tons/year	Residential development >1,400 dwelling units OR 550 dwelling units Office space >1 million ft^2 OR 400,000 ft^2 Retail space >300,000 ft^2 OR 120,000 ft^2 Supermarkets >175,000 ft^2 OR 70,000 ft^2 medium/larger industrial
2.4: Regulated Inventory Capture	40,000 – 50,000 metric tons/year	Residential development >2,200 to 2,600 dwelling units Office space >1.5 to 1.8 million ft^2 Retail space >470,000 to 560,000 ft^2 Supermarkets >270,000 to 320,000 ft^2 medium/larger industrial
2.5: Unit-Based Threshold Based on Market Capture	Not applicable.	Residential development >50 dwelling units Commercial space >50,000 ft^2 > small, medium, large industrial (with GHG emissions > 900 tonsCO2e)
2.6: Projects of Statewide, Regional, or Areawide Significance	Not applicable.	Residential development >500 dwelling units Office space >250,000 ft^2 Retail space >500,000 ft^2 Hotels >500 units Industrial project >1,000 employees Industrial project >40 acre or 650,000 ft^2
2.7: Efficiency-Based Thresholds	TBD tons/year/person TBD tons/year/unit	Depends on the efficiency measure selected.

Implementing CEQA With Tiered Thresholds

Several issues related to Approach 2 are addressed below:

1. *Some applications of this approach may need to be embodied in a duly approved General Plan, or in some other formal regulation or ordinance to be fully enforceable.* Because CEQA does not expressly provide that projects may be deemed insignificant based on implementation of a set of mitigations, this approach may need to be supported with specific and enforceable mechanisms adopted with due public process.

2. *How would this concept affect adoption of air district rules and regulations?* Proposed air district rules and regulations may be subject to CEQA like other projects and plans. Thus, if significance thresholds were adopted by an APCD or AQMD, then they could also apply to air district discretionary actions. If GHG emissions would be increased by a rule or regulation for another regulated pollutant, that would be a potential issue for review under CEQA.

3. *Mitigation measures may not be all-inclusive; better measures now or new future technology would make these measures obsolete.* The mandatory mitigation measures could be periodically updated to reflect current technology, feasibility, and efficiency.

4. *Total reduction may not be quantified or difficult to quantify.* CEQA only requires the adoption of feasible mitigation and thus the reduction effectiveness of required mitigation should not be in question. However, the precise reduction effectiveness may indeed be difficult to identify. As described above, if a quantitative threshold is selected as the measure of how much mitigation is mandated, then best available evidence will need to be used to estimate resultant GHG emissions with mitigation adoption. If a qualitative threshold is selected, then it may not be necessary to quantify reductions.

5. *Difficult to measure progress toward legislative program goals.* One could require reporting of project inventories to the Climate Action Registry, air district, or regional council of governments, or other suitable body. Collection of such data would allow estimates of the GHG intensity of new development over time, which could be used by CARB to monitor progress toward AB 32 goals.

6. *Measures may have adverse impacts on other programs.* The identification of mandatory mitigation will need to consider secondary environmental impacts, including those to air quality.

7. *Consideration of life-cycle emissions.* In many cases, only direct and indirect emissions may be addressed, rather than life-cycle emissions. A project applicant has traditionally been expected to only address emissions that are closely related and within the capacity of the project to control and/or influence. The long chain

8. of economic production resulting in materials manufacture, for example, involves numerous parties, each of which in turn is responsible for the GHG emissions associated with their particular activity. However, there are situations where a lead agency could reasonably determine that a larger set of upstream and downstream emissions should be considered because they are being caused by the project and feasible alternatives and mitigation measures may exist to lessen this impact.

Approach 2 Tiered Threshold with Mandatory Mitigation

As shown in Table 2, due to the cumulative nature of GHG emissions and climate change impacts, there could be a level of mandatory reductions and/or mitigation for all projects integrated into a tiered threshold approach. In order to meet AB 32 mandates by 2020 and S-3-05 goals, there will need to be adoption of GHG reduction measures across a large portion of the existing economy and new development. As such, in an effort to support a determination under CEQA that a project has a less than considerable contribution to significant cumulative GHG emissions, mitigation could be required on a progressively more comprehensive basis depending on the level of emissions.

- Level 1 Reductions – These reduction measures would apply to all projects and would only consist of AB 32 and other local/state mandates. They would be applied to a project from other legal authority (not CEQA). Level 1 reductions could include such measures as bike parking, transit stops for planned routes, Energy Star roofs, Energy Star appliances, Title 24 compliance, water use efficiency, and other measures. All measures would have to be mandated by CARB or local regulations and ordinances.

- Level 2 Mitigation – Projects that exceed the determined threshold would be required to first implement readily available technologies and methodologies with widespread availability. Level 2 Mitigation could include such measures as: parking reduction below code minimum levels, solar roofs, LEED Silver or Gold Certification, exceed Title 24 building standards by 20 percent, Traffic Demand Management (TDM) measures, and other requirements.

- Level 3 Mitigation - If necessary to reduce emissions to the thresholds, more extensive mitigation measures that represent the top tier of feasible efficiency design would also be required. Level 3 Mitigation could include such measures as: on-site renewable energy systems, LEED Platinum certification, exceed Title 24 building requirements by 40 percent, required recycled water use for irrigation, zero waste/high recycling requirements, mandatory transit pass provision, and other measures.

- Offset Mitigation – If, after adoption of all feasible on-site mitigation, the project is still found to exceed a Tier 2 quantitative threshold, or exceed a Tier 3 qualitative threshold, or if a project cannot feasibly implement the mandatory on-site mitigation, then purchases of offsets could be used for mitigation. In the case

of a quantitative threshold, the amount of purchase would be to offset below the Tier 2 significance threshold. In the case of a qualitative threshold, the amount of purchase could be to offset GHG emissions overall to below the lowest equivalent GHG emissions among the Tier 2 qualitative thresholds. With Threshold 2.5, this would be approximately 900 tons of GHG emissions (corresponding to 50 residential units). With Threshold 2.6, this would be approximately 9,000 tons (corresponding to 500 residential units). Alternatively, one could require purchase of offsets in the amount of a set percentage (such as 90% or 50% for example) of the residual GHG emissions (after other mitigation). As discussed earlier, any decision to include or require the use of emission reduction credits (or offsets) must consider issues of availability, quality, and environmental justice.

Substantial Evidence Supporting Different Thresholds

If a project can be shown by substantial evidence not to increase GHG emissions relative to baseline emissions, then no fair argument will be available that the project contributes considerably to a significant cumulative climate change impact.

It is more challenging to show that a project that increases GHG emissions above baseline emissions does not contribute considerably to a significant cumulative climate change impact. It is critical therefore, to establish an appropriate cumulative context, in which, although an individual project may increase GHG emissions, broader efforts will result in net GHG reductions.

Approach 1-based thresholds that by default will require an equal level of GHG reductions from the existing economy (Thresholds 1.1, 1.3, and 1.4) may be less supportable in the short run (especially before 2012) than Approach 1.2 (which requires new development to be relatively more efficient than a retrofitted existing economy). This is because, prior to 2012, there will only be limited mandatory regulations implementing AB 32 that could address the existing economy in a truly systematic way that can be relied upon to demonstrate that overall GHG reduction goals can be achieved by 2020. Approach 1.2 will still rely on substantial reductions in the existing economy but to a lesser degree.

Approach 1-based thresholds that would spread the mitigation burden across a sector (Threshold 1.3) or across a region (Threshold 1.4) will allow for tradeoffs between projects or even between municipalities. In order to demonstrate that a sector or a region is achieving net reductions overall, there would need to be feasible, funded, and mandatory requirements in place promoting an overall reduction scheme, in order for a project to result in nominal net increased GHG emissions.

Approach 2-based thresholds that capture larger portions of the new development GHG inventory (Thresholds 2.2 and 2.5) would promote growth that results in a smaller increase in GHG emissions; they may therefore be more supportable than thresholds that do not and that have a greater reliance on reductions in the existing economy (Thresholds

2.3, 2.4, and 2.6), especially in the next three to five years. With an established cumulative context that demonstrates overall net reductions, all threshold approaches could be effective in ensuring growth and development that significantly mitigates GHG emissions growth in a manner that will allow the CARB to achieve the emission reductions necessary to meet AB 32 targets. In that respect, all of these thresholds are supported by substantial evidence.

Evaluation of Non-Zero Threshold Options

Overarching issues concerning threshold development are reviewed below. Where appropriate, different features or application of the two conceptual approaches and the various options for thresholds under each conceptual approach described above are analyzed. The screening evaluation is summarized in Tables 4 (Approach 1) and 5 (Approach 2). The summary tables rate each threshold for the issues discussed below based on the level of confidence (low, medium or high) ascribed by J&S. The confidence levels relate to whether a threshold could achieve a particular attribute, such as emission reduction effectiveness. For example, a low emission reduction effectiveness rating means the threshold is not expected to capture a relatively large portion of the new development inventory.

As described above, Threshold 2.7 is not included in this evaluation because the data to develop an efficiency-based threshold has not been reviewed at this time and because this threshold is not considered feasible as an interim approach until more detailed inventory information is available across the California economy.

What is the GHG Emissions Effectiveness of Different Thresholds?

Effectiveness was evaluated in terms of whether a threshold would capture a large portion of the GHG emissions inventory and thus require mitigation under CEQA to control such emissions within the larger framework of AB 32. In addition, effectiveness was also evaluated in terms of whether a threshold would require relatively more or less GHG emissions reductions from the existing economy verses new development. This is presumptive that gains from the existing economy (through retrofits, etc.) will be more difficult and inefficient relative to requirements for new development.

Approach 1-based thresholds that require equivalent reductions relative to business-as-usual (Thresholds 1.1, 1.3, and 1.4) for both the existing and new economy will be less effective than thresholds that support lower-GHG intensity new development (Approach 1.2). However, since Approach 1-based thresholds do not establish a quantitative threshold below which projects do not have to mitigate, the market capture for new development is complete.

Approach 2-based thresholds can be more or less effective at capturing substantial portions of the GHG inventory associated with new development depending on where the quantitative or qualitative thresholds are set. Lower thresholds will capture a broader range of projects and result in greater mitigation. Based on the review of project data for

the select municipalities described in the Approach 2 section above, thresholds based on the CARB Reporting Threshold/Cap and Trade Entry Level (Threshold 2.4) or CEQA definitions of "Statewide, Regional or Areawide" projects (Threshold 2.6) will result in a limited capture of the GHG inventory. Lower quantitative or qualitative thresholds (Thresholds 2.1, 2.2 and 2.5) could result in capture of greater than 90 percent of new development.

Are the Different Thresholds Consistent with AB 32 and S-3-05?

Thresholds that require reductions compared to business-as-usual for all projects or for a large portion of new development would be consistent with regulatory mandates. In time, the required reductions will need to be adjusted from 2020 (AB 32) to 2050 (S-3-05) horizons, but conceptually broad identification of significance for projects would be consistent with both of these mandates. Thresholds that exclude a substantial portion of new development would likely not be consistent, unless it could be shown that other more effective means of GHG reductions have already been, or will be adopted, within a defined timeframe.

All Approach 1-based thresholds would be consistent with AB 32 and S-3-05 if it can be demonstrated that other regulations and programs are effective in achieving the necessary GHG reduction from the existing economy to meet the overall state goals.

Approach 2-based thresholds that include substantive parts of the new development GHG inventory (Thresholds 2.1, 2.2 and 2.5) will be more consistent with AB 32 and S-3-05 than those that do not (Thresholds 2.3, 2.4, and 2.6) unless it can be demonstrated that other regulations and programs are effective in achieving the necessary GHG reduction from the existing economy to meet the overall state goals.

What are the Uncertainties Associated with Different Thresholds?

All thresholds have medium to high uncertainties associated with them due to the uncertainty associated with the effectiveness of AB 32 implementation overall, the new character of GHG reduction strategies on a project basis, the immaturity of GHG reduction technologies or infrastructure (such as widespread biodiesel availability), and the uncertainty of GHG reduction effectiveness of certain technologies (such as scientific debate concerning the relative lifecycle GHG emissions of certain biofuels, for example).

In general, Approach 1-based thresholds have higher uncertainties than Approach 2 thresholds because they rely on a constantly changing definition of business-as-usual. Threshold 1.2, with its relatively smaller reliance on the existing economy for GHG reductions has relatively less uncertainty than other Approach 1 thresholds. Thresholds that spread mitigation more broadly (Thresholds 1.3 and 1.4) have less uncertainty by avoiding the need for every project to mitigate equally.

Approach 2 thresholds with lower quantitative (2.1 and 2.2) or qualitative (2.5) thresholds will have uncertainties associated with the ability to achieve GHG reductions

from small to medium projects. Approach 2 thresholds with higher quantitative (2.3, 2.4) or qualitative (2.6) thresholds will have uncertainties associated with the ability to achieve relatively larger GHG reductions from the existing economy.

What are Other Advantages/Disadvantages of the Different Thresholds?

Thresholds with a single project metric (Thresholds 1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 2.5, and 2.6) will be easier to apply to individual projects and more easily understood by project applicants and lead agencies broadly. Thresholds that spread mitigation across sectors (1.3) or regions (1.4), while simple in concept, will require adoption of more complicated cross-jurisdictional reduction plans or evaluation of broad sector-based trends in GHG intensity reduction over time. Approach 1 options would require all projects to quantify emissions in order to determine needed reductions relative to business-as-usual (which will change over time as described above). Concepts that are unit-based (Threshold 2.5 and 2.6) will not result in thresholds that have equal amount of GHG emissions, and thus equity issues may arise.

Table 4: Non-Zero Threshold Evaluation Matrix – Approach 1

Approach 1	**1.1**	**1.2**	**1.3**	**1.4**
	28% - 33% Reduction from BAU by 2020 by Project	**50% Reduction from BAU by 2020 by Project**	**28% - 33% Reduction by 2020 by Sector**	**28% - 33% Reduction by 2020 by Region**
GHG Emissions Reduction Effectiveness	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.	**Medium** - Captures all new projects and has a more realistic level of reductions from the existing economy.	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.
Economic Feasibility	**Low** - Some projects will not be able to afford this level of reduction without effective market-based mechanisms like offsets.	**Low** - Some projects will not be able to afford this level of reduction without effective market-based mechanisms like offsets.	**Medium** - Sectors as a whole will be better able to achieve reductions than individual projects.	**Low** - Some regions and newly developed areas may not be able to afford this level of reduction without effective market-based mechanisms like offsets.
Technical Feasibility	**Medium** - Some projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**Low** - Relatively larger set of projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**High** - Some projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**Medium** - Some regions and newly developed areas may not be able to afford this level of reduction without effective market-based mechanisms like offsets.
Logistical Feasibility	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.
Consistency with AB-32 and S-03-05	**Medium** - Would require heavy reliance on command and control gains.	**High**	**Medium-High** - Would rely on command and control gains, but would allow sectoral flexibility.	**Medium-High** - Would rely on command and control gains, but would allow regional flexibility.
Cost Effectiveness	**Low** - Will require all types of projects to reduce the same regardless of the cost/ton of GHG reductions.	**Low** - Will require all types of projects to reduce the same regardless of the cost/ton of GHG reductions.	**Low/Medium** - Allows tradeoffs within sector between high and low cost reduction possibilities but not between sectors.	**Low/Medium** - Allows tradeoffs within region between high and low cost reduction possibilities, but not between regions.
Uncertainties	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.	**Medium/High** - BAU changes over time. Ability to limit GHG emissions from other new development will take years to demonstrate.	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.
Other Advantages	Simple/easy to explain.	Simple/easy to explain.	Spreads mitigation broadly	Spreads mitigation broadly
Other Disadvantages	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.

Table 5: Non-Zero Threshold Evaluation Matrix – Approach 2

Approach 2	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**
	Zero Threshold	**Quantitative (900 tons)**	**Quantitative CARB Reporting Threshold/Cap and Trade (25,000 tons/ 10,000 tons)**	**Quantitative Regulated Inventory Capture (~40,000 - 50,000 tons)**	**Qualitative Unit-Based Thresholds**	**Statewide, Regional or Areawide (CEQA Guidelines 15206(b)).**
GHG Emissions Reduction Effectiveness	**High** - Captures all sources.	**High** - Market capture at >90%. Captures diverse sources.	**Medium** - Moderate market capture.	**Low** - Low market capture.	**High** - Market capture at ~90%. Captures diverse sources; excl. smallest proj.	**Medium** - Moderate market capture. Excludes small and med. projects.
Economic Feasibility	**Low** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**High** - Large projects have greater ability to absorb cost.	**High** - Large projects have greater ability to absorb cost.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**High** - Large projects have greater ability to absorb cost.
Technical Feasibility	**Low** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be inefficient to mitigate.	**High** - Greater opportunities for multiple reduction approaches.	**High** - Greater opportunities for multiple reduction approaches.	**Medium** - Early phases will be substantial change in BAU, particularly for smaller projects may be inefficient to mitigate.	**High** - Greater opportunities for multiple reduction approaches.
Logistical Feasibility	**Low** - Unless fee or offset basis,very difficult to mitigate all projects.	**Medium** - BMPs broadly written to allow diversity; new req. will take time to integrate into new dev.	**High** - Less mitigation.	**High** - Less mitigation.	**Medium** - BMPs broadly written to allow diversity; new req. will take time to integrate into new dev.	**High** - Less mitigation.
Consistency with AB-32 and S-03-05	**High** - Market capture.	**High** - Market capture at >90%.	**Low** - Would rely on command and control success heavily.	**Low** - Would rely on command and control success heavily.	**Medium** - Need to demonstrate adequate market capture over time.	**Low** - Would rely on command and control success heavily.
Cost Effectiveness	**Low** - Will result in inefficient mitigation approaches. Efficiency will improve in time.	**Medium** - Emphasis is on new dev., req. for mitigation will result in inefficient mitigation approaches in early phases. Efficiency will improve in time.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.	**Medium** - Emphasis is on new dev.; req. for mitigation will result in inefficient mitigation approaches in early phases. Efficiency will improve in time.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.
Uncertainties	**High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects unlikely.	**Medium/High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects uncertain.	**High** - Gains from command and control likely longer to be realized.	**High** - Gains from command and control likely longer to be realized.	**Medium/High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects uncertain.	**High** - Gains from command and control likely longer to be realized.
Other Advantages	Single threshold.	Single threshold. BMPs can be updated. Greenlist can be updated.	Single threshold. Does not change CEQA processing for most projects. CARB inventory = project inv.. All projects treated same.	Single threshold. Does not change CEQA processing for most projects. Follows established SIP practice.	BMPs can be updated. Greenlist can be updated. Unit-Based thresholds can be updated.	Existing guideline. Does not change CEQA processing for most projects. Endorsed by Cal. Chapter of the APA.
Other Disadvantages	Requires all projects to quantify emissions.	Requires nearly all projects to quantify emissions.			Sectoral projects have different GHG emis. Only largest projects to quantify emis.	Sectoral projects have different GHG emissions.

Introduction

This chapter evaluates the availability of various analytical methods and modeling tools that can be applied to estimate the greenhouse gas emissions from different project types subject to CEQA. This chapter will also provide comments on the suitability of the methods and tools to accurately characterize a projects emissions and offer recommendations for the most favorable methodologies and tools available. Some sample projects will be run through the methodologies and modeling tools to demonstrate what a typical GHG analysis might look like for a lead agency to meet its CEQA obligations. The air districts retained the services of EDAW environmental consultants to assist with this effort.

Methodologies/Modeling Tools

There are wide varieties of discretionary projects that fall under the purview of CEQA. Projects can range from simple residential developments to complex expansions of petroleum refineries to land use or transportation planning documents. It is more probably than not, that a number of different methodologies would be required by any one project to estimate its direct and indirect GHG emissions. Table 10 contains a summary of numerous modeling tools that can be used to estimate GHG emissions associated with various emission sources for numerous types of project's subject to CEQA. The table also contains information about the models availability for public use, applicability, scope, data requirements and its advantages and disadvantages for estimating GHG emissions.

In general, there is currently not one model that is capable of estimating all of a project's direct and indirect GHG emissions. However, one of the models identified in Table 9 would probably be the most consistently used model to estimate a projects direct GHG emissions based on the majority of projects reviewed in the CEQA process. The Urban Emissions Model (URBEMIS) is designed to model emissions associated with development of urban land uses. URBEMIS attempts to summarize criteria air pollutants and CO_2 emissions that would occur during construction and operation of new development. URBEMIS is publicly available and already widely used by CEQA practitioners and air districts to evaluate criteria air pollutants emissions against air district-adopted significance thresholds. URBEMIS is developed and approved for statewide use by CARB. The administrative reasons for using URBEMIS are less important than the fact that this model would ensure consistency statewide in how CO_2 emissions are modeled and reported from various project types.

One of the shortfalls of URBEMIS is that the model does not contain emission factors for GHGs other than CO_2, except for methane (CH_4) from mobile-sources, which is converted to CO_2e. This may not be a major problem since CO_2 is the most important GHG from land development projects. Although the other GHGs have a higher global warming potential, a metric used to normalize other GHGs to CO_2e, they are emitted in far fewer quantities. URBEMIS does not calculate other GHG emissions associated with

off-site waste disposal, wastewater treatment, emissions associated with goods and services consumed by the residents and workers supported by a project. Nor does URBEMIS calculate GHGs associated with consumption of energy produced off-site. (For that matter, URBEMIS does not report criteria air pollutant emissions from these sources either).

Importantly, URBEMIS does not fully account for interaction between land uses in its estimation of mobile source operational emissions. Vehicle trip rates are defaults derived from the Institute of Transportation Engineers trip generation manuals. The trip rates are widely used and are generally considered worst-case or conservative. URBEMIS does not reflect "internalization" of trips between land uses, or in other words, the concept that a residential trip and a commercial trip are quite possibly the same trip, and, thus, URBEMIS counts the trips separately. There are some internal correction settings that the modeler can select in URBEMIS to correct for "double counting"; however, a project-specific "double-counting correction" is often not available. URBEMIS does allow the user to overwrite the default trip rates and characteristics with more project-specific data from a traffic study prepared for a project.

Residential, Commercial, Mixed-Use Type Projects/ Specific Plans

Direct Emissions

URBEMIS can be used to conduct a project-specific model run and obtain CO_2e emissions for area and mobile sources from the project, and convert to metric tons CO_2e. When a project-specific traffic study is not available, the user should consult with their local air district for guidance. Many air district staff are experienced practitioners of URBEMIS and can advise the lead agency or the modeler on how to best tailor URBEMIS default input parameters to conduct a project-specific model run. When a traffic study has been prepared for the project, the user must overwrite default trip length and trip rates in URBEMIS to match the total number of trips and vehicle miles traveled (VMT) contained in the traffic study to successfully conduct a project-specific model run. URBEMIS is recommended as a calculation tool to combine the transportation study (if available) and EMFAC emission factors for mobile-sources. Use of a project-specific traffic study gets around the main shortfall of URBEMIS: the lack of trip internalization. URBEMIS also provides the added feature of quantifying direct area-source GHG emissions.

Important steps for running URBEMIS

1. Without a traffic study prepared for the project, the user should consult with the local air district for direction on which default options should be used in the modeling exercise. Some air districts have recommendations in the CEQA guidelines.

2. If a traffic study was prepared specifically for the project, the following information must be provided:

a. Total number of average daily vehicle trips *or* trip-generation rates by land use type per number of units; and,

b. Average VMT per residential *and* nonresidential trip.

c. The user overwrites the "Trip Rate (per day)" fields for each land use in URBEMIS such that the resultant "Total Trips" and the "Total VMT" match the number of total trips and total VMT contained in the traffic study.

d. Overwrite "Trip Length" fields for residential and nonresidential trips in UBEMIS with the project-specific lengths obtained form the traffic study.

3. Calculate results and obtain the CO_2 emissions from the URBEMIS output file (units of tons per year [TPY]).

Indirect Emissions

URBEMIS does estimate indirect emissions from landscape maintenance equipment, hot water heaters, etc. URBEMIS does not however, provide modeled emissions from indirect sources of emissions, such as those emissions that would occur off-site at utility providers associated with the project's energy demands. The California Climate Action Registry (CCAR) Protocol v.2.2 includes methodology, which could be used to quantify and disclose a project's increase in indirect GHG emissions from energy use. Some assumptions must be made for electrical demand per household or per square foot of commercial space, and would vary based on size, orientation, and various attributes of a given structure. An average rate of electrical consumption for residential uses is 7,000 kilowatt hours per year per household and 16,750 kilowatt hours per thousand square feet of commercial floor space. Commercial floor space includes offices, retail uses, warehouses, and schools. These values have been increasing steadily over the last 20 years. Energy consumption from residential uses has increased due to factors such as construction and occupation of larger homes, prices of electricity and natural gas, and increased personal income allowing residents to purchase more electronic appliances. Commercial energy consumption is linked to factors such as vacancy rates, population, and sales.

The modeler will look up the estimated energy consumption for the project's proposed land uses under year of project buildout, or use the values given in the previous paragraph for a general estimate. The CCAR Protocol contains emission factors for CO_2, CH_4, and nitrous oxide. The "CALI" region grid serves most of the State of California. If a user has information about a specific utility provider's contribution from renewable sources, the protocol contains methodology to reflect that, rather than relying on the statewide average grid. The incremental increase in energy production associated with project operation should be accounted for in the project's total GHG emissions for inclusion in the environmental document.

The incremental increase in energy production associated with project operation should be accounted for in the project's total GHG emissions, but it should be noted that these emissions would be closely controlled by stationary-source control-based regulations and additional regulations are expected under AB 32. However, in the interest of disclosing project-generated GHG emissions and mitigating to the extent feasible, the indirect emissions from off-site electricity generation can be easily calculated for inclusion in the environmental document.

Example Project Estimates for GHG Emissions

Residential Project

Project Attributes:

- 68 detached dwelling units
- 15.9 acres
- 179 residents
- 0 jobs
- Located in unincorporated Placer County (PCAPCD jurisdiction)
- Analysis year 2009

As shown in Table 6, the project's direct GHG emissions per service population (SP) would be approximately 8 metric tons CO_2e/SP/year.

Table 6: Residential Project Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	251	Residents	179
Mobile-source emissions	1,044	Jobs	0
Indirect emissions (from CCAR Protocol)	174		
Total operational emissions	**1,469**	Service population	179
Operational emissions/SP	**8.2**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population(see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Commercial Project

Project Attributes:

- Free Standing Discount Superstore: 241 thousand square feet (ksf)
- 0 residents

- 400 jobs
- Located in the San Joaquin Valley Air Pollution Control District's (SJVAPCD) jurisdiction
- Analysis year 2009

Table 7: Commercial Project Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	464	Residents	0
Mobile-source emissions	13,889	Jobs	400
Indirect emissions (from CCAR Protocol)	1,477		
Total operational emissions	**15,830**	Service population	400
Operational emissions/SP	**39.6**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Specific Plan

If used traditionally with default trip rates and lengths, rather than project-specific (Traffic Analysis Zone-specific) trip rates and lengths, URBEMIS does not work well for specific plan or general plan-sized projects with multiple land use types proposed. However, in all instances, projects of these sizes (several hundred or thousand acres) would be accompanied by a traffic study. Thus, for large planning-level projects, URBEMIS can be used as a calculation tool to easily obtain project-specific mobile-source emissions. The user should follow the steps discussed above; wherein he/she overwrites the default ITE trip rates for each land use type with that needed to make total VMT match that contained in the traffic study. The URBEMIS interface is a simple calculator to combine the traffic study and EMFAC emissions factors for mobile-source CO_2.

Project Attributes:

- 985 acres
- Total dwelling units: 5,634
- Commercial/Mixed Use: 429 ksf
- Educational: 2,565 ksf
- 14,648 residents
- 3,743 jobs
- Located in Sacramento County (SMAQMD jurisdiction)
- Analysis year 2009

Table 8: Specific Plan Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	23,273	Residents	14,648
Mobile-source emissions	73,691	Jobs	3,743
Indirect emissions (from CCAR Protocol)	32,744	Service population	18,391
Total operational emissions	**129,708**		
Operational emissions/SP	**7.1**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

The specific plan example, when compared to the residential or commercial examples, illustrates the benefit of a mixed-use development when you look at CO_2e emissions per resident or job (service population) metric (see definition of service population below in discussion of Normalization/Service Population Metric). Though this particular specific plan is not an example of a true jobs/housing balance, the trend is clear: accommodating residents and jobs in a project is more efficient than residents or jobs alone.

Stationary- and Area-Source Project Types

GHG emissions from stationary or area sources that require a permit to operate from the air district also contain both direct and indirect sources of emissions. Examples of these types of sources would be fossil fuel power plants, cement plants, landfills, wastewater treatment plants, gas stations, dry cleaners and industrial boilers. All air districts have established procedures and methodologies for projects subject to air district permits to calculate their regulated pollutants. It is anticipated that these same procedures and methodologies could be extended to estimate a permitted facility's GHG calculations. For stationary and area sources that do not require air district permits, the same methodologies used for permitted sources could be used in addition to URBEMIS and CCAR GRP to calculate GHG emissions from these facilities.

Wastewater Treatment Facilities

Direct GHG emissions associated with a proposed waste water treatment plant can be calculated using AP-42 emission factors from Chapter 4.3.5 Evaporative Loss Sources: Waste Water-Greenhouse Gases and the CCAR methodology. In general, most wastewater operations recover CH_4 for energy, or use a flare to convert the CH_4 to CO_2. There are many types of wastewater treatment processes and the potential for GHG emissions from different types of plants varies substantially. There is not one standard set of emission factors that could be used to quantify GHG emissions for a state

"average" treatment plant. Thus, research will need to be conducted on a case-by-case basis to determine the "Fraction Anaerobically Digested" which is a function of the type of treatment process. Indirect emissions from these facilities can be calculated using the CCAR energy use protocols and URBEMIS model for transportation emissions.

Solid Waste Disposal Facilities

Air districts will have emission estimate methodologies established for methane emissions at permitted landfills. In addition, EPA's Landfill Gas Emissions Model (LandGem) and the CCAR methodology could also be used to quantify GHG emissions from landfill off gassing; however, this model requires substantial detail be input. The model uses a decomposition rate equation, where the rate of decay is dependent on the quantity of waste in place and the rate of change over time. This modeling tool is free to the public, but substantial project detail about the operation of the landfill is needed to run the model. Indirect emissions from these facilities can be calculated using the CCAR energy use protocols and URBEMIS model for transportation emissions.

Construction Emissions

GHG emissions would occur during project construction, over a finite time. In addition, a project could result in the loss of GHG sequestration opportunity due primarily to the vegetation removed for construction. URBEMIS should be used to quantify the mass of CO_2 that would occur during the construction of a project for land development projects. Some construction projects would occur over an extended period (up to 20–30 years on a planning horizon for general plan buildout, or 5–10 years to construct a dam, for example). OFFROAD emission factors are contained in URBEMIS for CO_2 emissions from construction equipment. For other types of construction projects, such as roadway construction projects or levee improvement projects, SMAQMD's spreadsheet modeling tool, the Road Construction Emissions Model (RoadMod), should be used. This tool is currently being updated to include CO_2 emissions factors from OFFROAD.

The full life-cycle of GHG emissions from construction activities is not accounted for in the modeling tools available, and the information needed to characterize GHG emissions from manufacture, transport, and end-of-life of construction materials would be speculative at the CEQA analysis level. The emissions disclosed will be from construction equipment and worker commutes during the duration of construction activities. Thus, the mass emissions in units of metric tons CO_2e/year should be reported in the environmental document as new emissions.

General Plans

In the short-term, URBEMIS can be used as a calculation tool to model GHG emissions from proposed general plans, but only if data from the traffic study is incorporated into model input. The same methodology applied above in the specific plan example applies to general plans. The CCAR GRP can be used to approximate indirect emissions from

increased energy consumption associated with the proposed plan area. The same models and methodologies discussed previously for wastewater, water supply and solid waste would be used to estimate indirect emissions resulting from buildout of the general plan.

In the longer-term, more complex modeling tools are needed, which would integrate GHG emission sources from land use interaction, such as I-PLACE^{3}S or CTG Energetics' Sustainable Communities Custom Model attempt to do. These models are not currently available to the public and only have applicability in certain areas of the state. It is important that a tool with statewide applicability be used to allow for consistency in project treatment, consideration, and approval under CEQA.

Scenarios

At the general plan level, the baseline used for analyzing most environmental impacts of a general plan update is typically no different from the baseline for other projects. The baseline for most impacts represents the existing conditions, normally on the date the Notice of Preparation is released. Several comparative scenarios could be relevant, depending on the exact methodological approach and significance criteria used for GHG assessment:

- Existing Conditions. The GHG emissions associated with the existing, on-the-ground conditions within the planning area.

- 1990 conditions. The GHG emissions associated with the general plan area in 1990. This is relevant due to the state's AB 32 GHG emission reduction goals' benchmark year of 1990. The GHG-efficiency of 1990 development patterns could be compared to that of the general plan buildout.

- Buildout of the Existing General Plan. The GHG emissions associated with buildout of the existing general plan (without the subject update). This is the no project alternative for the purposes of general plan CEQA analysis.

- Buildout of the Updated General Plan. The GHG emissions associated with buildout of the general plan, as proposed as a part of the subject update. This would include analysis of any changes included as a part of the general plan update for the existing developed portions of the planning area. Many communities include redevelopment and revitalization strategies as a part of the general plan update. The general plan EIR can include assumptions regarding what level and type of land use change could be facilitated by infill and redevelopment. Many jurisdictions wish to provide future projects consistent with these land use change assumptions with some environmental review streamlining. In addition, many communities include transit expansions, pedestrian/bicycle pathway improvements, multi-modal facility construction, travel demand policies, energy efficiency policies, or other measures that could apply to the existing developed area, just as they may apply to any new growth

areas. Such policies could affect the overall GHG emissions of the built out general plan area.

- Increment between Buildout of Updated General Plan and Existing General Plan Area. There are many important considerations associated with the characterization of the impact of the General Plan update. The actual GHG emissions impact could be described as the difference between buildout under the existing and proposed land use plan (No-Build Alternative). However, the courts have held that an EIR should also analyze the difference between the proposed General Plan and the existing environment (*Environmental Planning & Information Council v. County of El Dorado* (EPIC) (1982) 131 Cal.App.3d 350). At the General Plan level, over the course of buildout, some new land uses are introduced, which could potentially add operational GHG emissions and potentially remove existing sequestration potential. Some properties become vacant and are not redeveloped. Other properties become vacant and then are redeveloped. Communities cannot pretend to understand fully in advance each component of land use change. The programmatic document is the preferred method of environmental analysis. Through this programmatic framework, communities develop buildout assumptions as a part of the General Plan that are normally used as a basis of environmental analysis. For certain aspects of the impact analysis, it becomes important not just to understand how much "new stuff" could be accommodated under the updated General Plan, but also the altered interactions between both "new" and "existing" land uses within the planning area. As addressed elsewhere, there are tools available for use in understanding land use/transportation interactions at the General Plan level. Without the GHG targets established by AB 32, a simple mass comparison of existing conditions to General Plan buildout might be appropriate.

However, within the current legal context, the GHG efficiency of the updated General Plan becomes the focus of analysis. Some options in this regard include:

- Estimate the GHG emissions associated with all the land uses included within the planning area upon buildout of the General Plan using no project specific information (regional, countywide, or statewide defaults). Estimate GHG emissions using project specific information from the transportation engineer, transportation demand policies, community design elements, energy efficiency requirements, wastewater treatment and other public infrastructure design changes, and other components. Compare these two calculations. Is the second calculation reduced by the percent needed to meet AB 32 goals compared to the first calculation?

- Estimate the GHG emissions associated with the 1990 planning area and the per-capita or per-service population GHG associated with the 1990 planning area. (Many communities are establishing GHG inventories using different tools). Estimate the GHG emissions associated with buildout of the proposed General Plan update and the resulting per-capita or per-service population GHG

emissions. Compare the two calculations. Is the General Plan buildout per-capita or per-service population level greater than the 1990 estimate?

Example General Plan Update: Proposed new growth area

Project Attributes:

- 10,050 single family dwelling units
- 652 multi-family dwelling units
- 136 acres parks
- 2,047 ksf commercial (regional shopping center)
- 2,113 ksf office
- 383 acres industrial park
- 31,293 new residents
- 4,945 new jobs
- Located in Stanislaus County (SJVAPCD jurisdiction)
- Analysis year 2025

Table 9: General Plan Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	**Metric Tons/Year CO_2e**	**Demographic Data**	
Construction emissions	12,083*	Residents	31,293
Area-source emissions	45,708		
Mobile-source emissions	263,954	Jobs	4,945
Indirect emissions (from CCAR Protocol)	78,385		
Total operational emissions	**388,046**	Service population	36,238
Operational emissions/SP	**10.7**		

* Approximately 241,656 metric tons CO_2e total at general plan buildout (assumes 20-year buildout period). Construction emissions were not included in total operational emissions.
Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).
Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Due to the programmatic level of analysis that often occurs at the general plan level, and potential for many relevant GHG emission quantities, it could be preferable to use a qualitative approach. Such an analysis could address the presence of GHG-reducing policy language in the general plan.

Three possible tiers of approaches to addressing GHG mitigation strategies, either as general plan policy, general plan EIR mitigation measures, or both, include:

- Forward planning
- Project toolbox
- Defer to GHG reductions plan

The three basic approaches are described below.

1. Bring reduction strategies into the plan itself. The most effective way for local jurisdictions to achieve GHG emissions reductions in the medium- and long-term is through land use and transportation policies that are built directly into the community planning document. This involves creating land use diagrams and circulation diagrams, along with corresponding descriptive standards, that enable and encourage alternatives to travel and goods movement via cars and trucks. The land use and circulation diagrams provide a general framework for a community where people can conduct their everyday business without necessarily using their cars. The overall community layout expressed as a part of the land use and circulation diagrams is accompanied by a policy and regulatory scheme designed to achieve this community layout. Impact fees, public agency spending, regulations, administrative procedures, incentives, and other techniques are designed to facilitate land use change consistent with the communities' overall vision, as expressed in policy and in the land use diagram. There are many widely used design principles that can be depicted in land use and circulation diagrams and implemented according to narrative objectives, standards, and policies:

- Connectivity. A finely-connected transportation network shortens trip lengths and creates the framework for a community where homes and destinations can be placed close in proximity and along direct routes. A hierarchical or circuitous transportation network can increase trip lengths and create obstacles for walking, bicycling, and transit access. This policy language would likely be found in the Circulation Element.

- Compactness. Compact development, by its nature, can increase the efficiency of infrastructure provision and enable travel modes other than the car. If communities can place the same level of activity in a smaller space, GHG emissions would be reduced concurrently with VMT and avoid unnecessary conversion of open space. This policy language would likely be found in the Land Use Element.

- Diversity. Multiple land use types mixed in proximity around central "nodes" of higher-activity land uses can accommodate travel through means other than a car. The character and overall design of this land use mix is, of course, different from community to community. This policy language would likely be found in the Land Use Element.

- Facilities. Pedestrian, bicycle, and public transportation improvements, planning, and programming are sometimes an afterthought. To get a more GHG-efficient mode share, safe and convenient bike lanes, pedestrian pathways, transit shelters, and other facilities are required to be planned along with the vehicular travel network. This policy language would likely be found in the Circulation Element.

- Redevelopment. One way to avoid GHG emissions is to facilitate more efficient and economic use of the lands in already-developed portions of a community. Reinvestment in existing neighborhoods and retrofit of existing buildings is appreciably more GHG efficient than greenfield development, and can even result in a net reduction in GHG emissions. This policy language would likely be found in the Conservation or Land Use Element.

- Housing and Employment. Most communities assess current and future economic prospects along with long-range land use planning. Part of the objective for many communities is to encourage the coalescence of a labor force with locally available and appropriate job opportunities. This concept is best known as "jobs-housing balance." This policy language would likely be found in the Housing Element.

- Planning Level Versus Project Level. For transportation-related GHG emissions that local governments can mitigate through land use entitlement authority, the overall community land use strategy and the overall transportation network are the most fruitful areas of focus. The reduction capacity of project-specific mitigation measures is greatly limited if supportive land use and transportation policies are lacking at the community planning level. The regional economic context, of course, provides an important backdrop for land use and transportation policy to address GHG emissions. Within this context, the general plan is the readily available tool for local governments to establish such land use and transportation strategies. This policy language would likely be found in the Land Use and Circulation Elements.

- Shipping Mode Shift. Locate shipping-intensive land uses in areas with rail access. Some modes of shipping are more GHG-intensive than others. Rail, for example, requires only about 15 to 25 percent of the energy used by trucks to ship freight equivalent distances and involves reduced transportation-related GHG emissions. Cities and counties have little direct control over the method of shipment that any business may choose. Nevertheless, as a part of the general planning process, cities and counties can address constraints on the use of rail for transporting goods. This policy language would likely be found in the Land Use and Circulation Elements.

2. Provide a "toolbox" of strategies after the project site has been selected. In addition to the examples of design principles that are built into the community planning process, communities can offer project applicants a range of tools to reduce GHG emissions. Mitigation strategies are elaborated in detail in Chapter 9.

3. Defer to General Plan implementation measure. Develop and implement a GHG Emissions Reduction Plan. Another option for local governments would be development of an implementation measure as a part of the general plan that outlines an enforceable GHG reduction program. Perhaps the most well known example of this approach is the result of California's Attorney General settlement of the lawsuit brought against San

Bernardino County. The County has agreed to create a 1990 GHG inventory and develop measures to reduce such emissions according to the state's overall goals. Other communities have pursued similar programs (i.e., the City of San Diego, Marin County). Along with the inventories, targets, and example reduction measures, these programs would include quantitative standards for new development; targets for reductions from retrofitting existing development; targets for government operations; fee and spending program for GHG reduction programs; monitoring and reporting; and other elements. The local government itself should serve as a model for GHG reduction plan implementation, by inventorying emissions from government operations and achieving emission reductions in accordance with the plan's standards. An optional climate change element could be added to contain goals, policies, and this implementation strategy, or this could belong in an optional air quality element.

Other Project Types

Air District Rules, Regulations and Air Quality Plans

Air district air quality plans, rules and regulations could have the potential to increase or decrease GHG emissions within their respective jurisdiction. In general, air district air quality plans, rules and regulations act to reduce ozone precursors, criteria air pollutant and toxic air contaminant emissions, which would almost always act to reduce GHG emissions simultaneously. However, this may not always be the case.

Air Quality Plans

Air districts will have to include GHG emissions analysis as part of their criteria air pollutant and toxic air contaminant air pollutant analysis when considering the adoption of air quality plans and their subsequent rules and regulations needed to implement the plans. Multiple models and methodologies will be needed to accomplish this analysis.

Regional Transportation Plans

Regional transportation plans would also need to be evaluated on a case-by-case basis to determine if a net increase or decrease in GHG emissions would occur. Complex interactions between the roadway network, operating conditions, alternative transportation availability (such as public transit, bicycle pathways, and pedestrian infrastructure), and many other independent parameters specific to a region should be considered. Regional transportation models exist to estimate vehicular emissions associated with regional transportation plans, which includes the ability to estimate GHG emissions.

Normalization/Service Population Metric

The above methodology would provide an estimate of the mass GHG emissions generated by a proposed project, which could be compared to a mass emission threshold. EDAW developed a methodology that would measure a project's overall GHG efficiency

in order to determine if a project is more efficient than the existing statewide average for per capita GHG emissions. The following steps could be employed to estimate the GHG-"efficiency," which may be more directly correlated to the project's ability to help obtain objectives outlined in AB 32, although it relies on establishment of an efficiency-based significance threshold. The subcommittee believes this methodology may eventually be appropriate to evaluate the long-term GHG emissions from a project in the context of meeting AB 32 goals. However, this methodology will need substantially more work and is not considered viable for the interim guidance presented in this white paper.

- Divide the total operational GHG emissions by the Service Population (SP) supported by the project (where SP is defined as the sum of the number of residents and the number of jobs supported by the project). This value should be compared to that of the projected statewide GHG emissions inventory from the applicable end-use sectors (electricity generation, residential, commercial/institutional, and mobile-source) in 1990 divided by the projected statewide SP for the year 2020 (i.e., AB 32 requirements), to determine if the project would conflict with legislative goals.

    - If the project's operational GHG/SP falls below AB 32 requirements, then the project's GHG emissions are less than cumulatively considerable.

    - If the project's operational GHG/SP exceed AB 32 requirements (a substantial contribution), then the project's GHG emissions would conflict with legislative requirements, and the impact would be cumulatively considerable and mitigation would be required where feasible.

- New stationary and area sources/facilities: calculate GHG emissions using the CCAR GRP. All GHG emissions associated with new stationary or area sources should be treated as a net increase in emissions, and if deemed significant, should be mitigated where feasible.

- Road or levee construction projects or other construction-only projects: calculate GHG emissions using the RoadMod, which will be updated to contain GHG emission factors from EMFAC and OFFROAD. All construction-generated GHG emissions should be treated as a net increase, and if deemed significant, should be mitigated to the extent feasible.

- Air District rulemaking or air quality management plan-type projects should be evaluated on a case-by-case basis for secondary impacts of increased GHG emissions generation. In most cases, the types of projects that act to reduce regional air pollution simultaneously act to reduce GHG emissions, and would be beneficial, but should be evaluated for secondary effects from GHG emissions.

- Regional transportation plans should also be evaluated on a case-by-case basis for potential to either reduce or increase GHG emissions from the transportation sector. EMFAC can be utilized to determine the net change in GHG emissions

associated with projected vehicle VMT and from operating speed changes associated with additional or alleviated congestion.

To achieve the goals of AB 32, which are tied to GHG emission rates of specific benchmark years (i.e., 1990), California would have to achieve a lower rate of emissions per unit of population and per unit of economic activity than it has now. Further, in order to accommodate future population and economic growth, the state would have to achieve an even lower rate of emissions per unit than was generated in 1990. (The goal to achieve 1990 quantities of GHG emissions by 2020 means that this will need to be accomplished in light of 30 years of population and economic growth in place beyond 1990.) Thus, future planning efforts that would not encourage new development to achieve its fair share of reductions in GHG emissions would conflict with the spirit of the policy decisions contained in AB 32, thus impeding California's ability to comply with the mandate.

Thus, if a statewide context for GHG emissions were pursued, any net increase in GHG emissions within state boundaries would be considered "new" emissions. For example, a land development project, such as a specific plan, does not necessarily create "new" emitters of GHG, but would theoretically accommodate a greater number of residents in the state. Some of the residents that move to the project could already be California residents, while some may be from out of state (or would 'take the place' of in-state residents who 'vacate' their current residences to move to the new project). Some may also be associated with new births over deaths (net population growth) in the state. The out-of-state residents would be contributing new emissions in a statewide context, but would not necessarily be generating new emissions in a global context. Given the California context established by AB 32, the project would need to accommodate an increase in population in a manner that would not inhibit the state's ability to achieve the goals of lower total mass of emissions.

The average net influx of new residents to California is approximately 1.4 percent per year (this value represents the net increase in population, including the net contribution from births and deaths). With population growth, California also anticipates economic growth. Average statewide employment has grown by approximately 1.1 percent over the last 15 years. The average percentage of population employed over the last 15 years is 46 percent. Population is expected to continue growing at a projected rate of approximately 1.5 percent per year through 2050. Long-range employment projection data is not available from the California Department of Finance (DOF) and can be extrapolated in different ways (e.g., linear extrapolation by percentage rate of change, percentage of population employed, mathematical series expansion, more complex extrapolation based on further research of demographic projections such as age distribution). Further study would be needed to refine accurate employment projections from the present to 2050. For developing this framework, employment is assumed to have a constant proportionate relationship with the state's population. The projected number of jobs is assumed to be roughly 46 percent of the projected population.

In light of the statewide context established by California law, consistency is most important for evaluating GHG emissions from projects. Thus, URBEMIS and the CCAR GRP are the recommended tools for quantification of GHG emissions from most project types in the short term. Over the long term, more sophisticated models that integrate the relationship between GHG emissions and land use, transportation, energy, water, waste, and other resources, and have similar application statewide would have better application to the problem, but may not currently be as accessible or as easily operable. I-PLACE^{3}S and CTG Energetics' Sustainable Communities Model (SCM) are two examples of such models that contain emission factors for GHGs, which could be refined to have applicability statewide and made available to CEQA practitioners. Other models are likely to be developed, given the importance of this issue.

Short-Term and Long-Term Methodologies

The following tools can be used to quantify a project's GHG emissions until tools that are more comprehensive become available statewide:

1. Land development projects: URBEMIS 2007 v. 9.2 and the CCAR GRP v. 2.2 (short-term); further development of I-PLACE^{3}S or CTG's Sustainable Communities Model (long-term).
2. New stationary and area sources/facilities: AP-42 Chapter 4.3, LandGem v. 3.02, and/or CCAR GRP v. 2.2.
3. Road or levee construction projects or other construction-only projects: RoadMod/OFFROAD 2007.

Ideally, I-PLACE^{3}S or CTG's Sustainable Communities Model would be expanded to apply to all regions of the state. These types of models use an integrated approach, which is the best approach for reasonably approximating the emissions that result from interaction between land uses, but neither is available to the public and would create consistency problems in reporting emissions from projects across the state if these were used today. However, a similar model with statewide applicability will likely be developed due to the importance of the issue.Table 10 Summary of Modeling Tools for Estimating GHG Emissions and Project Applicability

Table 10: Summary of Modeling Tools for GHG Emissions

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
URBEMIS 2007	*Public domain -Download (www.urbemis.com) free of charge*	*Land development and construction projects (construction, mobile- and area-source emissions)*	*Local*	*Fairly Easy*	*Land use information, construction and operational data and assumptions (e.g., jurisdiction, acres of land use type, year of operation, etc.)*	*Mobile-source Construction & Operational CO_2 (lb/day or tons/year)*	*-Recommended for land use development and construction projects -Also recommended for net change in land use (zoning changes)*	*-Does not quantify indirect emissions from energy consumption or other GHGs (except methane from mobile-sources) -Free, available to public, and applicable statewide -Widely used for assessment of other air quality impacts*
California Climate Action Registry General Reporting Protocol v. 2.2	*Public guidance document*	*Indirect emissions from land development projects, stationary- and area-source facilities regulated under AB 32*	*State*	*Easy*	*Energy consumption*	*CO_2e (Metric tons/year)*	*-Recommended for indirect emissions from energy consumption for land use development projects, and for new stationary- or area- sources to be regulated*	*-Contains emission factors for CH_4 and N_2O in addition to CO_2 -Does not contain emission factors broken down by utility provider (statewide average grid only)*
Clean Air and Climate Projection (CACP) Software	*Public agencies (members of ICLEI, NACAA, or similar)*	*Local governments used for emissions inventories*	*Local*	*N/A*	*Energy usage, waste generation/disposal transportation*	*CO_2e (tons/year)*	*-Recommended for inventories of local government entities activities (must be a member of affiliated agency or group)*	*-Not available to public*
CTG Sustainable Communities Model	*Custom model*	*Land development*	*Regional, scalable*	*N/A*	*Land use information, operational (mobile, energy, economic, infrastructure) assumptions*	*CO_2e (tons/year)*	*-An integrated and comprehensive modeling tool, but cannot obtain*	*-Not available to public*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
I-PLACE^{3}S	*Access fee through local COG* *Only available for eight California counties*	*Land use change*	*Regional, scalable*	*Fairly Easy*	*Parcel information*	*CO_2 (lb/day or tons/year)*	*-Recommended for land use development projects and land use changes* *-Especially good for general plans*	*-Not freely available to public* *-Not applicable statewide* *-Actually provides insight into land use interaction* *-Can include very specific project attributes* *-Trip rates are from behavioral survey data, instead of ITE*
EMFAC 2007	*Public domain*	*On-road mobile-sources*	*Statewide, regional*	*Fairly Easy*	*Vehicle fleet information*	*CO_2 (grams/mile)*	*-Not recommended for most projects (URBEMIS preferred)* *-Could be used for certain Air District Rulemaking applications*	*-Can compare emissions based on speed-distribution* *-Emission factors contained in URBEMIS* *-Not a stand-alone model*
OFFROAD 2007	*Public domain*	*Off-road mobile sources (construction equipment)*	*Statewide, regional*	*Fairly Easy*	*Construction fleet information*	*CO_2 (lb/day)*	*-Not recommended (URBEMIS preferred)* *-could be used for certain Air District Rulemaking applications (re: construction equipment)*	*-Emission factors contained in URBEMIS*
RoadMod (to be updated to include CO_2)	*Public domain*	*Off-road and on-road mobile sources (construction equipment and material haul trucks)*	*Statewide*	*Easy*	*Construction information*	*CO_2 (lb/day or tons/project)*	*-Recommended for construction-only projects (linear in nature; i.e., levees, roads, pipelines)*	*-To be updated to support emissions factors from OFFROAD 2007*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
DTIM	*Public domain*	*On-road mobile-sources*	*Statewide, regional*	*Difficult (consists of a series of three programs and requires input files from traffic and emissions modeling)*	*-EMFAC files* *-Traffic model output files (e.g., link, interzonal, and trip end data)* *-User options file* *-Optional files*	*CO_2 (tons/year)*	*-Not recommended*	*-Not updated to support EMFAC 2007 emission factors* *-Input files include output files from regional transportation models which more accurately reflect VMT*
Southeast Climate Change Partnership Spreadsheet Model (UK)	*Public domain http://www.climatesoutheast.org.uk/*	*UK Local government/ agencies/ organizations used for emissions inventories*	*Local, county, regional*	*Fairly easy*	*Energy usage, waste generation/disposal, transportation*	*CO_2 (tonnes/year)*	*-Not recommended for use in California, but could be a valuable source for building an applicable spreadsheet model*	*-Applicability for UK, but could be updated with CA-specific emission factors*
EPA AP-42; Evaporation Loss Sources Chapter 4.3.5	*Public reference document*	*GHG emissions from waste water treatment facilities*	*Facility level*	*Easy equation; substantial research needed to use*	*Biochemical oxygen demand (BOD) loading, Fraction anaerobically digested*	*CH4 (lb/year)*	*-Recommended for Publicly owned treatment works (POTW) projects*	*-Substantial research needed to determine the "fraction anaerobically digested" parameter, which is dependent on the type of treatment plant/process*
LandGem v. 3.02	*Public domain http://www.epa.gov/ttn/catc/dir1/landgem-v302.xls*	*GHG emissions from anaerobic decomposition associated with landfills*	*Facility Level*	*Moderate*	*Solid waste processing, year of analysis, lifetime of waste in place*	*CO_2, CH_4 (Mega grams/year)*	*-Recommended for landfill emissions*	*-Emission rates change dependent on years of decomposition, waste in place rates of change.* *-Complex decomposition rate equation, but good first approximation*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
CARROT	*Registry members*	*Stationary source emissions, vehicle fleet mobile sources*	*Facility level*	*Moderate*	*Facility-specific information*	*All GHGs*	*-Recommended for reporting facilities under AB 32 and for indirect emissions from energy consumption (CCAR Protocol)*	*-Estimates all GHGs and normalizes to CO_2e* *-Not publicly available*

Notes:

GHG = greenhouse gas; AB = assembly bill; CO_2e = carbon dioxide equivalent; CH_4 = methane; N_2O = nitrous oxide; COG = council of governments ; ITE = Institute of Transportation Engineers; CCAR = California Climate Action Registry

Source: Data compiled by EDAW and the California Air Pollution Control Officers Association in 2007

Introduction

This chapter (and Appendix B) identifies existing and potential mitigation measures that could be applied to projects during the CEQA process to reduce a project's GHG emissions that would be identified using the analytical methodologies included in this white paper. The Subcommittee retained the services of EDAW to assist with this effort. EDAW performed a global search of mitigation measures currently in practice and under study that would reduce GHG emissions.

Table 16 (Appendix B) provides a brief description of each measure along with an assessment of their feasibility (from a standpoint of economical, technological, and logistical feasibility, and emission reduction effectiveness), and identifies their potential for secondary impacts to air quality. During the global search performed, EDAW also took note of GHG reduction strategies being implemented as rules and regulation (e.g., early action items under AB 32), which are summarized in Table 18 (Appendix C). It is important to note that though compliance with such would be required by regulation for some sources, such strategies may be applicable to other project and source types.

The recurring theme that echoes throughout a majority of these measures is the shift toward New Urbanism, and research has consistently shown that implementation of Neotraditional Development techniques reduces VMT and associated emissions. The material reviewed assessed reductions from transportation-related measures (e.g., bicycle, pedestrian, transit, and parking) as a single comprehensive approach to land use. This comprehensive approach focuses on development design criteria conducive to enhancing alternate modes of transportation, including transit, walking, and bicycling. Transportation Demand Management (TDM) programs are viewed as a mechanism to implement specific measures. TDM responsibilities may include offering incentives to potential users of alternative modes of transportation and monitoring and reporting mode split changes.

The comprehensive approach makes it more difficult to assess reductions attributable to each measure. Nevertheless, there is a strong interrelationship between many of the measures, which justifies a combined approach. Consider the relationship between bike parking nonresidential, bike parking residential, endtrip facilities, and proximity to bike path/bike lane measures. In reality, these measures combined act as incentives for one individual to bike to work, while implementation of a single measure without the others reduces effectiveness.

The global nature of GHG emissions is an important feature that enables unique mitigation: abatement. When designing a project subject to CEQA, the preferred practice is first to avoid, then to minimize, and finally to compensate for impacts. Where the impact cannot be mitigated on-site, off-site mitigation is often and effectively implemented in several resource areas, either in the form of offsetting the same impact or preserving the resource elsewhere in the region. Frequently, mitigation fee programs or funds are established, where the proponent pays into the program and fees collected

throughout the region or state are used to implement projects that, in turn, proportionately offset the impacts of the projects to the given resource. It may be more cost-effective to reduce as much GHG on-site as feasible (economically and technologically). Then the proponent would pay into a "GHG retrofit fund" to reduce equivalent GHG emissions off-site. In contrast to regional air pollutant offset programs such as the Carl Moyer Program, it matters greatly where reductions of ozone precursors occur, as ozone affects regional air quality. The GHG retrofit fund could be used to provide incentives to upgrade older buildings and make them more energy efficient. This would reduce demand on the energy sector and reduce stationary source emissions associated with utilities. This program has been successfully implemented in the United Kingdom where developments advertise "carbon neutrality." Of course, some GHG emissions occur associated with operation of the development, but the development would offset the remainder of emissions through off-site retrofit. Avoiding emissions that would otherwise continue to occur at existing development would be a unique opportunity for mitigation of GHG emissions. Reduction of GHG emissions also may have important side benefits including reduction of other forms of pollution.

Depending on the significance threshold concept adopted, projects subject to the CEQA process would either qualitatively or quantitatively identify the amount of GHG emissions associated with their project using the analytical methodologies identified in the previous chapter. The analysis would then apply the appropriate number of mitigation measures listed in Appendix B to their project to reduce their GHG emissions below the significance level. Calculating the amount of GHG emission reductions attributable to a given mitigation measure would require additional research. The examples below illustrate how a project would be mitigated using this approach.

Residential Project Example

Project Attributes:

- 68 detached dwelling units
- 15.9 acres
- Located in unincorporated Placer County PCAPCD jurisdiction)
- Assume URBEMIS defaults for a rural project in Placer County, in absence of a traffic study (This is contrary to the recommendations contained under Task 1; a traffic study is necessary to asses project-specific GHG emissions).
- Analysis year 2009

Table 11: Residential Project Example GHG Emissions Estimates with Mitigation

URBEMIS Output (Unmitigated)	Metric Tons/Year CO_2e	URBEMIS Output (Mitigated)	Metric Tons/Year CO_2e	Percent Reduction
Area-source emissions	252	Area-source emissions	215	14.6
Mobile-source emissions	1,047	Mobile-source emissions	916	12.5
Total direct operational emissions (area + mobile)	1,299	Total operational emissions (area + mobile)	1,131	12.9

Notes:
CO_2e = carbon dioxide equivalent

Sources: Data compiled by EDAW in 2007

Using URBEMIS 2007 and assuming the project would implement the mitigation measures listed below, yearly project-generated emissions of CO_2e would be reduced by approximately 13 percent. Implementation of the following mitigation measures is assumed:

- 100 housing units within one-half-mile radius of project's center, including this project's 68 residential units;
- provision of 80 jobs in the study area;
- retail uses present with one-half-mile radius of project's center;
- 10 intersections per square mile;
- 100% of streets with sidewalks on one side;
- 50% of streets with sidewalks on both sides;
- 30% of collectors and arterials with bike lanes, or where suitable, direct parallel routes exist;
- 15% of housing units deed restricted below market rate;
- 20% energy efficiency increase beyond Title 24; and
- 100% of landscape maintenance equipment electrically powered and electrical outlets in front and rear of units.

Example Project Methodology and Mitigation

Table 12 –Residential Projects Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	URBEMIS (EMFAC emission factors)	MM T-3→MM T-8, MM T-10→ MM T-14, MM T-16, MM T-19→ MM T-21 MM D-2→MM D-8, MM D-10→ MM D-15, MM D-17 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	URBEMIS	MM D-13→MM D-15, MM D-17 MM E-1→MM E-8, MM E-10, MM E-12→MM E-23 MM S-1→MM S-2 MM M-1→MM M-2
Indirect Emissions		
Energy Consumption	CCAR GRP & CEC	

Table 13 –Commercial Projects Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	URBEMIS (EMFAC emission factors)	MM T-1→MM T-2, MM T-4→ MM T-15, MM T-17→MM T-21 MM D-1→MM D-3, MM D-5→ MM D-6, MM D-10, MM D-12, MM D-14→MM D-17 MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	URBEMIS	MM D-14→MM D-17 MM E-1, MM E-4→MM E-13, MM E-16→MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Indirect Emissions		
Energy Consumption	CCAR GRP & CEC	

Table 14 –Specific Plans Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MM T-1→MM T-21 MM D-1→MM D-12, MM D-18→ MM D-19 MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MM D-13→MM D-19 MM E-1→MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Indirect Emissions		
Energy Consumption	Short-term: CCAR GRP & CEC. Long-term: I-PLACE^{3}S/CTG SCM	

General Plans

- Include a general plan policy to reduce emissions within planning area to a level consistent with legislative requirements.
- Implementation strategies include preparation of a GHG reduction plan.
- Projects consistent with a general plan could be responsible for complying with such a policy.

Table 15 –General Plans Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors).	MS G-1 MM G-15
Mobile Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MS G-1 MS G-2→MS C-7, MS G-9, MS G-12, MS-13→MS-14, MS-16→MS-23
Area Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MS G-1 MS G-8→MS C-11, MS G-134, MS G-12, MS-15, MS-17, MS-22
Indirect Emissions		
Energy Consumption	Short-term: CCAR GRP & CEC. Long-term: I-PLACE^{3}S/CTG SCM	

Other Project Types

Air District Rules and Regulations

Air district rules and regulations could have the potential to increase or decrease GHG emissions within the respective jurisdiction. In general, air district rules and regulations act to decrease criteria air pollutant or toxic air contaminant emissions, which would usually act to reduce GHG emissions simultaneously. However, this may not always be the case and air district rules and regulations could address emissions from a large variety of different source types. Reductions of GHG emissions associated with implementation of applicable mitigation, which could also vary greatly, would need to be evaluated on a case-by-case basis. However, once applicable mitigation measures are identified, percent reductions based on the best available research to date, such as those specified in Table 15, could be applied to determine mitigated emissions.

Air Quality Plans

Similarly to air district rules and regulations, air quality plans could have the potential to increase or decrease GHG emissions because of criteria air pollutant reduction strategies. In general, strategies implemented by air districts to reduce criteria air pollutants also act to reduce GHG emissions. However, this may not always be the case. Reductions of GHG emissions associated with implementation of applicable mitigation would need to be evaluated on a case-by-case basis. The methodology identified above for determining whether the strategies contained within the GHG reduction plan would adhere to the level specified in general plan policy could also be used to determine the reductions associated with CAP strategies.

Regional Transportation Plans

Regional transportation plans and reductions of GHG emissions associated with implementation of applicable mitigation would also need to be evaluated on a case-by-case basis to determine if a net increase or decrease in GHG emissions would occur. Complex interactions between the roadway network, operating conditions, alternative transportation availability (such as public transit, bicycle pathways, and pedestrian infrastructure), and many other independent parameters specific to a region should be considered. EMFAC 2007 can be used with VMT from the RTP to create an inventory of GHG emissions. Reductions associated with implementation of applicable measures contained in Table 16 could be accomplished by accounting for VMT reductions in the traffic model.

Many states, counties, and cities have developed policies and regulations concerning greenhouse gas emissions that seek to require or promote reductions in GHG emissions through standards for vehicle emissions, fuels, electricity production/renewables, building efficiency, and other means. However, we could only identify three public agencies in the United States that are considering formally requiring the analysis of greenhouse gas emissions and climate change for development projects during their associated environmental processes. There may be others, but they were not identified during research conducted during preparation of this paper.

The following is a summary of those three efforts.

Commonwealth of Massachusetts - MEPA Greenhouse Gas Emissions Policy and Protocol

The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) has determined that the phrase "damage to the environment" as used in the Massachusetts Environmental Policy Act (MEPA) includes the emission of greenhouse gases caused by projects subjects to MEPA Review. EEA has published a Greenhouse Gas Emissions Policy (GGEP) to fulfill the statutory obligation to take all feasible measurers to avoid, minimize or mitigate damage to the environment.

The GGEP concerns the following projects only:

- The Commonwealth or a state agency is the proponent;
- The Commonwealth or a state agency is providing financial assistance;
- The project is privately funded, but requires an Air Quality Permit from the department of Environmental Protection;
- The project is privately funded, but will generate:
    - 3,000 or more new vehicle trips per day for office projects;
    - 6,000 or more new vehicle trips per day for mixed use projects that are 25% or more office space; or
    - 10,000 or more new vehicle trips per day for other projects.

As a comparison, the trip generation amounts correspond as follows:

- 3,000 vehicle trips per day = approximately 250,000 square foot office development;
- 6,000 or more new vehicle trips per day for mixed use projects that are 25% or more office space = if 25% office space, then equivalent to approximately 130,000 square feet of office and either 100,000 square feet of retail or 450 single-family residential units or some combination thereof.
- 10,000 or more new vehicle trips per day = approximately 1,000 single family residential units or 250,000 square feet retail.

The draft policy states it is not intended to create a numerical GHG emission limit or a numerical GHG emissions reduction target, but rather to ensure that project proponents and reviewers have considered the GHG emissions impacts of their projects and taken all feasible means and measure to reduce those impacts.

The draft policy notes that some projects within these categories will have little or no greenhouse gas emission and the policy will not apply to such projects. EEA intends to identify in the scoping certificate whether a project falls within this *de minimis* exception.

The GGEP requires qualifying projects to do the following:

- to quantify their GHG emissions;
- identify measures to minimize or mitigate such emissions;
- quantify the reduction in emissions and energy savings from mitigation.

Emissions inventories are intended to focus on carbon dioxide, but analysis of other GHGs may be required for certain projects. EEA will require analysis of direct GGH emissions and indirect (electricity and transportation) emissions. The GGEP references the protocols prepared by the World Resource Institute as guidance for inventory preparation.

The policy is still in draft form, but the comment period closed on August 10, 2007.

King County, Washington - Executive Order on the Evaluation of Climate Change Impacts through the State Environmental Policy Act (SEPA)

On June 27, 2007, the King County Executive Ron Sims directed all King County Departments, as follows:

> *"…effective September 1, 2007 to require that climate impacts, including, but not limited to those pertaining to greenhouse gases, be appropriately identified and evaluated when such Departments are acting as the lead agency in reviewing the environmental impacts of private or public proposals pursuant to the State Environmental Policy Act".*

The Executive Order does not define what a "climate impact" is. Based on statements of the County Deputy Chief of Staff[*]

- County agencies will ask project proponents to supply information on transportation, energy usage and other impacts of proposed projects using the County's existing SEPA checklist.

[*] Marten Law Group: Environmental News, August 1, 2007, "King County (WA) First in Nation to Require Climate Change Impacts to be Considered During Environmental Review of New Projects".

- There is no current plan to require project proponents to take action to mitigate the impacts identifies.
- Development of emissions thresholds and mitigation requirements will be undertaken in connection with the County's upcoming 2008 update of its Comprehensive Plan.

Sacramento Metropolitan Air Quality Management District

The Sacramento Metropolitan Air Quality Management District released an interim guidance on addressing climate change in CEQA documents on September 6, 2007. While very general in nature, the District recommends that CEQA environmental documents include a discussion of anticipated GHG emissions during both the construction and operation phases of the project. This includes assessing the GHG emissions from projects (using readily available models) to determine whether a project may have a significant impact. If so, then the District recommends addressing all of the District's GHG mitigation measures (drawn from comments made by the California Attorney General) – with explanations on how the mitigation will be implemented or providing rationale for why a measure would be considered infeasible. The District provides assistance to agencies in their analysis of GHG emissions and the applicability of specific mitigation measures. The District's guidance can be found at: http://64.143.64.21/climatechange/ClimateChangeCEQAguidance.pdf

Mendocino Air Quality Management District – CEQA Guidelines

The Mendocino AQMD updated its "Guidelines for Use During Preparation of Air Quality Impacts in EIRs or Mitigated Negative Declarations" in May 2007. The guidelines call for preparing estimates of the increased emissions of air contaminations (including GHG) for projects.

The guidelines state that GHG emissions should be presumed to have a significant impact if CO emissions from District-approved modeling exceed either of the following:

- 80% of the level defined as significant for stationary sources in Regulation1, Rule 130 (s2) of the District (which is 550 lbs/day for CO, meaning a threshold of 440 lbs/day for CO for stationary sources); or
- levels established in District Regulation 1 Rule 130 (i2) for indirect sources (which is 690 lbs/day for CO for indirect sources).

If an average passenger vehicle emits 22 grams of CO/mile and 0.8 lb/mile of CO_2, then the 690-lb/day threshold for CO corresponds to approximately 11,400 lb/day CO_2 threshold for passenger vehicle-related emissions. If one assumes that the average passenger vehicle goes 12,500 miles/year (about 35 miles/day), then this is a threshold equivalent to about 420 vehicles. Using an average in California of about 1.77 vehicles/household, this would correspond to about 250 households/dwelling units.

Appendix A

Relevant Citations

Citations from the Public Resources Code (Division 13, §21000 et seq.) as amended through January 1, 2005.

Public Resources Code – Section 21004, MITIGATING OR AVOIDING A SIGNIFICANT EFFECT; POWERS OF PUBLIC AGENCY:

"In mitigating or avoiding a significant effect of a project on the environment, a public agency may exercise only those express or implied powers provided by law other than this division. However, a public agency may use discretionary powers provided by such other law for the purpose of mitigating or avoiding a significant effect on the environment subject to the express or implied constraints or limitations that may be provided by law."

Public Resources Code – Section 21082.2, SIGNIFICANT EFFECT ON ENVIRONMENT; DETERMINATION; ENVIRONMENTAL IMPACT REPORT PREPARATION:

(a) The lead agency shall determine whether a project may have a significant effect on the environment based on substantial evidence in light of the whole record.

(b) The existence of public controversy over the environmental effects of a project shall not require preparation of an environmental impact report if there is no substantial evidence in light of the whole record before the lead agency that the project may have a significant effect on the environment.

(c) Argument, speculation, unsubstantiated opinion or narrative, evidence which is clearly inaccurate or erroneous, or evidence of social or economic impacts which do not contribute to, or are not caused by, physical impacts on the environment, is not substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion supported by facts.

(d) If there is substantial evidence, in light of the whole record before the lead agency, that a project may have a significant effect on the environment, an environmental impact report shall be prepared.

(e) Statements in an environmental impact report and comments with respect to an environmental impact report shall not be deemed determinative of whether the project may have a significant effect on the environment.

Citations from the Guidelines for California Environmental Quality Act, CCR, Title 14, Division 6 (§15000 et seq.) as amended through July 27, 2007.

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

State CEQA Guidelines – Section 15064, DETERMINING THE SIGNIFICANCE OF THE ENVIRONMENTAL EFFECTS CAUSED BY A PROJECT:

(a) Determining whether a project may have a significant effect plays a critical role in the CEQA process.

(1) If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, the agency shall prepare a draft EIR.

(2) When a final EIR identifies one or more significant effects, the Lead Agency and each Responsible Agency shall make a finding under Section 15091 for each significant effect and may need to make a statement of overriding considerations under Section 15093 for the project.

(b) The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data. An ironclad definition of significant effect is not always possible because the significance of an activity may vary with the setting. For example, an activity which may not be significant in an urban area may be significant in a rural area.

(c) In determining whether an effect will be adverse or beneficial, the Lead Agency shall consider the views held by members of the public in all areas affected as expressed in the whole record before the lead agency. Before requiring the preparation of an EIR, the Lead Agency must still determine whether environmental change itself might be substantial.

(d) In evaluating the significance of the environmental effect of a project, the Lead Agency shall consider direct physical changes in the environment which may be caused by the project and reasonably foreseeable indirect physical changes in the environment which may be caused by the project.

(1) A direct physical change in the environment is a physical change in the environment which is caused by and immediately related to the project. Examples of direct physical changes in the environment are the dust, noise, and traffic of heavy equipment that would result from construction of a sewage treatment plant and possible odors from operation of the plant.

(2) An indirect physical change in the environment is a physical change in the environment which is not immediately related to the project, but which is caused indirectly by the project. If a direct physical change in the environment in turn causes another change in the environment, then the other change is an indirect physical change in the environment. For example, the construction of a new sewage treatment plant may facilitate population growth in the service area due to the increase in sewage treatment capacity and may lead to an increase in air pollution.

(3) An indirect physical change is to be considered only if that change is a reasonably foreseeable impact which may be caused by the project. A change which is speculative or unlikely to occur is not reasonably foreseeable.

(e) Economic and social changes resulting from a project shall not be treated as significant effects on the environment. Economic or social changes may be used, however, to determine that a physical change shall be regarded as a significant effect on the environment. Where a physical change is caused by economic or social effects of a

project, the physical change may be regarded as a significant effect in the same manner as any other physical change resulting from the project. Alternatively, economic and social effects of a physical change may be used to determine that the physical change is a significant effect on the environment. If the physical change causes adverse economic or social effects on people, those adverse effects may be used as a factor in determining whether the physical change is significant. For example, if a project would cause overcrowding of a public facility and the overcrowding causes an adverse effect on people, the overcrowding would be regarded as a significant effect.

(f) The decision as to whether a project may have one or more significant effects shall be based on substantial evidence in the record of the lead agency.

(1) If the lead agency determines there is substantial evidence in the record that the project may have a significant effect on the environment, the lead agency shall prepare an EIR (Friends of B Street v. City of Hayward (1980) 106 Cal.App.3d 988). Said another way, if a lead agency is presented with a fair argument that a project may have a significant effect on the environment, the lead agency shall prepare an EIR even though it may also be presented with other substantial evidence that the project will not have a significant effect (No Oil, Inc. v. City of Los Angeles (1974) 13 Cal.3d 68).

(2) If the lead agency determines there is substantial evidence in the record that the project may have a significant effect on the environment but the lead agency determines that revisions in the project plans or proposals made by, or agreed to by, the applicant would avoid the effects or mitigate the effects to a point where clearly no significant effect on the environment would occur and there is no substantial evidence in light of the whole record before the public agency that the project, as revised, may have a significant effect on the environment then a mitigated negative declaration shall be prepared.

(3) If the lead agency determines there is no substantial evidence that the project may have a significant effect on the environment, the lead agency shall prepare a negative declaration (Friends of B Street v. City of Hayward (1980) 106 Cal.App. 3d 988).

(4) The existence of public controversy over the environmental effects of a project will not require preparation of an EIR if there is no substantial evidence before the agency that the project may have a significant effect on the environment.

(5) Argument, speculation, unsubstantiated opinion or narrative, or evidence that is clearly inaccurate or erroneous, or evidence that is not credible, shall not constitute substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion support by facts.

(6) Evidence of economic and social impacts that do not contribute to or are not caused by physical changes in the environment is not substantial evidence that the project may have a significant effect on the environment.

(7) The provisions of sections 15162, 15163, and 15164 apply when the project being analyzed is a change to, or further approval for, a project for which an EIR or negative declaration was previously certified or adopted (e.g. a tentative subdivision, conditional use permit). Under case law, the fair argument standard does not apply to determinations of significance pursuant to sections 15162, 15163, and 15164.

(g) After application of the principles set forth above in Section 15064(f)(g), and in marginal cases where it is not clear whether there is substantial evidence that a project may have a significant effect on the environment, the lead agency shall be guided by the following principle: If there is disagreement among expert opinion supported by facts

over the significance of an effect on the environment, the Lead Agency shall treat the effect as significant and shall prepare an EIR.
(h)(1) When assessing whether a cumulative effect requires an EIR, the lead agency shall consider whether the cumulative impact is significant and whether the effects of the project are cumulatively considerable. An EIR must be prepared if the cumulative impact may be significant and the project's incremental effect, though individually limited, is cumulatively considerable. "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.
(2) A lead agency may determine in an initial study that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and thus is not significant. When a project might contribute to a significant cumulative impact, but the contribution will be rendered less than cumulatively considerable through mitigation measures set forth in a mitigated negative declaration, the initial study shall briefly indicate and explain how the contribution has been rendered less than cumulatively considerable.
(3) A lead agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project will comply with the requirements in a previously approved plan or mitigation program which provides specific requirements that will avoid or substantially lessen the cumulative problem (e.g., water quality control plan, air quality plan, integrated waste management plan) within the geographic area in which the project is located. Such plans or programs must be specified in law or adopted by the public agency with jurisdiction over the affected resources through a public review process to implement, interpret, or make specific the law enforced or administered by the public agency. If there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding that the project complies with the specified plan or mitigation program addressing the cumulative problem, an EIR must be prepared for the project.
(4) The mere existence of significant cumulative impacts caused by other projects alone shall not constitute substantial evidence that the proposed project's incremental effects are cumulatively considerable.

State CEQA Guidelines – Section 15130, DISCUSSION OF CUMULATIVE IMPACTS:
(a)(3). "An EIR may determine that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and thus is not significant. A project's contribution is less than cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact. The lead agency shall identify facts and analysis supporting its conclusion that the contribution will be rendered less than cumulatively considerable.

State CEQA Guidelines – Section 15064.7, THRESHOLDS OF SIGNIFICANCE:
"Each public agency is encouraged to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is an identifiable quantitative, qualitative or performance level

of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which means the effect normally will be determined to be less than significant."

Appendix B

Mitigation Measure Summary

Table 16
Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Transportation								
Bicycle/Pedestrian/Transit Measures								
MM T-1: Bike Parking	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	1%-5%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates combined reductions among individual measures (e.g., 2.5% reduction for all bicycle-related measures and one-quarter of 2.5% for each individual measure) (TIAX 2005, EDAW 2006, SMAQMD 2007). VTPI presents % reductions for showers and combined measures in the TDM encyclopedia (VTPI	Yes: Lockers ($1,200-$2,950, $700/bike on average), Racks ($70-$2,000, $70/bike on average).	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	Caltrans, Portland Bicycle Master Plan (City of Portland 1998), CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Nonresidential projects provide plentiful short- and long-term bicycle parking facilities to meet peak season maximum demand (e.g., one bike rack space per 20 vehicle/employee parking spaces.
MM T-2: End of Trip Facilities	LD (C, M), I, SP, TP, AQP, RR, P/Mobile		Yes	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Nonresidential projects provide "end-of-trip" facilities including showers, lockers, and changing space (e.g., four clothes lockers and one shower provided for every 80 employee parking spaces, separate facilities for each gender for projects with 160 or more employee parking spaces).
MM T-3: Bike-Parking at Multi-	LD (R, M), SP, AQP, RR,		Yes: Lockers ($1,200-	Yes (Caltrans 2005,	Yes (Caltrans	Adverse: No Beneficial:		Long-term bicycle parking is provided at apartment

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Unit Residential	P/Mobile	2007). JSA bases estimates on CCAP information (JSA 2004).	$2,950, $700/bike on average), Racks ($70-$2,000, $70/bike on average).	Dierkers et al. 2007, VTPI 2007)	2005, Dierkers et al. 2007, VTPI 2007)	CAPs, TACs		complexes or condominiums without garages (e.g., one long-term bicycle parking space for each unit without a garage). Long-term facilities shall consist of one of the following: a bicycle locker, a locked room with standard racks and access limited to bicyclists only, or a standard rack in a location that is staffed and/or monitored by video surveillance 24 hours per day.
MM T-4: Proximity to Bike Path/Bike Lanes	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile		Yes	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Entire project is located within one-half mile of an existing/planned Class I or Class II bike lane and project design includes a comparable network that connects the project uses to the existing offsite facility. Project design includes a designated bicycle route connecting all units, on-site bicycle parking facilities, offsite bicycle facilities, site entrances, and primary building entrances to existing Class I or Class II bike lane(s) within one-half mile. Bicycle route connects to all streets contiguous with project site. Bicycle route has minimum conflicts with automobile parking and circulation

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								facilities. All streets internal to the project wider than 75 feet have Class II bicycle lanes on both sides.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-5: Pedestrian Network	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-10%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates 1% for each individual measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	The project provides a pedestrian access network that internally links all uses and connects to all existing/planned external streets and pedestrian facilities contiguous with the project site. Project design includes a designated pedestrian route interconnecting all internal uses, site entrances, primary building entrances, public facilities, and adjacent uses to existing external pedestrian facilities and streets. Route has minimal conflict with parking and automobile circulation facilities. Streets (with the exception of alleys) within the project have sidewalks on both sides. All sidewalks internal and adjacent to project site are minimum of five feet wide. All sidewalks feature vertical curbs. Pedestrian facilities and improvements such as grade separation, wider sidewalks, and traffic calming are implemented wherever feasible to minimize pedestrian barriers. All site entrances provide pedestrian access.
MM T-6: Pedestrian	LD (R, C, M), I, SP, TP,		Yes	Yes (Dierkers et al. 2007,	Yes (Dierkers et	Adverse: No Beneficial:		Site design and building placement minimize barriers to

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Barriers Minimized	AQP, RR, P/Mobile			VTPI 2007)	al. 2007, VTPI 2007)	CAPs, TACs		pedestrian access and interconnectivity. Physical barriers such as walls, berms, landscaping, and slopes between residential and nonresidential uses that impede bicycle or pedestrian circulation are eliminated.
MM T-7: Bus Shelter for Existing/Planned Transit Service	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-2%/High: CCAP presents these % reductions (Dierkers et al., 2007). SMAQMD assigns from .25%-1%, depending on headway frequency (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes: $15,000-$70,000.	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, City of Calgary (City of Calgary 2004), CA air quality management and control districts, and cities/counties.	Bus or streetcar service provides headways of one hour or less for stops within one-quarter mile; project provides safe and convenient bicycle/pedestrian access to transit stop(s) and provides essential transit stop improvements (i.e., shelters, route information, benches, and lighting).

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-8: Traffic Calming	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-10%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates .25%-1.0% for each individual measure depending on percent of intersections and streets with improvements (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Project design includes pedestrian/bicycle safety and traffic calming measures in excess of jurisdiction requirements. Roadways are designed to reduce motor vehicle speeds and encourage pedestrian and bicycle trips by featuring traffic calming features. All sidewalks internal and adjacent to project site are minimum of five feet wide. All sidewalks feature vertical curbs. Roadways that converge internally within the project are routed in such a way as to avoid "skewed intersections;" which are intersections that meet at acute, rather than right, angles. Intersections internal and adjacent to the project feature one or more of the following pedestrian safety/traffic calming design techniques: marked crosswalks, count-down signal timers, curb extensions, speed tables, raised crosswalks, raised intersections, median islands, tight corner radii, and roundabouts or mini-circles. Streets internal and adjacent to the project feature pedestrian safety/traffic calming measures such as on-street parking, planter strips with street trees,

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Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
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								and chicanes/chokers (variations in road width to discourage high-speed travel).
Parking Measures								
MM T-9: Paid Parking (Parking Cash Out)	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a range of 1.0%-7.2%, depending on cost/day and distance to transit (TIAX 2005, EDAW 2006, SMAQMD 2007). Shoupe presents a 21% reduction [$5/day for commuters to downtown LA, with elasticity of -0.18 (e.g., if price increases 10%, then solo driving goes down by 1.8% more)] (Shoupe 2005). Urban Transit Institute	Yes: Vary by location and project size.	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Project provides employee and/or customer paid parking system. Project must have a permanent and enforceable method of maintaining user fees for all parking facilities. The facility may not provide customer or employee validations. Daily charge for parking must be equal to or greater than the cost of a transit day/monthly pass plus 20%.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
		presents a range of 1%-10% reduction in trips to central city sites, and 2%-4% in suburban sites (VTPI 2007).						
MM T-10: Minimum Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a maximum of 6% (Nelson/Nygaard Consulting Associates, 2005, TIAX 2005, EDAW 2006).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007), Note that in certain areas of the state, the minimum parking required by code is greater than the peak period parking demand for most land uses. Simply meeting minimum code requirements in these areas would not result in an emissions reduction.	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, Governor's Office of Smart Growth (Annapolis, Maryland) (Zimbler), CA air quality management and control districts, and cities/counties.	Provide minimum amount of parking required. Once land uses are determined, the trip reduction factor associated with this measure can be determined by utilizing the ITE parking generation publication. The reduction in trips can be computed as shown below by the ratio of the difference of minimum parking required by code and ITE peak parking demand to ITE peak parking demand for the land uses multiplied by 50%. Percent Trip Reduction = 50 * [(min parking required by code – ITE peak parking demand)/ (ITE peak parking demand)]

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MM T-11: Parking Reduction Beyond Code/Shared Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a maximum of 12% (Nelson/Nygaard, 2005, TIAX 2005, EDAW 2006).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Provide parking reduction less than code. This measure can be readily implemented through a shared parking strategy, wherein parking is utilized jointly among different land uses, buildings, and facilities in an area that experience peak parking needs at different times of day and day of the week.
MM T-12: Pedestrian Pathway Through Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-4%/Moderate: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates 0.5% reduction for this measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Provide a parking lot design that includes clearly marked and shaded pedestrian pathways between transit facilities and building entrances.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-13: Off - Street Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-4%/Moderate: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates a range of 0.1%-1.5% for this measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Parking facilities are not adjacent to street frontage.
MM T-14: Parking Area Tree Cover	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	Annual net CO_2 reduction of 3.1 kg/m^2 canopy cover/Moderate (McPherson 2001).	Yes: $19 per new tree for CA, cost varies for maintenance, removal and replacement (McPherson 2001).	Yes	Yes	Adverse: VOCs Beneficial: CAPs, TACs	AG, State of CA Department of Justice (Goldberg 2007) and cities/counties (e.g., parking lot ordinances in Sacramento, Davis, and Los Angeles, CA).	Provide parking lot areas with 50% tree cover within 10 years of construction, in particular low emitting, low maintenance, native drought resistant trees. Reduces urban heat island effect and requirement for air conditioning, effective when combined with other measures (e.g., electrical maintenance equipment and reflective paving material).
MM T-15: Valet Bicycle Parking	LD (C, M), SP, AQP, TP, RR, P/Mobile	NA/Low	Yes	Yes	Yes: Raley Field (Sacramento, CA)	Adverse: No Beneficial: CAPs, TACs	Raley Field (Sacramento, CA).	Provide spaces for the operation of valet bicycle parking at community event "centers" such as amphitheaters, theaters, and stadiums.
MM T-16: Garage Bicycle Storage	LD (R, M), SP, AQP, TP, RR, P/Mobile	NA/Low	Yes: Less than $200/multiple bike rack.	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	City of Fairview, OR	Provide storage space in one-car garages for bicycles and bicycle trailers.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-17: Preferential Parking for EVs/CNG Vehicles	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	USGBC, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Provide preferential parking space locations for EVs/CNG vehicles.
MM T-18: Reduced/No Parking Fee for EVs/CNG Vehicles	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	Hotels (e.g., Argonaut in San Francisco, CA)	Provide a reduced/no parking fee for EVs/CNG vehicles.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Miscellaneous Measure								
MM T-19: TMA Membership	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-28%/High: CCAP presents a range of 3%-25% for TDMs with complementary transit and land use measures (Dierkers et al. 2007). VTPI presents a range of 6%-7% in the TDM encyclopedia (VTPI 2007). URBEMIS offers a 2%-10% range in reductions for a TDM that has 5 elements that are pedestrian and transit friendly and 1%-5% for 3 elements. SMAQMD presents a reduction of 5% (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Include permanent TMA membership and funding requirement. Funding to be provided by Community Facilities District or County Service Area or other nonrevocable funding mechanism. TDMs have been shown to reduce employee vehicle trips up to 28% with the largest reductions achieved through parking pricing and transit passes. The impact depends on the travel alternatives.
MM T-20: ULEV	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes: Higher than corresponding gasoline models.	Yes	Yes: Fueling stations might not be readily available depending on location. More than 900 E85 fueling	Adverse: No Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Use of and/or provide ULEV that are 50% cleaner than average new model cars (e.g., natural gas, ethanol, electric).

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
					stations in the U.S., 5 in CA. Vehicles available in select regions only			
MM T-21: Flex Fuel Vehicles	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	5466.97 lb GHG/year/Low (DOE Fuel Economy)	Yes: E85 costs less than gasoline per gallon, but results in lower fuel economy.	Yes	Yes: More than 900 E85 fueling stations in the U.S., 5 in CA. Vehicles available in select regions only	Adverse: Yes Issues with the energy intensive ethanol production process (e.g., wastewater treatment requirements). Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., SJVAPCD).	Use of and/or provide vehicles that utilize gasoline/ethanol blends (e.g., E85).
Design								
Commercial & Residential Building Design Measures								
MM D-1: Office/Mixed Use Density	LD (C, M), SP, TP, AQP, RR, P/Mobile	0.05%-2%/Moderate: This range is from SMAQMD, depending	Yes	Yes (VTPI 2007)	Yes (VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties	Project provides high density office or mixed-use proximate to transit. Project must provide

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
		on FAR and headway frequencies (Nelson/Nygaard Consulting Associates 2005, EDAW 2006, SMAQMD 2007).					(e.g., SMAQMD).	safe and convenient pedestrian and bicycle access to all transit stops within one-quarter mile.
MM D-2: Orientation to Existing/Planned Transit, Bikeway, or Pedestrian Corridor	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	0.4%-1%/Moderate: CCAP attributes a 0.5% reduction per 1% improvement in transit frequency (Dierkers et al. 2007). SMAQMD presents a range of 0.25%-5% (JSA 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007)	Yes (Dierkers et al. 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project is oriented towards existing transit, bicycle, or pedestrian corridor. Setback distance between project and existing or planned adjacent uses is minimized or nonexistent. Setback distance between different buildings on project site is minimized. Setbacks between project buildings and planned or existing sidewalks are minimized. Buildings are oriented towards existing or planned street frontage. Primary entrances to buildings are located along planned or existing public street frontage. Project provides bicycle access to any planned bicycle corridor(s). Project provides pedestrian access to any planned pedestrian corridor(s).
MM D-3: Services Operational	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	0.5%-5%/Moderate	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides on-site shops and services for employees.

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MM D-4: Residential Density (Employ Sufficient Density for New Residential Development to Support the Use of Public Transit)	LD (R, M), SP, TP, AQP, RR, P/Mobile	1%-40%/High: #7, EPA presents a range of 32%-40% (EPA 2006). SMAQMD presents a range of 1%-12% depending on density and headway frequencies (Nelson/Nygaard Consulting Associates 2005, JSA 2005, EDAW 2006, SMAQMD 2007). Nelson/Nygaard presents a trip reduction formula: Trip Reduction = 0.6*(1-(19749*((4.814+ households per residential acre)/(4.814+7.14))^-06.39)/25914).	Yes	Yes (VTPI 2007, Holtzclaw 2007)	Yes (VTPI 2007, Holtzclaw 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides high-density residential development. Transit facilities must be within one-quarter mile of project border. Project provides safe and convenient bicycle/pedestrian access to all transit stop(s) within one-quarter mile of project border.
MM D-5: Street Grid	LD (R, C, M), I, SP, TP, AQP, RR,	1%/Moderate: SMAQMD presents this % reduction (JSA	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007,	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties	Multiple and direct street routing (grid style). This measure only applies to projects

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	P/Mobile	2005, EDAW 2006, SMAQMD 2007).			VTPI 2007)		(e.g., SMAQMD).	with an internal CF >/= 0.80, and average of one-quarter mile or less between external connections along perimeter of project. [CF= # of intersections / (# of cul-de-sacs + intersections)]. Cul-de-sacs with bicycle/pedestrian through access may be considered "complete intersections" when calculating the project's internal connectivity factor. External connections are bike/pedestrian pathways and access points, or streets with safe and convenient bicycle and pedestrian access that connect the project to adjacent streets, sidewalks, and uses. If project site is adjacent to undeveloped land; streets, pathways, access points, and right-of-ways that provide for future access to adjacent uses may count for up to 50% of the external connections. Block perimeter (the sum of the measurement of the length of all block sides) is limited to no more than 1,350 feet. Streets internal to the project should connect to streets external to the project whenever possible.

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MM D-6: NEV Access	LD (R, C, M), SP, TP, AQP, RR, P/Mobile	0.5%-1.5%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (Litman 1999, Sperling 1994)	Yes (Litman 1999, Sperling 1994)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Make physical development consistent with requirements for neighborhood electric vehicles. Current studies show that for most trips, NEVs do not replace gas-fueled vehicles as the primary vehicle.
MM D-7: Affordable Housing Component	LD (R, M), SP, TP, AQP, RR, P/Mobile	0.4%-6%/Moderate: SMAQMD presents this % reduction (Nelson/Nygaard Consulting Associates 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Residential development projects of five or more dwelling units provide a deed-restricted low-income housing component on-site (or as defined in the code). Developers who pay into In-Lieu Fee Programs are not considered eligible to receive credit for this measure. The award of emission reduction credit shall be based only on the proportion of affordable housing developed on-site because in-lieu programs simply induce a net increase in development. Percentage reduction shall be calculated according to the following formula:

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								% reduction = % units deed-restricted below market rate housing * 0.04
MM D-8: Recharging Area	LD (R, M), SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Provide residential buildings with a "utility" room or space for recharging batteries, whether for use in a car, electric lawnmower, other electric landscaping equipment, or even batteries for small items such as flashlights.
Mixed-Use Development Measures								
MM D-9: Urban Mixed-Use	LD (M), SP, TP, AQP, RR, P/Mobile	3%-9%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Development of projects predominantly characterized by properties on which various uses, such as office, commercial, institutional, and residential, are combined in a single building or on a single site in an integrated development project with functional interrelationships and a coherent physical design.
MM D-10: Suburban Mixed-Use	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	3%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Have at least three of the following on site and/or offsite within one-quarter mile: Residential Development, Retail Development, Park, Open Space, or Office.
MM D-11: Other Mixed-Use	LD (R, M), SP, TP, AQP, RR, P/Mobile	1%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	All residential units are within one-quarter mile of parks, schools or other civic uses.

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		2006, SMAQMD 2007).						
MM D-12: Infill Development	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	3%-30%/High: Infill development reduces vehicle trips and VMT by 3% and 20%, respectively (Fehr & Peers 2007). CCAP identifies a site level VMT reduction range of 20%-30% (Dierkers et al. 2007).	Yes	Yes (Dierkers et al. 2007)	Yes (Dierkers et al. 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project site is on a vacant infill site, redevelopment area, or brownfield or greyfield lot that is highly accessible to regional destinations, where the destinations rating of the development site (measured as the weighted average travel time to all other regional destinations) is improved by 100% when compared to an alternate greenfield site.
Miscellaneous Measures								
MM D-13: Electric Lawnmower	LD (R, M), SP, AQP, RR, P/Area	1%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Provide a complimentary electric lawnmower to each residential buyer.

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MM D-14: Enhanced Recycling/Waste Reduction, Reuse, Composting	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Low	Yes	Yes	Yes: Association with social awareness.	Adverse: No Beneficial: CAPs, TACs	CIWMB	Provide infrastructure/education that promotes the avoidance of products with excessive packaging, recycle, buying of refills, separating of food and yard waste for composting, and using rechargeable batteries.
MM D-15: LEED Certification	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Moderate	Yes: Receive tax rebates, incentives (e.g., EDAW San Diego office interior remodel cost $1,700,000 for 32,500 square feet) (USGBC 2007)	Yes	Yes: More than 700 buildings of different certifications in CA (USGBC 2007).	Adverse: No Beneficial: CAPs, TACs	USGBC, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.
MM D-16: Retro-Commissioning	LD (C, M), I, SP, AQP, RR, P/Stationary & Area	8%-10% reduction in energy usage/Moderate: (Mills et al. 2004)	Yes: Average $0.28/square feet, varies with building size (Haasl and Sharp 1999).	Yes	Yes: 27 projects underway in CA, 21 more to be completed in 2007, mostly state buildings owned by DGS (DGS 2007).	Adverse: No Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	The process ensures that all building systems perform interactively according to the contract documents, the design intent and the owner's operational needs to optimize energy performance.
MM D-17 Landscaping	LD (R, C, M), I, SP, AQP, RR,	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	Alliance for the Chesapeake Bay, EPA Green Landscaping	Project shall use drought resistant native trees, trees with low emissions and high carbon

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	P/Stationary & Area						Resources	sequestration potential. Evergreen trees on the north and west sides afford the best protection from the setting summer sun and cold winter winds. Additional considerations include the use of deciduous trees on the south side of the house that will admit summer sun; evergreen plantings on the north side will slow cold winter winds; constructing a natural planted channel to funnel summer cooling breezes into the house. Neighborhood CCR's not requiring that front and side yards of single family homes be planted with turf grass. Vegetable gardens, bunch grass, and low-water landscaping shall also be permitted, or even encouraged.
MM D-18: Local Farmers' Market	LD (M), SP/Mobile, Stationary, &	NA/Low	Yes	Yes	Yes: Associated with social	Adverse: No Beneficial: CAPs, TACs	Cities/counties (e.g., Davis, Sacramento)	Project shall dedicate space in a centralized, accessible location for a weekly farmers' market.

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	Area				choice and public awareness.			
MM D-19: Community Gardens	LD (M), SP/Mobile, Stationary, & Area	NA/Low	Yes	Yes	Yes: Associated with social choice and public awareness.	Adverse: No Beneficial: CAPs, TACs	Cities/counties (e.g., Davis)	Project shall dedicate space for community gardens.
Energy Efficiency/Building Component								
MM E-1: High-Efficiency Pumps	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Project shall use high-efficiency pumps.
MM E-2: Wood Burning Fireplaces/Stoves	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low: EDAW 2006	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project does not feature fireplaces or wood burning stoves.
MM E-3: Natural Gas Stove	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low: EDAW 2006	Yes: Cost of stove—$350 (gas) and $360 (electric) same brand, total yearly cost of $42.17 as opposed to $56.65 for electric (Saving Electricity 2006).	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project features only natural gas or electric stoves in residences.

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MM E-4: Energy Star Roof	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	0.5%-1%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes: 866 Energy Star labeled buildings in California (Energy Star 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project installs Energy Star labeled roof materials.
MM E-5: On-site Renewable Energy System	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	1%-3%/Moderate: SMAQMD presents this % reduction (USGBC 2002 and 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides onsite renewable energy system(s). Nonpolluting and renewable energy potential includes solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies. When applying these strategies, projects may take advantage of net metering with the local utility.

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MM E-6: Exceed Title 24	LD (R, C, M), I, GSP, AQP, RR, P/Stationary & Area	1%/Moderate: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (PG&E 2002, SMUD 2006)	Yes (PG&E 2002, SMUD 2006)	Adverse: No Beneficial: CAPs, TACs	PG&E, SMUD, CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project exceeds title 24 requirements by 20%.
MM E-7: Solar Orientation	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	0.5%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project orients 75% or more of homes and/or buildings to face either north or south (within 30° of N/S). Building design includes roof overhangs that are sufficient to block the high summer sun, but not the lower winter sun, from penetrating south facing windows. Trees, other landscaping features and other buildings are sited in such a way as to maximize shade in the summer and maximize solar access to walls and windows in the winter.
MM E-8: Nonroof Surfaces	LD (R, C, M), I, GSP, AQP, RR, P/Stationary & Area	1.0%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Provide shade (within 5 years) and/or use light-colored/high-albedo materials (reflectance of at least 0.3) and/or open grid pavement for at least 30% of the site's nonroof impervious surfaces, including parking lots, walkways, plazas, etc.; OR place a minimum of 50% of parking spaces underground or covered by structured parking; OR use an open-grid pavement system (less than 50% impervious) for a minimum of

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							50% of the parking lot area. The mitigation measure reduces heat islands (thermal gradient differences between developed and undeveloped areas to minimize impact on microclimate and human and wildlife habitats. This measure requires the use of patented or copyright protected methodologies created by the ASTM. The SRI is a measure of the constructed surface's ability to reflect solar heat, as shown by a small rise in temperature. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is "0" and a standard white (reflectance 0.80, emittance 0.90) is 100. To calculate SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980-01. Reflectance is measured

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								according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371. Default values for some materials will be available in the LEED-NC v2.2 Reference Guide.
MM E-9: Low-Energy Cooling	LD (C, M), I, SP, AQP, RR, P/Stationary & Area	1%-10%/Low: EDAW presents this percent reduction range (EDAW 2006).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project optimizes building's thermal distribution by separating ventilation and thermal conditioning systems.
MM E-10: Green Roof	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	1.0%/Moderate: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: Increased Water Consumption Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Install a vegetated roof that covers at least 50% of roof area. The reduction assumes that a vegetated roof is installed on a least 50% of the roof area or that a combination high albedo and vegetated roof surface is installed that meets the following standard: (Area of SRI Roof/0.75)+(Area of vegetated roof/0.5) >= Total Roof Area. Water consumption reduction measures shall be considered in the design of the green roof.
MM E-11: EV Charging Facilities	LD (C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: $500-$5000/ vehicle site (PG&E 1999)	Yes	Yes: 381 facilities in CA (Clean Air Maps 2007).	Adverse: No Beneficial: CAPs, TACs	DOE, EERE, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Project installs EV charging facilities.
MM E-12:	LD (R, C, M),	NA/Low: Increasing	Yes: Light	Yes	Yes: Apply	Adverse: No		Project provides light-colored

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Light-Colored Paving	I, SP, AQP, RR, P/Stationary & Area	the albedo of 1,250 km of pavement by 0.25 would save cooling energy worth $15M per year.	colored aggregates and white cement are more expensive than gray cement. Certain blended cements are very light in color and may reflect similarly to white cement at an equivalent cost to normal gray cement.		natural sand or gravel colored single surface treatments to asphalt (EOE 2007).	Beneficial: CAPs, TACs		paving (e.g., increased albedo pavement).
MM E-13: Cool Roofs	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: 0.75–1.5/square feet coating (EPA 2007a)	Yes	Yes: Over 90% of the roofs in the United States are dark colored	Adverse: No Beneficial: CAPs, TACs	CEC	Project provides cool roofs. Highly reflective, highly emissive roofing materials that stay 50-60°F cooler than a normal roof under a hot summer sun. CA's Cool Savings

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Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
					(EPA 2007a).			Program provided rebates to building owners for installing roofing materials with high solar reflectance and thermal emittance. The highest rebate went to roofs on air conditioned buildings, while buildings with rooftop ducts and other nonresidential buildings were eligible for slightly less. The program aimed to reduce peak summer electricity demand and was administered by the CEC.
MM E-14: Solar Water Heaters	LD (R, M), SP, AQP, RR, P/Stationary & Area	20%–70% reduction in cooling energy needs/Moderate	Yes: $1675/20 square feet, requires a 50 gallon tank, annual operating cost of $176 (DOE 2007).	Yes	Yes: Based on solar orientation, building codes, zoning ordinances.	Adverse: No Beneficial: CAPs, TACs	Europe	Project provides solar water heaters.
MM E-15: Electric Yard Equipment Compatibility	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: $75–$250/outlet from existing circuit (Cost Helper 2007).	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Project provides electrical outlets at building exterior areas.
MM E-16: Energy Efficient Appliance Standards	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: Varies for each appliance—higher capital costs, lower operating costs (Energy	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Project uses energy efficient appliances (e.g., Energy Star).

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			Star 2007).					
MM E-17: Green Building Materials	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low: 25-30% more efficient on average.	Yes	Yes: BEES software allows users to balance the environmental and economic performance of building products; developed by NIST (NIST 2007).	Yes	Adverse: No Beneficial: CAPs, TACs		Project uses materials which are resource efficient, recycled, with long life cycles and manufactured in an environmentally friendly way.
MM E-18: Shading Mechanisms	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: Up to $450 annual energy savings (Energy Star 2007).	Yes: Higher capital costs, lower operating and maintenance costs (Energy Star 2007).	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing shading mechanisms for windows, porch, patio and walkway overhangs.

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MM E-19: Ceiling/Whole-House Fans	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: 50% more efficient than conventional fans (Energy Star 2007).	Yes: $45-$200/fan, installation extra (Lowe's 2007).	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing ceiling/whole-house fans.
MM E-20: Programmable Thermostats	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: $100 annual savings in energy costs (Energy Star 2007).	Yes: $60/LCD display and 4 settings for typical residential use (Lowe's 2007).	Yes	Yes: Major retail stores.	Adverse: Yes, Mercury Beneficial: CAPs, TACs		Install energy-reducing programmable thermostats that automatically adjust temperature settings.
MM E-21: Passive Heating and Cooling Systems	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low	Yes: $800 (wall heaters) to $4,000+ (central systems)	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing passive heating and cooling systems (e.g., insulation and ventilation).
MM E-22: Day Lighting Systems	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low	Yes: $1,300 to $1,500 depending upon the kind of roof (Barrier 1995), installation extra.	Yes	Yes: Work well only for space near the roof of the building, little benefit in multi-floor buildings.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing day lighting systems (e.g., skylights, light shelves and interior transom windows).
MM E-23: Low-Water Use Appliances	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: Avoided water agency cost for using water-efficient kitchen pre-rinse spray valves of $65.18 per acre-foot.	Yes: Can return their cost through reduction in water consumption,	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Require the installation of low-water use appliances.

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			pumping, and treatment.					
MM E-24: Goods Transport by Rail	LD (C, M), I, SP, AQP, RR, P/Mobile	NA/Moderate	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	ARB Goods Movement Plan (ARB 2007)	Provide a spur at nonresidential projects to use nearby rail for goods movement.
Social Awareness/Education								
MM S-1: GHG Emissions Reductions Education	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Mobile	NA/Low	Yes	Yes	Yes: Similar programs currently exist in CA.	Adverse: No Beneficial: CAPs, TACs		Provide local governments, businesses, and residents with guidance/protocols/information on how to reduce GHG emissions (e.g., energy saving, food miles).
MM S-2: School Curriculum	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Mobile	NA/Low	Yes	Yes	Yes: Similar programs currently exist in CA.	Adverse: No Beneficial: CAPs, TACs		Include how to reduce GHG emissions (e.g., energy saving, food miles) in the school curriculum.
Construction								
MM C-1: ARB-Certified Diesel Construction Equipment	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes: Oxidation Catalysts, $1,000-	Yes	Yes	Adverse: Yes, NO_x Beneficial: CAPs, TACs	AG, EPA, ARB, and CA air quality management and pollution control districts.	Use ARB-certified diesel construction equipment. Increases CO_2 emissions when trapped CO and carbon particles

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			$2,000. DPF, $5000-$10,000; installation extra (EPA 2007b).					are oxidized (Catalyst Products 2007, ETC 2007).
MM C-2: Alternative Fuel Construction Equipment	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: Yes, THC, NO_x Beneficial: CO, PM, SO_x	AG, EPA, ARB, and CA air quality management and pollution control districts.	Use alternative fuel types for construction equipment. At the tailpipe biodiesel emits 10% more CO_2 than petroleum diesel. Overall lifecycle emissions of CO_2 from 100% biodiesel are 78% lower than those of petroleum diesel (NREL 1998, EPA 2007b).
MM C-3: Local Building Materials	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes: Depends on location of building material manufacture sites.	Adverse: No Beneficial: CAPs, TACs		Use locally made building materials for construction of the project and associated infrastructure.
MM C-4: Recycle Demolished Construction Material	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Recycle/Reuse demolished construction material. Use locally made building materials for construction of the project and associated infrastructure.

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Miscellaneous								
MM M-1: Off-Site Mitigation Fee Program	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile & Area	NA/Moderate-High: Though there is currently no program in place, the potential for real and quantifiable reductions of GHG emissions could be high if a defensible fee program were designed.	Yes	Yes	No: Program does not exist in CA, but similar programs currently exist (e.g., Carl Moyer Program, SJVAPCD Rule 9510, SMAQMD Off-Site Construction Mitigation Fee Program).	Adverse: No Beneficial: CAPs, TACs		Provide/Pay into an off-site mitigation fee program, which focuses primarily on reducing emissions from existing development and buildings through retro-fit (e.g., increased insulation).
MM M-2: Offset Purchase	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Area	NA/Low	Yes	Yes	No: ARB has not adopted official program, but similar programs	No		Provide/purchase offsets for additional emissions by acquiring carbon credits or engaging in other market "cap and trade" systems.

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					currently exist.			
Regional Transportation Plan Measures								
MM RTP-1: Dedicate High Occupancy Vehicle (HOV) lanes prior to adding capacity to existing highways.	RTP		Yes	Yes	Yes	Adverse: possible local CO Beneficial: regional CAPs, TACs	Caltrans, local government	Evaluate the trip reduction (and GHG reduction) potential of adding HOV lanes prior to adding standard lanes.
MM RTP-2: Implement toll/user fee programs prior to adding capacity to existing highways.	RTP		Yes	Yes	Yes	Adverse: possible local CO. Beneficial: regional CAPs, TACs	Caltrans	Evaluate price elasticity and associated trip reduction (and GHG reduction) potential with adding or increasing tolls prior to adding capacity to existing highways.

Note:
[1] Where LD (R, C, M) =Land Development (Residential, Commercial, Mixed-Use), I=Industrial, GP=General Plan, SP=Specific Plan, TP=Transportation Plans, AQP=Air Quality Plans, RR=Rules/Regulations, and P=Policy. It is important to note that listed project types may not be directly specific to the mitigation measure (e.g., TP, AQP, RR, and P) as such could apply to a variety of source types, especially RR and P.
[2] This score system entails ratings of high, moderate, and low that refer to the level of the measure to provide a substantive, reasonably certain (e.g., documented emission reductions with proven technologies), and long-term reduction of GHG emissions.
[3] Refers to whether the measure would provide a cost-effective reduction of GHG emissions based on available documentation.
[4] Refers to whether the measure is based on currently, readily available technology based on available documentation.
[5] Refers to whether the measure could be implemented without extraordinary effort based on available documentation.
[6] List is not meant to be all inclusive.
Source: Data complied by EDAW in 2007

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Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-1: Adopt a GHG reduction plan	GP/ Mobile, Stationary, & Area	City of San Bernardino	- Adopt GHG reduction targets for the planning area, based on the current legislation providing direction for state-wide targets, and update the plan as necessary. -The local government agency should serve as a model by inventorying its GHG emissions from agency operations, and implementing those reduction goals.
Circulation			
MS G-2: Provide for convenient and safe local travel	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Create a gridded street pattern with small block sizes. This promotes walkability through direct routing and ease of navigation. -Maintain a high level of connectivity of the roadway network. Minimize cul-de-sacs and incomplete roadway segments. -Plan and maintain an integrated, hierarchical and multi-modal system of roadways, pedestrian walks, and bicycle paths throughout the area. -Apply creative traffic management approaches to address congestion in areas with unique problems, particularly on roadways and intersections in the vicinity of schools in the morning and afternoon peak hours, and near churches, parks and community centers. -Work with adjacent jurisdictions to address the impacts of regional development patterns (e.g. residential development in surrounding communities, regional universities, employment centers, and commercial developments) on the circulation system. -Actively promote walking as a safe mode of local travel, particularly for children attending local schools. -Employ traffic calming methods such as median landscaping and provision of bike or transit lanes to slow traffic, improve roadway capacity, and address safety issues.
MS G-3: Enhance the regional transportation network and maintain effectiveness	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage the transportation authority to reduce fees for short distance trips. -Ensure that improvements to the traffic corridors do not negatively impact the operation of local roadways and land uses.

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			-Cooperate with adjacent jurisdictions to maintain adequate service levels at shared intersections and to provide adequate capacity on regional routes for through traffic. -Support initiatives to provide better public transportation. Work actively to ensure that public transportation is part of every regional transportation corridor. - Coordinate the different modes of travel to enable users to transfer easily from one mode to another. -Work to provide a strong paratransit system that promotes the mobility of all residents and educate residents about local mobility choices. - Promote transit-oriented development to facilitate the use of the community's transit services.
MS G-4: Promote and support an efficient public transportation network connecting activity centers in the area to each other and the region.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Promote increased use of public transportation and support efforts to increase bus service range and frequency within the area as appropriate. -Enhance and encourage provision of attractive and appropriate transit amenities, including shaded bus stops, to encourage use of public transportation. -Encourage the school districts, private schools and other operators to coordinate local bussing and to expand ride-sharing programs. All bussing options should be fully considered before substantial roadway improvements are made in the vicinity of schools to ease congestion.
MS G-5: Establish and maintain a comprehensive system, which is safe and convenient, of pedestrian ways and bicycle routes that provide viable options to travel by automobile.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Improve area sidewalks and rights-of-way to make them efficient and appealing for walking and bicycling safely. Coordinate with adjacent jurisdictions and regional agencies to improve pedestrian and bicycle trails, facilities, signage, and amenities. -Provide safe and convenient pedestrian and bicycle connections to and from town centers, other commercial districts, office complexes, neighborhoods, schools, other major activity centers, and surrounding communities. -Work with neighboring jurisdictions to provide well-designed pedestrian and bicycle crossings of major roadways. -Promote walking throughout the community. Install sidewalks where missing and make improvements

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			to existing sidewalks for accessibility purposes. Particular attention should be given to needed sidewalk improvement near schools and activity centers. -Encourage businesses or residents to sponsor street furniture and landscaped areas. - Strive to provide pedestrian pathways that are well shaded and pleasantly landscaped to encourage use. - Attract bicyclists from neighboring communities to ride their bicycles or to bring their bicycles on the train to enjoy bicycling around the community and to support local businesses. - Meet guidelines to become nationally recognized as a Bicycle-Friendly community. - Provide for an education program and stepped up code enforcement to address and minimize vegetation that degrades access along public rights-of-way. -Engage in discussions with transit providers to increase the number of bicycles that can be accommodated on buses
MS G-6: Achieve optimum use of regional rail transit.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Support regional rail and work with rail authority to expand services. - Achieve better integration of all transit options. -Work with regional transportation planning agencies to finance and provide incentives for multimodal transportation systems. - Promote activity centers and transit-oriented development projects around the transit station.
MS G-7: Expand and optimize use of local and regional bus and transit systems.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage convenient public transit service between area and airports. -Support the establishment of a local shuttle to serve commercial centers. -Promote convenient, clean, efficient, and accessible public transit that serves transit-dependent riders and attracts discretionary riders as an alternative to reliance on single-occupant automobiles.

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			- Empower seniors and those with physical disabilities who desire maximum personal freedom and independence of lifestyle with unimpeded access to public transportation. -Integrate transit service and amenities with surrounding land uses and buildings.
Conservation, Open Space			
MS G-8: Emphasize the importance of water conservation and maximizing the use of native, low-water landscaping.	GP/Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Reduce the amount of water used for landscaping and increase use of native and low water plants. Maximize use of native, low-water plants for landscaping of areas adjacent to sidewalks or other impermeable surfaces. -Encourage the production, distribution and use of recycled and reclaimed water for landscaping projects throughout the community, while maintaining urban runoff water quality objectives. -Promote water conservation measures, reduce urban runoff, and prevent groundwater pollution within development projects, property maintenance, area operations and all activities requiring approval. -Educate the public about the importance of water conservation and avoiding wasteful water habits. -Work with water provider in exploring water conservation programs, and encourage the water provider to offer incentives for water conservation.
MS G-9: Improve air quality within the region.	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Integrate air quality planning with area land use, economic development and transportation planning efforts. -Support programs that reduce air quality emissions related to vehicular travel. -Support alternative transportation modes and technologies, and develop bike- and pedestrian-friendly neighborhoods to reduce emissions associated with automobile use. -Encourage the use of clean fuel vehicles. -Promote the use of fuel-efficient heating and cooling equipment and other appliances, such as water

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			heaters, swimming pool heaters, cooking equipment, refrigerators, furnaces, and boiler units. - Promote the use of clean air technologies such as fuel cell technologies, renewable energy sources. UV coatings, and alternative, non-fossil fuels. -Require the planting of street trees along streets and inclusion of trees and landscaping for all development projects to help improve airshed and minimize urban heat island effects. - Encourage small businesses to utilize clean, innovative technologies to reduce air pollution. - Implement principles of green building. - Support jobs/housing balance within the community so more people can both live and work within the community. To reduce vehicle trips, encourage people to telecommute or work out of home or in local satellite offices.
MS G-10: Encourage and maximize energy conservation and identification of alternative energy sources.	GP/ Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage green building designs for new construction and renovation projects within the area. -Coordinate with regional and local energy suppliers to ensure adequate supplies of energy to meet community needs, implement energy conservation and public education programs, and identify alternative energy sources where appropriate. -Encourage building orientations and landscaping that enhance natural lighting and sun exposure. -Encourage expansion of neighborhood-level products and services and public transit opportunities throughout the area to reduce automobile use. - Incorporate the use of energy conservation strategies in area projects. - Promote energy-efficient design features, including appropriate site orientation, use of light color roofing and building materials, and use of evergreen trees and wind-break trees to reduce fuel consumption for heating and cooling.

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			-Explore and consider the cost/benefits of alternative fuel vehicles including hybrid, natural gas, and hydrogen powered vehicles when purchasing new vehicles. -Continue to promote the use of solar power and other energy conservation measures. - Encourage residents to consider the cost/benefits of alternative fuel vehicles. - Promote the use of different technologies that reduce use of non-renewable energy resources. -Facilitate the use of green building standards and LEED in both private and public projects. -Promote sustainable building practices that go beyond the requirements of Title 24 of the California Administrative Code, and encourage energy-efficient design elements, as appropriate. -Support sustainable building practices that integrate building materials and methods that promote environmental quality, economic vitality, and social benefit through the design, construction, and operation of the built environment. - Investigate the feasibility of using solar (photovoltaic) street lights instead of conventional street lights that are powered by electricity in an effort to conserve energy. - Encourage cooperation between neighboring development to facilitate on-site renewable energy supplies or combined heat and power co-generation facilities that can serve the energy demand of contiguous development.

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MS G-11: Preserve unique community forests, and provide for sustainable increase and maintenance of this valuable resource.	GP/Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Develop a tree planting policy that strives to accomplish specific % shading of constructed paved and concrete surfaces within five years of construction. -Provide adequate funding to manage and maintain the existing forest, including sufficient funds for tree planting, pest control, scheduled pruning, and removal and replacement of dead trees. -Coordinate with local and regional plant experts in selecting tree species that respect the natural region in which Claremont is located, to help create a healthier, more sustainable urban forest. - Continue to plant new trees (in particular native tree species where appropriate), and work to preserve mature native trees. -Increase the awareness of the benefits of street trees and the community forest through a area wide education effort. -Encourage residents to properly care for and preserve large and beautiful trees on their own private property.
Housing			
MS G-12: Provide affordability levels to meet the needs of community residents.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage development of affordable housing opportunities throughout the community, as well as development of housing for elderly and low and moderate income households near public transportation services. -Ensure a portion of future residential development is affordable to low and very low income households.
Land Use			
MS G-13: Promote a visually-cohesive urban form and establish connections between the urban core and outlying portions of the	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Preserve the current pattern of development that encourages more intense and higher density development at the core of the community and less intense uses radiating from the central core. -Create and enhance landscaped greenway, trail and sidewalk connections between neighborhoods and to commercial areas, town centers, and parks.

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community.			-Identify ways to visually identify and physically connect all portions of the community, focusing on enhanced gateways and unifying isolated and/or outlying areas with the rest of the area. -Study and create a diverse plant identity with emphasis on drought-resistant native species.
MS G-14: Provide a diverse mix of land uses to meet the future needs of all residents and the business community.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Attract a broad range of additional retail, medical, and office uses providing employment at all income levels. -Support efforts to provide beneficial civic, religious, recreational, cultural and educational opportunities and public services to the entire community. -Coordinate with public and private organizations to maximize the availability and use of parks and recreational facilities in the community. -Support development of hotel and recreational commercial land uses to provide these amenities to local residents and businesses.
MS G-15: Collaborate with providers of solid waste collection, disposal and recycling services to ensure a level of service that promotes a clean community and environment.	GP/ Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Require recycling, composting, source reduction and education efforts throughout the community, including residential, businesses, industries, and institutions, within the construction industry, and in all sponsored activities.
MS G-16: Promote construction, maintenance and active use of publicly- and privately-operated parks, recreation programs, and a community center.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Work to expand and improve community recreation amenities including parks, pedestrian trails and connections to regional trail facilities. -As a condition upon new development, require payment of park fees and/or dedication and provision of parkland, recreation facilities and/or multi-use trails that improve the public and private recreation system. -Research options or opportunities to provide necessary or desired community facilities.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-17: Promote the application of sustainable development practices.	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Encourage sustainable development that incorporates green building best practices and involves the reuse of previously developed property and/or vacant sites within a built-up area. - Encourage the conservation, maintenance, and rehabilitation of the existing housing stock. -Encourage development that incorporates green building practices to conserve natural resources as part of sustainable development practices. -Avoid development of isolated residential areas in the hillsides or other areas where such development would require significant infrastructure investment, adversely impact biotic resources. - Provide land area zoned for commercial and industrial uses to support a mix of retail, office, professional, service, and manufacturing businesses.
MS G-18: Create activity nodes as important destination areas, with an emphasis on public life within the community.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide pedestrian amenities, traffic-calming features, plazas and public areas, attractive streetscapes, shade trees, lighting, and retail stores at activity nodes. -Provide for a mixture of complementary retail uses to be located together to create activity nodes to serve adjacent neighborhoods and to draw visitors from other neighborhoods and from outside the area.
MS G-19: Make roads comfortable, safe, accessible, and attractive for use day and night.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide crosswalks and sidewalks along streets that are accessible for people with disabilities and people who are physically challenged. -Provide lighting for walking and nighttime activities, where appropriate. -Provide transit shelters that are comfortable, attractive, and accommodate transit riders.
MS G-20: Maintain and expand where possible the system of neighborhood connections that attach neighborhoods to larger roadways.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Provide sidewalks where they are missing, and provide wide sidewalks where appropriate with buffers and shade so that people can walk comfortably. -Make walking comfortable at intersections through traffic-calming, landscaping, and designated crosswalks.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			-Look for opportunities for connections along easements & other areas where vehicles not permitted.
MS G-21: Create distinctive places throughout the area.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide benches, streetlights, public art, and other amenities in public areas to attract pedestrian activities. -Encourage new developments to incorporate drought tolerant and native landscaping that is pedestrian friendly, attractive, and consistent with the landscaped character of area. -Encourage all new development to preserve existing mature trees. -Encourage streetscape design programs for commercial frontages that create vibrant places which support walking, bicycling, transit, and sustainable economic development. -Encourage the design and placement of buildings on lots to provide opportunities for natural systems such as solar heating and passive cooling. - Ensure that all new industrial development projects are positive additions to the community setting, provide amenities for the comfort of the employees such as outdoor seating area for breaks or lunch, and have adequate landscape buffers.
MS G-22: Reinvest in existing neighborhoods and promote infill development as a preference over new, greenfield development	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Identify all underused properties in the plan area and focus development in these opportunity sites prior to designating new growth areas for development. - Implement programs to retro-fit existing structures to make them more energy-efficient. -Encourage compact development, by placing the desired activity areas in smaller spaces.

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
Public Safety			
MS G-23: Promote a safe community in which residents can live, work, shop, and play.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Foster an environment of trust by ensuring non-biased policing, and by adopting policies and encouraging collaboration that creates transparency. - Facilitate traffic safety for motorists and pedestrians through proper street design and traffic monitoring.

Note:
[1] Where GP=General Plan.
[2] List is not meant to be all inclusive.
Source: Data complied by EDAW in 2007

Appendix C

Rule and Regulation Summary

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Low Carbon Fuel Standard	10-20 MMT CO_2e by 2020	January 1, 2010	ARB	This rule/regulation will require fuel providers (e.g., producers, importers, refiners and blenders) to ensure that the mix of fuels they sell in CA meets the statewide goal to reduce the carbon intensity of CA's transportation fuels by at least 10% by the 2020 target.	ARB Early Action Measure
Reduction of HFC-134a Emissions from Nonprofessional Servicing of Motor Vehicle Air Conditioning Systems	1-2 MMT CO_2e by 2020	January 1, 2010	ARB	This rule/regulation will restrict the use of high GWP refrigerants for nonprofessional recharging of leaky automotive air conditioning systems.	ARB Early Action Measure
Landfill Gas Recovery	2-4 MMT CO_2e by 2020	January 1, 2010	IWMB, ARB	This rule/regulation will require landfill gas recovery systems on small to medium landfills that do not have them and upgrade the requirements at landfills with existing systems to represent best capture and destruction efficiencies.	ARB Early Action Measure
Vehicle Climate Change Standards (AB 1493 Pavley, Chapter 200, Statutes of 2002)	30 MMT CO_2e by 2020	2009	ARB	This rule/regulation will require ARB to achieve the maximum feasible and cost effective reduction of GHG emissions from passenger vehicles and light-duty trucks.	ARB Early Action Measure
Reduction of PFCs from the Semiconductor Industry	0.5 MMT CO_2e by 2020	2007–2009	ARB	This rule/regulation will reduce GHG emissions by process improvements/source reduction, alternative chemicals capture and beneficial reuse, and destruction technologies	Underway or to be initiated by CAT members in 2007-2009 period

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Restrictions on High GWP Refrigerants	9 MMT CO_2e by 2020	2010	ARB	This rule/regulation will expand and enforce the national ban on release of high GWP refrigerants during appliance lifetime.	ARB Early Action Measure
Cement Manufacture	<1 MMT CO_2e per year (based on 2004 production levels)	2010	Caltrans	This rule/regulation will allow 2.5% interground limestone concrete mix in cement use.	CAT Early Action Measure
Hydrogen Fuel Standards (SB 76 of 2005)	TBD	By 2008	CDFA	This rule/regulation will develop hydrogen fuel standards for use in combustion systems and fuel cells.	CAT Early Action Measure
Regulation of GHG from Load Serving Entities (SB 1368)	15 MMT CO_2e by 2020	May 23, 2007	CEC, CPUC	This rule/regulation will establish a GHG emission performance standard for baseload generation of local publicly owned electric utilities that is no higher than the rate of emissions of GHG for combined-cycle natural gas baseload generation.	CAT Early Action Measure
Energy Efficient Building Standards	TBD	In 2008	CEC	This rule/regulation will update of Title 24 standards.	CAT Early Action Measure
Energy Efficient Appliance Standards	TBD	January 1, 2010	CEC	This rule/regulation will regulate light bulb efficiency	CAT Early Action Measure
Tire Efficiency (Chapter 8.7 Division 15 of the Public Resources Code)	<1 MMT CO_2e by 2020	January 1, 2010	CEC & IWMB	This rule/regulation will ensure that replacement tires sold in CA are at least as energy efficient, on average, as tires sold in the state as original equipment on these vehicles.	CAT Early Action Measure
New Solar Homes Partnership	TBD	January 2007	CEC	Under this rule/regulation, approved solar systems will receive incentive funds based on system performance above building standards.	CAT Early Action Measure

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Water Use Efficiency	1 MMT CO_2e by 2020	2010	DWR	This rule/regulation will adopt standards for projects and programs funded through water bonds that would require consideration of water use efficiency in construction and operation.	CAT Early Action Measure
State Water Project	TBD	2010	DWR	This rule/regulation will include feasible and cost effective renewable energy in the SWP's portfolio.	CAT Early Action Measure
Cleaner Energy for Water Supply	TBD	2010	DWR	Under this rule/regulation, energy supply contracts with conventional coal power plants will not be renewed.	CAT Early Action Measure
IOU Energy Efficiency Programs	4 MMT CO_2e by 2020	2010	CPUC	This rule/regulation will provide a risk/reward incentive mechanism for utilities to encourage additional investment in energy efficiency; evaluate new technologies and new measures like encouraging compact fluorescent lighting in residential and commercial buildings	CAT Early Action Measure
Solar Generation	TBD	2007–2009	DGS	3 MW of clean solar power generation implemented in CA last year, with another 1 MW coming up. The second round is anticipated to total additional 10 MW and may include UC/CSU campuses and state fairgrounds.	Underway or to be initiated by CAT members in 2007-2009 period

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Transportation Efficiency	9 MMT CO_2e by 2020	2007–2009	Caltrans	This rule/regulation will reduce congestion, improve travel time in congested corridors, and promote coordinated, integrated land use.	Underway or to be initiated by CAT members in 2007-2009 period
Smart Land Use and Intelligent Transportation	10 MMT CO_2e by 2020	2007–2009	Caltrans	This rule/regulation will integrate consideration of GHG reduction measures and energy efficiency factors into RTPs, project development etc.	Underway or to be initiated by CAT members in 2007-2009 period
Cool Automobile Paints	1.2 to 2.0 MMT CO_2e by 2020	2009	ARB	Cool paints would reduce the solar heat gain in a vehicle and reduce air conditioning needs.	ARB Early Action Measure
Tire Inflation Program	TBD	2009	ARB	This rule/regulation will require tires to be checked and inflated at regular intervals to improve fuel economy.	ARB Early Action Measure
Electrification of Stationary Agricultural Engines	0.1 MMT CO_2e by 2020	2010	ARB	This rule/regulation will provide incentive funding opportunities for replacing diesel engines with electric motors.	ARB Early Action Measure
Desktop Power Management	Reduce energy use by 50%	2007–2009	DGS, ARB	This rule/regulation will provide software to reduce electricity use by desktop computers by up to 40%.	Currently deployed in DGS
Reducing CH_4 Venting/Leaking from Oil and Gas Systems (EJAC-3/ARB 2-12)	1 MMT CO_2e by 2020	2010	ARB	This rule/regulation will reduce fugitive CH_4 emissions from production, processing, transmission, and distribution of natural gas and oil.	ARB Early Action Measure
Replacement of High GWP Gases Used in Fire Protection Systems with Alternate Chemical (ARB 2-10)	0.1 MMT CO_2e by 2020	2011	ARB	This rule/regulation will require the use of lower GWP substances in fire protection systems.	ARB Early Action Measure
Contracting for Environmentally Preferable Products	NA	2007–2009	DGS	New state contracts have been or are being created for more energy and resource efficient IT goods, copiers, low mercury fluorescent lamps, the CA Gold Carpet Standard and office furniture.	Underway or to be initiated by CAT members in 2007-2009 period
Hydrogen Fuel Cells	NA	2007–2009	DGS	This rule/regulation will incorporate clean hydrogen fuel cells in stationary applications	Underway or to be initiated by CAT members in 2007-2009

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
				at State facilities and as back-up generation for emergency radio services.	period
High Performance Schools	NA	2007–2009	DGS	New guidelines adopted for energy and resource efficient schools; up to $100 million in bond money for construction of sustainable, high performance schools.	Underway or to be initiated by CAT members in 2007-2009 period
Urban Forestry	1 MMT CO_2e by 2020	2007–2009	Calfire, CUFR	This rule/regulation will provide five million additional trees in urban areas by 2020.	Underway or to be initiated by CAT members in 2007-2009 period
Fuels Management/Biomass	3 MMT CO_2e by 2020	2007–2009	Calfire	This rule/regulation will provide biomass from forest fuel treatments to existing biomass utilization facilities.	Underway or to be initiated by CAT members in 2007-2009 period
Forest Conservation and Forest Management	10 MMT CO_2e by 2020	2007–2009	Calfire, WCB	This rule/regulation will provide opportunities for carbon sequestration in Proposition 84 forest land conservation program to conserve an additional 75,000 acres of forest landscape by 2010.	Underway or to be initiated by CAT members in 2007-2009 period
Afforestation/Reforestation	2 MMT CO_2e by 2020	2007–2009	Calfire	This rule/regulation will subsidize tree planting.	Underway or to be initiated by CAT members in 2007-2009 period
Dairy Digesters	TBD	January 1, 2010	CDFA	This rule/regulation will develop a dairy digester protocol to document GHG emission reductions from these facilities.	ARB Early Action Measure

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Conservation Tillage and Enteric Fermentation	1 MMT CO_2e by 2020	2007–2009	CDFA	This rule/regulation will develop and implement actions to quantify and reduce enteric fermentation emissions from livestock and sequester soil carbon using cover crops and conservation tillage.	Underway or to be initiated by CAT members in 2007-2009 period
ULEV	TBD	2007–2009	DGS	A new long term commercial rental contract was released in March 2007 requiring a minimum ULEV standard for gasoline vehicles and requires alternative fuel and hybrid-electric vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Flex Fuel Vehicles	370 metric tons CO_2, 0.85 metric tons of CH_4, and 1.14 metric tons of N_2O	2007–2009	DGS	Under this rule/regulation, DGS is replacing 800 vehicles with new, more efficient vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Climate Registry	TBD	2007–2009	DGS	Benchmarking and reduction of GHG emissions for state owned buildings, leased buildings and light duty vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Municipal Utilities Electricity Sector Carbon Policy	Included in SB 1368 reductions	2007–2009	CEC, CPUC, ARB	Under this rule/regulation, GHG emissions cap policy guidelines for CA's electricity sector (IOUs and POUs).	Underway or to be initiated by CAT members in 2007-2009 period
Alternative Fuels: Nonpetroleum Fuels	TBD	2007–2009	CEC	State plan to increase the use of alternative fuels for transportation; full fuel cycle assessment.	Underway or to be initiated by CAT members in 2007-2009 period
Zero Waste/High Recycling Strategy	5 MMT CO_2e by 2020	2007–2009	IWMB	This rule/regulation will identify materials to focus on to achieve GHG reduction at the lowest possible cost; Builds on the success of 50% Statewide Recycling Goal.	Underway or to be initiated by CAT members in 2007-2009 period
Organic Materials Management	TBD	2007–2009	IWMB	This rule/regulation will develop a market incentive program to increase organics diversion to the agricultural industry.	Underway or to be initiated by CAT members in 2007-2009 period
Landfill Gas Energy	TBD	2007–2009	IWMB	Landfill Gas to Energy & LNG/biofuels	Underway or to be initiated by CAT members in 2007-2009 period

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Target Recycling	TBD	2007–2009	IWMB	This rule/regulation will focus on industry/public sectors with high GHG components to implement targeted commodity recycling programs.	Underway or to be initiated by CAT members in 2007-2009 period
Accelerated Renewable Portfolio Standard	Included in SB 1368 reductions	2007–2009	CPUC	This rule/regulation will examine RPS long term planning and address the use of tradable renewable energy credits for RPS compliance.	Underway or to be initiated by CAT members in 2007-2009 period
CA Solar Initiative	1 MMT CO_2e by 2020	2007–2009	CPUC	Initiative to deliver 2000 MWs of clean, emissions free energy to the CA grid by 2016.	Underway or to be initiated by CAT members in 2007-2009 period
Carbon Capture and Sequestration	TBD	2007–2009	CPUC	Proposals for power plants with IGCC and/or carbon capture in the next 18 months.	Underway or to be initiated by CAT members in 2007-2009
Source: Data complied by EDAW in 2007					

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

California Environmental Quality Act Guidelines Update

Proposed Thresholds of Significance

December 7, 2009

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Bay Area Air Quality Management District

Proposed Air Quality CEQA Thresholds of Significance

1 INTRODUCTION

Bay Area Air Quality Management District (BAAQMD or Air District) staff analyzed various options for California Environmental Quality Act (CEQA) air quality thresholds of significance for use within BAAQMD's jurisdiction. The analysis and evaluation undertaken by Air District staff is documented in the *Revised Draft Options and Justification Report – California Environmental Quality Act Thresholds of Significance* (Draft Options Report) (BAAQMD October 2009).

Air District staff hosted public workshops in February, April, September and October 2009 at several locations around the Bay Area. In addition, Air District staff met with regional stakeholder groups to discuss and receive input on the threshold options being evaluated. Throughout the course of the public workshops and stakeholder meetings Air District staff received many comments on the various options under consideration. Based on comments received and additional staff analysis, the threshold options and staff-recommended thresholds were further refined. The culmination of this year-long effort was presented in the Proposed Thresholds of Significance Report published on November 2, 2009 as the Air District staff's proposed air quality thresholds of significance.

The Air District Board of Directors (Board) held public hearings on November 18 and December 2, 2009, to receive comments on staff's Proposed Thresholds of Significance (November 2009). After public testimony and Board deliberations, the Board requested staff to present additional options for risk and hazard thresholds for Board consideration. This Report includes risks and hazards threshold options, as requested by the Board, in addition to staff's previously recommended thresholds of significance. The proposed thresholds presented herein, upon adoption by the Air District Board of Directors, are intended to replace all of the Air District's currently recommended thresholds. The proposed air quality thresholds of significance, and Board-requested risk and hazard threshold options, are provided in Table 1 at the end of this introduction.

1.1 BAAQMD/CEQA REGULATORY AUTHORITY

The BAAQMD has direct and indirect regulatory authority over sources of air pollution in the San Francisco Bay Area Air Basin (SFBAAB). CEQA requires that public agencies consider the potential adverse environmental impacts of any project that a public agency proposes to carry out, fund or approve. CEQA requires that a lead agency prepare an Environmental Impact Report (EIR) whenever it can be fairly argued (the "fair argument" standard), based on substantial evidence,[1] that a project may have a significant effect[2] on

[1] "Substantial evidence" includes facts, reasonable assumptions predicated upon facts, or expert opinions supported by facts, but does not include argument, speculation, unsubstantiated opinion or narrative, evidence that is clearly inaccurate or erroneous, or evidence of social or

the environment, even if there is substantial evidence to the contrary (CEQA Guidelines §15064). CEQA requires that the lead agency review not only a project's direct effects on the environment, but also the cumulative impacts of a project and other projects causing related impacts. When the incremental effect of a project is cumulatively considerable, the lead agency must discuss the cumulative impacts in an EIR. (CEQA Guidelines §15064).

The "fair argument" standard refers to whether a fair argument can be made that a project may have a significant effect on the environment (*No Oil, Inc. v. City of Los Angeles* (1974) 13 Cal.3d 68, 84). The fair argument standard is generally considered a low threshold requirement for preparation of an EIR. The legal standards reflect a preference for requiring preparation of an EIR and for "resolving doubts in favor of environmental review." *Meija v. City of Los Angeles* (2005) 130 Cal. App. 4th 322, 332. "The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data." (CEQA Guidelines §15064(b).

In determining whether a project may have a significant effect on the environment, CEQA Guidelines Section 15064.7 provides that lead agencies may adopt and/or apply "thresholds of significance." A threshold of significance is "an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which means the effect normally will be determined to be less than significant" (CEQA Guidelines §15064.7).

While thresholds of significance give rise to a presumption of insignificance, thresholds are not conclusive, and do not excuse a public agency of the duty to consider evidence that a significant effect may occur under the fair argument standard. *Meija*, 130 Cal. App. 4th at 342. "A public agency cannot apply a threshold of significance or regulatory standard 'in a way that forecloses the consideration of any other substantial evidence showing there may be a significant effect.'" *Id.* This means that if a public agency is presented with factual information or other substantial evidence establishing a fair argument that a project may have a significant effect on the environment, the agency must prepare an EIR to study those impacts even if the project's impacts fall below the applicable threshold of significance.

Thresholds of significance must be supported by substantial evidence. This Report provides the substantial evidence in support of the thresholds of significance developed by the BAAQMD. If adopted by the BAAQMD Board of Directors, the Air District will recommend that lead agencies within the nine counties of the BAAQMD's jurisdiction

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economic impacts that do not contribute to, or are not caused by, physical impacts on the environment. Cal. Pub. Res. C. §21080(c); *see also* CEQA Guidelines §15384.

[2] A "significant effect" on the environment is defined as a "substantial, or potentially substantial, adverse change in the environment." Cal. Pub. Res. C. §21068; *see also* CEQA Guidelines §15382.

use the thresholds of significance in this Report when considering the air quality impacts of projects under their consideration.

1.2 JUSTIFICATION FOR UPDATING CEQA THRESHOLDS

Any analysis of environmental impacts under CEQA includes an assessment of the nature and extent of each impact expected to result from the project to determine whether the impact will be treated as significant or less than significant. CEQA gives lead agencies discretion whether to classify a particular environmental impact as significant. Ultimately, formulation of a standard of significance requires the lead agency to make a policy judgment about where the line should be drawn distinguishing adverse impacts it considers significant from those that are not deemed significant. This judgment must, however, be based on scientific information and other factual data to the extent possible (CEQA Guidelines §15064(b)).

In the sense that advances in science provide new or refined factual data, combined with advances in technology and the gradual improvement or degradation of an environmental resource, the point where an environmental effect is considered significant is fluid over time. Other factors influencing this fluidity include new or revised regulations and standards, and emerging, new areas of concern.

In the ten years since BAAQMD last reviewed its recommended CEQA thresholds of significance for air quality, there have been tremendous changes that affect the quality and management of the air resources in the Bay Area. Traditional criteria air pollutant ambient air quality standards, at both the state and federal levels, have become increasingly more stringent. A new criteria air pollutant standard for fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) has been added to federal and state ambient air quality standards. We have found, through technical advances in impact assessment, that toxic air contaminants are not only worse than previously thought from a health perspective, but that certain communities experience high levels of toxic air contaminants, giving rise to new regulations and programs to reduce the significantly elevated levels of ambient toxic air contaminant concentrations in the Bay Area.

In response to the elevated levels of toxic air contaminants in some Bay Area communities, the Air District created the Community Air Risk Evaluation (CARE) Program. Phase 1 of the BAAQMD's CARE program compiled and analyzed a regional emissions inventory of toxic air contaminants (TACs), including emissions from stationary sources, area sources, and on-road and off-road mobile sources. Phase 2 of the CARE Program conducted regional computer modeling of selected TAC species, species which collectively posed the greatest risk to Bay Area residents. In both Phases 1 and 2, demographic data were combined with estimates of TAC emissions or concentrations to identify communities that are disproportionally impacted from high concentrations of TACs. Bay Area Public Health Officers, in discussions with Air District staff and in comments to the Air District's Advisory Council (February 11, 2009, Advisory Council Meeting on Air Quality and Public Health), have recommended that $PM_{2.5}$, in addition to TACs, be considered in assessments of community-scale impacts of air pollution.

Another significant issue that affects the quality of life for Bay Area residents is the growing concern with global climate change. In just the past few years, estimates of the global atmospheric temperature and greenhouse gas concentration limits needed to stabilize climate change have been adjusted downward and the impacts of greenhouse gas emissions considered more dire. Previous scientific assessments assumed that limiting global temperature rise to 2-3°C above pre-industrial levels would stabilize greenhouse gas concentrations in the range of 450-550 parts per million (ppm) of carbon dioxide-equivalent (CO_2e). Now the science indicates that a temperature rise of 2°C would not prevent dangerous interference with the climate system. Recent scientific assessments suggest that global temperature rise should be kept below 2°C by stabilizing greenhouse gas concentrations below 350 ppm CO_2e, a significant reduction from the current level of 385 ppm CO_2e.

For the reasons stated above, and to further the goals of other District programs such as encouraging transit-oriented and infill development, BAAQMD has undertaken an effort to review all of its currently-recommended CEQA thresholds, revise them as appropriate, and develop new thresholds where appropriate. The overall goal of this effort is to develop CEQA significance criteria that ensure new development implements appropriate and feasible emission reduction measures to mitigate significant air quality impacts. The Air District's recommended CEQA significance thresholds have been vetted through a public review process and will be presented to the BAAQMD Board of Directors for adoption.

Table 1 – Proposed Air Quality CEQA Thresholds of Significance

Pollutant	**Construction-Related**	**Operational-Related**	
Project-Level			
Criteria Air Pollutants and Precursors (Regional)	**Average Daily Emissions (lb/day)**	**Average Daily Emissions (lb/day)**	**Maximum Annual Emissions (tpy)**
ROG	54	54	10
NO_X	54	54	10
PM_{10} (exhaust)	82	82	15
$PM_{2.5}$ (exhaust)	54	54	10
$PM_{10}/PM_{2.5}$ (fugitive dust)	Best Management Practices	None	
Local CO	None	9.0 ppm (8-hour average), 20.0 ppm (1-hour average)	
GHGs **Projects other than Stationary Sources**	None	Compliance with Qualified Climate Action Plan OR 1,100 MT of CO_2e/yr OR 4.6 MT CO_2e/SP/yr (residents + employees)	

Table 1 – Proposed Air Quality CEQA Thresholds of Significance		
Pollutant	**Construction-Related**	**Operational-Related**
GHGs **Stationary Sources**	None	10,000 MT/yr
Risks and Hazards (Individual Project) **Staff Proposal**	Same as Operational Thresholds*	**All Areas:** Siting a New Source or Receptor Compliance with Qualified Risk Reduction Plan OR Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor
Risks and Hazards (Individual Project) **Board Option 1** **Tiered Thresholds**	Same as Operational Thresholds*	**Impacted Communities:** Siting a New Source Compliance with Qualified Risk Reduction Plan OR Increased cancer risk of >5.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.2 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor
	Same as Operational Thresholds*	**Impacted Communities:** Siting a New Receptor **All Other Areas:** Siting a New Source or Receptor Compliance with Qualified Risk Reduction Plan OR Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor
Risks and Hazards (Individual Project) **Board Option 2** **Quantitative Thresholds**	Same as Operational Thresholds*	**All Areas**: Siting a New Source or Receptor Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor

Table 1 – Proposed Air Quality CEQA Thresholds of Significance		
Pollutant	**Construction-Related**	**Operational-Related**
Risks and Hazards (Cumulative Thresholds)	Same as Operational Thresholds*	**All Areas**: Siting a New Source or Receptor Compliance with Qualified Risk Reduction Plan OR Cancer: > 100 in a million (from all local sources) Non-cancer: > 1.0 Hazard Index (from all local sources) (Chronic or Acute) $PM_{2.5}$: > 0.8 µg/m^3 annual average (from all local sources) Zone of Influence: 1,000-foot radius from fence line of source or receptor
Accidental Release of Acutely Hazardous Air Pollutants	None	Storage or use of acutely hazardous materials locating near receptors or receptors locating near stored or used acutely hazardous materials considered significant
Odors	None	Screening Level Distances and Complaint History
Plan-Level		
Criteria Air Pollutants and Precursors (Regional and Local)	None	1. Consistency with Current Air Quality Plan control measures 2. Projected VMT or vehicle trip increase is less than or equal to projected population increase
GHGs	None	Compliance with Qualified Climate Action Plan (or similar criteria included in a General Plan) OR 6.6 MT CO2e/ SP/yr (residents + employees)
Risks and Hazards/Odors	None	1. Overlay zones around existing and planned sources of TACs (including adopted Risk Reduction Plan areas) and odors 2. Overlay zones of at least 500 feet (or Air District-approved modeled distance) from all freeways and high volume roadways
Accidental Release of Acutely Hazardous Air Pollutants	None	None

Notes: CO = carbon monoxide; CO_2e = carbon dioxide equivalent; GHGs = greenhouse gases; lb/day = pounds per day; MT = metric tons; NO_X = oxides of nitrogen; $PM_{2.5}$= fine particulate matter with an aerodynamic resistance diameter of 2.5 micrometers or less; PM_{10} = respirable particulate matter with an aerodynamic resistance diameter of 10 micrometers or less; ppm = parts per million; ROG = reactive organic gases; SO_2 = sulfur dioxide; SP = service population; TACs = toxic air contaminants; TBP = toxic best practices; tons/day = tons per day; tpy = tons per year; yr= year.

* Note: The Air District recommends that for construction projects that are less than one year duration, Lead Agencies should annualize impacts over the scope of actual days that peak impacts are to occur, rather than the full year.

2 GREENHOUSE GAS THRESHOLDS

BAAQMD does not currently have an adopted threshold of significance for GHG emissions. BAAQMD currently recommends that lead agencies quantify GHG emissions resulting from new development and apply all feasible mitigation measures to lessen the potentially adverse impacts. One of the primary objectives in updating the current CEQA Guidelines is to identify a GHG significance threshold, analytical methodologies, and mitigation measures to ensure new land use development meets its fair share of the emission reductions needed to address the cumulative environmental impact from GHG emissions. GHG emissions contribute, on a cumulative basis, to the significant adverse environmental impacts of global climate change. As reviewed herein, climate change impacts include an increase in extreme heat days, higher ambient concentrations of air pollutants, sea level rise, impacts to water supply and water quality, public health impacts, impacts to ecosystems, impacts to agriculture, and other environmental impacts. No single land use project could generate enough GHG emissions to noticeably change the global average temperature. The combination of GHG emissions from past, present, and future projects contribute substantially to the phenomenon of global climate change and its associated environmental impacts.

2.2 PROPOSED THRESHOLDS OF SIGNIFICANCE

Project Type	Proposed Thresholds
Projects other than Stationary Sources	Compliance with Qualified Climate Action Plan OR 1,100 MT of CO_2e/yr OR 4.6 MT CO_2e/SP/yr* (residents + employees)
Stationary Sources	10,000 MT of CO_2e/yr
Plans	Compliance with Qualified Climate Action Plan (or similar criteria included in a General Plan) OR 6.6 MT CO_2e/SP/yr (residents + employees)

* Staff notes that the efficiency-based thresholds should be applied to individual projects with caution. As explained herein, lead agencies may determine that the efficiency-based GHG thresholds for individual land use projects may not be appropriate for very large projects. If there is a fair argument that the project's emissions on a mass level will have a cumulatively considerable impact on the region's GHG emissions, the insignificance presumption afforded to a project that meets an efficiency-based GHG threshold would be overcome.

2.3 JUSTIFICATION AND SUBSTANTIAL EVIDENCE SUPPORTING THRESHOLDS

BAAQMD's approach to developing a threshold of significance for GHG emissions is to identify the emissions level for which a project would not be expected to substantially conflict with existing California legislation adopted to reduce statewide GHG emissions.

If a project would generate GHG emissions above the threshold level, it would be considered to contribute substantially to a cumulative impact, and would be considered significant. If mitigation can be applied to lessen the emissions such that the project meets its share of emission reductions needed to address the cumulative impact, the project would normally be considered less than significant.

As explained in the District's *Revised Draft Options and Justifications Report* (BAAQMD 2009), there are several types of thresholds that may be supported by substantial evidence and be consistent with existing California legislation and policy to reduce statewide GHG emissions. In determining which thresholds to recommend, Staff studied numerous options, relying on reasonable, environmentally conservative assumptions on growth in the land use sector, predicted emissions reductions from statewide regulatory measures and resulting emissions inventories, and the efficacies of GHG mitigation measures. The thresholds recommended herein were chosen based on the substantial evidence that such thresholds represent quantitative and/or qualitative levels of GHG emissions, compliance with which means that the environmental impact of the GHG emissions will normally not be cumulatively considerable under CEQA. Compliance with such thresholds will be part of the solution to the cumulative GHG emissions problem, rather than hinder the state's ability to meet its goals of reduced statewide GHG emissions. Staff notes that it does not believe there is only one threshold for GHG emissions that can be supported by substantial evidence.

GHG CEQA significance thresholds recommended herein are intended to serve as interim levels during the implementation of the AB 32 Scoping Plan and SB 375, which will occur over time. Until AB 32 has been fully implemented in terms of adopted regulations, incentives, and programs and until SB 375 required plans have been fully adopted, or the California Air Resources Board (ARB) adopts a recommended threshold, the BAAQMD recommends that local agencies in the Bay Area apply the GHG thresholds recommended herein.

If left unchecked, GHG emissions from new land use development in California will result in a cumulatively considerable amount of GHG emissions and a substantial conflict with the State's ability to meet the goals within AB 32. Thus, BAAQMD proposes to adopt interim GHG thresholds for CEQA analysis, which can be used by lead agencies within the Bay Area. This would help lead agencies navigate this dynamic regulatory and technological environment where the field of analysis has remained wide open and inconsistent. BAAQMD's framework for developing a GHG threshold for land development projects that is based on policy and substantial evidence follows.

2.3.1 SCIENTIFIC AND REGULATORY JUSTIFICATION

Climate Science Overview

Prominent GHGs contributing to the greenhouse effect are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, chlorofluorocarbons, and sulfur hexafluoride. Human-caused emissions of these GHGs in excess of natural ambient concentrations are responsible for intensifying the greenhouse effect and have led to a

trend of unnatural warming of the earth's climate, known as global climate change or global warming. It is *extremely unlikely* that global climate change of the past 50 years can be explained without the contribution from human activities (IPCC 2007a).

According to Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC), "Avoiding Dangerous Climate Change" means: *"stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."* Dangerous climate change defined in the UNFCCC is based on several key indicators including the potential for severe degradation of coral reef systems, disintegration of the West Antarctic Ice Sheet, and shut down of the large-scale, salinity- and thermally-driven circulation of the oceans. (UNFCCC 2009). The global atmospheric concentration of carbon dioxide has increased from a pre-industrial value of about 280 ppm to 379 ppm in 2005 (IPCC 2007a). "Avoiding dangerous climate change" is generally understood to be achieved by stabilizing global average temperatures between 2 and 2.4°C above pre-industrial levels. In order to limit temperature increases to this level, ambient global CO_2 concentrations must stabilize between 350 and 400 ppm (IPCC 2007b).

Executive Order S-3-05

Executive Order S-3-05, which was signed by Governor Schwarzenegger in 2005, proclaims that California is vulnerable to the impacts of climate change. It declares that increased temperatures could reduce the Sierra's snowpack, further exacerbate California's air quality problems, and potentially cause a rise in sea levels. To combat those concerns, the Executive Order established total GHG emission targets. Specifically, emissions are to be reduced to the 2000 level by 2010, the 1990 level by 2020, and to 80 percent below the 1990 level by 2050.

Assembly Bill 32, the California Global Warming Solutions Act of 2006

In September 2006, Governor Arnold Schwarzenegger signed Assembly Bill 32, the California Global Warming Solutions Act of 2006, which set the 2020 greenhouse gas emissions reduction goal into law. AB 32 finds and declares that "Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California." AB 32 requires that statewide GHG emissions be reduced to 1990 levels by 2020, and establishes regulatory, reporting, voluntary, and market mechanisms to achieve quantifiable reductions in GHG emissions to meet the statewide goal.

In December of 2008, ARB adopted its *Climate Change Scoping Plan* (*Scoping Plan*), which is the State's plan to achieve GHG reductions in California, as required by AB 32 (ARB 2008). The Scoping Plan contains strategies California will implement to achieve a reduction of 169 MMT CO_2e emissions, or approximately 28 percent from the state's projected 2020 emission level of 596 MMT of CO_2e under a business-as-usual scenario (this is a reduction of 42 MMT of CO_2e, or almost 10 percent, from 2002-2004 average emissions), so that the state can return to 1990 emission levels, as required by AB 32.

While the Scoping Plan establishes the policy intent to control numerous GHG sources through regulatory, incentive, and market means, given the early phase of implementation and the level of control that local CEQA lead agencies have over numerous GHG sources, CEQA is an important and supporting tool in achieving GHG reductions overall in compliance with AB 32. In this spirit, BAAQMD is considering the adoption of thresholds of significance for GHG emissions for stationary source and land use development projects.

Senate Bill 375

Senate Bill (SB) 375, signed in September 2008, aligns regional transportation planning efforts, regional GHG reduction targets, and land use and housing allocation. SB 375 requires Metropolitan Planning Organizations (MPOs) to adopt a Sustainable Communities Strategy (SCS) or Alternative Planning Strategy (APS), which will prescribe land use allocation in that MPO's Regional Transportation Plan (RTP). ARB, in consultation with MPOs, will provide each affected region with reduction targets for GHGs emitted by passenger cars and light trucks in the region for the years 2020 and 2035. These reduction targets will be updated every eight years, but can be updated every four years if advancements in emission technologies affect the reduction strategies to achieve the targets. ARB is also charged with reviewing each MPO's SCS or APS for consistency with its assigned targets. If MPOs do not meet the GHG reduction targets, transportation projects would not be eligible for State funding programmed after January 1, 2012. New provisions of CEQA would incentivize qualified projects that are consistent with an approved SCS or APS, categorized as "transit priority projects."

While SB 375 is considered in the development of these thresholds, given that the Association of Bay Area Governments (ABAG) and the Metropolitan Transportation Commission (MTC) development of the SCS for the Bay Area is in its early stages and the ARB GHG reduction target for light duty and passenger vehicles in the Bay Area has not yet been proposed, it is not appropriate from a CEQA perspective to expect SB 375 to completely address the emission reductions needed from this transportation sector in meeting AB 32 goals. In the future, as SB 375 implementation progresses, BAAQMD may need to revisit GHG thresholds.

2.3.2 PROJECT-LEVEL GHG THRESHOLDS

Staff recommends setting GHG significance thresholds based on AB 32 GHG emission reduction goals while taking into consideration emission reduction strategies outlined in ARB's Scoping Plan. Staff proposes two quantitative thresholds for land use projects: a bright line threshold based on a "gap" analysis and an efficiency threshold based on emission levels required to be met in order to achieve AB 32 goals.

Staff also proposes one qualitative threshold for land use projects: if a project complies with a Qualified Climate Action Plan (as defined in Section 2.3.4 below) that addresses the project it would be considered less than significant. As explained in detail in Section 2.3.4 below, compliance with a Qualified Climate Action Plan (or similar adopted policies, ordinances and programs), would provide the evidentiary basis for making

CEQA findings that development consistent with the plan would result in feasible, measureable, and verifiable GHG reductions consistent with broad state goals such that projects approved under qualified Climate Action Plans or equivalent demonstrations would achieve their fair share of GHG emission reductions.

2.3.2.1 LAND USE PROJECTS "GAP-BASED" THRESHOLD

Staff took eight steps in developing this threshold approach, which are summarized here and detailed in the sections that follow. It should be noted that the "gap-based approach" used for threshold development is a conservative approach that focuses on a limited set of state mandates that appear to have the greatest potential to reduce land use development-related GHG emissions at the time of this writing. It is also important to note that over time, as the effectiveness of the State's implementation of AB 32 (and SB 375) progresses, BAAQMD will need to reconsider the extent of GHG reductions needed over and above those from the implementation thereof for the discretionary approval of land use development projects. Although there is an inherent amount of uncertainty in the estimated capture rates (i.e., frequency at which project-generated emissions would exceed a threshold and would be subject to mitigation under CEQA) and the aggregate emission reductions used in the gap analysis, they are based on BAAQMD's expertise, the best available data, and use conservative assumptions for the amount of emission reductions from legislation in derivation of the gap (e.g., only adopted legislation was relied upon). This approach is intended to attribute an appropriate share of GHG emission reductions necessary to reach AB 32 goals to new land use development projects in BAAQMD's jurisdiction that are evaluated pursuant to CEQA.

Step 1 Estimate from ARB's statewide GHG emissions inventory the growth in emissions between 1990 and 2020 attributable to "land use-driven" sectors of the emission inventory as defined by OPR's guidance document (*CEQA and Climate Change*). Land use-driven emission sectors include Transportation (On-Road Passenger Vehicles; On-Road Heavy Duty), Electric Power (Electricity; Cogeneration), Commercial and Residential (Residential Fuel Use; Commercial Fuel Use) and Recycling and Waste (Domestic Waste Water Treatment).

Result: 1990 GHG emissions were 295.53 MMT CO_2e/yr and projected 2020 business-as-usual GHG emissions would be 400.22 MMT CO_2e/yr; thus a 26.2 percent reduction from statewide land use-driven GHG emissions would be necessary to meet the AB 32 goal of returning to 1990 emission levels by 2020. (See Table 2)

Step 2 Estimate the anticipated GHG emission reductions affecting the same land use-driven emissions inventory sectors associated with adopted statewide regulations identified in the AB 32 Scoping Plan.

Result: Estimated a 23.9 percent reduction can be expected in the land use-driven GHG emissions inventory from adopted Scoping Plan regulations, including AB 1493 (Pavley), LCFS, Heavy/Medium Duty Efficiency, Passenger Vehicle Efficiency, Energy-Efficiency

Measures, Renewable Portfolio Standard, and Solar Roofs. (See Table 3)

Step 3 Determine any short fall or "gap" between the 2020 statewide emission inventory estimates and the anticipated emission reductions from adopted Scoping Plan regulations. This "gap" represents additional GHG emission reductions needed statewide from the land use-driven emissions inventory sectors, which represents new land use development's share of the emission reductions needed to meet statewide GHG emission reduction goals.

Result: With the 23.9 percent reductions from AB 32 Scoping Measures, there is a "gap" of 2.3 percent in necessary additional GHG emissions reductions to meet AB 32 goals of a 26.2 percent reduction from statewide land use-driven GHG emissions to return to 1990 levels in 2020. (See Table 2)

Step 4 Determine the percent reduction this "gap" represents in the "land use-driven" emissions inventory sectors from BAAQMD's 2020 GHG emissions inventory. Identify the mass of emission reductions needed in the SFBAAB from land use-driven emissions inventory sectors.

Result: Estimated that a 2.3 percent reduction in BAAQMD's projected 2020 emissions projections requires emissions reductions of 1.6 MMT CO_2e/yr from the land use-driven sectors. (See Table 4)

Step 5 Assess BAAQMD's historical CEQA database (2001-2008) to determine the frequency distribution trend of project sizes and types that have been subject to CEQA over the past several years.

Result: Determined historical patterns of residential, commercial and industrial development by ranges of average sizes of each development type. Results were used in Step 6 below to distribute anticipated Bay Area growth among different future project types and sizes.

Step 6 Forecast new land use development for the Bay Area using DOF/EDD population and employment projections and distribute the anticipated growth into appropriate land use types and sizes needed to accommodate the anticipated growth (based on the trend analysis in Step 5 above). Translate the land use development projections into land use categories consistent with those contained in the Urban Emissions Model (URBEMIS).

Result: Based on population and employment projections and the trend analysis from Step 5 above, forecasted approximately 4,000 new development projects, averaging about 400 projects per year through 2020 in the Bay Area.

Step 7 Estimate the amount of GHG emissions from each land use development project type and size using URBEMIS and post-model manual calculation methods (for emissions not included in URBEMIS). Determine the amount of GHG emissions that can reasonably and feasibly be reduced through currently available mitigation measures ("mitigation effectiveness") for future land use development projects subject to CEQA (based on land use development projections and frequency distribution from Step 6 above).

Result: Based on the information available and on sample URBEMIS calculations, found that mitigation effectiveness of between 25 and 30 percent is feasible.

Step 8 Conduct a sensitivity analysis of the numeric GHG mass emissions threshold needed to achieve the desired emissions reduction (i.e., "gap") determined in Step 4. This mass emission GHG threshold is that which would be needed to achieve the emission reductions necessary by 2020 to meet the Bay Area's share of the statewide "gap" needed from the land use-driven emissions inventory sectors.

Result: The results of the sensitivity analysis conducted in Step 8 found that reductions between about 125,000 MT/yr (an aggregate of 1.3 MMT in 2020) and over 200,000 MT/yr (an aggregate of over 2.0 MMT in 2020) were achievable and feasible. A mass emissions threshold of 1,100 MT of CO_2e/yr would result in approximately 59 percent of all projects being above the significance threshold (e.g., this is approximately the operational GHG emissions that would be associated with a 60 residential unit subdivision) and must implement feasible mitigation measures to meet CEQA requirements. With an estimated 26 percent mitigation effectiveness, the 1,100 MT threshold would achieve 1.6 MMT CO_2e/yr in GHG emissions reductions.

2.3.2.2 DETAILED BASIS AND ANALYSIS

Derivation of Greenhouse Gas Reduction Goal

To meet the target emissions limit established in AB 32 (equivalent to levels in 1990), total GHG emissions would need to be reduced by approximately 28 percent from projected 2020 forecasts (ARB 2009a). The AB 32 Scoping Plan is ARB's plan for meeting this mandate (ARB 2008). While the Scoping Plan does not specifically identify GHG emission reductions from the CEQA process for meeting AB 32 derived emission limits, the scoping plan acknowledges that "other strategies to mitigate climate change . . . should also be explored." The Scoping Plan also acknowledges that "Some of the measures in the plan may deliver more emission reductions than we expect; others less . . . and new ideas and strategies will emerge." In addition, climate change is considered a significant environmental issue and, therefore, warrants consideration under CEQA. SB 97 represents the State Legislature's confirmation of this fact, and it directed the Governor's Office of Planning and Research (OPR) to develop CEQA Guidelines for

evaluation of GHG emissions impacts and recommend mitigation strategies. In response, OPR released the *Technical Advisory: CEQA and Climate Change* (OPR 2008), and has released proposed CEQA guidelines (April 14, 2009) for consideration of GHG emissions. It is known that new land use development must also do its fair share toward achieving AB 32 goals (or, at a minimum, should not hinder the State's progress toward the mandated emission reductions).

Foreseeable Scoping Plan Measures Emission Reductions and Remaining "Gap"

Step 1 of the Gap Analysis entailed estimating from ARB's statewide GHG inventory the growth in emissions between 1990 and 2020 attributable to land use driven sectors of the emissions inventory. As stated above, to meet the requirements set forth in AB 32 (i.e., achieve California's 1990-equivalent GHG emissions levels by 2020) California would need to achieve an approximate 28 percent reduction in emissions across all sectors of the GHG emissions inventory compared with 2020 projections. However, to meet the AB 32 reduction goals in the emissions sectors that are related to land use development (e.g., on-road passenger and heavy-duty motor vehicles, commercial and residential area sources [i.e., natural gas], electricity generation/consumption, wastewater treatment, and water distribution/consumption), staff determined that California would need to achieve an approximate 26 percent reduction in GHG emissions from these land use-driven sectors (ARB 2009a) by 2020 to return to 1990 land use emission levels.

Next, in Step 2 of the Gap Analysis, Staff determined the GHG emission reductions within the land use-driven sectors that are anticipated to occur from implementation of the Scoping Plan measures statewide, which are summarized in Table 2 and described below. Since the GHG emission reductions anticipated with the Scoping Plan were not accounted for in ARB's or BAAQMD's 2020 GHG emissions inventory forecasts (i.e., business as usual), an adjustment was made to include (i.e., give credit for) GHG emission reductions associated with key Scoping Plans measures, such as the Renewable Portfolio Standard, improvements in energy efficiency through periodic updates to Title 24, AB 1493 (Pavley) (which recently received a federal waiver to allow it to be enacted in law), the Low Carbon Fuel Standard (LCFS), and other measures. With reductions from these State regulations (Scoping Plan measures) taken into consideration and accounting for an estimated 23.9 percent reduction in GHG emissions, in Step 3 of the Gap Analysis Staff determined that the Bay Area would still need to achieve an additional 2.3 percent reduction from projected 2020 GHG emissions to meet the 1990 GHG emissions goal from the land-use driven sectors. This necessary 2.3 percent reduction in projected GHG emissions from the land use sector is the "gap" the Bay Area needs to fill to do its share to meet the AB 32 goals. Refer to the following explanation and Tables 2 through 4 for data used in this analysis.

Because the transportation sector is the largest emissions sector of the state's GHG emissions inventory, it is aggressively targeted in early actions and other priority actions in the Scoping Plan including measures concerning gas mileage (Pavley), fuel carbon intensity (LCFS) and vehicle efficiency measures.

Table 2 – California 1990, 2002-2004, and 2020 Land Use Sector GHG[1] ($MMT CO_2e/yr$)				
Sector	**1990 Emissions**	**2002-2004 Average**	**2020 BAU Emissions Projections**	**% of 2020 Total**
Transportation	**137.98**	**168.66**	**209.06**	**52%**
On-Road Passenger Vehicles	108.95	133.95	160.78	40%
On-Road Heavy Duty	29.03	34.69	48.28	12%
Electric Power	**110.63**	**110.04**	**140.24**	**35%**
Electricity	95.39	88.97	107.40	27%
Cogeneration[2]	15.24	21.07	32.84	8%
Commercial and Residential	**44.09**	**40.96**	**46.79**	**12%**
Residential Fuel Use	29.66	28.52	32.10	8%
Commercial Fuel Use	14.43	12.45	14.63	4%
Recycling and Waste[1]	**2.83**	**3.39**	**4.19**	**1%**
Domestic Wastewater Treatment	2.83	3.39	4.19	1%
TOTAL GROSS EMISSIONS	**295.53**	**323.05**	**400.22**	
% Reduction Goal from Statewide land use driven sectors (from 2020 levels to reach 1990 levels in these emission inventory sectors)			26.2%	
% Reduction from AB32 Scoping Plan measures applied to land use sectors (see Table 3)			-23.9%	
% Reduction needed statewide beyond Scoping Plan measures (Gap)			2.3%	

Notes: MMT CO_2e /yr = million metric tons of carbon dioxide equivalent emissions per year.
[1] Landfills not included. See text.
[2] Cogeneration included due to many different applications for electricity, in some cases provides substantial power for grid use, and because electricity use served by cogeneration is often amenable to efficiency requirements of local land use authorities.
Sources: Data compiled by EDAW and ICF Jones & Stokes from ARB data.

Pavley Regulations. The AB 32 Scoping Plan assigns an approximate 20 percent reduction in emissions from passenger vehicles associated with the implementation of AB 1493. The AB 32 Scoping Plan also notes that "AB 32 specifically states that if the Pavley regulations do not remain in effect, ARB shall implement alternative regulations to control mobile sources to achieve equivalent or greater reductions of greenhouse gas emissions (HSC §38590)." Thus, it is reasonable to assume full implementation of AB 1493 standards, or equivalent programs that would be implemented by ARB. While the Obama administration has proposed national CAFE standards that may be equivalent to or even surpass AB 1493, the timing for implementation of the proposed federal standards is uncertain such that development of thresholds based on currently unadopted federal standards would be premature. BAAQMD may need to revisit this methodology as the federal standards come on line, particularly if such standards are more aggressive than that forecast under state law.

Table 3 – 2020 Land Use Sector GHG Emission Reductions from State Regulations and AB 32 Measures

Affected Emissions Source	California Legislation	% Reduction from 2020 GHG inventory	End Use Sector (% of Bay Area LU Inventory)	Scaled % Emissions Reduction (credit)
Mobile	AB 1493 (Pavley)	19.7%	On road passenger/light truck transportation (45%)	8.9%
	LCFS	7.2%	On road passenger/light truck transportation (45%)	3.2%
	LCFS	7.2%	On road Heavy/Medium Duty Transportation (5%)	0.4%
	Heavy/Medium Duty Efficiency	2.9%	On road Heavy/Medium Duty Transportation (5%)	0.2%
	Passenger Vehicle Efficiency	2.8%	On road passenger/light truck transportation (45%)	1.3%
Area	Energy-Efficiency Measures	9.5%	Natural gas (Residential, 10%)	1.0%
			Natural gas (Non-residential,13%)	1.2%
Indirect	Renewable Portfolio Standard	21.0%	Electricity (excluding cogen) (17%)	3.5%
	Energy-Efficiency Measures	15.7%	Electricity (26%)	4.0%
	Solar Roofs	1.5%	Electricity (excluding cogen) (17%)	0.2%
Total credits given to land use-driven emission inventory sectors from Scoping Plan measures				**23.9%**

Notes: AB = Assembly Bill; LCFS = Low Carbon Fuel Standard; SB = Senate Bill; RPS = Renewable Portfolio Standard
Please refer to Appendix D for detailed calculations. Sources: Data compiled by ICF Jones & Stokes.

LCFS. According to the adopted LCFS rule (CARB, April 2009), the LCFS is expected to result in approximately 10 percent reduction in the carbon intensity of transportation fuels. However, a portion of the emission reductions required from the LCFS would be achieved over the life cycle of transportation fuel production rather than from mobile-source emission factors. Based on CARB's estimate of nearly 16 MMT reductions in on-road emissions from implementation of the LCFS and comparison to the statewide on-road emissions sector, the LCFS is assumed to result in a 7.2 percent reduction compared to 2020 BAU conditions (CARB 2009e).

Table 4 – SFBAAB 1990, 2007, and 2020 Land Use Sector GHG Emissions Inventories and Projections (MMT CO_2e/yr)				
Sector	**1990 Emissions**	**2007 Emissions**	**2020 Emissions Projections**	**% of 2020 Total[2]**
Transportation	**26.1**	**30.8**	**35.7**	**50%**
On-Road Passenger Vehicles	23.0	27.5	32.0	
On-Road Heavy Duty	3.1	3.3	3.7	
Electric Power	**25.1**	**15.2**	**18.2**	**26%**
Electricity	16.5	9.9	11.8	
Cogeneration	8.6	5.3	6.4	
Commercial and Residential	**8.9**	**15.0**	**16.8**	**24%**
Residential Fuel Use	5.8	7.0	7.5	
Commercial Fuel Use	3.1	8.0	9.3	
Recycling and Waste[1]	**0.2**	**0.4**	**0.4**	**1%**
Domestic Waste Water Treatment	0.2	0.4	0.4	
TOTAL GROSS EMISSIONS	**60.3**	**61.4**	**71.1**	
SFBAAB's "Fair Share" % Reduction (from 2020 levels to reach 1990 levels) with AB-32 Reductions (from Table 3)			2.3%	
SFBAAB's Equivalent Mass Emissions Land Use Reduction Target at 2020 (MMT CO2e/yr)			1.6	

Notes: MMT CO_2e /yr = million metric tons of carbon dioxide equivalent emissions per year; SFBAAB = San Francisco Bay Area Air Basin.
[1] Landfills not included.
[2] Percentages do not sum exactly to 100% in table due to rounding.
Please refer to Appendix D for detailed calculations.
Sources: Data compiled by EDAW 2009, ICF Jones & Stokes 2009, BAAQMD 2008.

Renewable Portfolio Standard, Energy Efficiency and Solar Roofs. Energy efficiency and renewable energy measures from the Scoping Plan were also included in the gap analysis. The Renewable Portfolio Standard (rules) will require the renewable energy portion of the retail electricity portfolio to be 33 percent in 2020. For PG&E, the dominant electricity provider in the Basin, approximately 12 percent of their current portfolio qualifies under the RPS rules and thus the gain by 2020 would be approximately 21 percent. The Scoping Plan also estimates that energy efficiency gains with periodic improvement in building and appliance energy standards and incentives will reach 10 to 15 percent for natural gas and electricity respectively. The final state measure included in this gap analysis is the solar roof initiative, which is estimated to result in reduction of the overall electricity inventory of 1.5 percent.

Landfill emissions are excluded from this analysis. While land use development does generate waste related to both construction and operations, the California Integrated Waste Management Board (CIWMB) has mandatory diversion requirements that will, in all probability, increase over time to promote waste reductions, reuse, and recycle. The Bay Area has relatively high levels of waste diversion and extensive recycling efforts. Further, ARB has established and proposes to increase methane capture requirements for all major landfills. Thus, at this time, landfill emissions associated with land use

development waste generation is not included in the land use sector inventory used to develop this threshold approach.

Industrial stationary sources thresholds were developed separately from the land use threshold development using a market capture approach as described below. However, mobile source and area source emissions, as well as indirect electricity emissions that derive from industrial use are included in the land use inventory above as these particular activities fall within the influence of local land use authorities in terms of the affect on trip generation and energy efficiency.

AB 32 mandates reduction to 1990-equivalent GHG levels by 2020, with foreseeable emission reductions from State regulations and key Scoping Plan measures taken into account, were applied to the land use-driven emission sectors within the SFBAAB (i.e., those that are included in the quantification of emissions from a land use project pursuant to a CEQA analysis [on-road passenger vehicles, commercial and residential natural gas, commercial and residential electricity consumption, and domestic waste water treatment], as directed by OPR in the Technical Advisory: *Climate Change and CEQA* [OPR 2008]). This translates to a 2.3 percent gap in necessary GHG emission reductions by 2020 from these sectors.

2.3.2.3 LAND USE PROJECTS BRIGHT LINE THRESHOLD

In Steps 4 and 5 of the gap analysis, Staff determined that applying a 2.3 percent reduction to these land use emissions sectors in the SFBAAB's GHG emissions inventory would result in an equivalent fair share of 1.6 million metric tons per year (MMT/yr) reductions in GHG emissions from new land use development. As additional regulations and legislation aimed at reducing GHG emissions from land use-related sectors become available in the future, the 1.6 MMT GHG emissions reduction goal may be revisited and recalculated by BAAQMD.

In order to derive the 1.6 MMT "gap," a projected development inventory for the next ten years in the SFBAAB was calculated. (See Table 4 and *Revised Draft Options and Justifications Report* (BAAQMD 2009).) CO_2e emissions were modeled for projected development in the SFBAAB and compiled to estimate the associated GHG emissions inventory. The GHG (i.e., CO_2e) CEQA threshold level was adjusted for projected land use development that would occur within BAAQMD's jurisdiction over the period from 2010 through 2020.

Projects with emissions greater than the threshold would be required to mitigate to the threshold level or reduce project emissions by a percentage (mitigation effectiveness) deemed feasible by the Lead Agency under CEQA compared to a base year condition. The base year condition is defined by an equivalent size and character of project with annual emissions using the defaults in URBEMIS and the California Climate Action Registry's General Reporting Protocol for 2008. By this method, land use project mitigation subject to CEQA would help close the "gap" remaining after application of the key regulations and measures noted above supporting overall AB 32 goals.

This threshold takes into account Steps 1-8 of the gap analysis described above to arrive at a numerical mass emissions threshold. Various mass emissions significance threshold levels (i.e., bright lines) could be chosen based on the mitigation effectiveness and performance anticipated to be achieved per project to meet the aggregate emission reductions of 1.6 MMT needed in the SFBAAB by 2020. (See Table 5 and *Revised Draft Options and Justifications Report* (BAAQMD 2009).) Staff recommends a 1,100 MT CO_2e per year threshold. Choosing a 1,100 MT mass emissions significance threshold level (equivalent to approximately 60 single-family units), would result in about 59 percent of all projects being above the significance threshold and having to implement feasible mitigation measures to meet their CEQA obligations. These projects account for approximately 92 percent of all GHG emissions anticipated to occur between now and 2020 from new land use development in the SFBAAB.

Project applicants and lead agencies could use readily available computer models to estimate a project's GHG emissions, based on project specific attributes, to determine if they are above or below the bright line numeric threshold. With this threshold, projects that are above the threshold level, after consideration of emission-reducing characteristics of the project as proposed, would have to reduce their emissions to below the threshold to be considered less than significant.

Establishing a "bright line" to determine the significance of a project's GHG emissions impact provides a level of certainty to lead agencies in determining if a project needs to reduce its GHG emissions through mitigation measures and when an EIR is required.

Table 5 – Operational GHG Threshold Sensitivity Analysis

Option	Mitigation Effectiveness Assumptions		Mass Emission Threshold Level (MT CO_2e/yr)	% of Projects Captured (>threshold)	% of Emissions Captured (> threshold)	Emissions Reduction per year (MT/yr)	Aggregate Emissions Reduction (MMT) at 2020	Threshold Project Size Equivalent (single family dwelling units)
	Performance Standards Applied to All Projects with Emissions < Threshold Level	Mitigation Effectiveness Applied to Emissions > Threshold Level						
1A	N/A	30%	975	60%	93%	201,664	2.0	53
1A	N/A	25%	110	96%	100%	200,108	2.0	66
1A	N/A	30%	1,225	21%	67%	159,276	1.6	67
1A	N/A	26%	1,100	59%	92%	159,877	1.6	60
1A	N/A	30%	2,000	14%	61%	143,418	1.4	109
1A	N/A	25%	1,200	58%	92%	136,907	1.4	66
1A	N/A	30%	3,000	10%	56%	127,427	1.3	164
1A	N/A	25%	1,500	20%	67%	127,303	1.3	82
1B	26%	N/A	N/A	100%	100%	208,594	2.1	N/A[1]
1C	5%	30%	1,900	15%	62%	160,073	1.6	104
1C	10%	25%	1,250	21%	67%	159,555	1.6	68
1C	5%	30%	3,000	10%	56%	145,261	1.5	164
1C	10%	25%	2,000	4%	61%	151,410	1.5	109
1C	10%	30%	10,000	2%	33%	125,271	1.3	547

Notes: MMT = million metric tons per year; MT CO_2e/yr = metric tons of carbon dioxide equivalent emissions per year; MT/yr = metric tons per year; N/A = not applicable.

[1] Any project subject to CEQA would trigger this threshold.

Please refer to Appendix E for detailed calculations.

Source: Data modeled by ICF Jones & Stokes.

2.3.2.4 LAND USE PROJECTS EFFICIENCY-BASED THRESHOLD

GHG efficiency metrics can also be utilized as thresholds to assess the GHG efficiency of a project on a per capita basis (residential only projects) or on a "service population" basis (the sum of the number of jobs and the number of residents provided by a project) such that the project will allow for consistency with the goals of AB 32 (i.e., 1990 GHG emissions levels by 2020). GHG efficiency thresholds can be determined by dividing the GHG emissions inventory goal (allowable emissions), by the estimated 2020 population and employment. This method allows highly efficient projects with higher mass emissions to meet the overall reduction goals of AB 32. Staff believes it is more appropriate to base the land use efficiency threshold on the service population metric for the land use-driven emission inventory. This approach is appropriate because the threshold can be applied evenly to all project types (residential or commercial/retail only and mixed use) and uses only the land use emissions inventory that is comprised of all land use projects. Staff will provide the methodology to calculate a project's GHG emissions in the revised CEQA Guidelines, such as allowing infill projects up to a 50 percent or more reduction in daily vehicle trips if the reduction can be supported by close proximity to transit and support services, or a traffic study prepared for the project.

Table 6 – California 2020 GHG Emissions, Population Projections and GHG Efficiency Thresholds - Land Use Inventory Sectors

Land Use Sectors Greenhouse Gas Emissions Target	295,530,000
Population	44,135,923
Employment	20,194,661
California Service Population (Population + Employment)	64,330,584
AB 32 Goal GHG emissions (metric tons CO_2e)/SP[1]	**4.6**

Notes: AB = Assembly Bill; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; SP = service population.
[1] Greenhouse gas efficiency levels were calculated using only the "land use-related" sectors of ARB's emissions inventory.
Please refer to Appendix D for detailed calculations.
Sources: Data compiled by EDAW 2009, ARB 2009a, DOF 2009, EDD 2009, ICF Jones & Stokes 2009.

Staff proposes a project-level efficiency threshold of 4.6 MT CO_2e/SP, the derivation of which is shown Table 6. This efficiency-based threshold reflects very GHG-efficient projects. As stated previously and below, staff anticipates that significance thresholds (rebuttable presumptions of significance at the project level) will function on an interim basis only until adequate programmatic approaches are in place at the city, county, and regional level that will allow the CEQA streamlining of individual projects. (See Draft CEQA Guidelines, proposed section 15183.5 ["Tiering and Streamlining the Analysis of Greenhouse Gas Emissions"]). In advance of such programmatic approaches, local agencies may wish to apply this efficiency-based recommended threshold with some discretion, taking into account not only the project's efficiency, but also its total GHG emissions. Even where a project is relatively GHG-efficient as compared to other projects, in approving the project, the lead agency is committing to use what is essentially

its GHG "budget" in a given way. Expending this "budget" on the proposed project may affect other development opportunities and associated obligations to mitigate or conflict with other actions that the community may wish to take to reduce its overall GHG emissions after it has conducted its programmatic analysis.

Accordingly, in applying the efficiency-based threshold of 4.6 MT CO_2e/SP, the lead agency might also wish to consider the project's total emissions. Where a project meets the efficiency threshold but would still have very large GHG emissions, the lead agency may wish to consider whether the project's contributions to climate change might still be cumulatively considerable and whether additional changes to the project or mitigation should be required. Staff notes that even where the project may be significant as it relates to climate change, the lead agency may find that the project should nonetheless be approved in light of its benefits; in that case, the lead agency may wish to note the project's efficiency and any innovative design features in the Statement of Overriding Considerations.

2.3.3 PLAN-LEVEL GHG THRESHOLDS

Staff proposes using a two step process for determining the significance of proposed plans and plan amendments for GHG. As a first step in assessing plan-level impacts, Staff is proposing that agencies that have adopted a qualified climate action plan (or have incorporated similar criteria in their General Plan) and the General Plan or Transportation Plan are consistent with the climate action plan, the General Plan or Transportation Plan would be considered less than significant. In addition, as discussed above for project-level GHG impacts, Staff is proposing an efficiency threshold to assess plan-level impacts. Staff believes a programmatic approach to limiting GHG emissions is appropriate at the plan-level. Thus, as projects consistent with the climate action plan are proposed, they may be able to tier off the plan and its environmental analysis.

2.3.3.1 GHG EFFICIENCY METRICS FOR PLANS

For local land use plans, a GHG-efficiency metric (e.g., GHG emissions per unit) would enable comparison of a proposed general plan to its alternatives and to determine if the proposed general plan meets AB 32 emission reduction goals.

AB 32 identifies local governments as essential partners in achieving California's goal to reduce GHG emissions. Local governments have primary authority to plan, zone, approve, and permit how and where land is developed to accommodate population growth and the changing needs of their jurisdiction. ARB has developed the Local Government Operations Protocol and is developing a protocol to estimate community-wide GHG emissions. ARB encourages local governments to use these protocols to track progress in reducing GHG emissions. ARB encourages local governments to institutionalize the community's strategy for reducing its carbon footprint in its general plan. SB 375 creates a process for regional integration of land development patterns and transportation infrastructure planning with the primary goal of reducing GHG emissions from the largest sector of the GHG emission inventory, light duty vehicles.

If the statewide AB 32 GHG emissions reduction context is established, GHG efficiency can be viewed independently from the jurisdiction in which the plan is located. Expressing projected 2020 mass of emissions from land use-related emissions sectors by comparison to a demographic unit (e.g., population and employment) provides evaluation of the GHG efficiency of a project in terms of what emissions are allowable while meeting AB 32 targets.

Two approaches were considered for efficiency metrics. The "service population" (SP) approach would consider efficiency in terms of the GHG emissions compared to the sum of the number of jobs and the number of residents at a point in time. The per capita option would consider efficiency in terms of GHG emissions per resident only. Staff recommends that the efficiency threshold for plans be based on all emission inventory sectors because, unlike land use projects, community-wide or regional plans comprise more than just land use related emissions (e.g. industrial). Further, Staff recommends that plan threshold be based on the service population metric as community-wide plans or regional plans include a mix of residents and employees. The Service Population metric would allow decision makers to compare GHG efficiency of general plan alternatives that vary residential and non-residential development totals, encouraging GHG efficiency through improving jobs/housing balance. This approach would not give preference to communities that accommodate more residential (population-driven) land uses than non-residential (employment driven) land uses which could occur with the per capita approach.

A SP-based GHG efficiency metric (see Table 7) was derived from the emission rates at the State level that would accommodate projected population and employment growth under trend forecast conditions, and the emission rates needed to accommodate growth while allowing for consistency with the goals of AB 32 (i.e., 1990 GHG emissions levels by 2020).

Table 7 – California 2020 GHG Emissions, Population Projections and GHG Efficiency Thresholds - All Inventory Sectors

All Inventory Sectors Greenhouse Gas Emissions Target	426,500,000
Population	44,135,923
Employment	20,194,661
California Service Population (Population + Employment)	64,330,584
AB 32 Goal GHG emissions (metric tons CO_2e)/SP[1]	**6.6**

Notes: AB = Assembly Bill; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; SP = service population.
[1] Greenhouse gas efficiency levels were calculated using only the "land use-related" sectors of ARB's emissions inventory.
Please refer to Appendix D for detailed calculations.
Sources: Data compiled by EDAW 2009, ARB 2009a, DOF 2009, EDD 2009, ICF Jones & Stokes 2009.

If a general plan demonstrates, through dividing the emissions inventory projections (MT CO_2e) by the amount of growth that would be accommodated in 2020, that it could meet the GHG efficiency metrics proposed in this section (6.6 MT CO_2e/SP from all emission

sectors, as noted in Table 7), then the amount of GHG emissions associated with the general plan would be considered less than significant, regardless of its size (and magnitude of GHG emissions). In other words, the general plan would accommodate growth in a manner that would not hinder the State's ability to achieve AB 32 goals, and thus, would be less than significant for GHG emissions and their contribution to climate change. The efficiency metric would not penalize well-planned communities that propose a large amount of development. Instead, the SP-based GHG efficiency metric acts to encourage the types of development that BAAQMD and OPR support (i.e., infill and transit-oriented development) because it tends to reduce GHG and other air pollutant emissions overall, rather than discourage large developments for being accompanied by a large mass of GHG emissions. Plans that are more GHG efficient would have no or limited mitigation requirements to help them complete the CEQA process more readily than plans that promote GHG inefficiencies, which will require detailed design of mitigation during the CEQA process and could subject a plan to potential challenge as to whether all feasible mitigation was identified and adopted. This type of threshold can shed light on a well-planned general plan that accommodates a large amount of growth in a GHG-efficient way.

When analyzing long-range plans, such as general plans, it is important to note that the planning horizon will often surpass the 2020 timeframe for implementation of AB 32. Executive Order S-3-05 establishes a more aggressive emissions reduction goal for the year 2050 of 80 percent below 1990 emissions levels. The year 2020 should be viewed as a milestone year, and the general plan should not preclude the community from a trajectory toward the 2050 goal. However, the 2020 timeframe is examined in this threshold evaluation because doing so for the 2050 timeframe (with respect to population, employment, and GHG emissions projections) would be too speculative. Advances in technology and policy decisions at the state level will be needed to meet the aggressive 2050 goals. It is beyond the scope of the analysis tools available at this time to examine reasonable emissions reductions that can be achieved through CEQA analysis in the year 2050. As the 2020 timeframe draws nearer, BAAQMD will need to reevaluate the threshold to better represent progress toward 2050 goals.

2.3.4 CLIMATE ACTION PLANS

Finally, many local agencies have already undergone or plan to undergo efforts to create general or other plans that are consistent with AB 32 goals. The Air District encourages such planning efforts and recognizes that careful upfront planning by local agencies is invaluable to achieving the state's GHG reduction goals. If a project is consistent with an adopted Qualified Climate Action Plan that addresses the project's GHG emissions, it can be presumed that the project will not have significant GHG emission impacts. This approach is consistent with CEQA Guidelines Section 15064(h)(3), which provides that a "lead agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project will comply with the requirements in a previously approved plan or mitigation program which provides specific requirements that will avoid or substantially lessen the cumulative problem."

A qualified Climate Action Plan (or similar adopted policies, ordinances and programs) is one that is consistent with all of the AB 32 Scoping Plan measures and goals. The Climate Action Plan should identify a land use design, transportation network, goals, policies and implementation measures that would achieve AB 32 goals. Plans with horizon years beyond 2020 should consider continuing the downward reduction path set by AB 32 and move toward climate stabilization goals established in Executive Order S-3-05.

Qualified Climate Action Plans

A qualified Climate Action Plan adopted by a local jurisdiction should include the following. The District's revised CEQA Guidelines will provide the methodology to determine if a Climate Action Plan meets these requirements.

- GHG Inventory for Current Year and Forecast for 2020 (and for 1990 if the reduction goal is based on 1990 emission levels).
- An adopted GHG Reduction Goal for 2020 for the jurisdiction from all sources (existing and future) which is at least one of the following: 1990 GHG emission levels, 15 percent below 2008 emission levels, or 28 percent below BAU Forecasts for 2020 (if including non-land use sector emissions in the local inventory; otherwise can use 26.2 percent if only including land use sector emissions).
- Identification of feasible reduction measures to reduce GHG emissions for 2020 to the identified target.
- Application of relevant reduction measures included in the AB 32 Scoping Plan that are within the jurisdiction of the local land use authority (such as building energy efficiency, etc.).
- Quantification of the reduction effectiveness of each of the feasible measures identified including disclosure of calculation method and assumptions.
- Identification of implementation steps and financing mechanisms to achieve the identified goal by 2020.
- Procedures for monitoring and updating the GHG inventory and reduction measures at least twice before 2020 or at least every five years.
- Identification of responsible parties for Implementation.
- Schedule of implementation.
- Certified CEQA document, or equivalent process (see below).

Local Climate Action Policies, Ordinances and Programs

Air District staff recognizes that many communities in the Bay Area have been proactive in planning for climate change but have not yet developed a stand-alone Climate Action

Plan that meets the above criteria. Many cities and counties have adopted climate action policies, ordinances and program that may in fact achieve the goals of a qualified climate action plan. Staff recommends that if a local jurisdiction can demonstrate that its collective set of climate action policies, ordinances and other programs is consistent with AB 32, includes requirements or feasible measures to reduce GHG emissions and achieves one of the following GHG emission reduction goals,[3] the AB 32 consistency demonstration should be considered equivalent to a qualified climate action plan:

- 1990 GHG emission levels,
- 15 percent below 2008 emission levels, or
- 28 percent below BAU Forecasts for 2020 (if including non-land use sector emissions in the local inventory; otherwise can use 26.2 percent if only including land use sector emissions).

Qualified Climate Action Plans that are tied to the AB 32 reduction goals would promote reductions on a plan level without impeding the implementation of GHG-efficient development, and would recognize the initiative of many Bay Area communities who have already developed or are in the process of developing a GHG reduction plan. The details required above for a qualified Climate Action Plan (or similar adopted policies, ordinances and programs) would provide the evidentiary basis for making CEQA findings that development consistent with the plan would result in feasible, measureable, and verifiable GHG reductions consistent with broad state goals such that projects approved under qualified Climate Action Plans or equivalent demonstrations would achieve their fair share of GHG emission reductions.

2.3.5 STATIONARY SOURCE GHG THRESHOLD

Staff's recommended threshold for stationary source GHG emissions is based on estimating the GHG emissions from combustion sources for all permit applications submitted to the Air District in 2005, 2006 and 2007. The analysis is based only on CO_2 emissions from stationary sources, as that would cover the vast majority of the GHG emissions due to stationary combustion sources in the SFBAAB. The estimated CO_2 emissions were calculated for the maximum permitted amount, i.e. emissions that would be emitted if the sources applying for a permit application operate at maximum permitted load and for the total permitted hours. All fuel types are included in the estimates. For boilers burning natural gas, diesel fuel is excluded since it is backup fuel and is used only if natural gas is not available. Emission values are estimated before any offsets (i.e., Emission Reduction Credits) are applied. GHG emissions from mobile sources, electricity use and water delivery associated with the operation of the permitted sources are not included in the estimates.

[3] Lead agencies using consistency with their jurisdiction's climate action policies, ordinances and programs as a measure of significance under CEQA Guidelines section 15064(h)(3) should ensure that the policies, ordinances and programs satisfy all of the requirements of that subsection before relying on them in a CEQA analysis.

It is projected that a threshold level of 10,000 metric tons of CO_2e per year would capture approximately 95 percent of all GHG emissions from new permit applications from stationary sources in the SFBAAB. That threshold level was calculated as an average of the combined CO_2 emissions from all stationary source permit applications submitted to the Air District during the three year analysis period.

Staff recommends this 10,000 MT of CO_2/yr as it would address a broad range of combustion sources and thus provide for a greater amount of GHG reductions to be captured and mitigated through the CEQA process. As documented in the Scoping Plan, in order to achieve statewide reduction targets, emissions reductions need to be obtained through a broad range of sources throughout the California economy and this threshold would achieve this purpose. While this threshold would capture 95 percent of the GHG emissions from new permit applications, the threshold would do so by capturing only the large, significant projects. Permit applications with emissions above the 10,000 MT of CO_2/yr threshold account for less than 10 percent of stationary source permit applications which represent 95 percent of GHG emissions from new permits analyzed during the three year analysis period.

This threshold would be considered an interim threshold and Air District staff will reevaluate the threshold as AB 32 Scoping Plan measures such as cap and trade are more fully developed and implemented at the state level.

2.3.6 SUMMARY OF JUSTIFICATION FOR GHG THRESHOLDS

The bright-line numeric threshold of 1,100 MT CO_2e/yr is a numeric emissions level below which a project's contribution to global climate change would be less than "cumulatively considerable." This emissions rate is equivalent to a project size of approximately 60 single-family dwelling units, and approximately 59 percent of all future projects and 92 percent of all emissions from future projects would exceed this level. For projects that are above this bright-line cutoff level, emissions from these projects would still be less than cumulatively significant if the project as a whole would result in an efficiency of 4.6 MT CO_2e per service population or better for mixed-use projects. Projects with emissions above 1,100 MT CO_2e/yr would therefore still be less than significant if they achieved project efficiencies below these levels. If projects as proposed exceed these levels, they would be required to implement mitigation measures to bring them back below the 1,100 MT CO_2e/yr bright-line cutoff or within the 4.6 MT CO_2e Service Population efficiency threshold. If mitigation did not bring a project back within the threshold requirements, the project would be cumulatively significant and could be approved only with a Statement of Overriding Considerations and a showing that all feasible mitigation measures have been implemented. Projects' GHG emissions would also be less than significant if they comply with a Qualified Climate Action Plan.

As explained in the preceding analyses of these thresholds, the greenhouse gas emissions from land use projects expected between now and 2020 built in compliance with these thresholds would be approximately 26 percent below BAU 2020 conditions and thus would be consistent with achieving an AB 32 equivalent reduction. The 26 percent

reduction from BAU 2020 from new projects built in conformance with these proposed thresholds would achieve an aggregate reduction of approximately 1.6 MMT CO_2e/yr, which is the level of emission reductions from new Bay Area land use sources needed to meet the AB 32 goals, per ARB's Scoping Plan as discussed above.

Projects with greenhouse gas emissions in conformance with these proposed thresholds would therefore not be considered significant for purposes of CEQA. Although the emissions from such projects would add an incremental amount to the overall greenhouse gas emissions that cause global climate change impacts, emissions from projects consistent with these thresholds would not be a "cumulatively considerable" contribution under CEQA. Such projects would not be "cumulatively considerable" because they would be helping to solve the cumulative problem as a part of the AB 32 process.

California's response to the problem of global climate change is to reduce greenhouse gas emissions to 1990 levels by 2020 under AB 32 as a near-term measure and ultimately to 80 percent below 1990 levels by 2050 as the long-term solution to stabilizing greenhouse gas concentrations in the atmosphere at a level that will not cause unacceptable climate change impacts. To implement this solution, the Air Resources Board has adopted a Scoping Plan and budgeted emissions reductions that will be needed from all sectors of society in order to reach the interim 2020 target.

The land-use sector in the Bay Area needs to achieve aggregate emission reductions of approximately 1.6 MMT CO_2e/yr from new projects between now and 2020 to achieve this goal, as noted above, and each individual new project will need to achieve its own respective portion of this amount in order for the Bay Area land use sector as a whole to achieve its allocated emissions target. Building all of the new projects expected in the Bay Area between now and 2020 in accordance with the thresholds that District staff are proposing will achieve the overall appropriate share for the land use sector, and building each individual project in accordance with the proposed thresholds will achieve that individual project's respective portion of the emission reductions needed to implement the AB 32 solution. For these reasons, projects built in conformance with the proposed thresholds will be part of the solution to the cumulative problem, and not part of the continuing problem. They will allow the Bay Area's land use sector to achieve the emission reductions necessary from that sector for California to implement its solution to the cumulative problem of global climate change. As such, even though such projects will add an incremental amount of greenhouse gas emissions, their incremental contribution will be less than "cumulatively considerable" because they are helping to achieve the cumulative solution, not hindering it. Such projects will therefore not be "significant" for purposes of CEQA. (*See* CEQA Guidelines §15064(h)(1).)

The conclusion that land use projects that comply with these proposed thresholds is also supported by CEQA Guidelines Section 15030(a)(3), which provides that a project's contribution to a cumulative problem can be less that cumulatively considerable "if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact." In the case of greenhouse gas emissions associated with land use projects, achieving the amount of emission reductions below BAU that will be required to achieve the AB 32 goals is the project's "fair share" of the

overall emission reductions needed under ARB's scoping plan to reach the overall statewide AB 32 emissions levels for 2020. If a project is designed to implement greenhouse gas mitigation measures that achieve a level of reductions consistent with what is required from all new land use projects to achieve the land use sector "budget" – *i.e.*, keeping overall project emissions below 1,100 MT CO_2e/yr or ensuring that project efficiency is better than 4.6 MT CO_2e/service population – then it will be implementing its share of the mitigation measures necessary to alleviate the cumulative impact, as shown in the analyses set forth above.

It is also worth noting that this "fair share" approach is flexible and will allow a project's significance to be determined by how well it is designed from a greenhouse-gas efficiency standpoint, and not just by the project's size. For example, a large high-density infill project located in an urban core nearby to public transit and other alternative transportation options, and built using state-of-the-art energy efficiency methods and improvements such as solar panels, as well as all other feasible mitigation measures, would not become significant for greenhouse gas purposes (and thus require a Statement of Overriding Considerations in order to be approved) simply because it happened to be a large project. Projects such as this hypothetical development with low greenhouse-gas emissions per service population are what California will need in the future in order to do its part in achieving a solution to the problem of global climate change. The determination of significance under CEQA should therefore take these factors into account, and staff's proposed significance thresholds would achieve this important policy goal. In all, land use sector projects that comply with the GHG thresholds would not be "cumulatively considerable" because they would be helping to solve the cumulative problem as a part of the AB 32 process.

Likewise, new Air District permit applications for stationary sources that comply with the quantitative threshold of 10,000 MT CO_2e/yr would not be "cumulatively considerable" because they also would not hinder the state's ability to solve the cumulative greenhouse gas emissions problem pursuant to AB 32. Unlike the land use sector, the AB 32 Scoping Plan measures, including the cap-and-trade program, provide for necessary emissions reductions from the stationary source sector to achieve AB 32 2020 goals.

While stationary source projects will need to comply with the cap-and-trade program once it is enacted and reduce their emissions accordingly, the program will be phased in over time starting in 2012 and at first will only apply to the very largest sources of GHG emissions. In the mean time, certain stationary source projects, particularly those with large GHG emissions, still will have a cumulatively considerable impact on climate change. The 10,000 MT CO_2e/yr threshold will capture 95 percent of the stationary source sector GHG emissions in the Bay Area. The five percent of emissions that are from stationary source projects below the 10,000 MT CO_2e/yr threshold account for a small portion of the Bay Area's total GHG emissions from stationary sources and these emissions come from very small projects. Such small stationary source projects will not significantly add to the global problem of climate change, and they will not hinder the Bay Area's ability to reach the AB 32 goal in any significant way, even when considered cumulatively. In Air District's staff's judgment, the potential environmental benefits from

requiring EIRs and mitigation for these projects would be insignificant. In all, based on staff's expertise, stationary source projects with emissions below 10,000 MT CO_2e/yr will not provide a cumulatively considerable contribution to the cumulative impact of climate change.

3 COMMUNITY RISK AND HAZARD THRESHOLDS

To address community risk from air toxics, the Air District initiated the Community Air Risk Evaluation (CARE) program in 2004 to identify locations with high levels of risk from ambient toxic air contaminants (TAC) co-located with sensitive populations and use the information to help focus mitigation measures. Through the CARE program, the Air District developed an inventory of TAC emissions for 2005 and compiled demographic and heath indicator data. According to the findings of the CARE Program, diesel PM—mostly from on and off-road mobile sources—accounts for over 80 percent of the inhalation cancer risk from TACs in the Bay Area (BAAQMD 2006).

The Air District applied a regional air quality model using the 2005 emission inventory data to estimate excess cancer risk from ambient concentrations of important TAC species, including diesel PM, 1,3-butadiene, benzene, formaldehyde and acetaldehyde. The highest cancer risk levels from ambient TAC in the Bay Area tend to occur in the core urban areas, along major roadways and adjacent to freeways and port activity. Cancer risks in areas along these major freeways are estimated to range from 200 to over 500 excess cases in a million for a lifetime of exposure. Priority communities within the Bay Area – defined as having higher emitting sources, highest air concentrations, and nearby low income and sensitive populations – include the urban core areas of Concord, eastern San Francisco, western Alameda County, Redwood City/East Palo Alto, Richmond/San Pablo, and San Jose.

Fifty percent of BAAQMD's population was estimated to have an ambient background inhalation cancer risk of less than 500 cases in one million, based on emission levels in 2005. Table 8 presents a summary of percentages of the population exposed to varying levels of cancer risk from ambient TACs. Approximately two percent of the SFBAAB population is exposed to background risk levels of less than 200 excess cases in one million. This is in contrast to the upper percentile ranges where eight percent of the SFBAAB population is exposed to background risk levels of greater than 1,000 excess cases per one million. To identify and reduce risks from TAC, this chapter presents thresholds of significance for both cancer risk and non-cancer health hazards.

Table 8 – Statistical Summary of Estimated Population-Weighted Ambient Cancer Risk in 2005	
Percentage of Population (Percent below level of ambient risk)	**Ambient Cancer Risk (inhalation cancer cases in one million)**
92	1,000
90	900
83	800
77	700
63	600
50	500
32	400
13	300
2	200
<1	100
Source: Data compiled by EDAW 2009.	

Many scientific studies have linked fine particulate matter and traffic-related air pollution to respiratory illness (Hiltermann et al. 1997, Schikowski et al 2005, Vineis et al. 2007) and premature mortality (Dockery 1993, Pope et al. 1995, Jerrett et al. 2005). Traffic-related air pollution is a complex mix of chemical compounds (Schauer et al. 2006), often spatially correlated with other stressors, such as noise and poverty (Wheeler and Ben-Shlomo 2005). While such correlations can be difficult to disentangle, strong evidence for adverse health effects of fine particulate matter ($PM_{2.5}$) has been developed for regulatory applications in a recent consensus-based study by the California Air Resources Board. This study found that a 10 percent increase in $PM_{2.5}$ concentrations increased the non-injury death rate by 10 percent (ARB 2008).

Public Health Officers for four counties in the San Francisco Bay Area in 2009 provided testimony to the Air District's Advisory Council (February 11, 2009, Advisory Council Meeting on Air Quality and Public Health). Among the recommendations made, was that $PM_{2.5}$, in addition to TACs, be considered in assessments of community-scale impacts of air pollution. In consideration of the scientific studies and recommendations by the Bay Area Health Directors, it is apparent that, in addition to the significance thresholds for local-scale TAC, thresholds of significance are required for near-source, local-scale concentrations of $PM_{2.5}$.

3.2 PROPOSED THRESHOLDS OF SIGNIFICANCE

Proposed thresholds of significance and Board-requested options are presented in this section:

- The **Staff Proposal** includes thresholds for cancer risk, non-cancer health hazards, and fine particulate matter.

- **Board Option 1** includes tiered thresholds for new sources in impacted communities. Thresholds for receptors and cumulative impacts are the same as the Staff Proposal.
- **Board Option 2** removes the option for a qualified Community Risk Reduction Plan from the Staff Proposal.

Proposal/Option	Construction-Related	Operational-Related
Project-Level – Individual Project		
Risks and Hazards (Individual Project) **Staff Proposal**	Same as Operational Thresholds*	**All Areas:** Siting a New Source or Receptor Compliance with Qualified Risk Reduction Plan OR Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor
Risks and Hazards (Individual Project) **Board Option 1** **Tiered Thresholds**	Same as Operational Thresholds*	**Impacted Communities:** Siting a New Source Compliance with Qualified Risk Reduction Plan OR Increased cancer risk of >5.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.2 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor
	Same as Operational Thresholds*	**Impacted Communities:** Siting a New Receptor **All Other Areas:** Siting a New Source or Receptor Compliance with Qualified Risk Reduction Plan OR Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor

Proposal/Option	Construction-Related	Operational-Related
Risks and Hazards (Individual Project) **Board Option 2** **Quantitative Thresholds**	Same as Operational Thresholds*	**All Areas**: Siting a New Source or Receptor Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor
Accidental Release of Acutely Hazardous Air Pollutants	None	Storage or use of acutely hazardous materials locating near receptors or receptors locating near stored or used acutely hazardous materials considered significant
Project-Level – Cumulative		
Risks and Hazards (Cumulative Thresholds)	Same as Operational Thresholds*	**All Areas**: Siting a New Source or Receptor Compliance with Qualified Risk Reduction Plan OR Cancer: > 100 in a million (from all local sources) Non-cancer: > 1.0 Hazard Index (from all local sources) (Chronic or Acute) $PM_{2.5}$: > 0.8 µg/m^3 annual average (from all local sources) Zone of Influence: 1,000-foot radius from fence line of source or receptor
Plan-Level		
Plans	None	1. Overlay zones around existing and planned sources of TACs (including adopted Risk Reduction Plan areas) and odors. 2. Overlay zones of at least 500 feet (or Air District-approved modeled distance) from all freeways and high volume roadways.
Accidental Release of Acutely Hazardous Air Pollutants	None	None

* Note: The Air District recommends that for construction projects that are less than one year duration, Lead Agencies should annualize impacts over the scope of actual days that peak impacts are to occur, rather than the full year.

3.3 JUSTIFICATION AND SUBSTANTIAL EVIDENCE SUPPORTING THRESHOLDS

The goal of the proposed thresholds is to ensure that no source creates, or receptor endures, a significant adverse impact from any individual project, and that the total of all nearby directly emitted risk and hazard emissions is also not significantly adverse. The thresholds for local risks and hazards from TAC and $PM_{2.5}$ are intended to apply to all sources of emissions, including both permitted stationary sources and on- and off-road mobile sources, such as sources related to construction, busy roadways, or freight movement.

Thresholds for an individual new source are designed to ensure that the source does not contribute a cumulatively significant impact. Cumulative thresholds for sources recognize that some areas are already near or at levels of significant impact. If within such an area there are receptors, or it can reasonably be foreseen that there will be receptors, then a cumulative significance threshold sets a level beyond which any additional risk is significant.

For new receptors – sensitive populations or the general public – thresholds of significance are designed to identify levels of contributed risk or hazards from existing local sources that pose a significant risk to the receptors. Single-source thresholds for receptors are provided to recognize that within the area defined there can be variations in risk levels that may be significant. Single-source thresholds assist in the identification of significant risks, hazards, or concentrations in a subarea, within the area defined by the selected radius. Cumulative thresholds for receptors are designed to account for the effects of all sources within the defined area.

Cumulative thresholds, for both sources and receptors, must consider the size of the source area, defined by a radius from the proposed project. To determine cumulative impacts from a prescribed zone of influence requires the use of modeling. The larger the radius, the greater the number of sources considered that may contribute to the modeled risk and, until the radius approaches a regional length scale, the greater the expected modeled risk increment. If the area of impact considered were grown to the scale of a city, the modeled risk increment would approach the risk level present in the ambient air.

3.3.1 SCIENTIFIC AND REGULATORY JUSTIFICATION

Regulatory Framework for TACs

Prior to 1990, the Clean Air Act required EPA to list air toxics it deemed hazardous and to establish control standards which would restrict concentrations of hazardous air pollutants (HAP) to a level that would prevent any adverse effects “with an ample margin of safety.” By 1990, EPA had regulated only seven such pollutants and it was widely acknowledged by that time that the original Clean Air Act had failed to address toxic air emissions in any meaningful way. As a result, Congress changed the focus of regulation in 1990 from a risk-based approach to technology-based standards. Title III, Section 112(b) of the 1990 Clean Air Act Amendment established this new regulatory approach.

Under this framework, prescribed pollution control technologies based upon maximum achievable control technology (MACT) were installed without the a priori estimation of the health or environmental risk associated with each individual source. The law listed 188 HAPs that would be subject to the MACT standards. EPA issued 53 standards for 89 different types of major industrial sources of air toxics and eight categories of smaller sources such as dry cleaners. These requirements took effect between 1996 and 2002. Under the federal Title V Air Operating Permit Program, a facility with the potential to emit 10 tons of any toxic air pollutant, or 25 tons per year of any combination of toxic air pollutants, is defined as a major source HAPs. Title V permits include requirements for these facilities to limit toxic air pollutant emissions.

Several state and local agencies adopted programs to address gaps in EPA's program prior to the overhaul of the national program in 1990. California's program to reduce exposure to air toxics was established in 1983 by the Toxic Air Contaminant Identification and Control Act (AB 1807, Tanner 1983) and the Air Toxics "Hot Spots" Information and Assessment Act (AB 2588, Connelly 1987). Under AB 1807, ARB and the Office of Environmental Health Hazard Assessment (OEHHA) determines if a substance should be formally identified as a toxic air contaminant (TAC) in California. OEHHA also establishes associated risk factors and safe concentrations of exposure.

AB 1807 was amended in 1993 by AB 2728, which required ARB to identify the 189 federal hazardous air pollutants as TACs. AB 2588 (Connelly, 1987) supplements the AB 1807 program, by requiring a statewide air toxics inventory, notification of people exposed to a significant health risk, and facility plans to reduce these risks. In September 1992, the "Hot Spots" Act was amended by Senate Bill 1731 which required facilities that pose a significant health risk to the community to reduce their risk through a risk management plan.

Cancer Risk

Cancer risk from TACs is typically expressed in numbers of excess cancer cases per million persons exposed over a defined period of exposure, for example, over an assumed 70 year lifetime. The Air District is not aware of any agency that has established an acceptable level of cancer risk for TACs. However, a range of what constitutes a significant increment of cancer risk from any compound has been established by the U.S. EPA. EPA's guidance for conducting air toxics analyses and making risk management decisions at the facility- and community-scale level considers a range of acceptable cancer risks from one in a million to one in ten thousand (100 in a million). The guidance considers an acceptable range of cancer risk increments to be from one in a million to one in ten thousand. In protecting public health with an ample margin of safety, EPA strives to provide maximum feasible protection against risks to health from HAPs by limiting additional risk to a level no higher than the one in ten thousand estimated risk that a person living near a source would be exposed to at the maximum pollutant concentrations for 70 years. This goal is described in the preamble to the benzene National Emissions Standards for Hazardous Air Pollutants (NESHAP) rulemaking (54 Federal Register 38044, September 14, 1989) and is incorporated by Congress for EPA's residual risk program under Clean Air Act section 112(f).

Regulation 2, Rule 5 of the Air District specifies permit requirements for new and modified stationary sources of TAC. The Project Risk Requirement (2-5-302.1) states that the Air Pollution Control Officer shall deny an Authority to Construct or Permit to Operate for any new or modified source of TACs if the project cancer risk exceeds 10.0 in one million.

Hazard Index for Non-cancer Health Effects

Non-cancer health hazards for chronic and acute diseases are expressed in terms of a hazard index (HI), a ratio of TAC concentration to a reference exposure level (REL), below which no adverse health effects are expected, even for sensitive individuals. As such, OEHHA has defined acceptable concentration levels, and also significant concentration increments, for compounds that pose non-cancer health hazards. If the HI for a compound is less than one, non-cancer chronic and acute health impacts have been determined to be less than significant.

State and Federal Ambient Air Quality Standards for $PM_{2.5}$

The Children's Environmental Health Protection Act (Senate Bill 25), passed by the California state legislature in 1999, requires ARB, in consultation with OEHHA, to "review all existing health-based ambient air quality standards to determine whether, based on public health, scientific literature and exposure pattern data, these standards adequately protect the public, including infants and children, with an adequate margin of safety." As a result of the review requirement, in 2002 ARB adopted an annual average California Ambient Air Quality Standard (CAAQS) for $PM_{2.5}$ of 12 ug/m^3 that is not to be exceeded (California Code of Regulations, Title 17 § 70200, Table of Standards.) The National Ambient Air Quality Standard (NAAQS) established an annual standard for $PM_{2.5}$ (15 ug/m^3) that is less stringent that the CAAQS, but also set a 24-hour average standard (35 ug/m^3), which is not included in the CAAQS (Code of Federal Regulations, Title 40, Part 50.7).

Significant Impact Levels for $PM_{2.5}$

EPA recently proposed and documented alternative options for $PM_{2.5}$ Significant Impact Levels (SILs) (Federal Register 40 CFR Parts 51 and 52, September 21, 2007). The EPA is proposing to facilitate implementation of a $PM_{2.5}$ Prevention of Significant Deterioration (PSD) program in areas attaining the $PM_{2.5}$ NAAQS by developing $PM_{2.5}$ increments, or SILs. These "increments" are maximum increases in ambient $PM_{2.5}$ concentrations ($PM_{2.5}$ increments) allowed in an area above the baseline concentration.

The SIL is a threshold that would be applied to individual facilities that apply for a permit to emit a regulated pollutant in an area that meets the NAAQS. The State and EPA must determine if emissions from that facility will cause the air quality to worsen. If an individual facility projects an increase in emissions that result in ambient impacts greater than the established SIL, the permit applicant would be required to perform additional analyses to determine if those impacts will be more than the amount of the PSD increment. This analysis would combine the impact of the proposed facility when added to all other sources in the area.

The EPA is proposing such values for $PM_{2.5}$ that will be used as screening tools by a major source subject to PSD to determine the subsequent level of analysis and data gathering required for a PSD permit application for emissions of $PM_{2.5}$. The SIL is one element of the EPA program to prevent deterioration in regional air quality and is utilized in the new source review (NSR) process. New source review is required under Section 165 of the Clean Air Act, whereby a permit applicant must demonstrate that emissions from the proposed construction and operation of a facility "will not cause, or contribute to, air pollution in excess of any maximum allowable increase or maximum allowable concentration for any pollutant." The purpose of the SIL is to provide a screening level that triggers further analysis in the permit application process.

For the purpose of NSR, SILs are set for three types of areas: Class I areas where especially clean air is most desirable, including national parks and wilderness areas; Class II areas where there is not expected to be substantial industrial growth; and Class III areas where the highest relative level of industrial development is expected. In Class II and Class III areas, a $PM_{2.5}$ concentration of 0.3, 0.8, and 1 $\mu g/m^3$ has been proposed as a SIL. To arrive at the SIL $PM_{2.5}$ option of 0.8 $\mu g/m^3$, EPA scaled an established PM_{10} SILs of 1.0 $\mu g/m^3$ by the ratio of emissions of $PM_{2.5}$ to PM_{10} using the EPA's 1999 National Emissions Inventory. To arrive at the SIL option of 0.3 $\mu g/m^3$, EPA scaled the PM_{10} SIL of 1.0 $\mu g/m^3$ by the ratio of the current Federal ambient air quality standards for $PM_{2.5}$ and PM_{10} (15/50). These options represent what EPA currently considers as a range of appropriate SIL values.

EPA interprets the SIL to be the level of $PM_{2.5}$ increment that represents a "significant contribution" to regional non-attainment. While SIL options were not designed to be thresholds for assessing community risk and hazards, they are being considered to protect public health at a regional level by helping an area maintain the NAAQS. Furthermore, since it is the goal of the Air District to achieve and maintain the NAAQS and CAAQS at both regional and local scales, the SILs may be reasonably be considered as thresholds of significance under CEQA for local-scale increments of $PM_{2.5}$.

Roadway Proximity Health Studies

Several medical research studies have linked near-road pollution exposure to a variety of adverse health outcomes impacting children and adults. Kleinman et al. (2007) studied the potential of roadway particles to aggravate allergic and immune responses in mice. Using mice that were not inherently susceptible, the researchers placed these mice at various distances downwind of State Road 60 and Interstate 5 freeways in Los Angeles to test the effect these roadway particles have on their immune system. They found that within five meters of the roadway, there was a significant allergic response and elevated production of specific antibodies. At 150 meters (492 feet) and 500 meters (1,640 feet) downwind of the roadway, these effects were not statistically significant.

Another significant study (Ven Hee et al. 2009) conducted a survey involving 3,827 participants that aimed to determine the effect of residential traffic exposure on two preclinical indicators of heart failure; left ventricular mass index (LVMI), measured by the cardiac magnetic resonance imaging (MRI), and ejection fraction. The studies

classified participants based on the distance between their residence and the nearest interstate highway, state or local highway, or major arterial road. Four distance groups were defined: less than 50 meters (165 feet), 50-100 meters, 101-150 meters, and greater than 150 meters. After adjusting for demographics, behavioral, and clinical covariates, the study found that living within 50 meters of a major roadway was associated with a 1.4 g/m^2 higher LVMI than living more than 150 meters from one. This suggests an association between traffic-related air pollution and increased prevalence of a preclinical predictor of heart failure among people living near roadways.

To quantify the roadway concentrations of $PM_{2.5}$ that contributed to the health impacts reported by Kleinman et al (2007), the Air District modeled the emissions and associated particulate matter concentrations for the roadways studied. To perform the modeling, emissions were estimated for Los Angeles using the EMFAC model and annual average vehicle traffic data taken from Caltrans was used in the roadway model (CAL3QHCR) to estimate the downwind $PM_{2.5}$ concentrations at 50 meters and 150 meters. Additionally, emissions were assumed to occur from 10:00 a.m. to 2:00 p.m. corresponding to the time in which the mice were exposed during the study. The results of the modeling indicate that at 150 meters, where no significant health effects were found, the downwind concentration of $PM_{2.5}$ was 0.78 $\mu g/m^3$, consistent with the proposed EPA SIL option of 0.8 $\mu g/m^3$.

Concentration-Response Function for $PM_{2.5}$

In a recent report, ARB reevaluated the relative risk of premature death associated with $PM_{2.5}$ exposure based on a review of all relevant scientific literature available, and a new relative risk factor was developed (ARB 2008). This consensus-based review found that a 10 $\mu g/m^3$ increase in $PM_{2.5}$ concentrations increased the risk of premature death by 10 percent (uncertainty interval: 3 percent to 20 percent) and provides a basis for determining the risk increment from an increase in $PM_{2.5}$ concentration. Twelve experts participated in the study to review the literature and develop the concentration response function. The experts were selected through a two-part peer nomination process, designed to obtain a balanced set of views and included experts in epidemiology, toxicology, and medicine.

The methodologies and results presented in this report were endorsed by scientific advisors from Harvard University, OEHHA, and Brigham Young University. The report underwent an external peer review by experts selected through an independent process involving the University of California at Berkeley, Institute of the Environment. The results of the peer review process were incorporated into the report. Subsequent to the peer review, Schwartz et al. (2008) examined the linearity of the concentration-response function of $PM_{2.5}$-mortality and showed that the response function is in agreement with Laden et al. (2006) and, moreover, found that this response function was linear down to background levels.

San Francisco Ordinance on Roadway Proximity Health Effects

In 2008, the City and County of San Francisco adopted an ordinance (San Francisco Health Code, Article 38 - Air Quality Assessment and Ventilation Requirement for Urban

Infill Residential Development, Ord. 281-08, File No. 080934, December 5, 2008) requiring that public agencies in San Francisco take regulatory action to prevent future air quality health impacts from new sensitive uses proposed near busy roadways (SFDPH 2008). The regulation requires that developers screen sensitive use projects for proximity to traffic and calculate the concentration of $PM_{2.5}$ from traffic sources where traffic volumes suggest a potential hazard. If modeled levels of traffic-attributable $PM_{2.5}$ at a project site exceed an action level (currently set at 0.2 $\mu g/m^3$) developers would be required to incorporate ventilation systems to remove 80 percent of $PM_{2.5}$ from outdoor air. The regulation does not place any requirements on proposed sensitive uses if modeled air pollutant levels fall below the action threshold. This ordinance only considers impacts from on-road motor vehicles, not impacts related to construction equipment or stationary sources.

A report with supporting documentation for the ordinance (SFPHD 2008) provided a threshold to trigger action or mitigation of 0.2 $\mu g/m^3$ of $PM_{2.5}$ annual average exposure from roadway vehicles within a 150 meter (492 feet) maximum radius of a sensitive receptor. The report applied the concentration-response function from Jerrett et al. (2005) that attributed 14 percent increase in mortality to a 10 $\mu g/m^3$ increase in $PM_{2.5}$ to estimate an increase in non-injury mortality in San Francisco of about 21 excess deaths per year from a 0.2 $\mu g/m^3$ increment of annual average $PM_{2.5}$.

Distance for Significant Impact

The distance used for the radius around the project boundary should reflect the zone or area over which sources may have a significant influence. For cumulative thresholds, for both sources and receptors, this distance also determines the size of the source area, defined. To determine cumulative impacts from a prescribed zone of influence requires the use of modeling. The larger the radius, the greater the number of sources considered that may contribute to the risk and the greater the expected modeled risk increment. If the area of impact considered were grown to approach the scale of a city, the modeled risk increment would approach the risk level present in the ambient air.

A summary of research findings in ARB's Land Use Compatibility Handbook (ARB 2005) indicates that traffic-related pollutants were higher than regional levels within approximately 1,000 feet downwind and that differences in health-related effects (such as asthma, bronchitis, reduced lung function, and increased medical visits) could be attributed in part to the proximity to heavy vehicle and truck traffic within 300 to 1,000 feet of receptors. In the same summary report, ARB recommended avoiding siting sensitive land uses within 1,000 feet of a distribution center and major rail yard, which supports the use of a 1,000 feet evaluation distance in case such sources may be relevant to a particular project setting. A 1,000 foot zone of influence is also supported by Health & Safety Code §42301.6 (Notice for Possible Source Near School).

Some studies have shown that the concentrations of particulate matter tend to be reduced substantially or can even be indistinguishable from upwind background concentrations at a distance 1,000 feet downwind from sources such as freeways or large distribution centers. Zhu et al. (2002) conducted a systematic ultrafine particle study near Interstate

710, one of the busiest freeways in the Los Angeles Basin. Particle number concentration and size distribution were measured as a function of distances upwind and downwind of the I-710 freeway. Approximately 25 percent of the 12,180 vehicles per hour are heavy duty diesel trucks based on video counts conducted as part of the research. Measurements were taken at 13 feet, 23 feet, 55 feet, 252 feet, 449 feet, and 941 feet downwind and 613 feet upwind from the edge of the freeway. The particle number and supporting measurements of carbon monoxide and black carbon decreased exponentially and all constituents simultaneously tracked with each other as one moves away from the freeway. Ultrafine particle size distribution changed markedly and its number concentrations dropped dramatically with increasing distance. The study found that ultrafine particle concentrations measured 941 feet downwind of I-710 were indistinguishable from the upwind background concentration.

Impacted Communities

Starting in 2006, the Air District's CARE program developed gridded TAC emissions inventories and compiled demographic information that were used to identify communities that were particularly impacted by toxic air pollution for the purposes of distributing grant and incentive funding. In 2009, the District completed regional modeling of TAC on a one kilometer by one kilometer grid system. This modeling was used to estimate cancer risk and TAC population exposures for the entire District. The information derived from the modeling was then used to update and refine the identification of impacted communities. One kilometer modeling yielded estimates of annual concentrations of five key compounds – diesel particulate matter, benzene, 1,3-butadiene, formaldehyde, and acetaldehyde – for year 2005. These concentrations were multiplied by their respective unit cancer risk factors, as established by OEHHA, to estimate the expected excess cancer risk per million people from these compounds.

Sensitive populations from the 2000 U.S. Census database were identified as youth (under 18) and seniors (over 64) and mapped to the same one kilometer grid used for the toxics modeling. Excess cancers from TAC exposure were determined by multiplying these sensitive populations by the model-estimated excess risk to establish a data set representing sensitive populations with high TAC exposures. TAC emissions (year 2005) were mapped to the one kilometer grid and also scaled by their unit cancer risk factor to provide a data set representing source regions for TAC emissions. Block-group level household income data from the U.S. Census database were used to identify block groups with family incomes where more than 40 percent of the population was below 185 percent of the federal poverty level (FPL). Poverty-level polygons that intersect high (top 50 percent) exposure cells and are within one grid cell of a high emissions cell (top 25 percent) were used to identify impacted areas. Boundaries were constructed along major roads or highways that encompass nearby high emission cells and low income areas. This method identified the following six areas as priority communities: (1) portions of the City of Concord; (2) Western Contra Costa County (including portions of the Cities of Richmond and San Pablo); (3) Western Alameda County along the Interstate-880 corridor (including portions of the Cities of Berkeley, Oakland, San Leandro, San Lorenzo, Hayward; (4) Portions of the City of San Jose. (5) Eastern San Mateo County

(including portions of the Cities of Redwood City and East Palo Alto); and (6) Eastern portions of the City of San Francisco.

3.3.2 CONSTRUCTION, LAND USE AND STATIONARY SOURCE RISK AND HAZARD THRESHOLDS

The proposed options for local risk and hazards thresholds of significance are based on U.S. EPA guidance for conducting air toxics analyses and making risk management decisions at the facility and community-scale level. The thresholds consider reviews of recent health effects studies that link increased concentrations of fine particulate matter to increased mortality. The proposed thresholds would apply to both siting new sources and siting new receptors.

For new sources of TACs, thresholds of significance for a single source are designed to ensure that emissions do not raise the risk of cancer or non-cancer health impacts to cumulatively significant levels. For new sources of $PM_{2.5}$, thresholds are designed to ensure that $PM_{2.5}$ concentrations are maintained below state and federal standards in all areas where sensitive receptors or members of the general public live or may foreseeably live, even if at the local- or community-scale where sources of TACs and PM may be nearby.

Project Radius for Assessing Impacts

For a project proposing a new source or receptor it is recommended to assess impacts within 1,000 feet, taking into account both its individual and nearby cumulative sources (i.e. proposed project plus existing and foreseeable future projects). Cumulative sources are the combined total risk values of each individual source within the 1,000-foot evaluation zone. A lead agency should enlarge the 1,000-foot radius on a case-by-case basis if an unusually large source or sources of risk or hazard emissions that may affect a proposed project is beyond the recommended radius.

The 1,000 foot radius is consistent with findings in ARB's Land Use Compatibility Handbook (ARB 2005), the Health & Safety Code §42301.6 (Notice for Possible Source Near School), and studies such as that of Zhu et al (2002) which found that concentrations of particulate matter tend to be reduced substantially at a distance 1,000 feet downwind from sources such as freeways or large distribution centers.

Qualified Community Risk Reduction Plan

Within the framework of these thresholds, proposed projects would be considered to be less than significant if they are consistent with a qualified Community Risk Reduction Plan (CRRP) adopted by the local jurisdiction with enforceable measures to reduce the community risk. Board Option 2 does not include the CCRP as a significance threshold.

Project proposed in areas where a CRRP has been adopted that are not consistent with the CRRP would be considered to have a significant impact.

Projects proposed in areas where a CRRP has not been adopted and that have the potential to expose sensitive receptors or the general public to emissions-related risk in excess of the thresholds below from any source would be considered to have a significant air quality impact.

The conclusion that land use projects that comply with qualified Community Risk Reduction Plans are less than significant is supported by CEQA Guidelines Sections 15030(a)(3) and 15064(h)(3), which provides that a project's contribution to a cumulative problem can be less that cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact.

Increased Cancer Risk to Maximally Exposed Individual (MEI)

Emissions from a new source or emissions affecting a new receptor would be considered significant where ground-level concentrations of carcinogenic TACs from any source result in an increased cancer risk greater than 10.0 in one million, assuming a 70 year lifetime exposure. Under Board Option 1, within Impacted Communities as defined through the CARE program, the significance level for cancer would be reduced to 5.0 in one million for new sources.

The 10.0 in one million cancer risk threshold for a single source is supported by EPA's guidance for conducting air toxics analyses and making risk management decisions at the facility and community-scale level. It is also the level set by the Project Risk Requirement in the Air District's Regulation 2, Rule 5 new and modified stationary sources of TAC, which states that the Air Pollution Control Officer shall deny an Authority to Construct or Permit to Operate for any new or modified source of TACs if the project risk exceeds a cancer risk of 10.0 in one million.

This threshold for an individual new source is designed to ensure that the source does not contribute a cumulatively significant impact. The justification for the Board Option 1 threshold of 5.0 in one million for new sources in an impacted community is that in these areas the cancer risk burden is higher than in other parts of the Bay Area; the threshold at which an individual source becomes significant is lower for an area that is already at or near unhealthy levels. However, even without a tiered approach, the recommended thresholds already address the burden of impacted communities via the cumulative thresholds: specifically, if an area has many existing TAC sources near receptors, then the cumulative threshold will be reached sooner than it would in another area with fewer TAC sources.

The single-source threshold for receptors is provided to address the possibility that within the area defined by the 1,000 foot radius there can be variations in risk levels that may be significant, below the corresponding cumulative threshold. Single-source thresholds assist in the identification of significant risks, hazards, or concentrations in a subarea, within the 1,000 foot radius.

Increased Non-Cancer Risk to MEI

Emissions from a new source or emissions affecting a new receptor would be considered significant where ground-level concentrations of non-carcinogenic TACs result in an increased chronic or acute Hazard Index (HI) from any source greater than 1.0. This threshold is unchanged under Board Option 1.

A HI less than 1.0 represents a TAC concentration, as determined by OEHHA that is at a health protective level. While some TACs pose non-carcinogenic, chronic and acute health hazards, if the TAC concentrations result in a HI less than one, those concentrations have been determined to be less than significant.

Increased Ambient Concentration of $PM_{2.5}$

Emissions from a new source or emissions affecting a new receptor would be considered significant where ground-level concentrations of $PM_{2.5}$ from any source would result in an average annual increase greater than 0.3 $\mu g/m^3$. Under Board Option 1, within Impacted Communities as defined through the CARE program, the significance level for a $PM_{2.5}$ increment is 0.2 $\mu g/m^3$.

If one applies the concentration-response function from the ARB consensus review (ARB 2008) and attribute a 10 percent increase in mortality to a 10 $\mu g/m^3$ increase in $PM_{2.5}$, one finds an increase in non-injury mortality in the Bay Area of about 20 excess deaths per year from a 0.3 $\mu g/m^3$ increment of $PM_{2.5}$. This is consistent with the impacts reported and considered significant by SFDPH (2008) using an earlier study (Jerrett et al. 2005) to estimate the increase in mortality from a 0.2 $\mu g/m^3$ $PM_{2.5}$ increment.

The SFDPH recommended a lower threshold of significance for multiple sources but only considered roadway emissions within a 492 foot radius. This recommendation applies to a single source but considers all types of emissions within 1,000 feet. On balance, the Air District estimates that the SFDPH threshold and this proposed one, in combination with the cumulative threshold for $PM_{2.5}$, will afford similar levels of health protection.

The proposed $PM_{2.5}$ threshold represents the lower range of an EPA proposed Significant Impact Level (SIL). EPA interprets the SIL to be the level of ambient impact that is considered to represent a "significant contribution" to regional non-attainment. While this threshold was not designed to be a threshold for assessing community risk and hazards, it was designed to protect public health at a regional level by helping an area maintain the NAAQS. Since achieving and maintaining state and federal AAQS is a reasonable goal at the local scale, the SIL provides a useful reference for comparison.

This threshold for an individual new source is designed to ensure that the source does not contribute a cumulatively significant impact. The justification for the Board Option 1 threshold of 0.2 $\mu g/m^3$ for new sources in an impacted community is that these areas have higher levels of diesel particulate matter than do other parts of the Bay Area; the threshold at which an individual source becomes significant is lower for an area that is already at or near unhealthy levels. However, even without a tiered approach, the recommended thresholds already address the burden of impacted communities via the

cumulative thresholds: specifically, if an area has many existing $PM_{2.5}$ sources near receptors, then the cumulative threshold will be reached sooner than it would in another area with fewer $PM_{2.5}$ sources.

The single-source threshold for receptors is provided to address the possibility that within the area defined by the 1,000 foot radius there can be variations in risk levels that may be significant, below the corresponding cumulative threshold. Single-source thresholds assist in the identification of significant risks, hazards, or concentrations in a subarea, within the 1,000 foot radius.

3.3.2.1 ACCIDENTAL RELEASE OF ACUTELY HAZARDOUS AIR EMISSIONS

The BAAQMD currently recommends, at a minimum, that the lead agency, in consultation with the administering agency of the Risk Management Prevention Program (RMPP), find that any project resulting in receptors being within the Emergency Response Planning Guidelines (ERPG) exposure level 2 for a facility has a significant air quality impact. ERPG exposure level 2 is defined as "the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action."

Staff proposes continuing with the current threshold for the accidental release of hazardous air pollutants. Staff recommends that agencies consult with the California Emergency Management Agency for the most recent guidelines and regulations for the storage of hazardous materials. Staff proposes that projects using or storing acutely hazardous materials locating near existing receptors, and projects resulting in receptors locating near facilities using or storing acutely hazardous materials be considered significant.

The current Accidental Release/Hazardous Air Emissions threshold of significance could affect all projects, regardless of size, and require mitigation for Accidental Release/Hazardous Air Emissions impacts.

3.3.3 CUMULATIVE RISK AND HAZARD THRESHOLDS

Qualified Community Risk Reduction Plan

Proposed projects would be considered to be less than significant if they are consistent with a qualified Community Risk Reduction Plan (CRRP) adopted by the local jurisdiction with enforceable measures to reduce the community risk. Board Option 2 does not include the CCRP as a significance threshold.

Project proposed in areas where a CRRP has been adopted that are not consistent with the CRRP would be considered to have a significant impact.

Projects proposed in areas where a CRRP has not been adopted and that have the potential to expose sensitive receptors or the general public to emissions-related risk in

excess of the following thresholds from the aggregate of cumulative sources would be considered to have a significant air quality impact.

The conclusion that land use projects that comply with qualified Community Risk Reduction Plans are less than significant is supported by CEQA Guidelines Sections 15030(a)(3) and 15064(h)(3), which provides that a project's contribution to a cumulative problem can be less that cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact.

Increased Cancer Risk to Maximally Exposed Individual (MEI)

Emissions from a new source or emissions affecting a new receptor would be considered significant where ground-level concentrations of carcinogenic TACs from any source result in an increased cancer risk greater than 100.0 in one million.

The significance threshold of 100 in a million increased excess cancer risk would be applied to the cumulative emissions. The 100 in a million threshold is based on EPA guidance for conducting air toxics analyses and making risk management decisions at the facility and community-scale level. In protecting public health with an ample margin of safety, EPA strives to provide maximum feasible protection against risks to health from hazardous air pollutants (HAPs) by limiting risk to a level no higher than the one in ten thousand (100 in a million) estimated risk that a person living near a source would be exposed to at the maximum pollutant concentrations for 70 years (NESHAP 54 Federal Register 38044, September 14, 1989; CAA section 112(f)). One hundred in a million excess cancer cases is also consistent with the ambient cancer risk in the most pristine portions of the Bay Area based on the District's recent regional modeling analysis.

Increased Non-Cancer Risk to MEI

Emissions from a new source or emissions affecting a new receptor would be considered significant where ground-level concentrations of non-carcinogenic TACs result in an increased chronic or acute Hazard Index from any source greater than 1.0.

OEHHA has defined acceptable concentration levels for compounds that pose non-cancer health hazards. If the HI for a compound is less than one, non-cancer chronic and acute health impacts have been determined to be less than significant.

Increased Ambient Concentration of $PM_{2.5}$

Emissions from a new source or emissions affecting a new receptor would be considered significant where ground-level concentrations of $PM_{2.5}$ from any source would result in an average annual increase greater than 0.8 $\mu g/m^3$.

If one applies the concentration-response function from the ARB consensus review (ARB 2008) and attributes a 10 percent increase in mortality to a 10 $\mu g/m^3$ increase in $PM_{2.5}$, one finds an increase in non-injury mortality in the Bay Area of about 50 excess deaths per year from a 0.8 $\mu g/m^3$ increment of $PM_{2.5}$. This is greater the impacts reported and considered significant by SFDPH (2008) using an earlier study (Jerrett et al. 2005) to

estimate the increase in mortality from a 0.2 μg/m^3 $PM_{2.5}$ increment (SFDPH reported 21 excess deaths per year). However, SFDPH only considered roadway emissions within a 492 foot radius. This proposed threshold applies to all types of emissions within 1,000 feet. In modeling applications for proposed projects, a larger radius results in a greater number of sources considered and higher modeled concentrations. On balance, the Air District estimates that the SFDPH threshold and this proposed one, in combination with the individual source threshold for $PM_{2.5}$, will afford similar levels of health protection.

The proposed cumulative $PM_{2.5}$ threshold represents the middle range of an EPA proposed Significant Impact Level (SIL). EPA interprets the SIL to be the level of ambient impact that is considered to represent a "significant contribution" to regional non-attainment. While this threshold was not designed to be a threshold for assessing community risk and hazards, it was designed to protect public health at a regional level by helping an area maintain the NAAQS. Since achieving and maintaining state and federal AAQS is a reasonable goal at the local scale, the SIL provides a useful reference for comparison. Furthermore, the 0.8 μg/m^3 threshold is consistent with studies (Kleinman et al 2007) that examined the potential health impacts of roadway particles.

3.3.4 PLAN-LEVEL RISK AND HAZARD THRESHOLDS

Staff proposes plan-level thresholds that will encourage a programmatic approach to addressing the overall adverse conditions resulting from risks and hazards that many Bay Area communities experience. By designating overlay zones in land use plans, local land use jurisdictions can take preemptive action before project-level review to reduce the potential for significant exposures to risk and hazard emissions. While this will require more up-front work at the general plan level, in the long-run this approach is a more feasible approach consistent with Air District and CARB guidance about siting sources and sensitive receptors that is more effective than project by project consideration of effects that often has more limited mitigation opportunities. This approach would also promote more robust cumulative consideration of effects of both existing and future development for the plan-level CEQA analysis as well as subsequent project-level analysis.

For local plans to have a less-than-significant impact with respect to potential risks and hazards, overlay zones would have to be established around existing and proposed land uses that would emit these air pollutants. Overlay zones to avoid risk impacts should be reflected in local plan policies, land use map(s), and implementing ordinances (e.g., zoning ordinance). The overlay zones around existing and future risk sources would be delineated using the quantitative approaches described above for project-level review and the resultant risk buffers would be included in the General Plan (or the EIR for the General Plan) to assist in site planning. BAAQMD will provide guidance as to the methods used to establish the TAC buffers and what standards to be applied for acceptable exposure level in the updated CEQA Guidelines document. Special overlay zones of at least 500 feet (or an appropriate distance determined by modeling and approved by the Air District) on each side of all freeways and high volume roadways would be included in this proposed threshold.

The threshold of significance for plan impacts could affect all plan adoptions and amendments and require mitigation for a plan's air quality impacts. Where sensitive receptors would be exposed above the acceptable exposure level, the plan impacts would be considered significant and mitigation would be required to be imposed either at the plan level (through policy) or at the project level (through project level requirements).

3.3.5 COMMUNITY RISK REDUCTION PLANS

The goal of a Community Risk Reduction Plan would be to bring TAC and $PM_{2.5}$ concentrations for the entire community covered by the Plan down to acceptable levels as identified by the local jurisdiction and approved by the Air District. This approach provides local agencies a proactive alternative to addressing communities with high levels of risk on a project-by-project approach. This approach is supported by CEQA Guidelines Section 15030(a)(3), which provides that a project's contribution to a cumulative problem can be less than cumulatively considerable "if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact." This approach is also further supported by CEQA Guidelines Section 15064(h)(3), which provides that a project's contribution to a cumulative effect is not considerable "if the project will comply with the requirements in a previously approved plan or mitigation program which provides specific requirements that will avoid or substantially lessen the cumulative problem."

Qualified Community Risk Reduction Plans

A qualified Community Risk Reduction Plan adopted by a local jurisdiction should:

- Include a defined CRRP planning area.
- Include base year and future year emissions inventories of TACs and $PM_{2.5}$.
- Establish risk and exposure reduction targets for the community.
- Identify measures to reduce emissions and exposures.
- Include Air District–approved risk modeling.
- Include procedures for monitoring and updating the TAC inventory, modeling and reduction measures, in coordination with Air District staff.
- Include public participation processes to facilitate community input into goals and strategies.

4 CRITERIA POLLUTANT THRESHOLDS

4.2 PROPOSED THRESHOLDS OF SIGNIFICANCE

Project Construction	
Pollutant	**Average Daily (pounds/day)**
ROG (reactive organic gases)	54
NO_X (nitrogen oxides)	54
PM_{10} (exhaust) (particulate matter-10 microns)	82
$PM_{2.5}$ (exhaust) (particulate matter-2.5 microns)	54
$PM_{10}/PM_{2.5}$ (fugitive dust)	Best Management Practices
Local CO (carbon monoxide)	None

Project Operations		
Pollutant	**Average Daily (pounds/day)**	**Maximum Annual (tons/year)**
ROG	54	10
NO_X	54	10
PM_{10}	82	15
$PM_{2.5}$	54	10
Local CO	9.0 ppm (8-hour average), 20.0 ppm (1-hour average)	

Plans
1. Consistency with Current Air Quality Plan control measures 2. Projected VMT or vehicle trip increase is less than or equal to projected population increase

4.3 JUSTIFICATION AND SUBSTANTIAL EVIDENCE SUPPORTING THRESHOLDS

4.3.1 PROJECT CONSTRUCTION CRITERIA POLLUTANT THRESHOLDS

Staff proposes criteria pollutant construction thresholds that add significance criteria for exhaust emissions to the existing fugitive dust criteria employed by the Air District. While our current Guidelines considered construction exhaust emissions controlled by the overall air quality plan, the implementation of new and more stringent state and federal standards over the past ten years now warrants additional control of this source of emissions.

The average daily criteria air pollutant and precursor emission levels shown above are recommended as the thresholds of significance for construction activity for exhaust emissions. These thresholds represent the levels above which a project's individual

emissions would result in a considerable contribution (i.e., significant) to the SFBAAB's existing non-attainment air quality conditions and thus establish a nexus to regional air quality impacts that satisfies CEQA requirements for evidence-based determinations of significant impacts.

For fugitive dust emissions, staff recommends following the current best management practices approach which has been a pragmatic and effective approach to the control of fugitive dust emissions. Studies have demonstrated (Western Regional Air Partnership, U.S.EPA) that the application of best management practices at construction sites have significantly controlled fugitive dust emissions. Individual measures have been shown to reduce fugitive dust by anywhere from 30 percent to more than 90 percent. In the aggregate best management practices will substantially reduce fugitive dust emissions from construction sites. These studies support staff's recommendation that projects implementing construction best management practices will reduce fugitive dust emissions to a less than significant level.

4.3.2 PROJECT OPERATION CRITERIA POLLUTANT THRESHOLDS

The proposed thresholds for project operations are the average daily and maximum annual criteria air pollutant and precursor levels shown above. These thresholds are based on the federal BAAQMD Offset Requirements to ozone precursors for which the SFBAAB is designated as a non-attainment area which is an appropriate approach to prevent further deterioration of ambient air quality and thus has nexus and proportionality to prevention of a regionally cumulative significant impact (e.g. worsened status of non-attainment). Despite non-attainment area for state PM_{10} and pending nonattainment for federal $PM_{2.5}$, the federal NSR Significant Emission Rate annual limits of 15 and 10 tons per year, respectively, are proposed thresholds as BAAQMD has not established an Offset Requirement limit for $PM_{2.5}$ and the existing limit of 100 tons per year is much less stringent and would not be appropriate in light of our pending nonattainment designation for the federal 24-hour $PM_{2.5}$ standard. These thresholds represent the emission levels above which a project's individual emissions would result in a cumulatively considerable contribution to the SFBAAB's existing air quality conditions. The thresholds would be an evaluation of the incremental contribution of a project to a significant cumulative impact. These threshold levels are well-established in terms of existing regulations as promoting review of emissions sources to prevent cumulative deterioration of air quality. Using existing environmental standards in this way to establish CEQA thresholds of significance under Guidelines section 15067.4 is an appropriate and effective means of promoting consistency in significance determinations and integrating CEQA environmental review activities with other areas of environmental regulation. (*See Communities for a Better Environment v. California Resources Agency* (2002) 103 Cal. App. 4th 98, 111.[4])

[4] The Court of Appeal in the *Communities for a Better Environment* case held that existing regulatory standards could not be used as a definitive determination of whether a project would be significant under CEQA where there is substantial evidence to the contrary. Staff's proposed thresholds would not do that. The thresholds are levels at which a project's emissions would normally be significant, but would not be binding on a lead agency if there is contrary evidence in the record.

4.3.3 LOCAL CARBON MONOXIDE THRESHOLDS

The proposed carbon monoxide thresholds are based solely on ambient concentration limits set by the California Clean Air Act for Carbon Monoxide and Appendix G of the State of California CEQA Guidelines.

Since the ambient air quality standards are health-based (i.e., protective of public health), there is substantial evidence (i.e., health studies that the standards are based on) in support of their use as CEQA significance thresholds. The use of the ambient standard would relate directly to the CEQA checklist question. By not using a proxy standard, there would be a definitive bright line about what is or is not a significant impact and that line would be set using a health-based level.

The CAAQS of 20.0 ppm and 9 ppm for 1-hour and 8-hour CO, respectively, would be used as the thresholds of significance for localized concentrations of CO. Carbon monoxide is a directly emitted pollutant with primarily localized adverse effects when concentrations exceed the health based standards established by the California Air Resources Board (ARB).

In addition, Appendix G of the State of California CEQA Guidelines includes the checklist question: Would the project violate any air quality standard or contribute substantially to an existing or projected air quality violation? Answering yes to this question would indicate that the project would result in a significant impact under CEQA. The use of the ambient standard would relate directly to this checklist question.

4.3.4 PLAN-LEVEL CRITERIA POLLUTANT THRESHOLDS

This proposed threshold achieves the same goals as the Air District's current approach while alleviating the existing analytical difficulties and the inconsistency of comparing a plan update with AQP growth projections that may be up to several years old. Eliminating the analytical inconsistency provides better nexus and proportionality for evaluating air quality impacts for plans.

Over the years staff has received comments on the difficulties inherent in the current approach regarding the consistency tests for population and VMT growth. First, the population growth estimates used in the most recent AQP can be up to several years older than growth estimates used in a recent plan update, creating an inconsistency in this analysis. Staff recommends that this test of consistency be eliminated because the Air District and local jurisdictions all use regional population growth estimates that are disaggregated to local cities and counties. In addition, the impact to air quality is not necessarily growth but where that growth is located. The second test, rate of increase in vehicle use compared to growth rate, will determine if planned growth will impact air quality. Compact infill development inherently has less vehicle travel and more transit opportunities than suburban sprawl.

Second, the consistency test of comparing the rate of increase in VMT to the rate of increase in population has been problematic at times for practitioners because VMT is not always available with the project analysis. Staff recommends that either the rate of increase in VMT or vehicle trips be compared to the rate of increase in population. Staff also recommends that the growth estimates used in this analysis be for the years covered by the plan. Staff also recommends that the growth estimates be obtained from the Association of Bay Area Governments since the Air District uses ABAG growth estimates for air quality planning purposes.

5 ODOR THRESHOLDS

5.2 PROPOSED THRESHOLDS OF SIGNIFICANCE

Project Operations – Source or Receptor	Plans
1. More than one confirmed complaint per year averaged over a three year period; or 2. More than three unconfirmed complaints per year averaged over a three year period	Identify (Overlay Zones) and include policies to reduce the impacts of existing or planned sources of odors

5.3 JUSTIFICATION AND SUBSTANTIAL EVIDENCE SUPPORTING THRESHOLDS

Staff proposes continuing the current CEQA significance threshold for odors (based on complaint history). The current approach has proven adaptable to different projects and locations and thus continuation of the current approach with more qualitative guidance is considered an appropriate approach to CEQA evaluation.

Odors are generally considered a nuisance, but can result in a public health concern. Some land uses that are needed to provide services to the population of an area can result in offensive odors, such as filling portable propane tanks or recycling center operations. When a proposed project includes the siting of sensitive receptors in proximity to an existing odor source, or when siting a new source of potential odors, the following qualitative evaluation should be performed.

When determining whether potential for odor impacts exists, it is recommended that Lead Agencies consider the following factors and make a determination based on evidence in each qualitative analysis category:

- **Distance**: Use the screening-level distances in Table 9.

- **Wind Direction:** Consider whether sensitive receptors are located upwind or downwind from the source for the most of the year. If odor occurrences associated with the source are seasonal in nature, consider whether sensitive receptors are located downwind during the season in which odor emissions occur.

- **Complaint History:** Consider whether there is a history of complaints associated with the source. If there is no complaint history associated with a particular source (perhaps because sensitive receptors do not already exist in proximity to the source), consider complaint-history associated with other similar sources in BAAQMD's jurisdiction with potential to emit the same or similar types of odorous chemicals or compounds, or that accommodate similar types of processes.

- **Character of Source:** Consider the character of the odor source, for example, the type of odor events according to duration of exposure or averaging time (e.g., continuous release, frequent release events, or infrequent events).

- **Exposure:** Consider whether the project would result in the exposure of a substantial number of people to odorous emissions.

Table 9 – Screening Distances for Potential Odor Sources

Type of Operation Project Screening	Distance
Wastewater Treatment Plant	2 miles
Wastewater Pumping Facilities	1 mile
Sanitary Landfill	2 miles
Transfer Station	1 mile
Composting Facility	1 mile
Petroleum Refinery	2 miles
Asphalt Batch Plant	2 miles
Chemical Manufacturing	2 miles
Fiberglass Manufacturing	1 mile
Painting/Coating Operations	1 mile
Rendering Plant	2 miles
Food Processing Facility	1 mile
Confined Animal Facility/Feed Lot/Dairy	1 mile
Green Waste and Recycling Operations	1 mile
Coffee Roaster	1 mile

California Integrated Waste Management Board (CIWMB). Facilities that are regulated by the CIWMB (e.g. landfill, composting, etc.) are required to have Odor Impact Minimization Plans (OIMP) in place and have procedures that establish fence line odor detection thresholds. The Air District recognizes a Lead Agency's discretion under CEQA to use established odor detection thresholds as thresholds of significance for CEQA review for CIWMB regulated facilities with an adopted OIMP.

REFERENCES

ARB. *See* California Air Resources Board.

BAAQMD. *See* Bay Area Air Quality Management District.

Bay Area Air Quality Management District. 1999 (December). *BAAQMD CEQA Guidelines*. San Francisco, CA.

_____. 2005. Regulation 2, Rule 2. New Source Review. Available: <http://www.baaqmd.gov/dst/regulations/rg0202.pdf>. Accessed February 2009.

_____. 2006. CARE Phase 1 Findings and Policy Recommendations. Available: <http://baaqmd.gov/CARE/documents/care_p1_findings_recommendations_v2.pdf>. Accessed March 2009.

_____. 2008. Source Inventory of Bay Area Greenhouse Gas Emissions. San Francisco, CA.

_____. 2009. *Revised Draft Options and Justifications Report – California Environmental Quality Act Thresholds of Significance* (http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/Revised%20Draft%20CEQA%20Thresholds%20%20Justification%20Report%20Oct%202009.ashx)

California Air Pollution Control Officers Association. 2008 (January). *CEQA and Climate Change*. Sacramento, CA. Available: <http://www.capcoa.org/CEQA/CAPCOA%20White%20Paper.pdf>. Accessed April 10, 2009.

California Air Resources Board. 2000. Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles. Stationary Source Division. Mobile Source Control Division. October.

_____. 2002. Staff Report: Public Hearing to Consider Amendments to the Ambient Air Quality Standards for Particulate Matter and Sulfates. Available: http://www.arb.ca.gov/research/aaqs/std-rs/pm-final/pm-final.htm.

_____. 2005. *Land Use Compatibility Handbook. A Community Health Perspective*. Sacramento, CA.

_____. 2008a. *Climate Change Proposed Scoping Plan*. Sacramento, CA. Adopted in December 2008Available: <http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm>. Accessed March 2009.

_____. 2008b. *Methodology for Estimating Premature Deaths Associated with Long-term Exposure to Fine Airborne Particulate Matter in California*. Staff

Report. Sacramento, CA. October 24. Available: <http://www.arb.ca.gov/research/health/pm-mort/pm-mort.htm#NEW>. Accessed November 2009.

Climate Change Proposed Scoping Plan. Sacramento, CA. Adopted in December 2008Available: <http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm>. Accessed March 2009.

_____. 2009a. Greenhouse Gas Inventory and Forecast. Available: <http://www.arb.ca.gov/cc/inventory/data/tables/arb_ghg_inventory_forecast_2008_06_26.xls>. Accessed March 2009.

_____. 2009b. *Preliminary Draft Staff Proposal: Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the California Environmental Quality Act*. Available: <http://www.arb.ca.gov/cc/localgov/ceqa/meetings/10270prelimdraftproposal102408.pdf>. Accessed March 2009.

_____. 2009c. *Area Designations and Maps*. Available: <http://www.arb.ca.gov/desig/desig.htm>, Accessed April 10.

_____. 2009d. Proposed Regulation to Implement the Low Carbon Fuel Standard, Staff Report Initial Statement Reasons. March 5. Available: http://www.arb.ca.gov/fuels/lcfs/lcfs.htm. Accessed, August 20, 2009.

CEC. *See* California Energy Commission.

CEC. 2007. Impact Analysis 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available: <http://www.energy.ca.gov/title22008standards/rulemaking/documents/2007-11-07_IMPACT_ANALYSIS.PDF>. Accessed March 2009.

California Department of Finance. 2009. Residential Development Data: E5 – City and County Population Estimates. 2000-2050 - Race and Ethnic Populations Totals. Available: <http://www.labormarketinfo.edd.ca.gov/?pageid=145 >. Accessed February 2009.

California Economic Development Department. 2009. Commercial/Industrial Employment Data: Projections of Employment by Industry and Occupation. Available: <http://www.labormarketinfo.edd.ca.gov/?pageid=145>. Accessed February 2009.

City and County of San Francisco Department of Public Health. 2008. Assessment and Mitigation of Air Pollutant Health Effects from Intra-urban Roadways: Guidance for Land Use Planning and Environmental Review. Program on Health, Equity, & Sustainability. Occupational & Environmental Health Section. Prepared by Rajiv Bhatia and Thomas Rivard. May 6.

Dockery D. 1993. An association between air pollution and mortality in six U.S. cities. N Engl J Med 329:1753–1759.

EPA. *See* U.S. Environmental Protection Agency.

Governor's Office of Planning and Research. 2008 (June 19). *Technical Advisory: CEQA and Climate Change: Addressing Climate Change Through California Environmental Quality Act (CEQA) Review*. Sacramento, CA. Available: <http://opr.ca.gov/ceqa/pdfs/june08-ceqa.pdf>. Accessed February 2009.

Hiltermann T, Bruijne Cd, Stolk J, Zwinderman A, Spieksma F, Roemer W, et al. 1997. Effects of photochemical air pollution and allergen exposure on upper respiratory tract inflammation in asthmatics. Am J Respir Crit Care Med 156(6):1765–1772.

Intergovernmental Panel on Climate Change. 2007a (February). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC.* Geneva, Switzerland.

_____. 2007a (February). *Climate Change 2007: Climate Change 2007:Synthesis Report*
Summary for Policymakers. Geneva, Switzerland.

IPCC. *See* Intergovernmental Panel on Climate Change.

Jerrett M et al. 2005. Spatial Analysis of Air Pollution and Mortality in Los Angeles. Epidemiology. 16: 727-736

Kleinman, M.T., Sioutas, C., Froines, J.R., Fanning, E., Hamade, A., Mendez, L., Meacher, D., Oldham, M. Inhalation of Concentrated Ambient Particulate Matter Near a Heavily Trafficked Road Simulates Antigen-Induced Airway Responses in Mice; Inhal. Toxicol. 2007, 19 (Supp. 1), 117-126.

Laden, F.; Schwartz, J.; Speizer, F.E.; Dockery, D.W. Reduction in Fine Particulate Air Pollution and Mortality: Extended Follow-Up of the Harvard Six Cities Study. *Am. J. Respir. Crit. Care Med.* (2006), *173,* 667-672.

OPR. *See* Governor's Office of Planning and Research.

Pope C III, Thun M, Namboordiri M, Dockery D, Evans J, Speizer F. 1995. Particulate air pollution as a predictor of mortality in a prospective study of U.S. adults. Am J Respir Crit Care Med 151(3):669–6

Rimpo and Associates. 2009. BAAQMD CEQA Projects Database. Orangevale, CA.

Schauer JJ, Lough GC, Schafer MM, Christensen WF, Arndt MF, DeMinter JT, et al. 2006. Characterization of metals emitted from motor vehicles. Res Rep Health Eff Inst 133:1–7.

Schikowski T, Sugiri D, Ranft U, Gehring U, Heinrich J, Wichmann E, et al. 2005. Long-term air pollution exposure and living close to busy roads are associated with COPD in women. Respir Res 6(1):152.

Schwartz, J.; Coull, B.; Laden, F.; Ryan, L. The Effect of Dose and Timing of Dose on the Association between Airborne Particles and Survival. Env Health Persp (2008) 116, 1: 64-69.

SFDPH. See City and County of San Francisco Department of Public Health.

UNFCCC. *See* United Nations Framework Convention on Climate Change.

United Nations Framework Convention on Climate Change. 2009. *Article 1 of the UNFCCC.* Available: http://unfccc.int/essential_background/convention/background/items/2536.php. Accessed April 8, 2009.

U.S. Environmental Protection Agency. 2008. Federal Register: Implementation of the New Source Review (NSR) Program for Particulate Matter ($PM_{2.5}$) less than 2.5 Micrometers. Available: <http://www.epa.gov/fedrgstr/EPA-AIR/200May/Day-1a10768.pdf>. Accessed February 2009.

_____. 2009. Monitor Values Report Data. Available: <http://www.epa.gov/air/data/index.html>. Accessed April 8, 2009.

_____. 1988. C. Cowherd, et al., *Control of Open Fugitive Dust Sources*, EPA-450/3-88-008, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1988.

Van Hee, V.C., Adar, S.D., Szpiro, A.A., Barr, R.G., Bluemke, D.A., Diez Roux, A.V., Gill, E.A., Sheppard, L., Kaufman, J.D. Exposure to Traffic and Left Ventricular Mass and Function; Am. J. Respir. Crit. Care Med. 2009, 179 (9), 827-834.

Vineis P, Hoek G, Krzyzanowski M, Vigna-Taglianti F, Veglia F, Airoldi L, et al. 2007. Lung cancers attributable to environmental tobacco smoke and air pollution in non-smokers in different European countries: a prospective study. Environ Health 6:7; doi:10.1186/1476-069X-6-7 [Online 15 February 2007]

Western Regional Air Partnership. 2006. *WRAP Fugitive Dust Handbook.* September 7, 2006. Available: http://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf. Accessed September 2009.

Zhu, Y. Hinds, W.C., Kim S, and Sioutas, C. 2002. Concentration and size distribution of ultrafine particles near a major highway. Journal of Air and Waste Management Association. 2002 Sep; 52 (9): 1032-42.

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4.0 Construction Noise Criteria and Descriptors

4.1 Criteria

Construction noise levels may be evaluated in terms of human response and considered in the assessment of effects on wildlife and other non-human species. Noise levels and criteria are expressed in English, metric, or both conventions, depending upon the geographic area or the policies of the controlling agency. Typically, the English convention is used mostly in the United States, with the metric convention used in Canada and other countries.

While the issue of construction noise must be addressed as part of the planning of any transportation project, there are no standardized criteria on the federal level for assessing construction noise impacts related to transportation projects. Where project-specific construction noise criteria have been developed by individual agencies or municipalities, they typically consider the following factors which form the fundamentals for defining construction noise impact:

- Difference between existing noise levels prior to construction startup and expected noise levels during construction: This takes into account specific construction operations and/or individual pieces of equipment.
- Absolute level of expected construction noise: This may constitute the combined levels of all equipment and operations at a given time or be specifically related to the absolute noise level of a specific operation and/or piece of equipment.
- Adjacent land uses: Consideration of this factor provides an indicator of the degree of sensitivity that may be expected and will likely have a major effect on the operational time restraints and the noise level increases tolerated. For example, residential areas may typically have a restriction on night operations and possibly a noise level restriction during the day. Industrial areas may have no restrictions at all, and offices may or may not have a restriction on the noise levels during the day, with possibly no restriction for night operations. Examples of absolute and relative construction noise level criteria are provided in Table 7.1.
- Duration of construction/operation: The duration of high noise levels may play a significant role in how a noise impact is perceived and/or mitigated. If the levels are of a brief nature, possibly only occurring once or twice during the project, the perceived impact could be quite different than that associated with a constant noise source. Similarly, any related noise mitigation techniques employed could be substantially different in terms of type and/or duration of application.

4.1.1 History of Construction Noise Criteria

4.1.1.1 United States

While noise impact and abatement criteria have been established for the operation of transportation facilities in the United States, standardized criteria have not yet been established related to noise associated with the construction of such facilities. However, since the publication of the original 1977 Report[ref001], additional guidance has been disseminated (through agencies such as FHWA and FTA) and analysis tools developed to better address construction noise. For example, the FTA Transit Noise and Vibration Impact Assessment document[ref014] presents guidelines that "can be considered reasonable criteria for assessment" of construction noise impacts. In addition, a number of agencies, municipalities, and other entities have developed procedures for addressing construction noise impacts and implementing related noise mitigation for their areas of jurisdiction or on a project-specific basis.

Figure 4.1 Local noise ordinance (Photo #314)

In some instances, local entities may have developed noise ordinances that contain restrictions associated with construction noise levels. Noise practitioners and others involved in the project development process are encouraged to become familiar with such ordinances and their relationship to other State and/or municipal ordinances. In certain instances, the State jurisdiction may supersede any local noise ordinances.

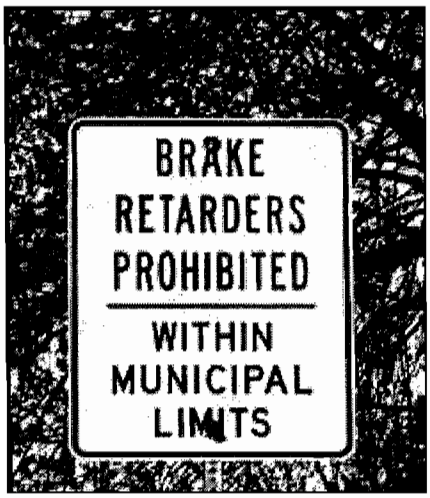


Figure 4.2 Local noise restrictions
(Photo #1206)

Noise restrictions may also be imposed by local and/or State authorities to deal with specific activities or operations. An example is the growing practice of restricting the use of engine compression brakes on heavy trucks in residential areas.

Noise restrictions may also be applied within the workplace associated with employee/worker exposure to noise levels over varying durations. These criteria have been established by OSHA. However, such criteria are typically not relevant or applicable to the transportation-related project construction noise levels experienced by people residing or working in areas adjacent to such projects. As such, they are not discussed within this Handbook.

Construction noise criteria within the United States vary considerably in terms of both scope and specificity and can be broadly categorized as follows, in order of complexity:

- No criteria specified;
- Qualitative criteria, e.g. "Noise levels shall not cause a disturbance";
- Relative criteria, e.g. "Noise levels shall not exceed existing (or ambient, or background) noise levels by more than x dB";
- Absolute criteria, e.g. "Maximum noise levels shall not exceed xx dB";
- Criteria containing a combination absolute and relative noise level limits; and
- Combinations of the above criteria elements with additional restrictions placed on time periods and types of land uses or activities.

An example of more complex criteria is that associated with the Central Artery/Tunnel Project in Boston, MA. Data related to these criteria are discussed in Reference 023 and illustrated in Table 7.1 of this Handbook. This project established criteria that include both L_{10} and L_{max} absolute noise level limits for defined noise sensitive locations (residences, institutions, hotels, etc.) for daytime, evening, and nighttime periods. In addition, the criteria established maximum noise level increases relative to established baseline noise levels. Relative and absolute noise level limits were also established for commercial and industrial areas.

From the standpoint of construction noise criteria, the intent of this Handbook is not to address all State and local noise ordinances and/or criteria, but rather, to address the approaches and techniques that may be contained in such criteria. As such, the discussions contained within this Handbook are meant to provide a summary of considerations related to all aspects of construction noise. The reader is encouraged to refer to specific references in Table 10.1 for more detailed information on noise criteria and other factors related to construction noise.

4.1.1.2 Canada

Similar to the United States, no standardized Canadian criteria exist related to transportation project construction noise. Where project-specific analysis techniques have been employed to address and/or mitigate construction-related noise and its impacts, such methods have been similar to those employed in the United States. Examples of such efforts may be found in References 010 and 019.

4.1.1.3 Other International

While an exhaustive survey of international criteria was not conducted, several criteria are discussed here for informational use only. More specifics may be found by accessing the relative links found in the Reference Database in Chapter 10.

- The Official Journal of the European Communities' Directive 2000/14/EC of the European Parliament and of the Council of 8 May 2000[ref017] establishes legislation dictating specific noise levels for individual pieces of construction equipment. It also contains specifics related to the measurement locations and equipment operating conditions relative to the testing of individual pieces of equipment.
- The Australian EPA's Environmental Noise Control Manual[ref015] establishes the following criteria which officers may specify related to construction noise:
  - For a construction period of four (4) weeks or less, the maximum L_{10} noise level measured over a period of not less than 15 minutes when the construction site is operating must not exceed the background noise level by more than 20 dBA;
  - For a construction period greater than four (4) weeks, the maximum L_{10} noise level measured over a period of not less than 15 minutes when the construction site is operating must not exceed the background noise level by more than 10 dBA;
  - Construction limited to 0700 to 1800 time period on Monday through Friday;
  - Construction limited on Saturdays to 0700 to 1300 time period if inaudible on residential premises; otherwise, 0800 to 1300;
  - No construction work may take place on Sundays or public holidays; and
  - All possible steps should be taken to silence construction site equipment. It is particularly important that silenced equipment should be used on road or rail works where 24-hour operation is necessary.

4.2 Descriptors

While it is not the intent of this Handbook to establish criteria for evaluating construction noise impacts, it is important to stress that reasonable and defensible noise descriptors must be used to describe construction noise levels. The following are important elements related to selecting a workable noise descriptor for use in measuring and analyzing construction noise:

- Suitable for practical measuring methods;
- Accounts for temporal variations in equipment noise levels;
- Accounts for temporal variations in overall site noise level;
- Suitable for prediction modeling;
- Suitable for combining noise levels from various source types; and
- Relative to subjective responses.

The descriptor most commonly chosen for use is the A-weighted equivalent sound level (energy basis), L_{Aeq}. In many cases, the time average period applied to the L_{Aeq} value is one hour (designated L_{Aeq1h}). For certain projects and operations, the time period over which the L_{Aeq} is applied may need to be examined on a case-by-case basis. For several major construction projects in the United States and Canada, the L_{10} (applied generally during daytime periods) and L_{max} (applied for specific equipment and/or nighttime operations) descriptors have been used over varying time periods.

The L_{dn} descriptor has been used to assess annoyance and community reaction to construction noise. L_{dn} is an L_{Aeq}-based descriptor that applies a 10 dBA penalty to nighttime noise levels.

The L_{Aeq}-based and L_{10}-based descriptors satisfy the first four elements listed above. The L_{Aeq} satisfies the fifth element and may also satisfy the sixth element (relative to subjective responses). However, the L_{Aeq}, L_{10}, and L_{max} descriptors may not be suited for determining responses by some aquatic wildlife (where using an un-weighted sound pressure level may be more suitable) or for owls (where use of a different weighting category such as dBO or a descriptor such as SEL may be more suitable to account for effects such as air blasts associated with blasting). More detailed information related to these specific conditions might be found in documents listed in Section 3.2.6 of this document.

Updated: 05/21/2010

Construction Noise Handbook

9.0 Construction Equipment Noise Levels and Ranges

9.1 Equipment Type Inventory and Related Emission Levels

Noise levels generated by individual pieces of construction equipment and specific construction operations form the basis for the prediction of construction-related noise levels. A variety of information exists related to sound emissions related to such equipment and operations. This data transcends the period beginning in the 1970s thru 2006. This information exists for both stationary and mobile sources and for steady, intermittent, and impulse type generators of noise.

9.1.1 Stationary Equipment

Stationary equipment consists of equipment that generates noise from one general area and includes items such as pumps, generators, compressors, etc. These types of equipment operate at a constant noise level under normal operation and are classified as non-impact equipment. Other types of stationary equipment such as pile drivers, jackhammers, pavement breakers, blasting operations, etc., produce variable and sporadic noise levels and often produce impact-type noises. Impact equipment is equipment that generates impulsive noise, where impulsive noise is defined as noise of short duration (generally less than one second), high intensity, abrupt onset, rapid decay, and often rapidly changing spectral composition. For impact equipment, the noise is produced by the impact of a mass on a surface, typically repeating over time.

9.1.2 Mobile Equipment

Mobile equipment such as dozers, scrapers, graders, etc., may operate in a cyclic fashion in which a period of full power is followed by a period of reduced power. Other equipment such as compressors, although generally considered to be stationary when operating, can be readily relocated to another location for the next operation.

9.2 Sources of Information

Construction-related equipment and operation noise level data may be provided by numerous sources, including suppliers, manufacturers, agencies, organizations, etc. Some information is included in this document, and many web-based links are given for equipment manufacturers.

9.3 Specifics of Construction Equipment and Operation Noise Inventories

Details included in each specific inventory of construction equipment and operation noise emission levels are often variable in terms of how data is represented. Some inventories include ranges of noise levels while others present single numbers for each equipment type.

Others provide levels for specific models of each type of construction equipment. Often, different noise descriptors are used, such as L_{Aeq}, L_{max}, L_{10}, sound power level, etc. As such, the array of data does not readily lend itself to being combined into a single table or easily compared. As such, this Handbook attempts to summarize a variety of such inventories and provide links to each, thereby providing the reader with a variety of sources from which to choose the appropriate levels for use in his or her respective analysis.

9.4 Summaries of Referenced Inventories

Included below are examples of several inventories of construction-related noise emission values. These and additional inventories are included on the companion CD-ROM.

9.4.1 RCNM Inventory

Equipment and operation noise levels in this inventory are expressed in terms of L_{max} noise levels and are accompanied by a usage factor value. They have been recently updated and are based on extensive measurements taken in conjunction with the Central Artery/Tunnel (CA/T) Project. Table 9.1 summarizes the equipment noise emissions database used by the CA/T Project. While these values represent the "default" values for use in the RCNM, user-defined equipment and corresponding noise levels can be added.

Table 9.1 RCNM Default Noise Emission Reference Levels and Usage Factors.

Equipment Description	Impact Device?	Acoustical Usage Factor (%)	Spec. 721.560 L_{max} @ 50 feet (dBA, slow)	Actual Measured L_{max}@ 50 feet (dBA, slow) (Samples Averaged)	Number of Actual Data Samples (Count)
All Other Equipment > 5 HP	No	50	85	N/A	0
Auger Drill Rig	No	20	85	84	36
Backhoe	No	40	80	78	372
Bar Bender	No	20	80	N/A	0
Blasting	Yes	N/A	94	N/A	0
Boring Jack Power Unit	No	50	80	83	1
Chain Saw	No	20	85	84	46
Clam Shovel (dropping)	Yes	20	93	87	4
Compactor (ground)	No	20	80	83	57
Compressor (air)	No	40	80	78	18
Concrete Batch Plant	No	15	83	N/A	0
Concrete Mixer Truck	No	40	85	79	40

Concrete Pump Truck	No	20	82	81	30
Concrete Saw	No	20	90	90	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Drill Rig Truck	No	20	84	79	22
Drum Mixer	No	50	80	80	1
Dump Truck	No	40	84	76	31
Excavator	No	40	85	81	170
Flat Bed Truck	No	40	84	74	4
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Generator (<25KVA, VMS Signs)	No	50	70	73	74
Gradall	No	40	85	83	70
Grader	No	40	85	N/A	0
Grapple (on backhoe)	No	40	85	87	1
Horizontal Boring Hydraulic Jack	No	25	80	82	6
Hydra Break Ram	Yes	10	90	N/A	0
Impact Pile Driver	Yes	20	95	101	11
Jackhammer	Yes	20	85	89	133
Man Lift	No	20	85	75	23
Mounted Impact Hammer (hoe ram)	Yes	20	90	90	212
Pavement Scarifier	No	20	85	90	2
Paver	No	50	85	77	9
Pickup Truck	No	40	55	75	1
Pneumatic Tools	No	50	85	85	90
Pumps	No	50	77	81	17

Refrigerator Unit	No	100	82	73	3
Rivit Buster/Chipping Gun	Yes	20	85	79	19
Rock Drill	No	20	85	81	3
Roller	No	20	85	80	16
Sand Blasting (single nozzle)	No	20	85	96	9
Scraper	No	40	85	84	12
Sheers (on backhoe)	No	40	85	96	5
Slurry Plant	No	100	78	78	1
Slurry Trenching Machine	No	50	82	80	75
Soil Mix Drill Rig	No	50	80	N/A	0
Tractor	No	40	84	N/A	0
Vacuum Excavator (Vac-Truck)	No	40	85	85	149
Vacuum Street Sweeper	No	10	80	82	19
Ventilation Fan	No	100	85	79	13
Vibrating Hopper	No	50	85	87	1
Vibratory Concrete Mixer	No	20	80	80	1
Vibratory Pile Driver	No	20	95	101	44
Warning Horn	No	5	85	83	12
Welder/Torch	No	40	73	74	5

For each generic type of equipment listed in Table 9.1, the following information is provided:

- an indication as to whether or not the equipment is an impact device;
- the acoustical usage factor to assume for modeling purposes;
- the specification "Spec" limit for each piece of equipment expressed as an L_{max} level in dBA "slow" at a reference distance of 50 foot from the loudest side of the equipment;
- the measured "Actual" emission level at 50 feet for each piece of equipment based on hundreds of emission measurements performed on CA/T work sites; and

- the number of samples that were averaged together to compute the "Actual" emission level.

A comparison of the "Spec" emission limits against the "Actual" emission levels reveals that the Spec limits were set, in general, to realistically obtainable noise levels based on the equipment used by contractors on the CA/T Project. When measured in the field, some equipment such as pile drivers, sand blasting, demolition shears, and pumps tended to exceed their applicable emission limit. As such, these noisy devices needed to have some form of noise mitigation in place in order to comply with the Spec emission limits. Other equipment, such as clamshell shovels, concrete mixer trucks, truck-mounted drill rigs, man-lifts, chipping guns, ventilation fans, pavers, dump trucks, and flatbed trucks, easily complied. Therefore, the Spec emission limits for these devices could have been reduced somewhat further. It is recommended that the user review the RCNM User's Guide contained in Appendix A for detailed guidance regarding application of values contained in Table 9.1.

9.4.2 FHWA Special Report Inventories

Appendix A of the 1977 Handbook provides tables of construction equipment noise levels and ranges. The majority of the data were provided by the American Road Builders Association. These data were taken during a 1973 survey in which member contractors were asked to secure readings of noise exposure to operators of various types of equipment. Additionally, the contractors were asked to take readings at 50 feet from the machinery. These 50-foot peak readings are provided in Tables 9.2 through 9.8. Though the data were produced under varying conditions and degrees of expertise, the values are relatively consistent.

Table 9.2 Construction Equipment Noise Levels Based on Limited Data Samples - Cranes.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Northwestern	80D	77	Within 15m 1958 mod
Northwestern	8	84	Within 15m 1940 mod
Northwestern	6	72	Within 15m 1965 mod
American	7260	82	Within 15m 1967 mod
American	599	76	Within 15m 1969 mod
American	5299	70	Within 15m 1972 mod
American	4210	82	Within 15m 1968 mod
Buck Eye	45C	79	Within 15m 1972 mod
Buck Eye	308	74	Within 15m 1968 mod
Buck Eye	30B	73	Within 15m 1965 mod
Buck Eye	30B	70	Within 15m 1959 mod

Link Belt	LS98	76	Within 15m 1956 mod
Manitowoc	4000	94	Within 15m 1956 mod
Grove	RF59	82	Within 15m 1973 mod
Koehr	605	76	Within 15m 1967 mod
Koehr	435	86	Within 15m 1969 mod
Koehr	405	84	Within 15m 1969 mod

Table 9.3 Construction Equipment Noise Levels Based on Limited Data Samples - Backhoes.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Link Belt	4000	92	Within 15m 1971 mod
John Deere	609A	85	Within 15m 1971 mod
Case	680C	74	Within 15m 1973 mod
Drott	40 yr.	82	Within 15m 1971 mod
Koehr	1066	81 & 84	Within 15m 2 tested

Table 9.4 Construction Equipment Noise Levels Based on Limited Data Samples - Front Loaders.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	980	84	Within 15m 1972 mod
Caterpillar	977K	79	Within 15m 1969 mod
Caterpillar	977	87	Within 15m 1971 mod
Caterpillar	977	94	Within 15m 1967 mod
Caterpillar	966C	84	Within 15m 1973 mod
Caterpillar	966C	85	Within 15m 1972 mod
Caterpillar	966	81	Within 15m 1972 mod
Caterpillar	966	77	Within 15m 1972 mod
Caterpillar	966	85	Within 15m 1966 mod
Caterpillar	955L	90	Within 15m ;1973 mod
Caterpillar	955K	79	Within 15m 1969 mod
Caterpillar	955H	94	Within 15m 1963 mod
Caterpillar	950	78 & 80	Within 15m 1972 mod
Caterpillar	950	75	Within 15m 1968 mod

Caterpillar	950	88	Within 15m 1967 mod
Caterpillar	950	86	Within 15m 1965 mod
Caterpillar	944A	80	Within 15m 1965 mod
Caterpillar	850	82	Within 15m 1968 mod
Michigan	75B	90	Within 15m 1969 mod
Michigan	475A	96	Within 15m 1967 mod
Michigan	275	85	Within 15m 1971 mod
Michigan	125	87	Within 15m 1967 mod
Hough	65	82	Within 15m 1971 mod
Hough	60	91	Within 15m 1961 mod
Hough	400B	94	Within 15m 1961 mod
Hough	H90	86	Within 15m 1961 mod
Trojan	3000	85	Within 15m 1956 mod
Trojan	RT	82	Within 15m 1965 mod
Payloader	H50	85	Within 15m 1963 mod

Table 9.5 Construction Equipment Noise Levels Based on Limited Data Samples - Dozers.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	D5	83	Within 15m 1967 mod
Caterpillar	D6	85	Within 15m 1967 mod
Caterpillar	D6	86	Within 15m 1964 mod
Caterpillar	D6	81	Within 15m 1967 mod
Caterpillar	D6B	83	Within 15m 1967 mod
Caterpillar	D6C	82	Within 15m 1962 mod
Caterpillar	D7	85	Within 15m 1956 mod
Caterpillar	D7	86	Within 15m 1969 mod
Caterpillar	D7	84	Within 15m 1969 mod
Caterpillar	D7	78	Within 15m 1970 mod
Caterpillar	D7	78	Within 15m 1972 mod
Caterpillar	D7E	86	Within 15m 1965 mod

Caterpillar	D7E	78	Within 15m 1970 mod
Caterpillar	D7E	84	Within 15m 1973 mod
Caterpillar	D7F	80	Within 15m 1972 mod
Caterpillar	D8	92	Within 15m 1954 mod
Caterpillar	D8	95	Within 15m 1968 mod
Caterpillar	D8	86	Within 15m 1972 mod
Caterpillar	D8H	88	Within 15m 1966 mod
Caterpillar	D8H	82	Within 15m 1972 mod
Caterpillar	D9	85	Within 15m 1972 mod
Caterpillar	D9	94	Within 15m 1972 mod
Caterpillar	D9	90	Within 15m 1963 mod
Caterpillar	D9	87	Within 15m 1965 mod
Caterpillar	D9	90	Within 15m 1965 mod
Caterpillar	D9	88	Within 15m 1968 mod
Caterpillar	D9	92	Within 15m 1972 mod
Caterpillar	D9G	85	Within 15m 1965 mod
Allis Chambers	HD41	93	Within 15m 1970 mod
International	TD15	79	Within 15m 1970 mod
International	TD20	87	Within 15m 1970 mod
International	TD25	90	Within 15m 1972 mod
International	TD8	83	Within 15m 1970 mod
Case	1150	82	Within 15m 1972 mod
John Deer	350B	77	Within 15m 1971 mod
John Deer	450B	65	Within 15m 1972 mod
Terex	8230	70	Within 15m 1972 mod
Terex	8240	93	Within 15m 1969 mod
Michigan	280	85	Within 15m 1961 mod
Michigan	280	90	Within 15m 1962 mod
Caterpillar	824	90	Within 15m 1968 mod

Table 9.6 Construction Equipment Noise Levels Based on Limited Data Samples - Graders.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	16	91	Within 15m 1969 mod
Caterpillar	16	86	Within 15m 1968 mod
Caterpillar	140	83	Within 15m 1970 mod
Caterpillar	14E	84	Within 15m 1972 mod
Caterpillar	14E	85	Within 15m 1971 mod
Caterpillar	14C	85	Within 15m 1971 mod
Caterpillar	14B	84	Within 15m 1967 mod
Caterpillar	12F	82	Within 15m 1961-72 mod
Caterpillar	12F	72-92	Within 15m 1961-72 mod
Caterpillar	12E	81.3	Within 15m 1959-67 mod
Caterpillar	12E	80-83	Within 15m 1959-67 mod
Caterpillar	12	84.7	Within 15m 1960-67 mod
Caterpillar	12	82-88	Within 15m 1960-67 mod
Gallon	T500	84	Within 15m 1964 mod
Allis Chambers		87	Within 15m 1964 mod

Table 9.7 Construction Equipment Noise Levels Based on Limited Data Samples - Scrapers.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	660	92	Within 15m
Caterpillar	641B	85	Within 15m 1972 mod
Caterpillar	641B	86	Within 15m 1972 mod
Caterpillar	641	80 & 84	Within 15m 1972 mod
Caterpillar	641	83 & 89	Within 15m 1965 mod
Caterpillar	637	87	Within 15m 1971 mod
Caterpillar	633	87	Within 15m 1972 mod
Caterpillar	631C	89	Within 15m 1973 mod
Caterpillar	631C	83	Within 15m 1972 mod
Caterpillar	631B	94	Within 15m 1969 mod

Caterpillar	631B	84-87	Within 15m 1968 mod
Caterpillar		85 avg.	Within 15m 1968 mod
Caterpillar	621	90	Within 15m 1970 mod
Caterpillar	621	86	Within 15m 1967 mod
Caterpillar	613	76	Within 15m 1972 mod
Terex	TS24	87	Within 15m 1972 mod
Terex	TS24	84-91	
Terex	TS24	82	Within 15m 1971 mod
Terex	TS24	81-83	Within 15m 1971 mod
Terex	TS24	94	Within 15m 1966 mod
Terex	TS24	92-98	Within 15m 1966 mod
Terex	TS24	94.7	Within 15m 1963 mod
Terex	TS24	94-95	Within 15m 1963 mod
Terex	TS14	82	Within 15m 1969 mod
Terex	S35E	84	Within 15m 1971 mod

Table 9.8 Noise Levels of Standard Compressors.

Manufacturer	Model	Silenced or Standard	Type Eng.	Type Comp.	Test Avg. Cond. (cfm.psi)	Avg. Cond. Noise Lev. (cfm.psi) (dBA) at 7m*
Atlas	ST-48	Standard	Diesel	Reciprocal	160,100	83.6
Atlas	ST-95	Standard	Diesel	Reciprocal	330,105	80.2
Atlas	VSS-170Dd	Silenced	Diesel	Reciprocal	170,850	70.2
Atlas	VT-85M	Standard	Gas	Reciprocal	85,100	81.4
Atlas	VS-85Dd	Silenced	Gas	Reciprocal	85,100	75.5
Atlas	VSS-125Dd	Silenced	Diesel	Reciprocal	125,100	70.1
Atlas	STS-35Dd	Silenced	Diesel	Reciprocal	125,100	73.5
Atlas	VSS-170Dd	Silenced	Diesel	Reciprocal	170,100	
Gardner-Denver	SPWDA/2	Silenced	Diesel	Rotary-Screw	1200,000	73.3
Gardner-Denver	SPQDA/2	Silenced	Diesel	Rotary-Screw	750,000	78.2

Gardner-Denver	SPHGC	Silenced	Gas	Rotary-Screw	185,000	77.1
Ingersoll-Rand	DXL 1200	Standard	Diesel	Rotary-Screw	1200,125	92.6
Ingersoll-Rand	DXL 1200 (doors open)	Standard	Diesel	Rotary-Screw	1200,125	
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	76.0
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	75.1
Ingersoll-Rand	DXLCU1050	Standard	Diesel	Rotary-Screw	1050,125	90.2
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	75.3
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	75.0
Ingersoll-Rand	DXL 900	Standard	Diesel	Rotary-Screw	900,125	89.9
Ingersoll-Rand	DXL 750	Standard	Diesel	Rotary-Screw	750,125	87.7
Jaeger	A	Standard	Gas	Rotary-Screw	175,100	88.2
Jaeger	A(doors open)	Standard	Gas	Rotary-Screw	175,100	
Jaeger	E	Standard	Gas	Vane	85,100	81.5
Jaeger	E(doors open)	Standard	Gas	Vane	85,100	
Worthington	60 G/2Qt	Silenced	Gas	Vane	160,100	74.2
Worthington	750-QTEX	Silenced	Diesel	Rotary-Screw	750,100	74.7

*Data taken from EPA Report - EPA 550/9-76-004.

9.4.3 FTA Noise and Vibration Assessment Procedure

Chapter 12 of the FTA Transit Noise and Vibration Guidance Handbook discusses construction noise evaluation methodology and contains the noise emission levels for construction equipment displayed in Table 9.9.

Table 9.9 FTA Construction Equipment Noise Emission Levels.

Equipment	Typical Noise Level (dBA) 50 ft from Source*

Air Compressor	81
Backhoe	80
Ballast Equalizer	82
Ballast Tamper	83
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane Derrick	88
Crane Mobile	83
Dozer	85
Generator	81
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	85
Paver	89
Pile Driver (Impact)	101
Pile Driver (Sonic)	96
Pneumatic Tool	85
Pump	76
Rail Saw	90
Rock Drill	98
Roller	74
Saw	76
Scarifier	83
Scraper	89
Shovel	82
Spike Driver	77

Tie Cutter	84
Tie Handler	80
Tie Inserter	85
Truck	88

*Table based on EPA Report, measured data from railroad construction equipment taken during Northeast Corridor improvement project and other measured data.

9.5 Links to Equipment Manufacturers

Table 9.10 contains web-based links to manufacturers of construction equipment. While few of these links contain noise-related data associated with the equipment, they provide descriptions and/or specifications related to the equipment, as well as sources for possibly obtaining additional information related to the equipment. Information in this table is by no means all-inclusive and does not represent any type of endorsement of the manufacturers, suppliers, or equipment. Users are hereby advised that the referenced websites may have certain restrictions, copyrights, etc., associated with any use of data contained therein.

Table 9.10 Equipment Manufacturers and Websites.

Equipment	Manufacturer	Website Address
Arrow Boards		
	North Star	http://northstar-traffic.com/index.cfm?SC=14&PT=1
	Trafcom	http://www.trafcon.com
	Allmand	http://www.allmand.com/MB%20AB%20page.htm
Articulated Trucks		
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=196
	Hitachi	http://www.hitachi-c-m.com/global/products/articulate/index.html
	Terex	http://www.terex.com/main.php
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/articulatedhaulers/
Asphalt Saws		
	Allied	http://www.alliedcp.com/products/rotocut.asp
Augers - See Drills / Augers		
Backhoes - See Loaders/Backhoes		
Boring Equipment - See Pile Drivers/Boring Equipment		
Compaction Equipment		

	Allied	http://www.alliedcp.com/products/compactor.asp
Compressors		
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5714,00.html
	Compair	http://www.compair.com/Products/Portable_Compressors.aspx
Concrete and Asphalt Batch/Mixing Plants and Equipment		
	Con-E-Co	http://www.con-e-co.com/products.cfm
	Terex	http://www.terex.com/main.php
	Gunter & Zimmerman	http://www.guntert.com/concrete_mobilebatching.asp
	Rex Con	http://www.rexcon.com
Concrete Breakers/ Hydraulic Hammers/Hydraulic Breakers		
	Drillman	http://www.drillmanindia.com/concrete-breaker.html
	Hydro Khan	http:/www.sangi.co.kr/english/e_product1_2.php
	Stanley	http://www.stanley-hydraulic-tools.com/Hand%20Held/NoAmbreakers.htm
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/breakers.htm
Concrete Chain Saws		
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/concrete-saws.htm
Concrete Core Drilling Machines		
	Multiquip	http://www.multiquip.com/multiquip/318_ENU_HTML.htm
Concrete Cutters		
	Vermeer	http://www.vermeermfg.com/vcom/TrenchingEquipment/Line.jsp?PrdlnID=3618
Concrete/Material Pumps		
	Multiquip	http://www.multiquip.com/multiquip/309_ENU_HTML.htm
	Reed	http://www.reedpumps.com/
Concrete Mixer Trucks		
	Oshkosh	http://www.oshkoshtruck.com/concrete/products~overview~home.cfm
	London	http://www.lmi.ca/mixers.cfm
	Terex/Advance	http://www.advancemixer.com
Concrete Saws		

	Multiquip	http://www.multiquip.com/multiquip/315_ENU_HTML.htm
	Diamond Core Cut	http://www.diamondproducts.com/dp_home.htm
Concrete Screeds		
	Multiquip	http://www.multiquip.com/multiquip/317_ENU_HTML.htm
Concrete Vibrators		
	Multiquip	http://www.multiquip.com/multiquip/313_ENU_HTML.htm
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5722,00.html
Cranes		
	Malcolm Drilling	www.malcolmdrilling.com
	Link-Belt	http://www.linkbelt.com/lit/products/frameproducthome.htm
	Casagrande	http://www.casagrandegroup.com
	Liebherr	http://www.liebherr.com/em/en/35381.asp
	Terex	http://www.terex.com/main.php
Crawler Tractors - See Dozers/Crawler Tractors		
Crushing and Screening Equipment		
	Cedarapids	http://www.cedarapids.com/crushscr.htm
	Hitachi	http://www.hitachi-c-m.com/
	Komatsu	http://www.komatsu.com/ce/products/mobile_crushers.html
	Terex	http://www.terex.com/main.php
Crushers/Pulverizers		
	Hydro Khan	http://www.sangi.co.kr/english/e_product3.php
Cutoff Saws		
	Multiquip	http://www.multiquip.com/multiquip/309_ENU_HTML.htm
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/cutoff%20saw.htm
Dozers/CrawlerTractors		
	John Deere	http://www.deere.com/en_US/cfd/construction/deere_const/crawlers/deere_dozer_selection.html
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7

	Case	http://www.casece.com/products/products.asp?RL=NAE&id=2
	Komatsu	http://www.komatsu.com/ce/products/crawler_dozers.html
Dewatering Pumps		
	Multiquip	http://www.multiquip.com/multiquip/371_ENU_HTML.htm
Drills / Augers		
	Malcolm Drilling	www.malcolmdrilling.com
	Casagrande	www.casagrandegroup.com
	Soilmec	http://www.soilmec.com/_vti_g1_techno.aspx?rpstry=4_
	Terex	http://www.terex.com/main.php
Excavators		
	Hitachi	http://www.hitachi-c-m.com/global/products/excavator/index.html
	Caterpiller	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/compactexcavators/
		http://www.volvo.com/constructionequipment/na/en-us/products/wheeledexcavators/
		http://www.volvo.com/constructionequipment/na/en-us/products/crawlerexcavators/
	John Deere	http://www.deere.com/en_US/cfd/construction/deere_const/excavators/deere_excavator_selection.html
	Liebherr	http://www.liebherr.com/em/en/18891.asp
	Soilmec	http://www.soilmec.com/_vti_g1_t02.aspx?rpstry=29_
	Gehl	http://www.gehl.com
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=216
	Komatsu	http://www.komatsu.com/ce/products/crawler_excavators.html
		http://www.komatsu.com/ce/products/wheel_excavators.html
	Terex	http://www.terex.com/main.php
	Link-Belt	http://www.lbxco.com/lx_series.asp
	Gradall	http://www.gradall.com/
	Badger Daylighting	http://www.badgerinc.com/
Fork Lifts - See Lifts / Variable Reach Fork Lifts/ Material Handlers		

Generators		
	Terex	http://www.terex.com/main.php
	Multiquip	http://www.multiquip.com/multiquip/212_ENU_HTML.htm
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5714,00.html
	Baldor	http://www.baldor.com/products/generators/ts.asp
Graders		
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=190
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/MotorGraders/
	Komatsu	http://www.komatsu.com/ce/products/motor_graders.html
	Terex	http://www.terex.com/main.php
Hand Compaction Equipment		
	Terex	http://www.terex.com/main.php
	Multiquip	http://www.multiquip.com/multiquip/56_ENU_HTML.htm
Hydraulic Hammers/Hydraulic Breakers - See Concrete Breakers/ Hydraulic Hammers/Hydraulic Breakers		
Jackhammers - See Rock Drilling Equipment/Jackhammers		
Lifts / Variable Reach Fork Lifts/ Material Handlers		
	Genie Lift	www.genielift.com
	Sky Track	www.kirby-smith.com/
	Ingersol-Rand	www.ingersollrand.com
	Terex	http://www.terex.com/main.php
	Roadtec	http://www.roadtec.com/www/docs/102/mtv-material-transfer-vehicle/
Light Towers		
	Baldor	http://www.baldor.com/products/generators/mlt.asp
	Multiquip	http://www.multiquip.com/multiquip/293_ENU_HTML.htm
	Allmand	http://www.allmand.com/Night%20Lite%20Pro%20page.htm
Loaders/Backhoes		
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=54
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/backhoeloaders/

	John Deere	http://www.deere.com/en_US/cfd/construction/deere_const/backhoes/deere_backhoe_selection.html
	Komatsu	http://www.komatsu.com/ce/products/backhoe_loaders.html
Material Handlers - See Lifts / Variable Reach Fork Lifts/ Material Handlers		
Milling Machines		
	Wirtgen	http://www.wirtgenamerica.com/us/
Mining Trucks - See Rigid Dump Trucks/Mining Trucks		
Pans - See Scrapers/Pans		
Pavers/Paving Equipment		
	Caterpillar/ Barber Greene	http://www.cat.com/cda/layout?m=37840&x=7
	Rosco	http://www.leeboy.com/rosco/
	Bomag	http://www.bomag.com/americas/index.aspx?&Lang=478
	Gehl	http://www.gehl.com/const/prodpg_ap.html
	Leeboy	http://www.leeboy.com/leeboy/
	Terex	http://www.terex.com/main.php
	Ingersoll-Rand	http://www.road-development.irco.com/Default.aspx?MenuItemID=12
	Vogele	http://www.vogeleamerica.com/noflash.html
	GOMACO	http://www.gomaco.com/index.html
	Roadtec	http://www.roadtec.com
Pile Drivers/Boring Equipment		
	Soilmec	http://www.soilmec.com/_vti_g1_t09.aspx?rpstry=29_
	Leffer	http://www.leffer.com/hme.html
	Bauer	http://www.bauer.de/en/maschinenbau/produkte/drehbohrgeraete/bg_reihe/usbg15h.htm
Pipelayers/Trenchers		
	Liebherr	http://www.liebherr.com/em/en/18908.asp
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=28&archived=1

	Vermeer	http://www.vermeermfg.com/vcom/TrenchingEquipment/trenching-equipment.htm
	Ditchwitch	http://www.ditchwitch.com/dwcom/Product/ProductView/115
	Eagle	http://www.guntert.com/trenchers_home.asp
Profilers - See Roadway Planers/Profilers		
Rammers		
	Multiquip	http://www.multiquip.com/multiquip/56_ENU_HTML.htm
Rebar Benders/Cutters		
	Multiquip	http://www.multiquip.com/multiquip/1316_ENU_HTML.htm
Recyclers - See Stabilizers/Recyclers		
Rigid Dump Trucks/Mining Trucks		
	Hitachi	http://www.hitachi-c-m.com/global/products/rigid/index.html
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Liebherr	http://www.liebherr.com/em/en/18898.asp
	Komatsu	http://www.komatsu.com/ce/products/dump_trucks.html
	Terex	http://www.terex.com/main.php
Roadway Planers/Profilers		
	Terex	http://www.terex.com/main.php
	Roadtec	http://www.roadtec.com/products/cold_planers/default.htm
Rock Drilling Equipment/Jackhammers		
	Drillman	http://www.drillmanindia.com/rock-drilling-machine.html
	Whaker	http://www.wackergroup.com/webapp/wcs/stores/servlet/
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5721,00.html
	Allied	http://www.alliedcp.com/products/hammers.asp
Rollers - See Tampers/Rollers		
Scrapers/Pans		
	Terex	http://www.terex.com/main.php
Screening Equipment - See Crushing and Screening Equipment		
Slabbuster		
	Allied	http://www.alliedcp.com/products/slabbuster.asp

Slip Form Pavers		
	Huron	http://www.huronmanufacturing.com/
	Guntert & Zimmerman	http://www.guntert.com/concreteSlipformPavers.asp
Stabilizers/Recyclers		
	Bomag	http://www.bomag.com/americas/index.aspx?&Lang=478
	Komatsu	http://www.komatsu.com/ce/products/mobile_crushers.html
	Terex	http://www.terex.com/main.php
	Wirtgen	http://www.wirtgenamerica.com/us/
	Roadtec	http://www.roadtec.com
Sweepers		
	Elgin	http://www.elginsweeper.com
	Johnston	http://www.johnstonsweepers.com/
Tampers/ Rollers		
	Bomag	http://www.bomag.com/americas/index.aspx?&Lang=478
	Komatsu	http://www.komatsu.com/ce/products/vibratory_rollers.html
	Whaker	http://www.wackergroup.com/webapp/wcs/stores/servlet/
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/tamper.htm
	Multiquip	http://www.multiquip.com/multiquip/181_ENU_HTML.htm
	Ingersoll-Rand	http://www.road-development.irco.com/Default.aspx?MenuItemID=15
Trenchers - See Pipelayers/Trenchers		
Trucks - See Articulated Trucks, Concrete Mixer Trucks, Rigid Dump Trucks/Mining Trucks		
Vacuum Units		
	Advanced Recycling Systems	www.arsrecycling.com/
	Vacmasters	http://www.vacmasters.com/airsystm.htm
	Vector	http://www.vector-vacuums.com/
Variable Message Signs		
	Allmand	http://www.allmand.com/MB%20only%20page.htm

	North Star	http://northstar-traffic.com/index.cfm?SC=13&PT=1
	Trafcom	http://www.trafcon.com
	Daktronics	http://www.daktronics.com/vms_prod/dak_vms_products.cfm
Vibratory Rammers		
	Whaker	http://www.wackergroup.com/webapp/wcs/stores/servlet/
Welders/Welding Equipment		
	Airgas	www.airgas.com
	Multiquip	http://www.multiquip.com/multiquip/408_ENU_HTML.htm
	Miller	http://www.millerwelds.com/products/
	Lincoln	http://www.mylincolnelectric.com/Catalog/equipmentseries.asp?browse=101|400|
Wheel Loaders		
	Hitachi	http://www.hitachi-c-m.com/global/products/loader/index.html
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=30
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/wheelloaders/
	Terex	http://www.terex.com/main.php
	Komatsu	http://www.komatsu.com/ce/products/wheel_loaders.html
	TCM	http://www.tcmglobal.net/products/main02.html

Updated: 05/20/2010

U.S. Department of Housing and Urban Development
Office of Community Planning and Development

The Noise Guidebook

The Noise Guidebook

A Reference Document for
Implementing the Department of
Housing and Urban Development's
Noise Policy

Prepared By The Environmental
Planning Division,
Office of Environment and Energy

For sale by the Superintendent of Documents, U.S. Government Printing Office Washington, D.C. 20402

Preface

Introduction

This *Noise Guidebook* has been prepared to serve as the basic reference document for all HUD field staff who are responsible for implementing the Department's noise policy. It brings together in one place all the various reports, informational papers and other items that have been put out by the Department over the past several years. It also contains several new items designed to make your job easier.

This *Guidebook* is designed to serve not only the experienced HUD staff member but also the new employee or the old employee who is new to the noise field. Because of this, the *Guidebook* contains some fairly basic background material as well as quizzes and other material specifically geared for the "learner."

Chapter 1

Basic Overview of the Environmental Noise Problem

Introduction

Background

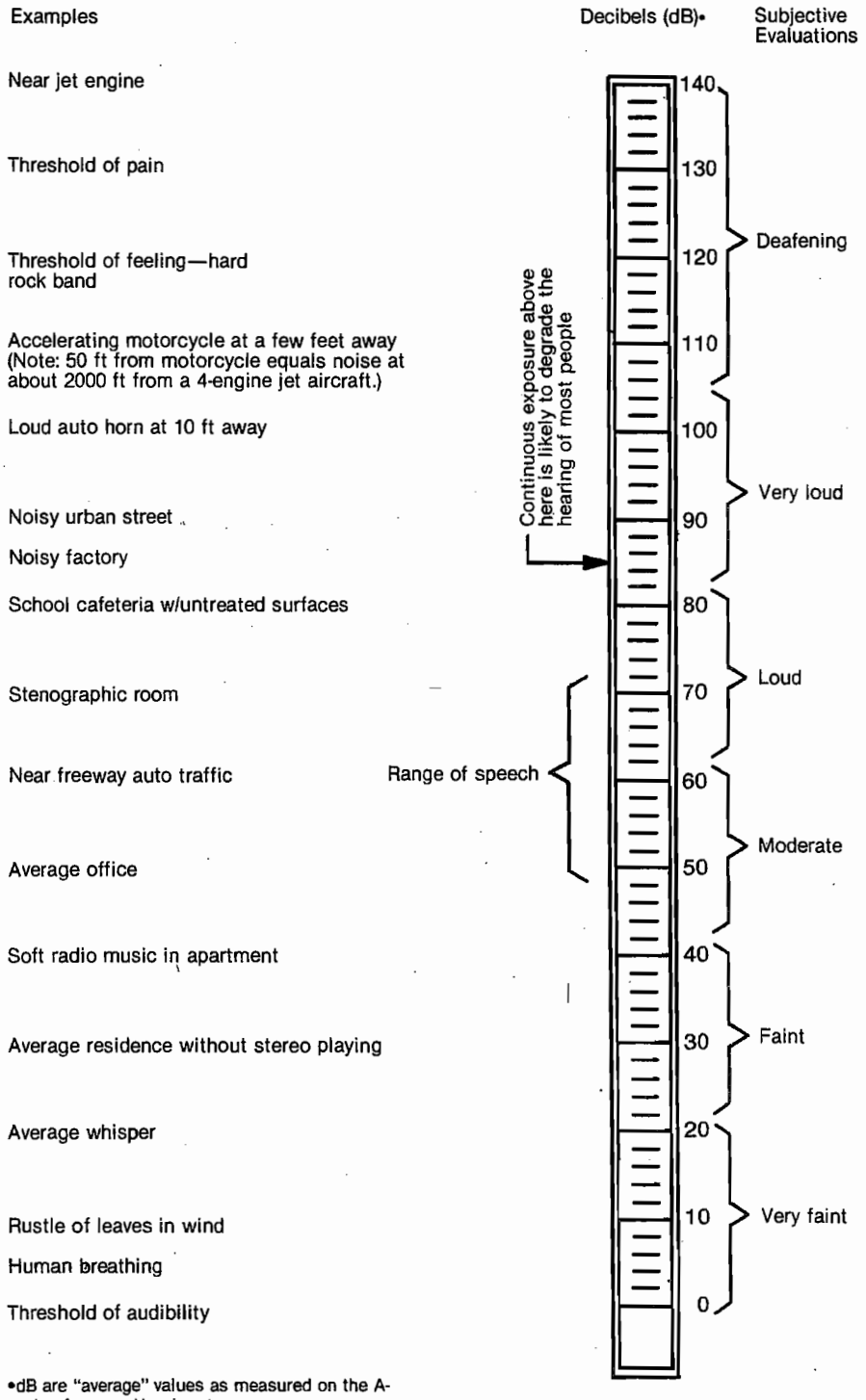
Definition and Scope of the Noise Problem

The air around us is constantly filled with sounds, yet most of us would probably not say we are surrounded by noise. What then is the difference between ordinary sound and what we call noise? The traditional definition of noise is that it is "unwanted sound." Sound becomes unwanted when it either interferes with our normal activities such as sleeping, conversation or recreation, when it causes actual physical harm such as hearing loss or has adverse effects on mental health. As we have become a more urbanized country and as technology has advanced, the level of sound in our environment has reached the point when it sometimes does cause interference and does cause physical and psychological harm, and thus we have developed a noise problem. (See Figure 1 for a listing of common sounds.)

The dimensions of the noise problem have grown larger and larger over the past few decades. In its 1979 Annual Report, The Council on Environmental Quality stated that "nearly half the US population is regularly exposed to levels of noise that interfere with ...normal activities" and about "1 in 10 ...are exposed to noises of duration and intensity sufficient to cause a permanent reduction in their ability to hear."

Figure 1
Common Sounds
Basic Theory: Common Sounds in Decibels (dB)

Some common, easily recognized sounds are listed below in order of increasing sound intensity levels in decibels. The sound levels shown for occupied rooms are typical general activity levels only and do *not* represent criteria for design.



•dB are "average" values as measured on the A-scale of a sound-level meter
(From *Concepts in Architectural Acoustics:* M. David Egan, McGraw Hill, 1972.)

The Dynamics of the Noise Problem

There are basically two types of noise problems. There is the specific, job related, occupational noise problem created by extremely loud machinery. Then there is the community noise problem where the combined effect of many individual noise sources creates an overall noise level that is unacceptable. In the following pages we will be addressing the community noise problem only.

The main contributors to a community noise problem are transportation sources such as highways, railroads and airports. These sources are the most pervasive and continuing of the noise sources within the community. Of course, at any given site, there may be other noise sources which add to the problem, sources such as jackhammers at a construction site. But in general, and for the purposes of this section, the main concern is with the transportation sources.

The dynamics of a noise problem are based on the relationship between the noise source, the person or place exposed to the noise (hereafter called the receiver) and the path the noise will travel from source to receiver.

The source generates a given amount of noise which travels along the path and arrives at the receiver. The amount of noise will be reduced to some extent as a result of how long that path is or whether there are any barriers along the path. The severity of the impact on the receiver is a function of what type of activity is taking place, whether it is indoors or outdoors, and what type of building it is in if the activity is indoors. Figure 3 contains some basic compatibility guidelines.

The impact of the noise can be altered or mitigated by changing the characteristics of any of the three elements: source, path or receiver. Later on we will look at the various mitigation measures that are possible. Our concern however will be primarily with the receiver and the path. Control of the sources themselves is the specific responsibility of agencies such as the Environmental Protection Agency (EPA) or the Federal Aviation Administration (FAA).

Figure 2
Dynamics of a Noise Problem

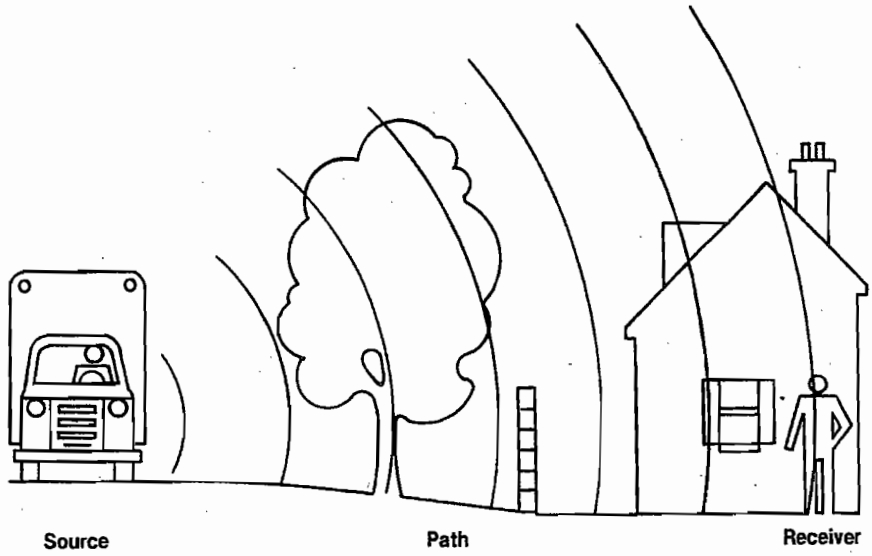
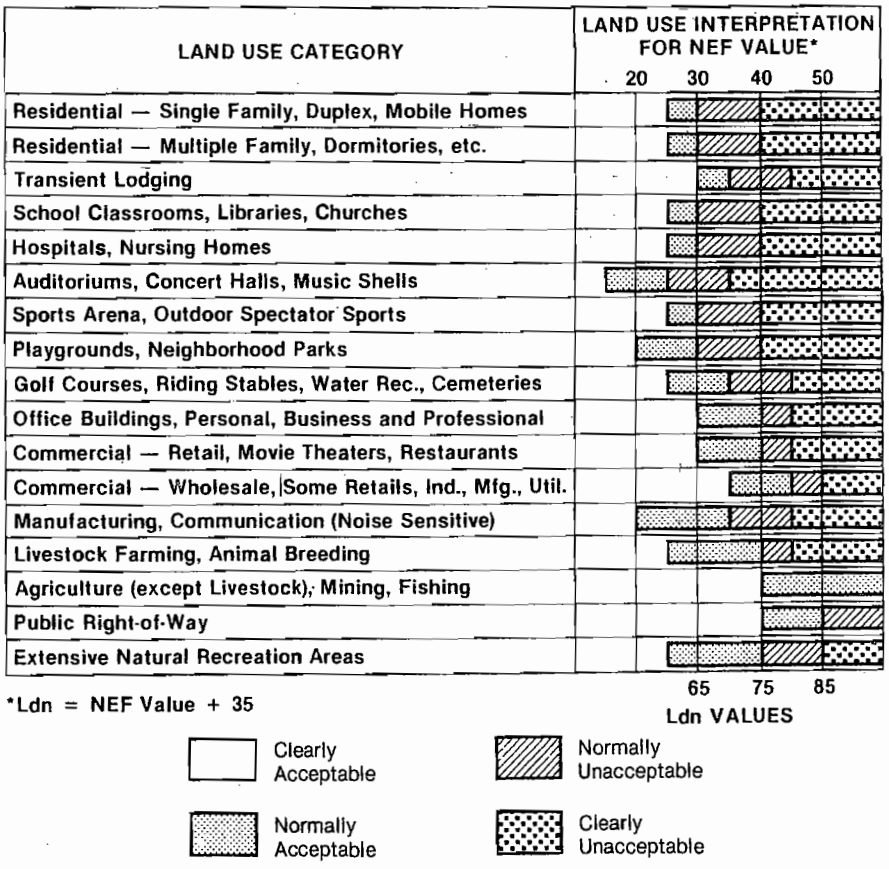


Figure 3
Land Use Compatibility Guidelines



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Dynamics of a Noise Problem

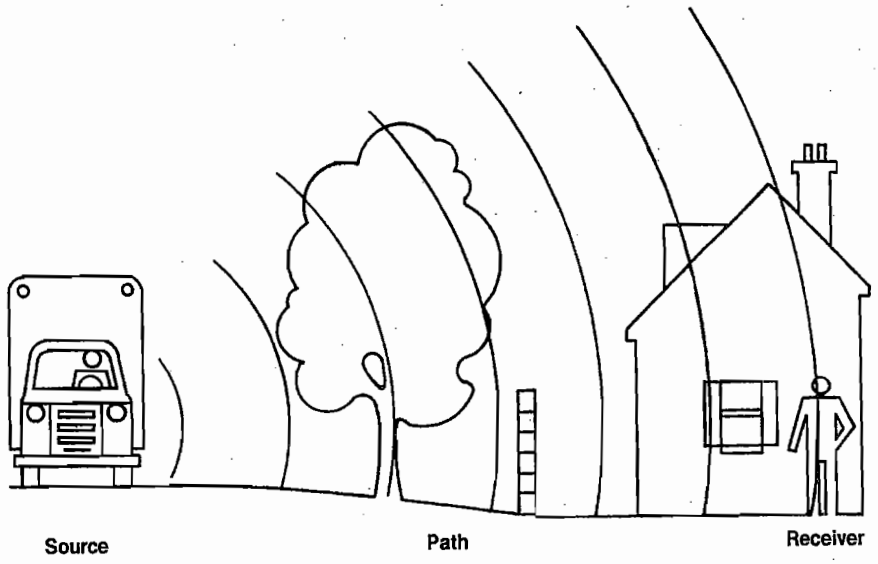
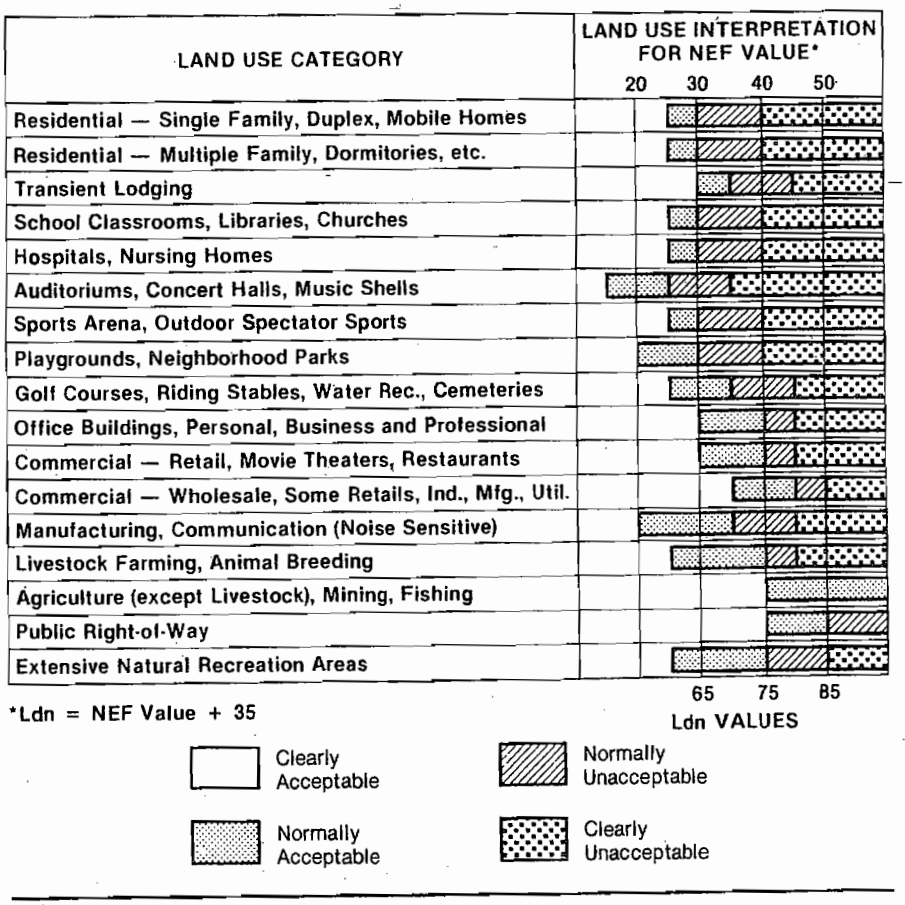


Figure 3
Land Use Compatibility Guidelines



The ideal solution to a potential problem is to reduce the noise being produced by the source. The best solution available to HUD, or the community, however, is to make sure that noise sensitive uses are located where they will not be exposed to high noise levels. The next best approach to mitigating noise impact is to attempt to reduce the amount of noise that reaches the receiver. This can be accomplished through the use of barriers such as walls or earthen berms, or combinations of both, along the noise path. If the use of barriers is not possible then the only alternative available is to provide noise reduction measures in any structures associated with the activity so that at least the interior spaces are not exposed to high noise levels. This approach is considered the least desirable because most of the land uses we are concerned about, such as residential, do have outdoor areas and activities associated with them which would remain exposed to high noise levels.

A Note on Descriptors

A key factor in the growth of our ability to evaluate and reduce noise impacts has been the development of better tools to measure and describe the noise levels generated by various sources. The development of better tools (called noise descriptors or metrics) has been particularly important for dealing with community noise problems. Many of the older descriptor systems could only be used for one or two sources such as cars and railroads, but not airplanes. Since the community noise problem very often includes noise from all these sources the lack of an adequate descriptor made it difficult to do an adequate evaluation.

The most advanced descriptor currently in general use is the day night average sound level system, abbreviated as DNL and symbolized mathematically as L_{dn}. The day night average sound level is the 24 hour average sound level, expressed in decibels, obtained after the addition of a 10 decibel penalty for sound levels which occur at night between 10 PM and 7 AM. This nighttime penalty is based on the fact that many studies have shown that people are much more disturbed by noise at night than at any other time. This is not unusual in that background noise is often much less at night and also people tend to be doing very noise sensitive things at night, such as trying to sleep.

Another feature of the DNL system that is very important is that it can be used to describe noise from all sources. Thus, using the DNL system, we can describe the total noise exposure at a site, something many other descriptor systems couldn't do.

The DNL system has been adopted by the EPA, the Department of Defense (DOD) and HUD, and more recently by the FAA, specifically for describing environmental impacts for airport actions. We expect that very soon it will be in almost universal use in the U.S.

Issues

The main issues involved in any noise analysis can be summarized briefly.

- How much noise is a site exposed to
- What types of activities are being affected and how severely
- Is it reasonable to redesign the site to relocate noise sensitive activities
- And, if not, how much protection can be provided through various attenuation measures.

Your approach to these issues will be affected in many ways by the location of the project in question. Projects in suburban or rural areas can be approached differently because the available mitigation options are greater and often the noise exposure itself is not so severe. In urban situations, however, the noise exposure is often more severe but at the same time the options for mitigation or resiting are more limited. In the urban setting innovative design and the use of advanced attenuation measures becomes critical. Fortunately our experience has shown that good design and construction can relieve or substantially reduce major noise problems.

Legal Provisions

General Legislation and Background

The Federal legislation which addresses noise issues is somewhat different from other environmental legislation. The Clean Air Act, for example, required the Environmental Protection Agency to set up actual mandatory standards for air quality which were supposed to be met by all jurisdictions. EPA even has the authority to take punitive steps against cities which are not making "reasonable further progress" towards achieving these air quality goals. There is no similar legislation that covers noise. The approach has been to tackle the noise problem at the source by controlling the amount of noise that can be emitted by the individual airplane engine or the individual jackhammer. Agencies like HUD or the Farmers Home Administration have developed regulations which are related to the overall community noise level, but they only affect their own programs and are not binding on local communities. The Veterans Administration program only relates to aircraft noise and also only affects its own programs.

The major pieces of Federal legislation related to noise include:

The Noise Control Act of 1972 directed EPA to promote an environment for all Americans free from noise that jeopardizes their health and welfare. It also included a requirement for EPA to set a criterion for noise level adequate to protect health and welfare with an adequate margin of safety but without regard to cost or feasibility.

Quiet Communities Act of 1978 amended The Noise Control Act of 1972 to encourage noise control programs at the State and community level.

Federal Aid Highway Act of 1970 established the requirement that noise control be a part of the planning and design of all federally aided highways.

Aviation Safety and Noise Abatement Act of 1979 requires FAA to develop a single system for measuring noise at airports and under certain conditions to prepare and publish noise maps.

HUD Regulations

While the Department of Housing and Urban Development has no specific responsibility to try to reduce the noise problem at the source the way the Environmental Protection Agency and the Federal Aviation Administration do, it does have the responsibility to be aware of the noise problem and its impact on the housing environment. The most basic mandate which drives the Department's involvement with the noise issue is the Housing Act of 1949 (Public Law 81-171) which sets forth the national goal of "a decent home and suitable living environment for every American family." This goal was affirmed by the Housing and Urban Development Act of 1968 (Public Law 90-448). The Department was tasked by the Housing and Urban Development Act of 1965 (Public Law 89-117) "to determine feasible methods of reducing the economic loss and hardships suffered by homeowners as a result of the depreciation in the value of their properties following the construction of airports in the vicinity of their homes." The Noise Control Act of 1972, in addition to its specific tasking to EPA, tasked all Federal agencies to administer their programs in ways which reduce noise pollution. Finally, the Department is tasked by Federal Management Circular 75-2: *Compatible Land Uses at Federal Airfields* to make sure that its actions do not promote incompatible land uses around Federal airfields.

All of these legislative and regulatory mandates combine to create a serious requirement for the Department of Housing and Urban Development to be aware of the problem of noise and to take positive steps to protect residential and other sensitive land uses from high noise levels.

The Department of Housing and Urban Development first issued formal requirements related specifically to noise in 1971 (HUD Circular 1390.2). These requirements contained standards for exterior noise levels along with policies for approving HUD supported or assisted housing projects in high noise areas. In general the requirements established three zones: an acceptable zone where all projects could be approved, a normally unacceptable zone where mitigation measures would be required and where each project would have to be individually evaluated for approval or denial, and an unacceptable zone in which projects would not, as a rule, be approved.

In 1979, the Department issued revised regulations (24 CFR Part 51B) which kept the same basic standards but adopted new descriptor systems which were considerably advanced over those in use under the old requirements.

HUD's regulations also require that recipients of Community Development Block Grants (CDBG) and Urban Development Action Grants (UDAG) take into consideration the noise criteria and standards in the environmental review process and consider ameliorative actions when noise sensitive land developments are proposed in noise exposed areas. If CDBG or UDAG activities are planned in a noisy area, and HUD assistance is contemplated later for housing and/or other noise sensitive activities, the HUD standards must be met for those activities.

Project Analysis

General

While most of the analysis for noise focuses on noise sources located around the project site, there are some characteristics of the project itself that you should know about. These characteristics will help you to determine what is called the noise assessment location (NAL) for site analysis. (The NAL is a representative point (or points) on the site where significant noise exposure is expected. All distances, etc. are measured from the NAL). This information will also be helpful later in evaluating the potential for mitigating or reducing the impact of noise. All of this data should be available from preliminary plans and specifications. If not, a quick phone call to the developer/sponsor should get you all the information you need.

Data Required

- Location of outdoor noise sensitive uses relative to the noise source.
- Location of buildings containing noise sensitive activities.
- Location of other buildings, particularly ones which might serve to shield sensitive buildings or areas from the noise source.
- Design and construction features of buildings, particularly features such as use of central air conditioning which could provide noise reduction benefits by permitting windows to be kept closed.

Analysis of Site and Environs

General

The primary focus of this impact analysis is on noise sources and the primary item to be determined is the noise level created by those sources. In many instances, particularly with airports, data on the noise levels generated by the source will have already been prepared by another agency such as the airport operator, the local or State highway/transportation department or other similar agency. (Figure 4 shows typical airport noise contours.) In those cases no site or environs analysis is necessary and one can proceed directly to impact analysis. For those instances where there are no current data already prepared, the Department of Housing and Urban Development has developed a handbook called the *Noise Assessment Guidelines* which contains a detailed desk top methodology for use by individuals to determine noise impacts (see Chapter 5). Included in the handbook is a complete listing of the data about the site and its environs that are necessary to conduct an analysis. We don't want to repeat all the detailed requirements here, but the following are some of the types of information you would have to collect if you were to do your own analysis. You might note that most of the information is related to the noise sources themselves.

For the purpose of analysis, the *Noise Assessment Guidelines* require that you consider all military/civilian airports within 15 miles of the project, all significant roads within 1000 feet and basically all railroads within 3000 feet.

...es of Data Required

- ...number and type of vehicles
- ...perational data:
  - ...speed
  - ...daytime/nighttime split
- ...conditions where the vehicles are ...erated, i.e., freely flowing traffic ...sus stop and go, level versus hilly, ...ded railroad track versus bolted ...road track.

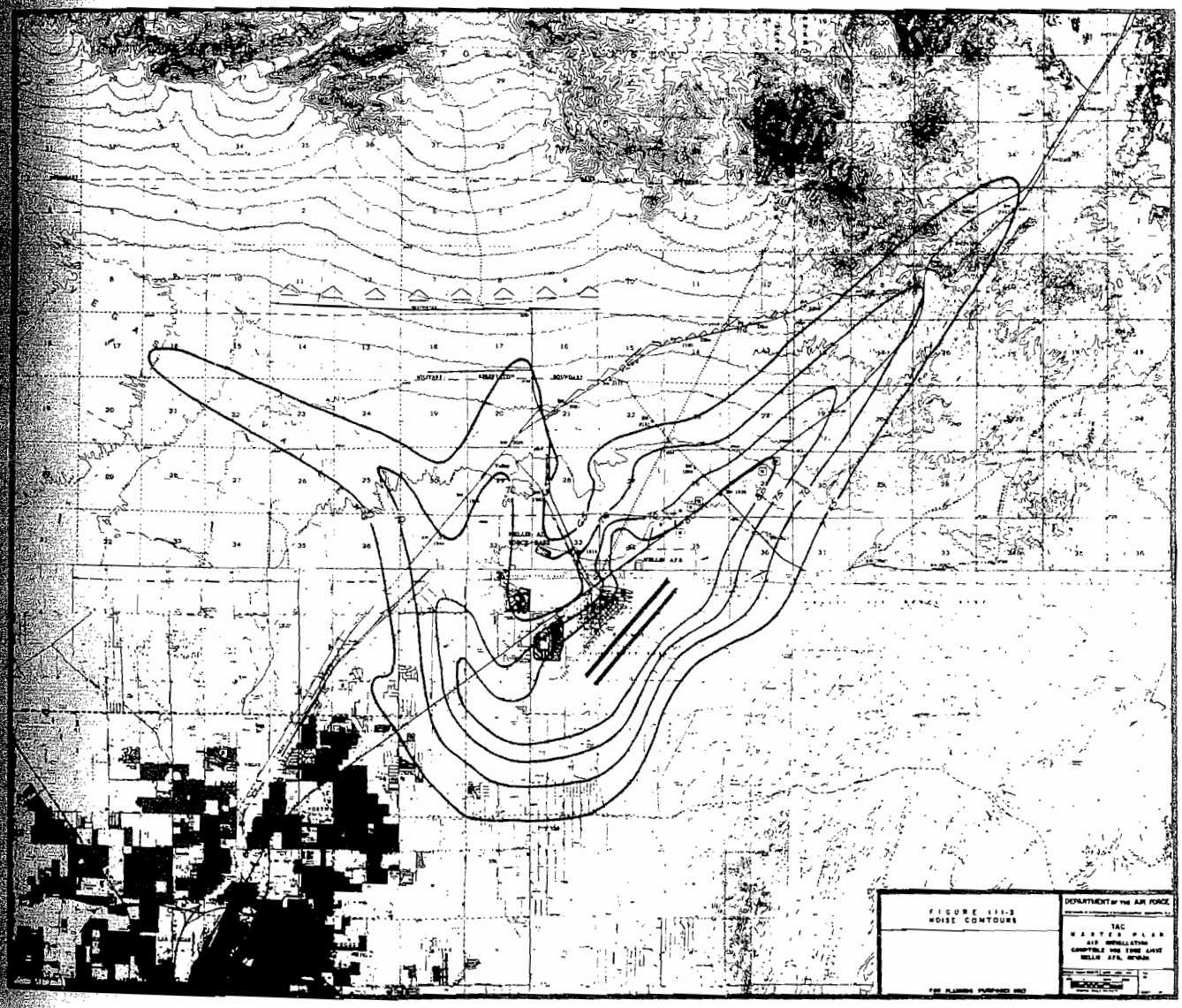
The *Noise Assessment Guidelines* contain guidance on sources for this data. Most of them are obtained from the "operator" of the transportation source. The *Guidelines* also contains model figures which can be used when actual data is unavailable. For example, if the actual number of vehicles traveling at night is not available then the *Guidelines* state that a figure of 15% should be used. Thus it is possible to make reasonably accurate noise level determinations even if some information is not available.

Determination of Impact

General

The specific procedures for determining the noise exposure levels for a site are clearly spelled out in the *Noise Assessment Guidelines*. The process is a fairly simple one in which the noise level from each source affecting the site is calculated and then combined to derive the overall exposure. If some kind of barrier exists or is proposed, the noise levels can be adjusted to reflect the mitigation provided by the barrier. The overall noise level is then compared to HUD's standards and the appropriate action, as spelled out in the regulations, is taken.

Figure 4
Noise Contours



Evaluation of Impact

HUD Regulations set forth the following exterior noise standards for new housing construction assisted or supported by the Department:

65 L_{dn} or less - Acceptable

Exceeding 65 L_{dn} but not exceeding 75 L_{dn} - Normally Unacceptable - appropriate sound attenuation measures must be provided: 5 decibels attenuation above the attenuation provided by standard construction required in 65 L_{dn} to 70 L_{dn} zone; 10 decibels additional attenuation in 70 L_{dn} to 75 L_{dn} zone.

Exceeding 75 L_{dn} - Unacceptable

HUD's regulations do not contain standards for interior noise levels. Rather a goal of 45 decibels is set forth and the attenuation requirements are geared towards achieving that goal. It is assumed that with standard construction any building will provide sufficient attenuation so that if the exterior level is 65 L_{dn} or less, the interior level will be 45 L_{dn} or less.

Once you have determined the overall noise exposure for the site you compare it to the above standards. If the overall site exposure is 65 L_{dn} or less the project is acceptable. If the exposure is between 65 L_{dn} and 75 L_{dn} you should consider alternative locations or providing adequate attenuation with the first preference, as we've noted, being for the construction of some kind of barrier to prevent noise from reaching the site. If providing adequate attenuation is impossible or impractical then the project should be considered unacceptable.

Suggested Mitigation

General Considerations

As discussed briefly earlier, there are three basic approaches for mitigating the high noise exposures. The first and best is to relocate noise sensitive uses out of the high noise area. The second is to prevent noise from reaching the noise sensitive user through some sort of barrier. And the third, and least desirable approach, is to provide attenuation for at least the interiors of any buildings located in the high noise areas.

Specific Considerations

Relocating Noise Sensitive Uses

By far the most desirable mitigation approach is to relocate noise sensitive uses out of the high noise area although. If the site is large enough it may be possible to locate non-noise sensitive uses between the source and the sensitive use, for example a parking lot might be located between a road and a park (see Figure 5). The workcharts in the *Noise Assessment Guidelines* can be used in reverse to tell you exactly how far away from the noise source you need to be.

When sites are small, very dense or when the source affects the entire site it is very difficult to mitigate by changing the site plan. Then the next option must be considered: erecting some type of barrier between the source and the receiver.

Barriers

Barriers are most effective for at or below ground level sources. They have no effect on noise from aircraft overflights and are limited in practical application with elevated sources such as elevated trains. The key to the effectiveness of a barrier is whether or not it breaks the line of sight between the source and the receiver. If a barrier does not completely break the line of sight either because it is not high enough, or not long enough then its effectiveness is greatly reduced.

Barriers can be actual walls, earthen mounds (called berms) or even other buildings. The use of other non-noise sensitive buildings as barriers is a particularly good approach in that it need not add to the cost of the project and may not create the aesthetic problem a large wall might create (see Figure 6).

Figure 5
The Audible Landscape

In cluster development, open space can be placed near the highway to reduce noise impacts on residences

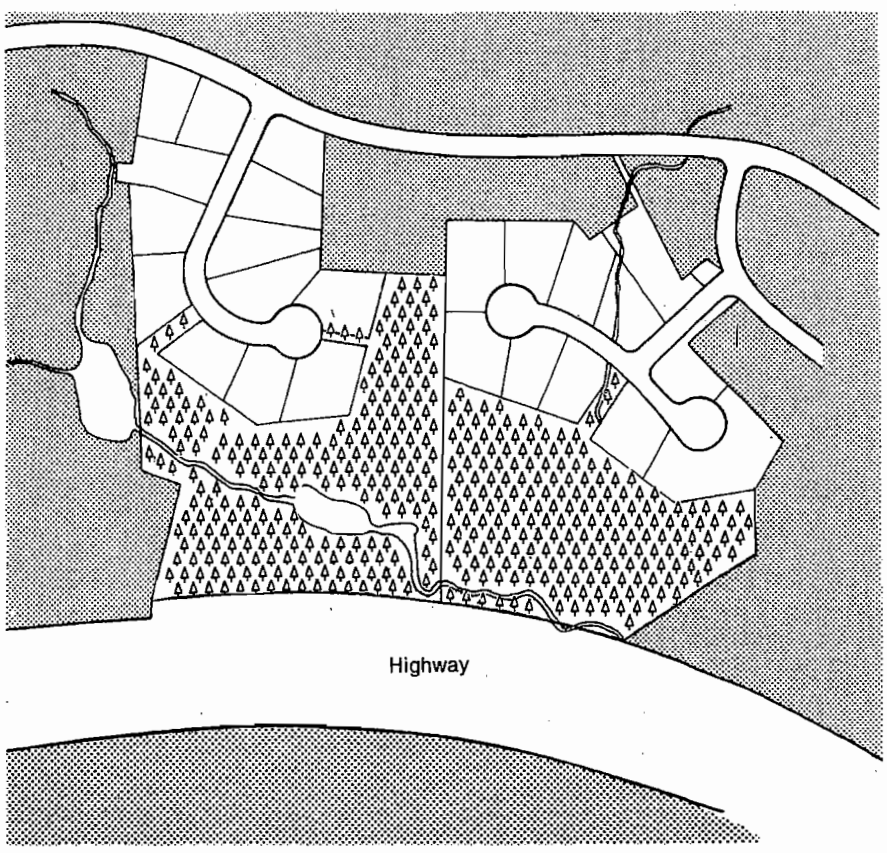


Figure 6
The Audible Landscape

Placement of noise compatible land uses near highway in Planned Unit Development

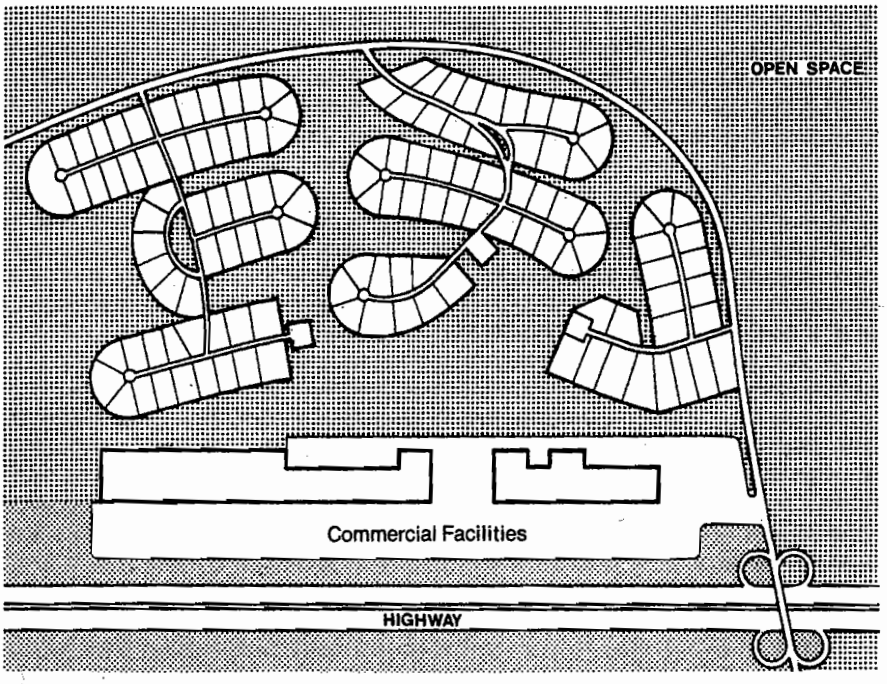
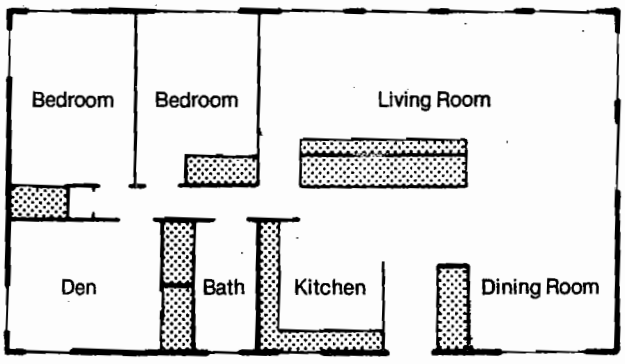


Figure 7
The Audible Landscape

Use of acoustical architectural design to reduce noise impacts on more noise sensitive living spaces



Highway

As pointed out earlier, the effectiveness of a barrier is determined in large part by its height and length. Some studies have shown that the effectiveness of a barrier can be reduced by as much as 50% if it isn't long enough. Again, the *Noise Assessment Guidelines* contain procedures for determining the effectiveness of barriers.

Incorporating Noise Attenuation Measures into the Building

If neither relocation or barriers is a reasonable noise attenuation option, the last resort is to incorporate noise attenuation measures into the buildings themselves. This is not considered the best solution because it leaves the outdoor areas, some of which may be for quiet recreation, exposed to high noise levels. But if development **must** take place and barriers are impossible, then the noise attenuation measures should be employed in building design and construction.

Without going into great technical detail, noise attenuation construction measures generally fall into four categories.

(1) Reducing the total area of windows or other acoustically weaker building elements

(2) Sealing off "leaks" around windows, doors, vents.

(3) Improving the actual sound attenuating properties of small building elements such as windows, doors, etc.

(4) Improving the actual sound attenuating properties of major building elements such as roof and wall construction.

In addition, noise attenuation in buildings can be provided by designing interior spaces so that "dead" spaces such as closets or corridors act as buffer zones (see Figure 7). And finally noise attenuation can be provided by reducing the need for open windows by providing air conditioning.

Many of the steps that would be taken to provide noise attenuation also help conserve energy. Good weatherstripping around windows and doors is one example. Another might be reducing window areas in walls if the noise source is to the north or west. Because many of these measures serve two purposes, they should not necessarily be considered a burdensome requirement but rather just good design and construction.

Information Resources

Publications

HUD Regulation 24 CFR Part 51 Subpart B – Noise Abatement and Control.

Noise Assessment Guidelines, HUD 1983, basic technical procedural resource.

Aircraft Noise Impact, HUD 1972, a bit dated but good overview of problem.

The Audible Landscape, DOT (FHWA) 1974, an excellent discusson of mitigation measures including land use planning and building design and construction.

Information on Levels of Environmental Noise Requisite to Protect Public health and Welfare With an Adequate margin of Safety, EPA, 1974. The "levels document" that explains basis for EPA standards.

Noise Barrier Design Handbook, Federal Highway Administration 1976. Good discussion of barriers, technical but readable.

Handbook of Noise Control, 2nd edition, 1979, McGraw Hill. A basic technical handbook covering all aspects of noise for those who wish to go into the subject further.

Experts

HUD environmental officers have been trained in the use of the *Noise Assessment Guidelines* and can help you work with them. Many architects are trained in acoustics and can help in development of noise attenuation strategies.

Quiz

Questions

1. Why is noise considered "unwanted sound"?
2. What is a community noise problem?
3. What are the three main contributors to a community noise problem?
4. What are the three components of a noise problem?
5. What are two key characteristics of the day-night average sound level descriptor system?
6. What are HUD's noise standards?
7. How do HUD's standards apply to CDBG recipients?
8. What are the three general mitigation measures available to HUD and the community and in what order of preference?
9. When are barriers effective and when are they not effective?
10. Describe how the *Noise Assessment Guidelines* can be used to determine appropriate mitigation measures.

Quiz

Answers

1. because it interferes with normal activities or causes physical or psychological damage
2. a community noise problem is where the combined effect of many individual sources creates an overall noise level that is unacceptable
3. highways, railroads and aircraft
4. the source, the path, the receiver
5. it is an average sound level and it can be used for all sources
6. 65 L_{dn} or below: Acceptable
   65 to 75 L_{dn}: Normally unacceptable, noise attenuation measures required,
   above 75 L_{dn}: Unacceptable
7. CDBG recipients must take into consideration the standards in their planning and environmental review. If they expect to use HUD assistance later for housing or other noise sensitive activities the standards must be met for those activities.
8. 1st relocate noise sensitive uses
   2nd reduce noise reaching receiver
   3rd redesign buildings
9. barriers are effective for at or below ground level sources. Are not effective for aircraft overflights or most elevated sources
10. can be used to determine separation distance required for relocation and the height and length of barriers required

Chapter 2

The Noise Regulation

Introduction

The basic foundation for and structure of the HUD noise program is set out in the noise regulation, 24 CFR 51B. The regulation establishes the actual standards, assigns implementation responsibilities, describes review and approval procedures, and identifies special situations which may warrant waivers of procedures or standards. Therefore, the key to your understanding and implementation of the HUD noise program is a clear understanding of the regulation.

There is no way to escape the task of sitting down and simply reading the regulations, over and over until you thoroughly understand them. We have however done two things that will help you apply the regulations. First, for quick reference, we have prepared a list of the key sections in the regulation and second we have prepared an annotated copy of the regulation.

The list of key sections was prepared to help you find the specific section you need for a specific question or issue. While the regulation itself is not really long, an index is always useful. We caution you, however, against using the index to avoid learning the regulations. The list was prepared for your convenience in applying the regulation once you have come to understand it.

We prepared the annotated regulation because, try as we might, it was impossible to anticipate all the questions, implementation problems and special situations that might arise and to address them in the regulation. So, now that we have had a few years' experience with the regulation, we have gathered together the important questions, notes, second thoughts etc. and prepared this annotated regulation. We hope it will give you further insight into what the regulation means when it is applied in the field.

Key Sections in Noise Regulation

Section	Subject
51.101(a)(2)	Application of Policy to Block Grants
51.101(a)(3)	Policy for New Construction
51.101(a)(4)	Policy for Existing Construction
51.101(a)(5)	Policy for Modernization and Rehabilitation
51.101(a)(8)	The Exterior Noise Goal
51.101(a)(9)	The Interior Noise Goal
51.102(a)	Authority to Approve Projects
51.103(a)	Identification of DNL as *The* Noise Descriptor to be Used
51.103(b)	How to Measure Loud Impulsive Noises
51.103(c)	The Noise Standards
51.104(a)	Attenuation Requirements Discussed
51.104(b)(1)	Special Approval and Environmental Review Requirements for the Normally Unacceptable Zone
51.104(b)(2)	Special Approval and Environmental Review Requirements for the Unacceptable zone
51.105(a)	Flexibility for Non-acoustic Benefits Provisions
51.106(a)	How to Tell If Existing Data on Noise Are Acceptable
51.106(a)(4)	Specific Review and Approval Procedures For Airport Noise Contours
51.106(d)	When Noise Measurements May be Used Instead of Calculated Levels
51.106(f)	When to Give Credit for Proposed Barriers

Part 51—Environmental Criteria and Standards

Subpart A—General Provisions

Sec.
§51.1 Purpose.
§51.2 Authority.
§51.3 Responsibilities.
§51.4 Program coverage.
§51.5 Coordination with environmental clearance requirements.
§51.6 [Reserved]

Subpart B—Noise Abatement and Control
§51.100 Purpose and authority.
§51.101 General policy.
§51.102 Responsibilities.
§51.103 Criteria and standards.
§51.104 Special requirements.
§51.105 Exceptions.
§51.106 Implementation.

Appendix to Subpart B

Authority: Sec. 7(d). Department of HUD Act (42 U.S.C. 3535(d)).

Subpart B—Noise Abatement and Control

This regulation replaces HUD Circular 1390.2, Noise Abatement and Control, 1971, which is now cancelled, along with all instructions and clarifying memoranda pertaining to the circular.

§51.100 Purpose and authority.

(a) *Purpose.* The Department of Housing and Urban Development finds that noise is a major source of environmental pollution which represents a threat to the serenity and quality of life in population centers and that noise exposure may be a cause of adverse physiological and psychological effects as well as economic losses.

It is the purpose of this Subpart to:

(1) Call attention to the threat of noise pollution;

(2) Encourage the control of noise at its source in cooperation with other Federal departments and agencies;

(3) Encourage land use patterns for housing and other noise sensitive urban needs that will provide a suitable separation between them and major noise sources;

(4) Generally prohibit HUD support for new construction of noise sensitive uses on sites having unacceptable noise exposure;

(5) Provide policy on the use of structural and other noise attenuation measures where needed; and

(6) Provide policy to guide implementation of various HUD programs.

(b) *Authority.* Specific authorities for noise abatement and control are contained in:

(1) The Noise Control Act of 1972 (Pub. L. 92-574) which directs Federal agencies to administer their programs in ways which reduce noise pollution.

(2) The Quiet Communities Act of 1978 (Pub. L. 95-609) which amended Pub. L. 92-574.

(3) The General Services Administration, Federal Management Circular 75-2: *Compatible Land Uses at Federal Airfields* prescribes the Executive Branch's general policy with respect to achieving compatible land uses on either public or privately owned property at or in the vicinity of Federal airfields.

(4) Section 1113 of the Housing and Urban Development Act of 1965 (Pub. L. 89-117) directs the Secretary "* * * to determine feasible methods of reducing the economic loss and hardships suffered by homeowners as a result of the depreciation in the value of their properties following the construction of airports in the vicnity of their homes, including a study of feasible methods of insulating such homes from the noise of aircraft."

§51.101 General policy.

(a) It is HUD's general policy to provide minimum national standards applicable to HUD programs to protect citizens against excessive noise in their communities and places of residence.

(1) *Comprehensive planning assistance.* HUD requires that grantees give adequate consideration to noise exposures and sources of noise as an integral part of the urban environment in HUD assisted comprehensive planning, as follows:

(i) Particular emphasis shall be placed on the importance of compatible land use planning in relation to airports, highways and other sources of high noise.

(ii) Applicants shall take into consideration HUD environmental standards impacting the use of land as required in 24 CFR Part 600.

(iii) Environmental studies, including noise assessments, are allowable costs.

(2) *Community Development Block Grants.* Recipients of community development block grants under the Housing and Community Development Act of 1974 (Pub. L. 93-383), as amended by the Housing and Community Development Act of 1977 (Pub. L. 95-128), must take into

consideration the noise criteria and standards in the environmental review process and consider ameliorative actions when noise sensitive land development is proposed in noise exposed areas. Grant recipients shall address deviations from the standards in their environmental reviews as required in 24 CFR Part 58.

Where CDBG activities are planned in a noisy area, and HUD assistance is contemplated later for housing and/or other noise sensitive activities, the CDBG grantee risks denial of the HUD assistance unless the HUD standards are met. Environmental studies, including noise assessments, are allowable costs.

(3) *HUD support for new construction.* HUD assistance for the construction of new noise sensitive uses is prohibited generally for projects with Unacceptable noise exposures and is discouraged for projects with Normally Unacceptable noise exposure. (Standards of acceptability are contained in §51.103(c).) This policy applies to all HUD programs providing assistance, subsidy or insurance for housing, college housing, mobile home parks, nursing homes, hospitals, and all programs providing assistance or insurance for land development, new communities, redevelopment or any other provision of facilities and services which are directed to make land available for housing or noise sensitive development. The policy does not apply to research demonstration projects which do not result in new construction or reconstruction, flood insurance, interstate land sales registration, or any action or emergency assistance under disaster assistance programs which are provided to save lives, protect property, protect public health and safety, remove debris and wreckage, or assistance provided that has the effect of restoring facilities substantially as they existed prior to the disaster.

(4) *HUD support for existing construction.* Noise exposure by itself will not result in the denial of HUD support for the resale and purchase of otherwise acceptable existing buildings. However, environmental noise is a marketability factor which HUD will consider in determining the amount of insurance or other assistance that may be given.

Existing construction means units which are either more than 1 year old or for which this is the second or subsequent purchaser.

The old definition of major or substantial rehabilitation and modernization as being any project where cost is 75% or more of replacement cost no longer applies. Now the criteria contained in individual program guidance applies.

(5) *HUD support of modernization and rehabilitation.* For modernization projects located in all noise exposed areas, HUD shall encourage noise attenuation features in alterations. For major or substantial rehabilitation projects in the Normally Unacceptable and Unacceptable noise zones, HUD actively shall seek to have project sponsors incorporate noise attenuation features, given the extent of the rehabilitation being undertaken and the level of exterior noise exposure. In Unacceptable noise zones, HUD shall strongly encourage conversion of noise-exposed sites to land uses compatible with the high noise levels.

(6) *Research, guidance and publications.* HUD shall maintain a continuing program designed to provide new knowledge of noise abatement and control to public and private bodies, to develop improved methods for anticipating noise encroachment, to develop noise abatement measures through land use and building construction practices, and to foster better understanding of the consequences of noise. It shall be HUD's policy to issue guidance documents periodically to assist HUD personnel in assigning an acceptability category to projects in accordance with noise exposure standards, in evaluating noise attenuation measures, and in advising local agencies about noise abatement strategies. The guidance documents shall be updated periodically in accordance with advances in the state-of-the-art.

(7) *Construction equipment, building equipment and appliances.* HUD shall encourage the use of quieter construction equipment and methods in population centers, the use of quieter equipment and appliances in buildings, and the use of appropriate noise abatement techniques in the design of residential structures with potential noise problems.

(8) *Exterior noise goals.* It is a HUD goal that exterior noise levels do not exceed a day-night average sound level of 55 decibels. This level is recommended by the Environmental Protection Agency as a goal for outdoors in residential areas. The levels recommended by EPA are not standards and do not take into account cost or feasibility. For the purposes of this regulation and to meet other program objectives, sites with a day-night average sound level of 65 and below are acceptable and are allowable (see Standards in §51.103(c)).

(9) *Interior noise goals.* It is a HUD goal that the interior auditory environment shall not exceed a day-night average sound level of 45 decibels. Attenuation measures to meet these interior goals shall be employed where feasible. Emphasis shall be given to noise sensitive interior spaces such as bedrooms. Minimum attenuation requirements are prescribed in §51.104(a).

(10) *Acoustical privacy in multifamily buildings.* HUD shall require the use of building design and acoustical treatment to afford acoustical privacy in multifamily buildings pursuant to requirements of the Minimum Property Standards.

§51.102 Responsibilities.

(a) *Authority to approve projects.* (1) Decisions on proposed projects with acceptable noise exposures shall be delegated to the program personnel within field offices, including projects where increased noise levels are considered acceptable because of non-acoustic benefits under §51.105(a). Field office program personnel may also approve projects in normally unacceptable noise exposed areas where adequate sound attenuation is provided and where the project does not require an Environmental Impact Statement under §51.104(b).

(2) Other approvals in normally unacceptable noise exposed areas require the concurrence of the Regional Administrator.

(3) Requests for approvals of projects or portions of projects with unacceptable noise exposures shall be referred through the Regional Office to the Assistant Secretary for Community Planning and Development for approval pursuant to §51.104(b).

The Noise Control Act of 1972 required EPA to "publish information on the levels of environmental noise. . .which. . .are requisite to protect the public health and welfare with an adequate margin of safety." EPA has interpreted this to mean that the levels should not reflect technical feasibility or economic costs. "Health and welfare" is defined as being "complete physical, mental and social well-being and not merely the absence of disease and infirmity."

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(4) In cases where the Regional Administrator determines that an important precedent or issue is involved, such cases shall be referred with recommendations to the Assistant Secretary for Community Planning and Development.

(b) *Surveillance of noise problem areas.* Appropriate field staff shall maintain surveillance of potential noise problem areas and advise local officials, developers, and planning groups of the unacceptability of sites because of noise exposure at the earliest possible time in the decision process. Every attempt shall be made to insure that applicants' site choices are consistent with the policy and standards contained herein.

(c) *Notice to applicants.* At the earliest possible stage, HUD program administrators shall:

(1) Determine the suitability of the acoustical environment of proposed projects;

(2) Notify applicants of any adverse or questionable situations; and

(3) Assure that prospective applicants are apprised of the standards contained herein so that future site choices will be consistent with these standards.

(d) *Technical assistance.* Technical assistance in the measurement, estimation, interpretation, or prediction of noise exposure is available from the Office of Community Planning and Development and the Office of Policy Development and Research. Field office questions shall be forwarded through the Regional Office to the Assistant Secretary for Community Planning and Development or his designee.

(e) *Interdepartmental coordination.* Regional Administrators shall foster appropriate coordination between field offices and other departments and agencies, particularly the Environmental Protection Agency, the Department of Transportation, Department of Defense representatives, and the Veterans Administration. HUD staff shall utilize the acceptability standards in commenting on the prospective impacts of transportation facilities and other noise generators in the Environmental Impact Statement review process.

§51.103 Criteria and standards.

These standards apply to all programs as indicated in §61.101.

(a) *Measure of external noise environments.* The magnitude of the external noise environment at a site is determined by the value of the day-night average sound level produced as the result of the accumulation of noise from all sources contributing to the external noise environment at the site. Day-night average sound level, abbreviated as DNL and symbolized as L_{dn}, is the 24-hour average sound level, in decibels, obtained after addition of 10 decibels to sound levels in the night from 10 p.m. to 7 a.m. Mathematical expressions for average sound level and day-night average sound level are stated in the Appendix.

(b) *Loud impulsive sounds.* On an interim basis, when loud impulsive sounds, such as explosions or sonic booms, are experienced at a site, the day-night average sound level produced by the loud impulsive sounds alone shall have 8 decibels added to it in assessing the acceptability of the site (see Appendix). Alternatively, the C-weighted day-night average sound level (L_{Cdn}) may be used without the 8 decibel addition, as indicated in Section 51.106(a)(3).

Methods for assessing the contribution of loud impulsive sounds to day-night average sound level at a site and mathematical expressions for determining whether a sound is classed as "loud impulsive" are provided in the Appendix.

(c) *Exterior standards.* The degree of acceptability of the noise environment at a site is determined by the sound levels external to buildings or other facilities containing noise sensitive uses. The standards shall usually apply at a location 2 meters (6.5 feet) from the building housing noise sensitive activities in the direction of the predominant noise source. Where the building location is undetermined, the standards shall apply 2 meters (6.5 feet) from the building setback line nearest to the predominant noise source. The standards shall also apply at other locations where it is determined that quiet outdoor space is required in an area ancillary to the principal use on the site.

The noise environment inside a building is considered acceptable if (a) the noise environment external to the building complies with these standards, and (b) the building is constructed in a manner common to the area or, if of uncommon construction, has at least the equivalent noise attenuation characteristics.

This is because the reverberation effect of sound waves hitting the wall will increase the noise levels at the site. You won't pick this up unless you back off from the wall to measure.

Site Acceptability Standards

	Day-night average sound level (in decibels)	Special approvals and requirements
Acceptable	Not exceeding 65 dB(1)	None
Normally Unacceptable	Above 65 dB but not exceeding 75 dB	Special Approvals (2) Environmental Review (3) Attenuation (4)
Unacceptable	Above 75 dB	Special Approvals (2) Environmental Review (3) Attenuation (5)

Notes.—(1) Acceptable threshold may be shifted to 70 dB in special circumstances pursuant to Section 51.105(a)

(2) See Section 51.104(b) for requirements.

(3) See Section 51.104(b) for requirements.

(4) 5 dB additional attenuation required for sites above 65 dB but not exceeding 70 dB and 10 dB additional attenuation required for sites above 70 dB but not exceeding 75 dB. (See Section 51.104(a).)

(5) Attenuation measures to be submitted to the Assistant Secretary for CPD for approval on a case-by-case basis.

§51.104 Special requirements.

(a) *Noise attenuation.* Noise attenuation measures are those required in addition to attenuation provided by buildings as commonly constructed in the area, and requiring open windows for ventilation. Measures that reduce external noise at a site shall be used wherever practicable in preference to the incorporation of additional noise attenuation in buildings. Building designs and construction techniques that provide more noise attenuation than typical construction may be employed also to meet the noise attenuation requirements.

(1) *Normally Unacceptable noise zone.* Approvals in this zone require a minimum of 5 decibels additional sound attenuation for buildings having noise-sensitive uses if the day-night average sound level is greater than 65 decibels but does not exceed 70 decibels, or a minimum of 10 decibels of additional sound attenuation if the day-night average sound level is greater than 70 decibels but does not exceed 75 decibels.

(2) *Unacceptable noise zone.* Noise attenuation measures require the approval of the Assistant Secretary for Community Planning and Development (See §51.104(b)(2).)

(b) *Special Approvals and Environmental Review Requirements.* Environmental clearances shall be conducted pursuant to the requirements of HUD's Departmental Policies, Responsibilities and Procedures for Protection and Enhancement of Environmental Quality (38 FR 19182 as amended) or other environmental regulations which may be issued by the Department. The Special Clearance and Environmental Impact Statement (EIS) threshold requirements are hereby modified for all projects proposed in the Normally Unacceptable and Unacceptable noise exposure zones as follows:

(1) *Normally Unacceptable noise zone.* (i) All projects located in the Normally Unacceptable Noise Zone require a Special Environmental Clearance except an EIS is required for a proposed project located in a largely undeveloped area, or where the HUD action is likely to encourage the establishment of incompatible land use in this noise zone.

Berms and barriers are our first choice because they provide protection for yards, playgrounds, etc. Since outdoor activity is often very important to residents we want to protect the outdoor areas as much as possible.

By definition a barrier must be separate from the building or area it is providing attenuation for. After all barriers are preferred because they improve exterior as well as interior levels. Non-noise sensitive buildings can, however, be used as barriers for noise sensitive buildings or exterior areas.

Assumption is that standard construction provides an average of 20 L_{dn} attenuation. At 65 L_{dn} or below this amount of attenuation would be sufficient to meet interior level of 45 L_{dn}. Additional requirements are designed to meet this goal even when exterior noise levels are higher.

Substitute Environmental Assessment (with ECO concurrence) wherever you see Special Clearance.

(ii) When an EIS is required, the concurrence of the Regional Administrator is also required before a project can be approved. For the purposes of this paragraph, an area will be considered as largely undeveloped unless the area within a 2-mile radius of the project boundary is more than 50 percent developed for urban uses and infrastructure (particularly water and sewers) is available and has capacity to serve the project.

(iii) All other projects in the Normally Unacceptable zone require a Special Environmental Clearance, except where an EIS is required for other reasons pursuant to HUD environmental policies.

(2) *Unacceptable noise zone.* An EIS is required prior to the approval of projects with unacceptable noise exposure. Projects in or partially in an Unacceptable Noise Zone shall be submitted through the Regional Administrator to the Assistant Secretary for Community Planning and Development for approval. The Assistant Secretary may waive the EIS requirement in cases where noise is the only environmental issue and no outdoor sensitive activity will take place on the site. In such cases, a Special Environmental Clearance is required.

When the area in question is in a small community outside an SMSA and the application of the 2 mile radius rule would be unreasonable, an area can be considered largely developed if it is contiguous to existing development and infrastructure is available and has capacity to serve the project. The Assistant Secretary will review them on a case-by-case basis. In all other cases the 2 mile radius/50% rule still applies.

§51.105 Exceptions.

(a) *Flexibility for non-acoustic benefits.* Where it is determined that program objectives cannot be achieved on sites meeting the acceptability standard of 65 decibels, the Acceptable Zone may be shifted to L_{dn} 70 on a case-by-case basis if all the following conditions are satisfied:

(1) The project does not require an Environmental Impact Statement under provisions of section 104(b)(1) and noise is the only environmental issue.

(2) The project has received a Special Environmental Clearance and has received the concurrence of the Environmental Clearance Officer.

(3) The project meets other program goals to provide housing in proximity to employment, public facilities and transportation.

(4) The project is in conformance with local goals and maintains the character of the neighborhood.

(5) The project sponsor has set forth reasons, acceptable to HUD, as to why the noise attenuation measures that would normally be required for new construction in the L_{dn} 65 to L_{dn} 70 zone cannot be met.

Caution—every effort should be made to get official contours—particularly for military installations and large air carrier airports rather than trying to use the *Noise Assessment Guidelines*.

What this really means is that the 5db attenuation requirement for the 65–70 L_{dn} zone is waived. Primarily intended for urban areas where alternative sites are not available. Note that *all* conditions must be met.

These requirements are very important. Be careful with design hour values.

(6) Other sites which are not exposed to noise above L_{dn} 65 and which meet program objectives are generally not available.

The above factors shall be documented and made part of the project file.

§51.106 Implementation.

(a) *Use of available data.* HUD field staff shall make maximum use of noise data prepared by others when such data are determined to be current and adequately projected into the future and are in terms of the following:

(1) *Sites in the vicinity of airports.* The noise environment around airports is described sometimes in terms of Noise Exposure Forecasts, abbreviated as NEF or, in the State of California, as Community Noise Equivalent Level, abbreviated as CNEL. The noise environment for sites in the vicinity of airports for which day-night average sound level data are not available may be evaluated from NEF or CNEL analyses using the following conversions to DNL:

DNL ≈ NEF + 35

DNL ≈ CNEL

(2) *Sites in the vicinity of highways.* Highway projects receiving Federal aid are subject to noise analyses under the procedures of the Federal Highway Administration.

Where such analyses are available they may be used to assess sites subject to the requirements of this standard. The Federal Highway Administration employs two alternate sound level descriptors: (a) The A-weighted sound level not exceeded more than 10 percent of the time for the highway design hour traffic flow, symbolized as L_{10}; or (b) the equivalent sound level for the design hour, symbolized as L_{eq}. The day-night average sound level may be estimated from the design hour L_{10} or L_{eq} values by the following relationships, provided heavy trucks do not exceed 10 percent of the total traffic flow in vehicles per 24 hours and the traffic flow between 10 p.m. and 7 a.m. does not exceed 15 percent of the average daily traffic flow in vehicles per 24 hours:

DNL ≈ L_{10} (design hour)—3 decibels

DNL ≈ L_{eq} (design hour) decibels

Where the auto/truck mix and time of day relationships as stated in this Section do not exist, the HUD Noise Assessment Guidelines or other noise analysis shall be used.

(3) *Sites in the vicinity of installations producing loud impulsive sounds.* Certain Department of Defense installations produce loud impulsive sounds from artillery firing and bombing practice ranges. Noise analyses for these facilities sometimes encompass sites that may be subject to the requirements of this standard. Where such analyses are available they may be used on an interim basis to establish the acceptability of sites under this standard.

The Department of Defense uses day-night average sound level based on C-weighted sound level, symbolized L_{Cdn}, for the analysis of loud impulsive sounds. Where such analyses are provided, the 8 decibel addition specified in 51.103(b), is not required, and the same numerical values of day-night average sound level used on an interim basis to determine site suitability for non-impulsive sounds apply to the L_{Cdn}.

(4) *Use of areawide acoustical data.* HUD encourages the preparation and use of areawide acoustical information, such as noise contours for airports. Where such new or revised contours become available for airports (civil or military) and military installations they shall first be referred to the Regional Office (Environmental Clearance Officer) for review, evaluation and decision on appropriateness for use by HUD. The Regional Office shall submit revised contours to the Assistant Secretary of Community Planning and Development for review, evaluation and decison whenever the area affected is changed by 20 percent or more, or whenever it is determined that the new contours will have a significant effect on HUD programs, or whenever the contours are not provided in a methodology acceptable under §51.106(a)(1) or in other cases where the Regional Office determines that Headquarters review is warranted. For other areawide acoustical data, review is required only where existing areawide data are being utilized and where such data have been changed to reflect changes in the measurement methodology or underlying noise source assumptions.

Contours for future noise levels based on new construction, mission changes etc. which become available as part of the Environmental Impact Statement process shall not be used until the NEPA process is complete and a decision on the proposed action is made.

When new or revised contours are approved, make sure all interested people in local area are informed that HUD will be using different contours. Make a special effort to inform the most active developers in area or developers who have worked with HUD before.

This is also required for noise studies for developers by consultants, whether to provide original data, or to contest existing data or a HUD analysis. It is particularly important to make sure the same traffic, vehicle or operational data were used for each study, when one study is being contested.

Requests for determination on usage of new or revised areawide data shall include the following:

(i) Maps showing old, if applicable, and new noise contours, along with brief description of data source and methodology.

(ii) Impact on existing and prospective urbanized areas and on development activity.

(iii) Impact on HUD-assisted projects currently in processing.

(iv) Impact on future HUD program activity. Where a field office has determined that immediate approval of new areawide data is necessary and warranted in limited geographic areas, the request for approval should state the circumstances warranting such approval. Actions on proposed projects shall not be undertaken while new areawide noise data are being considered for HUD use except where the proposed location is affected in the same manner under both the old and new noise data.

(b) *Site assessments.* Compliance with the standards contained in §51.103(c) shall, where necessary, be determined using noise assessment guidelines, handbooks, technical documents and procedures issued by the Department.

(c) *Variations in site noise levels.* In many instances the noise environment will vary across a site, with portions of the site being in an Acceptable noise environment and other portions in a Normally Unacceptable noise environment. The standards in §51.103(c) shall apply to the portions of a building or buildings used for residential purposes and for ancillary noise sensitive open spaces.

(d) *Noise measurements.* Where noise assessments result in a finding that the site is borderline or questionable, or is controversial, noise measurements may be performed. Where it is determined that noise measurements are required, such measurements will be conducted in accordance with methods and measurement criteria established by the Department. Locations for noise measurements will depend on the location of noise sensitive uses that are nearest to the predominant noise source (see §51.103(c)).

(e) *Projections of noise exposure.* In addition to assessing existing exposure, future conditions should be projected. To the extent possible, noise exposure shall be projected to be representative of conditions that are expected to exist at a time at least 10 years beyond the date of the project or action under review.

(f) *Reduction of site noise by use of berms and/or barriers.* If it is determined by adequate analysis that a berm and/or barrier will reduce noise at a housing site, and if the barrier is existing or there are assurances that it will be in place prior to occupancy, the environmental noise analysis for the site may reflect the benefits afforded by the berm and/or barrier.

In the environmental review process under §51.104(b), the location height and design of the berm and/or barrier shall be evaluated to determine its effectiveness, and impact on design and aesthetic quality, circulation and other environmental factors.

This provision should be used with caution. Very clear and strong assurances that berms or barriers will be constructed should be obtained in writing before approval.

Again also note that by definition a barrier must be physically separate from the building or area it is providing attenuation for.

The *Noise Assessment Guidelines* contain procedures for evaluating barrier effectiveness.

Appendix to Subpart B—definition of acoustical quantities

1. *Sound Level.* The quantity in decibels measured with an instrument satisfying requirements of American National Standard Specification for Type 1 Sound Level Meters S1.4–1971. Fast time-averaging and A-frequency weighting are to be used, unless others are specified. The sound level meter with the A-weighting is progressively less sensitive to sounds of frequency below 1,000 hertz (cycles per second), somewhat as is the ear. With fast time averaging the sound level meter responds particularly to recent sounds almost as quickly as does the ear in judging the loudness of a sound.

(2) *Average Sound Level.* Average sound level, in decibels, is the level of the mean-square A-weighted sound pressure during the stated time period, with reference to the square of the standard reference sound pressure of 20 micropascals.

When projections for airports are based on new construction or similar actions the likelihood that such major action will actually take place should be carefully evaluated. This is particularly important if local funding is required. Check to see if initial actions such as land purchases, bonds etc. been taken. If projections are just based on expanded traffic levels make sure they are reasonable for the area. Projections for smaller communities are often overly optimistic.

$$L_{dn} = 10 \log_{10} \left[\frac{1}{86400} \left(\int_{0000}^{0700} 10^{[L_A(t)+10]/10}\, dt + \int_{0700}^{2200} 10^{L_A(t)/10}\, dt + \int_{2200}^{2400} 10^{[L_A(t)+10]/10}\, dt \right) \right]$$

Time t is in seconds, so the limits shown in hours and minutes are actually interpreted in seconds. $L_A(t)$ is the time varying value of A-weighted sound level, the quantity in decibels measured by an instrument satisfying requirements of American National Standard Specification for Type 1 Sound Level Meters S1.4–1971.

3. *Loud Impulsive Sounds.* When loud impulsive sounds such as sonic booms or explosions are anticipated contributors to the noise environment at a site, the contribution to day-night average sound level produced by the loud impulsive sounds shall have 8 decibels added to it in assessing the acceptability of a site.

A loud impulsive sound is defined for the purpose of this regulation as one for which:

(i) The sound is definable as a discrete event wherein the sound level increases to a maximum and then decreases in a total time interval of approximately one second or less to the ambient background level that exists without the sound; and

(ii) The maximum sound level (obtained with slow averaging time and A-weighting of a Type 1 sound level meter whose characteristics comply with ANSI S1.4–1971) exceeds the sound level prior to the onset of the event by at least 6 decibels; and

(iii) The maximum sound level obtained with fast averaging time of a sound level meter exceeds the maximum value obtained with slow averaging time by at least 4 decibels.

Issued at Washington, D.C., on July 5, 1979.

Patricia Roberts Harris,
Secretary of Housing and Urban Development.

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Quiz on the Noise Regulations

Questions

1. What is the HUD policy on support for existing constructon in high noise areas?
2. What is the definition of "major or substantial rehabilitation"?
3. What is HUD's Interior noise goal?
4. What project approval authority does the Field Office have?
5. Who approves projects in the Unacceptable Zone?
6. What noise descriptor is used to express noise levels in the regulation?
7. How are loud impulsive sounds to be evaluated?
8. At what point on a building's exterior are sound levels to be determined?
9. What is the basic assumption behind the attenuation levels required?
10. What type of attenuation measures are preferred?
11. When should building attenuation measures be considered?
12. When are EIS's required?
13. When is an area considered "largely undeveloped"?
14. What is "Flexibility for Non-Acoustic Benefits"?
15. Six conditions are listed for waiving the attenuation requirement under the Flexibility for Non-Acoustic Benefits provision, how many must be met for the waiver to be granted?
16. Who has the authority to grant the attenuation requirements waiver under the "flexibility" provision?
17. What noise descriptors other than DNL are acceptable for aircraft noise contours?
18. Who normally approves areawide noise data such as airport noise contours?
19. If a site is partially in the Unacceptable Zone and partially in the Normally Unacceptable Zone, which review and approval procedures apply?
20. When should noise measurements be used in lieu of areawide data or *Noise Assessment Guidelines* calculations?

Quiz on the Noise Regulations

Answers

1. Noise exposure can not, by itself, be the basis for denying support for resale and purchase of existing buildings. (Section 51.101(a)(4))
2. "Major or substantial rehabilitation" is defined in individual program guidance. There is no single definition. (51.101(a)(5) marginal note)
3. 45 L_{dn} (Section 51.101(a)(9))
4. projects in Acceptable Zone; also projects in Normally Unacceptable Zone provided that
   - adequate sound attenuation is provided
   - no EIS is required

   (Section 51.102(a)(1))
5. The Assistant Secretary for Community Planning and Development.

   (Section 51.102(A)(3) and 51.104(b))
6. The day night average sound level system (DNL). (Section 51.103(a))
7. Two ways:
   - If plain DNL levels have been calculated or measured, add a 8 decibel penalty.
   - Alternatively, the C weighted day night average sound level system (L_{Cdn}) can be used as is.

   (Section 51.103(b))
8. Two meters (6.5 feet) away from the building exterior, moving towards the predominant noise source.

   (Section 51.103(c))
9. That current construction practices provide about 20 db attenuation. Thus in a 65 L_{dn} or lower area the interior goal of 45 L_{dn} would be met with standard construction. The additional attenuation required is the increment over that provided by standard construction necessary to achieve the interior goal of 45 L_{dn}. (Section 51.104(a) marginal note)
10. Measures which reduce **exterior** noise levels. (51.104(a))
11. Only after it has been determined that berms and barriers or site redesign are not practical alternatives. (Section 51.104(a))
12. When the project is located in the Unacceptable Zone or the project is located in a largely undeveloped area and the project is in the Normally Unacceptable Zone.

    (Section 51.104(b))
13. When the area within a 2 mile radius of the project is less than 50% developed for urban uses and infrastructure is not in place and available to serve the project. (Section 51.104(b)(1)(ii))
14. A provision in the regulations which allows the attenuation requirements for the 65–70 L_{dn} zone to be waived. (Section 51.105(a) and marginal note)
15. **All** six conditions must be met. (Section 51.105(a))
16. The field office. (Section 51.102(a))
17. NEF and CNEL. (Section 51.106(a)(1))
18. The Regional Office. (Section 51.106(a)(4))
19. The review and approval procedures for projects in the Unacceptable Zone apply. (Section 51.104(b)(2))
20. Only when the noise assessment indicates that the site is on the borderline between Acceptable and Unacceptable, or when the site is controversial. (Section 51.106(d))

Chapter 3

Major Policy and Implementation Questions Related to the Noise Regulation

As regulations are applied in the field, it is inevitable that questions will arise. It is, after all, very difficult to anticipate every situation when preparing a regulation. Sometimes the questions relate to specific and unique situations of limited interest to anyone but the office involved. Other questions, however, raise issues of more general concern. In this section we have brought together the most important and most relevant questions that have arisen since the noise regulation went into effect in August of 1979. We have used a question and answer format for your convenience.

The following are the topics included:

1. Noise projections for civil airports
2. Definition of infill for small towns
3. Areawide EIS waivers
4. Requirements for modernization and rehabilitation projects
5. Use of berms and barriers as attenuation measures
6. New and revised airport noise contours

Questions and Answers

1. How valid and useful are civil airport noise projections that show significant reductions in the amount of land exposed to high noise levels? Should we be suspicious?

Contours that show significant reductions in the area exposed to high noise levels may seem questionable, but, according to the Environmental Protection Agency, they may be quite accurate. The EPA does expect to see some significant reductions in the number of people exposed to high levels of aircraft noise over the next 15 years. In their report *Aviation Noise: The Next Twenty years*, EPA stated that they expected to see the number of people exposed to levels of 65 Ldn or greater to drop from a 1975 figure of 5,550,000 to about 2,650,000 in the year 2000. Much of this reduction would occur during the period 1980–1985 with more modest decreases thereafter. The reductions are expected to result from the Federal Aviation Administration's current noise certification requirements, even with up to 100% increases in aircraft operations. (Current certification requirements are for all new aircraft to achieve stage three noise levels and all older aircraft to achieve stage two levels by 1985. Progress has been good in meeting these requirements.)

In general then, you should not be surprised to see significant reductions in contour size if the following conditions are met:

- the decrease in size is no more than 50%;
- the increase in operations is no more than 100%; and
- FAR stage 3 aircraft, such as the B757 and B767, are included in the fleet mix, but not to the total exclusion of all other aircraft.

Assuming that the contours are otherwise technically correct, significantly smaller contours should be acceptable.

2. Many small towns aren't big enough for a project to meet the definition of infill contained in section 51.104 (b)(1)(ii). However, a project located in the heart of town can hardly be considered to be in a largely undeveloped area. Must an EIS be prepared?

Not necessarily. If the jurisdiction in which the project is located is not part of a standard metropolitan area, a project may be considered infill if it is within or contiguous to the already developed area and infrastructure (particularly water and sewer) is available and has the capacity to serve the project. It must also be clear that the project will not encourage the establishment of other incompatible land uses in the normally unacceptable noise zone.

If you believe a project meets these criteria, submit documentation to the Office of Environment and Energy for their review and determination.

3. What can we do to reduce the procedural burden when, for a variety of reasons, the Department expects to be considering a number of projects in an unacceptable noise zone? Most of the projects would probably qualify for an EIS waiver, but how can we avoid filling repetitive, individual requests?

While the number of cases where the Department would be seriously considering a number of projects exposed to unacceptable noise levels in the same jurisdiction is likely to be limited, there is an alternative to individual processing in those situations. The alternative is to issue an areawide waiver for the entire affected jurisdiction. Such a waiver can be useful when the unacceptable noise zone heavily impacts a substantially developed community with limited site alternatives. (In most cases we would expect that the noise source would be aircraft, but in very small towns it is possible that a heavily used rail line could create a large unacceptable noise zone.)

An areawide EIS waiver would, of course, have to have a more detailed environmental assessment than an individual project request, and there are other special processing steps.

But if you have a situation where you think the Department has a good reason to expect to process a number of projects within the unacceptable noise zone, there is an alternative to individual EIS waivers. Contact the Office of Environment and Energy for details on how to request the areawide waiver.

4. What exactly are the processing requirements and general policies for modernization and rehabilitation projects? Does secton 51.104 apply to them as well as to new construction? The noise regulation is a bit confusing on this.

Yes, the noise regulation is a bit confusing on this question. We have seen several instances where field offices have mistakenly applied the provisions of Section 51.104 to modernization and rehabilitation projects. We believe that this happens because section 51.104 is not as clearly titled as it might have been. It would be better if it read "special requirements for new construction" rather than simply "special requirements".

The only parts of the regulation that apply to modernization and rehabilitation projects are sections 51.101 (a)(5) and the definitions of normally unacceptable and unacceptable noise zones contained in the table in section 51.103. None of the other proessing or policy provisions of the table or of sections 51.102 and 51.104 apply. Therefore:

- modernization and rehabilitation projects are to be processed by the field offices regardless of the noise zone.
- EIS's are not required for modernization and rehabilitation projects unless mandated by other applicable environmental regulations.

You must however continue to encourage attenuation features in modernization and rehabilitation projects, in accordance with the general policy stated in section 51.101(a)(5).

5. We know that berms and barriers are the preferred type of noise attenuation because of the protection they provide for outdoor living areas, but we need some further guidance on when they are really the best choice.

While barriers can be an effective noise attenuation technique, they must, indeed, be used with caution and common sense because they can create more problems than they solve. Very high noise barriers can create significant aesthetic and financial problems relative to the noise benefit to be achieved. Barriers can block light, hinder natural ventilation, create an unpleasant sense of being walled in, and can be very unattractive. In addition, barriers do require continuing maintenance and can be very costly to build.

It is important to remember that the noise regulation says that "measures that reduce external noise at a site shall be used **wherever practicable.**" Is it practicable to propose a 20 foot high barrier only 15 feet from the rear of a two-story building? Granted it would certainly protect the building from noise, but what about the blocked light, the reduced ventilation, the visual impact, and the cost? The purpose of a barrier is primarily to reduce the noise levels in those outdoor areas that people use. The secondary purpose is to reduce the need for structural attenuation. Therefore, the barrier should only be as high as is necessary to protect those areas. Structural attenuation should be required for the parts of the building not protected by the barrier. And if there aren't any outdoor areas where low noise levels are important, barriers shouldn't be required unless they would be more cost effective than building attenuation measures.

6. What should we be doing once we have processed new or revised aircraft noise contours and they have been approved for use?

The most important thing you can do once new or revised aircraft noise contours have been approved for use is to tell the people who are most likely to be affected by the change. If you have a newsletter that you regularly publish, that is one way to get the word out. At the very least you should specifically notify the affected jurisdictions and the builders/developers who are known to be active in the vicinity of the noise impacted areas. Make sure you notify builders and developers who have large scale projects that you have been processing in sections. Go back and check your files to find them. Even though you should have done an overall environmental review of the project at the time the first section was submitted, the approval of individual sections is dependent on the noise levels at the time that section is submitted.

Chapter 4

Noise Attenuation

Introducton

HUD's noise policy (24 CFR 51B) clearly requires that noise attenuation measures be provided when proposed projects are to be located in high noise areas. The requirements set out in Section 51.104(a) are designed to insure that interior levels do not exceed the 45 L_{dn} level established as a goal in Section 51.101(a)(9). Thus, in effect, if the exterior noise level is 65 L_{dn} to 70 L_{dn}, 25 db of noise attenuation must be provided; if the exterior noise level is between 70 and 75 L_{dn}, then 30 db of attenuation is required. Likewise, for projects proposed for areas where noise levels exceed 75 L_{dn}, sufficient attenuaton must be provided to bring interior levels down to 45 L_{dn} or below.

There are three basic ways to provide the noise attenuation required:

1. the use of barriers or berms
2. site design
3. acoustical construction

Of these, only the first two provide any improvement in the exterior environment. Because HUD considers a quiet exterior environment to be important, we prefer the use of those measures that reduce exterior levels as well as interior levels. The use of acoustical construction by itself is, therefore, the least preferred alternative since it only affects the interior levels. While we recognize that in many cases barriers or site design cannot provide all the attenuation necessary, you should combine them with acoustical construction whenever possible.

Your responsibility as a HUD staff member is to:

- make sure the project sponsor or developer is aware of the attenuation requirements for the project.
- make the sponsor aware of the options available

and

- review attenuation proposals to make sure they are adequate.

While it is not your responsibility to provide detailed design assistance to the sponsor or developer, you should know enough about the attenuation options to give him or her a basic understanding of what must be done. In many cases, you may be able to reassure the sponsor or developer that the necessary attenuation can be achieved through the use of common construction techniques or materials. Or you may be able to point out how a simple site design change can achieve the desired result without additional cost.

The following sections are designed to provide you with the information you will need to fulfill your responsibilities. Each attenuation approach is discussed both in terms of basic concepts and in terms of what to look for in reviewing attenuation proposals. The discussion does assume that you have a working knowledge of the *Noise Assessment Gujidelines*. If you have not worked with the *Guidelines* before or not recently you may want to go back and review them, particularly the section on calculating the effects of barriers.

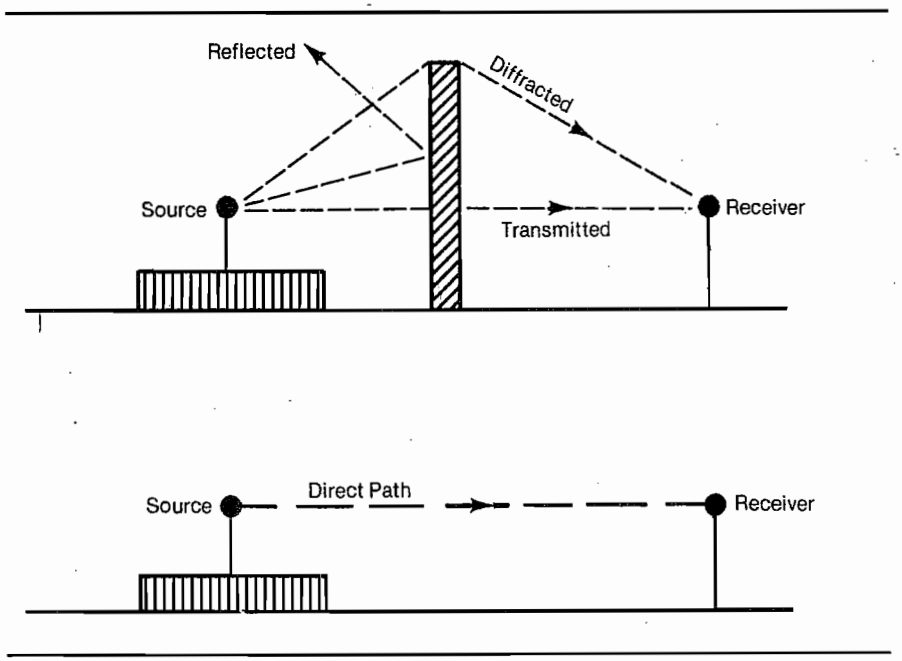
Barrier Noise Reduction Concepts

(The following, with some editing and with some additional graphics, is taken from the Federal Highway Administration's *Noise Barrier Design Handbook*.[1])

When no obstacles are present between [a source] and adjoining areas, sound travels by a **direct** path from the "sources"... to [the] "receivers"..., as shown in Figure 1. Introduction of a barrier between the source and receiver redistributes the sound energy into several [indirect] paths: a **diffracted** path, over the top of the barrier; a **transmitted** path, through the barrier; and a **reflected** path, directed away from the receiver. These paths are also illustrated in Figure 1.

[1] *Noise Barrier Design Handbook* US Department of Transportation, Federal Highway Administration, February 1976. (FHWA-RD-76-58).

Figure 1
Alteration of Noise Paths by a Barrier



Barrier Diffraction and Attenuation

Consider an infinitely long, infinitely massive noise barrier placed between a highway and the receiver. Figure 2 illustrates a cross-section through such a configuration. [In] this example, the only way that sound can reach the receiver is by bending over the top of the barrier; as shown in the figure. The bending of sound waves in this manner over an obstacle is known as diffraction. The area in which diffraction occurs behind the barrier is known as the "shadow zone." The straight path from the source over the top of the barrier forms the boundary of this zone.

All receivers located in the shadow zone will experience some sound attenuation; the amount of attenuation is directly related to the magnitude of the diffraction angle ϕ. As ϕ increases, the barrier attenuation increases. The angle ϕ will increase if the barrier height increases, or if the source or receiver are placed closer to the barrier. Clearly then the barrier attenuation is a function of the geometrical relationship between the source, receiver, and barrier. One way of relating these parameters to the barrier attenuation is to define the path-length difference as shown in Figure 3. This parameter is the difference in distance that the sound must travel in diffracting over the top of the barrier rather than passing directly through it.

In the preceding discussion it was assumed that the barrier was "infinite"; i.e., long enough to shield the receiver from all sound sources up and down the highway. For short barriers, the attenuation can be seriously limited by the sound from sections of highway beyond the barrier's ends, which are unshielded from the receiver, as shown in Figure 4. Similarly, when there are large gaps in the barrier (to permit access, for example), sound from the unshielded section of highway adjacent to the gap can greatly compromise barrier attenuation, especially for those receivers close to the opening.

Figure 2
Barrier Diffraction

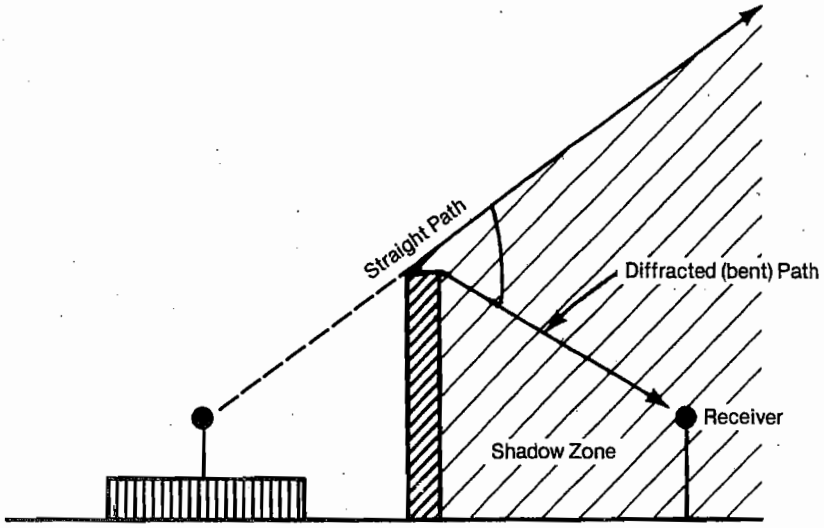


Figure 3
Path Length Difference $\delta = A + B - d$

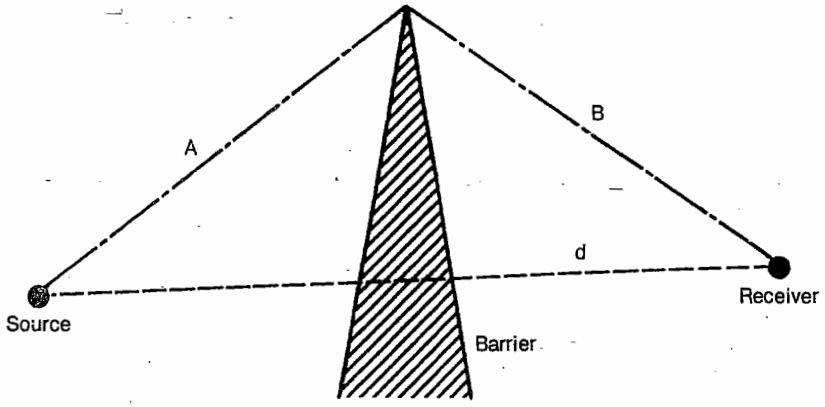
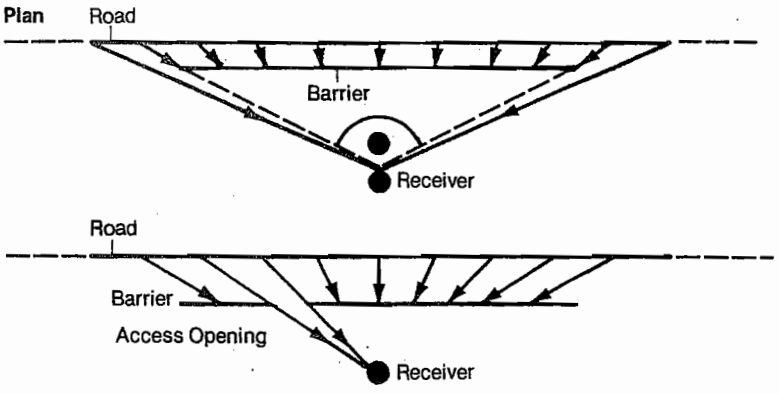


Figure 4
Short-circuit of Barrier Around Ends and Through Openings



It should be mentioned that the use of barrier walls with sloped sides (forming angles of grater than 10–15 degrees from the vertical) will also generally eliminate multiple reflections. Use of earth berms is particularly appropriate to accomplish this. Sloped barrier walls will require more material to achieve a desired height than a vertical wall, while berms will require greater right-of-way than a thin wall.

Ground Effects

Consider again the direct path of sound from the source to receiver as illustrated in Figure 1 in the absence of any obstacles. For sources and receivers located close to the ground, in addition to this direct path sound energy may reach the receiver by reflecting off the ground. When the terrain is relatively hard and flat, such a reflection will add to the noise from the direct path to increase the level at the receiver. However, when the ground is soft, there may be a phase reversal upon reflection such that the noise from the ground reflection path will destructively interfere with the noise from the direct path resulting in a significant reduction in noise levels at the receiver.

This reduction in level, known as ground-effect attenuation, is in excess of the 3 dB per doubling of distance propagation loss for a line source of noise and occurs only above soft absorptive ground (such as normal earth and most ground with vegetation). Over hard ground (such as concrete, stone and very hard-packed earth) these effects do not occur. These effects are most apparent for receivers on the ground floor, and decrease rapidly as receiver height above ground increases.

While ground absorption effects are not completely understood, it is generally believed that these effects account for the 4.5 dB per doubling of distance propagation loss observed over soft ground, as compared to the 3 dB propagation loss observed over hard ground. The implication with regard to barrier design is that placement of a barrier over soft ground between source and receiver will re-direct the sound over the top of the barrier, thus destroying the ground reflection and the additional 1.5 dB per doubling of distance attenuation. Thus, the barrier must be designed to provide more reduction than would otherwise be necessary, to compensate for the lost ground effects over absorptive ground.

Summary

(From: *Design Guide*, National Bureau of Standards[1])

In summary, the following can be said about noise barriers.

- If a barrier does not block the line-of-sight between the source and receiver, the barrier will provide little or no attenuation.
- If a barrier is constructed of a material with a surface weight density greater than 4 lb/ft^2 and there are no openings through the barrier, transmitted sound will usually be negligible.
- If there are openings totaling over 10 percent or more of the barrier area, barrier attenuation will be negligible.
- Diffracted sound is usually the most important aspect in estimating barrier attenuation.
- Reflected sound can be important for receivers on the source side of a barrier, but it normally is not a factor for receivers on the side opposite from the source. Hence reflected sound is usually not important to your building and site.
- Transmission of sound around the ends of the barrier can be critical if the barrier included angle is less than 170°.
- Barrier attenuations greater than an A-weighted sound level difference of 10 dB are difficult to obtain.
- For two or more barriers "in series," consider only the "dominant" barrier.
- Assume no attenuation for a receiver located beyond the end of a barrier.

Reviewing Barrier Proposals

An effective barrier is one which reduces the noise level behind the barrier to 65 L_{dn} or lower. If a barrier can reduce the exterior noise level to 65 L_{dn}, then standard construction techniques should be sufficient to insure an interior level of 45 L_{dn} or below. Therefore, if you determine that a proposed barrier is adequate to reduce the exterior noise level to 65 L_{dn} then no additional attenuation measures should be necessary.

There are four things to check when determining the adequacy of a proposed barrier:

1. Is it high enough?
2. Is it long enough?
3. Is it made of the right materials?
4. Is it properly constructed?

Is it High Enough?

In order for a barrier to be effective it must be at least high enough to break the line of sight between the source and the receiver. In the *Noise Assessment Guidelines* you will find the procedure for determining how much attenuation is provided by a barrier of a given height.

In general, barriers and berms are most effective for one and two story buildings because a relatively low barrier can often provide the attenuation needed. The height that might be required to provide attenuation for much taller buildings is often not feasible for either cost or aesthetic reasons. However, even if a barrier can not be made high enough to attenuate the upper floors of a multistory building, it may still be able to provide some protection for outdoor recreational areas. Before discarding the barrier idea check for this possibility.

If you find that the barrier as proposed is too short to be effective but the sponsor or developer tells you that he or she can not make the barrier any higher, there are some alternatives you can suggest. There are ways to get more attenuation out of each foot of overall height.

As a general rule, barriers work better the closer they are to the source. Figure 6 shows a barrier that does not block the line of sight at all when it is located next to the receiver, yet is quite tall enough when located next to the source. Thus, if the sponsor or developer can not make the barrier any taller, perhaps he or she can move it closer to the source.

Another way to get more attenuation without increasing overall barrier height is to bend the top of the barrier towards the source. Figure 7 shows a case where a barrier built perfectly straight provides 8 dB of attenuation. A barrier with the same overall height but with a 45 degree bend towards the source provides 9.5 dB of attenuation. Thus if the project sponsor or developer wants to keep the overall height of the barrier down, he or she can still increase the attenuation provided simply by bending the top.

[1] *Design Guide for Reducing Transportation Noise in and Around Buildings*, US Department of Commerce, National Bureau of Standards, April 1978. (Building Science Series 84)

Figure 6
Effect of Moving the Barrier Closer to the Source

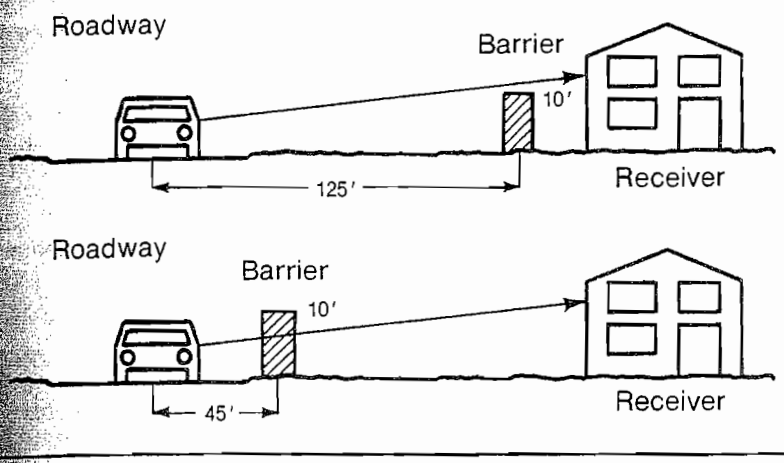
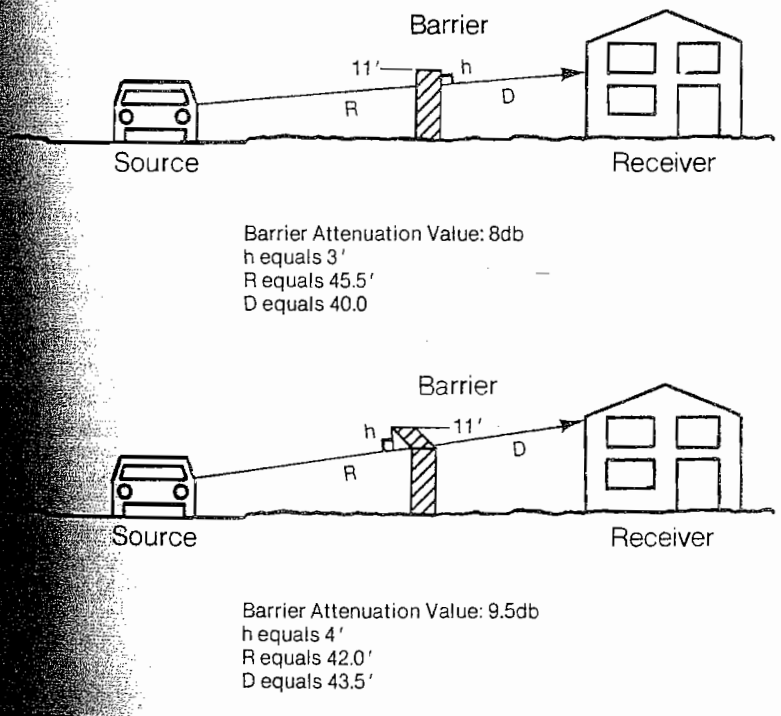


Figure 7
Effect of Bending the Top of the Barrier Towards the Source



Thus, if your review of a proposed barrier shows it to be too short, but it can not be made any higher, suggest that the barrier be moved closer to the source or that it be bent at the top, or both.

Is It Long Enough?

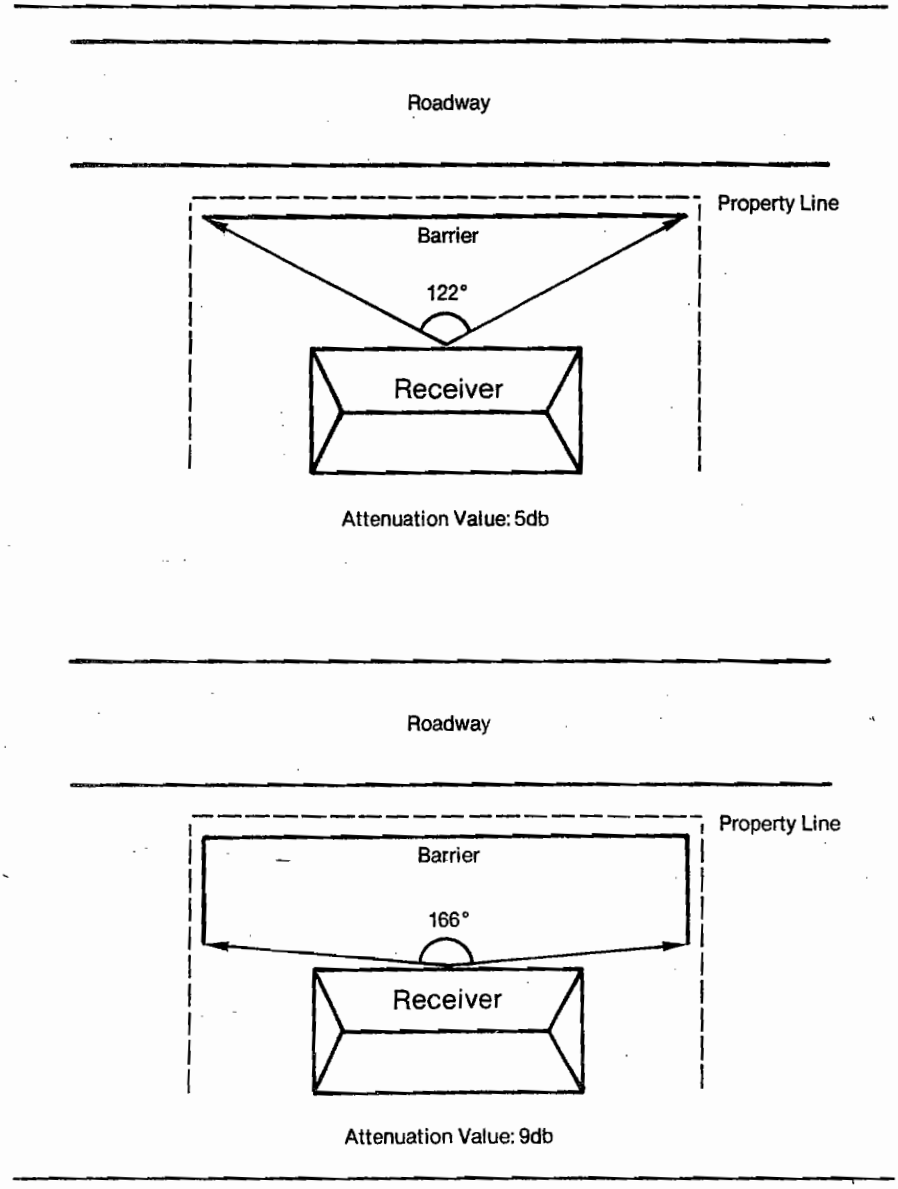
Once you have established how much attenuation the barrier provides due to its height, you must determine if the length of the barrier compromises that attenuation level. Again, *the Noise Assessment Guidelines* contain a procedure for calculating the effect of barrier length.

If you find that the barrier is too short but that there are limitations on how long it can be made, there are, as there were with barrier heights, some recommendations you can make on how to improve the effectiveness of the barrier.

Again, if you bend the edges of the barrier, this time towards the **receiver** not the source, you will increase the effectiveness of the barrier. Figure 8 shows how much a barrier's effectiveness can be improved by bending the edges.

You can also improve the effectiveness of the barrier by moving it closer to the receiver. Figure 9 shows how much a barrier's effectiveness can be increased by moving it closer to the receiver. Now obviously, this creates a conflict with what we said earlier about moving the barrier closer to the source. Clearly each case will require a different compromise. If height is not a limiting factor but length is, you might recommend to the project sponsor or developer that the barrier be moved closer to receiver and the height increased as necessary. If the reverse is true, you would want to recommend the opposite. If both height and length are limited, then the sponsor or developer must find that optimum point where the effeciveness of both the barrier height and the barrier length is as high as possible.

Figure 8
Effect of Bending the Edges of Barrier Towards Receiver
(Both Barriers have Potential Value of 10db)



Is It Made of The Right Materials?

Even if a barrier is high enough and long enough, its effectiveness can be severely reduced if it is made up of lightweight materials that easily transmit sound waves. In the preceding section on barrier concepts we talked about how if the transmission loss value for the barrier material was not at least 10 db higher than the attenuation value of the barrier based on length and height there would be a significant reduction in the effectiveness of the barrier.

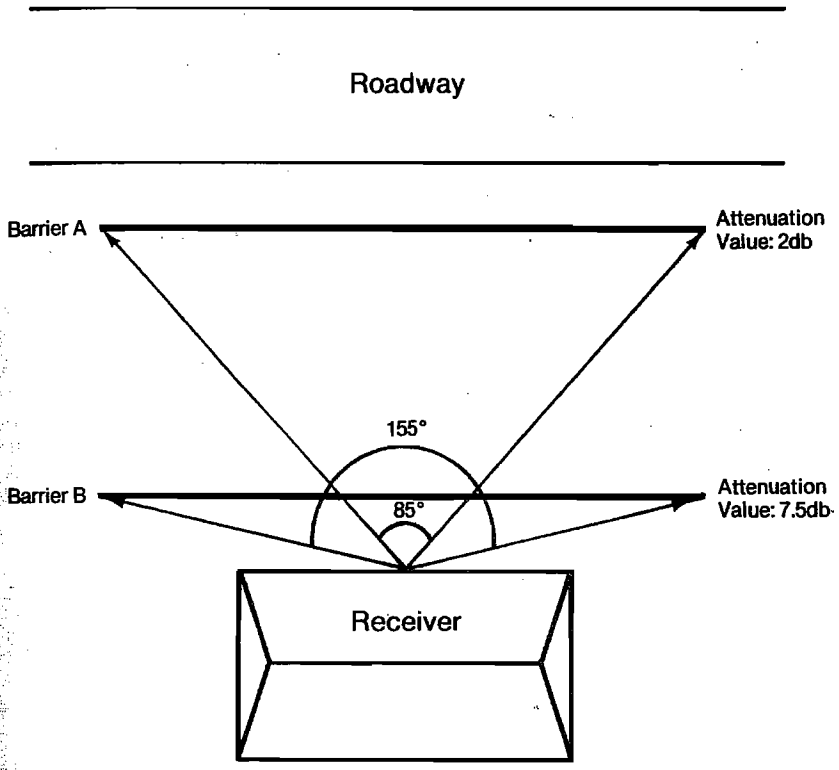
Therefore, once you have calculated the basic attenuation potential of the barrier, you must check to make sure the proper material is being used to build the barrier. Table 1 lists the transmission loss values for materials commonly used in barrier construction. Once you have found the transmission loss value for the material being used, go to Table 2. Read down the column with the transmission loss for the material at its top and across the line that has the attenuation potential for the barrier listed. Where the two intersect you will find the actual attenuation capability of the barrier.

If you find that the choice of material has severely reduced the effectiveness of the barrier, you should recommend that the sponsor or developer select another material.

Is It Properly Constructed?

Holes or openings can substantially reduce the effectiveness of a barrier. A barrier that has openings totaling 50% or more of its total area will provide no attenuation. A barrier that has openings totaling 10% of its total area has a maximum attenuation value of approximately 4db. That is 4db no matter how high, how long or how thick the barrier. So you can see that it is very important that the barrier is made of solid materials and that it is tightly constructed. In general the intended openings in a barrier should equal no more than 1% of total area and the construction specifications should require that all joints are tightly sealed.

Figure 9
Effect of Moving Barrier Closer to Receiver



A Final Note

One thing should have become clear to you as you have been reading this section, and that is that in order for you to adequately review a project sponsor or developer's proposed barrier you must be given fairly specific information about the exact dimensions of the proposed barrier, the type and thickness of the barrier material, and the exact design of the barrier including construction specifications. Without this information you will be unable to do any more than a cursory evaluation, an evaluation that could be far from accurate. Make sure you make it clear to the developer or sponsor what you need to have.

Table 1
Transmission Loss Value for Common Barrier Materials

Material	Thickness, (Inches)	Transmission Loss, dBA (1)
Woods		
	1/2	17
	1	20
	2	24
	1/2	16
	1	19
	2	23
Plywood	1/2	16
	1	19
	2	23
	1/2	15
	1	18
	2	22
Plywood	1/2	20
	1	23
Particle Board	1/2	20
Metals		
Aluminum	1/16	23
	1/8	25
	1/4	27
	24 ga	18
	20 ga	22
	16 ga	15
	1/16	28
Concrete, Masonry, etc.		
Light Concrete	4	36
	6	39
Dense Concrete	4	40
Concrete Block	4	32
	6	36
Cinder Block (Hollow Core)	6	28
Brick	4	33
Granite	4	40
Composites		
Aluminum Faced Plywood	3/4	21-23
Aluminum Faced Particle Board	3/4	21-23
Plastic Lamina on Plywood	3/4	21-23
Plastic Lamina on Particle Board	3/4	21-23
Miscellaneous		
Glass (Safety Glass)	1/8	22
	1/4	26
Plexiglass (Shatterproof)		22-25
Masonite	1/2	20
Fiberglass/ Resin	1/8	20
Stucco on Metal Lath	1	32
Polyester with Aggregate Surface	3	20-30

[1]A-weighted TL based on generalized truck spectrum. Source: *Noise Barrier Design Handbook*, FHWA

Table 2
Noise Reduction of a Barrier as a Function of its Transmission Loss

Designed Attenuation, dB (from height) and length)	Tramission Loss, dB of Materials				
	10	15	20	25	30
5	3.8	4.6	4.9	5.0	5.0
6	4.5	5.5	5.8	6.0	6.0
7	5.2	6.4	6.8	6.9	7.0
8	5.9	7.2	7.7	7.9	8.0
9	6.5	8.0	8.7	8.9	9.0
10	7.0	8.8	9.6	9.9	10.0
11	7.5	9.5	10.5	10.8	11.0
12	7.9	10.2	11.4	11.8	11.9
13	8.2	10.9	12.2	12.7	12.9
14	8.5	11.5	13.0	13.7	13.9
15	8.8	12.0	13.8	14.6	14.9
16	9.0	12.5	14.5	15.5	15.8
17	9.2	12.9	15.2	16.7	16.8
18	9.4	13.2	15.9	17.2	17.7
19	9.5	13.5	16.5	18.0	18.7
20	9.6	13.8	17.0	18.8	19.6

Source: *Noise Barrier Design Handbook, FHWA*

Acoustical Site Planning Concepts

(This section, with some editing, is from *The Audible Landscape*, FHWA.[1])

The arrangement of buildings on a site can be used to minimize noise impacts. If incompatible land uses already exist, or if a noise sensitive activity is planned, acoustical site planning often provides a successful technique for noise impact reduction.

Many site planning techniques can be employed to shield a residential development from noise. These can include:

1. increasing the distance between the noise source and the receiver;
2. placing noise compatible land uses such as parking lots, maintenance facilities, and utility areas between the source and the receivers. Playgrounds and parks are not necessarily noise compatible activities.
3. locating barrier-type buildings parallel to the noise source or the highway; and
4. orienting the residences away from the noise.

The implementation of many of the above site planning techniques can be combined through the use of cluster and planned unit development techniques.

Distance

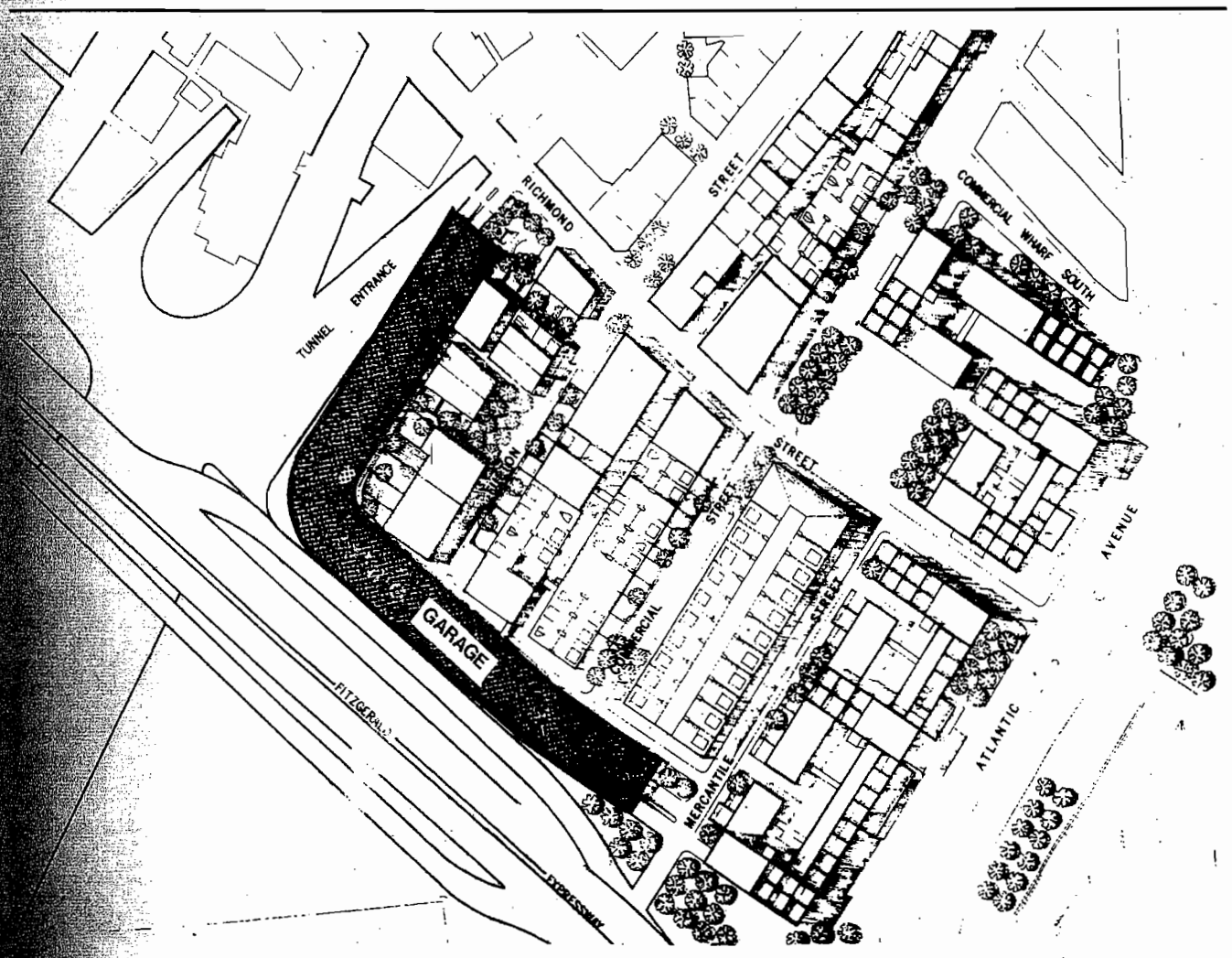
Noise can be effectively reduced by increasing the distance between a residential building and a highway. Distance itself reduces sound: doubling the distance from a noise source can reduce its intensity by as much as 3 dBA. In the case of highrise buildings, distance may be the only means, besides acoustical design and construction, of reducing noise impacts. This is because it is nearly impossible to provide physical shielding for the higher stories from adjacent noise.

Noise Compatible Land Uses as Buffers

Noise protection can be achieved by locating noise-compatible land uses between the highway and residential units. Whenever possible, compatible uses should be nearest the noise source. Figure 10 shows a proposed parking garage along two sides of a development in Boston. Both the

[1] *The Audible Landscape: A Manual for Highway Noise and Land Use*, US Department of Transportation, The Federal Highway Administration, November 1974. (GPO Stock Number: 5000-00079.)

Figure 10
Use of a Parking Garage to Shield a Residential Area



Fitzgerald Expressway and the entrance to the Callahan Tunnel which are shown on the site plan are major and noisy traffic routes. In addition to protecting the residential development from the noise and dirt of highway traffic, the parking garage provides needed facilities for the residents.

Buildings as Noise Shields

Additional noise protection can be achieved by arranging the site plan to use buildings as noise barriers. A long building, or a row of buildings parallel to a highway can shield other more distance structures or open areas from noise.

If the building being used as a barrier is sensitive to highway noise, the building itself must first be soundproofed. This technique was used in a housing project in England where a 3,900 foot long, 18 foot wide and 45-70 foot high wall (depending on the terrain) serves as both residence and a sound shield. The wall/building will contain 387 apartments in which the kitchens and bathrooms are placed towards the noise, and the bedrooms and living rooms face away from the highway. The wall facing the highway will be soundproofed and windows, when they exist, are sealed. Substantial noise reductions are expected.

Orientation

The orientation of buildings or activities on a site affects the impact of noise, and the building or activity area may be oriented in such a way as to reduce this impact.

Noise impacts can be severe for rooms facing the roadway since they are closest to the noise source. The noise impact may also be great for rooms perpendicular to the roadway because (a) the noise pattern can be more annoying in perpendicular rooms and (b) windows on perpendicular walls do not reduce noise as effectively as those on parallel walls because of the angle of the sound. Road noise can be more annoying in perpendicular rooms because it is more extreme when it suddenly comes in and out of earshot as the traffic passes around the side of the building, rather than rising and falling in a continuous sound, as it would if the room were parallel to passing vehicles.

Whether the noise impact is greater on the perpendicular or the parallel wall will depend on the specific individual conditions. Once the most severely impacted wall or walls are determined, noise impacts may be minimized by reducing or eliminating windows from these walls.

Buildings can also be oriented on a site in such a way as to exploit the site's natural features. With reference to noise, natural topography can be exploited and buildings placed in low noise pockets if they exist. If no natural noise pockets exist, it is possible to create them by excavating pockets for buildings and piling up earth mounds between them and the noise. Such a structure would obstruct the sound paths and reduce the noise impacts on the residences.

Cluster and Planned Unit Development

A cluster subdivision is one in which the densities prescribed by the zoning ordinance are adhered to but instead of applying to each individual parcel, they are aggregated over the entire site, and the land is developed as a single entity. A planned unit development, or P.U.D., is similar but changes in land use are included, such as apartments and commercial facilities in what would otherwise be a single-family district.

From Figure 11 it can be seen how the conventional grid subdivision affords no noise protection from the adjacent highway. The first row of houses bears the full impact of the noise. In contrast, the cluster and P.U.D. techniques enable open space and commercial uses respectively to serve as noise buffers. Examples of this are shown in Figures 12 and 13. A word of caution is necessary: in a cluster development, the required open space can be located near the highway to minimize noise to the residences. However, many recreation uses are noise sensitive, and when one takes advantage of the flexibility of cluster development to minimize noise, care must be taken not to use all of the available open space in

Figure 11
Conventional Grid Subdivision

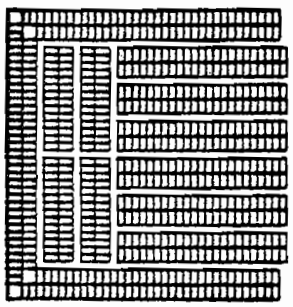
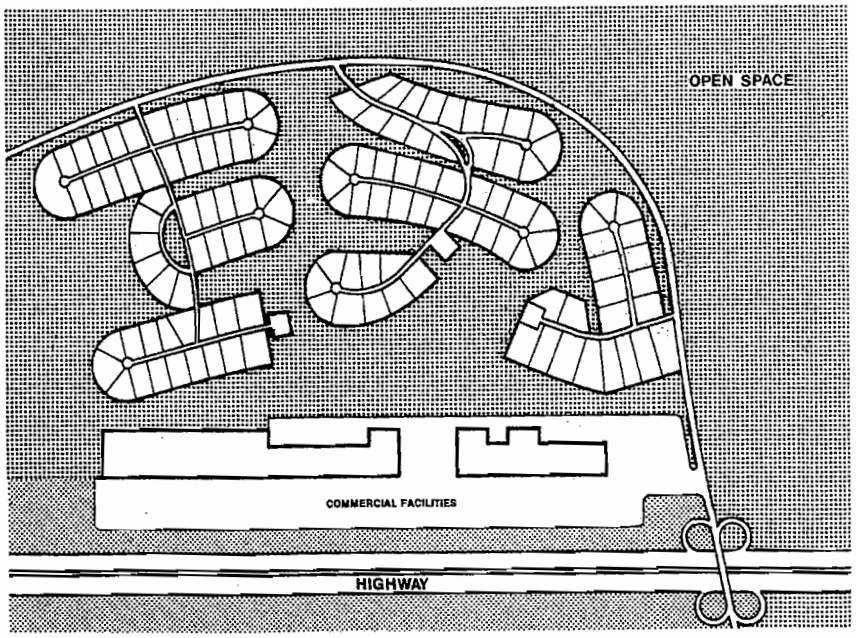


Figure 12
Placement of Noise Compatible Uses Near a Highway in a PUD



buffer strips, thus depriving the development of a significant open space area. Where high noise levels exist, a combination of buffer strips and other techniques (such as berms and acoustical sound proofing) can be employed.

The flexibility of the cluster and planned unit development techniques allows many of the above site planning techniques to be realized and effective noise reduction achieved.

Reviewing Site Plans

There are two main things to check when reviewing site plan changes to determine if the revised site plan provides adequate attenuation for the noise sensitive uses:

1. Is the separation between the source and the receiver great enough?
2. If noise-compatible buildings are being used as barriers for other buildings, are they adequate barriers, i.e. are they long enough and are they high enough? (And, if the buildings being used as barriers contain noise sensitive activities, have the buildings been properly soundproofed.)

In order to determine whether the proposed site plan changes will provide adequate separation between the source and the receiver, you simply go back to the *Noise Assessment Guidlines* procedures. You can use the *Guidelines* both to determine if the proposed separation distance is sufficient or to determine the necessary separation distance. You should at this point check to make sure that the uses being located in the "buffer zone" between the source and the receiver are indeed noise compatible uses. If parks or playgrounds are located in the buffer zone, make sure they are not the only ones associated with the project.

To determine whether the noise compatible buildings being proposed as barriers are adequate, you simply use the procedures outlined in the preceding section. Determine whether the building is high enough to properly break the line of sight between the receiver and the source. Then determine if the building is long enough. It is not necessary to check to make sure it is made of the proper materials or that it is properly constructed since the building will be inherently thick enough not to have any problems. Again, however, if the building being proposed as a barrier contains noise sensitive uses you must first verify that it is properly soundproofed. (See the next section for guidance on acoustical construction.) If the building is not properly soundproofed then it can not be used as a barrier for other buildings.

As you review the site plan check to see that the building locations will not aggravate noise problems. Figure 14 shows how building arrangement can make the noise problem worse.

Figure 13
Open Space Placed Near a Highway in a Cluster Development

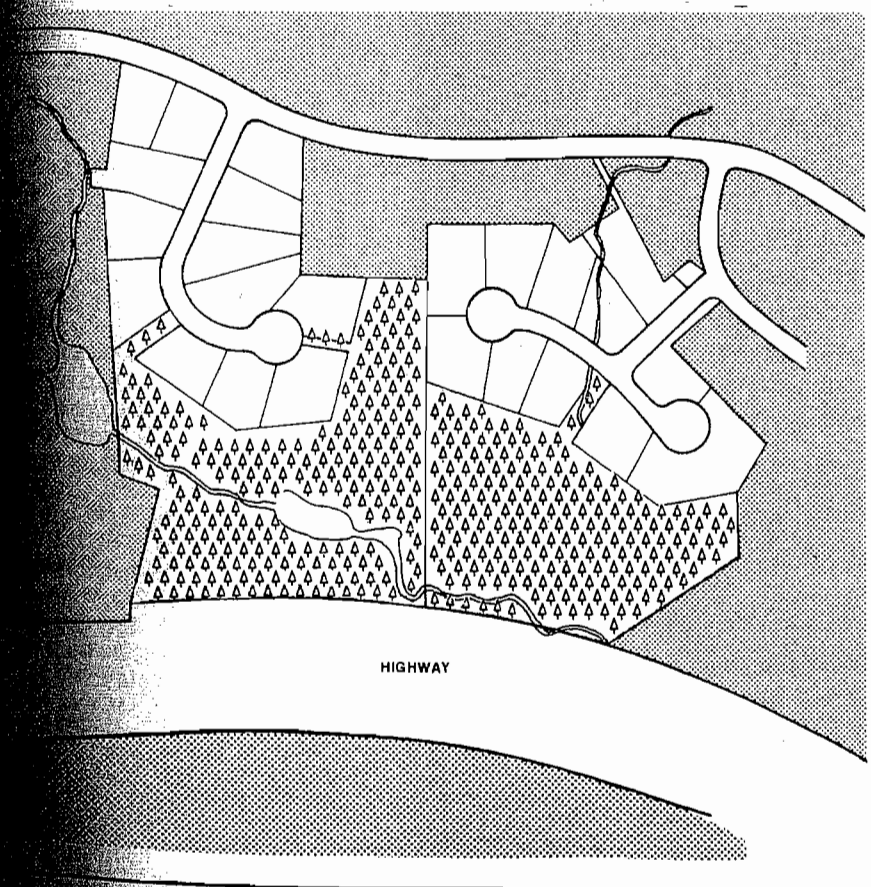
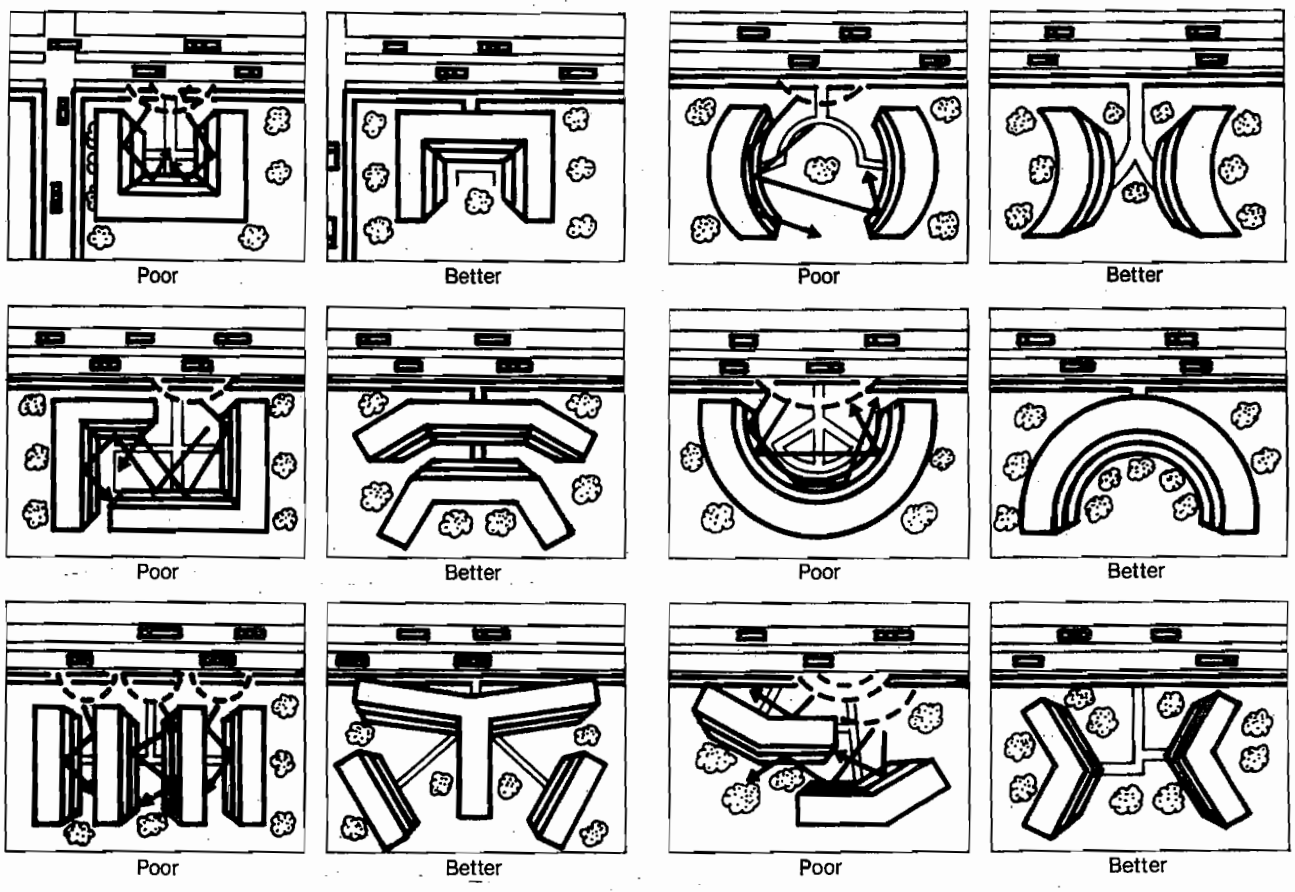


Figure 14
Orientation of Buildings on Sites



Acoustical Construction Concepts

(This section, with some editing is taken from the *Audible Landscape, FHWA.*[1])

Noise can be intercepted as it passes through the walls, floors, windows, ceilings, and doors of a building. Examples of noise reducing materials and construction techniques are described in the pages that follow.

To compare the insulation performance of alternative constructions, the Sound Transmission Class (STC) is used as a measure of a material's ability to reduce sound. Sound Transmission Class is equal to the number of decibels a sound is reduced as it passes through a material. Thus, a high STC rating indicates a good insulating material. It takes into account the influence of different frequencies on sound transmission, but essentially the STC is the difference between the sound levels on the side of the partition where the noise originates and the side where it is received. For example, if the external noise level is 85 dB and the desired internal level is 45 dB, a partition of 40 STC is required. The Sound Transmission Class rating is the official rating endorsed by the American Society of Testing and Measurement. It can be used as a guide in determining what type of construction is needed to reduce noise.

The use of the STC rating system for transportation noise is a subject of some debate. The STC rating was originally intended primarily for use with interior partitions and relates to the "subjective impressions of the sound insulation provided against the sounds of speech, radio, television, music, and similar sources of noise in offices and dwellings."[2] However, since it remains the only widely used noise reduction rating system for materials the STC system is very often used even with transportation noise. When STC ratings are used for transportation noise you should be aware that the STC ratings may be a few dB too high. For example, the STC rating for a standard frame 2 × 4 wall with exterior siding, and sheathing and interior sheetrock may be 37 dB.[3] If rated specifically for transportation noise the dB reduction rating might drop to 34 dB.[4] All this really means, however, is that you should use the STC ratings with a bit of caution and remain aware of the possible 2-3 dB overstating that you may get with the STC rating system. Throughout this text we will be talking in terms of STC ratings for materials and assemblies.

[1] *The Audible Landscape: A Manual for Highway Noise and Land Use*, US Department of Transportation, the Federal Highway Administration, November 1974. (GPO Stock #5000-00079).

[2] *Acoustical and Thermal Performance of Exterior Residential Walls, Doors, and Windows*, US Department of Commerce, National Bureau of Standards, November 1975. (NBS Building Science Series 77) page 21.

[3] Ibid., p. 29

[4] *Design Guide for Reducing Transportation Noise In and Around Buildings*, p. 137.

Walls

Walls provide building occupants with the most protection from exterior noise. Different wall materials and designs vary greatly in their sound insulating properties. Figure 15 provides a visual summary of some ways in which the acoustical properties can be improved:

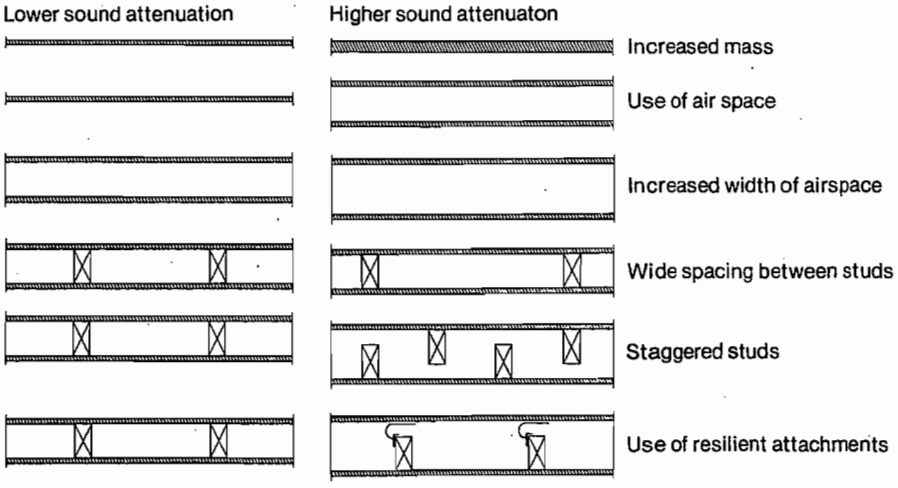
Increase the mass and stiffness of the wall. In general, the denser the wall material, the more it will reduce noise. Thus, concrete walls are better insulators than wood walls of equal thickness. Increasing the thickness of a wall is another way to increase mass and improve sound insulation. Doubling the thickness of a partition can result in as much as a 6 dB reduction in sound.[1] However, the costs of construction tend to limit the feasibility of large increases in wall mass.

The relative stiffness of the wall material can influence its sound attenuation value. Care must be taken to avoid wall constructions that can vibrate at audible frequencies and transmit exterior sounds.

[1] R. K. Cooke and P. Chrzanowski, "Transmission of Noise Through Walls and Floors," Cyril Harris, ed., Handbook of Noise Control, McGraw-Hill Book Company, Inc. (New York, 1957).

Figure 15
The Audible Landscape

Factors which influence sound attenuation of walls



Use cavity partitions. A cavity wall is composed of two or more layers separated by an airspace. The airspace makes the cavity wall a more effective sound insulator than a single wall of equal weight, leading to cost savings.

Increase the width of the airspace. A three inch airspace provides significant noise reduction, but increasing the spacing to six inches can reduce noise levels by an additional 5 dBA. Extremely wide airspaces are difficult to design.

Increase the spacing between studs. In a single stud wall, 24 inch stud spacing gives a 2-5 dB increase in STC over the common 16 inch spacing.[2]

Use staggered studs. Sound transmission can be reduced by attaching each stud to only one panel and alternating between the two panels.

[2]Leslie T. Doelle, Environmental Acoustics (New York, McGraw-Hill Book Company, 1972), pp. 232-233.

Use resilient materials to hold the studs and panels together. Nails severely reduce the wall's ability to reduce noise. Resilient layers such as fiber board and glass fiber board, resilient clips, and semi-resilient attachments are relatively inexpensive, simple to insert, and can raise the STC rating by 2-5 dB.[1]

Use dissimilar layers. If the layers are made of different materials and/or thickness, the sound reduction qualities of the wall are improved.[2]

Add acoustical blankets. Also known as isolation blankets, these can increase sound attenuation when placed in the airspace. Made from sound absorbing materials such as mineral or rock wool, fiberglass, hair felt or wood fibers, these can attenuate noise as much as 10 dB.[3] They are mainly effective in relatively lightweight construction.

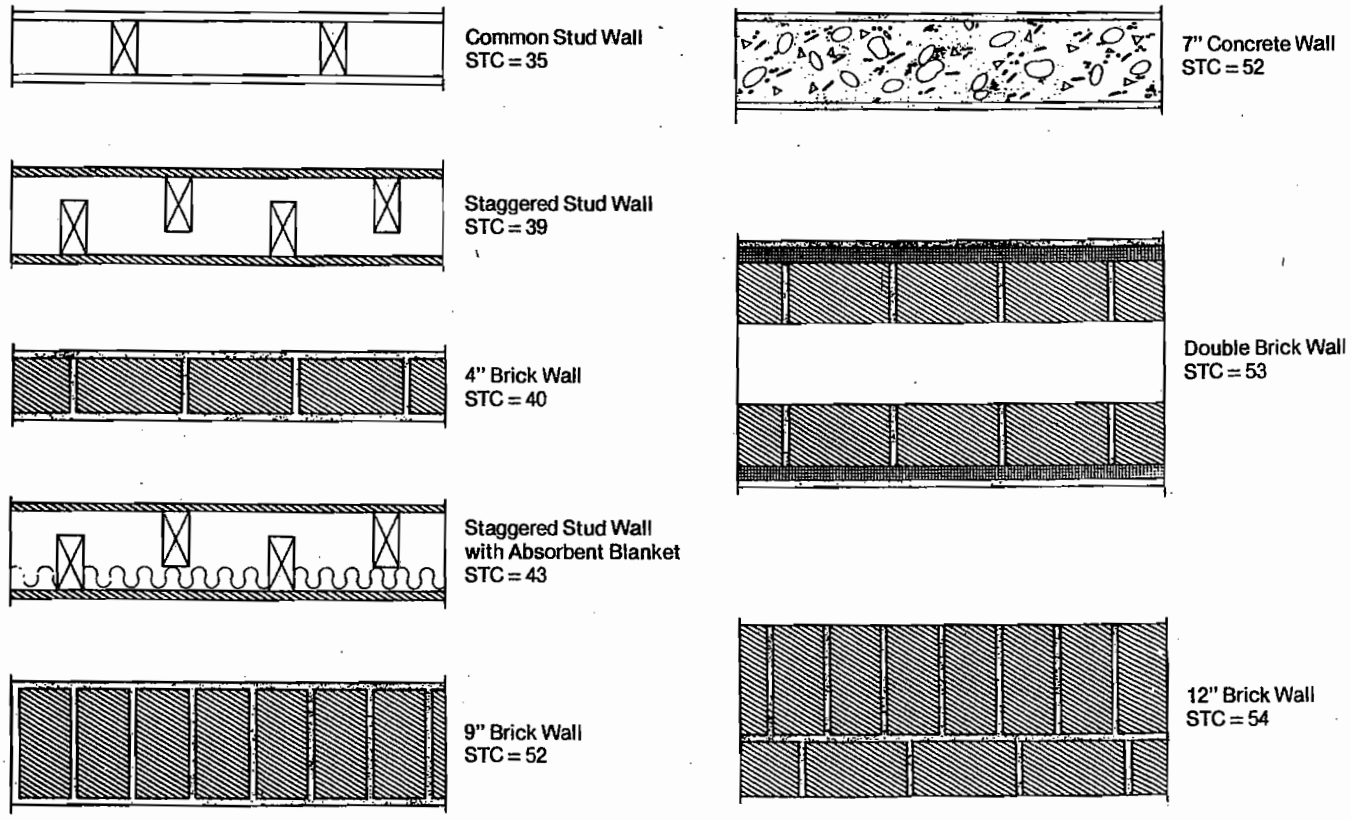
Seal cracks and edges. If the sound insulation of a high performance wall is ever to be realized, the wall must be well sealed at the perimeter. Small holes and cracks can be devastating to the insulation value of a wall. A one-inch square hole or a 1/16 inch crack 16 inches long will reduce a 50 STC wall to 40.[4]

Figure 16 shows a sample of wall types ranging from the lowest to the highest sound insulation values.

Remember that the effectiveness of best wall construction will be substantially reduced if you permit vents, mail slots or similar openings in the walls. If vents are permitted the ducts must be specially designed and insulated to make sure noise does not reach the inside. The best approach is simply to eliminate all such openings on impacted walls.

[1]Ibid, p. 172
[2]Ibid, p. 162
[3]Doelle, p. 20
[4]United States Gypsum, Sound Control Construction, Principles and Performance (Chicago, 1972), p. 66

Figure 16
Walls



Windows

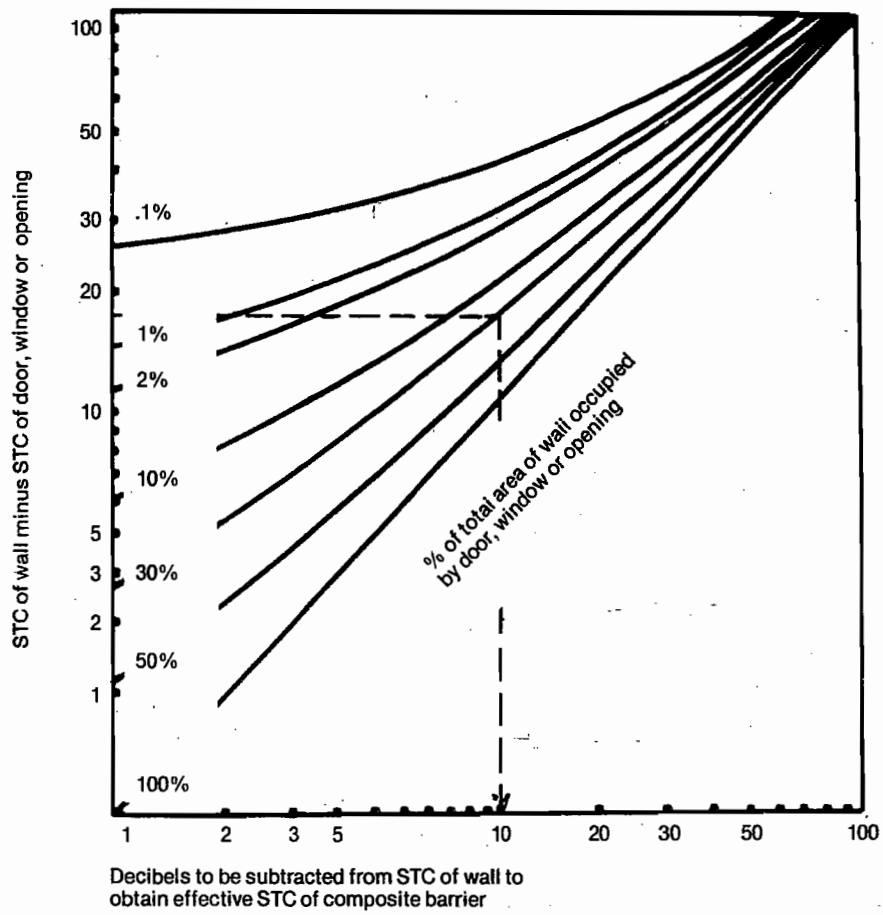
Sound enters a building through its acoustically weakest points, and windows are one of the weakest parts of a wall. An open or weak window will severely negate the effect of a very strong wall. Whenever windows are going to be a part of the building design, they should be given acoustical consideration. Figure 17 illustrates the effects of windows on the sound transmission of walls. For example, if a wall with an STC rating of 45 contains a window with an STC rating of 26 covering 30% of its area, the overall STC of the composite partition will be 35, a reduction of 10 dB.

The following is a discussion of techniques that can be used to reduce noise in a building by means of its windows. These techniques range from a blocking of the principal paths of noise entry to a blocking of the most indirect paths.

Close windows. The first step in reducing unwanted sound is to close and seal the windows. The greatest amount of sound insulation can be achieved if windows are permanently sealed. However, openable acoustical windows have been developed which are fairly effective in reducing sound.[1] Whether or not the sealing is permanent, keeping windows closed necessitates the installation of mechanical ventilation systems. If you are dealing with single family houses and some of the windows are facing away from all noise sources, a whole house fan may be better and cheaper than air conditioning. In multifamily housing or where all windows are exposed to the noise sources you will have to go with the air conditioning. If windows must be openable, special seals are available which allow windows to be opened.[2]

Reduce window size. The smaller the windows, the greater the transmission loss of the total partition of which the window is a part. Reducing the window size is a technique that is used because (a) it precludes the cost of expensive acoustical windows, and (b) it saves money by cutting down the use of glass. The problems with this technique are (a) it is not very effective in reducing noise; e.g., reducing the proportion of window to wall size from 50% to 20% reduces noise by only 3 decibels; and (b) many building codes require a minimum window to wall size ratio.

Figure 17
STC



Increase glass thickness. If ordinary windows are insufficient in reducing noise impacts in spite of sealing techniques, then thicker glass can be installed. In addition, this glass can be laminated with a tough transparent plastic which is both noise and shatter resistant. Glass reduces noise by the mass principle; that is, the thicker the glass, the more noise resistant it will be. A 1/2-inch thick glass has a maximum STC rating of 35 dB compared to a 25 dB rating for ordinary 3/16 inch glass.

Instructions on use of graph

1. Subtract the STC value of the door, window or opening from the STC value of the wall.
2. Enter the vertical axis of the graph at the point that matches the value from step 1.
3. Read across to the curve that represents the percentage of the total area of the wall that is taken up by the door, window, or opening.
4. Read down to the horizontal axis.
5. Subtract the value on the horizontal axis from the original STC value of the wall. The result is the composite STC value of the wall and the door, window or opening.

[1]U.S. Department of Housing and Urban Development, A Study of Techniques to increase the Sound Insulation of Building Elements, Report No. WR 73-5, Washington, D.C., June 1973.

[2]Los Angeles Department of Airports, *Guide to the Soundproofing of Existing Homes Against Exterior Noise*. Report No. WRC 70-2, March 1970, pp. 9-11, 22-30. In this report, the function and performance of a number of operable seals are described.

However, glass thicknesses are only practical up to a certain point, when STC increases become too insignificant to justify the cost. For example, a 1/2 inch thick glass can have an STC of 35; increasing the thickness to 3/4 inch only raises the STC to 37. However, a double glass acoustical window consisting of two 3/16 inch thick panes separated by an airspace will have an STC of 51 and can cost less than either solid window.

In addition to thickness, proper sealing is crucial to the success of the window. To prevent sound leaks, single windows can be mounted in resilient material such as rubber, cork, or felt.

Install Double-Glazed Windows. Double-glazed windows are paired panes separated by an airspace or hung in a special frame. Generally, the performance of the double-glazed window may be increased with:

- increased airspace width
- increased glass thickness
- proper use of sealings
- slightly dissimilar thicknesses of the panes
- slightly non-parallel panes

In general the airspace between the panes should not be less than 2–4 inches if an STC above 40 is desired. If this is not possible, a heavy single-glazed window can be used. The use of slightly non-parallel panes is a technique employed when extremely high sound insulation is required, such as in control rooms of television studios.

The thickness of double-glazed panes may vary from 1/8 to 1/4 inch or more per pane. Although thickness is important, the factors which most determine the noise resistance of the window is the use of sealant and the width of the airspace.

As in the case of all windows, proper sealing is extremely important. To achieve an STC above 43, double-glazed windows should be sealed permanently. If the windows must be openable, there are available special frames and sealers for openable windows which allow a maximum STC of 43.[1]

Permanently sealed double-glazed windows often require an air pressure control system to maintain a constant air pressure and minimal moisture in the airspace. Without this system, the panes may deflect, and, in extremely severe cases, pop out of the frames.

To further insure isolation of noise between double-glazed panes, the panes could be of different thicknesses, different weights, and slightly non-parallel to each other. This prevents acoustical coupling and resonance of sound waves.

Doors

Acoustically, doors are even weaker than windows, and more difficult to treat. Any door will reduce the insulation value of the surrounding wall. The common, hollow core wood door has an STC rating of 17 dB. Taking up about 20% of the wall, this door will reduce a 48 STC wall to 24 STC. To strengthen a door against noise, the hollow core door can be replaced by a heavier solid core wood door that is well sealed[1] and is relatively inexpensive. A solid core wood door with vinyl seal around the edges and carpeting on the floor will reduce the same 48 STC wall to only 33 dB.[2] An increased sound insulation value can be achieved if gasketed stops or drop bar threshold closers are installed at the bottom edge of the door. (See Figure 18)

The alternative solution to doors is to eliminate them whenever possible from the severely impacted walls and place them in more shielded walls.

In any case no mail slots or similar openings should be allowed in exterior doors.

Roofs

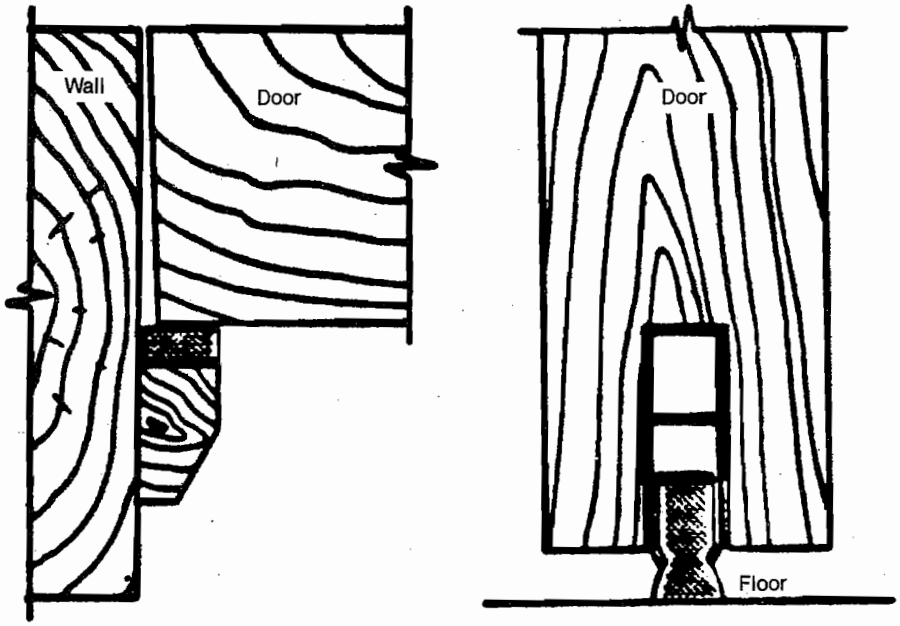
Acoustical treatment of roofs is not usually necessary unless the noise is extremely severe or the noise source is passing over the building. The ordinary plaster ceiling should provide adequate sound insulation except in extremely severe cases. An acoustically weak roof which is likely to require treatment is the beamed ceiling.[3] Beamed ceilings may be modified by the addition of a layer of fiberglass or some other noise resistent material. Suspended ceilings are the most effective noise reducers but they are also the most expensive.

[1]D.E. Bishop and P.W. Hirtle, "Notes on the Sound Transmission Loss of Residential-Type Windows and Doors," Journal of the Acoustical Society of America, 43:4 (1968).

[2]U.S. Gypsum, Sound Control... p. 100.

[3]Ibid p. 15.

Figure 18



Gasketed door stop

Drop bar threshold closer

[1]Ibid.

Floors

In the case of highway noise, floors would only require acoustical treatment if the highway were passing under the building. In this case, flooring would have to provide protection against structural vibrations as well as airborne sound.

Two ways to insulate a floor from noise are to install a solid concrete slab at least 6 inches thick or install a floating floor. In general, the floating floor gives the greatest amount of sound and vibration insulation; however, it is extremely expensive. Basically, a floating floor consists of a wood or concrete slab placed over the structural slab, but separated by a resilient material. The resilient material isolates the surface slab from the structural slab and the surrounding walls.

What to Look for When Reviewing Plans

The number of possible combinations of the building materials that go into walls, ceilings, windows and doors, is, no doubt, considerably short of infinite. It is however still a very large number, large enough that it would be impossible to compile a list of all the possible combinations. Therefore, do not expect to find in this section, or anywhere else for that matter, a neat table showing the STC ratings for all the types of construction you may encounter. In fact, it is not really your responsibility to determine the precise STC ratings for the walls, ceilings, windows and doors in the projects you review. Your job is simply to review the attenuation levels claimed by the sponsor/developer and determine whether or not they are reasonable.

To enable you to perform the above described task, we have prepared a list of the most common types of construction for which we have STC ratings. By comparing the type of construction proposed to one of these "model" types you should be able to tell whether the claimed STC rating is reasonable. For example, the sponsor/developer submits a description of his building stating that a 2 x 6 stud wall with standard sheathing, insulation, wood siding, and 1/2" gypsum board achieves a STC rating of 48. You look at Table 3 and find that the closest "model" wall is a 2 x 4 stud wall with wood siding, sheathing, insulation, and 1/2" gypsum board. This wall has a STC rating of 39. An 9 dB difference is quite significant considering that the walls are really quite similar. You would probably want to go back to the developer/sponsor and ask for some supporting data that proves that the 2 x 6 wall he proposes will indeed provide 48 dB of noise attenuation.

In order to make it easier to review the attenuation levels provided by the proposed construction, we suggest that you ask the developer/sponsor to complete a form such as shown in Figure 19. Such a form will give you all the information you need in a properly organized format that will facilitate your review. You could fill in the first part and simply have the developer/sponsor fill out the second part and return it with the developer certification or other project documents.

As you will recall from the previous section, most walls provide pretty good attenuation by themselves. It is the presence of windows and doors and openings such as vents that reduces the attenuation capability of the wall. Thus, after you have determined whether the basic wall itself has a reasonable STC, you must review the impact of the windows and doors. You do this by using Figure 17. First you determine the difference between the STC ratings for the wall and the windows. You enter the vertical axis of Figure 17 with that number. You read across until you intersect the line that represents the percentage of the wall taken up by the windows. Then you read down to the horizontal axis where you wil find the value to be subtracted from the basic STC value of the wall. The resulting number is the combined STC value for the wall. If the wall also contains a door, repeat the same procedure, only start out with the modified STC rating for the wall. If the wall has doors only, then obviously you start with the basic wall STC rating. Finally you compare the number you have derived with that listed by the developer/sponsor. If they are fairly close, you need not pursue it further. If there is a substantial difference, you should ask for an explanation or documentation from the developer.

Once again, we caution you about borderline cases. If the attenuation required is 30 dB and the STC rating for the proposed construction is exactly 30 dB, you may want to ask the developer to provide even more attenuation. Remember that we discussed how the STC rating may overstate the actual attenuation provided by as much as 3 dB. If an additional 3 dB can be achieved at minimum cost, we would strongly urge that you seek it from the developer/sponsor.

Finally check to make sure the developer has provided some form of mechanical ventilation. If it's a single family house and a whole house fan is the means of ventilation being provided make sure that there are operable windows on walls which do not face the noise source(s) nor are perpendicular to the source(s). Otherwise the residents will have to open windows on the exposed wall, thus cancelling out much of the attenuation achieved.

Table 3
STC Ratings for Typical Building Components[1]

Building Component	Description	STC Rating
Frame Wall	a. 5/8" x 10" Redwood Siding b. 1/2" Insulation Board Sheathing c. 2 x 4 studs 16" o.c. d. Fiberglass Building Insulation e. 1/2" Gypsum Board attached directly to studs	39 dB
Stucco/Frame Wall	a. 7/8" Stucco b. No. 15 felt Building Paper and 1" Wire Mesh c. 2 x 4 Studs 16" o.c. d. Fiberglass Building Insulation e. 1/2" Gypsum Board attached directly to studs	46
Brick Veneer Wall	a. Face Brick b. 1/2" Airspace with metal ties c. 3/4" Insulation Board Sheathing d. 2 x 4 Studs 16" o.c. e. Fiberglass Building Insulation f. 1/2" Gypsum Board attached directly to studs	56
Masonry Wall	a. 1" Stucco b. 8" thick Hollow Concrete Block c. 1/2" Gypsum Board attached to furring strips	49 (estimated)
Windows	Wood double hung, closed but unlocked, single glazing	23
	Aluminum sliding, latched, single glazing	24
	Wood double hung, closed but unlocked, glazed with 7/16" insulating glass	22
	Aluminum single hung, closed, glazed with 7/16" insulating glass	25
	Wood, double hung, sealed, glazed with 7/16" insulating glass with single glazed storm sash–2 1/8" separation	35
	Aluminum sliding, closed, single glazed with single glazed storm sash, 1/8" separation	22
Exterior Doors	Wood, flush solid core, with brass weather stripping	27
	Wood, flush solid core, plastic weather stripping, aluminum storm door	34
	Wood, French door, brass weather stripping	26
	Steel, flush, with urethane foam core, with magnetic weather stripping	28
Roof	Shingle Roof with attic, 1/2" gypsum wall board ceiling framed independently of roof	43 (estimated)

[1]Except as noted, all STC ratings are from: *Acoustical and Thermal Performance of Exterior Residential Walls, Doors and Windows*, National Bureau of Standards.

Figure 19
Description of Noise Attenuation Measures
(Acoustical Construction)

Part I

Project Name _____

Location _____

Sponsor/Developer _____

Noise Level (From NAG) _____ Attenuation Required _____

Primary Noise Source(s) _____

Part II

1. For Walls (s) facing and parallel to the noise source(s) (or closest to parallel):
   a. Descripton of wall construction* _____

   _____

   b. STC rating for wall (rated for nb windows or doors): _____

   c. Description of Windows: _____

   _____

   d. STC rating for window type _____

   e. Description of doors _____

   _____

   f. STC rating for doors _____

   g. Percentage of wall (per wall, per dwelling unit) composed of windows _____ and doors _____

   h. Combined STC rating for wall component _____

2. For walls perpendicular to noise source(s):
   a. Description of wall construction* _____

   _____

   b. STC rating for wall (rated for no windows or doors) _____

   c. Description of windows _____

   _____

   d. STC rating for windows _____

   e. Description of doors _____

   _____

f. STC rating for doors _____

g. Percentage of wall (per wall, per dwelling unit) composed of windows _____ and doors _____

h. Combined STC rating for wall component _____

3. Roofing component (if overhead attenuation is required due to aircraft noise):
   a. Description of roof construction _____

   _____

   b. STC rating (rated as if no skylights or other openings) _____

   c. Descripton of skylights or overhead windows _____

   _____

   d. STC rating for skylights or overhead windows _____

   e. Percentage of roof composed of skylights or windows (per dwelling unit) _____

   f. Percentage of roof composed of large uncapped openings such as chimneys _____

   g. Combined STC rating for roof component _____

4. Description of type of mechanical ventilation provided _____

   _____

Prepared by _____

Date: _____

*If walls contain vents or similar openings, attach a description of duct arrangement and insulation and a statement of how much the wall STC is reduced by the presence of the vent.

Figure 19
Description of Noise Attenuation Measures
(Acoustical Construction)

Part I

Project Name PARADISE HOMES

Location ANYTOWN

Sponsor/Developer JOAN DOE + ASSOC. INC.

Noise Level (From NAG) 73 Attenuation Required 30d6

Primary Noise Source(s) HIGHWAY

Part II

1. For Walls (s) facing and parallel to the noise source(s) (or closest to parallel):
   a. Descripton of wall construction* 3/8" FIR PLYWOOD SIDING, 2 X 4 STUDS 16"O.C. 3½" FIBERGLASS INSULATION
   b. STC rating for wall (rated for no windows or doors): 37
   c. Description of Windows: WOOD DOUBLE HUNG, INSULATING GLASS
   d. STC rating for window type 22
   e. Description of doors WOOD, FLUSH, SOLID CORE
   f. STC rating for doors 30
   g. Percentage of wall (per wall, per dwelling unit) composed of windows 10% and doors 5%
   h. Combined STC rating for wall component 30d6
2. For walls perpendicular to noise source(s):
   a. Description of wall construction* SAME AS ABOVE
   b. STC rating for wall (rated for no windows or doors) 37
   c. Description of windows SAME AS ABOVE
   d. STC rating for windows 22
   e. Description of doors NO DOORS

SAMPLE

f. STC rating for doors — —

g. Percentage of wall (per wall, per dwelling unit) composed of windows 10% and doors 0

h. Combined STC rating for wall component 30

3. Roofing component (if overhead attenuation is required due to aircraft noise):
   a. Description of roof construction N/A

   b. STC rating (rated as if no skylights or other openings) _____

   c. Descripton of skylights or overhead windows _____

   d. STC rating for skylights or overhead windows _____

   e. Percentage of roof composed of skylights or windows (per dwelling unit) _____

   f. Percentage of roof composed of large uncapped openings such as chimneys _____

   g. Combined STC rating for roof component _____

4. Description of type of mechanical ventilation provided CENTRAL AIR Conditioning

Prepared by _____

Date: _____

*If walls contain vents or similar openings, attach a description of duct arrangement and insulation and a statement of how much the wall STC is reduced by the presence of the vent.

SAMPLE

on Noise Attenuation

stions

What are the three basic ways to
ide noise attenuation?
What are the responsibilities of
personnel regarding noise
enuation?
When a barrier is introduced
een a source and a receiver the
d energy is redistributed along 3
irect paths. What are these three
s?
What is "Path Length Difference"
ow does it affect the attenuation
provided by a barrier?
What are "Transmission Loss
s?"
ow does the transmission loss
of barrier material affect the
ation capability of the barrier?
s a general rule, what
mission loss values should you
or?
you have more than one barrier
en the source and the receiver
amount of attenuation
sed substantially?
What are the four things to check
reviewing a proposed barrier?
st 3 ways to make a barrier more
e without increasing its overall
11. List 3 ways to make a barrier more effective without increasing its overall length.
12. What is the maximum percentage of the total area of a barrier that can be made up of openings without a significant loss in barrier effectiveness?
13. List 3 site planning techniques that are used to shield residential developments.
14. When are parks and playgrounds not noise compatible uses that can be employed as buffers?
15. What are the two main things to look for when reviewing site plan changes?
16. What are some of the building orientations which can aggravate noise problems?
17. What is the Sound Transmission Class (STC) rating?
18. Which is better a high STC or a low STC rating?
19. What kinds of conditions were STC ratings originally developed for?
20. What should you do when using STC ratings in a transportation noise situation?
21. List 5 ways to improve the attenuation capability of a wall.
22. Windows are one of the acoustically weakest components in a wall. List 3 ways to reduce the negative effects of windows.
23. What is the best way to reduce the effect of doors?

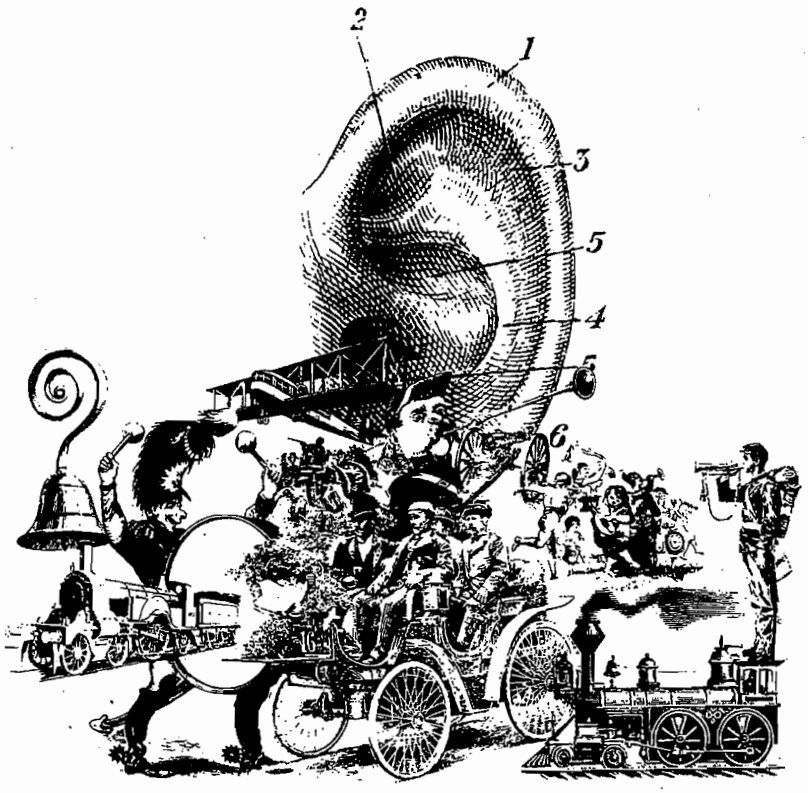
Quiz on Noise Attenuation

Answers

1. a. barriers or berms
   b. site design
   c. acoustical construction
2. a. to make sure the project sponsor/developer is aware of the attenuation requirements
   b. provide sponsor/developer with an overview of available options
   c. review attenuation proposals to make sure they are adequate
3. a. A **diffracted** path over the top of the barrier
   b. A **transmitted** path through the barrier
   c. A **reflected** path away from the receiver
4. "Path Length Difference" is the difference in distance that sound must travel diffracting over the barrier rather than passing directly through it. Since sound energy decreases over distance, the greater the path length distance the greater the attenuation.
5. "Transmission Loss Values" represent the amount noise levels will be reduced when the sound waves pass through a barrier.
6. Since the attenuation provided by a barrier is a function of both the sound energy that goes over the top **and** the energy that goes through the barrier, if the transmission loss value is low then the effectiveness of the barrier will be greatly reduced.
7. If the transmission loss value of the barrier material is at least 10dB greater than the attenuation level provided by diffraction (i.e. barrier height) there shouldn't be any problem.
8. No. The combined effect of multiple barriers does not normally provide significantly greater attenuation than a single barrier. For design purposes, the general procedure is to assume the attenuation of the most effective barrier.
9. a. Is it high enough?
   b. Is it long enough?
   c. Is it made of the right material?
   d. Is it properly constructed?
10. a. move the barrier closer to the source
    b. bend the top of the barrier towards the source
    c. do both
11. a. move it closer to the receiver
    b. bend the ends toward the receiver
    c. do both
12. 1 percent
13. Any 3 of the below:
    a. increasing the distance between the source and the receiver
    b. placing noise compatible land uses between the source and the receiver
    c. locating barrier type buildings parallel to the source
    d. orienting residences away from the noise
14. when they are the only ones associated with the project
15. a. is the separation between the source and receiver great enough
    b. If a noise compatible building is being used as a barrier is it tall and long enough?
16. Building orientations which trap noise and cause it to reverberate off building walls. This would include shapes where a court is open to the source or where a series of buildings are arranged perpendicular to the source.
17. The STC rating is equal to the number of decibels a sound is reduced as it passes through a material.
18. A high STC rating is better.
19. The STC ratings were originally intended primarily for use with interior partitions and for noise such as speech, radios, television.
20. Recognize that the STC rating may overstate the effectiveness of the materials by 2-3db.
21. Any of the 9 below:
    a. increase the mass and stiffness of the wall
    b. use cavity partitions
    c. increase the width of the airspace
    d. increase the spacing between studs
    e. use staggered studs
    f. use resilient materials to hold the studs and finish materials together
    g. use of dissimilar layers (leaves)
    h. add acoustical blankets
    i. seal cracks and edges
22. Any of the 4 below:
    a. close the windows and provide mechanical ventilation
    b. reduce window size
    c. increase glass thickness
    d. install double glazed windows
23. Eliminate them from severely impacted walls

U.S. Department of Housing and Urban Development
Office of Policy Development and Research

Noise Assessment Guidelines

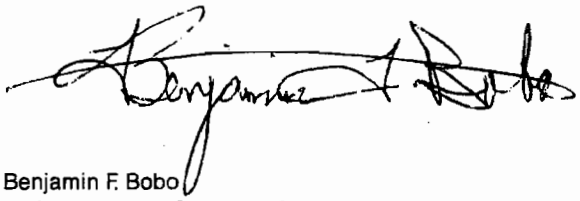


Noise Assessment Guidelines

Foreword

In choosing among alternative sites for housing, potential noise problems are prominent among the issues that must be examined. These Noise Assessment Guidelines were developed to provide HUD field staff, interested builders, developers, and local officials with an easy-to-use method of evaluating noise problems with a minimum of time and effort.

We believe that this set of tools will simplify the process of balancing the goal of environmental protection with those of efficiency and reduced housing costs. We hope you will find them useful, and invite your comments.



Benjamin F. Bobo
Acting Assistant Secretary for
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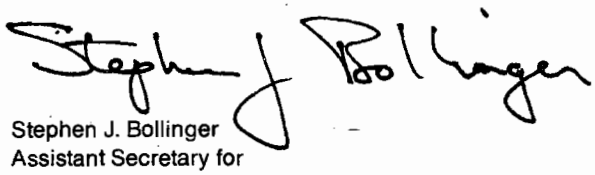

Stephen J. Bollinger
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Preface

The Department of Housing and Urban Development, in its efforts to provide decent housing and a suitable living environment, is concerned with noise as a major source of environmental pollution and has issued Subpart B on Noise Abatement and Control to Part 51 of Title 24 of the Code of Federal Regulations.

The policy established by Subpart B embodies HUD objectives to make the assessment of the suitability of the noise environment at a site: (1) easy to perform; (2) uniformly applicable to different noise sources; and (3) as consistent as possible with the assessment policies of other Federal departments and agencies. In furtherance of these objectives, the Office of Policy Development and Research has sponsored research to provide site analysis techniques. These *Noise Assessment Guidelines* do not constitute established policy of the Department but do provide a methodology whose use is encouraged by HUD as being consistent with its objectives. The *Guidelines* provide a means for assessing separately the noise produced by airport, highway, and railroad operations, as well as the means for aggregating their combined effect on the overall noise environment at a site.

This booklet has been prepared by Bolt Beranek and Newman Inc., under Contract No. H-2243R for the U.S. Department of Housing and Urban Development. It is a revision of an earlier edition published in August 1971. With the exception of changes made by the Department, the contractor is solely responsible for the accuracy and completeness of the data and information contained herein.

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Introduction

These guidelines are presented as part of a continuing effort by the Department of Housing and Urban Development to provide decent housing and a suitable living environment for all Americans.

The procedures described here have been developed so that people without technical training will be able to assess the exposure of a housing site to present and future noise conditions. In this context, the site may hold only one small building, in which case the noise assessment is straightforward. Larger sites may hold larger buildings, or many buildings, and the noise level may be different at different parts of the site (or building). Assessments of the noise exposure should be made at representative locations around the site where significant noise is expected. These are designated as "Noise Assessment Locations," abbreviated NAL in the following text.

The only materials required are a map of the area, a ruler (straight edge), a protractor and a pencil. Worksheets and working figures are provided separately.

All of the information you need can be easily obtained – usually by telephone. For convenience, this information is listed at the beginning of each section under headings that indicate the most likely source. While you are obtaining this information, be sure to ask about any approved plans for future changes that may affect noise levels at the site – for example: land-use changes, changes in airport runway traffic, widening of roads, and so forth. In all evaluations, you should assess the condition that will have the most severe or most lasting effect on the use of the site.

Wherever possible, you should try to assess noise environments expected at least ten years in the future.

The degree of acceptability of the noise environment at a site is determined by the outdoor day-night average sound level (DNL) in decibels (dB). The assessment of site acceptability is presented first as an evaluation of the site's exposure to three major sources of noise – aircraft, roadways, and railways. These are then combined to assess the total noise at a site. Worksheets are provided at the back of these Guidelines to use in summarizing your evaluations.

The noise environment at a site will come under one of three categories:

Acceptable (DNL not exceeding 65 decibels) The noise exposure may be of some concern but common building constructions will make the indoor environment acceptable and the outdoor environment will be reasonably pleasant for recreation and play.

Normally Unacceptable (DNL above 65 but not exceeding 75 decibels) The noise exposure is significantly more severe; barriers may be necessary between the site and prominent noise sources to make the outdoor environment acceptable; special building constructions may be necessary to ensure that people indoors are sufficiently protected from outdoor noise.

Unacceptable (DNL above 75 decibels) The noise exposure at the site is so severe that the construction cost to make the indoor noise environment acceptable may be prohibitive and the outdoor environment would still be unacceptable.

When measuring the distance from the site to any noise source, measure from the source to the nearest points on the site where buildings having noise-sensitive uses are located. These points define the Noise Assessment Locations for the site. The relevant measurement location for buildings is a point 2 meters (6.5 feet) from the facade.

If at any point during the assessment the site's exposure to noise is found to be Unacceptable or Normally Unacceptable, every effort should be made to improve the condition, e.g., the location of the proposed dwellings can be changed or some shielding can be provided to block the noise from that source.

Where quiet outdoor space is desired at a site, distances should be measured from the important noise sources to the outdoor area in question and the combined noise exposure should be assessed.

Frequently, the locations of dwellings have not yet been specified at the time the noise assessment of a site is made. In these instances, distances used in the noise assessment should be measured as 2 meters less than the distance from the building setback line to the major sources of noise.

Combining Sound Levels in Decibels

The noise environment at a site is determined by combining the contributions of different noise sources. In these Guidelines, Workcharts are provided to estimate the contribution of aircraft, automobile, truck, and train noise to the total day-night average sound level (DNL) at a site. The DNL contributions from each source are expressed in decibels and entered on Worksheet A. The combined DNL from all the sources is the DNL for the site and is the value used to determine the acceptability of the noise environment.

Sound levels in decibels *are not combined by simple addition!* The following table shows how to combine sound levels:

Table

Difference in Sound Level	Add to Larger Level
0	3.0
1	2.5
2	2.1
3	1.8
4	1.5
5	1.2
6	1.0
7	0.8
8	0.6
9	0.5
10	0.4
12	0.3
14	0.2
16	0.1
greater than 16	0

Use the table by first finding the numerical difference in sound level between two levels being combined. Entering the table with this value, find the value to be added to the larger of the two levels, add this value to the larger level to determine the total. Where more than two levels are to be combined, use the same procedure to combine any two levels; then use this subtotal and combine it with any other level, and so on. Fractional numerical values may be interpolated from the table; however, the final result should be rounded to the nearest whole number.

...ple 1: In performing a site evaluation, ...parate DNL values for airports, road ...nd railroads have been listed on ...eet A as 56, 63, and 61 decibels. In ...complete the final evaluation of the ...se separate DNL values must be ...d. The difference between 63 and ...om the table you find that 0.8 should ...d to 63, for a subtotal of 63.8. The ...e between 63.8 and 61 is 2.8; from ...you interpolate that approximately ...d be added to 63.8 for a total of 65.7 ...when rounded to whole numbers. ...mple shows how noise from different ...day be Acceptable, individually, at a ...hen combined, the total noise en... may exceed the Acceptable DNL ... decibels.

Aircraft

Necessary Information

To evaluate a site's exposure to aircraft noise, you will need to consider all airports (civil and military) within 15 miles of the site. The information required for this evaluation is listed below under headings that indicate the most likely source. Before beginning the evaluation, you should record the following information on Worksheet B:

From the FAA Area Office or the Military Agency in charge of the airport:

- Are current DNL or NEF (Noise Exposure Forecast) contours available? Noise contours are available for almost all military airports. These contours have been developed and published as part of the Air Installation Compatible Use Zone (AICUZ) program of the Department of Defense. The contours are published normally as part of an AICUZ report. Noise contours are also available for many civil airports. When available, they are superimposed on a map with an appropriately marked scale (see Figure 1, page 4).
- Any available information about approved plans for runway changes (extensions or new runways).

From the FAA Control Tower or Airport Operations (if DNL or NEF contours are *not* available):

- The number of nighttime jet operations (10 p.m. - 7 a.m.)
- The number of daytime jet operations (7 a.m. - 10 p.m.)
- The flight paths of the major runways.
- Any available information about expected changes in airport traffic, e.g., will the number of operations increase or decrease in the next 10 or 15 years.

In making your evaluation, use the data for the heaviest air traffic condition, whether present or future.

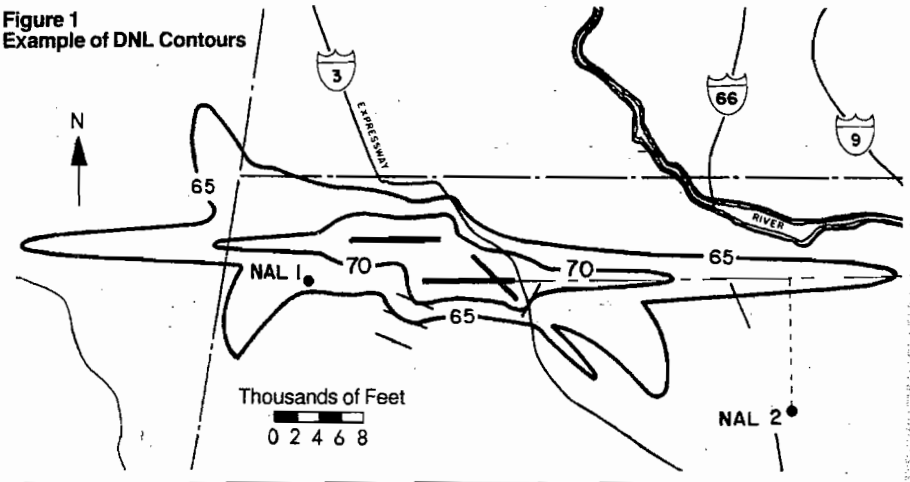
Evaluation of Site Exposure to Aircraft Noise

If current DNL (or NEF) contours are available (as in Figure 1 page 4), locate the site on the map by referring to the marked distance scale. If there are no other noise sources in the area, you do not need to do anything else. If there are other noise sources affecting the site, you will need to find the precise DNL value so you can combine it with the other sources. Obtain the DNL at the appropriate NAL on the site by interpolation between the contours on either side of the NAL. If NEF contours are used, estimate DNL by adding 35 decibels to the NEF values. Note that contours are usually provided in 5 decibel increments. (See Example 2 on page 4.) When supersonic aircraft operations are present, DNL contours are *required* for the assessment.

If DNL or NEF contours are *not* available, the DNL at a site may be estimated in several different ways:

- An FAA Handbook (Reference 1) can be used to estimate DNL contours for sites in general aviation airport vicinities. General aviation airports exclude commercial jet transports but may include business jets.
- A handbook available from EPA (Reference 2 at the back of this Guide) can be used to calculate DNL at individual points.
- A procedure for constructing approximate DNL contours for sites near commercial jet

Figure 1
Example of DNL Contours



Example 2: The illustration in Figure 1 at the top of page 4 shows the NAL's on a map that has DNL contours. We find that NAL number 1 lies between the 65 and 70 dB contours and that NAL number 2 lies outside the 65 dB contour.

We find the DNL at NAL number 1 by interpolation from the distances between the NAL and the 65 and 70 dB contours.

By scaling off the map, we find that the distance from the NAL, measured perpendicularly to the contours, is 800 feet to the 65 dB contour and 2400 feet to the 70 dB contour. The distance between the 65 and 70 dB contours is 2400 + 800 =3200 feet. We find the DNL at the NAL number 1 to be 65 decibels plus 800/3200 x 5 decibels = 66.3 decibels.

Example 3: The illustration in Figure 2 at the bottom of page 5 shows an airport for which DNL or NEF contours are not available. The airport has 10 nighttime and 125 daytime jet operations.

To construct the approximate contours, we determine the effective number of operations as follows:

10 (nighttime) x 10 = 100

Add to this the actual number of daytime operations:

100 + 125 (daytime) = 225

To determine the distances A and B in relation to the runway (see Figure 3, page 5), enter the effective number of operations on the horizontal scales of the charts in Figure 3;

airports without supersonic aircraft is as follows:

Determine the "effective" number of jet operations at the airport by first multiplying the number of nighttime jet operations by 10.

Then add the number of daytime jet operations to obtain an effective total (see Example 3, page 4).

On a map of the area showing the principal runways, mark the location of the site and, using the diagram and charts of Figure 3 on page 5, construct approximate DNL contours of 65, 70, and 75 dB for the major runways and flight paths most likely to affect the site. (see Figure 2, page 5.)

Although a site may be Acceptable for exposure to aircraft noise; exposure to other sources of noise, when combined with the aircraft noise, may make the site Unacceptable. Therefore, if necessary, values of aircraft noise exposure less than 65 dB can be estimated from Table 2. Scale the shortest distance D^2 from the NAL to the flight path, as in Figure 2. Scale the distance D^1 from the 65 dB contour to the flight path. Divide D^2 by D^1 and enter this value into the following table to find the approximate DNL at the NAL.

Table 2

$\frac{D2}{D1}$	DNL dB
1.00	65
1.12	64
1.26	63
1.41	62
1.58	61
1.78	60
2.00	59
2.24	58
2.51	57
2.82	56
3.16	55

Figure 2
Example of Approximate DNL Contours for an Airport with 225 Effective Number of Operations

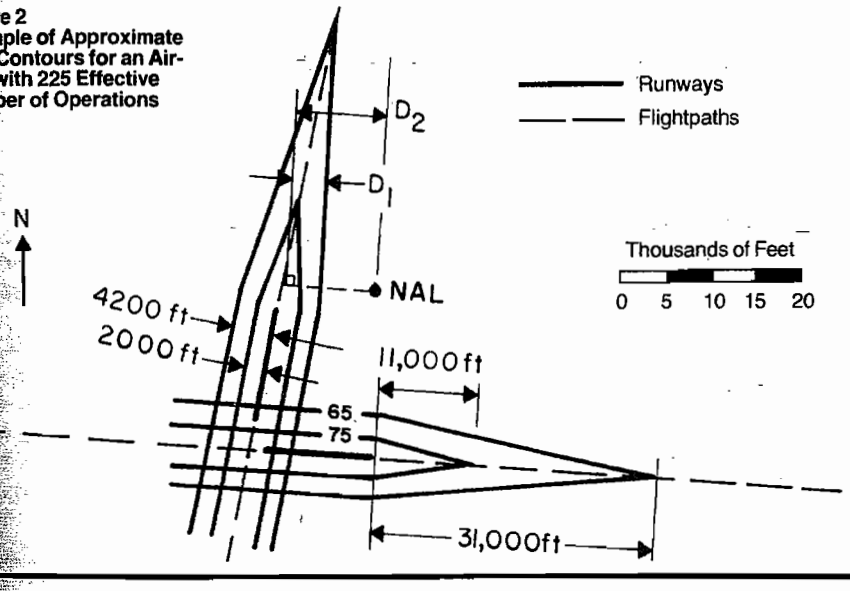
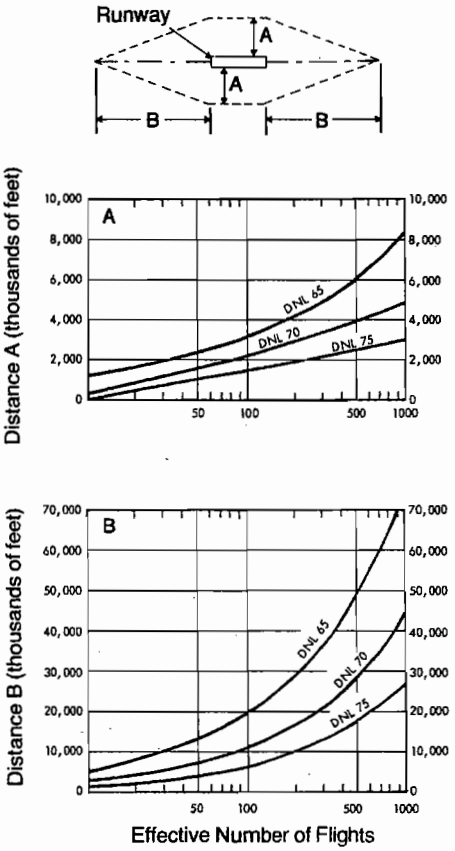


Figure 3
Charts for Estimating DNL for Aircraft Operations



...up to the DNL curves; read across the ...t to the left to obtain distances A and B ...the vertical scales on the charts. ...we find from Figure 3, for example, that for ...effective operations, distance A is 4200 ...for the 65 dB contour and 2000 feet for ...75 dB contour. Distance B is 31,000 feet ...the 65 dB contour and 11,000 feet for the ...dB contour.

Example 4a: The NAL shown in Figure 2 is outside the 65 dB contour. The distance D^2 from the NAL to the flight path is 9700 feet. The distance D^1 from the 65 dB contour to the flight path, measured perpendicularly from the contour, is 3700 feet. The ratio D^2/D^1 is 9700/3700 = 2.62. From Table 2 we find the DNL from the airport to be 56.6 dB. We do not know whether the site is Acceptable or not, however, since we must also assess the contribution of roadway and train noise to the total DNL at the site.

Example 4b: We observe that the perpendicular distance (D^2) from NAL number 2 (Figure 1) to the flight path is more than 3 times the distance (D^1) from the 65 dB contour to the flight path. From Table 2 we find that the contribution of the airport to the DNL at NAL number 2 is less than 55 decibels. We need not consider the airport further in accessing the noise environment at this site.

Roadways

Necessary Information

To evaluate a site's exposure to roadway noise, you will need to consider all roads that might contribute to the site's noise environment; roads farther away than 1000 feet normally may be ignored.

Before beginning the evaluation, determine if roadway noise predictions already exist for roads near the site. Also try to obtain all available information about approved plans for roadway changes (e.g., widening existing roads or building new roads) and about expected changes in road traffic (e.g., will the traffic on this road increase or decrease in the next 10 to 15 years).

If noise predictions have been made, they should be available from the City (County) Highway or Transportation Department. If not, record the following information on page 1 of Worksheet C:

- The distances from the NAL's for the site to the near edge of the nearest lane and the far edge of the farthest lane for each road.
- Distance to stop signs.
- Road gradient, if 2 percent or greater.
- Average speed.
- The total number of automobiles for both directions during an average 24-hour day. Traffic engineers refer to this as ADT, Average Daily Traffic (or sometimes AADT, meaning Annual Average Daily Traffic).
- The number of trucks during an average 24-hour day in each direction.

If possible, separate trucks into "heavy trucks" – those weighing more than 26,000 pounds with three or more axles – and "medium trucks" – those between 10,000 and 26,000 pounds. (Each medium truck is counted as equal to 10 automobiles.) Trucks under 10,000 pounds are counted as automobiles. Count buses capable of carrying more than 15 seated passengers as "heavy" trucks – others, as "medium" trucks. If it is not possible to separate the trucks into those that are heavy and those that are not, treat *all* trucks as though they are "heavy."

Note: If the road has a gradient of 2 percent of more, record the numbers for uphill and downhill traffic separately since these figures will be needed later; otherwise, simply record the total number of trucks. Most often you will have to assume that the uphill and downhill traffic are equally split.

- The fraction of ADT that occurs during nighttime (10 p.m. to 7 a.m.). If this is unknown, assume 0.15 for both trucks and autos.

Evauation of Site Exposure to Roadway Noise

Traffic surveys show that the amount of roadway noise depends on the percentage of trucks in the total traffic volume. To account for this effect, you must evaluate automobile and truck traffic separately and then combine the results.

The noise environment at each site due to traffic noise is determined by utilizing a series of Workcharts to define the contribution of automobiles and trucks from one or more roads at that site. Each noise source yields a separate DNL value.

Workchart 1 provides a graph for assessing a site with respect to the noise from automobiles, light and medium trucks; Workchart 2 provides a similar graph for assessment of heavy truck noise. These values are combined for each road affecting the noise environment at the site to obtain the total contribution of roadway noise. Remember, the noise from aircraft and railways must also be considered before determining the suitability of this site's noise environment.

Effective Distance

Before proceeding with these separate evaluations, however, determine the "effective distance" to each road from the dwelling or outdoor residential activity (the NAL's for the site) by averaging the distances to the nearest edge of the nearest lane and to the farthest edge of the farthest lane of traffic. (See Example 5, page 6, and Figure 4, page 7.)

Note: For roads with the same number of lanes in both directions, the effective distance is the distance to the center of the roadway (or median strip, if present).

Automobile Traffic

Workchart 1 was derived with the following assumptions:

- There is line-of-sight exposure from the site to the road; i.e., there is no barrier which effectively shields the site from the noise of the road.
- There is no stop sign within 600 feet of the site; traffic lights do not count because there is usually traffic moving on one street or the other.
- The average automobile traffic speed is 55 mph.
- The nightime portion of ADT is 0.15.

If each road meets these four conditions, proceed to Workchart 1 for the evaluation. Enter the horizontal axis with the effective distance from the roadway to the NAL; draw a vertical line upward from this point. Enter the vertical axis with the effective automobile ADT; draw a horizontal line across from this point. (The "effective" automobile ADT is the sum of automobiles, light trucks, and 10 times the number of medium trucks in a 24-hour day.) Read the DNL value from Workchart 1 where the vertical and horizontal lines intersect. Record this value in column 16, Worksheet C.

But:

If any of the four conditions is different, make

Example 5: The site shown in Figure 4 is exposed to noise from three major roads: Road No. 1 has four lanes, each 12 feet wide, and a 30-foot wide median strip which accommodates a railroad track. Road No. 2 has four lanes, each 12 feet wide. Road No. 3 has six lanes, each 15 feet wide, and a median strip 30 feet wide.

The distance from NAL No. 1 to the near edge of Road No. 1 is 300 feet. The distance to the far edge of Road No. 1 is 300 feet, plus the number of lanes times the lane width, plus the width of the median strip. Thus, the distance to the farthest edge of the road is:

$$300 + (4 \times 12) = 378 \text{ ft}$$

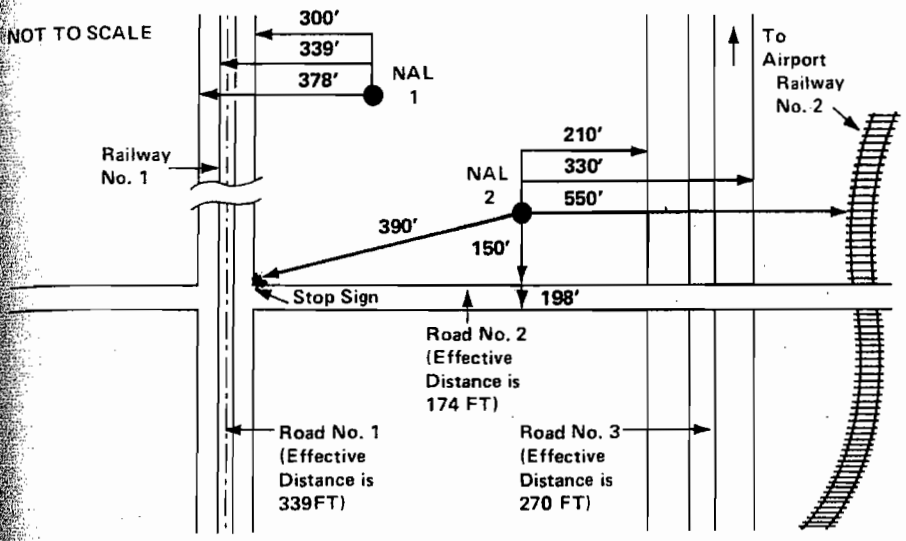
The effective distance is

$$\frac{378 + 300}{2} = 339 \text{ ft}$$

This is the value to be entered on line 1c of Worksheet C. The effective distances from the appropriate NAL's to Road No. 2 and Road No. 3 are found by the same method.

The distances shown in Figure 4 will be used for all roadway examples in this booklet.

Figure 4
Plan View of Site showing How Distance Should Be Measured from the Noise Assessment Location (NAL) of the Dwelling Nearest to the Source

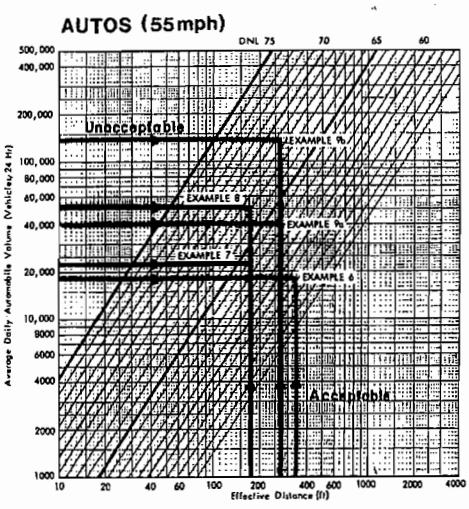


the necessary adjustments (on page 2, Worksheet C) listed below and *then* use Workchart 1 for the final evaluation.

First, a few general words about adjustments as they are applied in these Guidelines. Each Workchart has been derived for a baseline condition which is often found in practical cases. Where conditions differ from the baseline, they are accounted for by a series of one or more adjustment factors.

The adjustment factors are used as multipliers times the average number of vehicles operating during a 24-hour day. If more than one adjustment is required, it is not necessary that each be multiplied times the basic traffic flow separately; all adjustment factors are multiplied together, and them multiplied times the original traffic flow data. This will become clearer as you examine the Worksheets at the back of these Guidelines and work through the examples. After you have become familiar with the Guidelines, you will be able to work examples directly from the worksheets without referring back to the text. To simplify your work, all the adjustment factors are summarized at the back of these Guidelines.

Figure 5
Use of Workchart 1 To Evaluate Automobile Traffic Noise



Adjustments for Automobile Traffic

Stop-and-Go Traffic:
If there is a stop sign (not a traffic signal) within 600 feet of the NAL so that the flow of traffic is completely interrupted on the road under consideration, find the stop-and-go adjustment factor for automobiles from Table 3. Enter this value in column 9 on Worksheet C.

Table 3

Distance from NAL to Stop Sign In Feet	Automobile Stop-and-Go Adjustment Factor
0	0.10
100	0.25
200	0.40
300	0.55
400	0.70
500	0.85
600	1.00

Average Traffic Speed:
If the average automobile speed is other than 55 mph, enter the appropriate adjustment from Table 4 in column 10 of Worksheet C.

Table 4

Average Traffic Speed	Auto Speed Adjustment Factor
20 (mph)	0.13
25	0.21
30	0.30
35	0.40
40	0.53
45	0.67
50	0.83
55	1.00
60	1.19
65	1.40
70	1.62

Example 6: Road No. 1 meets the four conditions that allow for an immediate evaluation. In obtaining the information necessary for the evaluation, it was found that the automobile ADT is 18,000 vehicles (Line 5c of Worksheet C). On Workchart 1 we locate on the vertical scale the point representing 18,000 and on the horizontal scale the point representing 339 feet (see Figure 5). (Note that we must estimate the location of this point.) Using a straight-edge we draw lines to connect these two values and find that the noise exposure to automobile noise from this road is a DNL of 58 dB, as read from the scale at the top of the graph.

Example 7: Road No. 2 has a stop sign at 390 feet from NAL No. 2. The automobile ADT is reported as being 32,500 vehicles (line 5c of Worksheet C). From Table 3 we interpolate between 300 and 400 feet to find the adjustment factor for stop-and-go traffic to be 0.69. The adjusted traffic ADT is

0.69 × 32,500 = 22,425 vehicles per day

and with an effective distance of 174 feet from NAL No. 2, we find from Workchart 1 that the approximate value of DNL is 64 dB.

Example 8: Suppose that the stop sign on Road No. 2 were replaced by a traffic signal for which no stop-and-go adjustment is made and that the ADT increases to 75,000 vehicles. In addition, assume that the average speed is 45 mph instead of 55 mph. You adjust the new automobile ADT of 75,000 vehicles by the Auto Speed Adjustment Factor from Table 4

0.67 × 75,000 = 50,250 vehicles

and at an effective distance of 174 feet find from Workchart 1 that the approximate value of DNL is 67 dB.

Nighttime Adjustment.

DNL values are affected by the proportion of traffic volume that occurs during "daytime" (7 a.m. to 10 p.m.) and "nighttime" (10 p.m. to 7 a.m.). The graph on Workchart 1 assumes that 15 percent of the total ADT occurs during nighttime. If a different proportion of the traffic occurs at night, find the appropriate nighttime adjustment factor from Table 5. Record your answer in column 11 of Worksheet C.

Table 5

Nighttime Fraction of ADT	Nighttime Adjustment Factor
0	0.43
0.01	0.46
0.02	0.50
0.05	0.62
0.10	0.81
0.15	1.00
0.20	1.19
0.25	1.38
0.30	1.57
0.35	1.77
0.40	1.96
0.45	2.15
0.50	2.34

Once you have selected all the appropriate adjustment factors and entered them on page 2 of Worksheet C, multiply all the factors together, then multiply by the automobile ADT (column 12) for 24 hours, found on page 1 of Worksheet C. The resulting adjusted ADT should be entered in column 13. This is the ADT value to be used, in conjunction with the effective distance from the NAL to the road, to find the DNL value from Workchart 1. Enter this DNL value in column 14 of Worksheet C. Remember this is the DNL from automobile (as well as light and medium truck) noise; you must still find the DNL contribution from heavy truck noise in order to obtain the total DNL produced by the roadway you are assessing.

Attenuation of Noise by Barriers:

This adjustment reduces the noise produced by automobiles and trucks on the same road. Instructions for this adjustment appear after the noise assessment for truck traffic below.

Truck Traffic

Wherever possible, separate the average daily volume of trucks into heavy trucks (more than 26,000 pounds vehicle weight and three or more axles); medium trucks (less than 26,000 pounds but greater than 10,000 pounds), light trucks (counted as if they are automobiles). You should already have accounted for medium and light trucks in your automobile evaluation. Do not forget that buses that can carry more than 15 seated passengers are counted as heavy trucks. Heavy trucks (including buses) must be analyzed separately because they have quite different noise characteristics. If it is not possible to separate the trucks into those that are heavy and those that are not, treat *all* trucks as though they are "heavy."

Workchart 2, which is used to evaluate the site's exposure to heavy truck noise, was derived with the following assumptions:

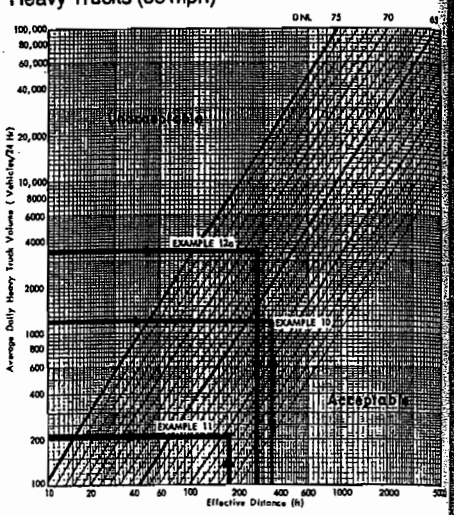
- There is line-of-sight exposure from the site to the road; i.e., there is no barrier which effectively shields the site from the road noise.
- The road gradient is less than 2 percent.
- There is no stop sign (traffic signals are permissible) within 600 feet of the site.
- The average truck traffic speed is 55 mph.
- The nighttime fraction of ADT is 0.15.

If the road meets these five conditions, proceed to Workchart 2 for an immediate evaluation of the site's exposure to heavy truck noise from that road.

But:

If any of the conditions is different, make the necessary adjustment(s) listed below and *then* use Workchart 2 for the evaluation.

Figure 6.
Use of Workchart 2 to Evaluate Heavy Truck Noise



Adjustments for Heavy Trucks

Road Gradient:

If there is a gradient of 2 percent or more, find the appropriate adjustment factor, for heavy trucks going uphill only, as shown in Table 6. List this factor in column 17 of Worksheet C.

Table 6

Percent of Gradient	Adjustment Factor
2	1.4
3	1.7
4	2.0
5	2.3
6 or more	2.5

Example 9a: Road No. 3 is a limited access highway with no stop signs and the average speed is 55 mph. Current traffic data indicate an automobile ADT of 40,000 vehicles of which 15 percent occurs during nighttime hours (10 p.m. to 7 a.m.). With an effective distance of 270 feet to NAL No. 2, Workchart 1 is used to show that the DNL for existing automobile traffic is between 63 and 64 dB. Round off to 64 dB.

Example 9b: However, traffic projections estimate that in 10 years the ADT will increase to 100,000 vehicles at an average speed of 55 mph and nighttime usage will increase to 25 percent. For future traffic, you must adjust the future ADT of 100,000 for the effect of increased nighttime use. From Table 5, you find an adjustment factor of 1.38. The adjusted ADT is

$1.38 \times 100{,}000 = 138{,}000$

and at an effective distance of 270 feet you find from Workchart 1 that the DNL will increase to 69 dB; therefore, provision for extra noise control measures should be explored. We will examine in Example 13 the effect of terrain as a shielding barrier that provides sound attenuation.

Example 10: Road No. 1 on Figure 4 meets the four conditions that allow for an immediate evaluation. The ADT for heavy truck flow is 1200 vehicles. Workchart 2 shows that the exposure to truck noise from this road at an effective distance of 339 feet is a DNL of 63 dB at NAL No. 1.

Average Traffic Speed:

Make this adjustment if the average speed differs from 55 mph. If the average truck speed differs with direction, treat the uphill and downhill traffic separately. Select the appropriate adjustment factors from Table 7 below, entering them in column 18 of Worksheet C.

Table 7

Average Traffic Speed MPH	Heavy Truck Speed Adjustment Factor
50 or less	0.81
55	1.00
60	1.17
65	1.38

Once you have found the speed adjustment factor, you can combine the uphill and downhill traffic. For uphill traffic, multiply the gradient factor times the speed adjustment factor times uphill traffic volume (truck ADT column 19) (assuming one half the total 24-hour average number of trucks unless specific information to the contrary exists), entering the product in column 20. Multiply the speed adjustment factor for downhill traffic times the downhill traffic volume (truck ADT/2 column 19). Add the values for uphill and downhill traffic, entering this sum in column 21. You may now complete the assessment of heavy truck noise without regard to uphill and downhill traffic separation.

Stop-and-Go Traffic:

If there is a stop sign (remember, not a traffic signal) within 600 feet of an NAL for the site on the road being assessed, find the adjustment factor determined according to Table 8. Enter it in Column 22 of Worksheet C.

Table 8

Heavy Truck Traffic Volume per Day	Heavy Truck Stop-and-Go Adjustment Factor
Less than 1200	1.8
1201 to 2400	2.0
2401 to 4800	2.3
4801 to 9600	2.8
9601 to 19,200	3.8
More than 19,200	4.5

Nighttime Adjustment

After all the above adjustments are made, do not forget to adjust for nighttime operations if they are not 15 percent of the total ADT, using the factors obtained from Table 5 just as for automobiles. Enter this value in column 23 of Worksheet C.

At this point, multiply the adjustment factors for nighttime and stop-and-go traffic times the heavy truck traffic volume in column 21 to find the adjusted heavy truck ADT, entering the product in column 24. Use this value and the effective distance from the NAL to the road to find the truck DNL from Workchart 2, entering your answer in column 25 of Worksheet C. If no shielding barriers are to be considered, combine the DNL from heavy trucks with the DNL from automobiles (column 14). The result is the DNL from the road being assessed and should be entered on Worksheet C.

But:

If a shielding barrier is to be considered for the site, make the analysis described below separately for automobiles and then for heavy trucks *before* combining the DNL values. This step is necessary since barriers are far more effective for automobiles than for heavy trucks. Once you have found the amount of attenuation provided by the barrier for automobiles, enter it in column 15. Find the value of barrier attenuation for heavy trucks and enter it in column 25. Subtract these attenuation values from the DNL values obtained previously (columns 14 and 24), entering the reduced DNL values in columns 16 and 27. Combine the automobile and heavy truck DNL values, reduced by the attenuation provided by the barrier, to find the final DNL produced by the roadway at the site.

Remember to combine the contributions to DNL of *all* roads that affect the noise environment at each NAL for the site to obtain the total DNL from all roadways. Enter this DNL on both Worksheet C and the summary Worksheet A.

Attenuation of Noise by Barriers

Noise barriers are useful for shielding sensitive locations from ground level noise sources. For example, a barrier may be the best way to deal with housing sites at which the noise exposure is not acceptable because of nearby roadway traffic.

A barrier may be formed by the road profile, by a solid wall or embankment, by a continuous row of noise-compatible buildings, or by the terrain itself. To be an *effective* shield, however, the barrier must block all residential levels from line of sight to the road; it must not have any gaps that would allow noise to leak through.

Some Preliminary Matters:

In evaluating noise barrier performance, you will be working with different kinds of "distances" between the sound source, the observer, and the barrier.

Actual Distance – the existing distance that would be measured using a tape measure with no corrections or adjustments. This may mean one of two things, *depending on the application;* either the:

- *slant distance* – the actual distance,

Example 11: Road No. 2 has a stop sign at 390 feet from NAL No. 2. There is also a road gradient of 4 percent. No heavy trucks are allowed on this road, but a schedule shows an average of 12 large buses pass along the road per hour between 7 a.m. and 10 p.m., although no buses are scheduled during the remaining nighttime period. The buses are equally divided in each direction along the road. (Remember large buses, those that carry over 15 seated passengers, count as heavy trucks.)

We find the ADT for the "heavy trucks" (the buses in this case) by multiplying the average number of vehicles per hour by the number of hours between 7 a.m. and 10 p.m. That is, 12 x 15 = 180, or 90 vehicles in each direction. We find from Table 6 that the gradient adjustment factor for uphill traffic is 2.0. We find the truck volume adjusted for gradient is

uphill: $90 \times 2.0 = 180$
downhill: $= 90$
total (column 21) $= 270$ *vehicles*

From Table 8, we find the adjustment factor for stop-and-go traffic to be 1.8.

We also remember that we have no buses in the nighttime period and find the factor in Table 5 on page 8 for zero nighttime operations to be 0.43.

Our final adjusted ADT is (column 24)

$1.8 \times 0.43 \times 270 = 209$ *Vehicles*

From Workchart 2, with an effective distance of 174 feet, we find a DNL of 59 dB.

Example 12a: Road No. 3 is a depressed highway and the profile shields all residential levels of the housing from line of sight to the traffic. The average truck speed is 50 mph. The ADT for heavy trucks is 4400 vehicles. We adjust for average speed (from Table 7)

$4400 \times 0.81 = 3564$

and find from Workchart 2 that, with an effective distance of 270 feet, the DNL from truck noise would be 69 dB if no barrier existed. We proceed to analyze the barrier attenuation.

measured along the line of sight between two points; or the

- *map distance* – the actual distance, measured on a horizontal plane, between the two points, as on a map or on the project plan.

For an observer high in an apartment tower, the slant distance to the road may be much longer than the map distance.

Barrier effectiveness is expressed in terms of noise attenuation in decibels (dB), determined with the aid of Workchart 6. This numerical value is subtracted from the previously calculated DNL in order to find the resultant DNL at the Noise Assessment Location.

Note: A noise barrier can be considered as a means of protecting a site from noise even if it cannot wrap around the site to shield from view practically all of the source of noise at every sensitive location on the site. It must be recognized, however, that such a barrier is much less effective than an ideal barrier. (See Workchart 7 and Step 6 below.)

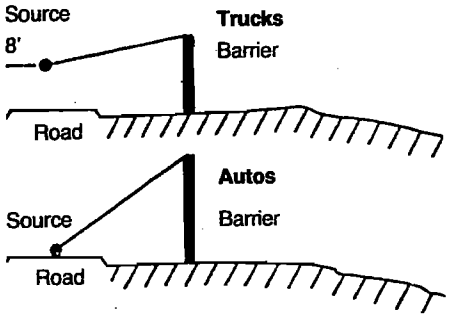
Barriers of reasonable height cannot be expected to protect housing more than a few stories above ground level. Barriers will generally protect the ground and the first two or three floors, but not the higher floors. If there are to be frequently occupied balconies on the upper levels, one solution is to move the building farther from the noise source and face the sensitive areas away from the noise.

Steps to Evaluate a Barrier

1. For the observer's position, use the mid-height of the highest residential level. For the source position, use the following heights (see Figure 7):

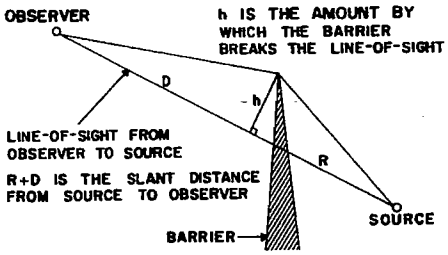
- autos, medium trucks, railway cars – the road or railway surface height
- heavy trucks – 8 feet above the road surface
- diesel locomotives or trains using horns or whistles at grade crossings – 15 feet above the rails.

Figure 7.
Source Heights to Be Used in Roadway Barrier Designs



Get accurate values for the following quantities: h, the shortest distance from the barrier top to the line of sight from source to observer; R and D, the slant distances along the line of sight from the barrier to the source and observer, respectively (see Figure 8).

Figure 8.
Generalized Geometry of Acoustical Barrier



Specifically, R and D are the two segments into which h breaks the line of sight. Note that h is *not* the height of the barrier above the ground but the distance from the barrier top to the line of sight.

2. Enter at the top of Workchart 6 with the value of h on the left-hand scale; move right to intersect the curve corresponding to R (or D, whichever is *smaller*).

3. Move down to intersect the curve corresponding to the value of D/R (or R/D, whichever is *smaller*).

4. Move right to intersect the vertical scale in order to find the barrier shielding value A in decibels.

5. Interruption of the line of sight with a barrier between the noise source and an observer reduces the amount of sound attenuation provided by the ground. Find the amount of this loss B from the table on Workchart 6 by entering the table with the value of D/R. Find the barrier attenuation value S corresponding to an ideal barrier that completely hides the noise source from view by subtracting B from the value of A obtained in Step 4.

6. If the barrier exists along only a part of the road so that unshielded sections of the road would be visible from the site, the barrier is less effective than an ideal barrier. On a plan view of the site, locate the two ends of the barrier and draw lines from these points to the Noise Assessment Location. Use a protractor to measure the angle formed at the NAL by the two lines. Enter the horizontal scale of Workchart 7 with the values of this angle; read up to the curve having the value of S determined from Step 5 (interpolating if necessary); read left across to the vertical scale labeled "actual barrier performance" to find the value of FS to use for the actual barrier in question.

7. Subtract the barrier attenuation value S (or FS if adjusted for finite barrier length according to Workchart 7) from the value of DNL previously determined to reevaluate the site with the noise barrier in place.

Example 12b: (Refer to Figure 9.) Six stories are planned for the housing where the site has an elevation of 130 feet. The effective elevation for the highest story is found by multiplying the number of stories by 10 feet, adding the site elevation, and subtracting 5 feet.

(6 × 10) + 130 - 5 = 185 feet

The barrier, which in this case is formed by the road profile, has no "height" other than the elevation of the natural terrain above the noise sources traveling on the roadway. The important dimensions are indicated in Figure 9.

Some people with a technical background will be able to fit the geometric diagram to the site situation readily, working from the project drawings and a scratch sheet.

But if you are *not* confident of your geometry, Workchart 5 gets you the values of R, D, and h from the map distances and elevations of the site. We illustrate that procedure in this example.

First, enter the elevations of the source (S), the observer (O), and the top of the barrier (H), as well as the map distances from the barrier to the source (R') and observer (D'), at the top right of Workchart 5. Then, follow the steps on that Workchart to derive the values of h, R, and D that are needed in using Workchart 6.

Entering Workchart 6 at the upper left with the value of h (5.5 feet), we move horizontally

Figure 9.
Detail of Site Showing Measurements Necessary for a Barrier Adjustment

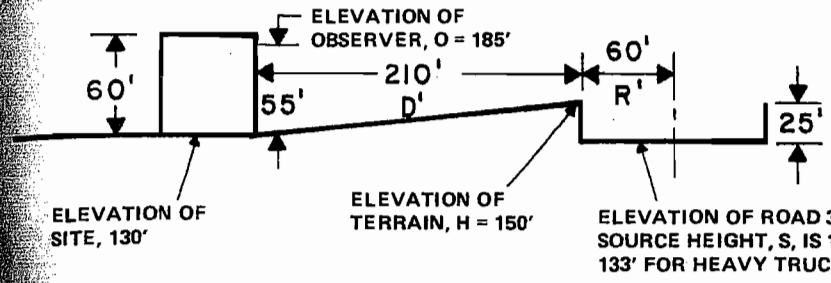
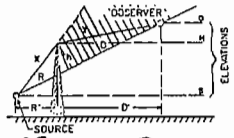


Figure 10.
Use of Workchart 5 to Determine Barrier Dimensions in Example 12b

Workchart 5
Noise Barrier
To find R, D and h from Site Elevations and Distances

Enter the values for:
H= 150 R'= 60
S= 133 D'= 210
O= 185



Carry out the following worksheet (all quantities are in feet):

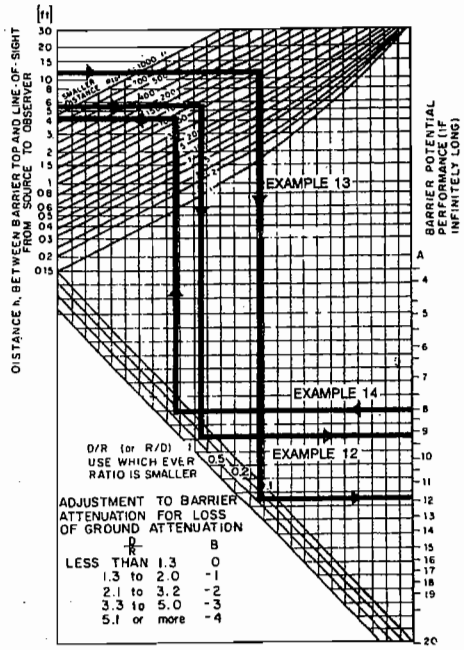
Elevation of barrier top minus elevation of source	[11 150] − [5 133]	= [1 17]	
Elevation of observer minus elevation of source	[0 185] − [5 133]	= [2 52]	
Line distance between source and observer (R' + D')		[3 270]	
Line distance between barrier and source (R')		[4 60]	
Line 2 divided by line 3	[2 52] ÷ [3 270]	= [5 0.19]	
Square the quantity on line 5 (i.e., multiply it by itself); always positive	[5 0.19] × [5 0.19]	= [6 0.04]	
0.4 times line 6	[0.4] × [6 0.04]	= [7 0.016]	
1.0 minus line 7	[1.0] − [7 0.016]	= [8 0.984]	
Line 5 times line 4 (will be negative if line 2 is negative)	[5 0.19] × [4 60]	= [9 11.4]	
Line 1 minus line 9	[1 17] − [9 11.4]	= [10 5.6]	
Line 10 times line 8	[10 5.6] × [8 0.984]	= [11 5.5]	= h
Line 5 times line 10	[5 0.19] × [10 5.6]	= [12 1.06]	
Line 4 divided by line 8	[4 60] ÷ [8 0.984]	= [13 61]	
Line 13 plus line 12	[13 61] + [12 1.06]	= [14 62]	= R
Line 3 minus line 4	[3 270] − [4 60]	= [15 210]	
Line 15 divided by line 8	[15 210] ÷ [8 0.984]	= [16 213]	
Line 16 minus line 12	[16 213] − [12 1.06]	= [17 212]	= D

Note: The value on line 2 may be negative, in which case the values on lines 5, 9, and 12 will also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: x + (-y) = x-y. And subtracting a negative number is like adding: X-(-y) = x + y

Round off R and D to nearest integer, h to one decimal place

Figure 11.
Use of Workchart 6 to Evaluate Barrier in Examples 12b, 13 and 14

Noise Barrier Workchart 6



right until we meet the value of R or D, ever is smaller: in this example, R = 62 rom that point we drop vertically down- until we meet the value of R/D or D/R, ever is smaller: in this case, R/D = rom that point, move horizontally to to find the value for A = 9 dB. Enter- able for determining loss of ground tion effect due to the barrier with a of D/R of 3.5, the reduction in tion (B) is found to be 3 dB. cting 3 dB from 9 dB provides a net tion of 6 dB. With 6 dB of attenuation, nal DNL of 69 dB (Example 12a) is to 63 dB.

Example 13: An alternative approach, which is somewhat more direct, is illustrated here for the noise of automobiles on Road No. 3.

A preliminary step is to make an accurately scaled sketch of the general geometry introduced on page 8. It must include the positions of the source (this time at the road surface), the observer, and the top of the barrier; and will show the distances h, R, and D. Such a sketch is shown superimposed on the profile of the road and its neighborhood in Figure 12.

If we carefully scale the dimensions directly from this sketch, we find the following values for h, R, and D:

R=63 feet

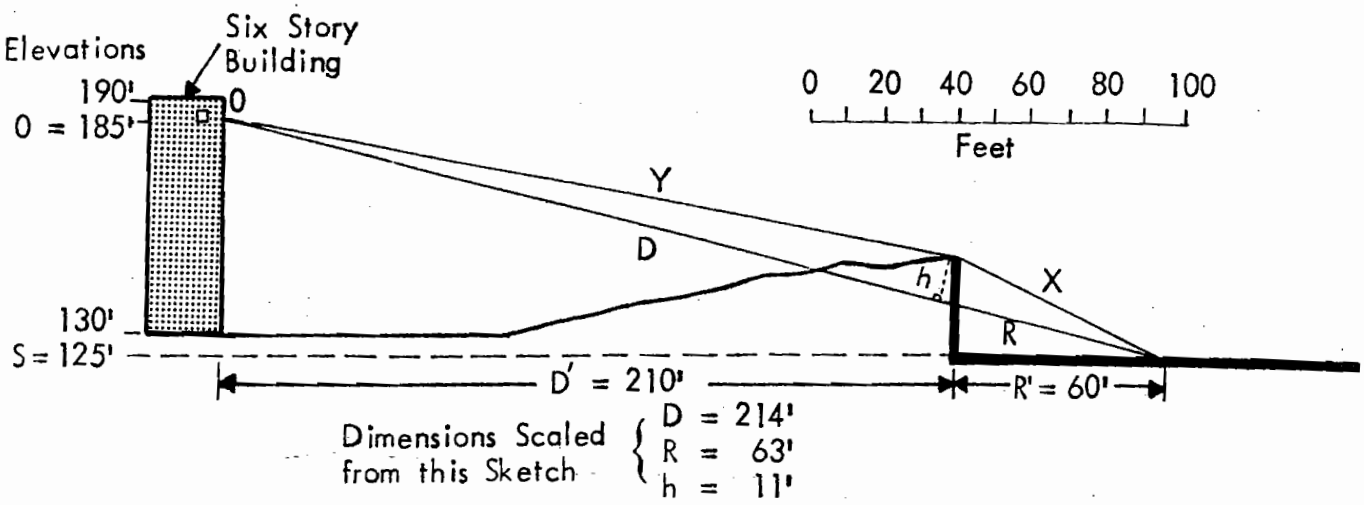
R/D=0.3

D=214 feet

h=11 feet

The barrier attenuation is found, by entering Workchart 6 with these values, to be A=12 dB. It is larger than that found for trucks because the noise source is lower and is, therefore, better shielded by the barrier. The loss from ground attenuation is again B=3 dB for a net attenuation of 12 - 3 = 9 dB. In Example 9b, we found that the DNL

Figure 12.
Sketch Showing Dimensions for Example 13



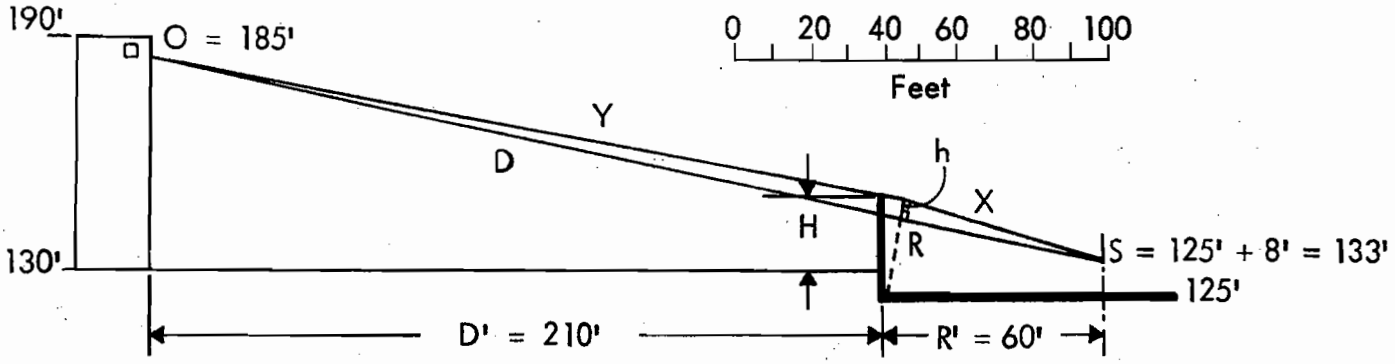
for the projected traffic volume of 100,000 vehicles per day was 69 dB if no consideration was given the shielding provided by the terrain. Subtracting the 9 dB attenuation from 69, we find the partial DNL for automobiles is 60 dB.

In order to find the combined truck and automobile noise for Road No. 3, we combine the 63 dB of truck noise with the 60 dB of automobile noise using Table 1. We find that 1.8 should be added to 63 dB, for a combined DNL of 64.8 dB, or 65 dB when rounded to the nearest whole number.

Example 14: Where no natural barrier exists, Workchart 6 can be used in reverse to estimate the height of a barrier needed to obtain a required attenuation. In example 9b we found that, without any attenuation from terrain or a barrier, the automobile traffic produced a DNL of 69 dB, and in Example 12a the heavy truck traffic produced a DNL of 69 dB. When combined, the total DNL is 72 dB. Suppose the terrain were not rising between NAL and Road No. 3, as shown in Figure 12, but instead was level between the NAL and the edge of the road, as shown in Figure 13. We want to find out how high a wall, infinite in length, would be required at the edge of the road to reduce the combined truck and automobile noise to less than 65 dB. We have found in the previous examples that a barrier of a given height will provide more attenuation for automobiles than it will for trucks. As a first step in our analysis, we will find the height of a wall that will reduce the truck noise to just below 65 dB, say 64 dB, and then find out whether the additional attenuation it provides for automobile noise will be sufficient to reduce the combined truck and automobile noise to less than 65 dB. We begin by finding the height of wall that will provide 5 dB attenuation for truck noise.

We estimate that the ratio of R/D is about the same as R'/D', the ratio of horizontal distance in Figure 13, which is equal to 0.29. Before entering Workchart 6, we find from the loss of ground attenuation table that for D/R = 3.4 we will lose 3 dB attenuation from an ideal barrier. In order to have a net attenua-

Figure 13.
Sketch Showing Dimensions for Example 14



tion of 5 dB, we must have an ideal barrier that provides 5 + 3 = 8 dB attenuation.

Entering Workchart 6 on the right side scale A at 8 decibels, we move across to the diagonal lines, finding 0.29 by interpolating between the lines marked at 0.2 and 0.5. Moving directly up to a point midway between the R lines of 50 and 70, we find our estimated R of approximately 60. Moving across to the left we find that the line of sight between the observer and the truck source height must be broken by a value of h equal to 4.5 feet.

We can determine the height of the wall H in several ways. By drawing h=4.5 feet to scale on Figure 13, we can scale the total wall height H to be approximately 20 feet. Those who feel comfortable with geometry can calculate H by using the similar triangle relationships in Figure 13 to determine that H is 19.1 feet.

Now we must find how much a wall 19 feet high will attenuate automobile noise, remembering that the source height for automobiles is at the road surface elevation of 125 feet. By scaling the drawing, or by geometry, we determine that the line of sight between the observer position and the automobile source is broken by a value of h that is approximately 13 feet. Entering Workchart 6 at 13 feet we find, for R=60 feet and R/D=0.29, that the potential barrier attenuation is 12dB. We must reduce this by 3 dB for loss of ground attenuation to find the actual shielding of automobile noise to be 9 dB. The original 69 dB of automobile noise is reduced to 69 - 9 = 60 dB.

Finally, we combine the heavy truck noise, attenuated by the wall to 69 - 5 = 64 dB, with the automobile noise reduced to 60 dB, to find a combined DNL of 65.5 dB, or 66 dB when rounded upward. Remember, however, that this is for an infinite wall. Further adjustments would have to be made once the actual length was known.

Necessary Information

To evaluate a site's exposure to railway noise, you will need to consider all rapid transit lines and railroads within 3000 feet of the site (except totally covered subways). The information required for this evaluation is listed below under headings that indicate the most likely source.

Before beginning the evaluation, you should record the following information on Worksheet D:

From the area map and/or the (County) Engineer:

- The distance from the appropriate NAL on the site to the center of the railway track carrying most of the traffic.

From the Supervisor of Customer Relations for the railway:

- The number of diesel trains and the number of electrified trains in both directions during an average 24-hour day.
- The fraction of trains that operate during nighttime (10 p.m. - 7 a.m.) If this is unknown, assume 0.15.
- The average number of diesel locomotives per train. If this is unknown, assume 2.
- The average number of railway cars per diesel train and per electrified train. If this is unknown, assume 50 for diesel trains and 8 for electrified trains.
- The average train speed. If this is unknown, assume 30 mph.
- Is the track made from welded or bolted rails?

From the Engineering Department of the railway:

- Is the site near a grade crossing that requires prolonged use of the train's horn or whistle? if so, where are the whistle posts located? (Whistle posts are signposts which tell the engineer to start blowing the horn or whistle. Every grade crossing has whistle posts and they are listed on the railroad's "track charts." If traffic on the track is one-way, there will be only one whistle post. The grade crossing itself is the other "whistle post."

Electrified rapid transit and commuter trains that do not use diesel engines should be treated the same as railway cars.

Note: Buildings closer than 100 feet to a railroad track are often subject to excessive vibration transmitted through the ground. Construction at such sites is discouraged.

Evaluation of Site Exposure to Railway Noise

Railway noise is produced by the combination of diesel engine noise and railway car noise. These Guidelines provide for the separate evaluation of diesel locomotives and railroad cars, and then the combination of the two, in order to obtain the DNL from trains. When rapid transit or electrified trains that do *not* use diesel engines are the only trains passing near a site go directly to the second part of the evaluation since these trains are treated in the same manner as railway cars.

Diesel Locomotives

Workchart 3 was derived with the following assumptions:

- A clear line of sight exists between the railway track and the Noise Assessment Location.
- There are two diesel locomotives per train.
- The average train speed is 30 mph.
- Nighttime operations are 0.15 of the 24-hour total.
- The site is not near a grade crossing requiring prolonged use of the train's horn or whistle.

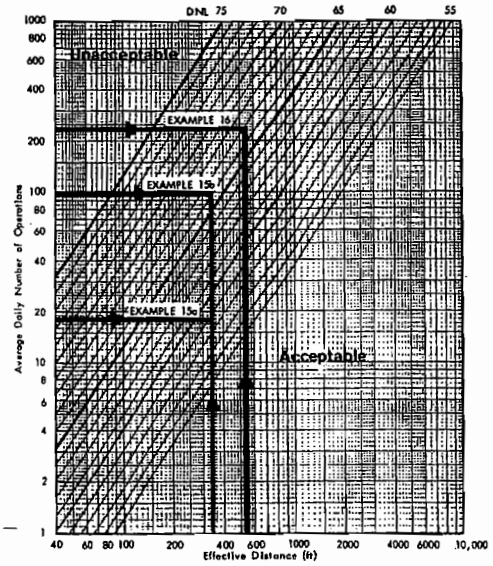
If the situation meets these conditions, proceed to Workchart 3 for an immediate evaluation of diesel locomotive noise.

But:

If any of the conditions is different, make the necessary adjustments listed below and *then* use Workchart 3 for the evaluation.

Figure 14.
Use of Workchart 3 to Evaluate Diesel Locomotive Noise

Railroads – Diesel Locomotives



Adjustments for Diesel Locomotives

Number of Locomotives:

If the average number of diesel locomotives per train is not 2, divide the average number by 2. Enter this value in column 9 of Worksheet D.

Example 15a: The distance from NAL number 1 to Railway Number 1 is 339 feet. Two percent of the 35 daily operations occur at night; there is clear line of sight between the tracks and the NAL, and no horns or whistles are used. No information is available on train size or speed, therefore we will assume 2 engines per train and a speed of 30 mph.

Since the percentage of nighttime operations is different from 15 percent, we must adjust the actual number of daily operations, multiplying by 0.50 according to Table 5.

0.50 x 35 = 17.5 = 18

Entering Workchart 3 with 18 daily operations and a distance of 339 feet, we find that the contribution of diesel engine noise is a DNL of 59 dB (see Figure 14).

In order to find the total contribution of the trains to the total DNL, we must also find the noise level produced by the train's cars. Entering Workchart 4 (see Figure 15) with 18 daily operations and a distance of 339 feet, we find the DNL is below 50 on the chart, or more than 10 decibels lower than the noise level produced by the engines. Based on the chart for decibel addition, the combination of the noise from the engines and the cars adds less than 0.5 decibels to the DNL value for the engines alone, 59 dB.

Example 15b: Suppose that a forecast of train operations for Railway 1 indicates that there will still be 35 trains per day, but now 50 percent of the operations will occur at night, the average train will have 4 engines and 75 cars, and the average speed will be 50 mph.

We first find the contribution to DNL made by diesel locomotives by using the following adjustment factors:

- number of engines adjustment: 2
- speed adjustment: 0.60
- day/night adjustment: 2.34

We multiply these adjustments together with the number of trains:

2 X 0.60 X 2.34 X 35 = 98

Entering Workchart 3 (see Figure 14) with 98 daily operations and a distance of 339

Average Train Speed:

If the average train speed is different from 30 mph, find the appropriate adjustment factor from Table 9 and list in column 10 of Worksheet D.

Table 9

Average Speed (mph)	Speed Adjustment Factor
10	3.00
20	1.50
30	1.00
40	0.75
50	0.60
60	0.50
70	0.43

Horns or Whistles:

If the NAL is perpendicular to any point on the track between the whistle posts for the grade crossing, enter the number 10 in column 11, Worksheet D.

Nighttime Adjustment:

Remember to adjust for nighttime operations, if different from 0.15 of the total, by selecting the appropriate adjustment factor from Table 5 on page 8. Enter in column 12, Worksheet D.

Multiply the adjustment factors together, times the number of diesel trains per day (you have listed this number previously on line 2a, page 1, of Worksheet D, and should enter this number again in column 13) to obtain the adjusted number of trains per day. Enter the adjusted number of diesel trains per day in column 14. Use this value, in conjunction with the distance from the NAL to the track (line 1, page 1, of Worksheet D), to find from Workchart 3 the DNL produced by diesel locomotives. List in column 15 of Worksheet D.

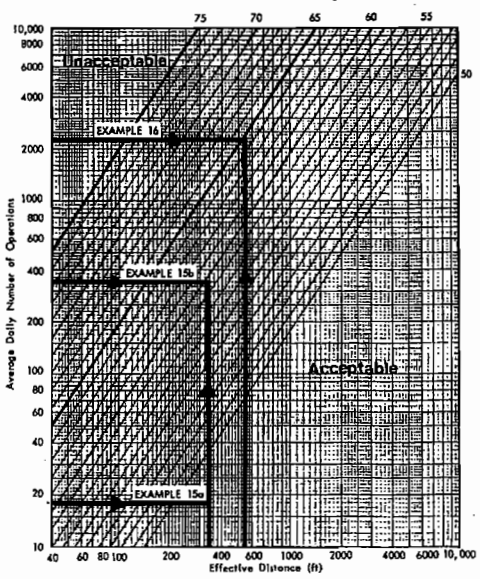
Railway Cars and Rapid Transit Systems

Workchart 4 was derived with the following assumptions:

- A clear line of sight exists between the railway and the NAL.
- There are 50 cars per train.
- The average train speed is 30 mph.
- Nighttime operations are 0.15 of the 24-hour total.
- Rails are welded together.

If the situation meets these conditions, proceed to Workchart 4 for an immediate evaluation of railway car noise. Again, if any of the conditions is different, make the necessary adjustments listed below and then use Workchart 4 for the evaluation.

Figure 15.
Use of Workchart 4 to Evaluate Railway Car Noise



Adjustments for Railway Cars and Rapid Transit Trains

Number of Cars:

Divide the average number of cars by 50 and enter this number in column 18 of Workchart D.

Average Speed:

Make this adjustment, if the average speed is not 30 mph, by selecting the appropriate value from Table 10, entering it in column 19 of Worksheet D.

Table 10

Average Speed (mph)	Speed Adjustment Factor
10	0.11
20	0.44
30	1.00
40	1.78
50	2.78
60	4.00
70	5.44
80	7.11
90	9.00
100	11.11

Bolted Rails:

Enter the number 4 in column 20 of Worksheet D.

Nighttime Adjustment:

Enter the appropriate adjustment factor from Table 5 in column 21 of Worksheet D.

---

feet, we find that the site has an engine noise contribution to DNL of 66 dB.

We next obtain the adjustment factors for the noise produced by the cars:

- number of cars adjustment: 1.50
- speed adjustment: 2.78
- day/night adjustment: 2.34

Multiplying the adjustment factors times the average daily number of trains:

1.5 X 2.78 X 2.34 X 35 = 342

Entering Workchart 4 (see Figure 15) with 342 operations and a distance of 339 feet, we find the contribution of the cars to the DNL is 60 dB. Using Table 1 for combining levels, we find that the 6 dB difference between engine noise at 66 and car noise at 60 gives a combined DNL of 67 dB for these trains.

Example 16: The distance from NAL number 2 to Railroad Number 2 is 550 feet; there are 100 operations per day, of which 30 percent occur at night. A clear line of sight exists between the site and the railroad, and no horns or whistles are used nearby. An average train on this track uses 4 engines, has 100 cars, the average speed is 40 miles per hour, and the track has bolted, not welded, rails.

We first find the adjustment factors for the diesel engines:

- number of engines adjustment: 2
- speed adjustment: 0.75
- day/night adjustment: 1.57

Multiplying the adjustments together, times the number of trains:

2 X 0.75 X 1.57 X 100 = 236

Entering Workchart 3 (see Figure 14) with 236 operations at a distance of 550 feet, we find the DNL contribution from engine noise to be 67 dB.

Next we find the adjustment factors for the railroad cars:

- number of cars adjustment: 2
- speed adjustment: 1.78
- bolted track adjustment: 4
- day/night adjustment: 1.57

Multiplying the adjustments together, times the number of trains:

2 X 1.78 X 4 X 1.57 X 100 = 2236

Entering Workchart 4 (see Figure 15) with

(Continued next page)

Figure 16.
Sketch Showing Dimensions for Example 16

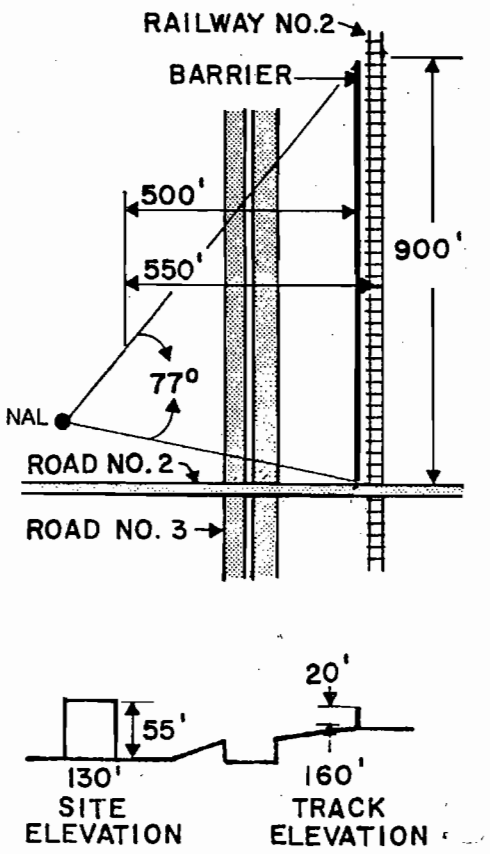


Figure 17.
Use of Workchart 6 in Example 16

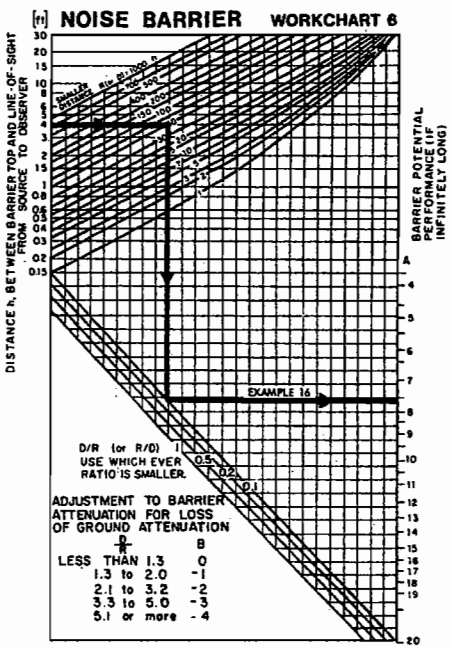
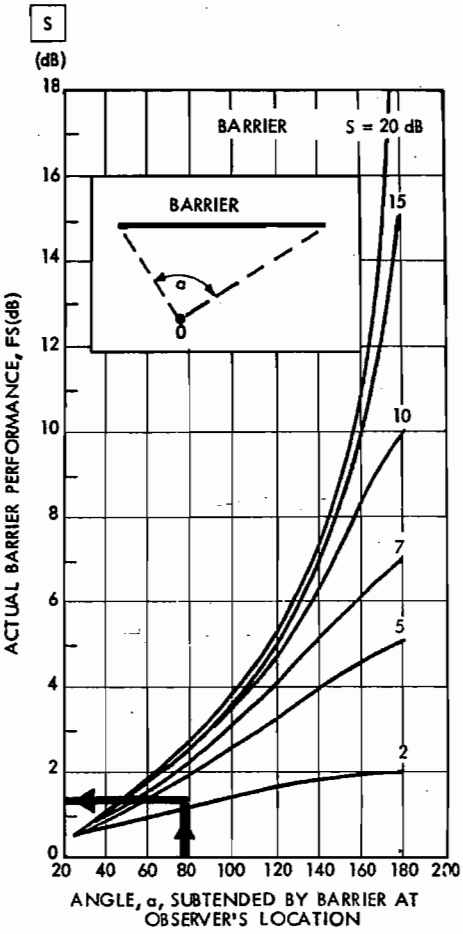


Figure 18.
Use of Workchart 7 in Example 16



2236 operations at a distance of 550 feet, we find the DNL contribution from the railroad cars to be 65 dB. Combining the engine sound levels with the car sound levels we find the total DNL from the trains to be 69 dB.

It would be possible to erect a 20-foot noise barrier, running parallel to the track at a distance of 50 feet; it could start at Road Number 2 and run 900 feet north toward the airport, as shown in Figure 16. Both the railroad track and the ground level at the barrier location are at an elevation of 160 feet. Thus, we have the following values with which to calculate the potential reduction in engine noise (using Workchart 5). (Because the distances involved are so unequal, this situation does not lend itself to direct scaling of the distances.)

H = 180 feet (20' above the ground)

S = 175 feet (15' above the track, see page 19)

0 = 285 feet (from Example 11 in the section on roadway noise)

R' = 50 feet

D' = 500 feet

We find from Worksheet 5 that the values of R and D are no different (within the accuracy of the calculation) from R' and D', a situation that will always occur when the differences in elevation are so much smaller than the distances from the site to the noise source. The value of h is 4 feet; R/D = 0.1

We can now use these numbers to enter Workchart 6 to find the *potential* barrier performance (that is, the barrier adjustment factor that would apply in the case of an infinitely long barrier). Entering Workchart 6 at h = 4 feet, with R/D = 0.1, we find the basic attenuation of the barrier to be 7.5 dB. However, with D/R = 10, we find from the table of loss-of-ground-effect attenuation that we must subtract 4 dB from the 7.5, or a net effect of 3.5 dB. However, the situation is even worse, since the barrier is finite in length.

To find the actual attenuation for this *finite* barrier, we must first find the angle subtended by the barrier to the NAL. Referring to Figure 16, we draw lines from the NAL each end of the barrier. With

References

1. D.E. Bishop, A.P. Hays, "Handbook for Developing Noise Exposure Contours for General Aviation Airports," FAA-AS-75-1, December 1975 (NTIS No. AD-A023429).

2. D.E. Bishop, et al., "Calculation of Day-Night Levels Resulting From Civil Aircraft Operations," BBN Report 3157 for Environmental Protection Agency, March 1976 (NTIS No. PB 266 165).

3. B.A. Kugler, D.E. Commins, W.J. Galloway, "Highway Noise – A Design Guide for Prediction and Control," NCHRP Report 174, Transportation Research Board, National Research Council, 1976.

4. T.J. Schultz, W.J. Galloway, "Noise Assessment Guidelines – Technical Background," Office of Policy Development and Research, U.S. Department of Housing and Urban Development," 1980.

5. M.A. Simpson, "Noise Barrier Design Handbook," FHWA-RD-76-58, Federal Highway Administration, February 1976 (NTIS No. PB 266 378).

a protractor we measure the angle between the two lines to be 77 degrees. Locate the curve on Workchart 7 corresponding to the potential barrier attenuation of 3.5 dB; it lies midway between the two lowest curves (see Figure 18). The point on this curve corresponding to a subtended angle of 77 degrees indicates that the actual barrier performance would be only 1.5 dB. With only 1.5 dB of attenuation, the barrier is clearly not cost-effective. In order to achieve a usable attenuation from the barrier, it would have to be extended beyond the other side of Road Number 2 to obtain a larger subtended angle. This extension, however, would still not be cost-effective unless the height of the barrier were increased substantially.

Summary of Adjustment Factors

Combination of Sound Levels

Table 1

Difference in Sound Level	Add to Larger Level
0	3.0
1	2.5
2	2.1
3	1.8
4	1.5
5	1.2
6	1.0
7	0.8
8	0.6
9	0.5
10	0.4
12	0.3
14	0.2
16	0.1
greater than 16	0.

Aircraft

Table 2 DNL Outside 65 dB Contour

D^1 = distance from 65 dB contour to flight path
D^2 = distance from site to flight path

D2 / D1	DNL dB
1.0	65
1.12	64
1.26	63
1.41	62
1.58	61
1.78	60
2.00	59
2.24	58
2.51	57
2.82	56
3.16	55

Automobile Traffic

Table 3 Stop-and-go

Distance from Site to Stop Sign feet	Automobile Stop-and-go Adjustment Factor
0	0.10
100	0.25
200	0.40
300	0.55
400	0.70
500	0.85
600	1.00

Table 4 Average Traffic Speed

Average Traffic Speed	Adjustment Factor
20 (mph)	0.13
25	0.21
30	0.30
35	0.40
40	0.53
45	0.67
50	0.83
55	1.00
60	1.19
65	1.40
70	1.62

Table 5 Nighttime (applies to all sources)

Nighttime Fraction of ADT	Nighttime Adjustment Factor
0	0.43
0.01	0.46
0.02	0.50
0.05	0.62
0.10	0.81
0.15	1.00
0.20	1.19
0.25	1.38
0.30	1.57
0.35	1.78
0.40	1.96
0.45	2.15
0.50	2.34

Medium Trucks

(less than 26,000 pounds, greater than 10,000 pounds)

Multiply adjusted automobile traffic by 10.

Heavy Trucks

Table 6 Road Gradient

Percent of Gradient	Adjustment Factor
2	1.4
3	1.7
4	2.0
5	2.2
6 or more	2.5

Table 7 Average Speed

Average Traffic Speed (mph)	Truck Speed Adjustment Factor
50 or less	0.81
55	1.00
60	1.17
65	1.38

Table 8 Stop-and-go

Heavy Truck Traffic Volume per Day	Heavy Truck Stop-and-Go Adjustment Factor
Less than 1200	1.8
1201 to 2400	2.0
2401 to 4800	2.3
4801 to 9600	2.8
9601 to 19,200	3.8
More than 19,200	4.5

Railroads - Diesel Engines

Number of Engines per Train
The number of engines divided by 2.

Table 9 Average Train Speed

Average Speed (mph)	Speed Adjustment Factor
10	3.00
20	1.50
30	1.00
40	0.75
50	0.60
60	0.50
70	0.43

Whistles or horns
Multiply number of trains by 10.

Railroads - Cars and Rapid Transit

Numbers of cars.
Number of cars per train divided by 50.

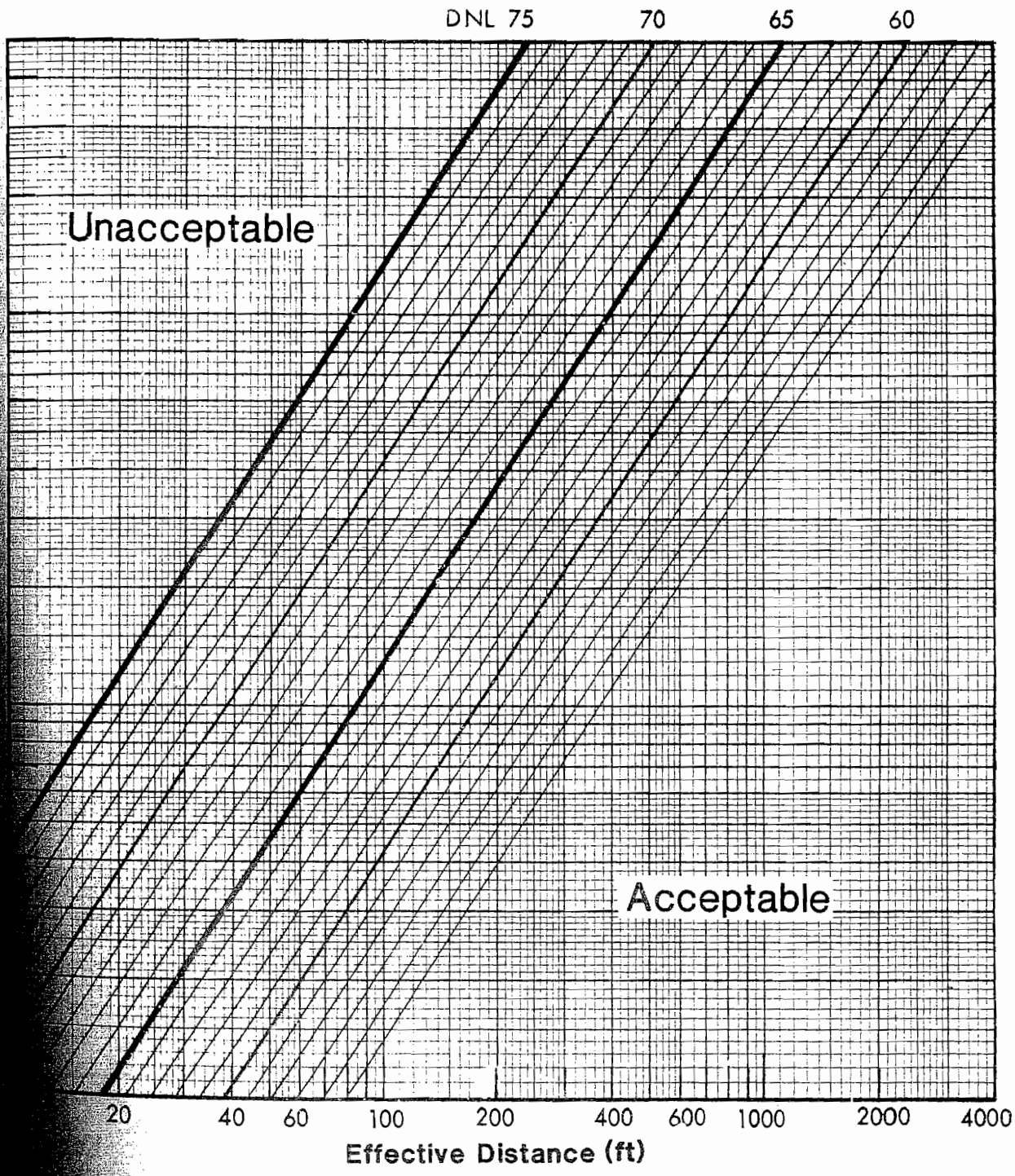
Table 10 Average Train Speed

Average Speed (mph)	Speed Adjustment Factor
10	0.11
20	0.44
30	1.00
40	1.78
50	2.78
60	4.00
70	5.44
80	7.11
90	9.00
100	11.11

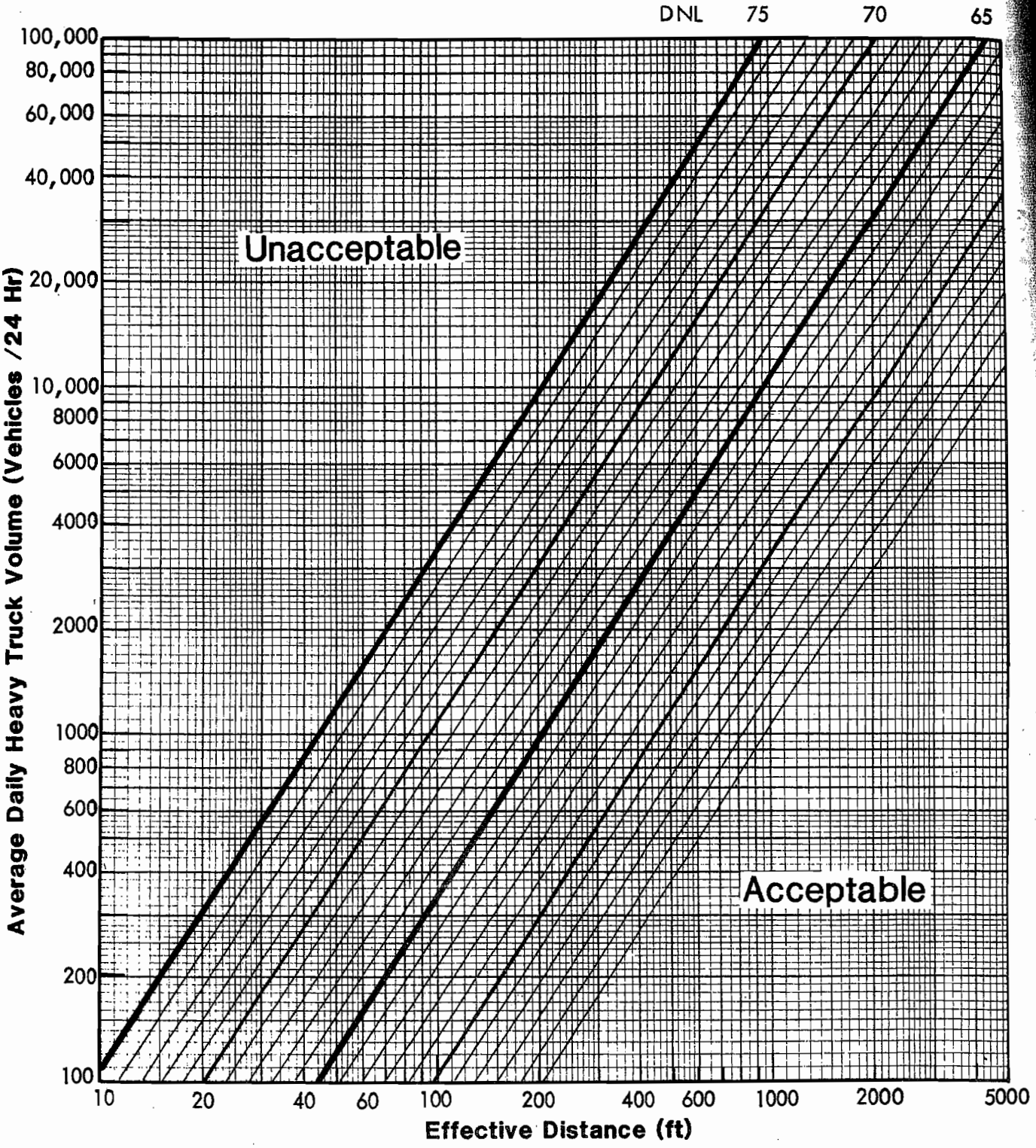
Bolted Rails
Multiply number of trains by 4.

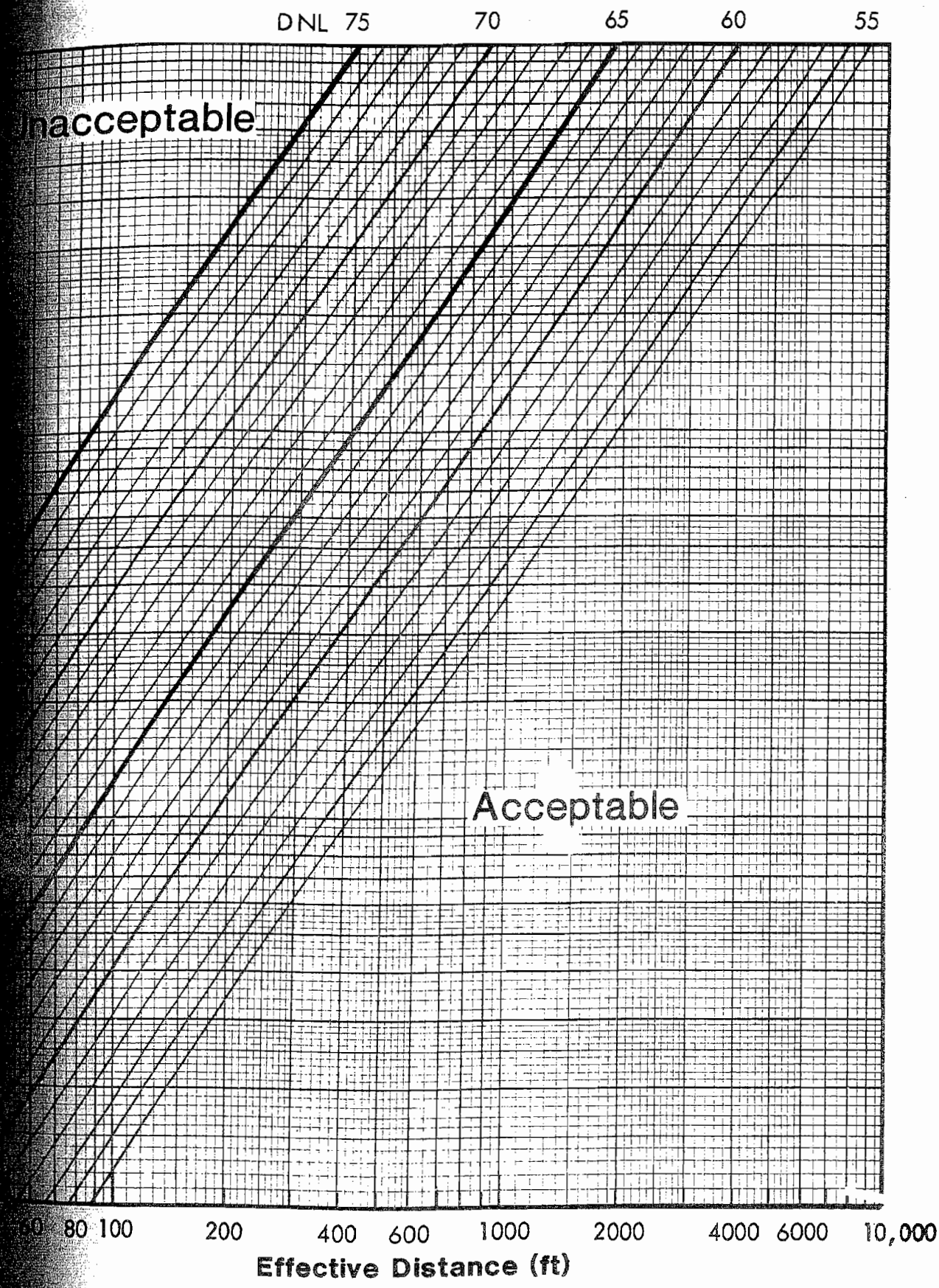
Whistles or Horns
Multiply number of trains by 100.

kchart 1
os (55 mph)



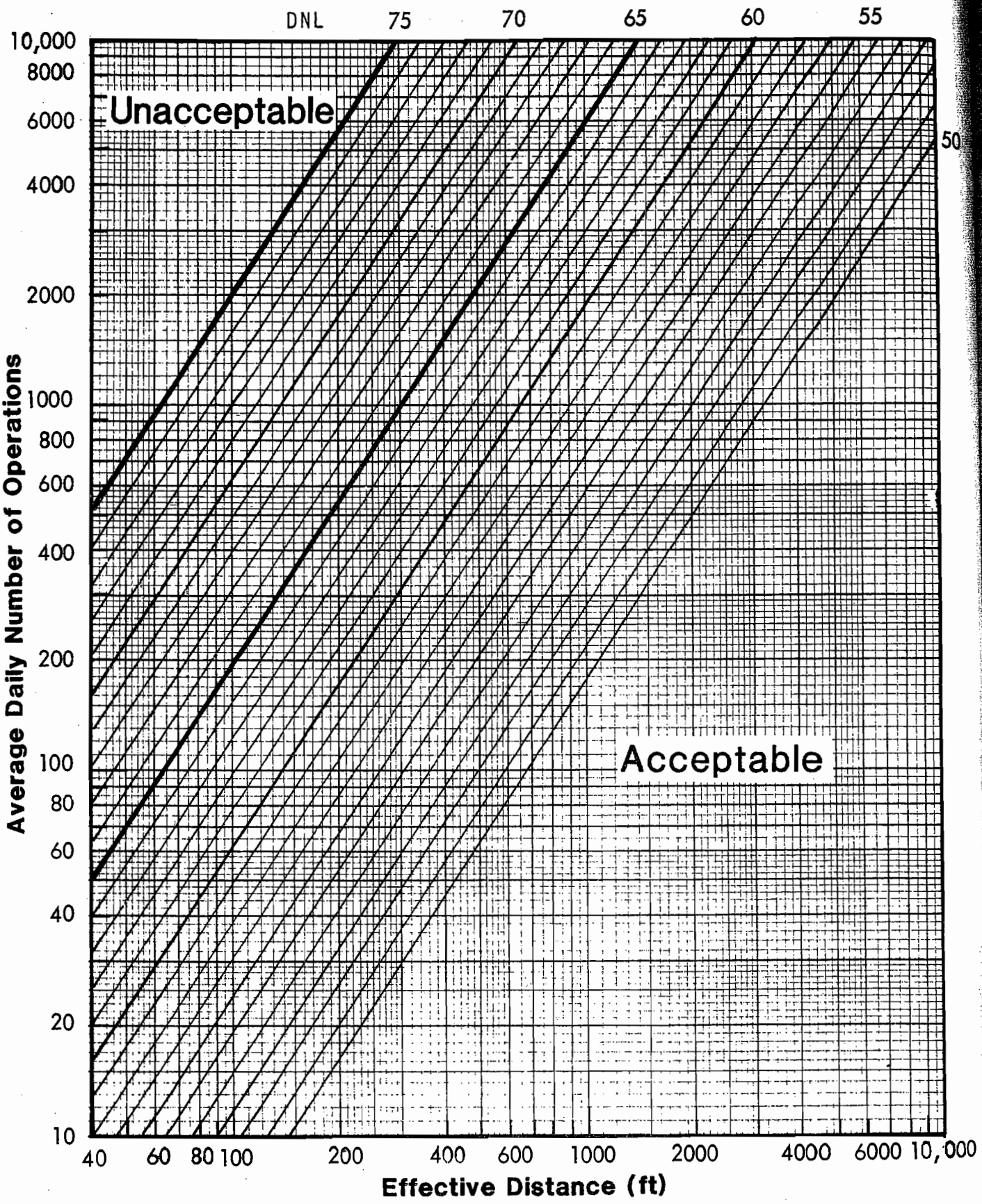
Workchart 2
Heavy Trucks (55 mph)




DNL 75
70
65
60
55
Unacceptable
Acceptable
80 100
200
400
600
1000
2000
4000
6000
10,000
Effective Distance (ft)

21

Workchart 4
Railroads - Cars and Rapid Transit



22

Workchart 5
Noise Barrier

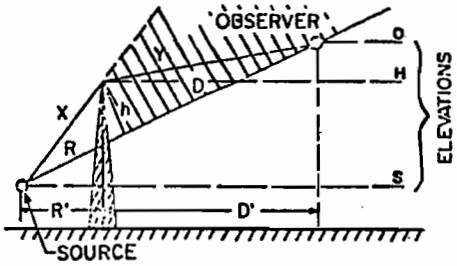
To find R, D and h from Site Elevations and Distances

Enter the values for:

H=_____ R'=_____

S=_____ D'=_____

O=_____



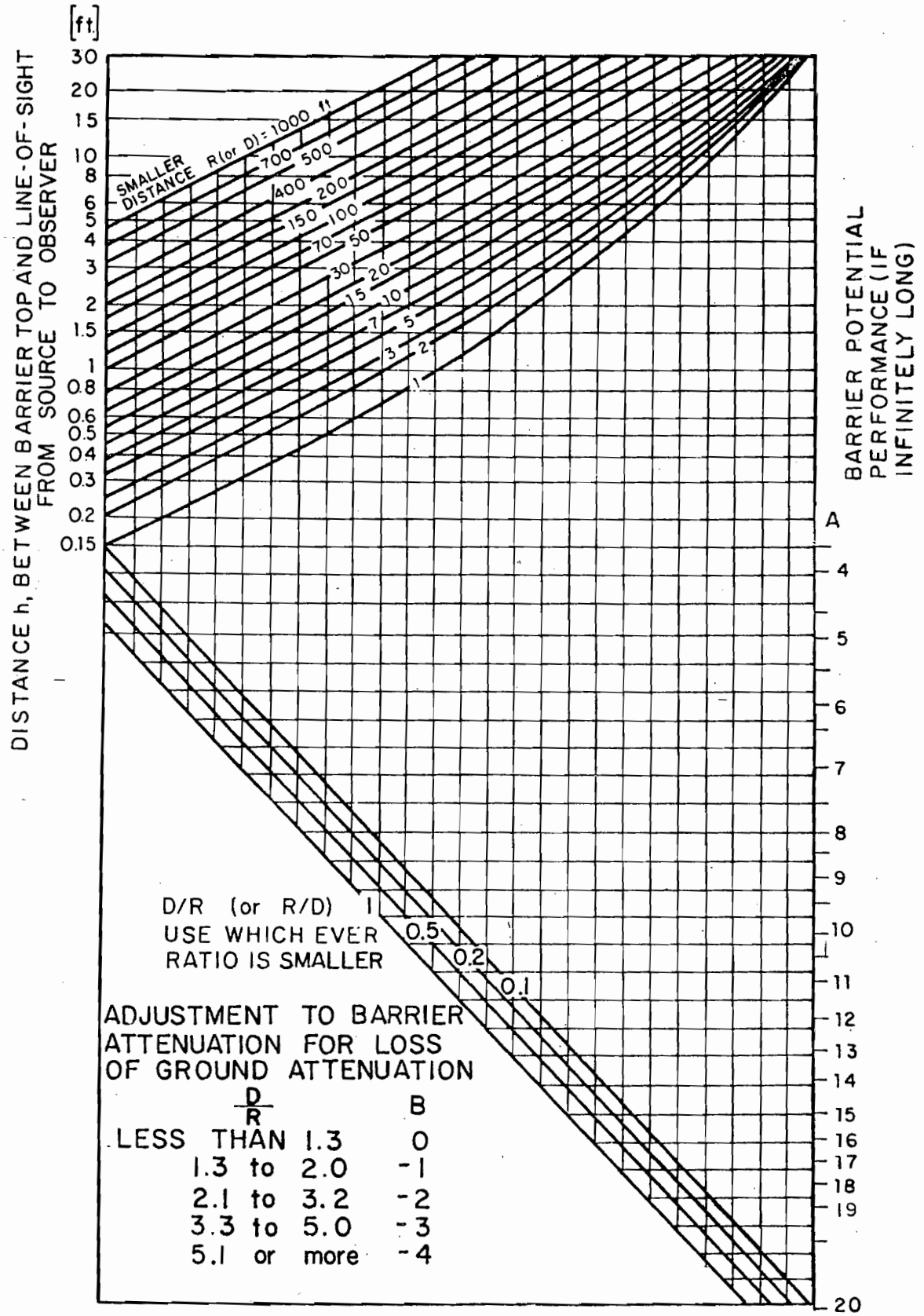
Fill out the following worksheet (all quantities are in feet):

1. Elevation of barrier top minus elevation of source	[H	] −	[S	] =	[1	]	
2. Elevation of observer minus elevation of source	[O	] −	[S	] =	[2	]	
3. Map distance between source and observer (R' + D')					[3	]	
4. Map distance between barrier and source (R')					[4	]	
5. Line 2 divided by line 3	[2	] ÷	[3	] =	[5	]	
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[5	] ×	[5	] =	[6	]	
7. 40% of line 6	[0.4	] ×	[6	] =	[7	]	
8. One minus line 7	[1.0	] −	[7	] =	[8	]	
9. Line 5 times line 4 (will be negative if line 2 is negative)	[5	] ×	[4	] =	[9	]	
10. Line 1 minus line 9	[1	] −	[9	] =	[10	]	
11. Line 10 times line 8	[10	] ×	[8	] =	[11	]	= h
12. Line 5 times line 10	[5	] ×	[10	] =	[12	]	
13. Line 4 divided by line 8	[4	] ÷	[8	] =	[13	]	
14. Line 13 plus line 12	[13	] +	[12	] =	[14	]	= R
15. Line 3 minus line 4	[3	] −	[4	] =	[15	]	
16. Line 15 divided by line 8	[15	] ÷	[8	] =	[16	]	
17. Line 16 minus line 12	[16	] −	[12	] =	[17	]	= D

If the value on line 2 may be negative, in which case so will the values on lines 5,9, and 12; R may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: x+(-y)=x-y. And subtracting a negative number is like adding: x-(-y)=x+y.

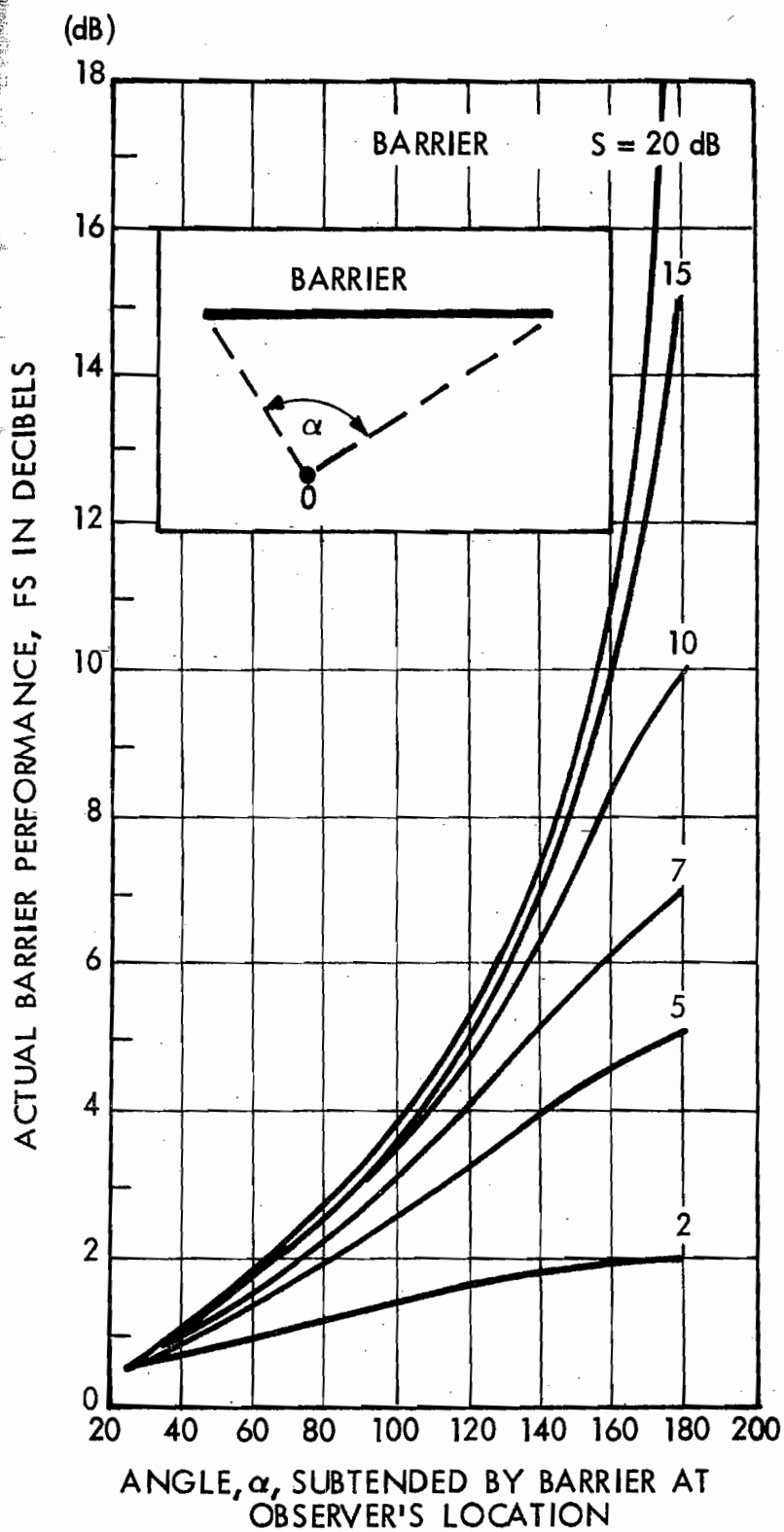
Round off R and D to nearest integer, h to one decimal place.

Workchart 6
Noise Barrier



Workchart 7

FS



Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

Worksheet A
Site Evaluation

Site Location

Program

Project Name

Locality

File Number

Sponsor's Name | Phone

Street Address | City, State

	Acceptability Category	DNL	Predicted for Operations in Year
1. Roadway Noise			
2. Aircraft Noise			
3. Railway Noise			

Value of DNL for all noise sources: (see page 3 for combination procedure)

Final Site Evaluation (circle one)

Acceptable

Normally Unacceptable

Unacceptable

Signature _____ Date _____

Clip this worksheet to the top of a package containing Worksheets B-E and Workcharts 1-7 that are used in the site evaluations

List all airports within 15 miles of the site:

1. _____

2. _____

3. _____

Necessary Information:	**Airport 1**	**Airport 2**	**Airport 3**
1. Are DNL, NEF or CNR contours available? (yes/no)			
2. Any supersonic aircraft operations? (yes/no)			
3. Estimating approximate contours from Figure 3:			
a. number of nighttime jet operations			
b. number of daytime jet operations			
c. effective number of operations (10 times a + b)			
d. distance A for 65 dB			
70dB			
75 dB			
e. distance B for 65 dB			
70 dB			
75 dB			
4. Estimating DNL from Table 2:			
a. distance from 65 dB contour to flight path, D^1			
b. distance from NAL to flight path, D^2			
c. D^2 divided by D^1			
d. DNL			
5. Operations projected for what year?			
6. Total DNL from all airports			

Signed _____ Date _____

List all major roads within 1000 feet of the site:

1. _____

2. _____

3. _____

4. _____

Necessary information	**Road 1**	**Road 2**	**Road 3**	**Road 4**
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane				
b. farthest lane				
c. average (effective distance)				
2. Distance to stop sign				
3. Road gradient in percent				
4. Average speed in mph				
a. Automobiles				
b. heavy trucks - uphill				
c. heavy trucks - downhill				
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles				
b. medium trucks				
c. effective ADT (a + (10xb))				
6. 24 hour average number of heavy trucks				
a. uphill				
b. downhill				
c. total				
7. Fraction of nighttime traffic (10 p.m. to 7 a.m.)				
8. Traffic projected for what year?				

Adjustments for Automobile Traffic

	9 Stop and-go Table 3		10 Average Speed Table 4		11 Night-Time Table 5		12 Auto ADT (line 5c)		13 Adjusted Auto ADT		14 DNL (Workchart 1)		15 Barrier Attenuation		16 Partial DNL
Road No. 1		X		X		X		=				–		=	
Road No. 2		X		X		x		=				–		=	
Road No. 3		X		X		X		=				–		=	
Road No. 4		X		X		X		=				–		=	

Adjustments for Heavy Truck Traffic

	17 Gradient Table 6		18 Average Speed Table 7		19 Truck $\frac{ADT}{2}$		20	21	22 Stop and-go Table 8		23 Night-Time Table 5		24 Adjusted Truck ADT		25 DNL (Work-chart 2)		26 Barrier Attn.		27 Partial DNL
Uphill		X		X		=													
Road No. 1								Add		X		X		=		–		=	
Downhill				X		=													
Uphill		X		X		=													
Road No. 2								Add		X		X		=		–		=	
Downhill				X		=													
Uphill		X		X		=													
Road No. 3								Add		X		X		=		–		=	
Downhill				X		=													
Uphill		X		X		=													
Road No. 4								Add		X		X		=		–		=	
Downhill				X		=													

Combined Automobile & Heavy Truck DNL

Road No. 1 _____ Road No. 2 _____ Road No. 3 _____ Road No. 4 _____ Total DNL for All Roads _____

Signature _____ Date _____

List All Railways within 3000 feet of the site:

1. _____

2. _____

3. _____

Necessary Information:	**Railway No. 1**	**Railway No. 2**	**Railway No. 3**
1. Distance in feet from the NAL to the railway track:			
2. Number of trains in 24 hours:			
a. diesel			
b. electrified			
3. Fraction of operations occuring at night (10 p.m. – 7 a.m.):			
4. Number of diesel locomotives per train:			
5. Number of rail cars per train:			
a. diesel trains			
b. electrified trains			
6. Average train speed:			
7. Is track welded or bolted?			
8. Are whistles or horns required for grade crossings?			

Adjustments for Diesel Locomotives

	9 No. of Locomotives / 2	10 Average Speed Table 9	11 Horns (enter 10)	12 Night-time Table 5	13 No. of Trains (line 2a)	14 Adj. No. of Opns.	15 DNL Workchart 3	16 Barrier Attn.	17 Partial DNL
Railway No. 1	_____ X	_____ X	_____ X	_____ X	_____ =	_____	_____ –	_____ =	_____
Railway No. 2	_____ X	_____ X	_____ X	_____ X	_____ =	_____	_____ –	_____ =	_____
Railway No. 3	_____ X	_____ X	_____ X	_____ X	_____ =	_____	_____ –	_____ =	_____

Adjustments for Railway Cars or Rapid Transit Trains

	18 Number of cars / 50	19 Average Speed Table 10	20 Bolted Rails (enter 4)	21 Night-time Table 5	22 No. of Trains (Line 2a or 2b)	23 Adj. No. of Opns.	24 DNL Work-chart 4	25 Barrier Attn.	26 Partial DNL
Railway No. 1	_____ X	_____ X	_____ X	_____ X	_____ =	_____	_____ –	_____ =	_____
Railway No. 2	_____ X	_____ X	_____ X	_____ X	_____ =	_____	_____ –	_____ =	_____
Railway No. 3	_____ X	_____ X	_____ X	_____ X	_____ =	_____	_____ –	_____ =	_____

Combined Locomotive and Railway Car DNL

Railway No. 1 _____ Railway No. 2 _____ Railway No. 3 _____ Total DNL for all Railways _____

Signature_____ Date_____

Chapter 6

A Workbook for the Noise Assessment Guidelines

Introduction

The following problems were prepared to give you the opportunity to practice the calculations and procedures described in the *Noise Assessment Guidelines*. Because it is so rarely used, we have not included any problems dealing with the aircraft noise procedure.

We have not reproduced the charts or tables from the *Guidelines* so you will need to have it at hand to do the problems.

Noise Assessment Guidelines Workbook

Problems

Problems 1 Through 7: Combining Sound Levels in Decibels

Calculate the Combined Sound Level for the Following Sets of Individual Levels:

1. 67 LDN
   61 LDN
   _____ Combined Level

2. 63 LDN
   63 LDN
   _____ Combined Level

3. 51 LDN
   68 LDN
   _____ Combined Level

4. 62 LDN
   65 LDN
   _____ Combined Level

5. 67 LDN
   72 LDN
   _____ Combined Level

6. 59 LDN
   63 LDN
   71 LDN
   _____ Combined Level

7. 73 LDN
   72 LDN
   61 LDN
   67 LDN
   _____ Combined Level

Problems 8 and 9: Calculating Effective Distance

Calculate the Effective Distances for the Following Roads:

8. Distance in Feet from NAL to:

Near Edge of Nearest Lane	22 Feet
Far Edge of Farthest Lane	76 Feet
Effective Distance	_____

9. Distance in Feet from NAL to:

Near Edge of Nearest Lane	60 Feet
Far Edge of Farthest Lane	84 Feet
Effective Distance	_____

Problems 10 Through 15: Adjustment Factors

List The Adjustment Factors Necessary for Each of the Following Situations and the Numerical Value for Each Adjustment Factor.

10. A Roadway Where the Road Gradient Is 1%, the Average Speed for Both Autos and Trucks Is 30 MPH and the Fraction of Nighttime Traffic is 10%.

    Adjustment Factors Needed: _____

    _____

    _____

    Value of Adjustment Factors: _____

    _____

    _____

11. A Roadway Where There Is A Stop Sign 400 Feet from the NAL. The Gradient Is 1%, the Average Speed for Autos Is 45 MPH (There Are No Trucks) and the Fraction of Nighttime Traffic Is 15%.

    Adjustment Factors Needed: _____

    _____

    _____

    Value of Adjustment Factors: _____

    _____

    _____

12. A Roadway Where the Road Gradient Is 2%, the Average Speed for Autos Is 50 MPH and for Trucks (Both Uphill and Downhill) Is 50 MPH and the Fraction of Nighttime Traffic Is 10%.

Adjustment Factors Needed: _____

_____

_____

Value of Adjustment Factors: _____

_____

13. A Railroad Where the Fraction of Operations Occurring at Night Is 30%, the Average Train Speed Is 40 MPH, the Track Is Bolted and There Are No Whistle Or Horns Required for Grade Crossings.

Adjustment Factors Needed: _____

_____

_____

Value of Adjustment Factors: _____

_____

_____

14. A Railroad Where the Fraction of Operations Occurring at Night Is 5%, the Average Train Speed Is 10 MPH, the Tracks Are Welded and There Are No Whistles Or Horns Required for Grade Crossing.

Adjustment Factors Needed: _____

_____

_____

Value of Adjustment Factors: _____

_____

_____

15. A Railroad Where the Fraction of Operations Occurring at Night Is 20%, the Average Train Speed Is 30 MPH, the Track Is Bolted and No Whistles or Horns Are Required for Grade Crossings.

Adjustment Factors Needed: _____

_____

_____

Value of Adjustment Factors: _____

_____

_____

Problems 16 Through 21: Some Basic Problems

Calculate the Combined Noise Levels for Each of the Following Situations:

16. A Roadway Where the distance in Feet from the NAL to the Near Edge of the Nearest Lane Is 310 Feet, the Distance to the Far Edge of the Farthest Lane Is 358 Feet. There Is A Stop Sign 400 Feet from the NAL. The Gradient Is 1%. The Average Number of Automobiles Is 17,000, the 24 Hour Average Number of Medium Trucks Is 1,500, the 24 Hour Average Number of Heavy Trucks Is 400 Total. The Fraction of Nighttime Traffic Is 20%.

    The Combined Noise Level for This Roadway Is _____.

17. A Site Exposed to Noise from Two Roads. For Roadway Number 1 the Distance in Feet from the NAL to the Near Edge of the Nearest Lane Is 125 Feet, the Distance to the Far Edge of the Farthest Lane Is 233 Feet. There Is A Stop Sign 250 Feet from the NAL. The Gradient Is 3%. The Average Speed for Both Autos and Trucks Is 30 MPH.

    The 24 Hour Average Number of Autos Is 22,000, the 24 Hour Average Number of Medium Trucks Is 2,000. The 24 Hour Average Number of Heavy Trucks Is 950 Total. The Fraction of Nighttime Traffic Is 10%.

    For Roadway Number 2, the Distance to the Near Edge of the Nearest Lane Is 45 Feet, the Distance to the Far Edge of the Farthest Lane Is 93 Feet. There Is A Stop Sign 100 Feet from the NAL and the Gradient Is 1%. The Average Speed for Both Autos and Heavy Trucks Is 30 MPH. The 24 Hour Average Number of Automobiles Is 14,000, for Medium Trucks 700, and for Heavy Trucks 600 Total. The Fraction of Nighttime Traffic Is 20%.

    The Combined Noise Level for This Site Is _____

18. A Site Exposed to Noise from Two Railroads. For Railroad 1, the Distance in Feet from the NAL to the Railway Track Is 150 Feet. There Are 35 Diesel Trains Every 24 Hours, No Electrified Trains. The Fraction of Operations Occurring at Night Is 25%. There Are 3 Diesel Locomotives Per Train and 70 Cars Per Train. The Average Speed Is 30 MPH and the Track Is Bolted. No Whistles Or Horns Are Used.

    For Railroad 2, the Distance in Feet from the NAL to the Railway Track Is 310 Feet. There Are 20 Diesel and 2 Electrified Trains Each 24 Hours. The Fraction of Operations Occurring at Night Is 15%. There Are 2 Locomotives Per Diesel Train and 45 Cars for Each Diesel Train and 15 Cars Per Electrified Train. The Average Train Speed Is 40 MPH and the Track Is Bolted. No Horns Or Whistles Are Used.

    The Combined Noise Level for This Site Is _____.

19. A Site Exposed to Noise from Two Railroads. For Railroad 1, the Distance in Feet from the NAL to the Railway Track Is 75 Feet. There Are 34 Diesel Trains Every 24 Hours, No Electrified Trains. Twenty Percent of the Operations Occur at Night. There Are 5 Locomotives Per Train and 75 Cars Per Train. The Average Train Speed Is 35 MPH and the Track Is Welded. No Horns Or Whistles.

    For Railway 2, the Distance in Feet from the NAL to the Railway Track Is 120 Feet. There Are 12 Diesel Trains in 24 Hours, No Electrified Trains. Twenty-Five Percent of the Operations Occur at Night. There Are 4 Locomotives Per Train and 40 Cars Per Train. The Average Train Speed Is 20 MPH and the Track Is Bolted. No Horns Or Whistles Are Used.

    The Combined Noise Level for This Site Is _____

20. A Site Exposed to Noise from Three Roads. For Road 1, the Distance in Feet from the NAL to the Near Edge of the Nearest Lane Is 100 Feet, to the Far Edge of the Farthest Lane, 208 Feet. There Is No Stop Sign and the Gradient Is 1%. The Average Speed for Autos Is 55 MPH. (There Are No Trucks Allowed On This Road.) The 24 Hour Average Number of Autos Is 40,000. The Fraction of Nighttime Traffic Is 15%.

    For Road 2, the Distance from the NAL to the Near Edge of the Nearest Lane Is 45 Feet, to the Far Edge of the Farthest Lane 75 Feet. There Is A Stop Sign 175 Feet from the NAL and the Road Gradient Is 4%. The average Speed for Both Autos and Trucks Is 40 MPH. The 24 Hour Average Number of Autos Is 15,000, for Medium Trucks 900 and for Heavy Trucks 320 Total. The Fraction of Nighttime Traffic Is 20%.

    For Road 3, the Distance from the NAL to the Near Edge of the Nearest Lane Is 52 Feet, to the Far Edge of the Farthest Lane 92 Feet. There Is A Stop Sign 400 Feet from the NAL and the Gradient Is 1%. The Average Speed for Both Autos and Trucks Is 25 MPH. The 24 Hour Average Number of Autos Is 5,000, for Medium Trucks 1,050 and for Heavy Trucks 175 Total. The Fraction of Nighttime Traffic Is 20%.

    The Combined Noise Level for This Site Is _____.

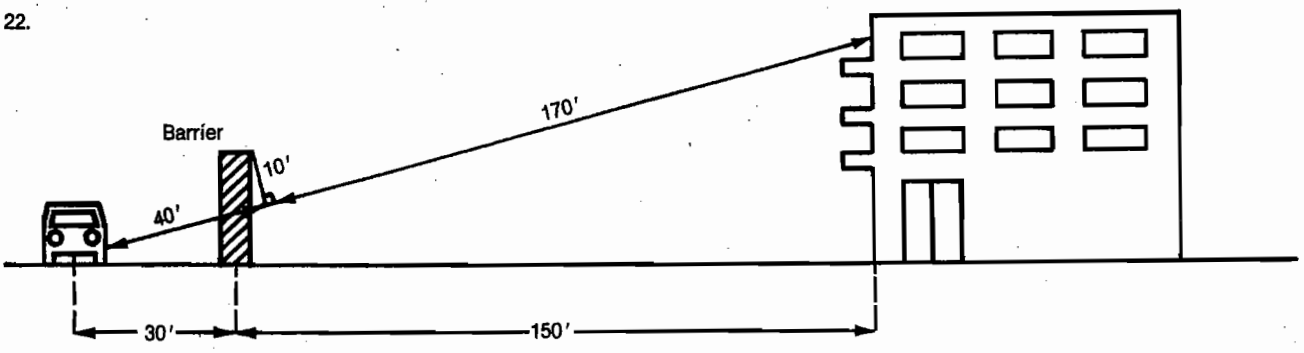
21. A Site Exposed to Noise from A Railroad. The Distance from the NAL to the Railroad Is 110 Feet. There Are 30 Diesel Trains Every 24 Hours, No Electrified Trains. Twenty Percent of the Operations Occur at Night. There Are 3 Locomotives Per Train and 50 Cars Per Train. The Average Train Speed Is 30 MPH, the Track Is Bolted and There Is A Grade Crossing Where Horns and Whistles Are Used 100 Feet from the NAL.

The Combined Noise Level at This Site Is _____.

Problems 22 Through 24: Barriers - Identifying the Values for H, R, R', D and D'

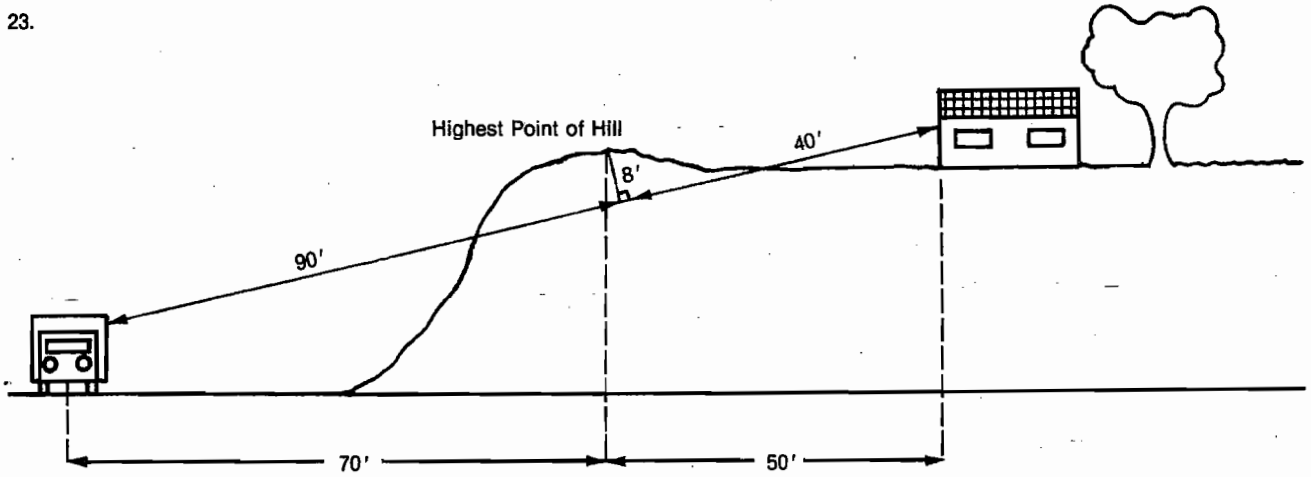
Identify the Values for H, R, R', D and D' for Each of the Following Barriers:

22.



H = _____, R = _____, R' = _____ D = _____ and D' = _____

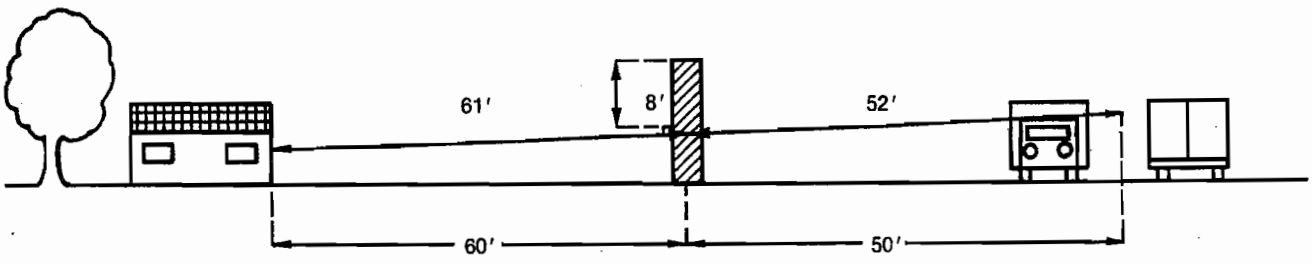
23.



H = _____, R = _____, R' = _____, D = _____ and D' = _____

Barrier	40'	10'	170'	90'	70'
Highest Point of Hill	30'	150'		8'	50'
				40'	

24.



H = _____, R = _____, R' _____, D = _____ and D' _____

Problems 25 Through 27: Barrier Calculations Using Workcharts 6 and 7.

Using Workcharts 6 and 7 Only, Calculate the Noise Attenuation Provided by the Barriers Illustrated in Problems 22 Through 24. Additional Data on the Angles Subtended by the Ends of the Barriers and the NAL for Each Location Is Provided.

25. Calculate the Noise Attenuation Provided by the Barrier Described In Problem 22. The Angle Subtended by the Ends of the Barrier and the NAL Is 150 Degrees.

    The Noise Attenuation Provided Is _____ Decibels.

26. Calculate the Noise Attenuation Provided by the Barrier Described in Problem 23. The Angle Subtended by the Ends of the Barrier and the NAL Is 90 Degrees.

    The Noise Attenuation Provided Is _____ Decibels.

27. Calculate the Noise Attenuation Provided by the Barrier Described in Problem 24. The Angle Subtended by the Ends of the Barrier and the NAL Is 130 Degrees.

    The Noise Attenuation Provided Is _____ Decibels.

Problems 28 Through 30: Barrier Calculations Using Workcharts 5, 6 and 7

Calculate the Attenuation Provided By the Barriers in the Following Situations. Use Workcharts 5, 6 and 7.

28. A Two Story Building Is Exposed to Noise Levels of 68 LDN from Automobiles. The Barrier Is 15 Feet High and Is Located 40 Feet from the Source and 20 Feet from the Building. The Source, Barrier, and Building Are All On Level Ground. The Angle Subtended by the Ends of the Barrier and the Noise Assessment Location Is 110 Degrees.

    The Noise Attenuation Provided by This Barrier Is _____ Decibels.

    Is This Sufficient? _____

29. A Three Story Building Is Exposed to A Noise Level of 72 LDN from Diesel Locomotives and 60 LDN from Railroad Cars. The Barrier Is 12 Feet High and Is Located 40 Feet from the Source and 85 Feet from the Building. The Barrier and the Building Are on the Same Level, But the Track Is Depressed 25 Feet. The Angle Subtended by the Ends Of the Barrier and the NAL Is 120 Degrees.

    The Noise Attenuation Provided by This Barrier Is _____ Decibels.

    Is This Sufficient? _____

30. A Three Story Building Is Exposed to Noise Levels of 67 LDN from Automobiles and 71 LDN from Trucks. The Barrier Is 16 Feet High and Is Located 36 Feet from the Source and 56 Feet from the Building. The Source, the Barrier and the Building Are All At the Same Level. The Angle Subtended by the Barrier Ends and the NAL Is 130 Degrees.

    The Noise Attenuation Provided by This Barrier Is _____ Decibels.

    Is This Sufficient? _____

Noise Assessment Guidelines Workbook
Answers

Problem

1. 68 LDN (67-61 = 6, Add 1dB (From Table) to 67 = 68 LDN)
2. 66 LDN (63-63 = 0, Add 3dB (From Table) to 63 = 66 LDN)
3. 69 LDN (69-51 = 0, Add 0dB to 69 = 69 LDN)
4. 67 LDN (65-62 = 3, Add 1.8dB to 65, Round Off to Nearest Whole Number, 66.8 = 67 LDN)
5. 73 LDN (72-65 = 5, Add 1.2 = 73.2 = 73 LDN)
6. 72 LDN (63-59 = 4, Add 1.5 = 64.5, 71-64.5 = 6.5
Interpolate From Table: 6 = 1.0, 7 = .8
6.5 = .9) 71 + .9 = 71.9 = 72 LDN)

7. 76 LDN (67-61 = 6, Add 1.0 = 68, 72-68 = 4, Add 1.5 = 73.5, 73.5-73 = .5, Interpolate From Table, Add 2.75 = 76.25 = 76 LDN)

8. 49 Feet (76 + 22 = 98 – 2 = 49)
9. 72 Feet (84 + 60 = 144 – 2 = 72)

10. Adjustment Factors Needed: Speed and Night-Time Percentage

    Value of Factors: Speed = Autos .30
    Trucks .81
    Nighttime
    Percentage .81

    Note—You Must Have Different Speed Adjustments for Autos and Trucks.

11. Adjustment Factors Needed: Speed and Stop and Go Traffic
    Value of Factors: Speed .67
    Stop and Go .70

12. Adjustment Factors Needed: Gradient, Speed and Nighttime Percentage

    Value of Factors: Gradient 1.4
    Speed = Autos .30
    Trucks .81
    Nighttime
    Percentage .81

13. Adjustment Factors Needed: Nighttime Percentage, Speed, Bolted Track

    Value of Factors: Nighttime
    Percentage 1.57
    Speed = Engines .75
    Cars 1.78
    Bolted Track 4

    Note—You Must Have Different Speed Adjustments for Engines and Cars.

14. Adjustment Factors Needed: Nighttime Percentage and Speed

    Value of Factors: Nighttime
    Percentage .62
    Speed = Engines 3.0
    Cars .11

15. Adjustment Factors Needed: Nighttime Percentage and Bolted Track

    Value of Factors: Nighttime
    Percentage 1.19
    Bolted Track 4

16. Combined Noise Level = 62 LDN (If Your Answer Is Plus or Minus 1dB Its OK – Between Rounding Off and the Large Scale on the Nomographs, That's Close Enough)

Worksheet C
Roadway Noise

Page 1

Noise Assessment Guidelines

List all major roads within 1000 ft of the site:

1. _____
2. _____
3. _____
4. _____

Necessary Information	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane	310			
b. farthest lane	358			
c. average (effective distance)	334			
2. Distance to stop sign	400			
3. Road gradient in percent	1%			
4. Average speed in mph				
a. Automobiles	40			
b. heavy trucks - uphill	40			
c. heavy trucks - downhill	40			
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	17000			
b. medium trucks	1500			
c. effective ADT (a + (10xb))	32000			
6. 24 hour average number of heavy trucks				
a. uphill	200			
b. downhill	200			
c. total	400			
7. Fraction of nighttime traffic (10:00 p.m. to 7: a.m.)	20%			
8. Traffic projected for what year?	—			

—

Worksheet C
Roadway Noise

Page 2

Noise Assessment Guidelines

Adjustments for Automobile Traffic

	9 Stop and-go Table 3	10 Average Speed Table 4	11 Night-Time Table 5	12 Auto ADT (line 5c)	13 Adjusted Auto ADT	14 DNL (Workchart 1)	15 Barrier Attenuation	16 Partial DNL
Road No. 1	.70	.53	1.19	32000	.14128	57	0	57
Road No. 2								
Road No. 3								
Road No. 4								

Adjustments for Heavy Truck Traffic

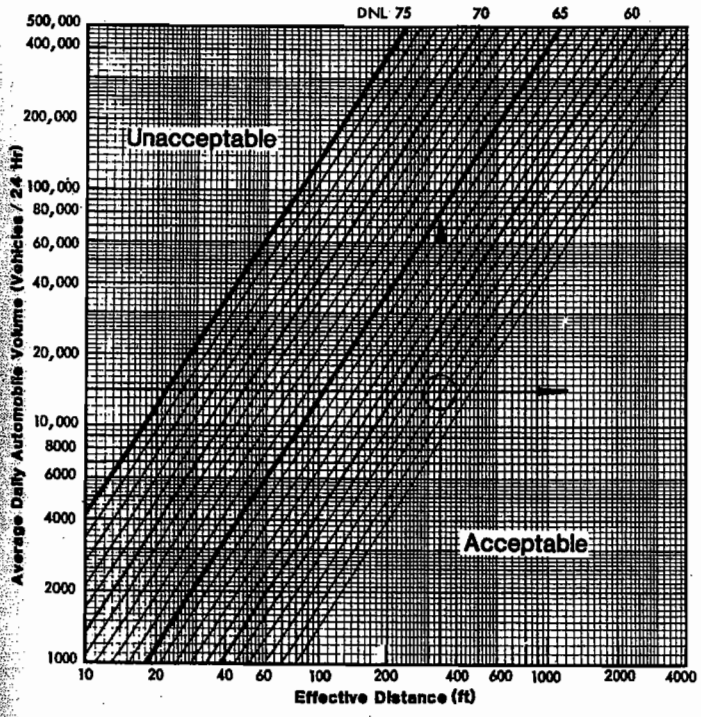
	17 Gradient Table 6	18 Average Speed Table 7	19 Truck ADT / 2	20	21	22 Stop and-go Table 6	23 Night-Time Table 5	24 Adjusted Truck ADT	25 DNL (Work chart 2)	26 Barrier Attn.	27 Partial DNL
Uphill	—	.81	200	162							
Road No. 1					Add 324		1.8	1.19	694	60	0	60
Downhill	.81	200	162								
Uphill											
Road No. 2					Add						
Downhill											
Uphill											
Road No. 3					Add						
Downhill											
Uphill											
Road No. 4					Add						
Downhill											

Combined Automobile & Heavy Truck DNL

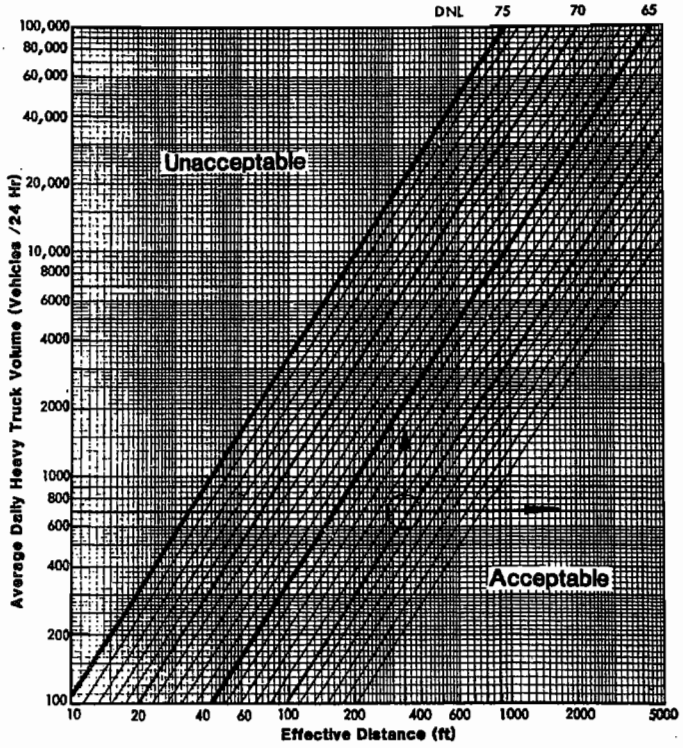
Road No. 1 62 Road No. 2 _____ Road No. 3 _____ Road No. 4 _____ Total DNL for All Roads 62

Signature _____ Date _____

Workchart 1
Autos (55 mph)



Workchart 2
Heavy Trucks (55 mph)



17. Combined Noise Level = 74 LDN (+ OR – 1 dB)

Worksheet C
Roadway Noise

Page 1

Noise Assessment Guidelines

List all major roads within 1000 ft of the site:

1. _____
2. _____
3. _____
4. _____

Necessary Information	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane	125	45		
b. farthest lane	233	93		
c. average (effective distance)	179	69		
2. Distance to stop sign	250	100		
3. Road gradient in percent	3%	1%		
4. Average speed in mph				
a. Automobiles	30	30		
b. heavy trucks - uphill	30	30		
c. heavy trucks - downhill	30	30		
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	22000	14000		
b. medium trucks	2000	700		
c. effective ADT (a + (10xb))	42000	21000		
6. 24 hour average number of heavy trucks				
a. uphill	475	300		
b. downhill	475	300		
c. total	950	600		
7. Fraction of nighttime traffic (10:00 p.m. to 7: a.m.)	10%	20%		
8. Traffic projected for what year?	–	–		

Worksheet C
Roadway Noise

Page 2

Noise Assessment Guidelines

Adjustments for Automobile Traffic

	9 Stop and-go Table 3	10 Average Speed Table 4	11 Night-Time Table 5	12 Auto ADT (line 5c)	13 Adjusted Auto ADT	14 DNL (Workchart 1)	15 Barrier Attenuation	16 Partial DNL
Road No. 1	.48	x .30	x .01	x 42000	= 4899	57	– 0	= 57
Road No. 2	.25	x .30	x 1.19	x 21000	= 1874	59	– 0	= 59
Road No. 3		x	x	x	=		–	=
Road No. 4		x	x	x	=		–	=

Adjustments for Heavy Truck Traffic

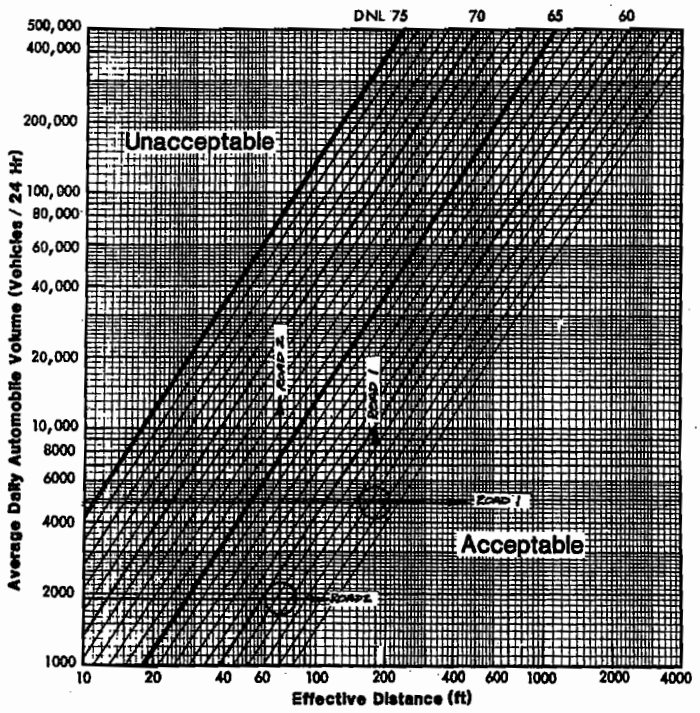
	17 Gradient Table 6	18 Average Speed Table 7	19 Truck ADT (line 5c) / 2	20	21	22 Stop and-go Table 8	23 Night-Time Table 5	24 Adjusted Truck ADT	25 DNL (Work chart 2)	26 Barrier Attn.	27 Partial DNL
Uphill	1.7	x .81	x 475	= 654							
Road No. 1					Add 1089	x 1.8	x .81	= 1515	68	– 0	= 68
Downhill	.81	x 475	= 385								
Uphill	–	x .81	x 300	= 243							
Road No. 2					Add 486	x 1.8	x 1.19	= 1041	72	– 0	= 72
Downhill	.81	x 300	= 243								
Uphill		x	x	=							
Road No. 3					Add	x	x	=		–	=
Downhill		x	=								
Uphill		x	x	=							
Road No. 4					Add	x	x	=		–	=
Downhill		x	=								

Combined Automobile & Heavy Truck DNL

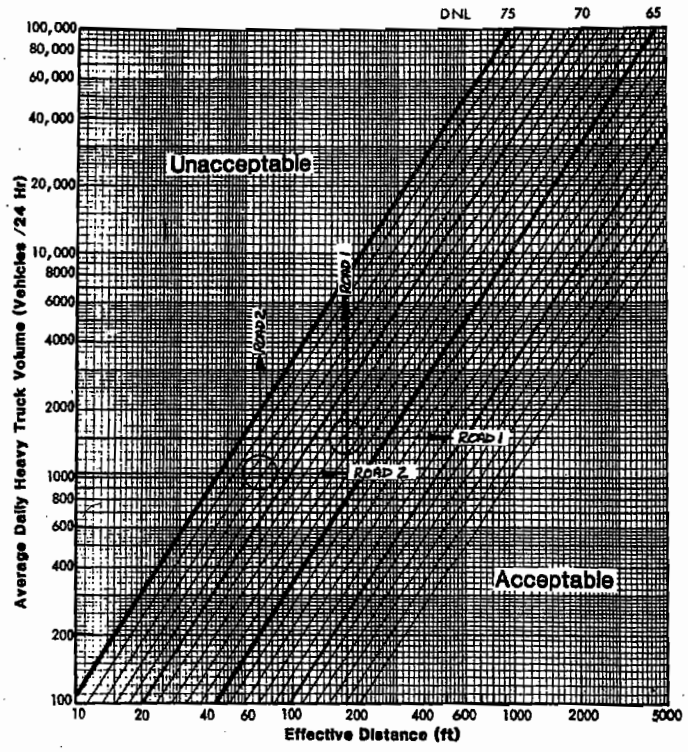
Road No. 1 68 Road No. 2 72 Road No. 3 _____ Road No. 4 _____ Total DNL for All Roads 74

Signature _____ Date _____

Workchart 1
Autos (55 mph)



Workchart 2
Heavy Trucks (55 mph)



18. Combined Noise Level = 71 LDN

Note—In Order to Complete Column 18 for Railway #2 You Must Find the Average Number of Cars Per Train. Multiply the Number of Diesel Trains Times the Number of Cars Per Train ($20 \times 45 = 900$). Multiply the Number of Electrified Trains Times the Number of Cars Per Train ($2 \times 15 = 30$). Add the Two Totals Together and Divide By the Total Number of Trains ($900 + 30 = 930 - 22 = 42$).

Worksheet D **Page 2** **Noise Assessment Guidelines**
Railway Noise

Adjustments for Diesel Locomotives

	9 No. of Locomotives / 2	10 Average Speed Table 9	11 Horns (enter 10)	12 Night-time Table 5	13 No. of Trains (line 2a)	14 Adj. No. of Opns.	15 DNL Workchart 3	16 Barrier Attn.	17 Partial DNL
Railway No. 1	1.5	1.0	–	1.38	35	72	70	0	72
Railway No. 2	1	.75	–	1.0	20	15	58	0	58
Railway No. 3									

Adjustments for Railway Cars or Rapid Transit Trains

	18 Number of cars / 50	19 Average Speed Table 10	20 Bolted Rails (enter 4)	21 Night-time Table 5	22 No. of Trains (Line 2a or 2b)	23 Adj. No. of Opns.	24 DNL Work-chart 4	25 Barrier Attn.	26 Partial DNL
Railway No. 1	1.4	1.0	4	1.38	35	270	64	0	64
Railway No. 2	.84	1.70	4	1.38	22	182	57	0	57
Railway No. 3									

Combined Locomotive and Railway Car DNL

Railway No. 1 71 Railway No. 2 61 Railway No. 3 71 Total DNL for all Railways

Signature _____ Date _____

19. Combined Noise Level = 76 LDN

Worksheet D **Page 2** **Noise Assessment Guidelines**
Railway Noise

Adjustments for Diesel Locomotives

	9 No. of Locomotives / 2	10 Average Speed Table 9	11 Horns (enter 10)	12 Night-time Table 5	13 No. of Trains (line 2a)	14 Adj. No. of Opns.	15 DNL Workchart 3	16 Barrier Attn.	17 Partial DNL
Railway No. 1	2.5	.88	–	1.19	34	89	75	0	75
Railway No. 2	2	1.50	–	1.38	12	50	70	0	70
Railway No. 3									

Adjustments for Railway Cars or Rapid Transit Trains

	18 Number of cars / 50	19 Average Speed Table 10	20 Bolted Rails (enter 4)	21 Night-time Table 5	22 No. of Trains (Line 2a or 2b)	23 Adj. No. of Opns.	24 DNL Work-chart 4	25 Barrier Attn.	26 Partial DNL
Railway No. 1	1.5	1.39	–	1.19	34	84	63	0	63
Railway No. 2	.80	.44	4	1.38	12	23	55	0	55
Railway No. 3									

Combined Locomotive and Railway Car DNL

Railway No. 1 75 Railway No. 2 70 Railway No. 3 _____ Total DNL for all Railways 76

Signature _____ Date _____

20. Combined Noise Level = 75 LDN

Worksheet C
Roadway Noise

Page 1

Noise Assessment Guidelines

List all major roads within 1000 ft of the site:

1. _____
2. _____
3. _____
4. _____

Necessary Information	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane	100	45	52	
b. farthest lane	208	75	92	
c. average (effective distance)	154	60	72	
2. Distance to stop sign	-	175	400	
3. Road gradient in percent	1%	4%	1%	
4. Average speed in mph				
a. Automobiles	55	40	25	
b. heavy trucks - uphill	55	40	25	
c. heavy trucks - downhill	55	40	25	
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	40000	15000	5000	
b. medium trucks	-	900	1050	
c. effective ADT (a + (10xb))	40000	24000	15500	
6. 24 hour average number of heavy trucks				
a. uphill	-	160	87	
b. downhill	-	160	88	
c. total	-	320	175	
7. Fraction of nighttime traffic (10:00 p.m. to 7: a.m.)	15%	20%	20%	
8. Traffic projected for what year?	-	-	-	

Worksheet C
Roadway Noise

Page 2

Noise Assessment Guidelines

Adjustments for Automobile Traffic

	9 Stop and-go Table 3		10 Average Speed Table 4		11 Night-Time Table 5		12 Auto ADT (line 5c)		13 Adjusted Auto ADT		14 DNL (Workchart 1)		15 Barrier Attenuation		16 Partial DNL
Road No. 1	0	x	1.0	x	1.0	x	40000	-	40000	-	67	-	0	-	67
Road No. 2	.36	x	.53	x	1.19	x	24000	-	5450	-	65	-	0	-	65
Road No. 3	.70	x	.21	x	1.19	x	15500	-	2711	-	60	-	0	-	60
Road No. 4		x		x		x		-		-		-		-	

Adjustments for Heavy Truck Traffic

	17 Gradient Table 6		18 Average Speed Table 7		19 Truck ADT /2		20		21		22 Stop and-go Table 8		23 Night-Time Table 5		24 Adjusted Truck ADT		25 DNL (Work chart 2)		26 Barrier Attn.		27 Partial DNL
Uphill	-	x	-	x	-	=	-														
Road No. 1									Add -	x	-	x	-	=	-		-		-	=	-
Downhill	-	x	-	=	-																
Uphill	2.0	x	.81	x	160	=	259														
Road No. 2									Add 389	x	1.8	x	1.19	=	833	-	72	-	0	=	72
Downhill			.81	x	160	=	130														
Uphill	1.0	x	.81	x	87	=	70														
Road No. 3									Add 141	x	1.8	x	1.19	=	303	-	67	-	0	=	67
Downhill			.81	x	88	=	71														
Uphill	___	x	___	x	___	=	___														
Road No. 4									Add ___	x	___	x	___	=	___	-	___	-	___	=	___
Downhill	___	x	___	=	___																

Combined Automobile & Heavy Truck DNL

Road No. 1 67 Road No. 2 73 Road No. 3 68 Road No. 4 _____ Total DNL for All Roads 75

Signature _____ Date _____

21. Combined Noise Level = 81 LDN

To Solve This Problem You Must Add Some More Lines to the Workchart for Engines Because the Workchart as Set up Does Not Go High Enough. There Are A Variety of Ways to Do This But One of the Easiest Is to Take A Piece of Blank Paper (A 3 x 5 Card Does Very Well) Place the Edge of the Paper Along Either the Top Or Bottom Edge of the Workchart and Mark Where the LDN Lines Fall Along the Edge of the Blank Paper. Then Once You Have Drawn Your Distance and Operations Lines on the Work Chart, You Take Your Paper with the Line Markings and Lay It along the Line for Adjusted Operations with the Mark Farthest to the Right Lined up with the 75 LDN Line. Now Just Count over until You Reach the Intersection of the Operations and Distance Lines.

Worksheet D **Page 2** **Noise Assessment Guidelines**
Railway Noise

Adjustments for Diesel Locomotives

	9 No. of Locomotives / 2	10 Average Speed Table 9	11 Horns (enter 10)	12 Night-time Table 5	13 No. of Trains (line 2a)	14 Adj. No. of Opns.	15 DNL Workchart 3	16 Barrier Attn.	17 Partial DNL
Railway No. 1	1.5	1.0	10	1.19	30	535	81	0	81
Railway No. 2									
Railway No. 3									

Adjustments for Railway Cars or Rapid Transit Trains

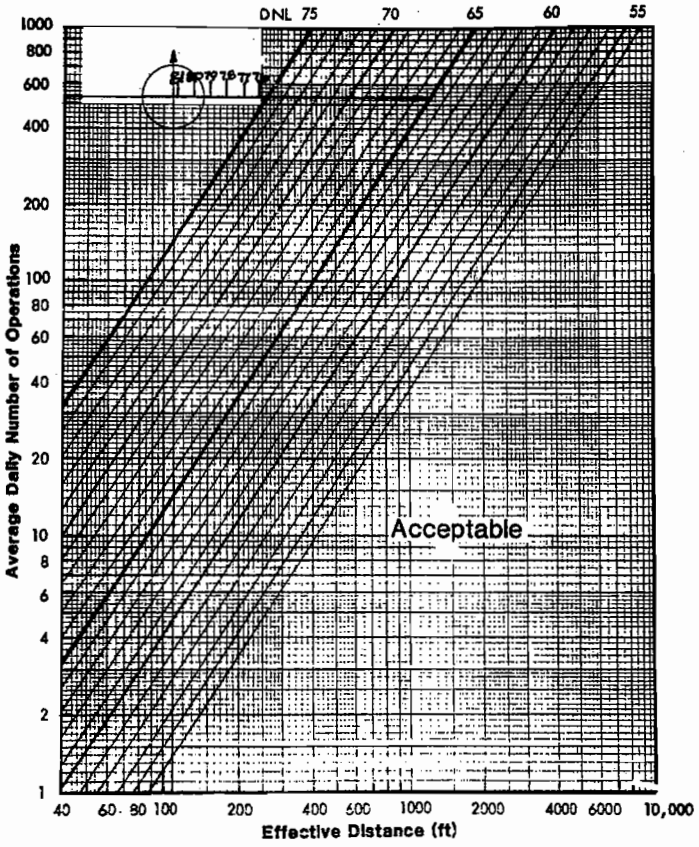
	18 Number of cars / 50	19 Average Speed Table 10	20 Bolted Rails (enter 4)	21 Night-time Table 5	22 No. of Trains (Line 2a or 2b)	23 Adj. No. of Opns.	24 DNL Work-chart 4	25 Barrier Attn.	26 Partial DNL
Railway No. 1	1.0	1.0	4	1.19	30	143	63	0	63
Railway No. 2									
Railway No. 3									

Combined Locomotive and Railway Car DNL

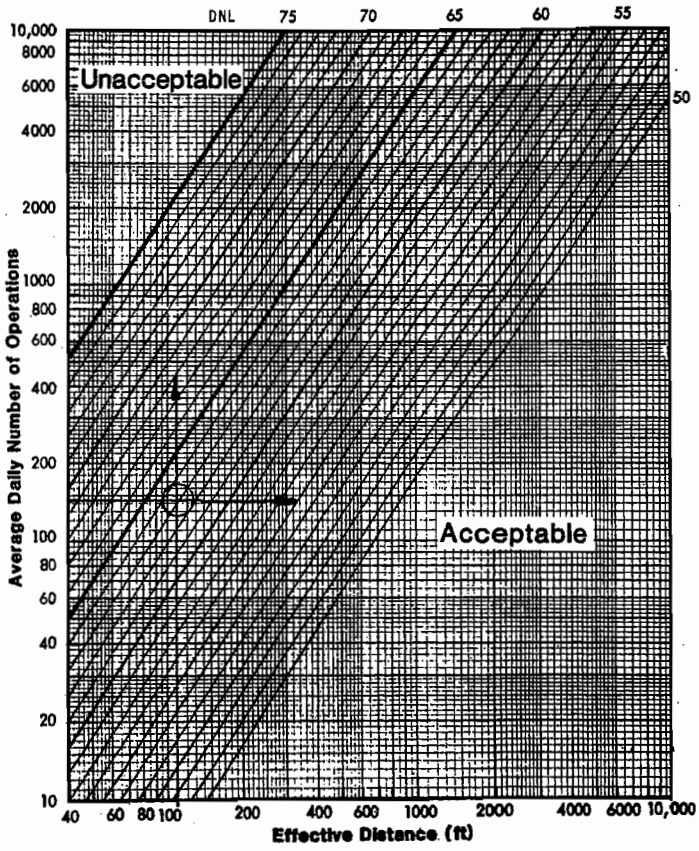
Railway No. 1 81 Railway No. 2 _____ Railway No. 3 _____ Total DNL for all Railways 81

Signature _____ Date _____

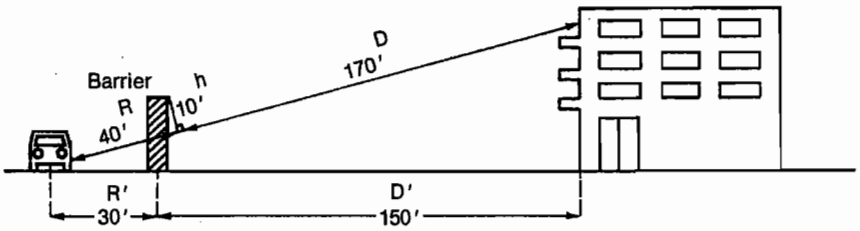
Workchart 3
Railroads - Diesel Locomotives



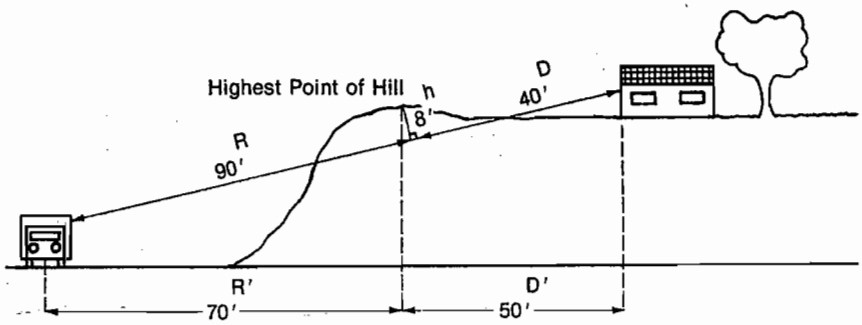
Workchart 4
Railroads - Cars and Rapid Transit



22. H = 10 Feet, R = 40 Feet, R′ = 30 Feet, D = 170 Feet, D′ = 150 Feet

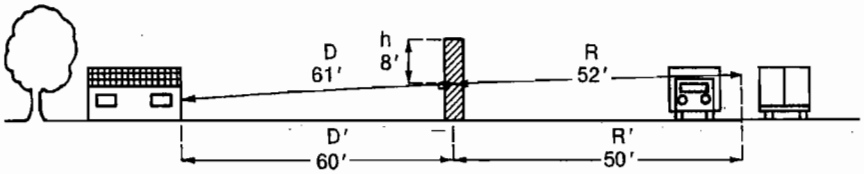


23. H = 8 Feet, R = 90 Feet, R′ = 70 Feet, D = 40 Feet, D′ = 50 Feet



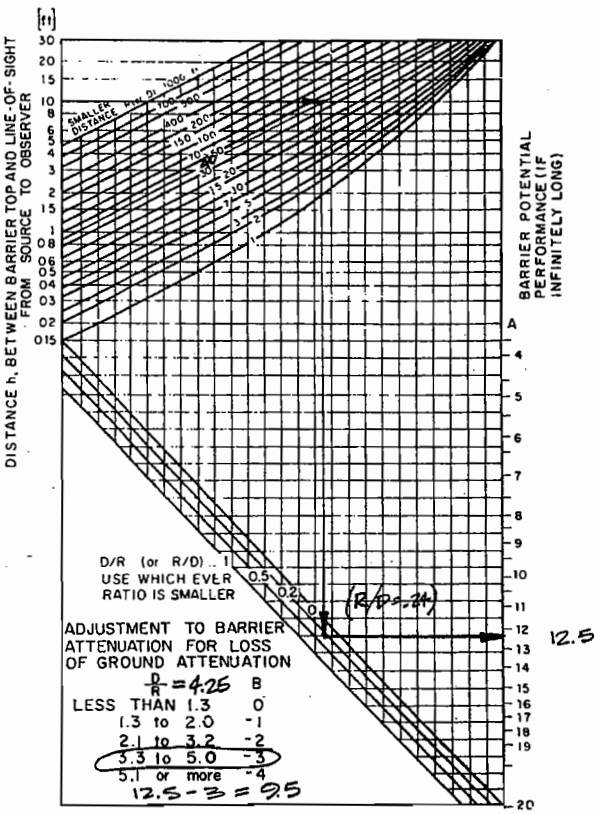
Note—The Line of Sight Line Starts Above the Road Level Because of the Trucks.

24. H = 8 Feet, R = 52 Feet, R′ = 50 Feet, D = 61 Feet, D′ = 60 Feet

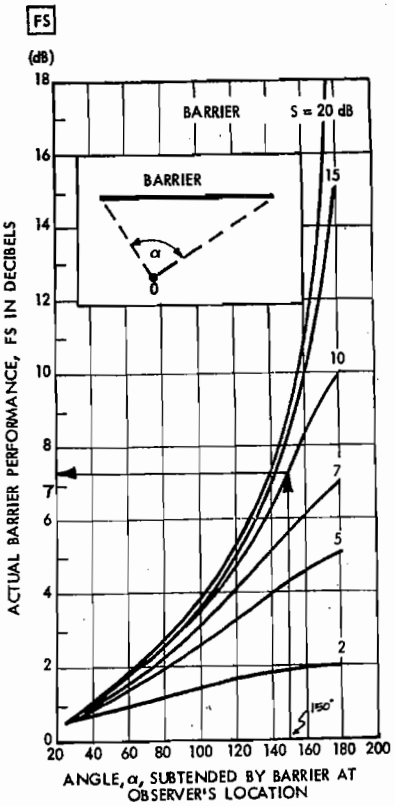


25. The Noise Attenuation Provided Is 7 Decibels

Workchart 6
Noise Barrier



Workchart 7

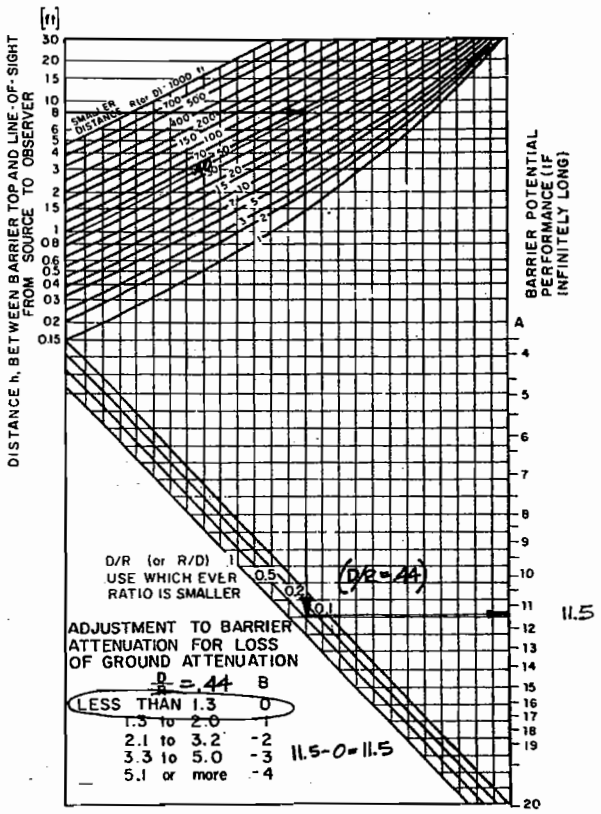


Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

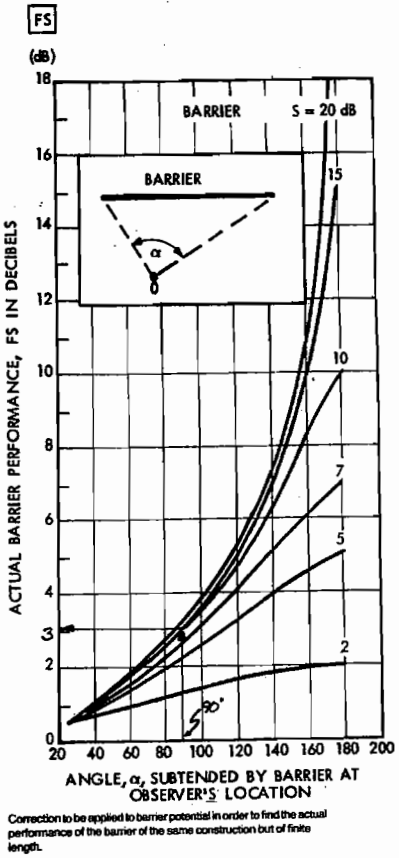
26. The Noise Attenuation Provided Is 3 Decibels

Note—When the Curves ARe So Close Together Don't Worry About Extrapolating. In This Case You Couldn't Anyway, the 15 dB and 10 dB Curves Have Merged.

Workchart 6
Noise Barrier



Workchart 7

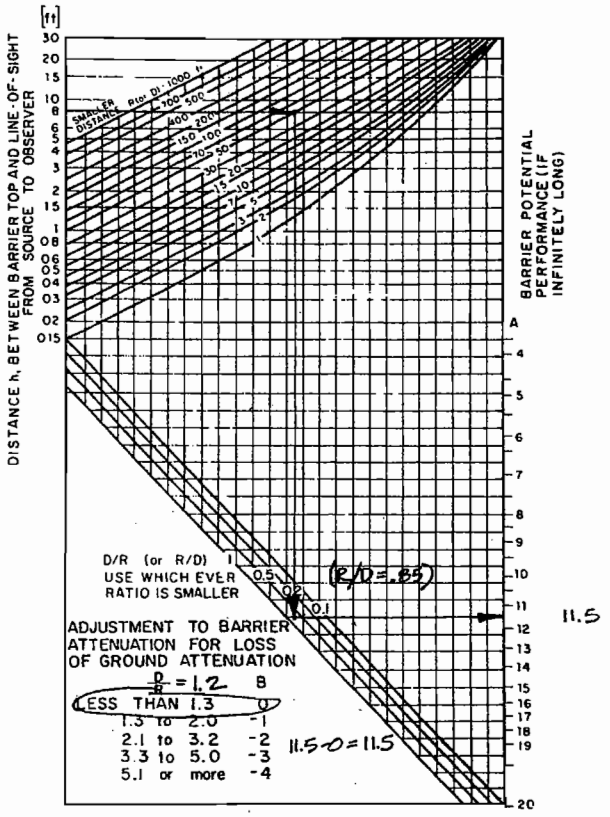


Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

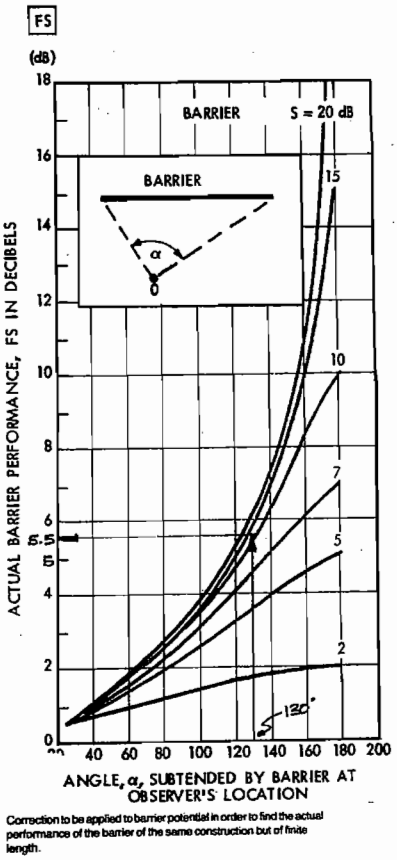
27. The Noise Attenuation Provided Is 6 Decibels (5.5 Rounded Up)

Note—Again You Have Problems With Extrapolating—Don't Worry About Being Too Precise.

Workchart 6
Noise Barrier



Workchart 7



Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

28. The Noise Attenuation Provided by This Barrier Is 4 dB. This Is Sufficient

Note—Don't Forget That the Height of the observor Is 5′ Less Than the Total Height of the Building and the Height of the Building Is 10 Feet Times the Number of Stories. And Did You Remember to Make the Adjustment for Ground Attenuation Loss.

Workchart 5
Noise Barrier

To find R, D and h from Site Elevations and Distances

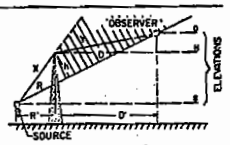
Fill out the following worksheet (all quantities are in feet):

Enter the values for:

H= 15 R'= 40

S= 0 D'= 20

O= 15

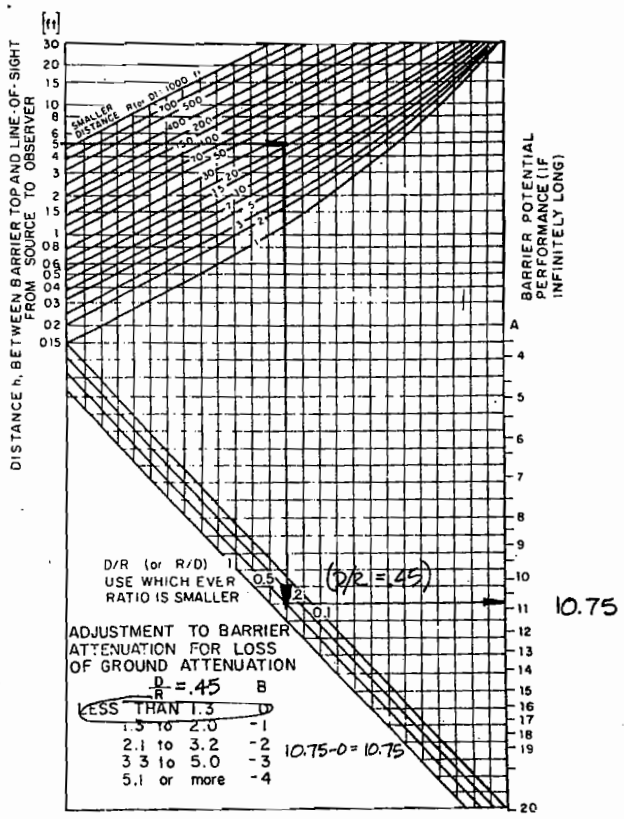


1. Elevation of barrier top minus elevation of source	[H 15] − [S 0]	= [1 15]	
2. Elevation of observer minus elevation of source	[O 15] − [S 0]	= [2 15]	
3. Map distance between source and observer (R' + D')		[3 60]	
4. Map distance between barrier and source (R')		[4 40]	
5. Line 2 divided by line 3	[2 15] ÷ [3 60]	= [5 .25]	
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[5 .25] × [5 .25]	= [6 .0625]	
7. 40% of line 6	[0.4] × [6 .0625]	= [7 .025]	
8. One minus line 7	[1.0] − [7 .025]	= [8 .975]	
9. Line 5 times line 4 (will be negative if line 2 is negative)	[5 .25] × [4 40]	= [9 10]	
10. Line 1 minus line 9	[1 15] − [9 10]	= [10 5]	
11. Line 10 times line 8	[10 5] × [8 .975]	= [11 4.9]	= h
12. Line 5 times line 10	[5 .25] × [10 5]	= [12 1.25]	
13. Line 4 divided by line 8	[4 40] ÷ [8 .975]	= [13 41]	
14. Line 13 plus line 12	[13 41] + [12 1.25]	= [14 42]	= R
15. Line 3 minus line 4	[3 60] − [4 40]	= [15 20]	
16. Line 15 divided by line 8	[15 20] ÷ [8 .975]	= [16 20.5]	
17. Line 16 minus line 12	[16 20.5] − [12 1.25]	= [17 19]	= D

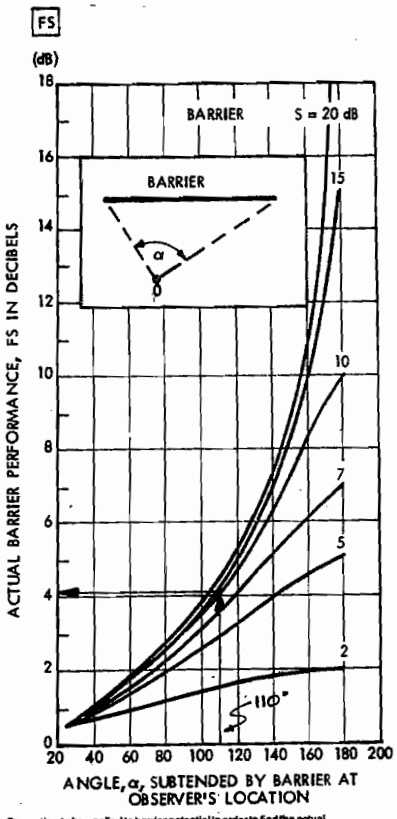
[Note: the value on line 2 may be negative, in which case so will the values on lines 5,9, and 12; line 1 may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: x + (-y) = x-y. And subtracting a negative number is like adding: X-(-y) = x+y.]

Round off R and D to nearest integer, h to one decimal place.

Workchart 6
Noise Barrier



Workchart 7



Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

29. The Noise Attenuation Provided by This Barrier Is Approximately 5 dB for Both the Engines and the Railroad Cars.

    This Is Not Sufficient.

    Note—You Were Supposed to Calculate Attenuation for Diesel Engines and Cars Separately Because the Source Heights Are Different. The Value of S for the Engines Should Have Been −10 and the Value of S for the Railroad Cars Should Have Been −25.

Workchart 5
Noise Barrier

To find R, D and h from Site Elevations and Distances

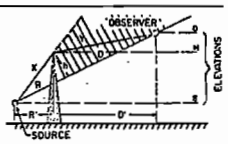
Fill out the following worksheet (all quantities are in feet):

Enter the values for:

H= 12 R'= 40

S= −10 D'= 85

O= 25

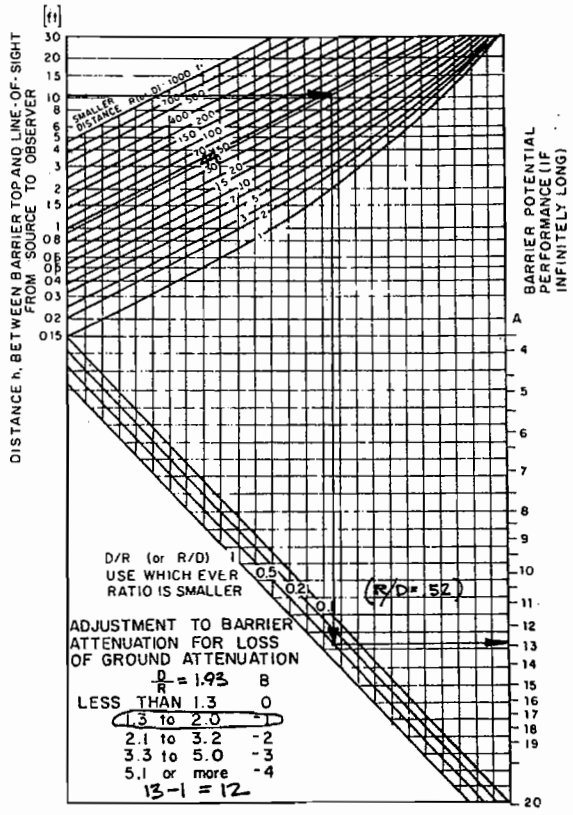


1. Elevation of barrier top minus elevation of source	[H 12] − [S −10]	= [1 22]	
2. Elevation of observer minus elevation of source	[O 25] − [S −10]	= [2 35]	
3. Map distance between source and observer (R' + D')		[3 125]	
4. Map distance between barrier and source (R')		[4 40]	
5. Line 2 divided by line 3	[2 35] ÷ [3 125]	= [5 .28]	
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[5 .28] × [5 .28]	= [6 .08]	
7. 40% of line 6	[0.4] × [6 .08]	= [7 .03]	
8. One minus line 7	[1.0] − [7 .03]	= [8 .97]	
9. Line 5 times line 4 (will be negative if line 2 is negative)	[5 .28] × [4 40]	= [9 11.2]	
10. Line 1 minus line 9	[1 22] − [9 11.2]	= [10 10.8]	
11. Line 10 times line 8	[10 10.8] × [8 .97]	= [11 10.5]	= h
12. Line 5 times line 10	[5 .28] × [10 10.8]	= [12 3]	
13. Line 4 divided by line 8	[4 40] ÷ [8 .97]	= [13 41]	
14. Line 13 plus line 12	[13 41] + [12 3]	= [14 44]	= R
15. Line 3 minus line 4	[3 125] − [4 40]	= [15 85]	
16. Line 15 divided by line 8	[15 85] ÷ [8 .97]	= [16 88]	
17. Line 16 minus line 12	[16 88] − [12 3]	= [17 85]	= D

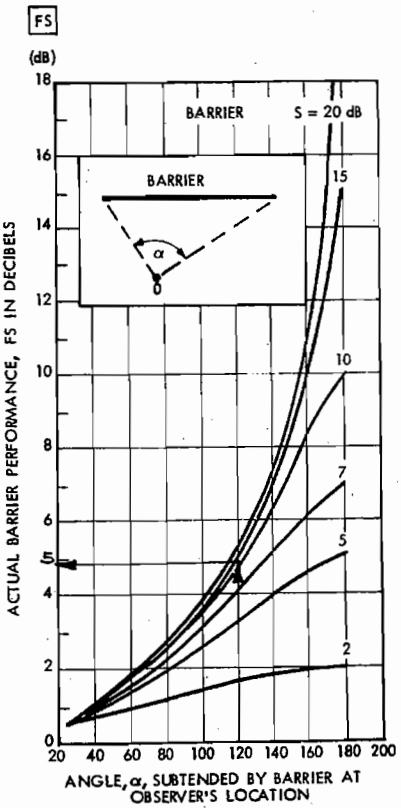
[Note: the value on line 2 may be negative, in which case so will the values on lines 5,9, and 12; line 1 may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: x+(-y)=x-y. And subtracting a negative number is like adding: X-(-y)=x+y.]

Round off R and D to nearest integer, h to one decimal place.

Workchart 6
Noise Barrier



Workchart 7



Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

Workchart 5
Noise Barrier

To find R, D and h from Site Elevations and Distances

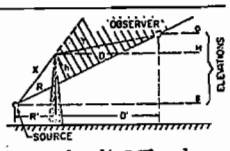
Fill out the following worksheet (all quantities are in feet):

Enter the values for:

H= 12 R'= 40

S= -25 D'= 85

O= 25

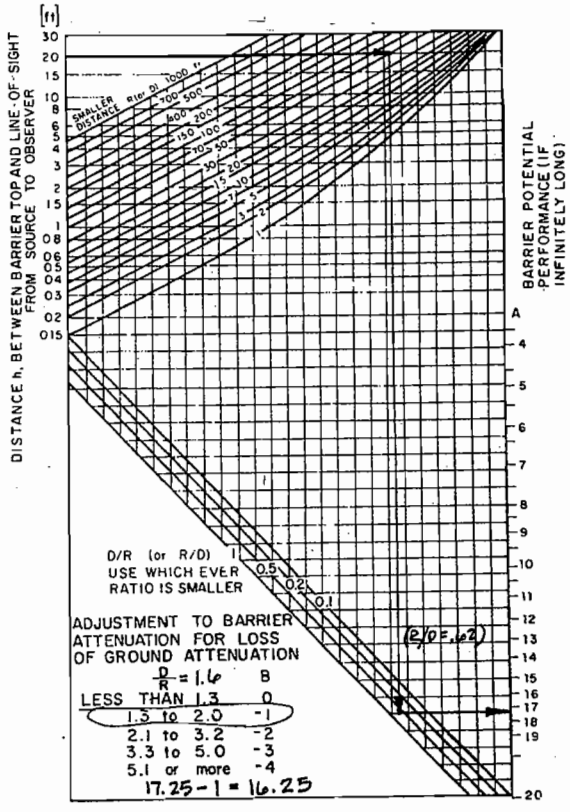


1. Elevation of barrier top minus elevation of source	[H 12]	− [S −25]	= [1 37]	
2. Elevation of observer minus elevation of source	[O 25]	− [S −25]	= [2 50]	
3. Map distance between source and observer (R' + D')			[3 125]	
4. Map distance between barrier and source (R')			[4 40]	
5. Line 2 divided by line 3	[2 50]	÷ [3 125]	= [5 .4]	
6. Square the quantity on line 5 (i.e., multiply it by itself): always positive	[5 .4]	× [5 .4]	= [6 .16]	
7. 40% of line 6	[0.4]	× [6 .16]	= [7 .06]	
8. One minus line 7	[1.0]	− [7 .06]	= [8 .94]	
9. Line 5 times line 4 (will be negative if line 2 is negative)	[5 .4]	× [4 40]	= [9 16]	
10. Line 1 minus line 9	[1 37]	− [9 16]	= [10 21]	
11. Line 10 times line 8	[10 21]	× [8 .94]	= [11 19.7]	= h
12. Line 5 times line 10	[5 .4]	× [10 21]	= [12 8.4]	
13. Line 4 divided by line 8	[4 40]	÷ [8 .94]	= [13 42.6]	
14. Line 13 plus line 12	[13 42.6]	+ [12 8.4]	= [14 51]	= R
15. Line 3 minus line 4	[3 125]	− [4 40]	= [15 85]	
16. Line 15 divided by line 6	[15 85]	÷ [8 .94]	= [16 90.4]	
17. Line 16 minus line 12	[16 90.4]	− [12 8.4]	= [17 82]	= D

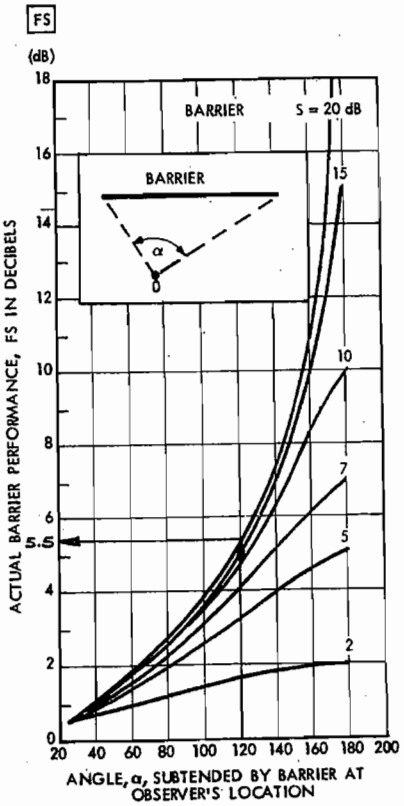
[Note: the value on line 2 may be negative, in which case so will the values on lines 5,9, and 12; line 1 may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: x + (-y) = x-y. And subtracting a negative number is like adding: X-(-y)=x+y.]

Round off R and D to nearest integer, h to one decimal place.

Workchart 6
Noise Barrier



Workchart 7



Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

30. The Noise Attenuation Provided by This Barrier Is 3 dB for Trucks and 5 dB for Autos. The Combined Level Resulting Is 69 LDN.

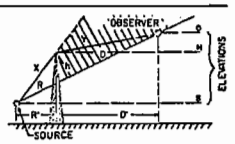
This Is Not Sufficient

Note—You Must Calculate the Barrier Effect Separately for Autos and Trucks Because the Source Height is Different. Then Recombine levels.

Workchart 5
Noise Barrier
To find R, D and h from Site Elevations and Distances

Enter the values for:
H= 16 R'= 36
S= 0 D'= 56
O= 25

Fill out the following worksheet (all quantities are in feet):

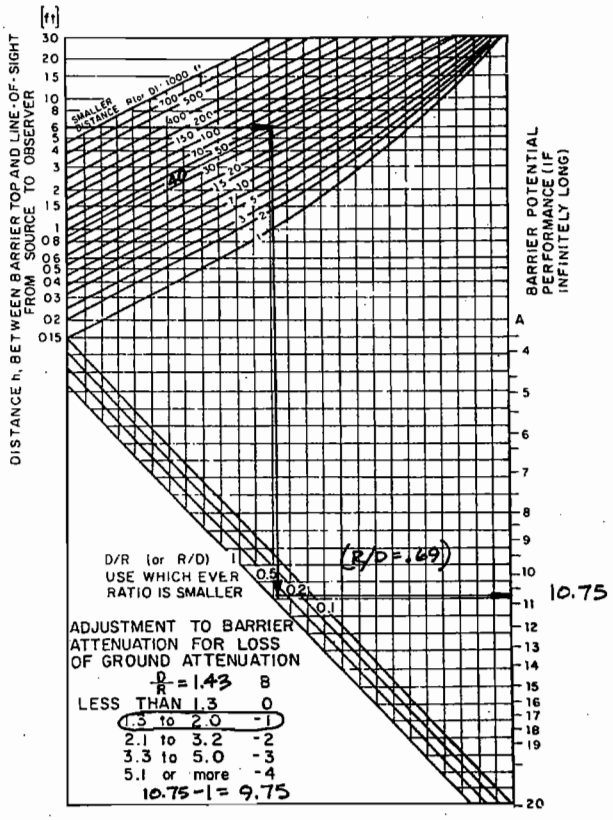


1. Elevation of barrier top minus elevation of source	[H 16] − [S 0]	= [1 16]		
2. Elevation of observer minus elevation of source	[O 25] − [S 0]	= [2 25]		
3. Map distance between source and observer (R' + D')		[3 92]		
4. Map distance between barrier and source (R')		[4 36]		
5. Line 2 divided by line 3	[2 25] ÷ [3 92]	= [5 .27]		
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[5 .27] × [5 .27]	= [6 .07]		
7. 40% of line 6	[0.4] × [6 .07]	= [7 .03]		
8. One minus line 7	[1.0] − [7 .03]	= [8 .97]		
9. Line 5 times line 4 (will be negative if line 2 is negative)	[5 .27] × [4 36]	= [9 9.7]		
10. Line 1 minus line 9	[1 16] − [9 9.7]	= [10 6.3]		
11. Line 10 times line 8	[10 6.3] × [8 .97]	= [11 6.1]	= h	
12. Line 5 times line 10	[5 .27] × [10 6.1]	= [12 1.7]		
13. Line 4 divided by line 8	[4 36] ÷ [8 .97]	= [13 37]		
14. Line 13 plus line 12	[13 37] + [12 1.7]	= [14 39]	= R	
15. Line 3 minus line 4	[3 92] − [4 36]	= [15 56]		
16. Line 15 divided by line 8	[15 56] ÷ [8 .97]	= [16 58]		
17. Line 16 minus line 12	[16 58] − [12 1.7]	= [17 56]	= D	

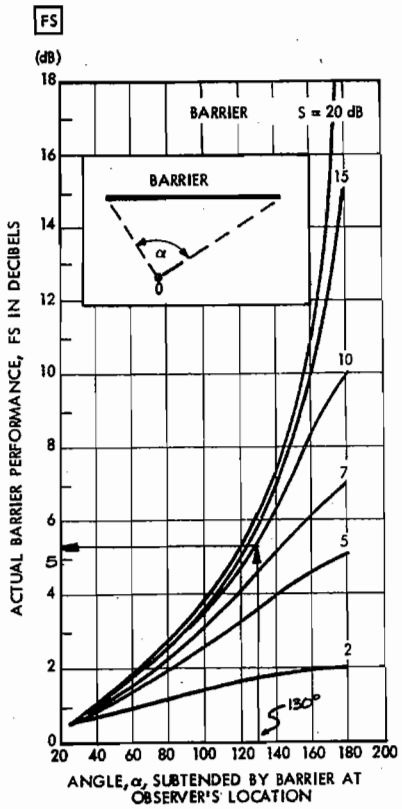
(Note: the value on line 2 may be negative, in which case so will the values on lines 5,9, and 12; line 1 may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: X-(-y)=x+y. And subtracting a negative number is like adding: X-(-y)=x+y.]

Round off R and D to nearest integer, h to one decimal place.

Workchart 6
Noise Barrier



Workchart 7



Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

Workchart 5
Noise Barrier

To find R, D and h from Site Elevations and Distances

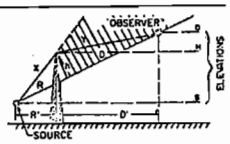
Enter the values for:

H= 16 R'= 36

S= 8 D'= 56

Fill out the following worksheet (all quantities are in feet):

O= 25

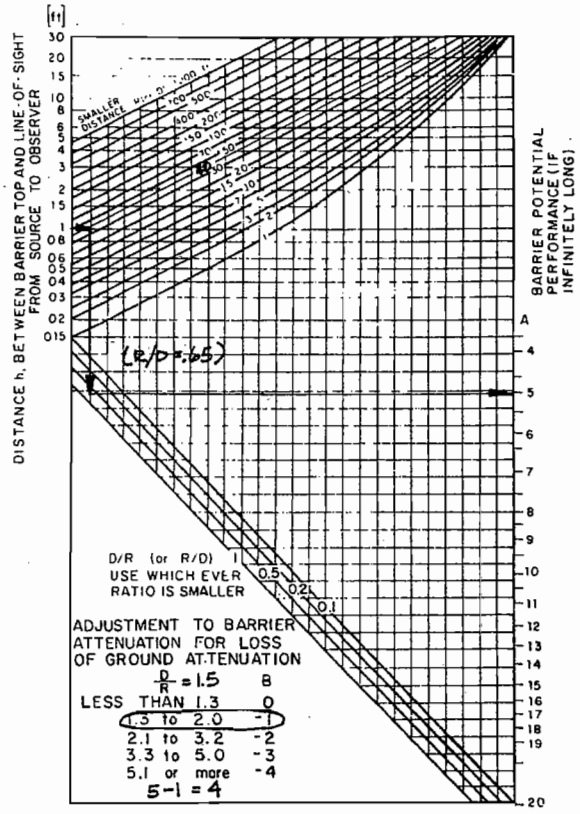


1. Elevation of barrier top minus elevation of source	[H	16	] − [S	8	] = [1	8	]	
2. Elevation of observer minus elevation of source	[O	25	] − [S	8	] = [2	17	]	
3. Map distance between source and observer (R' + D')						[3	92	]
4. Map distance between barrier and source (R')						[4	36	]
5. Line 2 divided by line 3	[2	17	] ÷ [3	92	] = [5	.2	]	
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[5	.2	] × [5	.2	] = [6	.04	]	
7. 40% of line 6	[	0.4	] × [6	.04	] = [7	.02	]	
8. One minus line 7	[	1.0	] − [7	.02	] = [8	.98	]	
9. Line 5 times line 4 (will be negative if line 2 is negative)	[5	.2	] × [4	36	] = [9	7	]	
10. Line 1 minus line 9	[1	8	] − [9	7	] = [10	1	]	
11. Line 10 times line 8	[10	1	] × [8	.98	] = [11	.98	]	= h
12. Line 5 times line 10	[5	.2	] × [10	1	] = [12	.2	]	
13. Line 4 divided by line 8	[4	36	] ÷ [8	.98	] = [13	37	]	
14. Line 13 plus line 12	[13	37	] + [12	.2	] = [14	37	]	= R
15. Line 3 minus line 4	[3	92	] − [4	36	] = [15	56	]	
16. Line 15 divided by line 8	[15	56	] ÷ [8	.98	] = [16	57	]	
17. Line 16 minus line 12	[16	57	] − [12	.2	] = [17	57	]	= D

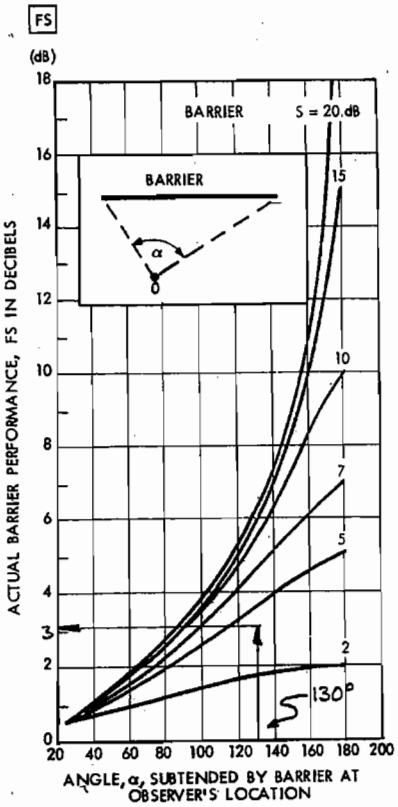
[Note: the value on line 2 may be negative, in which case so will the values on lines 5, 9, and 12; line 1 may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: x + (-y) = x-y. And subtracting a negative number is like adding: X-(-y) = x+y.]

Round off R and D to nearest integer, h to one decimal place.

Workchart 6
Noise Barrier



Workchart 7



Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

Chapter 7

The Use of Noise Measurements

Noise Calculations Are Best For HUD Use

There are two ways to determine noise levels for a site under review: the noise can be calculated or it can be measured. While one's first reaction might well be that it would obviously be better to go out and actually measure the noise levels at the site, calculated noise levels are really much better for implementing HUD's noise policy.

Calculated noise levels are developed using mathematical models that contain a variety of assumptions about the process of noise propagation as well as data on sound levels generated by typical sources (i.e. aircraft engines, automobile tires etc.). The model can be a complex computer model or it can be a simple desktop model such as the procedures in the *Noise Assessment Guidelines*. The models can also employ a variety of noise descriptors. (See chapter 1 for a discussion of noise descriptors.) Most noise studies done for the Federal Highway Administration, for example, use either the L_{10} or the L_{eq} noise descriptor. Many aircraft noise studies use the NEF or CNEL descriptor. All of these descriptors are compatible with the L_{dn} noise descriptor system that is preferred by HUD and the HUD noise regulation contains instructions for converting all of them into L_{dn}. (sections 51.106(a)(1) and (2))

Whether produced by a sophisticated computer model or by the desktop *Noise Assessment Guidelines*, calculated noise levels are more useful for HUD needs than measured levels for two significant reasons: The first is that with noise measurements you have no good way to take into account future changes in the future noise environment. The houses we help build today are going to be around for a long time and it is very important that we determine, to the extent we can, the noise environment that will exist throughout the life of the buildings. While there are clearly limitations on how far into the future we can reasonably project traffic levels for roads, railroads and airports, we can at least look 5 to 10 years ahead. The HUD noise regulation (24 CFR 51B) requires that "to the extent possible, noise exposure shall be projected to be representative of conditions that are expected to exist at a time at least 10 years beyond the date of the project or action under review." It is very easy to make these projections if you use the *Noise Assessment Guidelines* or a computer model to determine noise levels.

The second reason why we prefer that you calculate noise levels is that through the calculation process you can use monthly or yearly data to determine traffic levels. Thus you come up with a more typical picture of conditions. With noise measurements there is always the possibility that the day or even days chosen for measurements will not be typical and that the measurements may over or understate the problem. While the conscientious measurer will try to account for any unusual conditions, it isn't always possible. So long as cost considerations limit the number of days that measurements can be taken there will always be the problem of unrepresentative data. With calculations this isn't a problem. The computer model that generates contours for airports, for example, uses an entire years data to develop the average day. Certainly the results are more likely to be representative than the results that would be derived from just a few days measurements.

When Noise Measurements Are Useful

While it is the preferred procedure to calculate noise levels, there are a few situations where the noise models might not be accurate and it might be better to rely on measurements. One instance would be when there is insufficient or inadequate traffic data. Another case might be where you have a unique physical situation that is not accounted for in whatever mathematical model is available.

Obtaining good traffic data can be difficult. You may only be able to get gross data that simply lists total vehicles without making any distinctions between trucks and automobiles. Or you may not be able to get any reliable data on the percentage of traffic between 10 pm and 7 am. While the *Noise Assessment Guidelines* do contain some assumptions that you can use when you don't have all the data you need, there may be instances when you just don't think those assumptions would accurately portray the problem.

By the same token, there are certain physical situations that mathematical models such as the *Noise Assessment Guidelines* couldn't anticipate and therefore do not reflect in their formulas. For example, the *Guidelines* say that you don't have to calculate the noise levels for underground transit lines. Well what if the line is underground but there are large air vents that reach from the belowground tunnels to the surface? A great deal of noise can reach the surface through these vents but the *Noise Assessment Guidelines* don't have any way to take it into account. You couldn't treat it as if the subway line were aboveground because it isn't really and at least some of the noise is blocked. This would be a case where a noise measurement would probably be the best way to determine the noise levels. By the same token, the guidelines do not really take into account the sometimes significant amounts of reflected noise that can occur at urban sites surrounded by tall buildings, i.e. the canyon effect.

When Not to Use Measurements

One thing noise measurements should not be used for is to confirm or refute calculated noise levels, especially computer generated aircraft contours. Our experience with both the *Noise Assessment Guidelines* and with computer noise models is that both are quite accurate if done properly. If you are convinced that the calculations were done correctly, and if you believe that the data used were good, you should strongly discourage anyone who wants to take measurements because they think that measurements are inherently more accurate than calculations. Comparing measured noise levels to calculated levels is like comparing apples and oranges. The

calculated noise levels should include projected traffic levels, the measured ones will not. The calculated levels will be based on daily traffic counts derived by averaging months of data, the measured levels will, at best, reflect just a few days. (This is particularly true for aircraft noise contours. The day-to-day operations of an airport can vary significantly depending upon weather conditions and any one or two days worth of measurements are very likely to show different levels from those generated by a computer model employing a year of data to derive an average day.)

If you have determined that noise measurements are appropriate, you must make sure that they are done properly, otherwise the data will be useless. There are four elements to proper measurements: 1) where the measurements are taken; 2) when they are taken; 3) the type of equipment used; and 4) the actual measurement procedure.

Where measurements should be taken: The locations for noise measurements should be selected using the same criteria you would use to select a Noise Assessment Location for a *Noise Assessment Guidelines* calculation. The *Noise Assessment Guidelines* recommend that "assessments of the noise exposure should be made at representative locations around the site where significant noise is expected." Further, the *Guidelines* state that when selecting these locations you should consider those buildings containing noise sensitive uses which are closest to the predominant noise sources. Where quiet outdoor space is desired at a site, you should also select points in the outdoor area in question. Specifically, the "relevant measurement location for buildings is a point 2 meters (6.5 feet) from the facade." If there are no buildings yet the measurement point should be 2 meters from the closest point setback requirements would allow a building facade.

When measurements should be taken: Because measurements are only going to be taken for a few days at best, special care should be taken to make sure that the days selected are representative of average traffic levels. For highways, avoid both Monday and Friday, particularly before or after a holiday. In fact holiday periods, such as the Christmas/New Years season, should be avoided entirely. Highway traffic, or rather more importantly, truck traffic is likely to be down during these periods and noise levels may be significantly lower than normal. On the other hand, holiday periods are often peak travel periods for airlines and measurements taken around airports then would show unusually high noise levels.

Whoever is taking the measurements should also check to make sure that there aren't any special circumstances that might affect traffic levels. For example road construction or repair work might divert additonal traffic onto the road being measured, or divert traffic away. In both cases the noise levels measured would not be representative.

And finally, noise measurements should not be taken during extreme weather conditions both because of the possible effects on traffic levels but also because the weather conditions can exaggerate the actual noise levels.

Ideally, noise measurements should be taken over several days spread over at least a few months. But given that time and money will normally preclude this, at least make sure the one or two days you can get are as close to typical as possible.

What equipment to use: There are many sound level meters on the market which are suitable for taking noise measurements for transportation sources. They need only to meet the requirements of American National Standard Specification for Type 1 Sound Level Meters: S1.4-1971. Type 1 sound level meters are "precision" meters and provide the most accurate measurements. They are also, of course, the most expensive. Fast time-averaging and A frequency weighting are to be used. The sound level meter with the A-weighting is progressively less sensitive to sound with frequencies below 1,000 hertz, somewhat as is the ear. With fast time averaging the sound level meter responds particularly to recent sounds almost as quickly as does the ear in judging the loudness of a sound. Fast time averaging has a time constant of about 1/8 second.

While a sound level measuring system that averages decibel readouts on a short term basis such as for every minute or every hour is acceptable, it would be far better if a system that actually provides a 24 hour integrated L_{dn} readout were used. Such a system eliminates the need for calculating the L_{dn} value, an area where many inexperienced consultants go astray. These systems are more expensive however, and the consultant who doesn't do much noise work is unlikely to have one.

Measurement procedures: Detailed procedures for making sound level measurements are spelled out in the American National Standards Institute's Standard Methods ANSI S1.2-1962(R1976) *American National Standard Method for the Physical Measurement of Sound* and ANSI S1.13-1971(R1976) *American National Standard Methods for the Measurement of Sound Pressure Levels.*

Some of the basic procedures that should be followed are:

1. Measurements should normally be made over a continuous 24 hour period. If this is not possible, measurements may be made over a period of days but still must cover the entire 24 hour period. The selection of the days becomes even more critical so that they are as similar as possible. Sampling is not acceptable.
2. The sound level meter must be calibrated before each use.
3. The sound level meter should be provided with a wind screen.
4. Care should be taken to insure that there are no temporary obstructions, such as parked trucks, between the meter and the source.

The Noise Study

The noise study prepared to describe the measurement results should contain at least the following:

1. A map showing where the measurements were taken
2. A vicinity map showing the site and the major noise sources
3. A chart indicating the date, the time, and weather conditions when measurements were taken at each measurement location
4. The type of microphone used
5. Any variations from ANSI procedures
6. The results of the measurements in L_{dn} for each measurement location
7. Any unusual conditions that existed during the measurement period—i.e. construction activity, major traffic tieup, etc.
8. If an integrating sound level meter was not used, the calculations used to derive the L_{dn} value.

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Noise and Its Effects

Dr. Alice H. Suter
Conference Consultant
Administrative Conference of the United States
(November 1991)

This report was prepared for the consideration of the Administrative Conference of the United States. The views expressed are those of the author and do not necessarily reflect those of the members of the Conference or its committees except where formal recommendations of the Conference are cited.

I. Introduction

This report presents an overview of noise and its effects on people. Special emphasis is placed on developments over the past decade, both in terms of noise conditions and noise effects research. By doing so, this report should illustrate some of the reasons for concern about noise problems, which persist after the closing of EPA's Office of Noise Abatement and Control (ONAC).

Noise has a significant impact on the quality of life, and in that sense, it is a health problem in accordance with the World Health Organization's (WHO) definition of health. WHO's definition of health includes total physical and mental well-being, as well as the absence of disease. Along these lines, a 1971 WHO working group stated: "Noise must be recognized as a major threat to human well-being." (Suess, 1973)

The effects of noise are seldom catastrophic, and are often only transitory, but adverse effects can be cumulative with prolonged or repeated exposure. Although it often causes discomfort and sometimes pain, noise does not cause ears to bleed and noise-induced hearing loss usually takes years to develop. Noise-induced hearing loss can indeed impair the quality of life, through a reduction in the ability to hear important sounds and to communicate with family and friends. Some of the other effects of noise, such as sleep disruption, the masking of speech and television, and the

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Footnotes

(1) The day-night average sound level appears to be proportional to the log of population density in people per square mile (EPA.1974b).

(2) The total number of trucks registered includes personal-use as well as commercial trucks of all weight classes.

(3) According to Reinhart (1991) the most common complaint about truck noise is related to problems caused by tampering with the

Letter 14 Attachments

Letter 14 Continued

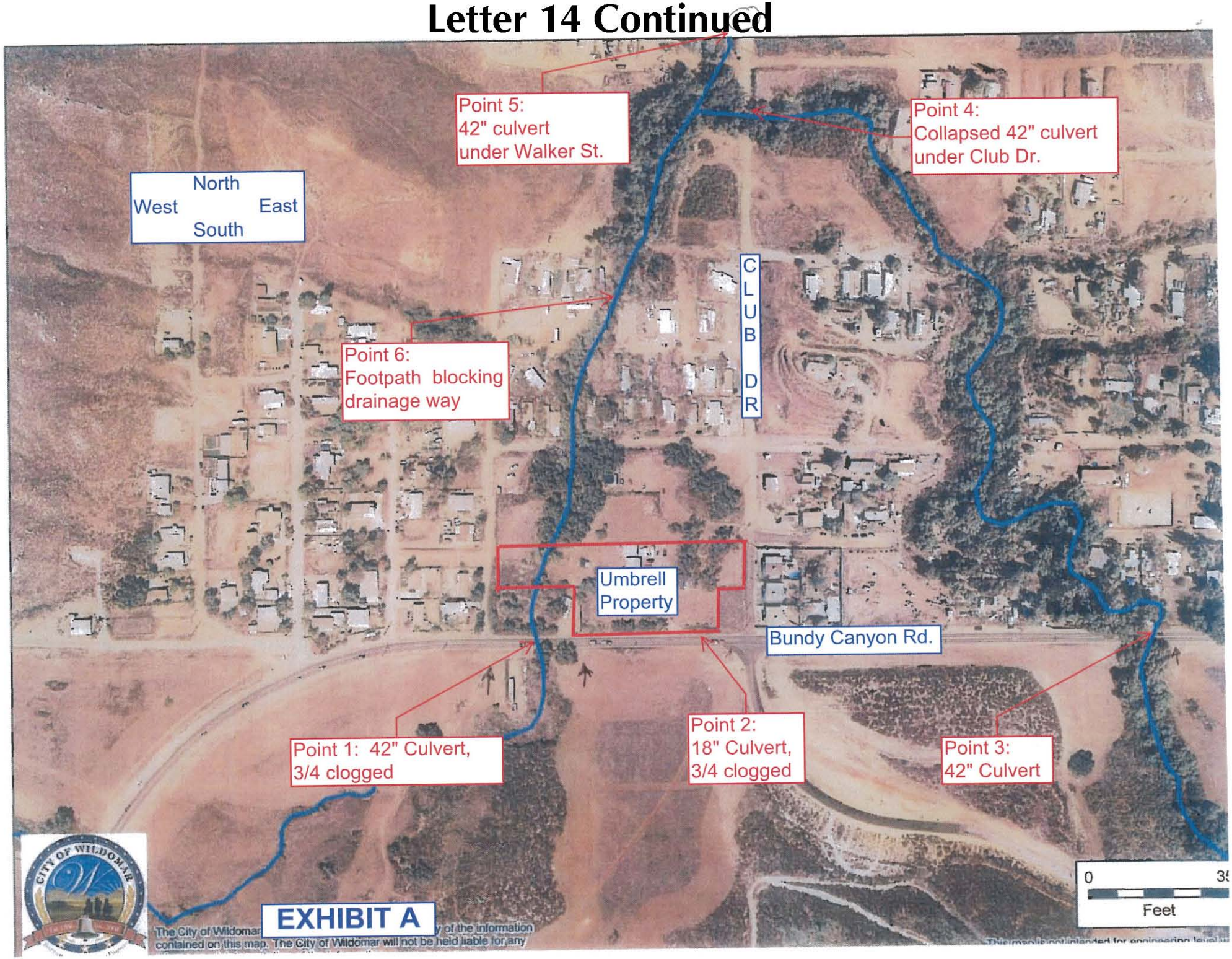


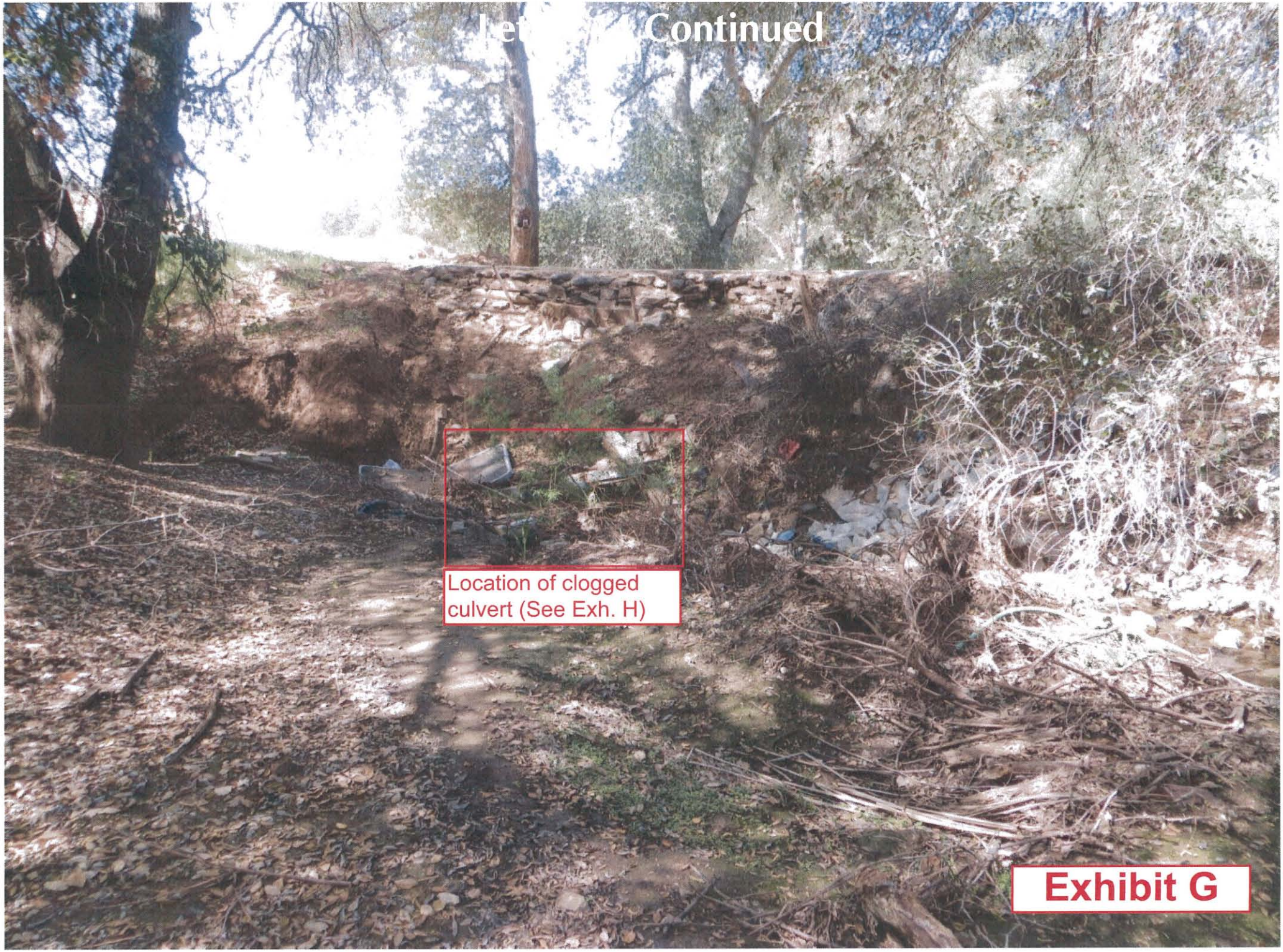
Exhibit B

Letter 14 Continued

1 2 3 4 5 6 7 8 9 10 11
Exhibit D

Exhibit E

Exhibit F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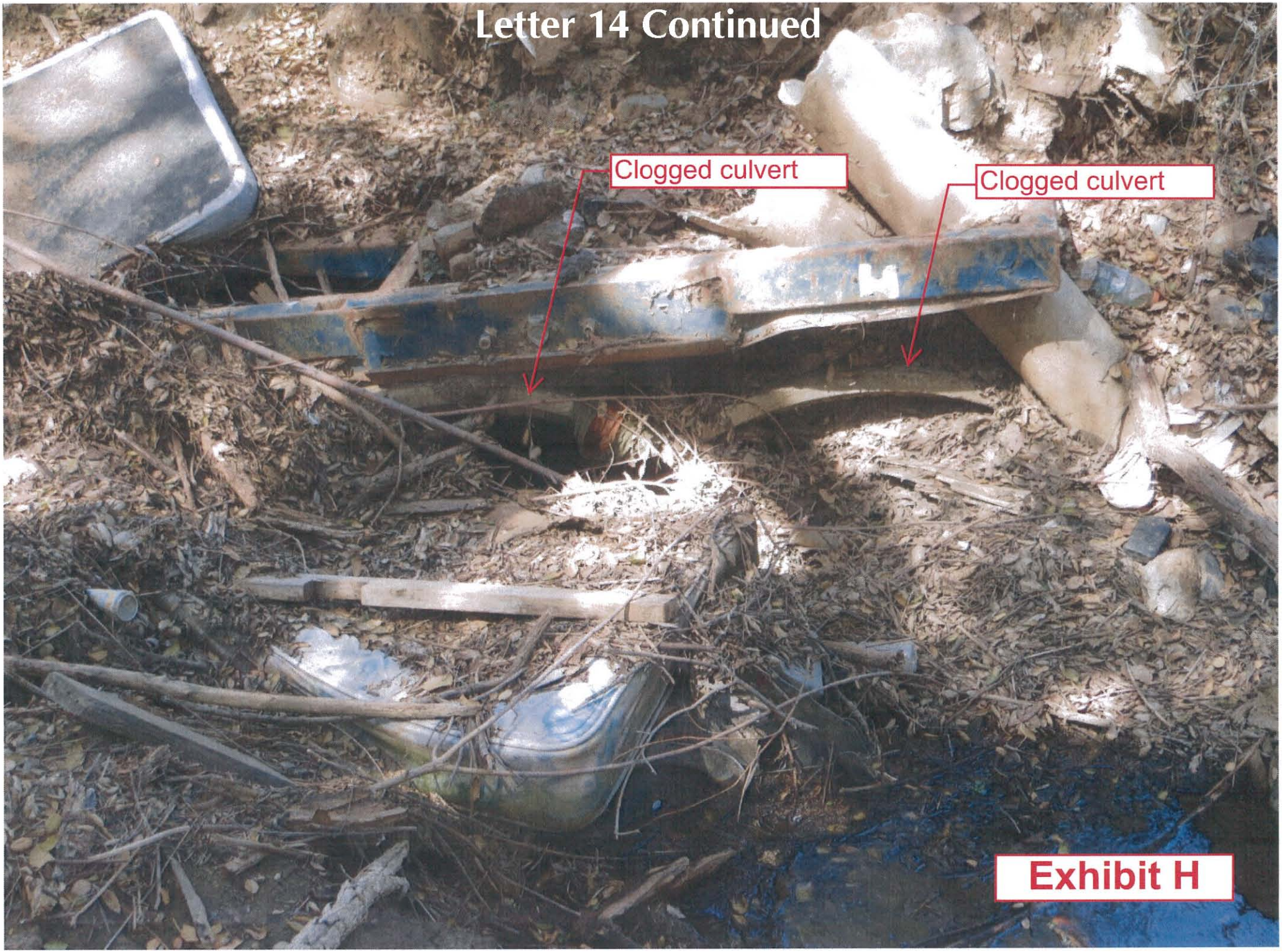
Location of clogged culvert (See Exh. H)
Exhibit G


Clogged culvert
Clogged culvert
Exhibit H

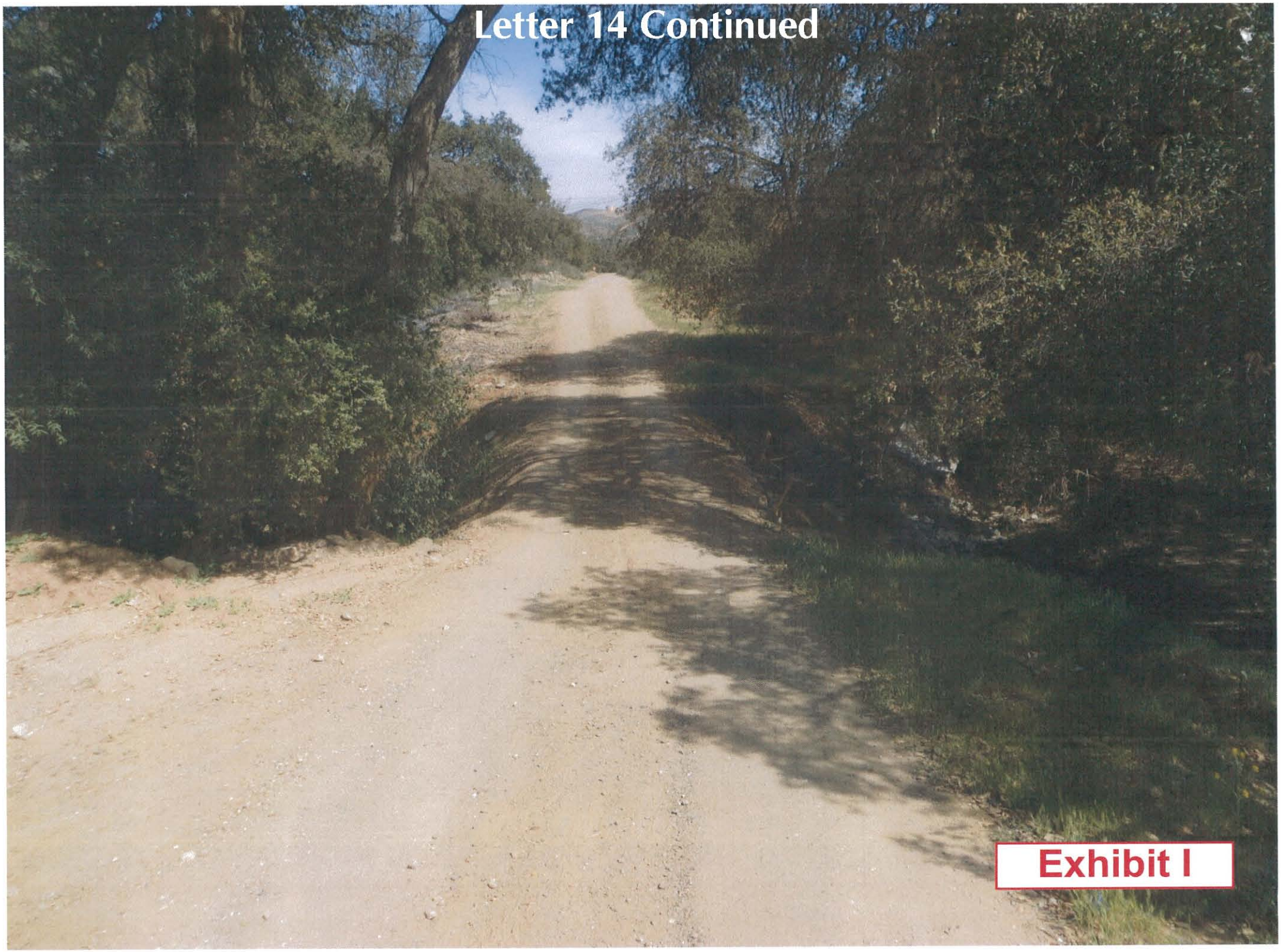


Exhibit I

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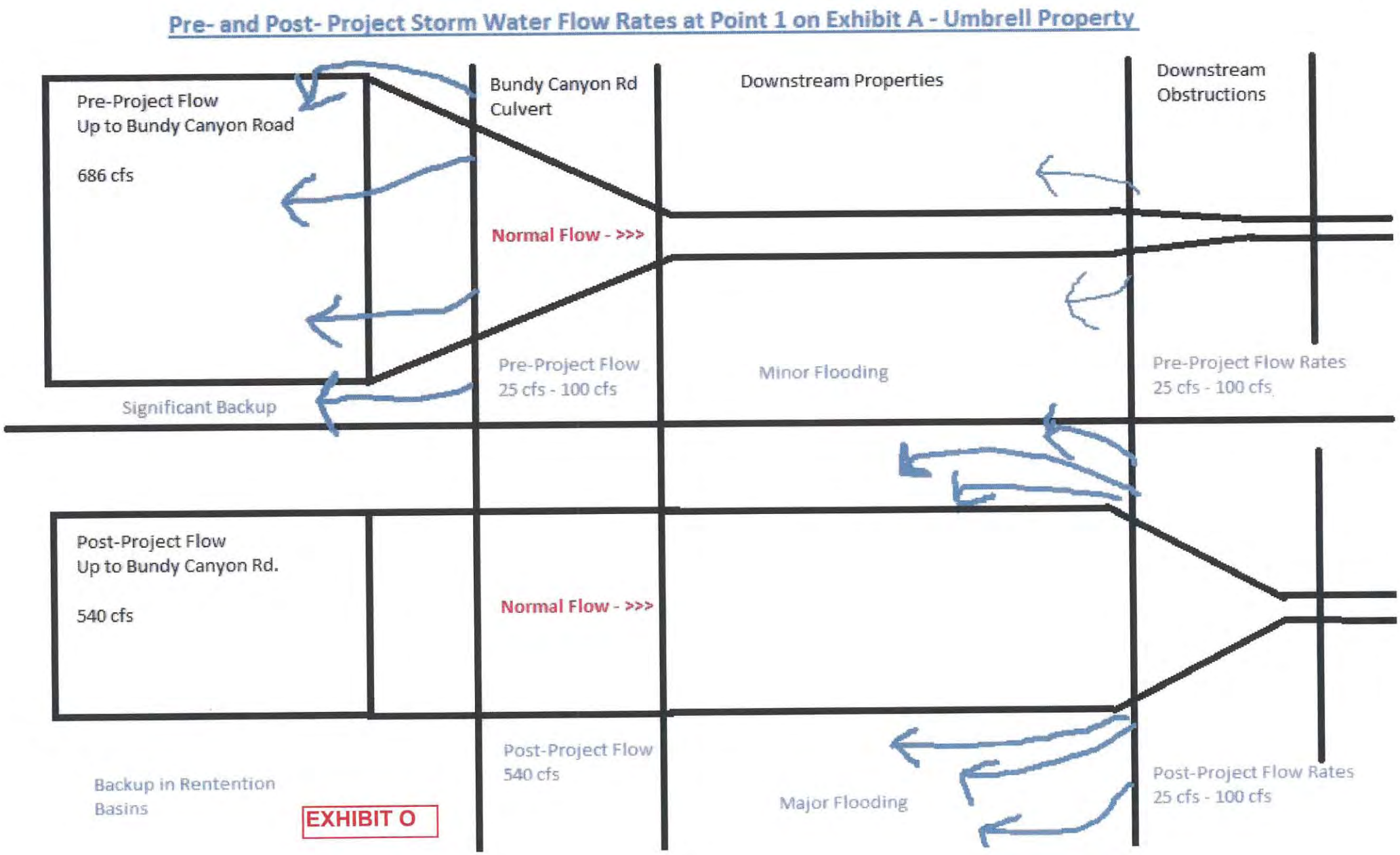
Exhibit K

Exhibit L

Exhibit M

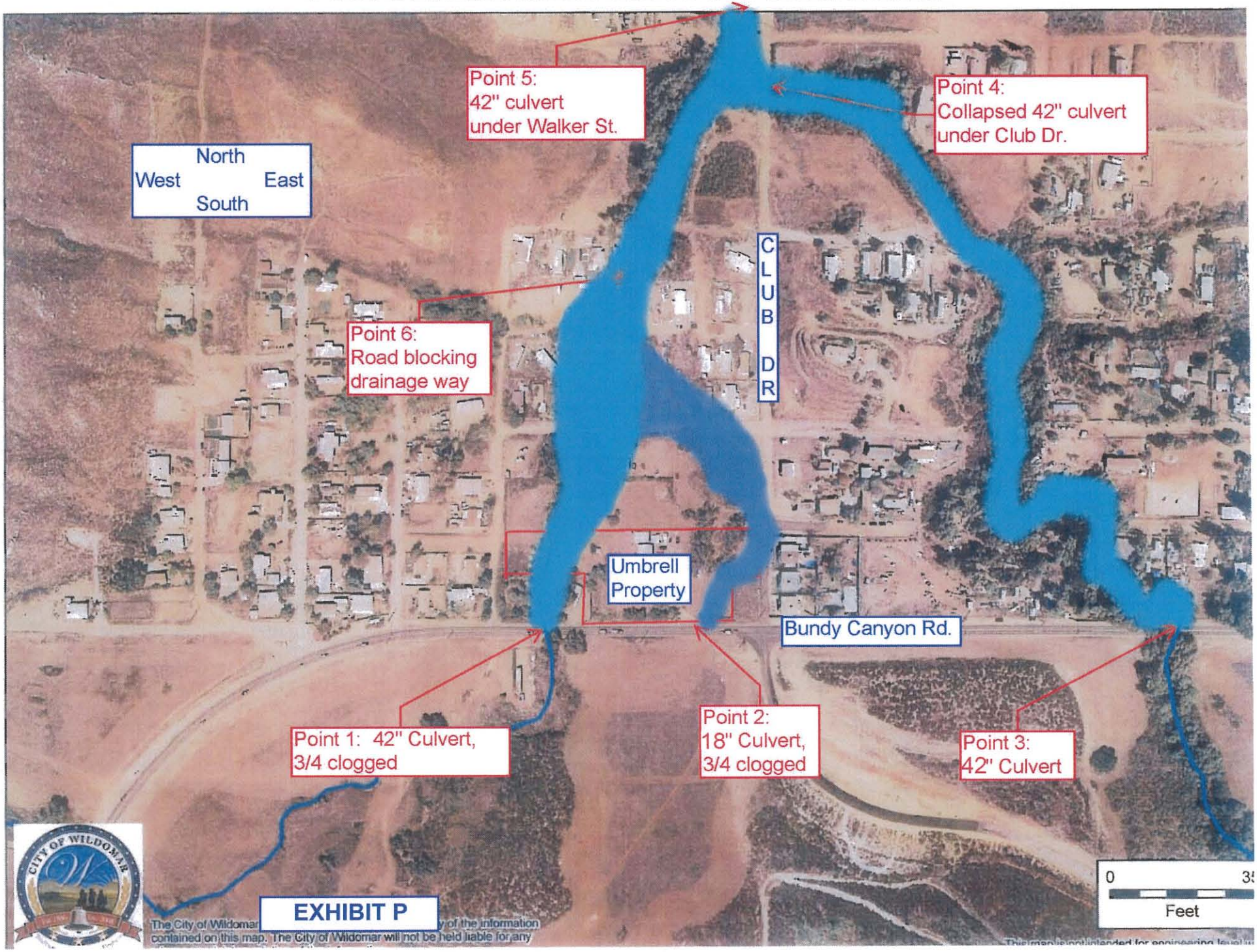
Letter 14 Continued

Letter 14 Continued



Letter 14 Continued

POST DEVELOPMENT FLOODING CONDITIONS



Letter 16 Attachments

California Air Resources Board

Preliminary Draft Staff Proposal

Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the California Environmental Quality Act

Released: October 24, 2008

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DOCUMENT AVAILABILITY

Electronic copies of this document and related materials can be found at: http://www.arb.ca.gov/cc/localgov/ceqa/ceqa.htm. Alternatively, paper copies may be obtained from the Board's Public Information Office, 1001 I Street, 1st Floor, Visitors and Environmental Services Center, Sacramento, California, 95814, (916) 322-2990.

For individuals with sensory disabilities, this document is available in Braille, large print, audiocassette or computer disk. Please contact ARB's Disability Coordinator at (916) 323-4916 by voice or through the California Relay Services at 711, to place your request for disability services. If you are a person with limited English and would like to request interpreter services, please contact ARB's Bilingual Manager at (916) 323-7053.

DISCLAIMER

This preliminary draft proposal has been reviewed by the staff of the Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does mention of trade names or commercial products constitute endorsement or recommendation of use.

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ATTACHMENT B: PRELIMINARY DRAFT PROPOSAL FOR RESIDENTIAL AND COMMERCIAL PROJECTS

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INTRODUCTION

Climate change is one of the most serious environmental problems facing the world, the United States, and California today. In this State, climate change already is impacting our coastlines, water supplies, agriculture, and public health, and putting millions of acres of forested land at increased risk of fire. These adverse effects will only increase in number and intensity if we do not promptly and substantially reduce pollution of the atmosphere with greenhouse gases (GHGs).

California law provides that climate change is an environmental effect subject to the California Environmental Quality Act (CEQA).[1] Lead agencies therefore are obligated to determine whether a project's climate change-related effects may be significant, requiring preparation of an Environmental Impact Report,[2] and to impose feasible mitigation to substantially lessen any significant effects.[3] Determining significance, however, can be a challenging task. Accordingly, the Governor's Office of Planning and Research in its June 2008 Technical Advisory, "CEQA and Climate Change,"[4] asked the Air Resources Board (ARB) to make recommendations for GHG-related thresholds of significance – identifiable benchmarks or standards that assist lead agencies in the significance determination.[5]

With this Staff Proposal, ARB staff is taking the first step toward developing recommended statewide interim thresholds of significance for GHGs that may be adopted by local agencies for their own use. The task that ARB staff is undertaking is, however, a limited one. Staff will not attempt to address every type of project that may be subject to CEQA, but instead will focus on common project types that, collectively, are responsible for substantial GHG emissions – specifically, industrial, residential, and commercial projects.[6] ARB staff believes that thresholds in these important sectors will advance our climate objectives, streamline project review, and encourage consistency and uniformity in the CEQA analysis of GHG emissions throughout the State.

Staff intends to make its final recommendations on thresholds in early 2009, in order to harmonize with OPR's timeline for issuing draft CEQA guidelines addressing GHG emissions[7] and to provide much needed guidance to lead agencies in the near term.

Public, stakeholder, and local lead agency participation is essential to the success of this project. ARB staff believes that the comment and feedback it receives, along with

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[1] Senate Bill 97, Public Resources Code, § 21083.05.
[2] California Code of Regulations, tit. 14, § 15064, subd. (f)(1).
[3] Id., § 15021, subd. (a)(2).
[4] See: http://opr.ca.gov/download.php?dl=ceqa/pdfs/june08-ceqa.pdf
[5] Id., § 15064.7, subd. (a).
[6] The collective greenhouse gas emissions from the industrial, residential and commercial sectors, together with the transportation sector, represent approximately 80% of the statewide greenhouse gas emissions inventory in 2004.
[7] See Senate Bill 97, Public Resources Code § 21083.05 (providing that draft guidelines are due June 1, 2009).

additional data and analyses, can form a body of evidence that lead agencies may rely on in adopting thresholds of significance consistent with ARB staff's recommendations.

Because the schedule is expedited, staff's recommendations must necessarily be interim and subject to review and revision as more information becomes available.[8]

BACKGROUND

Significance Under CEQA

A significant effect on the environment means a substantial, or potentially substantial, change in the environment caused directly or indirectly by the project.[9] The incremental effect of a project can be significant when it is cumulatively considerable – that is, when the effect is added to that of other past, present, and reasonably foreseeable probable future projects that also contribute to the problem.[10]

To streamline and facilitate consistency in the significance determination, the CEQA Guidelines[11] encourage agencies "to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects."[12] A threshold of significance is an identifiable quantitative, qualitative or performance level that marks the division between an impact that is significant and one that is not. A threshold of significance gives rise to a presumption, which can be rebutted by evidence that the threshold should not apply to a particular project.

Thresholds of significance must be supported by "substantial evidence." This does not mean that there is one best threshold. In CEQA, substantial evidence "means enough relevant information and reasonable inferences from this information that a fair argument can be made to support a conclusion, even though other conclusions might also be reached."[13]

Climate Change and GHG Thresholds of Significance

"The capacity of the environment is limited, and it is the intent of the Legislature that the government of the state take immediate steps to identify any critical thresholds for the health and safety of the people of the state and take all coordinated actions necessary to prevent such thresholds being reached."[14] But where should a threshold of significance be set for GHG emissions and climate change? This question can be answered only after considering the nature of the environmental problem.

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[8] ARB staff intends to monitor the implementation of thresholds that are adopted as a result of this process for effectiveness. In the same time frame as the update of the AB 32 Scoping Plan, staff intends to revisit its recommendations and to modify them if necessary.
[9] California Code of Regulations, title 14, §§ 15064, subd. (d), 15382.
[10] *Id.*, § 15355, subd. (b).
[11] Id., § 15000, et. seq.
[12] *Id.*, § 15064.7, subd. (a).
[13] *Id.*, § 15384, subd. (a).
[14] Public Resources Code, § 21000, subd. (d).

There is a scientific consensus that human activities, chief among them the burning of fossil fuels, profoundly affect the world's climate by increasing the atmospheric concentration of GHG beyond natural levels. Contributing additional GHG pollution to the atmosphere leads to higher global average temperatures, changes to climate, and adverse environmental impacts here in California and around the world.[15] Climate change, caused by "collectively significant projects taking place over a period of time[,]"[16] is a quintessential cumulative impact.

The experts tell us that an additional increase in global average temperatures of just 2 degrees Celsius (3.6 degrees Fahrenheit) is very likely dangerous.[17] With a 2 degree Celsius increase, disastrous effects become likely, including more extreme and more frequent severe weather, more wildfires, greater frequency of droughts and floods, rapid and higher sea level rise, and increased habitat destruction and extinctions.[18] These environmental effects will undoubtedly lead to serious economic, political, and national security disruptions.

In order to reduce the risk of dangerous climate change, we must stabilize atmospheric levels of GHGes at approximately 450 parts per million (ppm) by mid-century.[19] We are fast approaching this limit. Since the beginning of the industrial era, atmospheric concentrations of carbon dioxide, the primary GHG, have climbed to their highest point in the last half-million years, increasing from just under 300 ppm at the turn of the last century, to over 380 ppm today, and rising at about 2 ppm per year.[20]

In response to the challenge of climate change, California has taken a leadership role by committing to reduce its GHG emissions to 1990 levels by 2020 (about a thirty percent reduction in business-as-usual emissions in 2020) and to eighty percent below 1990 levels by 2050.[21] The latter target is consistent with the scientific consensus of the reductions needed to stabilize atmospheric levels of GHGs at 450 ppm by mid-century. Assembly Bill 32, the Global Warming Solutions Act of 2006, codifies the 2020 reduction

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[15] There is a large body of authoritative sources on the causes and current and projected impacts of climate change. An extended discussion of climate change is beyond the scope of this Staff Proposal. For additional information, ARB recommends the Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) and, in particular, the IPCC's "Frequently Asked Questions," available at: http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-faqs.pdf and the 2006 California Climate Action Team's Report to the Governor and Legislature, available at: http://www.climatechange.ca.gov/climate_action_team/reports/index.html.

[16] See California Code of Regulations, tit. 14, § 15355, subd. (b).

[17] See IPCC 4th Assessment Report, Working Group II, Summary for Policymakers, Figure 2, available at: http://www.ipcc.ch/graphics/graphics/ar4-wg2/jpg/spm2.jpg (chart showing global impacts at various temperature increases); California Climate Change Center, Our Changing Climate: Assessing the Risks to California (2008) at p. 15, available at http://www.energy.ca.gov/2006publications/CEC-500-2006-077/CEC-500-2006-077.PDF (chart showing impacts in California at various temperature increases.)

[18] *Id.*

[19] See IPCC 4th Assessment Report, Working Group III, Summary for Policymakers at p. 17, available at http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf.

[20] IPPC 4th Assessment Report, Working Group I, Figure FAQ 2.1, available at: http://www.ipcc.ch/graphics/graphics/ar4-wg1/jpg/faq-2-1-fig-1.jpg.

[21] Executive Order S-03-05

target and charges ARB with development of a Scoping Plan to map out how the State will achieve this target, including regulatory, voluntary, and market-based mechanisms beginning in 2012.[22]

There is strong need, however, to aggressively address GHG emissions right now. The pollution we contribute to the atmosphere today will continue to have climate impacts for years, decades, and, in some cases, millennia to come. And the longer we delay in addressing the problem, the more we risk being unable to meet our climate objective. CEQA provides a mechanism that is independent of AB 32 through which lead agencies can begin immediately to reduce the climate change-related impacts of the projects that come before them.

What Type of Threshold is Appropriate?

Some have suggested that because of the need for urgent action and the uncertainty of the precise "tipping point" for dangerous climate change, any contribution of GHGs to the atmosphere may be significant – a so-called "zero threshold."

ARB staff believes that for the project types under consideration, non-zero thresholds can be supported by substantial evidence. ARB staff believes that zero thresholds are not mandated in light of the fact that (1) some level of emissions in the near term and at mid-century is still consistent with climate stabilization and (2) current and anticipated regulations and programs apart from CEQA (e.g., AB 32, the Pavley vehicle regulations, the Renewable Portfolio Standard, the California Solar Initiative, and the commitment to net-zero-energy buildings by 2020 (residential) and 2030 (commercial)) will proliferate and increasingly will reduce the GHG contributions of past, present, and future projects.

But any non-zero threshold must be sufficiently stringent to make substantial contributions to reducing the State's GHG emissions peak, to causing that peak to occur sooner, and to putting California on track to meet its interim (2020) and long-term (2050) emissions reduction targets. ARB staff believes that the preliminary interim approaches outlined in this Staff Proposal are consistent with these objectives.

RECOMMENDED THRESHOLDS – CONCEPTUAL APPROACH

ARB staff believes that different GHG thresholds of significance may apply to projects in different sectors. Two primary reasons that sector-specific thresholds are appropriate are: (1) some sectors contribute more substantially to the problem, and therefore should have a greater obligation for emissions reductions, and, (2) looking forward, there are differing levels of emissions reductions expected from different sectors in order to meet California's climate objectives. We also believe that different types of thresholds – quantitative, qualitative, and performance-based – can apply to different sectors under the premise that the sectors can and must be treated separately given the state of the science and data. A sector-specific approach is consistent with ARB's

[22] Health and Safety Code, § 38500, et. seq.

Proposed Scoping Plan. Consequently, the Staff Proposal takes different, although harmonious, approaches to setting thresholds for different sectors.

The attached flowcharts describe ARB staff's preliminary interim threshold concepts for two important sectors: industrial projects (**Attachment A**) and residential and commercial projects (**Attachment B**). The objective is to develop thresholds for projects in these sectors that will result in a substantial portion of the GHG emissions from new projects being subject to CEQA's mitigation requirement, consistent with a lead agency's obligation to "avoid or minimize environmental damage where feasible."[23] ARB staff is working on a proposal for an interim approach for thresholds for transportation projects and large dairies. Electricity generation is another sector where clarity is needed in the near term. The California Energy Commission (CEC) recently began a public process for identifying an approach for assessing the significance of GHG emissions from power plant projects. CEC staff anticipates concluding that work in Spring 2009.[24]

ARB staff's proposed recommendations for GHG thresholds address projects for which local agencies are typically the CEQA lead agency. In addition to the CEC, other State agencies also serve as lead agencies under CEQA. ARB is coordinating with these State agencies on their approaches to thresholds of significance.

[23] California Code of Regulations, title 14, § 15021.
[24] The CEC adopted an Order Instituting Informational Proceeding on October 8, 2008 to address GHG emissions in power plant licensing cases: http://www.energy.ca.gov/ghg_powerplants/notices/2008-10-06_PROPOSED_GHG_CEQA_OII.PDF.

REQUEST FOR PUBLIC COMMENT

ARB staff believes that the concepts in this Staff Proposal can be further developed into interim thresholds of significance. However, staff recognizes that additional analyses and data are needed to fill in some of the blanks, and to understand how the thresholds will operate in the real world.

Comments on all aspects of the Staff Proposal are encouraged. In particular, ARB seeks the active participation of local lead agencies. Staff has identified a few questions to solicit public comment, but this list is not exhaustive.

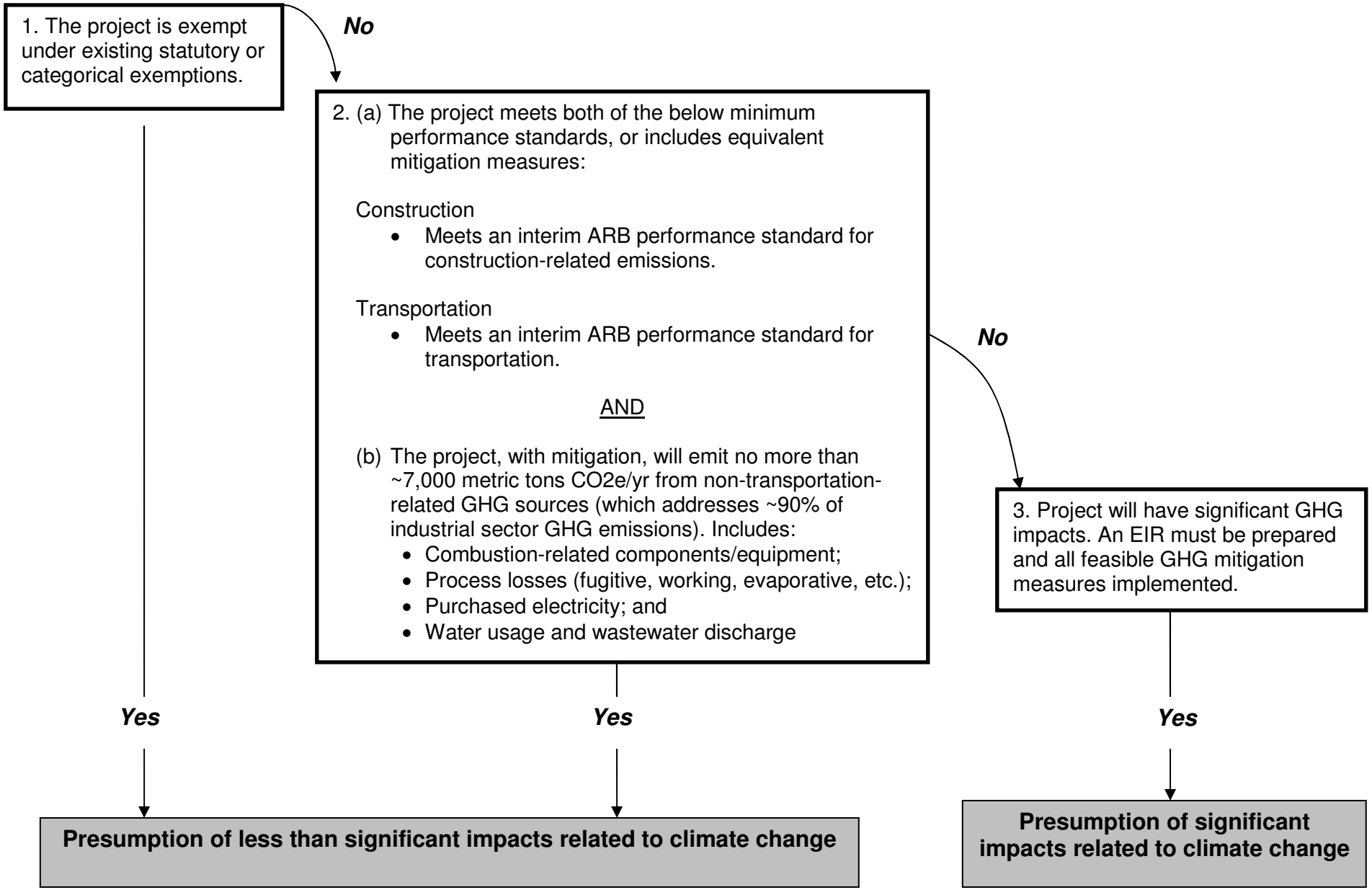
- Will the recommended approaches have any unintended consequences, for example, encouraging the piecemealing of projects?

- As set out in the attachments to the Staff Proposal, staff proposes to define certain performance standards (*e.g.*, for energy efficiency) by referencing or compiling lists from existing local, State or national standards. For some sub-sources of GHG emissions (*e.g.*, construction, transportation, waste), ARB staff has not identified reference standards. How should the performance standards for these sub-sources be defined?

- Are any of the industrial, residential, or commercial project types eligible for categorical exemptions likely to contribute more significantly to climate change than staff's preliminary analysis indicates?

- For residential and commercial projects, staff has proposed that the GHG emissions of some projects that meet GHG performance standards might under some circumstances still be considered cumulatively considerable and therefore significant. What types of projects might still have significant climate change-related impacts?

ATTACHMENT A
Preliminary Draft Proposal for Industrial Projects



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Preliminary Draft Proposal for Industrial Projects

Introduction

CEQA guidelines provide that thresholds of significance can be qualitative, quantitative, or in the form of performance standards. ARB staff's objective is to develop a threshold of significance that will result in the vast majority (~90% statewide) of the greenhouse gas (GHG) emissions from new industrial projects being subject to CEQA's requirement to impose feasible mitigation. ARB staff believes this can be accomplished with a threshold that allows small projects to be considered insignificant. ARB staff used existing data for the industrial sector to derive a proposed hybrid threshold. The threshold consists of a quantitative threshold of 7,000 metric tons of CO2 equivalent per year (MTCO2e/year) for operational emissions (excluding transportation), and performance standards for construction and transportation emissions.

The goal of this effort is to provide for the mitigation of GHG emissions from industrial projects on a statewide level. Over time, implementation of AB 32 will reduce or mitigate GHG emissions from industrial sources. Once such requirements are in place, they could become the performance standard for industrial projects for CEQA purposes. ARB staff intends to pursue this approach in conjunction with development of the regulatory requirements for industrial sources in the Proposed AB 32 Scoping Plan. Staff is proposing the use of a quantitative significance threshold at least until such time that performance standards, such AB 32 regulatory requirements, are in place to ensure mitigation of significant impacts of GHG emissions from projects in the industrial sector.

The performance standards are largely self explanatory and similar to the approaches proposed for residential and commercial projects. The method for deriving the quantitative aspect of the threshold warrants further explanation.

Technical foundation for proposed quantitative aspect of the threshold

Based on the available data, ARB staff found that for the industrial sector, small projects – defined as the portion of new projects that, when viewed collectively, were responsible for only a relatively small amount of emissions – could be allowed to proceed without requiring additional mitigation under CEQA. The question for ARB staff was what line divides these small projects from the rest of the projects that should undergo mitigation to achieve the larger environmental objective.

ARB decided to construct a representative small project and to estimate that project's expected emissions. First, ARB considered the common sub-sources of GHG emissions in the industrial sector. The four main broad emission categories and their approximate statewide contribution to GHG emissions from industrial facilities other than power plants are:

Category	MMTCO2e/year	Percent (%)
Combustion processes	70	63 %
Process Losses (evaporative, fugitive, working, etc.)	15	13 %
Purchased Electricity	18	17 %
Water Use and Wastewater Treatment	7	7 %

As the table indicates, GHG emissions from industrial sources are dominated by combustion emissions. To ensure that significant industrial emissions would be captured by the proposed threshold, ARB staff evaluated industrial boilers because they are a very common piece of equipment, are essential in many energy-intensive industries, and are a top contributor to industrial combustion emissions.

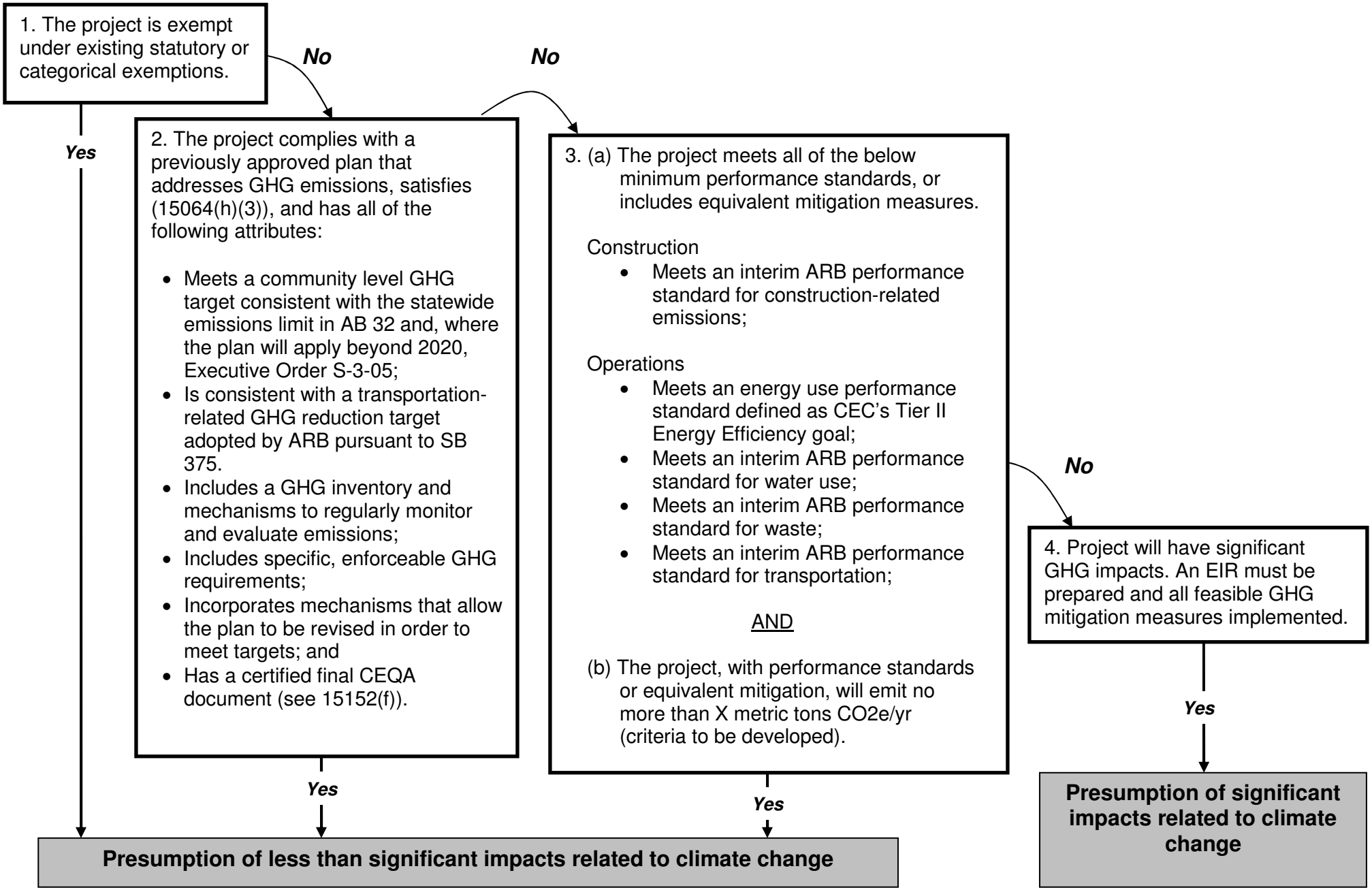
A recent comprehensive survey of industrial boilers by Oak Ridge National Laboratory[25] found that boilers with an input capacity of 10 MMBtu/hr or greater correspond to 93 percent of total industrial boiler input capacity. Based on this data, ARB staff used a natural gas boiler input capacity benchmark of 10 MMBtu/hr which equates to emissions of 4,660 MTCO2e/yr. This capacity benchmark defines a significant combustion source.

As shown in the above table, combustion processes account for 63 percent of the statewide GHG emissions from industrial facilities. Process losses, purchased electricity, and water use and water treatment account for the remaining 27 percent of emissions. Staff applied these proportions to the benchmark combustion emissions estimate (4,660 MTCO2e/yr). The result is an overall emissions estimate of approximately 7,000 MTCO2e/yr for a representative small project that accounts for the four main categories in the table above.

Based on the available data, staff believes that the 7,000 MTCO2e/year benchmark can be used to effectively mitigate industrial projects with significant GHG emissions.

[25] Characterization of the U.S. Industrial/Commercial Boiler Population, Energy, and Environmental Analysis, Inc. submitted to Oak Ridge National Laboratory, available at:: http://ww.eea-inc.com/natgas_reports/BoilersFinal.pdf.

ATTACHMENT B
Preliminary Draft Proposal for Residential and Commercial Projects



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Preliminary Draft Proposal for Residential and Commercial Projects

Introduction

CEQA guidelines provide that thresholds of significance can be qualitative, quantitative, or in the form of performance standards. ARB staff's objective is to develop a threshold for residential and commercial projects that will substantially reduce the greenhouse gas (GHG) emissions from new projects and streamline the permitting of carbon-efficient projects. To achieve this, staff's preliminary recommendation is to develop a threshold based on clear and stringent performance standards.

Performance standards will address the five major emission sub-sources for the sector: energy use, transportation, water use, waste, and construction. For the energy use performance standard, staff recommends reliance on the California Energy Commission's (CEC) Tier II Energy Efficiency standards for solar energy incentive programs. These standards are consistent with what is needed to meet the state's goal of zero net energy buildings and are continuously updated to reflect energy efficiency best practices. For the remaining sub-sources (water, waste, etc.), staff intends to compile benchmark performance standards as part of its final threshold recommendation. Projects may alternatively incorporate mitigation equivalent to these performance standards.

Staff recognizes that a substantial body of measures to address GHG emissions exists through programs like LEED, GreenPoint Rated, and the California Green Building Code. As work on performance standards moves forward, staff intends to make use of these projects.

In addition, staff proposes that a presumption of non-significance apply only to projects whose total net emissions, after meeting the performance standards or equivalent, are below a specified level. Staff proposes to develop this emissions level as part of its final threshold recommendation.

Discussion of Flow Chart

Box 1: In general, categorical exemptions will continue to apply.

Based on its preliminary analysis, ARB staff believes that projects described in CEQA's categorical and statutory exemption provisions (Articles 18 and 19 of the California Code of Regulations, title 14) will not interfere with achieving the objective to minimize emissions from new projects in this sector. GHG emissions from residential and commercial projects that are described in the categorical exemption language appear to be relatively small from a GHG perspective. For example, staff's preliminary analysis indicates that emissions from a project qualifying for the statutory infill project exemption (Cal. Code Regs., tit. 14, § 15195) will emit approximately 1,600 metric tons (MT)CO2e/yr. Staff believes

such infill projects represent some of the largest projects described in the exemption provisions. ARB staff expects to provide additional analyses to support a lead agency's determination that the GHG impact of these project types is less than significant. Staff invites the public and stakeholders to provide further evidence on the application of categorical exemptions to residential and commercial projects.

Box 2: If GHGs are adequately addressed at the programmatic level, the impact of certain individual projects can be found to be insignificant.

As OPR noted in its June 2008 Technical Advisory:

> CEQA can be a more effective tool for greenhouse gas emissions analysis and mitigation if it is supported and supplemented by sound development policies and practices that will reduce greenhouse gas emissions on a broad planning scale and that can provide the basis for a programmatic approach to project-specific CEQA analysis and mitigation…. For local government lead agencies, adoption of general plan policies and certification of general plan EIRs that analyze broad jurisdiction-wide impacts of greenhouse gas emissions can be part of an effective strategy for addressing cumulative impacts and for streamlining later project-specific CEQA reviews.

ARB staff encourages local agencies to take advantage of a programmatic approach to address climate change, consistent with existing law.

If a project complies with the requirements of a previously adopted GHG emission reduction plan or mitigation program that satisfies California Code of Regulations, title 14, section 15064(h)(3), and includes the attributes specified in that provision and Box 2, the lead agency may determine that the project's GHG impacts are less than significant with no further analysis required. Examples of plans that may satisfy this provision include Climate Action Plans incorporated into General Plans that have inventories, an emissions target, suites of specific and enforceable measures to reach that target, monitoring and reporting, and mechanisms to revise the plan to stay on target. Moreover, a prior EIR that "adequately addressed" climate change may be used for tiering purposes. (See Cal. Code Regs. tit. 14, § 15152.)

Box 3: Projects that meet performance standards, or include equivalent mitigation, can be found to be insignificant.

The threshold incorporates performance standards requiring carbon efficiency for each major sub-source of emissions from projects in these sectors. Provided they are set at a sufficiently stringent level, performance standards will dramatically reduce GHG emissions and promote a transition toward zero and low emission projects. In most cases, ARB staff expects that performance

standards will need to reach beyond current State mandates by a substantial amount, given that GHG emission reduction goals have not yet been adequately incorporated into State programs. Staff anticipates that performance standards will become more stringent over time.

ARB staff has identified the California Energy Commission's Tier II Energy Efficiency goals as an appropriate performance standard for energy use. Under State law, the CEC is required to establish eligibility criteria, conditions for incentives, and rating standards to qualify for ratepayer-funded solar energy system incentives in California. As part of this effort, the CEC establishes energy efficiency standards for homes and commercial structures, and requires new buildings to exceed current building standards by meeting Tier Energy Efficiency goals. CEC's Tier II Energy Efficiency goals will continue to be updated to achieve energy efficiency best practices, and are consistent with what is needed to meet the California Public Utilities Commission Strategic Plan goals of zero net energy buildings. Currently, the CEC's proposed guidelines for the solar energy incentive program recommend a Tier II goal for residential and commercial projects of a 30 percent reduction in building combined space heating, cooling, and water heating energy compared to the 2008 Title 24 Standards.[26]

For the remaining sub-sources, staff intends to compile benchmark performance standards as part of its final threshold recommendation. ARB staff believes that existing progressive green building standards provide a starting point for performance standards for transportation, water use, waste, and construction-related emissions. Existing green building rating systems like LEED, GreenPoint Rated, the California Green Building Code, and others, contain examples of measures that are likely to result in substantial GHG emission reductions from residential and commercial projects. The key to this approach will be identifying effective GHG reduction measures within these systems. ARB staff would like input from the public and stakeholders on appropriate performance standards for these sub-sources. Performance standards that already exist and have been proven to be effective – at the local, State, national or international level – are preferable.

Under staff's proposed approach, lead agencies would be allowed to find that a project's mitigation is "equivalent" to identified performance standards, thereby allowing for cost-effective and innovative approaches to reducing GHG emissions.

Staff believes that under some circumstances, projects that meet performance standards or include equivalent mitigation measures will have impacts that may still be cumulatively considerable and therefore significant. For this reason, staff recommends that, in addition to meeting performance standards or including

[26] Guidelines for California's Solar Electric Incentive Program Pursuant to Senate Bill 1 - SECOND EDITION - Draft Guidelines can be found at: http://www.energy.ca.gov/2008publications/CEC-300-2008-007/CEC-300-2008-007-D.PDF

equivalent mitigation measures, a project must also emit no more than “X” MTCO2e/yr. Criteria for determining this emissions level have yet to be defined. ARB requests public and stakeholder input on what types of projects might still have significant climate change-related impacts.

Box 4: Presumption of significant impacts.

If a project cannot meet the requirements in the previous boxes, it should be presumed to have significant impacts related to climate change. The lead agency must then prepare an EIR, or other appropriate document, and implement all feasible GHG mitigation measures.

CAPCOA

CALIFORNIA AIR POLLUTION CONTROL OFFICERS ASSOCIATION

CEQA & Climate Change

Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act

January 2008

Disclaimer

The California Air Pollution Control Officers Association (CAPCOA) has prepared this white paper consideration of evaluating and addressing greenhouse gas emissions under the California Environmental Quality Act (CEQA) to provide a common platform of information and tools to support local governments.

This paper is intended as a resource, not a guidance document. It is not intended, and should not be interpreted, to dictate the manner in which an air district or lead agency chooses to address greenhouse gas emissions in the context of its review of projects under CEQA.

This paper has been prepared at a time when California law has been recently amended by the Global Warming Solutions Act of 2006 (AB 32), and the full programmatic implications of this new law are not yet fully understood. There is also pending litigation in various state and federal courts pertaining to the issue of greenhouse gas emissions. Further, there is active federal legislation on the subject of climate change, and international agreements are being negotiated. Many legal and policy questions remain unsettled, including the requirements of CEQA in the context of greenhouse gas emissions. This paper is provided as a resource for local policy and decision makers to enable them to make the best decisions they can in the face of incomplete information during a period of change.

Finally, this white paper reviews requirements and discusses policy options, but it is not intended to provide legal advice and should not be construed as such. Questions of legal interpretation, particularly in the context of CEQA and other laws, or requests for advice should be directed to the agency's legal counsel.

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List of Acronyms and Abbreviations

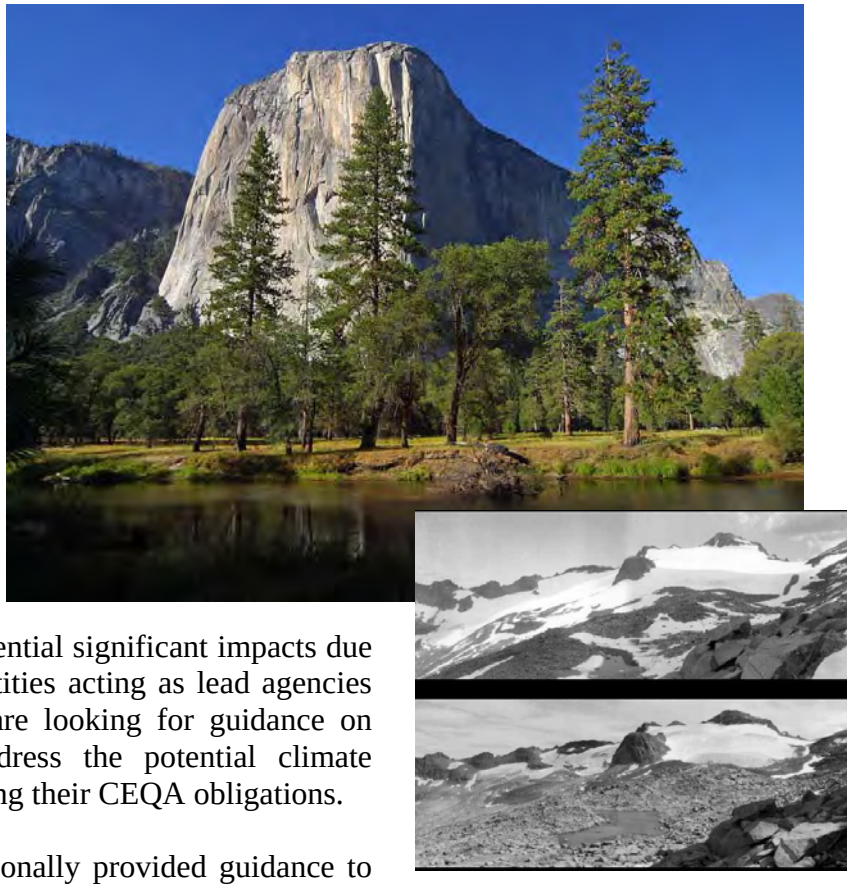
Acronym/ Abbreviation	Meaning
AB 32	Assembly Bill 32 Global Warming Solutions Act of 2006
AG	Attorney General
ARB	Air Resources Board
ASTM	American Society of Testing and Material
BAAQMD	Bay Area Air Quality Management District
BAU	Business as Usual
BEES	Building for Environmental and Economic Sustainability
Calfire	California Fire
Caltrans	California Department of Transportation
CAP	Criteria Air Pollutants
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resource Board
CAT	Climate Action Team
CCAP	Center for Clean Air Policy
CCAR	California Climate Action Registry
CDFA	California Department of Food and Agriculture
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CF	Connectivity Factor
CH_4	Methane
CIWMB	California Integrated Waste Management Board
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CNG	Compressed Natural Gas
CPUC	California Public Utilities Commission
CUFR	California Urban Forestry
DGS	Department of General Services
DOE	U.S. Department of Energy
DOF	Department of Finance
DPF	Diesel Particulate Filter
DWR	Department of Water Resources
E85	85% Ethanol
EEA	Massachusetts Executive Office of Energy and Environmental Affairs
EERE	Energy Efficiency and Renewable Energy
EIR	Environmental Impact Report
EOE	Encyclopedia of Earth
EPA	U.S. Environmental Protection Agency
ETC	Edmonton Trolley Coalition
EV	Electric Vehicles
FAR	Floor Area Ratio

GHG	Greenhouse Gas
GGEP	Greenhouse Gas Emissions Policy
GGRP	Greenhouse Gas Reduction Plan
GP	General Plan
GWP	Global Warming Potential
IGCC	Integrated Gasification Combined Cycle
IOU	Investor Owned Utility
IPCC	International Panel on Climate Change
IT	Information Technology
ITE	Institute of Transportation Engineers
J&S	Jones & Stokes
km	Kilometer
LandGem	Landfill Gas Emissions Model
LEED	Leadership in Energy and Environmental Design
LNG	Liquefied Natural Gas
MBUAPCD	Monterey Bay Unified Air Pollution Control District
MEPA	Massachusetts Environmental Policy Act
MND	Mitigated Negative Declaration
MMT CO_2e	Million Metric Tons Carbon Dioxide Equivalent
MW	Megawatts
N_2O	Nitrous Oxide
NACAA	National Association Clean Air Agencies
ND	Negative Declaration
NEV	Neighborhood Electric Vehicle
NIST	National Institute of Standards and Technology
NO_X	Oxides of Nitrogen
NREL	National Renewable Energy Laboratory
NSCAPCD	Northern Sonoma County Air Pollution Control District
NSR	New Source Review
OPR	State Office of Planning and Research
PFC	Perfluorocarbon
PG&E	Pacific Gas & Electric
POU	Publicly Owned Utility
PM	Particulate Mater
RoadMod	Road Construction Emissions Model
ROG	Reactive Organic Gas
RPS	Renewable Portfolio Standards
RTP	Regional Transportation Plan
S-3-05	Executive Order S-3-05
SB	Senate Bill
SBCAPCD	Santa Barbara County Air Pollution Control District
SCAQMD	South Coast Air Quality Management District
SCM	Sustainable Communities Model
SIP	State Implementation Plan
SJVAPCD	San Joaquin Valley Unified Air Pollution Control District
SLOCAPCD	San Luis Obispo County Air Pollution Control District

SMAQMD	Sacramento Metropolitan Air Quality Management District
SMUD	Sacramento Municipal Utilities District
SO_X	Sulfur Oxides
SP	Service Population
SRI	Solar Reflectance Index
SWP	State Water Project
TAC	Toxic Air Contaminants
TBD	To Be Determined
TDM	Transportation Demand Management
TMA	Transportation Management Association
THC	Total Hydrocarbon
UC	University of California
ULEV	Ultra Low Emission Vehicle
UNFCCC	United Nations Framework Convention on Climate Change
URBEMIS	Urban Emissions Model
USGBC	U.S. Green Building Council
VMT	Vehicle Miles Traveled
VTPI	Victoria Transit Policy
YSAQMD	Yolo-Solano Air Quality Management District

Introduction

The California Environmental Quality Act (CEQA) requires that public agencies refrain from approving projects with significant adverse environmental impacts if there are feasible alternatives or mitigation measures that can substantially reduce or avoid those impacts. There is growing concern about greenhouse gas emissions[1] (GHG) and recognition of their significant adverse impacts on the world's climate and on our environment. In its most recent reports, the International Panel on Climate Change (IPCC) has called the evidence for this "unequivocal." In California, the passage of the Global Warming Solutions Act of 2006 (AB 32) recognizes the serious threat to the "economic well-being, public health, natural resources, and the environment of California" resulting from global warming. In light of our current understanding of these impacts, public agencies approving projects subject to the CEQA are facing increasing pressure to identify and address potential significant impacts due to GHG emissions. Entities acting as lead agencies in the CEQA process are looking for guidance on how to adequately address the potential climate change impacts in meeting their CEQA obligations.



Air districts have traditionally provided guidance to local lead agencies on evaluating and addressing air pollution impacts from projects subject to CEQA. Recognizing the need for a common platform of information and tools to support decision makers as they establish policies and programs for GHG and CEQA, the California Air Pollution Control Officers Association has prepared a white paper reviewing policy choices, analytical tools, and mitigation strategies.

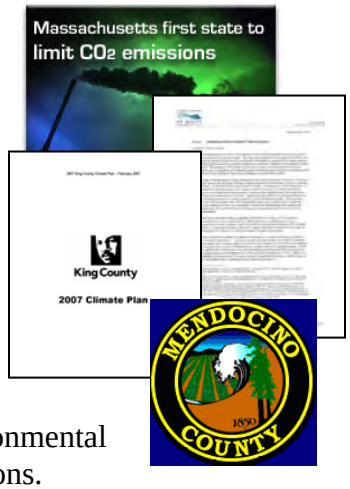
This paper is intended to serve as a resource for public agencies as they establish agency procedures for reviewing GHG emissions from projects under CEQA. It considers the application of thresholds and offers three alternative programmatic approaches toward

[1] Throughout this paper GHG, CO_2, CO_2e, are used interchangeably and refer generally to greenhouse gases but do not necessarily include all greenhouse gases unless otherwise specified.

determining whether GHG emissions are significant. The paper also evaluates tools and methodologies for estimating impacts, and summarizes mitigation measures. It has been prepared with the understanding that the programs, regulations, policies, and procedures established by the California Air Resources Board (CARB) and other agencies to reduce GHG emissions may ultimately result in a different approach under CEQA than the strategies considered here. The paper is intended to provide a common platform for public agencies to ensure that GHG emissions are appropriately considered and addressed under CEQA while those programs are being developed.

Examples of Other Approaches

Many states, counties, and cities have developed policies and regulations concerning greenhouse gas emissions that seek to require or promote reductions in GHG emissions through standards for vehicle emissions, fuels, electricity production/renewables, building efficiency, and other means. A few have developed guidance and are currently considering formally requiring or recommending the analysis of greenhouse gas emissions for development projects during their associated environmental processes. Key work in this area includes:



- Massachusetts Office of Energy and Environmental Affairs Greenhouse Gas Emissions Policy;
- King County, Washington, Executive Order on the Evaluation of Climate Change Impacts through the State Environmental Policy Act;
- Sacramento AQMD interim policy on addressing climate change in CEQA documents; and
- Mendocino AQMD updated guidelines for use during preparation of air quality impacts in Environmental Impact Reports (EIRs) or mitigated negative declarations.

The following paper evaluates options for lead agencies to ensure that GHG emissions are appropriately addressed as part of analyses under CEQA. It considers the use of significance thresholds, tools and methodologies for analyzing GHG emissions, and measures and strategies to avoid, reduce, or mitigate impacts.

Greenhouse Gas Significance Criteria

This white paper discusses three basic options air districts and lead agencies can pursue when contemplating the issues of CEQA thresholds for greenhouse gas emissions. This paper explores each path and discusses the benefits and disbenefits of each. The three basic paths are:

- No significance threshold for GHG emissions;

- GHG emissions threshold set at zero; or
- GHG threshold set at a non-zero level.

Each has inherent advantages and disadvantages. Air districts and lead agencies may believe the state or national government should take the lead in identifying significance thresholds to address this global impact. Alternatively, the agency may believe it is premature or speculative to determine a clear level at which a threshold should be set. On the other hand, air districts or lead agencies may believe that every GHG emission should be scrutinized and mitigated or offset due to the cumulative nature of this impact. Setting the threshold at zero will place all discretionary projects under the CEQA microscope. Finally, an air district or lead agency may believe that some projects will not benefit from a full environmental impact report (EIR), and may believe a threshold at some level above zero is needed.

This paper explores the basis and implications of setting no threshold, setting a threshold at zero and two primary approaches for those who may choose to consider a non-zero threshold. The first approach is grounded in statute (AB 32) and executive order (EO S-3-05) and explores four possible options under this scenario. The options under this approach are variations of ways to achieve the 2020 goals of AB 32 from new development, which is estimated to be about a 30 percent reduction from business as usual.

The second approach explores a tiered threshold option. Within this option, seven variations are discussed. The concepts explored here offer both quantitative and qualitative approaches to setting a threshold as well as different metrics by which tier cut-points can be set. Variations range from setting the first tier cut-point at zero to second-tier cut-points set at defined emission levels or based on the size of a project. It should be noted that some applications of the tiered threshold approach may require inclusion in a General Plan or adoption of enabling regulations or ordinances to render them fully effective and enforceable.

Greenhouse Gas Analytical Methodologies

The white paper evaluates various analytical methods and modeling tools that can be applied to estimate the greenhouse gas emissions from different project types subject to CEQA. In addition, the suitability of the methods and tools to characterize accurately a project's emissions is discussed and the paper provides recommendations for the most appropriate methodologies and tools currently available.

The suggested methodologies are applied to residential, commercial, specific plan and general plan scenarios where GHG emissions are estimated for each example. This chapter also discusses estimating emissions from solid waste facilities, a wastewater treatment plant, construction, and air district rules and plans.

Another methodology, a service population metric, that would measure a project's overall GHG efficiency to determine if a project is more efficient than the existing statewide average for per capita GHG emissions is explored. This methodology may be more directly correlated to a project's ability to help achieve objectives outlined in AB 32, although it relies on establishment of an efficiency-based significance threshold. The subcommittee believes this methodology may eventually be appropriate to evaluate the long-term GHG emissions from a project in the context of meeting AB 32 goals. However, this methodology will need further work and is not considered viable for the interim guidance presented in this white paper.

Greenhouse Gas Mitigation Measures

Common practice in environmental protection is first to avoid, then to minimize, and finally to compensate for impacts. When an impact cannot be mitigated on-site, off-site mitigation can be effectively implemented in several resource areas, either in the form of offsetting the same impact or preserving the resource elsewhere in the region.

This white paper describes and evaluates currently available mitigation measures based on their economic, technological and logistical feasibility, and emission reduction effectiveness. The potential for secondary impacts to air quality are also identified for each measure. A summary of current rules and regulations affecting greenhouse gas emissions and climate change is also provided.

Reductions from transportation related measures (e.g., bicycle, pedestrian, transit, and parking) are explored as a single comprehensive approach to land use. Design measures that focus on enhancing alternative transportation are discussed. Mitigation measures are identified for transportation, land use/building design, mixed-use development, energy efficiency, education/social awareness and construction.

Purpose

CEQA requires the avoidance or mitigation of significant adverse environmental impacts where there are feasible alternatives available. The contribution of GHG to climate change has been documented in the scientific community. The California Global Warming Solutions Act of 2006 (AB 32) mandates significant reductions in greenhouse gases (GHG); passage of that law has highlighted the need to consider the impacts of GHG emissions from projects that fall under the jurisdiction of the California Environmental Quality Act (CEQA). Because we have only recently come to fully recognize the potential for significant environmental impacts from GHG, most public agencies have not yet established policies and procedures to consider them under CEQA. As a result, there is great need for information and other resources to assist public agencies as they develop their programs.

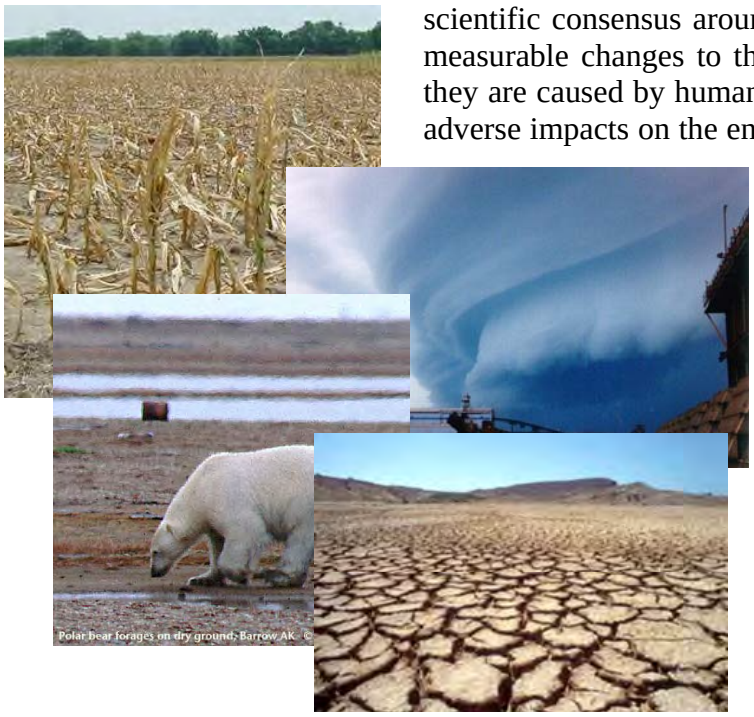
Air districts have historically provided guidance to local governments on the evaluation of air pollutants under CEQA. As local concern about climate change and GHG has increased, local governments have requested guidance on incorporating analysis of these impacts into local CEQA review. The California Air Pollution Control Officers Association (CAPCOA), in coordination with the CARB, the Governor's Office of Planning and Research (OPR) and two environmental consulting firms, has harnessed the collective expertise to evaluate approaches to analyzing GHG in CEQA. The purpose of this white paper is to provide a common platform of information and tools to address climate change in CEQA analyses, including the evaluation and mitigation of GHG emissions from proposed projects and identifying significance threshold options.

CEQA requires public agencies to ensure that potentially significant adverse environmental effects of discretionary projects are fully characterized, and avoided or mitigated where there are feasible alternatives to do so. Lead agencies have struggled with how best to identify and characterize the magnitude of the adverse effects that individual projects have on the global-scale phenomenon of climate change, even more so since Governor Schwarzenegger signed Executive Order S-3-05 and the state Legislature enacted The Global Warming Solutions Act of 2006 (AB 32). There is now a resounding call to establish procedures to analyze and mitigate greenhouse gas (GHG) emissions. The lack of established thresholds does not relieve lead agencies of their responsibility to analyze and mitigate significant impacts, so many of these agencies are seeking guidance from state and local air quality agencies. This white paper addresses issues inherent in establishing CEQA thresholds, evaluates tools, catalogues mitigation measures and provides air districts and lead agencies with options for incorporating climate change into their programs.

Background

National and International Efforts

International and Federal legislation have been enacted to deal with climate change issues. The Montreal Protocol was originally signed in 1987 and substantially amended in 1990 and 1992. In 1988, the United Nations and the World Meteorological Organization established the IPCC to assess the scientific, technical and socioeconomic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts, and options for adaptation and mitigation. The most recent reports of the IPCC have emphasized the scientific consensus around the evidence that real and measurable changes to the climate are occurring, that they are caused by human activity, and that significant adverse impacts on the environment, the economy, and human health and welfare are unavoidable.



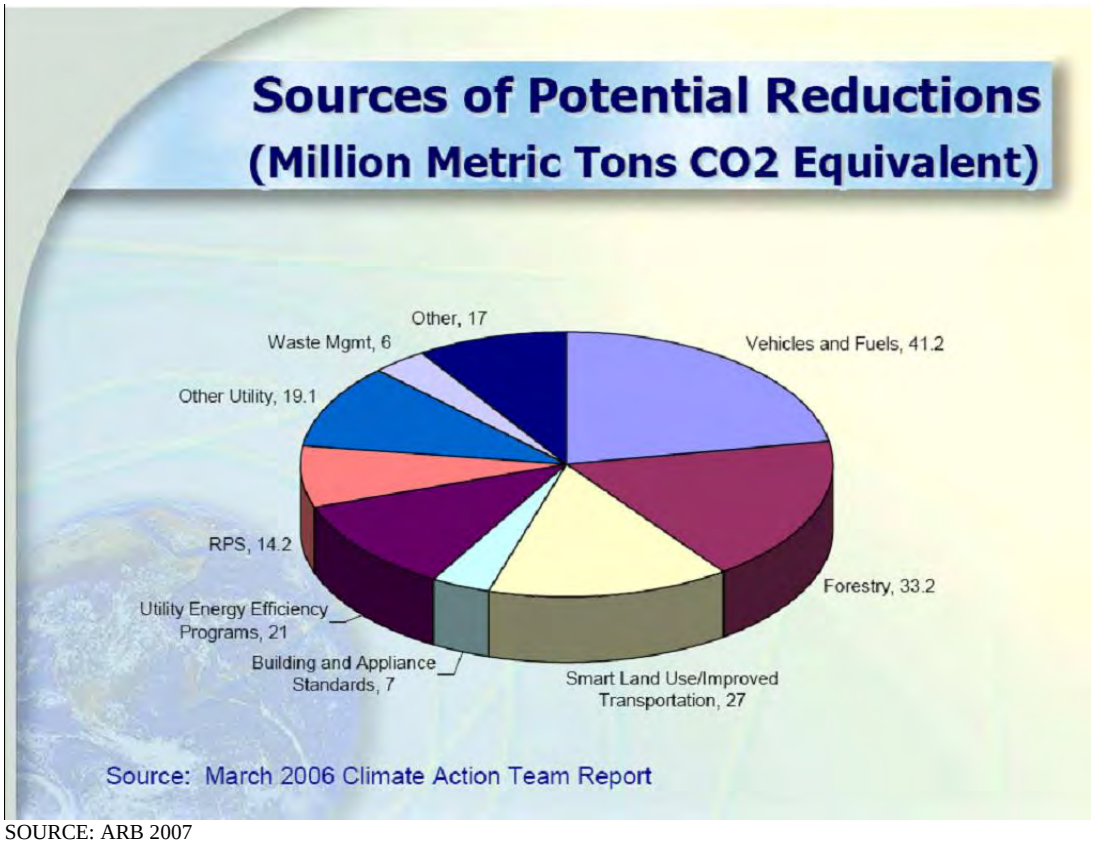
In October 1993, President Clinton announced his Climate Change Action Plan, which had a goal to return greenhouse gas emissions to 1990 levels by the year 2000. This was to be accomplished through 50 initiatives that relied on innovative voluntary partnerships between the private sector and government aimed at producing cost-effective reductions in greenhouse gas emissions. On March 21, 1994, the United States joined a number of countries around the world in signing the United Nations Framework Convention on Climate Change (UNFCCC). Under the Convention, governments agreed to gather and share information on greenhouse gas emissions, national policies, and best practices; launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and cooperate in preparing for adaptation to the impacts of climate change.

These efforts have been largely policy oriented. In addition to the national and international efforts described above, many local jurisdictions have adopted climate change policies and programs. However, thus far little has been done to assess the significance of the affects new development projects may have on climate change.

Executive Order S-3-05

On June 1, 2005, Governor Schwarzenegger issued Executive Order S-3-05 (S-3-05). It included the following GHG emission reduction targets: by 2010, reduce GHG emissions to 2000 levels; by 2020, reduce GHG emissions to 1990 levels; by 2050, reduce GHG emissions to 80 percent below 1990 levels. To meet the targets, the Governor directed the Secretary of the California Environmental Protection Agency to coordinate with the Secretary of the Business, Transportation and Housing Agency, Secretary of the Department of Food and Agriculture, Secretary of the Resources Agency, Chairperson of the CARB, Chairperson of the Energy Commission and President of the Public Utilities Commission on development of a Climate Action Plan.

The Secretary of CalEPA leads a Climate Action Team (CAT) made up of representatives from the agencies listed above to implement global warming emission reduction programs identified in the Climate Action Plan and report on the progress made toward meeting the statewide greenhouse gas targets that were established in the Executive Order.



SOURCE: ARB 2007

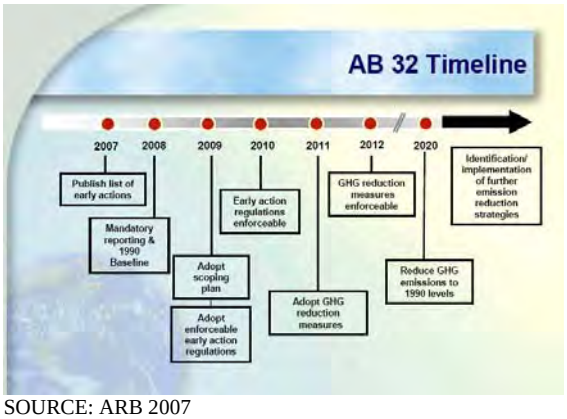
In accord with the requirements of the Executive Order, the first report to the Governor and the Legislature was released in March 2006 and will be issued bi-annually thereafter. The CAT Report to the Governor contains recommendations and strategies to help ensure the targets in Executive Order S-3-05 are met.

California Global Warming Solutions Act of 2006 (AB 32)

In 2006, the California State Legislature adopted the California Global Warming Solutions Act of 2006. AB 32 establishes a cap on statewide greenhouse gas emissions and sets forth the regulatory framework to achieve the corresponding reduction in statewide emissions levels. AB 32 charges the California Air Resources Board (CARB), the state agency charged with regulating statewide air quality, with implementation of the act. Under AB 32, greenhouse gases are defined as: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

The regulatory steps laid out in AB 32 require CARB to: adopt early action measures to reduce GHGs; to establish a statewide greenhouse gas emissions cap for 2020 based on 1990 emissions; to adopt mandatory reporting rules for significant source of greenhouse gases; and to adopt a scoping plan indicating how emission reductions will be achieved via regulations, market mechanisms and other actions; and to adopt the regulations needed to achieve the maximum technologically feasible and cost-effective reductions in greenhouse gases.

AB 32 requires that by January 1, 2008, the State Board shall determine what the statewide greenhouse gas emissions inventory was in 1990, and approve a statewide greenhouse gas emissions limit that is equivalent to that level, to be achieved by 2020. While the level of 1990 GHG emissions has not yet been approved, CARB's most recent emission inventory indicates that California had annual emissions of 436 million metric tons of carbon dioxide equivalent (MMT CO_2e) in 1990 and 497 MMT CO_2e in 2004.



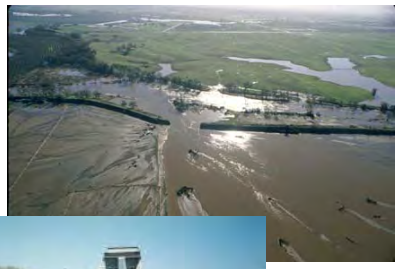
SOURCE: ARB 2007

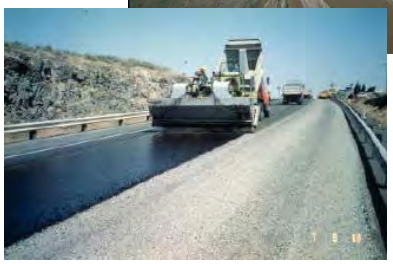
The regulatory timeline laid out in AB 32 requires that by July 1, 2007, CARB adopt a list of discrete early action measures, or regulations, to be adopted and implemented by January 1, 2010. These actions will form part of the State's comprehensive plan for achieving greenhouse gas emission reductions. In June 2007, CARB adopted three discrete early action measures. These three new proposed regulations meet the definition of "discrete early action greenhouse gas reduction measures," which include the following: a low carbon fuel standard; reduction of HFC-134a emissions from non-professional servicing of motor vehicle air conditioning systems; and improved landfill methane capture. CARB estimates that by 2020, the reductions from those three discrete early action measures would be approximately 13-26 MMT CO_2e.

CARB evaluated over 100 possible measures identified by the CAT for inclusion in the list of discrete early action measures. On October 25, 2007 CARB gave final approval to the list of Early Action Measures, which includes nine discrete measures and 35

additional measures, all of which are to be enforceable by January 1, 2010. AB 32 requires that by January 1, 2009, CARB adopt a scoping plan indicating how emission reductions will be achieved via regulations, market mechanisms and other actions.

Senate Bill 97





Senate Bill (SB) 97, signed in August 2007, acknowledges that climate change is an important environmental issue that requires analysis under CEQA. This bill directs the OPR to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions, by July 1, 2009. The Resources Agency is required to certify or adopt those guidelines by January 1, 2010. This bill also protects projects funded by the Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act of 2006, or the Disaster Preparedness and Flood Protection Bond Act of 2006 (Proposition 1B or 1E) from claims of inadequate analysis of GHG as a legitimate cause of action. This latter provision will be repealed on January 1, 2010. Thus, this "protection" is highly limited to a handful of projects and for a short time period.

The Role of Air Districts in the CEQA Process

Air districts assume one of three roles in the CEQA process. They may be lead agencies when they are adopting regulations and air quality plans. In some instances, they can also be a lead agency when approving permits to construct or operate for applicants subject to district rules. However, in many cases where an air district permit is involved, another agency has broader permitting authority over the project and assumes the role of lead agency. In these situations, the air district becomes what is referred to as a responsible agency under CEQA. When CEQA documents are prepared for projects that do not involve discretionary approval of a district regulation, plan or permit, the air district may assume the role of a concerned or commenting agency. In this role, it is typical for air districts to comment on CEQA documents where there may be air quality-related adverse impacts, such as projects that may create significant contributions to existing violations of ambient standards, cause a violation of an ambient standard or create an exposure to toxic air contaminants or odors. In some cases, the air district may also act in an "advisory" capacity to a lead agency early on in its review of an application for a proposed development project.

A few air districts in California began developing significance thresholds for use in CEQA analyses in the late 1980's and early 1990's. By the mid-1990's most air districts had developed CEQA thresholds for air quality analyses. Many of the districts have included in their guidance the analysis of rule development and permits that may be subject to CEQA.

What is Not Addressed in this Paper

Impacts of Climate Change to a Project

The focus of this paper is addressing adverse impacts to climate change and the ability to meet statewide GHG reduction goals caused by proposed new land development projects. CEQA also requires an assessment of significant adverse impacts a project might cause by bringing development and people into an area affected by climate change (CEQA Guidelines §15126.2). For example, an area that experiences higher average temperatures due to climate change may expose new development to more frequent exceedances and higher levels of ozone concentrations. Alternatively, a rise in sea level brought on by climate change may inundate new development locating in a low-lying area. The methodologies, mitigation and threshold approaches discussed in this paper do not specifically address the potential adverse impacts resulting from climate change that may affect a project.

Impacts from Construction Activity

Although construction activity has been addressed in the analytical methodologies and mitigation chapters, this paper does not discuss whether any of the threshold approaches adequately addresses impacts from construction activity. More study is needed to make this assessment or to develop separate thresholds for construction activity. The focus of this paper is the long-term adverse operational impacts of land use development.

Introduction

Any analysis of environmental impacts under CEQA includes an assessment of the nature and extent of each impact expected to result from the project to determine whether the impact will be treated as significant or less than significant. CEQA gives lead agencies discretion whether to classify a particular environmental impact as significant. "The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved," ref: CEQA Guidelines §15064(b) ("Guidelines"). Ultimately, formulation of a standard of significance requires the lead agency to make a policy judgment about where the line should be drawn distinguishing adverse impacts it considers significant from those that are not deemed significant. This judgment must, however, be based on scientific information and other factual data to the extent possible (Guidelines §15064(b)).

CEQA does not require that agencies establish thresholds of significance. Guidelines §15064.7(a) encourages each public agency "…to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which normally means the effect will be determined to be less than significant."

Once such thresholds are established, an impact that complies with the applicable threshold will "normally" be found insignificant and an impact that does not comply with the applicable threshold will "normally" be found significant.

Additionally, Guidelines §15064.7(b) requires that if thresholds of significance are adopted for general use as part of the lead agency's environmental review process they must be adopted by ordinance, resolution, rule or regulation, and developed through a public review process and be supported by substantial evidence.

While many public agencies adopt regulatory standards as thresholds, the standards do not substitute for a public agency's use of careful judgment in determining significance. They also do not replace the legal standard for significance (i.e., if there is a fair argument, based on substantial evidence in light of the whole record that the project may have a significant effect, the effect should be considered significant) (Guidelines §15064(f)(1). Also see *Communities for a Better Environment v. California Resource Agency* 103 Cal. App. 4th 98 (2002)). In other words, the adoption of a regulatory standard does not create an irrebuttable presumption that impacts below the regulatory standard are less than significant.

Summary of CEQA Thresholds at Air Districts

This section briefly summarizes the evolution of air district CEQA significance thresholds. Ventura County APCD, in 1980, was the first air district in California that formally adopted CEQA significance thresholds. Their first CEQA assessment document contained impact thresholds based on project type: residential, nonresidential, and government. Then, as now, the District's primary CEQA thresholds applied only to ROG and NO_x. The 1980 Guidelines did not address other air pollutants.

Santa Barbara County APCD and the Bay Area AQMD adopted thresholds in 1985. The South Coast AQMD recommended regional air quality thresholds in 1987 for CO, SO_2, NO_2, particulates, ROG, and lead. Most of the other California air districts adopted CEQA guidance and thresholds during the 1990's. Air districts have updated their thresholds and guidelines several times since they were first published.

Originally, most districts that established CEQA thresholds focused on criteria pollutants for which the district was nonattainment and the thresholds only addressed project level impacts. Updates during the 1990's began to add additional air quality impacts such as odors, toxic air contaminants and construction. Several air districts also developed thresholds for General Plans that relied on an assessment of the plan consistency with the district's air quality plans. A consistency analysis involves comparing the project's land use to that of the general plan and the population and employment increase to the forecasts underlying the assumptions used to develop the air quality plan.

Most air district thresholds for CEQA are based on the threshold for review under the New Source Review (NSR). The NSR threshold level is set by district rule and is different depending on the nonattainment classification of the air district. Areas with a less severe classification have a higher NSR trigger level while the most polluted areas have the lowest NSR trigger level. Some districts, such as Ventura County APCD, have significantly lower CEQA thresholds that are not tied to the NSR requirements. In Ventura, one set of CEQA thresholds is 25 pounds per day for all regions of Ventura County, except the Ojai Valley. The second set of CEQA thresholds was set at 5 pounds per day for the Ojai Valley.

The Sacramento Metropolitan AQMD bases its thresholds for ozone precursors on the projected land use share of emission reductions needed for attainment. The emission reductions needed to reach attainment are based on commitments made in the state implementation plan (SIP) prepared for the federal clean air act.

CEQA Considerations in Setting Thresholds

Public agencies use significance thresholds to disclose to their constituents how they plan on evaluating and characterizing the severity of various environmental impacts that could be associated with discretionary projects that they review. Significance thresholds are also used to help identify the level of mitigation needed to reduce a potentially significant impact to a less than significant level and to determine what type of an environmental document should be prepared for a project; primarily a negative declaration, mitigated negative declaration or an environmental impact report.

While public agencies are not required to develop significance thresholds, if they decide to develop them, they are required to adopt them by ordinance, resolution, rule or regulation through a public process. A lead agency is not restrained from adopting any significance threshold it sees as appropriate, as long as it is based on substantial evidence. CEQA Guidelines §15064.7 encourages public agencies to develop and publish significance thresholds that are identifiable, quantitative, qualitative or performance level that the agency uses in the determination of the significance of environmental effects. The courts have ruled that a "threshold of significance" for a given environmental effect is simply that level at which the lead agency finds the effects of the project to be significant.

Before an agency determines its course with regard to climate change and CEQA, it must be made clear that a threshold, or the absence of one, will not relieve a lead agency from having to prepare an EIR or legal challenges to the adequacy of an analysis leading to a conclusion, or lack of a conclusion, of significance under CEQA. CEQA has generally favored the preparation of an EIR where there is any substantial evidence to support a fair argument that a significant adverse environmental impact may occur due to a proposed project. This paper explores three alternative approaches to thresholds, including a no threshold option, a zero threshold option and a non-zero threshold option.

Fair Argument Considerations

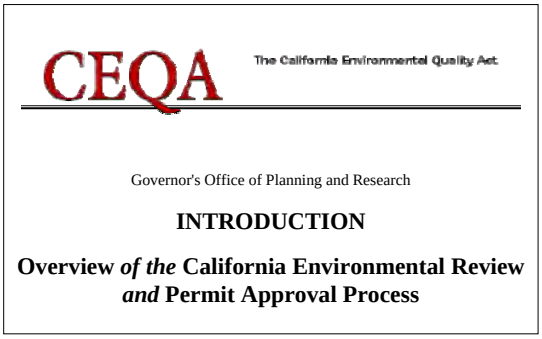
Under the CEQA fair argument standard, an EIR must be prepared whenever it can be fairly argued, based on substantial evidence in the administrative record, that a project may have a significant adverse effect on the environment. "Substantial evidence" comprises "enough relevant information and reasonable inferences from this information that a fair argument can be made to support a conclusion, even though other conclusions might also be reached." (Guidelines §15384) This means that if factual information is presented to the public agency that there is a reasonable possibility the project could have

a significant effect on the environment, an EIR is required even if the public agency has information to the contrary (Guidelines §15064 (f)).

The courts have held that the fair argument standard "establishes a low threshold for initial preparation of an EIR, which reflects a preference for resolving doubts in favor of environmental review." (*Santa Teresa Citizen Action Group v. City of San Jose* [2003] 114 Cal.App.4th 689) Although the determination of whether a fair argument exists is made by the public agency, that determination is subject to judicial scrutiny when challenged in litigation. When the question is whether an EIR should have been prepared, the court will review the administrative record for factual evidence supporting a fair argument.

The fair argument standard essentially empowers project opponents to force preparation of an EIR by introducing factual evidence into the record that asserts that the project may have a significant effect on the environment. This evidence does not need to be conclusive regarding the potential significant effect.

In 1998, the Resources Agency amended the State CEQA Guidelines to encourage the use of thresholds of significance. Guidelines §15064 (h) provided that when a project's impacts did not exceed adopted standards, the impacts were to be considered less than significant. The section went on to describe the types of adopted standards that were to be considered thresholds. Guidelines § 15064.7 provided that agencies may adopt thresholds of significance to guide their determinations of significance. Both of these sections were challenged when environmental groups sued the Resources Agency in 2000 over the amendments. The trial court concluded that §15064.7 was proper, if it was applied in the context of the fair argument standard.


CEQA The California Environmental Quality Act

Governor's Office of Planning and Research

INTRODUCTION

Overview *of the* California Environmental Review *and* Permit Approval Process

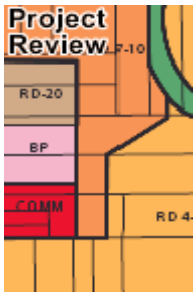
At the appellate court level, §15064(h) was invalidated. [2] Establishing a presumption that meeting an adopted standard would avoid significant impacts was "inconsistent with controlling CEQA law governing the fair argument approach." The Court of Appeal explained that requiring agencies to comply with a regulatory standard "relieves the agency of a duty it would have under the fair argument approach to look at evidence beyond the regulatory standard, or in contravention of the standard, in deciding whether an EIR must be prepared. Under the fair argument approach, any substantial evidence supporting a fair argument that a project may have a significant environmental effect would trigger the preparation of an EIR." (*Communities for a Better Environment v. California Resources Agency* [2002] 103 Cal.App.4th 98)

[2] Prior §15064(h) has been removed from the State CEQA Guidelines. Current §15064(h) discusses cumulative impacts.

In summary, CEQA law does not require a lead agency to establish significance thresholds for GHG. CEQA guidelines encourage the development of thresholds, but the absence of an adopted threshold does not relieve the agency from the obligation to determine significance.

Defensibility of CEQA Analyses

The basic purposes of CEQA, as set out in the State CEQA Guidelines, include: (1) informing decision makers and the public about the significant environmental effects of proposed projects; (2) identifying ways to reduce or avoid those impacts; (3) requiring the implementation of feasible mitigation measures or alternatives that would reduce or avoid those impacts; and (4) requiring public agencies to disclose their reasons for approving any project that would have significant and unavoidable impacts (Guidelines §15002). CEQA is enforced through civil litigation over procedure (i.e., did the public agency follow the correct CEQA procedures?) and adequacy (i.e., has the potential for impacts been disclosed, analyzed, and mitigated to the extent feasible?).



The California Supreme Court has held that CEQA is "to be interpreted in such manner as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language." (*Friends of Mammoth v. Board of Supervisors* [1972] 8 Cal.3d 247, 259) Within that context, the role of the courts is to weigh the facts in each case and apply their judgment. Although the court may rule on the adequacy of the CEQA work, the court is not empowered to act in the place of the public agency to approve or deny the project for which the CEQA document was prepared. Further, the court's review is limited to the evidence contained in the administrative record that was before the public agency when it acted on the project.

Putting aside the issue of CEQA procedure, the defensibility of a CEQA analysis rests on the following concerns:

- whether the public agency has sufficiently analyzed the environmental consequences to enable decision makers to make an intelligent decision;
- whether the conclusions of the public agency are supported by substantial evidence in the administrative record; and
- whether the agency has made a good faith effort at the full disclosure of significant effects.

CEQA analyses need not be perfect or exhaustive -- the depth and breadth of the analysis is limited to what is "reasonably feasible." (Guidelines §15151) At the same time, the analysis "must include detail sufficient to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed

project." (Laurel Heights Improvement Assn. v. Regents of University of California (1988) 47 Cal.3d 376)

By itself, establishment of a GHG threshold will not insulate individual CEQA analyses from challenge. Defensibility depends upon the adequacy of the analysis prepared by the lead agency and the process followed. However, the threshold can help to define the boundaries of what is a reasonable analysis by establishing when an analysis will be required and the basic scope of that analysis. The threshold would attempt to define the point at which an analysis will be required and when a level of impact becomes significant, requiring preparation of an EIR. If the threshold includes recommendations for the method or methods of analysis, it can establish the minimum level of analysis to address this issue.

Considerations in Setting Thresholds for Stationary Source Projects

In many respects, the analysis of GHG emissions from stationary sources is much more straightforward than the analysis of land use patterns, forecasted energy consumption, and emissions from mobile sources. The reason is that, for the most part, the latter analyses depend largely on predictive models with myriad inputs and have a wider range of error. Emissions from stationary sources involve a greater reliance on mass and energy balance calculations and direct measurements of emissions from the same or similar sources. Energy demand is more directly tied to production, and even associated mobile source emissions will likely fall within narrower predictive windows.

Implementing CEQA Without a Threshold

A lead agency is not required to establish significance thresholds for GHG emissions from stationary sources. The lead agency may find that it needs more information or experience evaluating GHG from these types of projects to determine an appropriate significance threshold. As with other project types, the lead agency could conduct a project specific analysis to determine whether an environmental impact report is needed and to determine the level of mitigation that is appropriate. The agency might also rely on thresholds established for criteria pollutants as a screening method, and analyze GHG emissions (and require mitigation) from projects with emissions above the criteria pollutant thresholds. Over time, the agency could amass information and experience with specific project categories that would support establishing explicit thresholds. The lead agency may also choose to base local CEQA thresholds on state guidelines or on the category-specific reduction targets established by ARB in its scoping plan for implementing AB32. Resource constraints and other considerations associated with implementing CEQA without GHG thresholds for stationary sources would be similar to those outlined for other types of projects (see Chapter 5 – No Threshold Option).

Implementing CEQA with Threshold of Zero

A lead agency may find that any increase in GHG emissions is potentially significant under CEQA. The resources and other considerations for implementing a threshold of zero for stationary sources are the same as those outlined for other types of projects (see Chapter 6 – Zero Threshold Option).

Implementing CEQA with a Non-Zero Threshold

A lead agency may identify one or more non-zero thresholds for significance of emissions of GHG from stationary sources. The agency could elect to rely on existing thresholds for reviewing new or modified stationary sources of GHG, if the state or local air district has established any. The agency could also apply the threshold(s) established for non-stationary sources to GHG emissions from stationary sources. Significance thresholds could also be established by ordinance, rule, or policy for a given category of stationary sources; this approach is especially conducive to a tiered threshold approach. For example, the agency could establish significance and mitigation tiers for stationary compression-ignition diesel-fueled generators. Under such an approach, the project proponent could be first required to use a lower GHG-emitting power source if feasible, and if not, to apply mitigation based on the size of the generator and other defined considerations, such as hours of operation. Certain classes of generators could be found to be insignificant under CEQA (e.g., those used for emergency stand-by power only, with a limit on the annual hours of use). As with non-stationary projects, the goal of establishing non-zero thresholds is to maximize environmental protection, while minimizing resources used. Resource and other considerations outlined for non-stationary projects are applicable here (see Chapter 7 – Non-Zero Threshold Options).

Implementing CEQA with Different Thresholds for Stationary and Non-stationary Projects

Although a lead agency may apply the same thresholds to stationary and non-stationary projects, it is not required to do so. There are, in fact, some important distinctions between the two types of projects that could support applying different thresholds. The lead agency should consider the methods used to estimate emissions. Are the estimates a "best/worst reasonable scenario" or are they based on theoretical maximum operation? How accurate are the estimates (are they based on models, simulations, emission factors, source test data, manufacturer specifications, etc.)? To what extent could emissions be reduced through regulations after the project is constructed if they were found to be greater than originally expected (i.e., is it possible to retrofit emissions control technology onto the source(s) of GHG at a later date, how long is the expected project life, etc.)? Are there emission limits or emissions control regulations (such as New Source Review) that provide certainty that emissions will be mitigated? Generally, stationary source emissions are based on maximum emissions (theoretical or allowed under law or regulation), are more accurate, and are more amenable to retrofit at a later time than non-stationary source emissions. It is also more likely that category specific

rules or some form of NSR will apply to stationary sources than non-stationary projects. Notwithstanding, it is almost always more effective and cost-efficient to apply emission reduction technology at the design phase of a project. There are, therefore, a number of considerations that need to be evaluated and weighed before establishing thresholds – and which may support different thresholds for stationary and non-stationary projects. Furthermore, the considerations may change over time as new regulations are established and as emissions estimation techniques and control technology evolves.

Direct GHG Emissions from Stationary Sources

The main focus of this paper has been the consideration of projects that do not, in the main, involve stationary sources of air pollution, because stationary source projects are generally a smaller percentage of the projects seen by most local land use agencies. That said, some discussion of stationary sources is warranted. As the broader program for regulating GHG from these sources is developed, the strategies for addressing them under CEQA will likely become more refined.

The primary focus of analysis of stationary source emissions has traditionally been those pollutants that are directly emitted by the source, whether through a stack or as fugitive releases (such as leaks). CAPCOA conducted a simplified analysis of permitting activity to estimate the number of stationary source projects with potentially significant emissions of greenhouse gases that might be seen over the course of a year. This analysis looked only at stationary combustion sources (such as boilers and generators), and only considered direct emissions. A lead agency under CEQA may see a different profile of projects than the data provided here suggest, depending on what other resources are affected by projects. In addition, air districts review like-kind replacements of equipment to ensure the new equipment meets current standards, but such actions might not constitute a project for many land use agencies or other media regulators. The data does provide a useful benchmark, however, for lead agencies to assess the order of magnitude of potential stationary source projects. A similar analysis is included for non-stationary projects in Chapter 7.

Table 1: Analysis of GHG Emissions from Stationary Combustion Equipment Permits[3]

	BAAQMD	SMAQMD	SJVUAPCD	SCAQMD
Total Applications for Year	1499	778	1535	1179
Affected at threshold of:				
900 metric tons/year	26	43	63	108
10,000 metric tons/year	7	5	26	8
25,000 metric tons/year	3	1	11	4

[3] District data varies based on specific local regulations and methodologies.

Emissions from Energy Use

In addition to the direct emissions of GHG from stationary projects, CEQA will likely need to consider the project's projected energy use. This could include an analysis of opportunities for energy efficiency, onsite clean power generation (e.g., heat/energy recovery, co-generation, geothermal, solar, or wind), and the use of dedicated power contracts as compared to the portfolio of generally available power. In some industries, water use and conservation may provide substantial GHG emissions reductions, so the CEQA analysis should consider alternatives that reduce water consumption and wastewater discharge. The stationary project may also have the opportunity to use raw or feedstock materials that have a smaller GHG footprint; material substitution should be evaluated where information is available to do so.

Emissions from Associated Mobile Sources

The stationary project will also include emissions from associated mobile sources. These will include three basic components: emissions from employee trips, emissions from delivery of raw or feedstock materials, and emissions from product transport. Employee trips can be evaluated using trip estimation as is done for non-stationary projects, and mitigations would include such measures as providing access to and incentives for use of public transportation, accessibility for bicycle and pedestrian modes of transport, employer supported car or vanpools (including policies such as guaranteed rides home, etc). Upstream and downstream emissions related to goods movement can also be estimated with available models. The evaluation will need to determine the extent of the transport chain that should be included (to ensure that all emissions in the chain have been evaluated and mitigated, but to avoid double counting). Mitigations could include direct actions by operators who own their own fleet, or could be implemented through contractual arrangements with independent carriers; again, the evaluation will need to consider how far up and down the chain mitigation is feasible and can be reasonably required.

Comparing Emissions Changes Across Pollutant Categories

The potential exists for certain GHG reduction measures to increase emissions of criteria and toxic pollutants known to cause or aggravate respiratory, cardiovascular, and other health problems. For instance, GHG reduction efforts such as alternative fuels and methane digesters may create significant levels of increased pollutants that are detrimental to the health of the nearby population (e.g.; particulate matter, ozone precursors, toxic air contaminants). Such considerations should be included in any CEQA analysis of a project's environmental impacts. While there are many win-win

strategies that can reduce both GHG and criteria/toxic pollutant emissions, when faced with situations that involve tradeoffs between the two, the more immediate public health concerns that may arise from an increase in criteria or toxic pollutant emissions should take precedence. GHG emission reductions could be achieved offsite through other mitigation programs.

Introduction

Under state law, it is the purview of each lead agency to determine what, if any, significance thresholds will be established to guide its review of projects under CEQA. While the state does provide guidelines for implementing CEQA, the guidelines have left the decision of whether to establish thresholds (and if so, at what level) to individual lead agencies. Frequently, lead agencies consult with resource-specific agencies (such as air districts) for assistance in determining what constitutes a significant impact on that specific resource.

With the passage of AB 32, the ARB has broad authority to regulate GHG emissions as necessary to meet the emission reduction goals of the statute. This may include authority to establish emission reduction requirements for new land use projects, and may also enable them to recommend statewide thresholds for GHG under CEQA.

In developing this white paper, CAPCOA recognizes that, as the GHG reduction program evolves over time, GHG thresholds and other policies and procedures for CEQA may undergo significant revision, and that uniform statewide thresholds and procedures may be established. This paper is intended to serve as a resource for public agencies until such time that statewide guidance is established, recognizing that decisions will need to be made about GHG emissions from projects before such guidance is available. This paper is not, however, uniform statewide guidance. As stated before, it outlines several possible approaches without endorsing any one over the others.

Some air districts may choose to use this paper to support their establishment of guidance for GHG under CEQA, including thresholds. This paper does not, nor should it be construed to require a district to implement any of the approaches evaluated here. Decisions about whether to provide formal local guidance on CEQA for projects with GHG emissions, including the question of thresholds, will be made by individual district boards.

Each of the 35 air districts operates independently and has its own set of regulations and programs to address the emissions from stationary, area and mobile sources, consistent with state and federal laws, regulations, and guidelines. The independence of the districts allows specific air quality problems to be addressed on a local level. In addition, districts have also established local CEQA thresholds of significance for criteria pollutants – also to address the specific air quality problems relative to that particular district.

The overall goal of air district thresholds is to achieve and maintain health based air quality standards within their respective air basins and to reduce transport of emissions to other air basins. In establishing recommended thresholds, air districts consider the existing emission inventory of criteria pollutants and the amount of emission reductions needed to attain and maintain ambient air quality standards.

However, unlike criteria pollutants where individual districts are characterized by varying levels of pollutant concentrations and source types, greenhouse gases (GHG) and their attendant climate change ramifications are a global problem and, therefore, may suggest a uniform approach to solutions that ensure both progress and equity.

Under SB97, the Office of Planning and Research is directed to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions through CEQA by July 1, 2009. Those guidelines may recommend thresholds. As stated, this paper is intended to provide a common platform of information and tools to support local decision makers until such time that statewide guidance or requirements are promulgated.

Local Ability to Promulgate District-Specific GHG Thresholds

One of the primary reasons behind the creation of air districts in California is the recognition that some regions within the state face more critical air pollution problems than others and, as has often been pointed out – one size does not fit all. For example, a "Serious" federal nonattainment district would need greater emission reductions than a district already in attainment – and, therefore, the more "serious" district would set its criteria pollutant CEQA thresholds of significance much lower than the air district already in attainment.

The action of GHGs is global in nature, rather than local or regional (or even statewide or national). Ultimately there may be a program that is global, or at least national in scope. That said, actions taken by a state, region, or local government can contribute to the solution of the global problem. Local governments are not barred from developing and implementing programs to address GHGs. In the context of California and CEQA, lead agencies have the primary responsibility and authority to determine the significance of a project's impacts.

Further, air districts have primary authority under state law for "control of air pollution from all sources, other than emissions from motor vehicles." (H&SC §40000) The term air contaminant or "air pollutant" is defined extremely broadly, to mean "any discharge, release, or other propagation into the atmosphere" and includes, but is not limited to, soot, carbon, fumes, gases, particulate matter, etc. Greenhouse gases and other global warming pollutants such as black carbon would certainly be included in this definition, just as the U.S. Supreme Court held in Massachusetts v. EPA that greenhouse gases were air pollutants under the federal Clean Air Act. Therefore, air districts have the primary authority to regulate global warming pollutants from nonvehicular sources. AB 32 does not change this result. Although it gives wide responsibility to CARB to regulate greenhouse gases from all sources, including nonvehicular sources, it does not preempt the districts. AB 32 specifically states That "nothing in this division shall limit or expand the existing authority of any district..."(H&SC § 38594). Thus, districts and CARB retain concurrent authority over nonvehicular source greenhouse gas emissions.

Introduction

The CEQA statutes do not require an air district or any lead agency to establish significance thresholds under CEQA for any pollutant. While there are considerations that support the establishment of thresholds (which are discussed in other sections of this document), there is no obligation to do so.

An air district or other lead agency may elect not to establish significance thresholds for a number of reasons. The agency may believe that the global nature of the climate change problem necessitates a statewide or national framework for consideration of environmental impacts. SB 97 directs OPR to develop "guidelines for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions by July 1, 2009," and directs the California Resources Agency to certify and adopt the guidelines by June 30, 2010.

An agency may also believe there is insufficient information to support selecting one specific threshold over another. As described earlier, air districts have historically set CEQA thresholds for air pollutants in the context of the local clean air plan, or (in the case of toxic air pollutants) within the framework of a rule or policy that manages risks and exposures due to toxic pollutants. There is no current framework that would similarly manage impacts of greenhouse gas pollutants, although the CARB is directed to establish one by June 30, 2009, pursuant to AB 32. A local agency may decide to defer any consideration of thresholds until this framework is in place.

Finally, an agency may believe that the significance of a given project should be assessed on a case-by-case basis in the context of the project at the time it comes forward.

Implementing CEQA Without Significance Thresholds for GHG

The absence of a threshold does not in any way relieve agencies of their obligations to address GHG emissions from projects under CEQA. The implications of not having a threshold are different depending on the role the agency has under CEQA – whether it is acting in an advisory capacity, as a responsible agency, or as a lead agency.

Implications of No Thresholds for an Agency Acting in an Advisory Capacity

Air districts typically act in an advisory capacity to local governments in establishing the framework for environmental review of air pollution impacts under CEQA. This may include recommendations regarding significance thresholds, analytical tools to assess emissions and impacts, and mitigations for potentially significant impacts. Although districts will also address some of these issues on a project-specific basis as responsible agencies, they may provide general guidance to local governments on these issues that

are program wide, and these are advisory (unless they have been established by regulation).

An air district that has not established significance thresholds for GHG will not provide guidance to local governments on this issue. This does not prevent the local government from establishing thresholds under its own authority. One possible result of this would be the establishment of different thresholds by cities and counties within the air district. Alternatively, the air district could advise local governments not to set thresholds and those jurisdictions may follow the air district's guidance.

It is important to note here (as has been clearly stated by the Attorney General in comments and filings) that lack of a threshold does *not* mean lack of significance. An agency may argue lack of significance for any project, but that argument would have to be carried forth on a case-by-case, project specific basis. By extension then, a decision not to establish thresholds for GHG is likely to result in a greater workload for responsible and lead agencies as they consider individual projects under CEQA.

Implications of No Thresholds for a Responsible Agency

If there are no established thresholds of significance, the significance of each project will have to be determined during the course of review. The responsible agency (e.g., the air district) will review each project referred by the lead agency. The review may be qualitative or quantitative in nature. A qualitative review would discuss the nature of GHG emissions expected and their potential effect on climate change as the district understands it. It could also include a discussion of the relative merits of alternative scenarios. A quantitative analysis would evaluate, to the extent possible, the expected GHG emissions; it would also need to evaluate their potential effect on climate change and might include corresponding analysis of alternatives. The air district, as a responsible agency, may also identify mitigation measures for the project.

The lack of established thresholds will make the determination of significance more resource intensive for each project. The district may defer to the lead agency to make this determination, however the district may be obligated, as a responsible agency, to evaluate the analysis and determination.

Implications of No Thresholds for a Lead Agency

The main impact of not having significance thresholds will be on the primary evaluation of projects by the lead agency. Without significance thresholds, the agency will have to conduct some level of analysis of every project to determine whether an environmental impact report is needed. There are three fundamental approaches to the case-by-case analysis of significance, including presumptions of significance or insignificance, or no presumption:

1. The agency can begin with a presumption of significance and the analysis would be used to support a case-specific finding of no significance. This is similar to establishing a threshold of zero, except that here, the "threshold" is rebuttable. This approach may result in a large number of projects proceeding to preparation of an environmental impact report. Because of the attendant costs, project proponents may challenge the determination of significance, although formal challenge is less likely than attempts to influence the determination.

2. The agency can begin with a presumption of insignificance, and the analysis would be used to support a case-specific finding of significance. A presumption of insignificance could be based on the perspective that it would be speculative to attempt to identify the significance of GHG emissions from a project relative to climate change on a global scale. This approach might reduce the number of projects proceeding to preparation of environmental impact reports. It is likely to have greater success with smaller projects than larger ones, and a presumption of *insignificance* may be more likely to be challenged by project opponents.

3. It is not necessary for the lead agency to have any presumption either way. The agency could approach each project from a *tabula rasa* perspective, and have the determination of significance more broadly tied to the specific context of the project; this approach is likely to be resource intensive, and creates the greatest uncertainty for project proponents. To the extent that it results in a lead agency approving similar projects based on different determinations of significance for GHG emissions, it may be more vulnerable to challenge from either proponents or opponents of the project. Alternatively, in the absence of either thresholds or presumptions, the lead agency could use each determination of significance to build its approach in the same way that subsequent judgments define the law.

Relevant Citations

The full text of relevant citations is in Appendix A.

Public Resources Code – §21082.2, Significant Effect on Environment; Determination; Environmental Impact Report Preparation.

State CEQA Guidelines – §15064, Determining the Significance of the Environmental Effects Caused by a Project.

Introduction

If an air district or lead agency determines that any degree of project-related increase in GHG emissions would contribute considerably to climate change and therefore would be a significant impact, it could adopt a zero-emission threshold to identify projects that would need to reduce their emissions. A lead agency may determine that a zero-emission threshold is justified even if other experts may disagree. A lead agency is not prevented from adopting any significance threshold it sees as appropriate, as long as it is based on substantial evidence.

If the zero threshold option is chosen, all projects subject to CEQA would be required to quantify and mitigate their GHG emissions, regardless of the size of the project or the availability of GHG reduction measures available to reduce the project's emissions. Projects that could not meet the zero-emission threshold would be required to prepare environmental impact reports to disclose the unmitigable significant impact, and develop the justification for a statement of overriding consideration to be adopted by the lead agency.

Implementing CEQA With a Zero Threshold for GHG

The scientific community overwhelmingly agrees that the earth's climate is becoming warmer, and that human activity is playing a role in climate change. Unlike other environmental impacts, climate change is a global phenomenon in that all GHG emissions generated throughout the earth contribute to it. Consequently, both large and small GHG generators cause the impact. While it may be true that many GHG sources are individually too small to make any noticeable difference to climate change, it is also true that the countless small sources around the globe combine to produce a very substantial portion of total GHG emissions.

A zero threshold approach is based on a belief that, 1) all GHG emissions contribute to global climate change and could be considered significant, and 2) not controlling emissions from smaller sources would be neglecting a major portion of the GHG inventory.

CEQA explicitly gives lead agencies the authority to choose thresholds of significance. CEQA defers to lead agency discretion when choosing thresholds. Consequently, a zero-emission threshold has merits.

The CEQA review process for evaluating a project's impact on global climate change under the zero threshold option would involve several components. Air quality sections would be written by lead agencies to include discussions on climate change in CEQA documents, GHG emissions would be calculated, and a determination of significance would be made. The local air districts would review and comment on the climate change discussions in environmental documents. Lead agencies may then revise final EIRs to accommodate air district comments. More than likely, mitigation measures will be specified for the project, and a mitigation monitoring program will need to be put in place to ensure that these measures are being implemented.

Since CEQA requires mitigation to a less than significant level, it is conceivable that many projects subjected to a zero threshold could only be deemed less than significant with offsite reductions or the opportunity to purchase greenhouse gas emission reduction credits. GHG emission reduction credits are becoming more readily available however the quality of the credits varies considerably. High quality credits are generated by actions or projects that have clearly demonstrated emission reductions that are real, permanent, verifiable, enforceable, and not otherwise required by law or regulation. When the pre- or post-project emissions are not well quantified or cannot be independently confirmed, they are considered to be of lesser quality. Similarly, if the reductions are temporary in nature, they are also considered to be poor quality. Adoption of a zero threshold should consider the near-term availability and the quality of potential offsets.

There are also environmental justice concerns about the effects of using offsite mitigations or emission reduction credits to offset, or mitigate, the impacts of a new project. Although GHGs are global pollutants, some of them are emitted with co-pollutants that have significant near-source or regional impacts. Any time that increases in emissions at a specific site will be mitigated at a remote location or using emission reduction credits, the agency evaluating the project should ensure that it does not create disproportionate impacts.

Administrative Considerations

If electing to pursue a zero threshold, an air district or lead agency should consider the administrative costs and the environmental review system capacity. Some projects that previously would have qualified for an exemption could require further substantial analysis, including preparation of a Negative Declaration (ND), a Mitigated Negative Declaration (MND) or an EIR. Moreover, the trade-offs between the volume of projects requiring review and the quality of consideration given to reviews should be considered. It may also be useful to consider whether meaningful mitigation can be achieved from smaller projects.

Consideration of Exemptions from CEQA

A practical concern about identifying GHG emissions as a broad cumulative impact is whether the zero threshold option will preclude a lead agency from approving a large set of otherwise qualified projects utilizing a Categorical Exemption, ND, or MND. The results could be a substantial increase in the number of EIR's. This is a valid and challenging concern, particularly for any threshold approach that is based on a zero threshold for net GHG emission increases.

CEQA has specified exceptions to the use of a categorical exception. Specifically, CEQA Guidelines §15300.2 includes the following exceptions:

"(b) Cumulative Impact. All exemptions for these classes are inapplicable when the cumulative impact of successive projects of the same type in the same place, over time is significant."

(c) Significant Effect. A categorical exemption shall not be used for an activity where there is a reasonable possibility that the activity will have a significant effect on the environment due to unusual circumstances."

These CEQA Guidelines sections could be argued to mean that any net increase in GHG emissions would preclude the use of a categorical exemption. However, as described below, if the following can be shown, then the exceptions above could be argued not to apply:

(1) Cumulative local, regional and/or state GHG emissions are being reduced or will be reduced by adopted, funded, and feasible measures in order to meet broader state targets.

(2) Mandatory state or local GHG reduction measures would apply to the project's emissions such that broader GHG reduction goals would still be met and the project contributions would not be cumulatively considerable.

(3) Project GHG emissions are below an adopted significance threshold designed to take into account the cumulative nature of GHG emissions.

A similar argument could be made relative to the use of a ND (provided no additional mitigation (beyond existing mandates) is required to control GHG emissions) and to the use of a MND instead of an EIR. However, due to the "fair argument" standard, which is discussed in Chapter 3, caution is recommended in use of a ND or MND unless all three elements above can be fully supported through substantial evidence and there is no substantial evidence to the contrary. Establishing a significance threshold of zero is likely to preclude the use of a categorical exemption.

Relevant Citations

The full text of relevant citations is in Appendix A.

Public Resources Code – §21004, Mitigating or Avoiding a Significant Effect; Powers of Public Agency.

State CEQA Guidelines – §15064, Determining the Significance of the Environmental Effects Caused by a Project.

State CEQA Guidelines – §15130, Discussion of Cumulative Impacts.

State CEQA Guidelines – §15064.7, Thresholds of Significance.

Introduction

A non-zero threshold could minimize the resources spent reviewing environmental analyses that do not result in real GHG reductions or to prevent the environmental review system from being overwhelmed. The practical advantages of considering non-zero thresholds for GHG significance determinations can fit into the concept regarding whether the project's GHG emissions represent a "considerable contribution to the cumulative impact" and therefore warrant analysis.

Specifying a non-zero threshold could be construed as setting a *de minimis* value for a cumulative impact. In effect, this would be indicating that there are certain GHG emission sources that are so small that they would not contribute substantially to the global GHG budget. This could be interpreted as allowing public agencies to approve certain projects without requiring any mitigation of their GHG. Any threshold framework should include a proper context to address the *de minimis* issue. However, the CEQA Guidelines recognize that there may be a point where a project's contribution, although above zero, would not be a *considerable contribution* to the cumulative impact and, therefore, not trigger the need for a significance determination.

GHG emissions from all sources are under the purview of CARB and as such may eventually be "regulated" no matter how small. Virtually all projects will result in some direct or indirect release of GHG. However, a decision by CARB to regulate a class of sources does not necessarily mean that an individual source in that class would constitute a project with significant GHG impacts under CEQA. For example, CARB has established criteria pollutant emission standards for automobiles, but the purchase and use of a single new car is not considered a project with significant impacts under CEQA. At the same time, it is important to note that it is likely that all meaningful sources of emissions, no matter how small are likely to be considered for regulation under AB 32. It is expected that projects will have to achieve some level of GHG reduction to comply with CARB's regulations meant to implement AB 32. As such all projects will have to play a part in reducing our GHG emissions budget and no project, however small, is truly being considered *de minimis* under CARB's regulations.

This chapter evaluates a range of conceptual approaches toward developing GHG significance criteria. The air districts retained the services of J&S an environmental consulting, firm to assist with the development of a Statute and Executive Order-based threshold (Approach 1) and a tiered threshold (Approach 2) based on a prescribed list of tasks and deliverables. Time and financial constraints limited the scope and depth of this analysis, however, the work presented here may be useful in developing interim guidance while AB 32 is being implemented. J&S recognized that approaches other than those described here could be used.

As directed, J&S explored some overarching issues, such as:

- what constitutes "new" emissions?

- how should "baseline emissions" be established?
- what is cumulatively "considerable" under CEQA?
- what is "business as usual" ? and
- should an analysis include "life-cycle" emissions?

The answers to these issues were key to evaluating each of the threshold concepts.

Approach 1 – Statute and Executive Order Approach

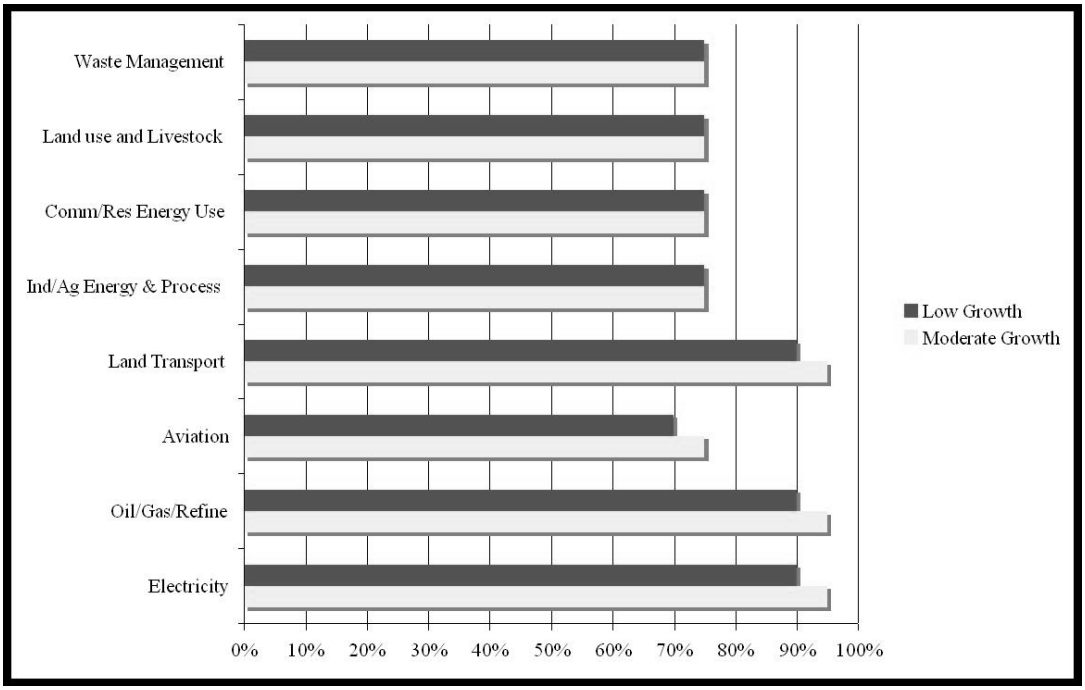
Thresholds could be grounded in existing mandates and their associated GHG emission reduction targets. A project would be required to meet the targets, or reduce GHG emissions to the targets, to be considered less than significant.

AB 32 and S-3-05 target the reduction of statewide emissions. It should be made clear that AB 32 and S-3-05 do not specify that the emissions reductions should be achieved through uniform reduction by geographic location or by emission source characteristics. For example, it is conceivable, although unlikely, that AB 32 goals could be achieved by new regulations that only apply to urban areas or that only apply to the transportation and/or energy sector. However, this approach to evaluating GHG under CEQA is based on the presumption that a new project must at least be consistent with AB 32 GHG emission reduction mandates.

The goal of AB 32 and S-3-05 is the significant reduction of future GHG emissions in a state that is expected to rapidly grow in both population and economic output. As such, there will have to be a significant reduction in the per capita GHG output for these goals to be met. CEQA is generally used to slow or zero the impact of new emissions, leaving the reduction of existing emission sources to be addressed by other regulatory means. With these concepts in mind, four options were identified for statute/executive order-based GHG significance thresholds and are described below.

Threshold 1.1: AB 32/S-3-05 Derived Uniform Percentage-Based Reduction. AB 32 requires the state to reduce California-wide GHG emissions to 1990 levels by 2020. Reducing greenhouse gas emission levels from 2020 to 1990 levels could require a 28 to 33 percent reduction of business-as-usual GHG emissions depending on the methodology used to determine the future emission inventories. The exact percent reduction may change slightly once CARB finalizes its 1990 and 2020 inventory estimates. In this context, business-as-usual means the emissions that would have occurred in the absence of the mandated reductions. The details of the business-as-usual scenario are established by CARB in the assumptions it uses to project what the state's GHG emissions would have been in 2020, and the difference between that level and the level that existed in 1990 constitutes the reductions that must be achieved if the mandated goals are to be met.

This threshold approach would require a project to meet a percent reduction target based on the average reductions needed from the business-as-usual emission from all GHG sources. Using the 2020 target, this approach would require all discretionary projects to achieve a 33 percent reduction from projected business-as-usual emissions in order to be considered less than significant. A more restrictive approach would use the 2050 targets. S-3-05 seeks to reduce GHG emissions to 80 percent below 1990 levels by 2050. To reach the 2050 milestone would require an estimated 90 percent reduction (effective immediately) of business-as-usual emissions. Using this goal as the basis for a significance threshold may be more appropriate to address the long-term adverse impacts associated with global climate change. Note that AB 32 and S-3-05 set emission inventory goals at milestone years; it is unclear how California will progress to these goals in non-milestone years.



SOURCE: ARB 2007

Threshold 1.2: Uniform Percentage-Based (e.g.50%) Reduction for New Development. This threshold is based on a presumption that new development should contribute a greater percent reduction from business-as-usual because greater reductions can be achieved at lower cost from new projects than can be achieved from existing sources. This approach would establish that new development emit 50 percent less GHG emissions than business-as-usual development. This reduction rate is greater than the recommended reduction rate for meeting the Threshold 1.1 2020 target (33 percent) but is significantly less restrictive than the Threshold 1.1 2050 target reduction rate (90 percent). If a 50 percent GHG reduction were achieved from new development, existing emissions would have to be reduced by 25 to 30 percent in order to meet the 2020 emissions goal depending on the year used to determine the baseline inventory. Although this reduction goal is reasonable for achieving the 2020 goal, it would not be possible to

reach the 2050 emissions target with this approach even if existing emissions were 100 percent controlled.

Threshold 1.3: Uniform Percentage-Based Reduction by Economic Sector. This threshold would use a discrete GHG reduction goal specific to the economic sector associated with the project. There would be specific reduction goals for each economic sector, such as residential, commercial, and industrial development. Specifying different reduction thresholds for each market sector allows selection of the best regulatory goal for each sector taking into account available control technology and costs. This approach would avoid over-regulating projects (i.e. requiring emissions to be controlled in excess of existing technology) or under-regulating projects (i.e. discouraging the use of available technology to control emissions in excess of regulations). This approach requires extensive information on the emission inventories and best available control technology for each economic sector. This data will be compiled as CARB develops its scoping plan under AB 32 and its implementing regulations; as a result, this approach will be more viable in the long term.

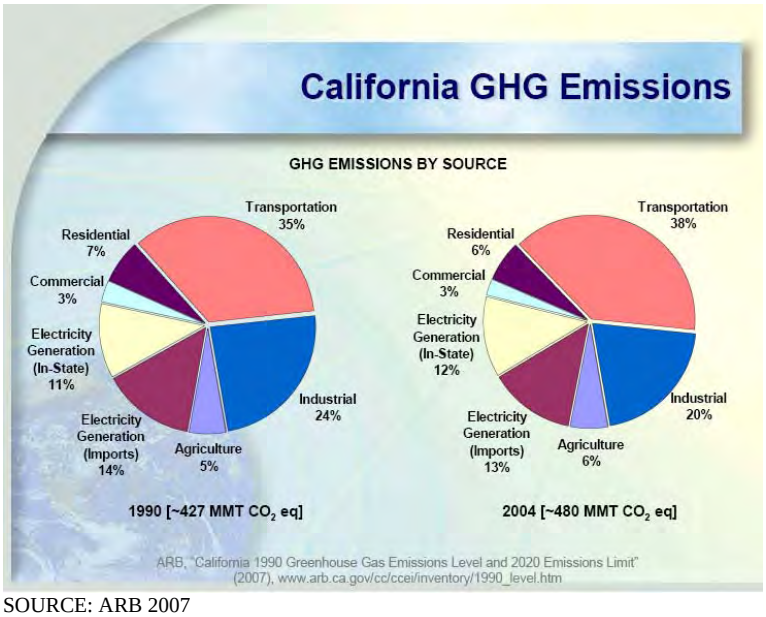
Threshold 1.4: Uniform Percentage-Based Reduction by Region. AB 32 and S-3-05 are written such that they apply to a geographic region (i.e. the entire state of California) rather than on a project or sector level. One could specify regions of the state such as the South Coast Air Basin, Sacramento Valley, or Bay Area which are required to plan (plans could be developed by regional governments, such as councils of governments) and demonstrate compliance with AB 32 and S-3-05 reduction goals at a regional level. To demonstrate that a project has less than significant emissions, one would have to show compliance with the appropriate regional GHG plan. Effectively this approach allows for analysis of GHG emissions at a landscape scale smaller than the state as a whole. Specifying regions in rough correlation to existing air basins or jurisdictional control allows for regional control of emissions and integration with regional emission reduction strategies for criteria and toxic air pollutants. Although differing GHG reduction controls for each region are possible, it is likely that all regions would be

required to achieve 1990 emission inventories by the year 2020 and 80 percent less emissions by 2050. Threshold 1.4 is considered viable long-term significance criteria that is unlikely to be used in the short term.

Implementing CEQA Thresholds Based on Emission Reduction Targets

Characterizing Baseline and Project Emissions

While the population and economy of California is expanding, all new projects can be considered to contribute new emissions. Furthermore, GHG impacts are exclusively cumulative impacts; there are no non-cumulative GHG emission impacts from a climate change perspective. "Business-as-usual" is the projection of GHG emissions at a future date based on current technologies and regulatory requirements in absence of other reductions. For example to determine the future emissions from a power plant for "business-as-usual" one would multiply the projected energy throughput by the current emission factor for that throughput. If adopted regulations (such as those that may be promulgated by CARB for AB 32) dictate that power plant emissions must be reduced at some time in the future, it is appropriate to consider these regulation standards as the new business-as-usual for a future date. In effect, business-as-usual will continue to evolve as regulations manifest. Note that "business-as-usual" defines the CEQA No Project conditions, but does not necessarily form the baseline under CEQA. For instance, it is common to subtract the future traffic with and without a project to determine the future cumulative contribution of a project on traffic conditions. However, existing conditions at the time of issuance of the notice of preparation is normally the baseline.



SOURCE: ARB 2007

Establishing Emission Reduction Targets

One of the obvious drawbacks to using a uniform percent reduction approach to GHG control is that it is difficult to allow for changes in the 1990 and future emission inventories estimates. To determine what emission reductions are required for new projects one would have to know accurately the 1990 budget and efficacy of other GHG promulgated regulations as a function of time. Since CARB will not outline its

regulation strategy for several more years, it is difficult to determine accurately what the new project reductions should be in the short term. Future updates to the 1990 inventory could necessitate changes in thresholds that are based on that inventory. It is important to note that it is difficult to create near term guidance for a uniform reduction threshold strategy since it would require considerable speculation regarding the implementation and effectiveness of forthcoming CARB regulations.

Of greater importance are the assumptions used to make the projected 2020 emission inventories. Projecting future inventories over the next 15-50 years involves substantial uncertainty. Furthermore, there are likely to be federal climate change regulations and possibly additional international GHG emission treaties in the near future. To avoid such speculation, this paper defines all future emission inventories as hypothetical business-as-usual projections.

This white paper is intended to support local decisions about CEQA and GHG in the near term. During this period, it is unlikely that a threshold based on emission reduction targets would need to be changed. However, it is possible that future inventory updates will show that targets developed on the current inventory were not stringent enough, or were more stringent than was actually needed.

Approach 2 – Tiered Approach

The goal of a tiered threshold is to maximize reduction predictability while minimizing administrative burden and costs. This would be accomplished by prescribing feasible mitigation measures based on project size and type, and reserving the detailed review of an EIR for those projects of greater size and complexity. This approach may require inclusion in a General Plan, or adoption of specific rules or ordinances in order to fully and effectively implement it.

A tiered CEQA significance threshold could establish different levels at which to determine if a project would have a significant impact. The tiers could be established based on the gross GHG emission estimates for a project or could be based on the physical size and characteristics of the project. This approach would then prescribe a set of GHG mitigation strategies that would have to be incorporated into the project in order for the project to be considered less than significant.

The framework for a tiered threshold would include the following:

- disclosure of GHG emissions for all projects;
- support for city/county/regional GHG emissions reduction planning;
- creation and use of a “green list” to promote the construction of projects that have desirable GHG emission characteristics;
- a list of mitigation measures;

- a decision tree approach to tiering; and
- quantitative or qualitative thresholds.

Decision-Tree Approach to Tiering

CEQA guidance that allows multiple methodologies to demonstrate GHG significance will facilitate the determination of significance for a broad range of projects/plans that would otherwise be difficult to address with a single non-compound methodology. Even though there could be multiple ways that a project can determine GHG significance using a decision-tree approach, only one methodology need be included in any single CEQA document prepared by the applicant. The presence of multiple methodologies to determine significance is designed to promote flexibility rather than create additional analysis overhead. Figure 1 shows a conceptual approach to significance determination using a tiered approach that shows the multiple routes to significance determination.

Figure 1 Detail Description

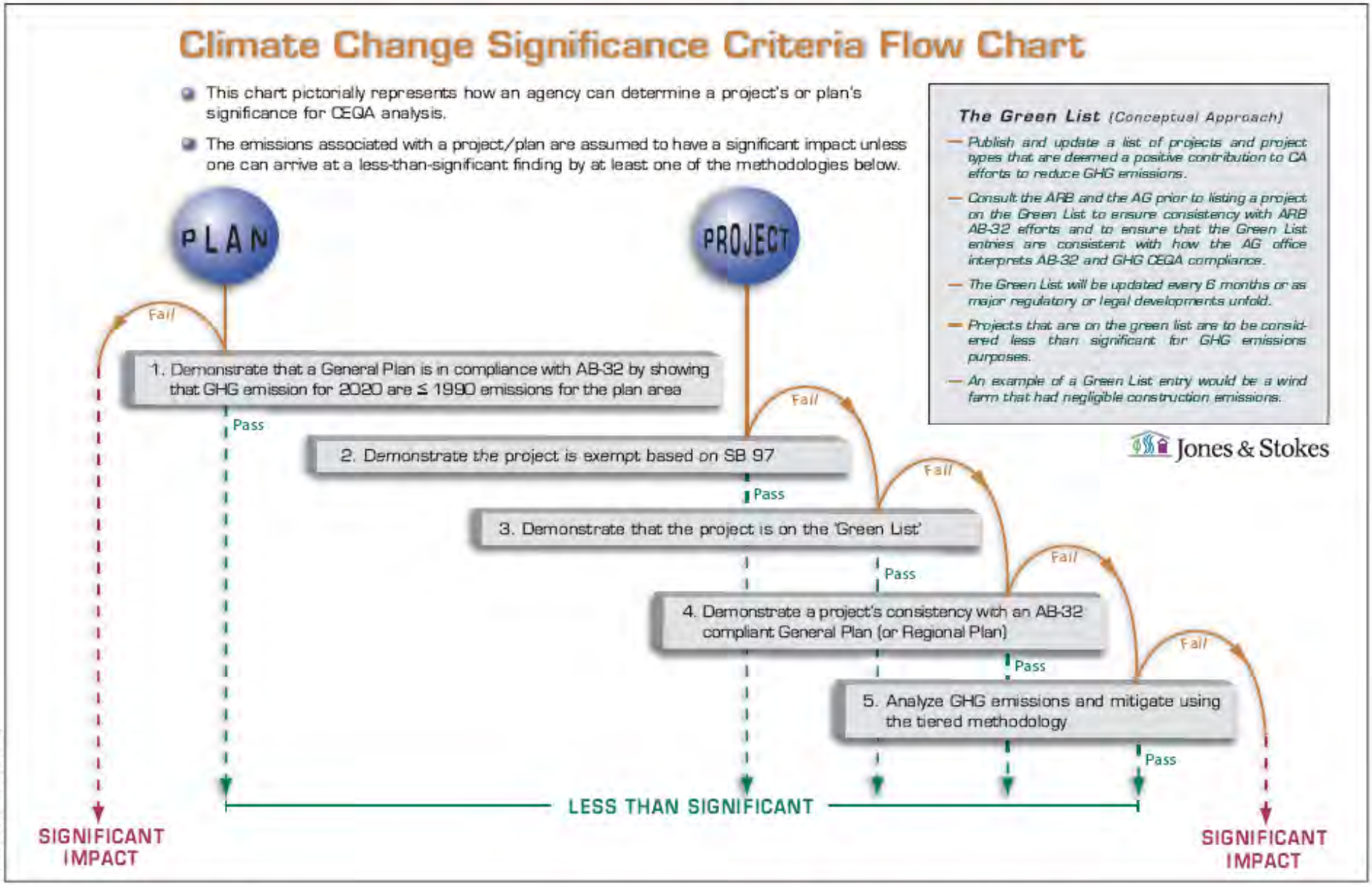
Figure 1 pictorially represents how an agency can determine a project's or plan's significance for CEQA analysis using the non-zero threshold methodology. The emissions associated with a project/plan are assumed to have a significant impact unless one can arrive at a less-than-significant finding by at least one of the methodologies below.

1. Demonstrate that a General Plan (GP) or Regional Plan is in Compliance with AB32

   - For most GPs or RPs this will require demonstration that projected 2020 emissions will be equal to or less than 1990 emissions.
   - GPs or RPs are expected to fully document 1990 and 2020 GHG emission inventories.
   - Projection of 2020 emissions is complicated by the fact that CARB is expected to promulgate emission reductions in the short term. Until explicit CARB regulations are in place, unmitigated GP 2020 emission inventories represent business-as-usual scenarios.
   - EIRs for GPs or RPs which demonstrate 2020 mitigated emissions are less than or equal to 1990 emissions are considered less than significant.

2. Demonstrate the Project is Exempt Based on SB 97

   - As specified in SB 97, projects that are funded under November 2006 Proposition 1B (Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act) and 1C (Disaster Preparedness and Flood Prevention Bond Act) may be exempt from analysis until January 1, 2010.



Jones & Stokes

Figure 1
Climate Change Significance Criteria Flow Chart

- An exemption can be used in an ND, MND, or EIR to support a less than significant finding for GHG impacts.

3. Demonstrate that the Project is on the 'Green List'

- This list would include projects that are deemed a positive contribution to California efforts to reduce GHG emissions. If the project is of the type described on the Green List it is considered less than significant.
- If the Green List entry description requires mitigation for impacts other than GHG, this methodology can be used in MNDs or EIRs; if the Green List entry does not require mitigation this methodology can be used in NDs, MNDs, or EIRs.

4. Demonstrate a Project's Compliance with a General Plan

- If a project is consistent with an appropriate General Plan's Greenhouse Gas Reduction Plan (GGRP), a project can be declared less than significant.
- Note that at this time there are no known jurisdictions that have a GGRP that has been fully subject to CEQA review. While Marin County has adopted a forward-thinking GGRP and it is described in the most recent GP update, the associated EIR does not analyze the secondary environmental impacts of some of the GGRP measures such as tidal energy. While one can reference GGRPs that have not been reviewed fully in CEQA, to attempt to show a project's compliance with such a plan as evidence that the project's GHG emission contributions are less than significant may not be supported by substantial evidence that cumulative emissions are being fully addressed in the particular jurisdiction.
- Compliance with a CEQA-vetted GGRP can be cited as evidence for all CEQA documents (Categorical Exemption, ND, MND, and EIR).

5. Analyze GHG Emissions and Mitigate using the Tiered Methodology

- Guidance and mitigation methodology for various development projects (residential, commercial, industrial) are listed in the form of tiered thresholds. If a project incorporates the mitigation measures specified in the tiered threshold tables the project is considered less than significant.
- All project emissions are considered less than significant if they are less than the threshold(s).
- If the tiered approach requires mitigation, this methodology can be used in MNDs or EIRs; if the tiered approach does not require mitigation this methodology can be used in NDs, MNDs, or EIRs.

The Green List

- The Green List would be a list of projects and project types that are deemed a positive contribution to California's efforts to reduce GHG emissions.
- If this approach is followed, it is suggested that CARB and the Attorney General (AG) are consulted prior to listing a project on the Green List to ensure consistency with CARB AB 32 efforts and to ensure that the Green List entries are consistent with how the AG office interprets AB 32 and GHG CEQA compliance.
- The Green List should be updated every 6 months or as major regulatory or legal developments unfold.
- Projects that are on the Green List are to be considered less than significant for GHG emissions purposes.
- A tentative list of potential Green List entries is presented below. Actual Green List entries should be far more specific and cover a broad range of project types and mitigation approaches. The list below is merely a proof-of-concept for the actual Green List.

    1. Wind farm for the generation of wind-powered electricity
    2. Extension of transit lines to currently developed but underserved communities
    3. Development of high-density infill projects with easily accessible mass transit
    4. Small hydroelectric power plants at existing facilities that generate 5 mw or less (as defined in Class 28 Categorical Exemption)
    5. Cogeneration plants with a capacity of 50 mw or less at existing facilities (as defined in Class 29 Cat Exemption)
    6. Increase in bus service or conversion to bus rapid transit service along an existing bus line
    7. Projects with LEED "Platinum" rating
    8. Expansion of recycling facilities within existing urban areas
    9. Recycled water projects that reduce energy consumption related to water supplies that services existing development
    10. Development of bicycle, pedestrian, or zero emission transportation infrastructure to serve existing regions

There are also several options for tiering and thresholds, as shown in Table 2 below. One could establish strictly numeric emissions thresholds and require mitigation to below the specific threshold to make a finding of less than significant. One could establish narrative emissions threshold that are based on a broader context of multiple approaches to GHG reductions and a presumption that projects of sufficiently low GHG intensity are less than significant.

In Concept 2A, a zero threshold would be applied to projects and thus only projects that result in a reduction of GHG emissions compared to baseline emissions would be less than significant absent mitigation. All projects would require quantified inventories. All projects that result in a net increase of GHG emissions would be required to mitigate their emissions to zero through direct mitigation or through fees or offsets or the impacts

Table 2: Approach 2 Tiering Options

	Concept 2A Zero	Concept 2B Quantitative	Concept 2C Qualitative
Tier 1	Project results in a net reduction of GHG emissions *Less than Significant*	Project in compliance with an AB 32-compliant General/Regional Plan, on the Green List, or below Tier 2 threshold. Level 1 Reductions (Could include such measures as: bike parking, transit stops for planned route, Energy Star roofs, Energy Star appliances, Title 24, water use efficiency, etc.) *Less than Significant*	Project in compliance with an AB 32-compliant General/Regional Plan, on the Green List, or below Tier 2 threshold. Level 1 Reductions (See measures under 2B) *Less than Significant*
Tier 2	Project results in net increase of GHG emissions Mitigation to zero (including offsets) *Mitigated to Less than Significant*	Above Tier 2 threshold Level 2 Mitigation (Could include such measures as: Parking reduction beyond code, solar roofs, LEED Silver or Gold Certification, exceed Title 24 by 20%, TDM measures, etc.) *Mitigated to Less than Significant*	Above Tier 2 threshold Level 2 Mitigation (See measures under 2B) *Mitigated to Less than Significant*
Tier 3	Mitigation infeasible to reduce emissions to zero (e.g., cost of offsets infeasible for project or offsets not available) *Significant and Unavoidable*	Above Tier 2 threshold With Level 1, 2 Mitigation Level 3 Mitigation: (Could include such measures as: On-site renewable energy systems, LEED Platinum certification, Exceed Title 24 by 40%, required recycled water use for irrigation, zero waste/high recycling requirements, mandatory transit passes, offsets/carbon impact fees) *Mitigated to Less than Significant*	Above Tier 3 thresholds Quantify Emissions, Level 3 Mitigation (see measures under 2B), and Offsets for 90% of remainder *Significance and Unavoidable*

would be identified as significant and unavoidable. This could be highly problematic and could eliminate the ability to use categorical exemptions and negative declarations for a wide range of projects.

In Concepts 2B and 2C, the first tier of a tiered threshold includes projects that are within a jurisdiction with an adopted greenhouse gas reduction plan (GGRP) and General Plan/Regional Plan that is consistent with AB 32 (and in line with S-3-05), or are on the Green List, or are below the Tier 2 threshold. All Tier 1 projects would be required to implement mandatory reductions required due to other legal authority (Level 1 reductions) such as AB 32, Title 24, or local policies and ordinances. With Level 1

reduction measures, qualifying Tier 1 projects would be considered less than significant without being required to demonstrate mitigation to zero.

In Concept 2B, the Tier 2 threshold would be quantitative, and quantified inventories would be required. Several quantitative threshold options are discussed below. A more comprehensive set of Level 2 mitigation would be required. If the project's emissions still exceed the Tier 2 threshold, an even more aggressive set of Level 3 mitigation measures would be required including offsets (when feasible) to reduce emissions below the Tier 2 threshold.

In Concept 2C, there would be two thresholds, a lower Tier 2 threshold (the "low bar") and a higher Tier 3 threshold (the "high bar"). The Tier 2 threshold would be the significance threshold for the purposes of CEQA and would be qualitative in terms of units (number of dwelling units, square feet of commercial space, etc.) or a per capita ratio. Projects above the Tier 2 threshold would be required to implement the comprehensive set of Level 2 mitigation. Projects below the Tier 2 threshold would not be required to quantify emissions or reductions. The Tier 3 threshold would be a threshold to distinguish the larger set of projects for which quantification of emissions would be required. Level 3 mitigation would be required and the project would be required to purchase offsets (when feasible) in the amount of 90 percent of the net emissions after application of Level 1 reductions and Level 2 and 3 mitigation. A variant on Concept 2C would be to require mandatory Level 3 mitigation without quantification and offsets.

Approach 2 Threshold Options

Seven threshold options were developed for this approach. The set of options are framed to capture different levels of new development in the CEQA process and thus allow different levels of mitigation. Options range from a zero first-tier threshold (Threshold 2.1) up to a threshold for GHG that would be equivalent to the capture level (i.e., number of units) of the current criteria pollutant thresholds used by some air districts (Threshold 2.4). The decision-based implementation approach discussed above could be used for any of these options. Table 3 below compares the results of each of the approaches discussed here.

Threshold 2.1: Zero First Tier Tiered Threshold.

This option would employ the decision tree concept and set the first tier cut-point at zero. The second tier cut-point could be one of the qualitative or quantitative thresholds discussed below. First-tier projects would be required to implement a list of very feasible and readily available mitigation measures.

Threshold 2.2: Quantitative Threshold Based on Market Capture

A single quantitative threshold was developed in order to ensure capture of 90 percent or more of likely future discretionary developments. The objective was to set the emission

threshold low enough to capture a substantial fraction of future residential and non-residential development that will be constructed to accommodate future statewide population and job growth, while setting the emission threshold high enough to exclude small development projects that will contribute a relatively small fraction of the cumulative statewide GHG emissions.

The quantitative threshold was created by using the following steps:

- Reviewing data from four diverse cities (Los Angeles in southern California and Pleasanton, Dublin, and Livermore in northern California) on pending applications for development.

- Determining the unit (dwelling unit or square feet) threshold that would capture approximately 90 percent of the residential units or office space in the pending application lists.

- Based on the data from the four cities, the thresholds selected were 50 residential units and 30,000 square feet of commercial space.

- The GHG emissions associated with 50 single-family residential units and 30,000 square feet of office were estimated and were found to be 900 metric tons and 800 metric tons, respectively. Given the variance on individual projects, a single threshold of 900 metric tons was selected for residential and office projects.

- A 900 metric ton threshold was also selected for non-office commercial projects and industrial projects to provide equivalency for different projects in other economic sectors.

- If this threshold is preferred, it is suggested that a more robust data set be examined to increase the representativeness of the selected thresholds. At a minimum, a diverse set of at least 20 cities and/or counties from throughout the state should be examined in order to support the market capture goals of this threshold. Further, an investigation of market capture may need to be conducted for different commercial project types and for industrial projects in order to examine whether multiple quantitative emissions thresholds or different thresholds should be developed.

The 900-ton threshold corresponds to 50 residential units, which corresponds to the 84th percentile of projects in the City of Los Angeles, the 79th percentile in the City of Pleasanton, the 50th percentile in the City of Livermore and the 4th percentile in the City of Dublin. This is suggestive that the GHG reduction burden will fall on larger projects that will be a relatively small portion of overall projects within more developed central cities (Los Angeles) and suburban areas of slow growth (Pleasanton) but would be the higher portion of projects within moderately (Livermore) or more rapidly developing areas (Dublin). These conclusions are suggestive but not conclusive due to the small sample size. The proposed threshold would exclude the smallest proposed developments

from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. While this would exclude perhaps 10 percent of new residential development, the capture of 90 percent of new residential development would establish a strong basis for demonstrating that cumulative reductions are being achieved across the state. It can certainly serve as an interim measure and could be revised if subsequent regulatory action by CARB shows that a different level or different approach altogether is called for.

The 900-ton threshold would correspond to office projects of approximately 35,000 square feet, retail projects of approximately 11,000 square feet, or supermarket space of approximately 6,300 square feet. 35,000 square feet would correspond to the 46th percentile of commercial projects in the City of Los Angeles, the 54th percentile in the City of Livermore, and the 35th percentile in the City of Dublin. However, the commercial data was not separated into office, retail, supermarket or other types, and thus the amount of capture for different commercial project types is not known. The proposed threshold would exclude smaller offices, small retail (like auto-parts stores), and small supermarkets (like convenience stores) from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA but would include many medium-scale retail and supermarket projects.

The industrial sector is less amenable to a unit-based approach given the diversity of projects within this sector. One option would be to adopt a quantitative GHG emissions threshold (900 tons) for industrial projects equivalent to that for the residential/commercial thresholds described above. Industrial emissions can result from both stationary and mobile sources. CARB estimates that their suggested reporting threshold for stationary sources of 25,000 metric tons accounts for more than 90 percent of the industrial sector GHG emissions (see Threshold 2.3 for 25,000 metric ton discussion). If the CARB rationale holds, then a 900 metric ton threshold would likely capture at least 90 percent (and likely more) of new industrial and manufacturing sources. If this approach is advanced, we suggest further examination of industrial project data to determine market capture.

This threshold would require the vast majority of new development emission sources to quantify their GHG emissions, apportion the forecast emissions to relevant source categories, and develop GHG mitigation measures to reduce their emissions.

Threshold 2.3: CARB Reporting Threshold

CARB has recently proposed to require mandatory reporting from cement plants, oil refineries, hydrogen plants, electric generating facilities and electric retail providers, cogeneration facilities, and stationary combustion sources emitting $\geq$ 25,000 MT CO_2e/yr. AB 32 requires CARB to adopt a regulation to require the mandatory reporting and verification of emissions. CARB issued a preliminary draft version of its proposed reporting requirements in August 2007 and estimates that it would capture 94 percent of the GHG emissions associated with stationary sources.

This threshold would use 25,000 metric tons per year of GHG as the CEQA significance level. CARB proposed to use the 25,000 metric tons/year value as a reporting threshold, not as a CEQA significance threshold that would be used to define mitigation requirements. CARB is proposing the reporting threshold to begin to compile a statewide emission inventory, applicable only for a limited category of sources (large industrial facilities using fossil fuel combustion).

A 25,000 metric ton significance threshold would correspond to the GHG emissions of approximately 1,400 residential units, 1 million square feet of office space, 300,000 square feet of retail, and 175,000 square feet of supermarket space. This threshold would capture far less than half of new residential or commercial development.

As noted above, CARB estimates the industrial-based criteria would account for greater than 90 percent of GHG emissions emanating from stationary sources. However, industrial and manufacturing projects can also include substantial GHG emissions from mobile sources that are associated with the transportation of materials and delivery of products. When all transportation-related emissions are included, it is unknown what portion of new industrial or manufacturing projects a 25,000-ton threshold would actually capture.

An alternative would be to use a potential threshold of 10,000 metric tons considered by the Market Advisory Committee for inclusion in a Greenhouse Gas Cap and Trade System in California. A 10,000 metric ton significance threshold would correspond to the GHG emissions of approximately 550 residential units, 400,000 square feet of office space, 120,000 square feet of retail, and 70,000 square feet of supermarket space. This threshold would capture roughly half of new residential or commercial development.

Threshold 2.4: Regulated Emissions Inventory Capture

Most California air districts have developed CEQA significance thresholds for NOx and ROG emissions to try to reduce emissions of ozone precursors from proposed sources that are not subject to NSR pre-construction air quality permitting. The historical management of ozone nonattainment issues in urbanized air districts is somewhat analogous to today's concerns with greenhouse gas emissions in that regional ozone concentrations are a cumulative air quality problem caused by relatively small amounts of NOx and ROG emissions from thousands of individual sources, none of which emits enough by themselves to cause elevated ozone concentrations. Those same conditions apply to global climate change where the environmental problem is caused by emissions from a countless number of individual sources, none of which is large enough by itself to cause the problem. Because establishment of NOx/ROG emissions CEQA significance thresholds has been a well-tested mechanism to ensure that individual projects address cumulative impacts and to force individual projects to reduce emissions under CEQA, this threshold presumes the analogy of NOx/ROG emission thresholds could be used to develop similar GHG thresholds.

The steps to develop a GHG emission threshold based on the NOx/ROG analogy were as follows:

- For each agency, define its NOx/ROG CEQA thresholds.
- For each agency, define the regional NOx/ROG emission inventory the agency is trying to regulate with its NOx/ROG thresholds.
- For each agency, calculate the percentage of the total emission inventory for NOx represented by that agency's CEQA emission threshold. That value represents the "minimum percentage of regulated inventory" for NOx.
- The current (2004) California-wide GHG emission inventory is 499 million metric tons per year of CO_2 equivalent (MMT CO_2e). Apply the typical "minimum percentage of regulated inventory" value to the statewide GHG inventory, to develop a range of analogous GHG CEQA thresholds.

The preceding methodology was applied to two different air quality districts: the Bay Area Air Quality Management District (BAAQMD), a mostly-urbanized agency within which most emissions are generated from urban areas; and the San Joaquin Valley Air Pollution Control District (SJVAPCD), which oversees emissions emanating in part from rural areas that are generated at dispersed agricultural sources and area sources. For example, in the Bay Area the NOx threshold is 15 tons/year. The total NOx inventory for 2006 was 192,000 tons/year (525 tons/day). The threshold represents 0.008 percent of the total NOx inventory. Applying that ratio to the total statewide GHG emissions inventory of 499 MMT CO_2e (2004) yields an equivalent GHG threshold of 39,000 MMT CO_2e.

The range of analogous CEQA GHG thresholds derived from those two agencies is tightly clustered, ranging from 39,000 to 46,000 tons/year. A 39,000 to 46,000 metric ton threshold would correspond to the GHG emissions of approximately 2,200 to 2,600 residential units, 1.5 to 1.8 million square feet of office space, 470,000 to 560,000 square feet of retail, and 275,000 to 320,000 square feet of supermarket space. This threshold would capture far less than half of new residential or commercial development. Similarly, this threshold would capture less of new industrial/manufacturing GHG emissions inventory than Thresholds 2.2 or 2.3.

Threshold 2.5: Unit-Based Thresholds Based on Market Capture

Unit thresholds were developed for residential and commercial developments in order to capture approximately 90 percent of future development. The objective was to set the unit thresholds low enough to capture a substantial fraction of future housing and commercial developments that will be constructed to accommodate future statewide population and job growth, while setting the unit thresholds high enough to exclude small development projects that will contribute a relatively small fraction of the cumulative statewide GHG emissions. Sector-based thresholds were created by using the same steps

and data used to create Threshold 2.2- Quantitative Threshold Based on Market Capture above.

The distribution of pending application data suggests that the GHG reduction burden will fall on larger projects that will be a relatively small portion of overall projects within more developed central cities and suburban areas of slow growth but would be the higher portion of projects within moderately or rapidly developing areas. The proposed threshold would exclude the smallest proposed developments from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. While this would exclude perhaps 10 percent of new residential development, the capture of 90 percent of new residential development would establish a strong basis for demonstrating that cumulative reductions are being achieved across the state. It can certainly serve as an interim measure and could be revised if subsequent regulatory action by CARB shows that a different level or different approach altogether is called for.

A similar rationale can be applied to the development of a commercial threshold. Threshold 2.5 would exclude many smaller businesses from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. It should be noted that the GHG emissions of commercial projects vary substantially. For example, the carbon dioxide emissions associated with different commercial types were estimated as follows:

- 30,000 square-foot (SF) office = 800 metric tons/year CO_2
- 30,000 SF retail = 2,500 metric tons/year CO_2
- 30,000 SF supermarket = 4,300 metric tons/year CO_2

Thus, in order to assure appropriate market capture on an emissions inventory basis, it will be important to examine commercial project size by type, instead of in the aggregate (which has been done in this paper).

The industrial sector is less amenable to a unit-based approach given the diversity of projects within this sector. One option would be to use a quantitative threshold of 900 tons for industrial projects in order to provide for rough equivalency between different sectors. Industrial emissions can result from both stationary and mobile sources. However, if the CARB rationale for > 90 percent stationary source capture with a threshold of 25,000 metric tons holds, then a 900 metric ton threshold would likely capture at least 90 percent (and likely more) of new industrial sources. Further examination of unit-based industrial thresholds, such as the number of employees or manufacturing floor space or facility size, may provide support for a unit-based threshold based on market capture.

This threshold would require the vast majority of new development emission sources to quantify their GHG emissions, apportion the forecast emissions to relevant source categories, and develop GHG mitigation measures to reduce their emissions.

Threshold 2.6. Projects of Statewide, Regional, or Areawide Significance

For this threshold, a set of qualitative, tiered CEQA thresholds would be adopted based on the definitions of "projects with statewide, regional or areawide significance" under the Guidelines for California Environmental Quality Act, CCR Title 14, Division 6, Section 15206(b).

Project sizes defined under this guideline include the following:

- Proposed residential development of more than 500 dwelling units.
- Proposed shopping center or business establishment employing more than 1,000 persons or encompassing more than 500,000 square feet of floor space.
- Proposed commercial office building employing more than 1,000 persons or encompassing more than 250,000 square feet of floor space.
- Proposed hotel/motel development of more than 500 rooms.
- Proposed industrial, manufacturing or processing plant or industrial park planned to house more than 1,000 persons, or encompassing more than 600,000 square feet of floor space.

These thresholds would correspond to the GHG emissions of approximately 9,000 metric tons for residential projects, 13,000 metric tons for office projects, and 41,000 metric tons for retail projects. These thresholds would capture approximately half of new residential development and substantially less than half of new commercial development. It is unknown what portion of the new industrial or manufacturing GHG inventory would be captured by this approach.

Threshold 2.7 Efficiency-Based Thresholds

For this approach, thresholds would be based on measurements of efficiency. For planning efforts, the metric could be GHG emissions per capita or per job or some combination thereof. For projects, the metric could be GHG emission per housing unit or per square foot of commercial space. In theory, one could also develop metrics for GHG emissions per dollar of gross product to measure the efficiency of the economy.

This approach is attractive because it seeks to benchmark project GHG intensity against target levels of efficiency. The thresholds would need to be set such that there is reasonably foreseeable and sufficient reductions compared to business as usual to support meeting AB 32 and S-3-05 goals in time (in combination with command and control regulations). Because this approach would require substantial data and modeling to fully develop, this is a concept considered as a potential future threshold and not appropriate

for interim guidance in the short term. Thus, it is not evaluated in the screening evaluation in the next section.

Table 3 compares the results for each of the approaches.

Table 3: Comparison of Approach 2 Tiered Threshold Options

Threshold	GHG Emission Threshold (metric tons/year)	Future Development Captured by GHG Threshold
2.1: Zero Threshold	0 tons/year	All
2.2: Quantitative Threshold Based on Market Capture	~900 tons/year	Residential development > 50 dwelling units Office space > 36,000 ft^2 Retail space >11,000 ft^2 Supermarkets >6.300 ft^2 small, medium, large industrial
2.3: CARB GHG Mandatory Reporting Threshold OR Potential Cap and Trade Entry Level	25,000 metric tons/year OR 10,000 metric tons/year	Residential development >1,400 dwelling units OR 550 dwelling units Office space >1 million ft^2 OR 400,000 ft^2 Retail space >300,000 ft^2 OR 120,000 ft^2 Supermarkets >175,000 ft^2 OR 70,000 ft^2 medium/larger industrial
2.4: Regulated Inventory Capture	40,000 – 50,000 metric tons/year	Residential development >2,200 to 2,600 dwelling units Office space >1.5 to 1.8 million ft^2 Retail space >470,000 to 560,000 ft^2 Supermarkets >270,000 to 320,000 ft^2 medium/larger industrial
2.5: Unit-Based Threshold Based on Market Capture	Not applicable.	Residential development >50 dwelling units Commercial space >50,000 ft^2 > small, medium, large industrial (with GHG emissions > 900 tonsCO2e)
2.6: Projects of Statewide, Regional, or Areawide Significance	Not applicable.	Residential development >500 dwelling units Office space >250,000 ft^2 Retail space >500,000 ft^2 Hotels >500 units Industrial project >1,000 employees Industrial project >40 acre or 650,000 ft^2
2.7: Efficiency-Based Thresholds	TBD tons/year/person TBD tons/year/unit	Depends on the efficiency measure selected.

Implementing CEQA With Tiered Thresholds

Several issues related to Approach 2 are addressed below:

1. *Some applications of this approach may need to be embodied in a duly approved General Plan, or in some other formal regulation or ordinance to be fully enforceable.* Because CEQA does not expressly provide that projects may be deemed insignificant based on implementation of a set of mitigations, this approach may need to be supported with specific and enforceable mechanisms adopted with due public process.

2. *How would this concept affect adoption of air district rules and regulations?* Proposed air district rules and regulations may be subject to CEQA like other projects and plans. Thus, if significance thresholds were adopted by an APCD or AQMD, then they could also apply to air district discretionary actions. If GHG emissions would be increased by a rule or regulation for another regulated pollutant, that would be a potential issue for review under CEQA.

3. *Mitigation measures may not be all-inclusive; better measures now or new future technology would make these measures obsolete.* The mandatory mitigation measures could be periodically updated to reflect current technology, feasibility, and efficiency.

4. *Total reduction may not be quantified or difficult to quantify.* CEQA only requires the adoption of feasible mitigation and thus the reduction effectiveness of required mitigation should not be in question. However, the precise reduction effectiveness may indeed be difficult to identify. As described above, if a quantitative threshold is selected as the measure of how much mitigation is mandated, then best available evidence will need to be used to estimate resultant GHG emissions with mitigation adoption. If a qualitative threshold is selected, then it may not be necessary to quantify reductions.

5. *Difficult to measure progress toward legislative program goals.* One could require reporting of project inventories to the Climate Action Registry, air district, or regional council of governments, or other suitable body. Collection of such data would allow estimates of the GHG intensity of new development over time, which could be used by CARB to monitor progress toward AB 32 goals.

6. *Measures may have adverse impacts on other programs.* The identification of mandatory mitigation will need to consider secondary environmental impacts, including those to air quality.

7. *Consideration of life-cycle emissions.* In many cases, only direct and indirect emissions may be addressed, rather than life-cycle emissions. A project applicant has traditionally been expected to only address emissions that are closely related and within the capacity of the project to control and/or influence. The long chain

8. of economic production resulting in materials manufacture, for example, involves numerous parties, each of which in turn is responsible for the GHG emissions associated with their particular activity. However, there are situations where a lead agency could reasonably determine that a larger set of upstream and downstream emissions should be considered because they are being caused by the project and feasible alternatives and mitigation measures may exist to lessen this impact.

Approach 2 Tiered Threshold with Mandatory Mitigation

As shown in Table 2, due to the cumulative nature of GHG emissions and climate change impacts, there could be a level of mandatory reductions and/or mitigation for all projects integrated into a tiered threshold approach. In order to meet AB 32 mandates by 2020 and S-3-05 goals, there will need to be adoption of GHG reduction measures across a large portion of the existing economy and new development. As such, in an effort to support a determination under CEQA that a project has a less than considerable contribution to significant cumulative GHG emissions, mitigation could be required on a progressively more comprehensive basis depending on the level of emissions.

- Level 1 Reductions – These reduction measures would apply to all projects and would only consist of AB 32 and other local/state mandates. They would be applied to a project from other legal authority (not CEQA). Level 1 reductions could include such measures as bike parking, transit stops for planned routes, Energy Star roofs, Energy Star appliances, Title 24 compliance, water use efficiency, and other measures. All measures would have to be mandated by CARB or local regulations and ordinances.

- Level 2 Mitigation – Projects that exceed the determined threshold would be required to first implement readily available technologies and methodologies with widespread availability. Level 2 Mitigation could include such measures as: parking reduction below code minimum levels, solar roofs, LEED Silver or Gold Certification, exceed Title 24 building standards by 20 percent, Traffic Demand Management (TDM) measures, and other requirements.

- Level 3 Mitigation - If necessary to reduce emissions to the thresholds, more extensive mitigation measures that represent the top tier of feasible efficiency design would also be required. Level 3 Mitigation could include such measures as: on-site renewable energy systems, LEED Platinum certification, exceed Title 24 building requirements by 40 percent, required recycled water use for irrigation, zero waste/high recycling requirements, mandatory transit pass provision, and other measures.

- Offset Mitigation – If, after adoption of all feasible on-site mitigation, the project is still found to exceed a Tier 2 quantitative threshold, or exceed a Tier 3 qualitative threshold, or if a project cannot feasibly implement the mandatory on-site mitigation, then purchases of offsets could be used for mitigation. In the case

of a quantitative threshold, the amount of purchase would be to offset below the Tier 2 significance threshold. In the case of a qualitative threshold, the amount of purchase could be to offset GHG emissions overall to below the lowest equivalent GHG emissions among the Tier 2 qualitative thresholds. With Threshold 2.5, this would be approximately 900 tons of GHG emissions (corresponding to 50 residential units). With Threshold 2.6, this would be approximately 9,000 tons (corresponding to 500 residential units). Alternatively, one could require purchase of offsets in the amount of a set percentage (such as 90% or 50% for example) of the residual GHG emissions (after other mitigation). As discussed earlier, any decision to include or require the use of emission reduction credits (or offsets) must consider issues of availability, quality, and environmental justice.

Substantial Evidence Supporting Different Thresholds

If a project can be shown by substantial evidence not to increase GHG emissions relative to baseline emissions, then no fair argument will be available that the project contributes considerably to a significant cumulative climate change impact.

It is more challenging to show that a project that increases GHG emissions above baseline emissions does not contribute considerably to a significant cumulative climate change impact. It is critical therefore, to establish an appropriate cumulative context, in which, although an individual project may increase GHG emissions, broader efforts will result in net GHG reductions.

Approach 1-based thresholds that by default will require an equal level of GHG reductions from the existing economy (Thresholds 1.1, 1.3, and 1.4) may be less supportable in the short run (especially before 2012) than Approach 1.2 (which requires new development to be relatively more efficient than a retrofitted existing economy). This is because, prior to 2012, there will only be limited mandatory regulations implementing AB 32 that could address the existing economy in a truly systematic way that can be relied upon to demonstrate that overall GHG reduction goals can be achieved by 2020. Approach 1.2 will still rely on substantial reductions in the existing economy but to a lesser degree.

Approach 1-based thresholds that would spread the mitigation burden across a sector (Threshold 1.3) or across a region (Threshold 1.4) will allow for tradeoffs between projects or even between municipalities. In order to demonstrate that a sector or a region is achieving net reductions overall, there would need to be feasible, funded, and mandatory requirements in place promoting an overall reduction scheme, in order for a project to result in nominal net increased GHG emissions.

Approach 2-based thresholds that capture larger portions of the new development GHG inventory (Thresholds 2.2 and 2.5) would promote growth that results in a smaller increase in GHG emissions; they may therefore be more supportable than thresholds that do not and that have a greater reliance on reductions in the existing economy (Thresholds

2.3, 2.4, and 2.6), especially in the next three to five years. With an established cumulative context that demonstrates overall net reductions, all threshold approaches could be effective in ensuring growth and development that significantly mitigates GHG emissions growth in a manner that will allow the CARB to achieve the emission reductions necessary to meet AB 32 targets. In that respect, all of these thresholds are supported by substantial evidence.

Evaluation of Non-Zero Threshold Options

Overarching issues concerning threshold development are reviewed below. Where appropriate, different features or application of the two conceptual approaches and the various options for thresholds under each conceptual approach described above are analyzed. The screening evaluation is summarized in Tables 4 (Approach 1) and 5 (Approach 2). The summary tables rate each threshold for the issues discussed below based on the level of confidence (low, medium or high) ascribed by J&S. The confidence levels relate to whether a threshold could achieve a particular attribute, such as emission reduction effectiveness. For example, a low emission reduction effectiveness rating means the threshold is not expected to capture a relatively large portion of the new development inventory.

As described above, Threshold 2.7 is not included in this evaluation because the data to develop an efficiency-based threshold has not been reviewed at this time and because this threshold is not considered feasible as an interim approach until more detailed inventory information is available across the California economy.

What is the GHG Emissions Effectiveness of Different Thresholds?

Effectiveness was evaluated in terms of whether a threshold would capture a large portion of the GHG emissions inventory and thus require mitigation under CEQA to control such emissions within the larger framework of AB 32. In addition, effectiveness was also evaluated in terms of whether a threshold would require relatively more or less GHG emissions reductions from the existing economy verses new development. This is presumptive that gains from the existing economy (through retrofits, etc.) will be more difficult and inefficient relative to requirements for new development.

Approach 1-based thresholds that require equivalent reductions relative to business-as-usual (Thresholds 1.1, 1.3, and 1.4) for both the existing and new economy will be less effective than thresholds that support lower-GHG intensity new development (Approach 1.2). However, since Approach 1-based thresholds do not establish a quantitative threshold below which projects do not have to mitigate, the market capture for new development is complete.

Approach 2-based thresholds can be more or less effective at capturing substantial portions of the GHG inventory associated with new development depending on where the quantitative or qualitative thresholds are set. Lower thresholds will capture a broader range of projects and result in greater mitigation. Based on the review of project data for

the select municipalities described in the Approach 2 section above, thresholds based on the CARB Reporting Threshold/Cap and Trade Entry Level (Threshold 2.4) or CEQA definitions of "Statewide, Regional or Areawide" projects (Threshold 2.6) will result in a limited capture of the GHG inventory. Lower quantitative or qualitative thresholds (Thresholds 2.1, 2.2 and 2.5) could result in capture of greater than 90 percent of new development.

Are the Different Thresholds Consistent with AB 32 and S-3-05?

Thresholds that require reductions compared to business-as-usual for all projects or for a large portion of new development would be consistent with regulatory mandates. In time, the required reductions will need to be adjusted from 2020 (AB 32) to 2050 (S-3-05) horizons, but conceptually broad identification of significance for projects would be consistent with both of these mandates. Thresholds that exclude a substantial portion of new development would likely not be consistent, unless it could be shown that other more effective means of GHG reductions have already been, or will be adopted, within a defined timeframe.

All Approach 1-based thresholds would be consistent with AB 32 and S-3-05 if it can be demonstrated that other regulations and programs are effective in achieving the necessary GHG reduction from the existing economy to meet the overall state goals.

Approach 2-based thresholds that include substantive parts of the new development GHG inventory (Thresholds 2.1, 2.2 and 2.5) will be more consistent with AB 32 and S-3-05 than those that do not (Thresholds 2.3, 2.4, and 2.6) unless it can be demonstrated that other regulations and programs are effective in achieving the necessary GHG reduction from the existing economy to meet the overall state goals.

What are the Uncertainties Associated with Different Thresholds?

All thresholds have medium to high uncertainties associated with them due to the uncertainty associated with the effectiveness of AB 32 implementation overall, the new character of GHG reduction strategies on a project basis, the immaturity of GHG reduction technologies or infrastructure (such as widespread biodiesel availability), and the uncertainty of GHG reduction effectiveness of certain technologies (such as scientific debate concerning the relative lifecycle GHG emissions of certain biofuels, for example).

In general, Approach 1-based thresholds have higher uncertainties than Approach 2 thresholds because they rely on a constantly changing definition of business-as-usual. Threshold 1.2, with its relatively smaller reliance on the existing economy for GHG reductions has relatively less uncertainty than other Approach 1 thresholds. Thresholds that spread mitigation more broadly (Thresholds 1.3 and 1.4) have less uncertainty by avoiding the need for every project to mitigate equally.

Approach 2 thresholds with lower quantitative (2.1 and 2.2) or qualitative (2.5) thresholds will have uncertainties associated with the ability to achieve GHG reductions

from small to medium projects. Approach 2 thresholds with higher quantitative (2.3, 2.4) or qualitative (2.6) thresholds will have uncertainties associated with the ability to achieve relatively larger GHG reductions from the existing economy.

What are Other Advantages/Disadvantages of the Different Thresholds?

Thresholds with a single project metric (Thresholds 1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 2.5, and 2.6) will be easier to apply to individual projects and more easily understood by project applicants and lead agencies broadly. Thresholds that spread mitigation across sectors (1.3) or regions (1.4), while simple in concept, will require adoption of more complicated cross-jurisdictional reduction plans or evaluation of broad sector-based trends in GHG intensity reduction over time. Approach 1 options would require all projects to quantify emissions in order to determine needed reductions relative to business-as-usual (which will change over time as described above). Concepts that are unit-based (Threshold 2.5 and 2.6) will not result in thresholds that have equal amount of GHG emissions, and thus equity issues may arise.

Table 4: Non-Zero Threshold Evaluation Matrix – Approach 1

Approach 1	**1.1**	**1.2**	**1.3**	**1.4**
	28% - 33% Reduction from BAU by 2020 by Project	**50% Reduction from BAU by 2020 by Project**	**28% - 33% Reduction by 2020 by Sector**	**28% - 33% Reduction by 2020 by Region**
GHG Emissions Reduction Effectiveness	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.	**Medium** - Captures all new projects and has a more realistic level of reductions from the existing economy.	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.
Economic Feasibility	**Low** - Some projects will not be able to afford this level of reduction without effective market-based mechanisms like offsets.	**Low** - Some projects will not be able to afford this level of reduction without effective market-based mechanisms like offsets.	**Medium** - Sectors as a whole will be better able to achieve reductions than individual projects.	**Low** - Some regions and newly developed areas may not be able to afford this level of reduction without effective market-based mechanisms like offsets.
Technical Feasibility	**Medium** - Some projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**Low** - Relatively larger set of projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**High** - Some projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**Medium** - Some regions and newly developed areas may not be able to afford this level of reduction without effective market-based mechanisms like offsets.
Logistical Feasibility	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.
Consistency with AB-32 and S-03-05	**Medium** - Would require heavy reliance on command and control gains.	**High**	**Medium-High** - Would rely on command and control gains, but would allow sectoral flexibility.	**Medium-High** - Would rely on command and control gains, but would allow regional flexibility.
Cost Effectiveness	**Low** - Will require all types of projects to reduce the same regardless of the cost/ton of GHG reductions.	**Low** - Will require all types of projects to reduce the same regardless of the cost/ton of GHG reductions.	**Low/Medium** - Allows tradeoffs within sector between high and low cost reduction possibilities but not between sectors.	**Low/Medium** - Allows tradeoffs within region between high and low cost reduction possibilities, but not between regions.
Uncertainties	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.	**Medium/High** - BAU changes over time. Ability to limit GHG emissions from other new development will take years to demonstrate.	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.
Other Advantages	Simple/easy to explain.	Simple/easy to explain.	Spreads mitigation broadly	Spreads mitigation broadly
Other Disadvantages	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.

Table 5: Non-Zero Threshold Evaluation Matrix – Approach 2

Approach 2	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**
	Zero Threshold	**Quantitative (900 tons)**	**Quantitative CARB Reporting Threshold/Cap and Trade (25,000 tons/ 10,000 tons)**	**Quantitative Regulated Inventory Capture (~40,000 - 50,000 tons)**	**Qualitative Unit-Based Thresholds**	**Statewide, Regional or Areawide (CEQA Guidelines 15206(b)).**
GHG Emissions Reduction Effectiveness	**High** - Captures all sources.	**High** - Market capture at >90%. Captures diverse sources.	**Medium** - Moderate market capture.	**Low** - Low market capture.	**High** - Market capture at ~90%. Captures diverse sources; excl. smallest proj.	**Medium** - Moderate market capture. Excludes small and med. projects.
Economic Feasibility	**Low** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**High** - Large projects have greater ability to absorb cost.	**High** - Large projects have greater ability to absorb cost.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**High** - Large projects have greater ability to absorb cost.
Technical Feasibility	**Low** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be inefficient to mitigate.	**High** - Greater opportunities for multiple reduction approaches.	**High** - Greater opportunities for multiple reduction approaches.	**Medium** - Early phases will be substantial change in BAU, particularly for smaller projects may be inefficient to mitigate.	**High** - Greater opportunities for multiple reduction approaches.
Logistical Feasibility	**Low** - Unless fee or offset basis,very difficult to mitigate all projects.	**Medium** - BMPs broadly written to allow diversity; new req. will take time to integrate into new dev.	**High** - Less mitigation.	**High** - Less mitigation.	**Medium** - BMPs broadly written to allow diversity; new req. will take time to integrate into new dev.	**High** - Less mitigation.
Consistency with AB-32 and S-03-05	**High** - Market capture.	**High** - Market capture at >90%.	**Low** - Would rely on command and control success heavily.	**Low** - Would rely on command and control success heavily.	**Medium** - Need to demonstrate adequate market capture over time.	**Low** - Would rely on command and control success heavily.
Cost Effectiveness	**Low** - Will result in inefficient mitigation approaches. Efficiency will improve in time.	**Medium** - Emphasis is on new dev., req. for mitigation will result in inefficient mitigation approaches in early phases. Efficiency will improve in time.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.	**Medium** - Emphasis is on new dev.; req. for mitigation will result in inefficient mitigation approaches in early phases. Efficiency will improve in time.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.
Uncertainties	**High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects unlikely.	**Medium/High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects uncertain.	**High** - Gains from command and control likely longer to be realized.	**High** - Gains from command and control likely longer to be realized.	**Medium/High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects uncertain.	**High** - Gains from command and control likely longer to be realized.
Other Advantages	Single threshold.	Single threshold. BMPs can be updated. Greenlist can be updated.	Single threshold. Does not change CEQA processing for most projects. CARB inventory = project inv.. All projects treated same.	Single threshold. Does not change CEQA processing for most projects. Follows established SIP practice.	BMPs can be updated. Greenlist can be updated. Unit-Based thresholds can be updated.	Existing guideline. Does not change CEQA processing for most projects. Endorsed by Cal. Chapter of the APA.
Other Disadvantages	Requires all projects to quantify emissions.	Requires nearly all projects to quantify emissions.			Sectoral projects have different GHG emis. Only largest projects to quantify emis.	Sectoral projects have different GHG emissions.

Introduction

This chapter evaluates the availability of various analytical methods and modeling tools that can be applied to estimate the greenhouse gas emissions from different project types subject to CEQA. This chapter will also provide comments on the suitability of the methods and tools to accurately characterize a projects emissions and offer recommendations for the most favorable methodologies and tools available. Some sample projects will be run through the methodologies and modeling tools to demonstrate what a typical GHG analysis might look like for a lead agency to meet its CEQA obligations. The air districts retained the services of EDAW environmental consultants to assist with this effort.

Methodologies/Modeling Tools

There are wide varieties of discretionary projects that fall under the purview of CEQA. Projects can range from simple residential developments to complex expansions of petroleum refineries to land use or transportation planning documents. It is more probably than not, that a number of different methodologies would be required by any one project to estimate its direct and indirect GHG emissions. Table 10 contains a summary of numerous modeling tools that can be used to estimate GHG emissions associated with various emission sources for numerous types of project's subject to CEQA. The table also contains information about the models availability for public use, applicability, scope, data requirements and its advantages and disadvantages for estimating GHG emissions.

In general, there is currently not one model that is capable of estimating all of a project's direct and indirect GHG emissions. However, one of the models identified in Table 9 would probably be the most consistently used model to estimate a projects direct GHG emissions based on the majority of projects reviewed in the CEQA process. The Urban Emissions Model (URBEMIS) is designed to model emissions associated with development of urban land uses. URBEMIS attempts to summarize criteria air pollutants and CO_2 emissions that would occur during construction and operation of new development. URBEMIS is publicly available and already widely used by CEQA practitioners and air districts to evaluate criteria air pollutants emissions against air district-adopted significance thresholds. URBEMIS is developed and approved for statewide use by CARB. The administrative reasons for using URBEMIS are less important than the fact that this model would ensure consistency statewide in how CO_2 emissions are modeled and reported from various project types.

One of the shortfalls of URBEMIS is that the model does not contain emission factors for GHGs other than CO_2, except for methane (CH_4) from mobile-sources, which is converted to CO_2e. This may not be a major problem since CO_2 is the most important GHG from land development projects. Although the other GHGs have a higher global warming potential, a metric used to normalize other GHGs to CO_2e, they are emitted in far fewer quantities. URBEMIS does not calculate other GHG emissions associated with

off-site waste disposal, wastewater treatment, emissions associated with goods and services consumed by the residents and workers supported by a project. Nor does URBEMIS calculate GHGs associated with consumption of energy produced off-site. (For that matter, URBEMIS does not report criteria air pollutant emissions from these sources either).

Importantly, URBEMIS does not fully account for interaction between land uses in its estimation of mobile source operational emissions. Vehicle trip rates are defaults derived from the Institute of Transportation Engineers trip generation manuals. The trip rates are widely used and are generally considered worst-case or conservative. URBEMIS does not reflect "internalization" of trips between land uses, or in other words, the concept that a residential trip and a commercial trip are quite possibly the same trip, and, thus, URBEMIS counts the trips separately. There are some internal correction settings that the modeler can select in URBEMIS to correct for "double counting"; however, a project-specific "double-counting correction" is often not available. URBEMIS does allow the user to overwrite the default trip rates and characteristics with more project-specific data from a traffic study prepared for a project.

Residential, Commercial, Mixed-Use Type Projects/ Specific Plans

Direct Emissions

URBEMIS can be used to conduct a project-specific model run and obtain CO_2e emissions for area and mobile sources from the project, and convert to metric tons CO_2e. When a project-specific traffic study is not available, the user should consult with their local air district for guidance. Many air district staff are experienced practitioners of URBEMIS and can advise the lead agency or the modeler on how to best tailor URBEMIS default input parameters to conduct a project-specific model run. When a traffic study has been prepared for the project, the user must overwrite default trip length and trip rates in URBEMIS to match the total number of trips and vehicle miles traveled (VMT) contained in the traffic study to successfully conduct a project-specific model run. URBEMIS is recommended as a calculation tool to combine the transportation study (if available) and EMFAC emission factors for mobile-sources. Use of a project-specific traffic study gets around the main shortfall of URBEMIS: the lack of trip internalization. URBEMIS also provides the added feature of quantifying direct area-source GHG emissions.

Important steps for running URBEMIS

1. Without a traffic study prepared for the project, the user should consult with the local air district for direction on which default options should be used in the modeling exercise. Some air districts have recommendations in the CEQA guidelines.

2. If a traffic study was prepared specifically for the project, the following information must be provided:

a. Total number of average daily vehicle trips *or* trip-generation rates by land use type per number of units; and,

b. Average VMT per residential *and* nonresidential trip.

c. The user overwrites the "Trip Rate (per day)" fields for each land use in URBEMIS such that the resultant "Total Trips" and the "Total VMT" match the number of total trips and total VMT contained in the traffic study.

d. Overwrite "Trip Length" fields for residential and nonresidential trips in UBEMIS with the project-specific lengths obtained form the traffic study.

3. Calculate results and obtain the CO_2 emissions from the URBEMIS output file (units of tons per year [TPY]).

Indirect Emissions

URBEMIS does estimate indirect emissions from landscape maintenance equipment, hot water heaters, etc. URBEMIS does not however, provide modeled emissions from indirect sources of emissions, such as those emissions that would occur off-site at utility providers associated with the project's energy demands. The California Climate Action Registry (CCAR) Protocol v.2.2 includes methodology, which could be used to quantify and disclose a project's increase in indirect GHG emissions from energy use. Some assumptions must be made for electrical demand per household or per square foot of commercial space, and would vary based on size, orientation, and various attributes of a given structure. An average rate of electrical consumption for residential uses is 7,000 kilowatt hours per year per household and 16,750 kilowatt hours per thousand square feet of commercial floor space. Commercial floor space includes offices, retail uses, warehouses, and schools. These values have been increasing steadily over the last 20 years. Energy consumption from residential uses has increased due to factors such as construction and occupation of larger homes, prices of electricity and natural gas, and increased personal income allowing residents to purchase more electronic appliances. Commercial energy consumption is linked to factors such as vacancy rates, population, and sales.

The modeler will look up the estimated energy consumption for the project's proposed land uses under year of project buildout, or use the values given in the previous paragraph for a general estimate. The CCAR Protocol contains emission factors for CO_2, CH_4, and nitrous oxide. The "CALI" region grid serves most of the State of California. If a user has information about a specific utility provider's contribution from renewable sources, the protocol contains methodology to reflect that, rather than relying on the statewide average grid. The incremental increase in energy production associated with project operation should be accounted for in the project's total GHG emissions for inclusion in the environmental document.

The incremental increase in energy production associated with project operation should be accounted for in the project's total GHG emissions, but it should be noted that these emissions would be closely controlled by stationary-source control-based regulations and additional regulations are expected under AB 32. However, in the interest of disclosing project-generated GHG emissions and mitigating to the extent feasible, the indirect emissions from off-site electricity generation can be easily calculated for inclusion in the environmental document.

Example Project Estimates for GHG Emissions

Residential Project

Project Attributes:

- 68 detached dwelling units
- 15.9 acres
- 179 residents
- 0 jobs
- Located in unincorporated Placer County (PCAPCD jurisdiction)
- Analysis year 2009

As shown in Table 6, the project's direct GHG emissions per service population (SP) would be approximately 8 metric tons CO_2e/SP/year.

Table 6: Residential Project Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	251	Residents	179
Mobile-source emissions	1,044	Jobs	0
Indirect emissions (from CCAR Protocol)	174		
Total operational emissions	**1,469**	Service population	179
Operational emissions/SP	**8.2**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population(see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Commercial Project

Project Attributes:

- Free Standing Discount Superstore: 241 thousand square feet (ksf)
- 0 residents

- 400 jobs
- Located in the San Joaquin Valley Air Pollution Control District's (SJVAPCD) jurisdiction
- Analysis year 2009

Table 7: Commercial Project Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	464	Residents	0
Mobile-source emissions	13,889	Jobs	400
Indirect emissions (from CCAR Protocol)	1,477		
Total operational emissions	**15,830**	Service population	400
Operational emissions/SP	**39.6**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Specific Plan

If used traditionally with default trip rates and lengths, rather than project-specific (Traffic Analysis Zone-specific) trip rates and lengths, URBEMIS does not work well for specific plan or general plan-sized projects with multiple land use types proposed. However, in all instances, projects of these sizes (several hundred or thousand acres) would be accompanied by a traffic study. Thus, for large planning-level projects, URBEMIS can be used as a calculation tool to easily obtain project-specific mobile-source emissions. The user should follow the steps discussed above; wherein he/she overwrites the default ITE trip rates for each land use type with that needed to make total VMT match that contained in the traffic study. The URBEMIS interface is a simple calculator to combine the traffic study and EMFAC emissions factors for mobile-source CO_2.

Project Attributes:

- 985 acres
- Total dwelling units: 5,634
- Commercial/Mixed Use: 429 ksf
- Educational: 2,565 ksf
- 14,648 residents
- 3,743 jobs
- Located in Sacramento County (SMAQMD jurisdiction)
- Analysis year 2009

Table 8: Specific Plan Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	23,273	Residents	14,648
Mobile-source emissions	73,691	Jobs	3,743
Indirect emissions (from CCAR Protocol)	32,744	Service population	18,391
Total operational emissions	**129,708**		
Operational emissions/SP	**7.1**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

The specific plan example, when compared to the residential or commercial examples, illustrates the benefit of a mixed-use development when you look at CO_2e emissions per resident or job (service population) metric (see definition of service population below in discussion of Normalization/Service Population Metric). Though this particular specific plan is not an example of a true jobs/housing balance, the trend is clear: accommodating residents and jobs in a project is more efficient than residents or jobs alone.

Stationary- and Area-Source Project Types

GHG emissions from stationary or area sources that require a permit to operate from the air district also contain both direct and indirect sources of emissions. Examples of these types of sources would be fossil fuel power plants, cement plants, landfills, wastewater treatment plants, gas stations, dry cleaners and industrial boilers. All air districts have established procedures and methodologies for projects subject to air district permits to calculate their regulated pollutants. It is anticipated that these same procedures and methodologies could be extended to estimate a permitted facility's GHG calculations. For stationary and area sources that do not require air district permits, the same methodologies used for permitted sources could be used in addition to URBEMIS and CCAR GRP to calculate GHG emissions from these facilities.

Wastewater Treatment Facilities

Direct GHG emissions associated with a proposed waste water treatment plant can be calculated using AP-42 emission factors from Chapter 4.3.5 Evaporative Loss Sources: Waste Water-Greenhouse Gases and the CCAR methodology. In general, most wastewater operations recover CH_4 for energy, or use a flare to convert the CH_4 to CO_2. There are many types of wastewater treatment processes and the potential for GHG emissions from different types of plants varies substantially. There is not one standard set of emission factors that could be used to quantify GHG emissions for a state

"average" treatment plant. Thus, research will need to be conducted on a case-by-case basis to determine the "Fraction Anaerobically Digested" which is a function of the type of treatment process. Indirect emissions from these facilities can be calculated using the CCAR energy use protocols and URBEMIS model for transportation emissions.

Solid Waste Disposal Facilities

Air districts will have emission estimate methodologies established for methane emissions at permitted landfills. In addition, EPA's Landfill Gas Emissions Model (LandGem) and the CCAR methodology could also be used to quantify GHG emissions from landfill off gassing; however, this model requires substantial detail be input. The model uses a decomposition rate equation, where the rate of decay is dependent on the quantity of waste in place and the rate of change over time. This modeling tool is free to the public, but substantial project detail about the operation of the landfill is needed to run the model. Indirect emissions from these facilities can be calculated using the CCAR energy use protocols and URBEMIS model for transportation emissions.

Construction Emissions

GHG emissions would occur during project construction, over a finite time. In addition, a project could result in the loss of GHG sequestration opportunity due primarily to the vegetation removed for construction. URBEMIS should be used to quantify the mass of CO_2 that would occur during the construction of a project for land development projects. Some construction projects would occur over an extended period (up to 20–30 years on a planning horizon for general plan buildout, or 5–10 years to construct a dam, for example). OFFROAD emission factors are contained in URBEMIS for CO_2 emissions from construction equipment. For other types of construction projects, such as roadway construction projects or levee improvement projects, SMAQMD's spreadsheet modeling tool, the Road Construction Emissions Model (RoadMod), should be used. This tool is currently being updated to include CO_2 emissions factors from OFFROAD.

The full life-cycle of GHG emissions from construction activities is not accounted for in the modeling tools available, and the information needed to characterize GHG emissions from manufacture, transport, and end-of-life of construction materials would be speculative at the CEQA analysis level. The emissions disclosed will be from construction equipment and worker commutes during the duration of construction activities. Thus, the mass emissions in units of metric tons CO_2e/year should be reported in the environmental document as new emissions.

General Plans

In the short-term, URBEMIS can be used as a calculation tool to model GHG emissions from proposed general plans, but only if data from the traffic study is incorporated into model input. The same methodology applied above in the specific plan example applies to general plans. The CCAR GRP can be used to approximate indirect emissions from

increased energy consumption associated with the proposed plan area. The same models and methodologies discussed previously for wastewater, water supply and solid waste would be used to estimate indirect emissions resulting from buildout of the general plan.

In the longer-term, more complex modeling tools are needed, which would integrate GHG emission sources from land use interaction, such as I-PLACE^{3}S or CTG Energetics' Sustainable Communities Custom Model attempt to do. These models are not currently available to the public and only have applicability in certain areas of the state. It is important that a tool with statewide applicability be used to allow for consistency in project treatment, consideration, and approval under CEQA.

Scenarios

At the general plan level, the baseline used for analyzing most environmental impacts of a general plan update is typically no different from the baseline for other projects. The baseline for most impacts represents the existing conditions, normally on the date the Notice of Preparation is released. Several comparative scenarios could be relevant, depending on the exact methodological approach and significance criteria used for GHG assessment:

- Existing Conditions. The GHG emissions associated with the existing, on-the-ground conditions within the planning area.

- 1990 conditions. The GHG emissions associated with the general plan area in 1990. This is relevant due to the state's AB 32 GHG emission reduction goals' benchmark year of 1990. The GHG-efficiency of 1990 development patterns could be compared to that of the general plan buildout.

- Buildout of the Existing General Plan. The GHG emissions associated with buildout of the existing general plan (without the subject update). This is the no project alternative for the purposes of general plan CEQA analysis.

- Buildout of the Updated General Plan. The GHG emissions associated with buildout of the general plan, as proposed as a part of the subject update. This would include analysis of any changes included as a part of the general plan update for the existing developed portions of the planning area. Many communities include redevelopment and revitalization strategies as a part of the general plan update. The general plan EIR can include assumptions regarding what level and type of land use change could be facilitated by infill and redevelopment. Many jurisdictions wish to provide future projects consistent with these land use change assumptions with some environmental review streamlining. In addition, many communities include transit expansions, pedestrian/bicycle pathway improvements, multi-modal facility construction, travel demand policies, energy efficiency policies, or other measures that could apply to the existing developed area, just as they may apply to any new growth

areas. Such policies could affect the overall GHG emissions of the built out general plan area.

- Increment between Buildout of Updated General Plan and Existing General Plan Area. There are many important considerations associated with the characterization of the impact of the General Plan update. The actual GHG emissions impact could be described as the difference between buildout under the existing and proposed land use plan (No-Build Alternative). However, the courts have held that an EIR should also analyze the difference between the proposed General Plan and the existing environment (*Environmental Planning & Information Council v. County of El Dorado* (EPIC) (1982) 131 Cal.App.3d 350). At the General Plan level, over the course of buildout, some new land uses are introduced, which could potentially add operational GHG emissions and potentially remove existing sequestration potential. Some properties become vacant and are not redeveloped. Other properties become vacant and then are redeveloped. Communities cannot pretend to understand fully in advance each component of land use change. The programmatic document is the preferred method of environmental analysis. Through this programmatic framework, communities develop buildout assumptions as a part of the General Plan that are normally used as a basis of environmental analysis. For certain aspects of the impact analysis, it becomes important not just to understand how much "new stuff" could be accommodated under the updated General Plan, but also the altered interactions between both "new" and "existing" land uses within the planning area. As addressed elsewhere, there are tools available for use in understanding land use/transportation interactions at the General Plan level. Without the GHG targets established by AB 32, a simple mass comparison of existing conditions to General Plan buildout might be appropriate.

However, within the current legal context, the GHG efficiency of the updated General Plan becomes the focus of analysis. Some options in this regard include:

- Estimate the GHG emissions associated with all the land uses included within the planning area upon buildout of the General Plan using no project specific information (regional, countywide, or statewide defaults). Estimate GHG emissions using project specific information from the transportation engineer, transportation demand policies, community design elements, energy efficiency requirements, wastewater treatment and other public infrastructure design changes, and other components. Compare these two calculations. Is the second calculation reduced by the percent needed to meet AB 32 goals compared to the first calculation?

- Estimate the GHG emissions associated with the 1990 planning area and the per-capita or per-service population GHG associated with the 1990 planning area. (Many communities are establishing GHG inventories using different tools). Estimate the GHG emissions associated with buildout of the proposed General Plan update and the resulting per-capita or per-service population GHG

emissions. Compare the two calculations. Is the General Plan buildout per-capita or per-service population level greater than the 1990 estimate?

Example General Plan Update: Proposed new growth area

Project Attributes:

- 10,050 single family dwelling units
- 652 multi-family dwelling units
- 136 acres parks
- 2,047 ksf commercial (regional shopping center)
- 2,113 ksf office
- 383 acres industrial park
- 31,293 new residents
- 4,945 new jobs
- Located in Stanislaus County (SJVAPCD jurisdiction)
- Analysis year 2025

Table 9: General Plan Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	**Metric Tons/Year CO_2e**	**Demographic Data**	
Construction emissions	12,083*	Residents	31,293
Area-source emissions	45,708		
Mobile-source emissions	263,954	Jobs	4,945
Indirect emissions (from CCAR Protocol)	78,385		
Total operational emissions	**388,046**	Service population	36,238
Operational emissions/SP	**10.7**		

* Approximately 241,656 metric tons CO_2e total at general plan buildout (assumes 20-year buildout period). Construction emissions were not included in total operational emissions.
Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).
Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Due to the programmatic level of analysis that often occurs at the general plan level, and potential for many relevant GHG emission quantities, it could be preferable to use a qualitative approach. Such an analysis could address the presence of GHG-reducing policy language in the general plan.

Three possible tiers of approaches to addressing GHG mitigation strategies, either as general plan policy, general plan EIR mitigation measures, or both, include:

- Forward planning
- Project toolbox
- Defer to GHG reductions plan

The three basic approaches are described below.

1. Bring reduction strategies into the plan itself. The most effective way for local jurisdictions to achieve GHG emissions reductions in the medium- and long-term is through land use and transportation policies that are built directly into the community planning document. This involves creating land use diagrams and circulation diagrams, along with corresponding descriptive standards, that enable and encourage alternatives to travel and goods movement via cars and trucks. The land use and circulation diagrams provide a general framework for a community where people can conduct their everyday business without necessarily using their cars. The overall community layout expressed as a part of the land use and circulation diagrams is accompanied by a policy and regulatory scheme designed to achieve this community layout. Impact fees, public agency spending, regulations, administrative procedures, incentives, and other techniques are designed to facilitate land use change consistent with the communities' overall vision, as expressed in policy and in the land use diagram. There are many widely used design principles that can be depicted in land use and circulation diagrams and implemented according to narrative objectives, standards, and policies:

- Connectivity. A finely-connected transportation network shortens trip lengths and creates the framework for a community where homes and destinations can be placed close in proximity and along direct routes. A hierarchical or circuitous transportation network can increase trip lengths and create obstacles for walking, bicycling, and transit access. This policy language would likely be found in the Circulation Element.

- Compactness. Compact development, by its nature, can increase the efficiency of infrastructure provision and enable travel modes other than the car. If communities can place the same level of activity in a smaller space, GHG emissions would be reduced concurrently with VMT and avoid unnecessary conversion of open space. This policy language would likely be found in the Land Use Element.

- Diversity. Multiple land use types mixed in proximity around central "nodes" of higher-activity land uses can accommodate travel through means other than a car. The character and overall design of this land use mix is, of course, different from community to community. This policy language would likely be found in the Land Use Element.

- Facilities. Pedestrian, bicycle, and public transportation improvements, planning, and programming are sometimes an afterthought. To get a more GHG-efficient mode share, safe and convenient bike lanes, pedestrian pathways, transit shelters, and other facilities are required to be planned along with the vehicular travel network. This policy language would likely be found in the Circulation Element.

- Redevelopment. One way to avoid GHG emissions is to facilitate more efficient and economic use of the lands in already-developed portions of a community. Reinvestment in existing neighborhoods and retrofit of existing buildings is appreciably more GHG efficient than greenfield development, and can even result in a net reduction in GHG emissions. This policy language would likely be found in the Conservation or Land Use Element.

- Housing and Employment. Most communities assess current and future economic prospects along with long-range land use planning. Part of the objective for many communities is to encourage the coalescence of a labor force with locally available and appropriate job opportunities. This concept is best known as "jobs-housing balance." This policy language would likely be found in the Housing Element.

- Planning Level Versus Project Level. For transportation-related GHG emissions that local governments can mitigate through land use entitlement authority, the overall community land use strategy and the overall transportation network are the most fruitful areas of focus. The reduction capacity of project-specific mitigation measures is greatly limited if supportive land use and transportation policies are lacking at the community planning level. The regional economic context, of course, provides an important backdrop for land use and transportation policy to address GHG emissions. Within this context, the general plan is the readily available tool for local governments to establish such land use and transportation strategies. This policy language would likely be found in the Land Use and Circulation Elements.

- Shipping Mode Shift. Locate shipping-intensive land uses in areas with rail access. Some modes of shipping are more GHG-intensive than others. Rail, for example, requires only about 15 to 25 percent of the energy used by trucks to ship freight equivalent distances and involves reduced transportation-related GHG emissions. Cities and counties have little direct control over the method of shipment that any business may choose. Nevertheless, as a part of the general planning process, cities and counties can address constraints on the use of rail for transporting goods. This policy language would likely be found in the Land Use and Circulation Elements.

2. Provide a "toolbox" of strategies after the project site has been selected. In addition to the examples of design principles that are built into the community planning process, communities can offer project applicants a range of tools to reduce GHG emissions. Mitigation strategies are elaborated in detail in Chapter 9.

3. Defer to General Plan implementation measure. Develop and implement a GHG Emissions Reduction Plan. Another option for local governments would be development of an implementation measure as a part of the general plan that outlines an enforceable GHG reduction program. Perhaps the most well known example of this approach is the result of California's Attorney General settlement of the lawsuit brought against San

Bernardino County. The County has agreed to create a 1990 GHG inventory and develop measures to reduce such emissions according to the state's overall goals. Other communities have pursued similar programs (i.e., the City of San Diego, Marin County). Along with the inventories, targets, and example reduction measures, these programs would include quantitative standards for new development; targets for reductions from retrofitting existing development; targets for government operations; fee and spending program for GHG reduction programs; monitoring and reporting; and other elements. The local government itself should serve as a model for GHG reduction plan implementation, by inventorying emissions from government operations and achieving emission reductions in accordance with the plan's standards. An optional climate change element could be added to contain goals, policies, and this implementation strategy, or this could belong in an optional air quality element.

Other Project Types

Air District Rules, Regulations and Air Quality Plans

Air district air quality plans, rules and regulations could have the potential to increase or decrease GHG emissions within their respective jurisdiction. In general, air district air quality plans, rules and regulations act to reduce ozone precursors, criteria air pollutant and toxic air contaminant emissions, which would almost always act to reduce GHG emissions simultaneously. However, this may not always be the case.

Air Quality Plans

Air districts will have to include GHG emissions analysis as part of their criteria air pollutant and toxic air contaminant air pollutant analysis when considering the adoption of air quality plans and their subsequent rules and regulations needed to implement the plans. Multiple models and methodologies will be needed to accomplish this analysis.

Regional Transportation Plans

Regional transportation plans would also need to be evaluated on a case-by-case basis to determine if a net increase or decrease in GHG emissions would occur. Complex interactions between the roadway network, operating conditions, alternative transportation availability (such as public transit, bicycle pathways, and pedestrian infrastructure), and many other independent parameters specific to a region should be considered. Regional transportation models exist to estimate vehicular emissions associated with regional transportation plans, which includes the ability to estimate GHG emissions.

Normalization/Service Population Metric

The above methodology would provide an estimate of the mass GHG emissions generated by a proposed project, which could be compared to a mass emission threshold. EDAW developed a methodology that would measure a project's overall GHG efficiency

in order to determine if a project is more efficient than the existing statewide average for per capita GHG emissions. The following steps could be employed to estimate the GHG-"efficiency," which may be more directly correlated to the project's ability to help obtain objectives outlined in AB 32, although it relies on establishment of an efficiency-based significance threshold. The subcommittee believes this methodology may eventually be appropriate to evaluate the long-term GHG emissions from a project in the context of meeting AB 32 goals. However, this methodology will need substantially more work and is not considered viable for the interim guidance presented in this white paper.

- Divide the total operational GHG emissions by the Service Population (SP) supported by the project (where SP is defined as the sum of the number of residents and the number of jobs supported by the project). This value should be compared to that of the projected statewide GHG emissions inventory from the applicable end-use sectors (electricity generation, residential, commercial/institutional, and mobile-source) in 1990 divided by the projected statewide SP for the year 2020 (i.e., AB 32 requirements), to determine if the project would conflict with legislative goals.

    - If the project's operational GHG/SP falls below AB 32 requirements, then the project's GHG emissions are less than cumulatively considerable.

    - If the project's operational GHG/SP exceed AB 32 requirements (a substantial contribution), then the project's GHG emissions would conflict with legislative requirements, and the impact would be cumulatively considerable and mitigation would be required where feasible.

- New stationary and area sources/facilities: calculate GHG emissions using the CCAR GRP. All GHG emissions associated with new stationary or area sources should be treated as a net increase in emissions, and if deemed significant, should be mitigated where feasible.

- Road or levee construction projects or other construction-only projects: calculate GHG emissions using the RoadMod, which will be updated to contain GHG emission factors from EMFAC and OFFROAD. All construction-generated GHG emissions should be treated as a net increase, and if deemed significant, should be mitigated to the extent feasible.

- Air District rulemaking or air quality management plan-type projects should be evaluated on a case-by-case basis for secondary impacts of increased GHG emissions generation. In most cases, the types of projects that act to reduce regional air pollution simultaneously act to reduce GHG emissions, and would be beneficial, but should be evaluated for secondary effects from GHG emissions.

- Regional transportation plans should also be evaluated on a case-by-case basis for potential to either reduce or increase GHG emissions from the transportation sector. EMFAC can be utilized to determine the net change in GHG emissions

associated with projected vehicle VMT and from operating speed changes associated with additional or alleviated congestion.

To achieve the goals of AB 32, which are tied to GHG emission rates of specific benchmark years (i.e., 1990), California would have to achieve a lower rate of emissions per unit of population and per unit of economic activity than it has now. Further, in order to accommodate future population and economic growth, the state would have to achieve an even lower rate of emissions per unit than was generated in 1990. (The goal to achieve 1990 quantities of GHG emissions by 2020 means that this will need to be accomplished in light of 30 years of population and economic growth in place beyond 1990.) Thus, future planning efforts that would not encourage new development to achieve its fair share of reductions in GHG emissions would conflict with the spirit of the policy decisions contained in AB 32, thus impeding California's ability to comply with the mandate.

Thus, if a statewide context for GHG emissions were pursued, any net increase in GHG emissions within state boundaries would be considered "new" emissions. For example, a land development project, such as a specific plan, does not necessarily create "new" emitters of GHG, but would theoretically accommodate a greater number of residents in the state. Some of the residents that move to the project could already be California residents, while some may be from out of state (or would 'take the place' of in-state residents who 'vacate' their current residences to move to the new project). Some may also be associated with new births over deaths (net population growth) in the state. The out-of-state residents would be contributing new emissions in a statewide context, but would not necessarily be generating new emissions in a global context. Given the California context established by AB 32, the project would need to accommodate an increase in population in a manner that would not inhibit the state's ability to achieve the goals of lower total mass of emissions.

The average net influx of new residents to California is approximately 1.4 percent per year (this value represents the net increase in population, including the net contribution from births and deaths). With population growth, California also anticipates economic growth. Average statewide employment has grown by approximately 1.1 percent over the last 15 years. The average percentage of population employed over the last 15 years is 46 percent. Population is expected to continue growing at a projected rate of approximately 1.5 percent per year through 2050. Long-range employment projection data is not available from the California Department of Finance (DOF) and can be extrapolated in different ways (e.g., linear extrapolation by percentage rate of change, percentage of population employed, mathematical series expansion, more complex extrapolation based on further research of demographic projections such as age distribution). Further study would be needed to refine accurate employment projections from the present to 2050. For developing this framework, employment is assumed to have a constant proportionate relationship with the state's population. The projected number of jobs is assumed to be roughly 46 percent of the projected population.

In light of the statewide context established by California law, consistency is most important for evaluating GHG emissions from projects. Thus, URBEMIS and the CCAR GRP are the recommended tools for quantification of GHG emissions from most project types in the short term. Over the long term, more sophisticated models that integrate the relationship between GHG emissions and land use, transportation, energy, water, waste, and other resources, and have similar application statewide would have better application to the problem, but may not currently be as accessible or as easily operable. I-PLACE^{3}S and CTG Energetics' Sustainable Communities Model (SCM) are two examples of such models that contain emission factors for GHGs, which could be refined to have applicability statewide and made available to CEQA practitioners. Other models are likely to be developed, given the importance of this issue.

Short-Term and Long-Term Methodologies

The following tools can be used to quantify a project's GHG emissions until tools that are more comprehensive become available statewide:

1. Land development projects: URBEMIS 2007 v. 9.2 and the CCAR GRP v. 2.2 (short-term); further development of I-PLACE^{3}S or CTG's Sustainable Communities Model (long-term).
2. New stationary and area sources/facilities: AP-42 Chapter 4.3, LandGem v. 3.02, and/or CCAR GRP v. 2.2.
3. Road or levee construction projects or other construction-only projects: RoadMod/OFFROAD 2007.

Ideally, I-PLACE^{3}S or CTG's Sustainable Communities Model would be expanded to apply to all regions of the state. These types of models use an integrated approach, which is the best approach for reasonably approximating the emissions that result from interaction between land uses, but neither is available to the public and would create consistency problems in reporting emissions from projects across the state if these were used today. However, a similar model with statewide applicability will likely be developed due to the importance of the issue.Table 10 Summary of Modeling Tools for Estimating GHG Emissions and Project Applicability

Table 10: Summary of Modeling Tools for GHG Emissions

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
URBEMIS 2007	*Public domain -Download (www.urbemis.com) free of charge*	*Land development and construction projects (construction, mobile- and area-source emissions)*	*Local*	*Fairly Easy*	*Land use information, construction and operational data and assumptions (e.g., jurisdiction, acres of land use type, year of operation, etc.)*	*Mobile-source Construction & Operational CO_2 (lb/day or tons/year)*	*-Recommended for land use development and construction projects -Also recommended for net change in land use (zoning changes)*	*-Does not quantify indirect emissions from energy consumption or other GHGs (except methane from mobile-sources) -Free, available to public, and applicable statewide -Widely used for assessment of other air quality impacts*
California Climate Action Registry General Reporting Protocol v. 2.2	*Public guidance document*	*Indirect emissions from land development projects, stationary- and area-source facilities regulated under AB 32*	*State*	*Easy*	*Energy consumption*	*CO_2e (Metric tons/year)*	*-Recommended for indirect emissions from energy consumption for land use development projects, and for new stationary- or area- sources to be regulated*	*-Contains emission factors for CH_4 and N_2O in addition to CO_2 -Does not contain emission factors broken down by utility provider (statewide average grid only)*
Clean Air and Climate Projection (CACP) Software	*Public agencies (members of ICLEI, NACAA, or similar)*	*Local governments used for emissions inventories*	*Local*	*N/A*	*Energy usage, waste generation/disposal transportation*	*CO_2e (tons/year)*	*-Recommended for inventories of local government entities activities (must be a member of affiliated agency or group)*	*-Not available to public*
CTG Sustainable Communities Model	*Custom model*	*Land development*	*Regional, scalable*	*N/A*	*Land use information, operational (mobile, energy, economic, infrastructure) assumptions*	*CO_2e (tons/year)*	*-An integrated and comprehensive modeling tool, but cannot obtain*	*-Not available to public*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
I-PLACE^{3}S	*Access fee through local COG* *Only available for eight California counties*	*Land use change*	*Regional, scalable*	*Fairly Easy*	*Parcel information*	*CO_2 (lb/day or tons/year)*	*-Recommended for land use development projects and land use changes* *-Especially good for general plans*	*-Not freely available to public* *-Not applicable statewide* *-Actually provides insight into land use interaction* *-Can include very specific project attributes* *-Trip rates are from behavioral survey data, instead of ITE*
EMFAC 2007	*Public domain*	*On-road mobile-sources*	*Statewide, regional*	*Fairly Easy*	*Vehicle fleet information*	*CO_2 (grams/mile)*	*-Not recommended for most projects (URBEMIS preferred)* *-Could be used for certain Air District Rulemaking applications*	*-Can compare emissions based on speed-distribution* *-Emission factors contained in URBEMIS* *-Not a stand-alone model*
OFFROAD 2007	*Public domain*	*Off-road mobile sources (construction equipment)*	*Statewide, regional*	*Fairly Easy*	*Construction fleet information*	*CO_2 (lb/day)*	*-Not recommended (URBEMIS preferred)* *-could be used for certain Air District Rulemaking applications (re: construction equipment)*	*-Emission factors contained in URBEMIS*
RoadMod (to be updated to include CO_2)	*Public domain*	*Off-road and on-road mobile sources (construction equipment and material haul trucks)*	*Statewide*	*Easy*	*Construction information*	*CO_2 (lb/day or tons/project)*	*-Recommended for construction-only projects (linear in nature; i.e., levees, roads, pipelines)*	*-To be updated to support emissions factors from OFFROAD 2007*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
DTIM	*Public domain*	*On-road mobile-sources*	*Statewide, regional*	*Difficult (consists of a series of three programs and requires input files from traffic and emissions modeling)*	*-EMFAC files* *-Traffic model output files (e.g., link, interzonal, and trip end data)* *-User options file* *-Optional files*	*CO_2 (tons/year)*	*-Not recommended*	*-Not updated to support EMFAC 2007 emission factors* *-Input files include output files from regional transportation models which more accurately reflect VMT*
Southeast Climate Change Partnership Spreadsheet Model (UK)	*Public domain http://www.climatesoutheast.org.uk/*	*UK Local government/ agencies/ organizations used for emissions inventories*	*Local, county, regional*	*Fairly easy*	*Energy usage, waste generation/disposal, transportation*	*CO_2 (tonnes/year)*	*-Not recommended for use in California, but could be a valuable source for building an applicable spreadsheet model*	*-Applicability for UK, but could be updated with CA-specific emission factors*
EPA AP-42; Evaporation Loss Sources Chapter 4.3.5	*Public reference document*	*GHG emissions from waste water treatment facilities*	*Facility level*	*Easy equation; substantial research needed to use*	*Biochemical oxygen demand (BOD) loading, Fraction anaerobically digested*	*CH4 (lb/year)*	*-Recommended for Publicly owned treatment works (POTW) projects*	*-Substantial research needed to determine the "fraction anaerobically digested" parameter, which is dependent on the type of treatment plant/process*
LandGem v. 3.02	*Public domain http://www.epa.gov/ttn/catc/dir1/landgem-v302.xls*	*GHG emissions from anaerobic decomposition associated with landfills*	*Facility Level*	*Moderate*	*Solid waste processing, year of analysis, lifetime of waste in place*	*CO_2, CH_4 (Mega grams/year)*	*-Recommended for landfill emissions*	*-Emission rates change dependent on years of decomposition, waste in place rates of change.* *-Complex decomposition rate equation, but good first approximation*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
CARROT	*Registry members*	*Stationary source emissions, vehicle fleet mobile sources*	*Facility level*	*Moderate*	*Facility-specific information*	*All GHGs*	*-Recommended for reporting facilities under AB 32 and for indirect emissions from energy consumption (CCAR Protocol)*	*-Estimates all GHGs and normalizes to CO_2e* *-Not publicly available*

Notes:

GHG = greenhouse gas; AB = assembly bill; CO_2e = carbon dioxide equivalent; CH_4 = methane; N_2O = nitrous oxide; COG = council of governments ; ITE = Institute of Transportation Engineers; CCAR = California Climate Action Registry

Source: Data compiled by EDAW and the California Air Pollution Control Officers Association in 2007

Introduction

This chapter (and Appendix B) identifies existing and potential mitigation measures that could be applied to projects during the CEQA process to reduce a project's GHG emissions that would be identified using the analytical methodologies included in this white paper. The Subcommittee retained the services of EDAW to assist with this effort. EDAW performed a global search of mitigation measures currently in practice and under study that would reduce GHG emissions.

Table 16 (Appendix B) provides a brief description of each measure along with an assessment of their feasibility (from a standpoint of economical, technological, and logistical feasibility, and emission reduction effectiveness), and identifies their potential for secondary impacts to air quality. During the global search performed, EDAW also took note of GHG reduction strategies being implemented as rules and regulation (e.g., early action items under AB 32), which are summarized in Table 18 (Appendix C). It is important to note that though compliance with such would be required by regulation for some sources, such strategies may be applicable to other project and source types.

The recurring theme that echoes throughout a majority of these measures is the shift toward New Urbanism, and research has consistently shown that implementation of Neotraditional Development techniques reduces VMT and associated emissions. The material reviewed assessed reductions from transportation-related measures (e.g., bicycle, pedestrian, transit, and parking) as a single comprehensive approach to land use. This comprehensive approach focuses on development design criteria conducive to enhancing alternate modes of transportation, including transit, walking, and bicycling. Transportation Demand Management (TDM) programs are viewed as a mechanism to implement specific measures. TDM responsibilities may include offering incentives to potential users of alternative modes of transportation and monitoring and reporting mode split changes.

The comprehensive approach makes it more difficult to assess reductions attributable to each measure. Nevertheless, there is a strong interrelationship between many of the measures, which justifies a combined approach. Consider the relationship between bike parking nonresidential, bike parking residential, endtrip facilities, and proximity to bike path/bike lane measures. In reality, these measures combined act as incentives for one individual to bike to work, while implementation of a single measure without the others reduces effectiveness.

The global nature of GHG emissions is an important feature that enables unique mitigation: abatement. When designing a project subject to CEQA, the preferred practice is first to avoid, then to minimize, and finally to compensate for impacts. Where the impact cannot be mitigated on-site, off-site mitigation is often and effectively implemented in several resource areas, either in the form of offsetting the same impact or preserving the resource elsewhere in the region. Frequently, mitigation fee programs or funds are established, where the proponent pays into the program and fees collected

throughout the region or state are used to implement projects that, in turn, proportionately offset the impacts of the projects to the given resource. It may be more cost-effective to reduce as much GHG on-site as feasible (economically and technologically). Then the proponent would pay into a "GHG retrofit fund" to reduce equivalent GHG emissions off-site. In contrast to regional air pollutant offset programs such as the Carl Moyer Program, it matters greatly where reductions of ozone precursors occur, as ozone affects regional air quality. The GHG retrofit fund could be used to provide incentives to upgrade older buildings and make them more energy efficient. This would reduce demand on the energy sector and reduce stationary source emissions associated with utilities. This program has been successfully implemented in the United Kingdom where developments advertise "carbon neutrality." Of course, some GHG emissions occur associated with operation of the development, but the development would offset the remainder of emissions through off-site retrofit. Avoiding emissions that would otherwise continue to occur at existing development would be a unique opportunity for mitigation of GHG emissions. Reduction of GHG emissions also may have important side benefits including reduction of other forms of pollution.

Depending on the significance threshold concept adopted, projects subject to the CEQA process would either qualitatively or quantitatively identify the amount of GHG emissions associated with their project using the analytical methodologies identified in the previous chapter. The analysis would then apply the appropriate number of mitigation measures listed in Appendix B to their project to reduce their GHG emissions below the significance level. Calculating the amount of GHG emission reductions attributable to a given mitigation measure would require additional research. The examples below illustrate how a project would be mitigated using this approach.

Residential Project Example

Project Attributes:

- 68 detached dwelling units
- 15.9 acres
- Located in unincorporated Placer County PCAPCD jurisdiction)
- Assume URBEMIS defaults for a rural project in Placer County, in absence of a traffic study (This is contrary to the recommendations contained under Task 1; a traffic study is necessary to asses project-specific GHG emissions).
- Analysis year 2009

Table 11: Residential Project Example GHG Emissions Estimates with Mitigation

URBEMIS Output (Unmitigated)	Metric Tons/Year CO_2e	URBEMIS Output (Mitigated)	Metric Tons/Year CO_2e	Percent Reduction
Area-source emissions	252	Area-source emissions	215	14.6
Mobile-source emissions	1,047	Mobile-source emissions	916	12.5
Total direct operational emissions (area + mobile)	1,299	Total operational emissions (area + mobile)	1,131	12.9

Notes:
CO_2e = carbon dioxide equivalent

Sources: Data compiled by EDAW in 2007

Using URBEMIS 2007 and assuming the project would implement the mitigation measures listed below, yearly project-generated emissions of CO_2e would be reduced by approximately 13 percent. Implementation of the following mitigation measures is assumed:

- 100 housing units within one-half-mile radius of project's center, including this project's 68 residential units;
- provision of 80 jobs in the study area;
- retail uses present with one-half-mile radius of project's center;
- 10 intersections per square mile;
- 100% of streets with sidewalks on one side;
- 50% of streets with sidewalks on both sides;
- 30% of collectors and arterials with bike lanes, or where suitable, direct parallel routes exist;
- 15% of housing units deed restricted below market rate;
- 20% energy efficiency increase beyond Title 24; and
- 100% of landscape maintenance equipment electrically powered and electrical outlets in front and rear of units.

Example Project Methodology and Mitigation

Table 12 –Residential Projects Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	URBEMIS (EMFAC emission factors)	MM T-3→MM T-8, MM T-10→ MM T-14, MM T-16, MM T-19→ MM T-21 MM D-2→MM D-8, MM D-10→ MM D-15, MM D-17 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	URBEMIS	MM D-13→MM D-15, MM D-17 MM E-1→MM E-8, MM E-10, MM E-12→MM E-23 MM S-1→MM S-2 MM M-1→MM M-2
Indirect Emissions		
Energy Consumption	CCAR GRP & CEC	

Table 13 –Commercial Projects Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	URBEMIS (EMFAC emission factors)	MM T-1→MM T-2, MM T-4→ MM T-15, MM T-17→MM T-21 MM D-1→MM D-3, MM D-5→ MM D-6, MM D-10, MM D-12, MM D-14→MM D-17 MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	URBEMIS	MM D-14→MM D-17 MM E-1, MM E-4→MM E-13, MM E-16→MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Indirect Emissions		
Energy Consumption	CCAR GRP & CEC	

Table 14 –Specific Plans Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MM T-1→MM T-21 MM D-1→MM D-12, MM D-18→ MM D-19 MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MM D-13→MM D-19 MM E-1→MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Indirect Emissions		
Energy Consumption	Short-term: CCAR GRP & CEC. Long-term: I-PLACE^{3}S/CTG SCM	

General Plans

- Include a general plan policy to reduce emissions within planning area to a level consistent with legislative requirements.
- Implementation strategies include preparation of a GHG reduction plan.
- Projects consistent with a general plan could be responsible for complying with such a policy.

Table 15 –General Plans Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors).	MS G-1 MM G-15
Mobile Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MS G-1 MS G-2→MS C-7, MS G-9, MS G-12, MS-13→MS-14, MS-16→MS-23
Area Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MS G-1 MS G-8→MS C-11, MS G-134, MS G-12, MS-15, MS-17, MS-22
Indirect Emissions		
Energy Consumption	Short-term: CCAR GRP & CEC. Long-term: I-PLACE^{3}S/CTG SCM	

Other Project Types

Air District Rules and Regulations

Air district rules and regulations could have the potential to increase or decrease GHG emissions within the respective jurisdiction. In general, air district rules and regulations act to decrease criteria air pollutant or toxic air contaminant emissions, which would usually act to reduce GHG emissions simultaneously. However, this may not always be the case and air district rules and regulations could address emissions from a large variety of different source types. Reductions of GHG emissions associated with implementation of applicable mitigation, which could also vary greatly, would need to be evaluated on a case-by-case basis. However, once applicable mitigation measures are identified, percent reductions based on the best available research to date, such as those specified in Table 15, could be applied to determine mitigated emissions.

Air Quality Plans

Similarly to air district rules and regulations, air quality plans could have the potential to increase or decrease GHG emissions because of criteria air pollutant reduction strategies. In general, strategies implemented by air districts to reduce criteria air pollutants also act to reduce GHG emissions. However, this may not always be the case. Reductions of GHG emissions associated with implementation of applicable mitigation would need to be evaluated on a case-by-case basis. The methodology identified above for determining whether the strategies contained within the GHG reduction plan would adhere to the level specified in general plan policy could also be used to determine the reductions associated with CAP strategies.

Regional Transportation Plans

Regional transportation plans and reductions of GHG emissions associated with implementation of applicable mitigation would also need to be evaluated on a case-by-case basis to determine if a net increase or decrease in GHG emissions would occur. Complex interactions between the roadway network, operating conditions, alternative transportation availability (such as public transit, bicycle pathways, and pedestrian infrastructure), and many other independent parameters specific to a region should be considered. EMFAC 2007 can be used with VMT from the RTP to create an inventory of GHG emissions. Reductions associated with implementation of applicable measures contained in Table 16 could be accomplished by accounting for VMT reductions in the traffic model.

Many states, counties, and cities have developed policies and regulations concerning greenhouse gas emissions that seek to require or promote reductions in GHG emissions through standards for vehicle emissions, fuels, electricity production/renewables, building efficiency, and other means. However, we could only identify three public agencies in the United States that are considering formally requiring the analysis of greenhouse gas emissions and climate change for development projects during their associated environmental processes. There may be others, but they were not identified during research conducted during preparation of this paper.

The following is a summary of those three efforts.

Commonwealth of Massachusetts - MEPA Greenhouse Gas Emissions Policy and Protocol

The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) has determined that the phrase "damage to the environment" as used in the Massachusetts Environmental Policy Act (MEPA) includes the emission of greenhouse gases caused by projects subjects to MEPA Review. EEA has published a Greenhouse Gas Emissions Policy (GGEP) to fulfill the statutory obligation to take all feasible measurers to avoid, minimize or mitigate damage to the environment.

The GGEP concerns the following projects only:

- The Commonwealth or a state agency is the proponent;
- The Commonwealth or a state agency is providing financial assistance;
- The project is privately funded, but requires an Air Quality Permit from the department of Environmental Protection;
- The project is privately funded, but will generate:
    - 3,000 or more new vehicle trips per day for office projects;
    - 6,000 or more new vehicle trips per day for mixed use projects that are 25% or more office space; or
    - 10,000 or more new vehicle trips per day for other projects.

As a comparison, the trip generation amounts correspond as follows:

- 3,000 vehicle trips per day = approximately 250,000 square foot office development;
- 6,000 or more new vehicle trips per day for mixed use projects that are 25% or more office space = if 25% office space, then equivalent to approximately 130,000 square feet of office and either 100,000 square feet of retail or 450 single-family residential units or some combination thereof.
- 10,000 or more new vehicle trips per day = approximately 1,000 single family residential units or 250,000 square feet retail.

The draft policy states it is not intended to create a numerical GHG emission limit or a numerical GHG emissions reduction target, but rather to ensure that project proponents and reviewers have considered the GHG emissions impacts of their projects and taken all feasible means and measure to reduce those impacts.

The draft policy notes that some projects within these categories will have little or no greenhouse gas emission and the policy will not apply to such projects. EEA intends to identify in the scoping certificate whether a project falls within this *de minimis* exception.

The GGEP requires qualifying projects to do the following:

- to quantify their GHG emissions;
- identify measures to minimize or mitigate such emissions;
- quantify the reduction in emissions and energy savings from mitigation.

Emissions inventories are intended to focus on carbon dioxide, but analysis of other GHGs may be required for certain projects. EEA will require analysis of direct GGH emissions and indirect (electricity and transportation) emissions. The GGEP references the protocols prepared by the World Resource Institute as guidance for inventory preparation.

The policy is still in draft form, but the comment period closed on August 10, 2007.

King County, Washington - Executive Order on the Evaluation of Climate Change Impacts through the State Environmental Policy Act (SEPA)

On June 27, 2007, the King County Executive Ron Sims directed all King County Departments, as follows:

> *"…effective September 1, 2007 to require that climate impacts, including, but not limited to those pertaining to greenhouse gases, be appropriately identified and evaluated when such Departments are acting as the lead agency in reviewing the environmental impacts of private or public proposals pursuant to the State Environmental Policy Act".*

The Executive Order does not define what a "climate impact" is. Based on statements of the County Deputy Chief of Staff[*]

- County agencies will ask project proponents to supply information on transportation, energy usage and other impacts of proposed projects using the County's existing SEPA checklist.

[*] Marten Law Group: Environmental News, August 1, 2007, "King County (WA) First in Nation to Require Climate Change Impacts to be Considered During Environmental Review of New Projects".

- There is no current plan to require project proponents to take action to mitigate the impacts identifies.
- Development of emissions thresholds and mitigation requirements will be undertaken in connection with the County's upcoming 2008 update of its Comprehensive Plan.

Sacramento Metropolitan Air Quality Management District

The Sacramento Metropolitan Air Quality Management District released an interim guidance on addressing climate change in CEQA documents on September 6, 2007. While very general in nature, the District recommends that CEQA environmental documents include a discussion of anticipated GHG emissions during both the construction and operation phases of the project. This includes assessing the GHG emissions from projects (using readily available models) to determine whether a project may have a significant impact. If so, then the District recommends addressing all of the District's GHG mitigation measures (drawn from comments made by the California Attorney General) – with explanations on how the mitigation will be implemented or providing rationale for why a measure would be considered infeasible. The District provides assistance to agencies in their analysis of GHG emissions and the applicability of specific mitigation measures. The District's guidance can be found at: http://64.143.64.21/climatechange/ClimateChangeCEQAguidance.pdf

Mendocino Air Quality Management District – CEQA Guidelines

The Mendocino AQMD updated its "Guidelines for Use During Preparation of Air Quality Impacts in EIRs or Mitigated Negative Declarations" in May 2007. The guidelines call for preparing estimates of the increased emissions of air contaminations (including GHG) for projects.

The guidelines state that GHG emissions should be presumed to have a significant impact if CO emissions from District-approved modeling exceed either of the following:

- 80% of the level defined as significant for stationary sources in Regulation1, Rule 130 (s2) of the District (which is 550 lbs/day for CO, meaning a threshold of 440 lbs/day for CO for stationary sources); or
- levels established in District Regulation 1 Rule 130 (i2) for indirect sources (which is 690 lbs/day for CO for indirect sources).

If an average passenger vehicle emits 22 grams of CO/mile and 0.8 lb/mile of CO_2, then the 690-lb/day threshold for CO corresponds to approximately 11,400 lb/day CO_2 threshold for passenger vehicle-related emissions. If one assumes that the average passenger vehicle goes 12,500 miles/year (about 35 miles/day), then this is a threshold equivalent to about 420 vehicles. Using an average in California of about 1.77 vehicles/household, this would correspond to about 250 households/dwelling units.

Appendix A

Relevant Citations

Citations from the Public Resources Code (Division 13, §21000 et seq.) as amended through January 1, 2005.

Public Resources Code – Section 21004, MITIGATING OR AVOIDING A SIGNIFICANT EFFECT; POWERS OF PUBLIC AGENCY:

"In mitigating or avoiding a significant effect of a project on the environment, a public agency may exercise only those express or implied powers provided by law other than this division. However, a public agency may use discretionary powers provided by such other law for the purpose of mitigating or avoiding a significant effect on the environment subject to the express or implied constraints or limitations that may be provided by law."

Public Resources Code – Section 21082.2, SIGNIFICANT EFFECT ON ENVIRONMENT; DETERMINATION; ENVIRONMENTAL IMPACT REPORT PREPARATION:

(a) The lead agency shall determine whether a project may have a significant effect on the environment based on substantial evidence in light of the whole record.

(b) The existence of public controversy over the environmental effects of a project shall not require preparation of an environmental impact report if there is no substantial evidence in light of the whole record before the lead agency that the project may have a significant effect on the environment.

(c) Argument, speculation, unsubstantiated opinion or narrative, evidence which is clearly inaccurate or erroneous, or evidence of social or economic impacts which do not contribute to, or are not caused by, physical impacts on the environment, is not substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion supported by facts.

(d) If there is substantial evidence, in light of the whole record before the lead agency, that a project may have a significant effect on the environment, an environmental impact report shall be prepared.

(e) Statements in an environmental impact report and comments with respect to an environmental impact report shall not be deemed determinative of whether the project may have a significant effect on the environment.

Citations from the Guidelines for California Environmental Quality Act, CCR, Title 14, Division 6 (§15000 et seq.) as amended through July 27, 2007.

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

State CEQA Guidelines – Section 15064, DETERMINING THE SIGNIFICANCE OF THE ENVIRONMENTAL EFFECTS CAUSED BY A PROJECT:

(a) Determining whether a project may have a significant effect plays a critical role in the CEQA process.

(1) If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, the agency shall prepare a draft EIR.

(2) When a final EIR identifies one or more significant effects, the Lead Agency and each Responsible Agency shall make a finding under Section 15091 for each significant effect and may need to make a statement of overriding considerations under Section 15093 for the project.

(b) The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data. An ironclad definition of significant effect is not always possible because the significance of an activity may vary with the setting. For example, an activity which may not be significant in an urban area may be significant in a rural area.

(c) In determining whether an effect will be adverse or beneficial, the Lead Agency shall consider the views held by members of the public in all areas affected as expressed in the whole record before the lead agency. Before requiring the preparation of an EIR, the Lead Agency must still determine whether environmental change itself might be substantial.

(d) In evaluating the significance of the environmental effect of a project, the Lead Agency shall consider direct physical changes in the environment which may be caused by the project and reasonably foreseeable indirect physical changes in the environment which may be caused by the project.

(1) A direct physical change in the environment is a physical change in the environment which is caused by and immediately related to the project. Examples of direct physical changes in the environment are the dust, noise, and traffic of heavy equipment that would result from construction of a sewage treatment plant and possible odors from operation of the plant.

(2) An indirect physical change in the environment is a physical change in the environment which is not immediately related to the project, but which is caused indirectly by the project. If a direct physical change in the environment in turn causes another change in the environment, then the other change is an indirect physical change in the environment. For example, the construction of a new sewage treatment plant may facilitate population growth in the service area due to the increase in sewage treatment capacity and may lead to an increase in air pollution.

(3) An indirect physical change is to be considered only if that change is a reasonably foreseeable impact which may be caused by the project. A change which is speculative or unlikely to occur is not reasonably foreseeable.

(e) Economic and social changes resulting from a project shall not be treated as significant effects on the environment. Economic or social changes may be used, however, to determine that a physical change shall be regarded as a significant effect on the environment. Where a physical change is caused by economic or social effects of a

project, the physical change may be regarded as a significant effect in the same manner as any other physical change resulting from the project. Alternatively, economic and social effects of a physical change may be used to determine that the physical change is a significant effect on the environment. If the physical change causes adverse economic or social effects on people, those adverse effects may be used as a factor in determining whether the physical change is significant. For example, if a project would cause overcrowding of a public facility and the overcrowding causes an adverse effect on people, the overcrowding would be regarded as a significant effect.

(f) The decision as to whether a project may have one or more significant effects shall be based on substantial evidence in the record of the lead agency.

(1) If the lead agency determines there is substantial evidence in the record that the project may have a significant effect on the environment, the lead agency shall prepare an EIR (Friends of B Street v. City of Hayward (1980) 106 Cal.App.3d 988). Said another way, if a lead agency is presented with a fair argument that a project may have a significant effect on the environment, the lead agency shall prepare an EIR even though it may also be presented with other substantial evidence that the project will not have a significant effect (No Oil, Inc. v. City of Los Angeles (1974) 13 Cal.3d 68).

(2) If the lead agency determines there is substantial evidence in the record that the project may have a significant effect on the environment but the lead agency determines that revisions in the project plans or proposals made by, or agreed to by, the applicant would avoid the effects or mitigate the effects to a point where clearly no significant effect on the environment would occur and there is no substantial evidence in light of the whole record before the public agency that the project, as revised, may have a significant effect on the environment then a mitigated negative declaration shall be prepared.

(3) If the lead agency determines there is no substantial evidence that the project may have a significant effect on the environment, the lead agency shall prepare a negative declaration (Friends of B Street v. City of Hayward (1980) 106 Cal.App. 3d 988).

(4) The existence of public controversy over the environmental effects of a project will not require preparation of an EIR if there is no substantial evidence before the agency that the project may have a significant effect on the environment.

(5) Argument, speculation, unsubstantiated opinion or narrative, or evidence that is clearly inaccurate or erroneous, or evidence that is not credible, shall not constitute substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion support by facts.

(6) Evidence of economic and social impacts that do not contribute to or are not caused by physical changes in the environment is not substantial evidence that the project may have a significant effect on the environment.

(7) The provisions of sections 15162, 15163, and 15164 apply when the project being analyzed is a change to, or further approval for, a project for which an EIR or negative declaration was previously certified or adopted (e.g. a tentative subdivision, conditional use permit). Under case law, the fair argument standard does not apply to determinations of significance pursuant to sections 15162, 15163, and 15164.

(g) After application of the principles set forth above in Section 15064(f)(g), and in marginal cases where it is not clear whether there is substantial evidence that a project may have a significant effect on the environment, the lead agency shall be guided by the following principle: If there is disagreement among expert opinion supported by facts

over the significance of an effect on the environment, the Lead Agency shall treat the effect as significant and shall prepare an EIR.
(h)(1) When assessing whether a cumulative effect requires an EIR, the lead agency shall consider whether the cumulative impact is significant and whether the effects of the project are cumulatively considerable. An EIR must be prepared if the cumulative impact may be significant and the project's incremental effect, though individually limited, is cumulatively considerable. "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.
(2) A lead agency may determine in an initial study that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and thus is not significant. When a project might contribute to a significant cumulative impact, but the contribution will be rendered less than cumulatively considerable through mitigation measures set forth in a mitigated negative declaration, the initial study shall briefly indicate and explain how the contribution has been rendered less than cumulatively considerable.
(3) A lead agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project will comply with the requirements in a previously approved plan or mitigation program which provides specific requirements that will avoid or substantially lessen the cumulative problem (e.g., water quality control plan, air quality plan, integrated waste management plan) within the geographic area in which the project is located. Such plans or programs must be specified in law or adopted by the public agency with jurisdiction over the affected resources through a public review process to implement, interpret, or make specific the law enforced or administered by the public agency. If there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding that the project complies with the specified plan or mitigation program addressing the cumulative problem, an EIR must be prepared for the project.
(4) The mere existence of significant cumulative impacts caused by other projects alone shall not constitute substantial evidence that the proposed project's incremental effects are cumulatively considerable.

State CEQA Guidelines – Section 15130, DISCUSSION OF CUMULATIVE IMPACTS:
(a)(3). "An EIR may determine that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and thus is not significant. A project's contribution is less than cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact. The lead agency shall identify facts and analysis supporting its conclusion that the contribution will be rendered less than cumulatively considerable.

State CEQA Guidelines – Section 15064.7, THRESHOLDS OF SIGNIFICANCE:
"Each public agency is encouraged to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is an identifiable quantitative, qualitative or performance level

of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which means the effect normally will be determined to be less than significant."

Appendix B

Mitigation Measure Summary

Table 16
Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Transportation								
Bicycle/Pedestrian/Transit Measures								
MM T-1: Bike Parking	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	1%-5%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates combined reductions among individual measures (e.g., 2.5% reduction for all bicycle-related measures and one-quarter of 2.5% for each individual measure) (TIAX 2005, EDAW 2006, SMAQMD 2007). VTPI presents % reductions for showers and combined measures in the TDM encyclopedia (VTPI	Yes: Lockers ($1,200-$2,950, $700/bike on average), Racks ($70-$2,000, $70/bike on average).	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	Caltrans, Portland Bicycle Master Plan (City of Portland 1998), CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Nonresidential projects provide plentiful short- and long-term bicycle parking facilities to meet peak season maximum demand (e.g., one bike rack space per 20 vehicle/employee parking spaces.
MM T-2: End of Trip Facilities	LD (C, M), I, SP, TP, AQP, RR, P/Mobile		Yes	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Nonresidential projects provide "end-of-trip" facilities including showers, lockers, and changing space (e.g., four clothes lockers and one shower provided for every 80 employee parking spaces, separate facilities for each gender for projects with 160 or more employee parking spaces).
MM T-3: Bike-Parking at Multi-	LD (R, M), SP, AQP, RR,		Yes: Lockers ($1,200-	Yes (Caltrans 2005,	Yes (Caltrans	Adverse: No Beneficial:		Long-term bicycle parking is provided at apartment

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Unit Residential	P/Mobile	2007). JSA bases estimates on CCAP information (JSA 2004).	$2,950, $700/bike on average), Racks ($70-$2,000, $70/bike on average).	Dierkers et al. 2007, VTPI 2007)	2005, Dierkers et al. 2007, VTPI 2007)	CAPs, TACs		complexes or condominiums without garages (e.g., one long-term bicycle parking space for each unit without a garage). Long-term facilities shall consist of one of the following: a bicycle locker, a locked room with standard racks and access limited to bicyclists only, or a standard rack in a location that is staffed and/or monitored by video surveillance 24 hours per day.
MM T-4: Proximity to Bike Path/Bike Lanes	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile		Yes	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Entire project is located within one-half mile of an existing/planned Class I or Class II bike lane and project design includes a comparable network that connects the project uses to the existing offsite facility. Project design includes a designated bicycle route connecting all units, on-site bicycle parking facilities, offsite bicycle facilities, site entrances, and primary building entrances to existing Class I or Class II bike lane(s) within one-half mile. Bicycle route connects to all streets contiguous with project site. Bicycle route has minimum conflicts with automobile parking and circulation

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Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								facilities. All streets internal to the project wider than 75 feet have Class II bicycle lanes on both sides.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-5: Pedestrian Network	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-10%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates 1% for each individual measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	The project provides a pedestrian access network that internally links all uses and connects to all existing/planned external streets and pedestrian facilities contiguous with the project site. Project design includes a designated pedestrian route interconnecting all internal uses, site entrances, primary building entrances, public facilities, and adjacent uses to existing external pedestrian facilities and streets. Route has minimal conflict with parking and automobile circulation facilities. Streets (with the exception of alleys) within the project have sidewalks on both sides. All sidewalks internal and adjacent to project site are minimum of five feet wide. All sidewalks feature vertical curbs. Pedestrian facilities and improvements such as grade separation, wider sidewalks, and traffic calming are implemented wherever feasible to minimize pedestrian barriers. All site entrances provide pedestrian access.
MM T-6: Pedestrian	LD (R, C, M), I, SP, TP,		Yes	Yes (Dierkers et al. 2007,	Yes (Dierkers et	Adverse: No Beneficial:		Site design and building placement minimize barriers to

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Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Barriers Minimized	AQP, RR, P/Mobile			VTPI 2007)	al. 2007, VTPI 2007)	CAPs, TACs		pedestrian access and interconnectivity. Physical barriers such as walls, berms, landscaping, and slopes between residential and nonresidential uses that impede bicycle or pedestrian circulation are eliminated.
MM T-7: Bus Shelter for Existing/Planned Transit Service	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-2%/High: CCAP presents these % reductions (Dierkers et al., 2007). SMAQMD assigns from .25%-1%, depending on headway frequency (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes: $15,000-$70,000.	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, City of Calgary (City of Calgary 2004), CA air quality management and control districts, and cities/counties.	Bus or streetcar service provides headways of one hour or less for stops within one-quarter mile; project provides safe and convenient bicycle/pedestrian access to transit stop(s) and provides essential transit stop improvements (i.e., shelters, route information, benches, and lighting).

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Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-8: Traffic Calming	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-10%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates .25%-1.0% for each individual measure depending on percent of intersections and streets with improvements (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Project design includes pedestrian/bicycle safety and traffic calming measures in excess of jurisdiction requirements. Roadways are designed to reduce motor vehicle speeds and encourage pedestrian and bicycle trips by featuring traffic calming features. All sidewalks internal and adjacent to project site are minimum of five feet wide. All sidewalks feature vertical curbs. Roadways that converge internally within the project are routed in such a way as to avoid "skewed intersections;" which are intersections that meet at acute, rather than right, angles. Intersections internal and adjacent to the project feature one or more of the following pedestrian safety/traffic calming design techniques: marked crosswalks, count-down signal timers, curb extensions, speed tables, raised crosswalks, raised intersections, median islands, tight corner radii, and roundabouts or mini-circles. Streets internal and adjacent to the project feature pedestrian safety/traffic calming measures such as on-street parking, planter strips with street trees,

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								and chicanes/chokers (variations in road width to discourage high-speed travel).
Parking Measures								
MM T-9: Paid Parking (Parking Cash Out)	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a range of 1.0%-7.2%, depending on cost/day and distance to transit (TIAX 2005, EDAW 2006, SMAQMD 2007). Shoupe presents a 21% reduction [$5/day for commuters to downtown LA, with elasticity of -0.18 (e.g., if price increases 10%, then solo driving goes down by 1.8% more)] (Shoupe 2005). Urban Transit Institute	Yes: Vary by location and project size.	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Project provides employee and/or customer paid parking system. Project must have a permanent and enforceable method of maintaining user fees for all parking facilities. The facility may not provide customer or employee validations. Daily charge for parking must be equal to or greater than the cost of a transit day/monthly pass plus 20%.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
		presents a range of 1%-10% reduction in trips to central city sites, and 2%-4% in suburban sites (VTPI 2007).						
MM T-10: Minimum Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a maximum of 6% (Nelson/Nygaard Consulting Associates, 2005, TIAX 2005, EDAW 2006).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007), Note that in certain areas of the state, the minimum parking required by code is greater than the peak period parking demand for most land uses. Simply meeting minimum code requirements in these areas would not result in an emissions reduction.	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, Governor's Office of Smart Growth (Annapolis, Maryland) (Zimbler), CA air quality management and control districts, and cities/counties.	Provide minimum amount of parking required. Once land uses are determined, the trip reduction factor associated with this measure can be determined by utilizing the ITE parking generation publication. The reduction in trips can be computed as shown below by the ratio of the difference of minimum parking required by code and ITE peak parking demand to ITE peak parking demand for the land uses multiplied by 50%. Percent Trip Reduction = 50 * [(min parking required by code – ITE peak parking demand)/ (ITE peak parking demand)]

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MM T-11: Parking Reduction Beyond Code/Shared Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a maximum of 12% (Nelson/Nygaard, 2005, TIAX 2005, EDAW 2006).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Provide parking reduction less than code. This measure can be readily implemented through a shared parking strategy, wherein parking is utilized jointly among different land uses, buildings, and facilities in an area that experience peak parking needs at different times of day and day of the week.
MM T-12: Pedestrian Pathway Through Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-4%/Moderate: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates 0.5% reduction for this measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Provide a parking lot design that includes clearly marked and shaded pedestrian pathways between transit facilities and building entrances.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-13: Off - Street Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-4%/Moderate: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates a range of 0.1%-1.5% for this measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Parking facilities are not adjacent to street frontage.
MM T-14: Parking Area Tree Cover	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	Annual net CO_2 reduction of 3.1 kg/m^2 canopy cover/Moderate (McPherson 2001).	Yes: $19 per new tree for CA, cost varies for maintenance, removal and replacement (McPherson 2001).	Yes	Yes	Adverse: VOCs Beneficial: CAPs, TACs	AG, State of CA Department of Justice (Goldberg 2007) and cities/counties (e.g., parking lot ordinances in Sacramento, Davis, and Los Angeles, CA).	Provide parking lot areas with 50% tree cover within 10 years of construction, in particular low emitting, low maintenance, native drought resistant trees. Reduces urban heat island effect and requirement for air conditioning, effective when combined with other measures (e.g., electrical maintenance equipment and reflective paving material).
MM T-15: Valet Bicycle Parking	LD (C, M), SP, AQP, TP, RR, P/Mobile	NA/Low	Yes	Yes	Yes: Raley Field (Sacramento, CA)	Adverse: No Beneficial: CAPs, TACs	Raley Field (Sacramento, CA).	Provide spaces for the operation of valet bicycle parking at community event "centers" such as amphitheaters, theaters, and stadiums.
MM T-16: Garage Bicycle Storage	LD (R, M), SP, AQP, TP, RR, P/Mobile	NA/Low	Yes: Less than $200/multiple bike rack.	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	City of Fairview, OR	Provide storage space in one-car garages for bicycles and bicycle trailers.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-17: Preferential Parking for EVs/CNG Vehicles	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	USGBC, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Provide preferential parking space locations for EVs/CNG vehicles.
MM T-18: Reduced/No Parking Fee for EVs/CNG Vehicles	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	Hotels (e.g., Argonaut in San Francisco, CA)	Provide a reduced/no parking fee for EVs/CNG vehicles.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Miscellaneous Measure								
MM T-19: TMA Membership	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-28%/High: CCAP presents a range of 3%-25% for TDMs with complementary transit and land use measures (Dierkers et al. 2007). VTPI presents a range of 6%-7% in the TDM encyclopedia (VTPI 2007). URBEMIS offers a 2%-10% range in reductions for a TDM that has 5 elements that are pedestrian and transit friendly and 1%-5% for 3 elements. SMAQMD presents a reduction of 5% (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Include permanent TMA membership and funding requirement. Funding to be provided by Community Facilities District or County Service Area or other nonrevocable funding mechanism. TDMs have been shown to reduce employee vehicle trips up to 28% with the largest reductions achieved through parking pricing and transit passes. The impact depends on the travel alternatives.
MM T-20: ULEV	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes: Higher than corresponding gasoline models.	Yes	Yes: Fueling stations might not be readily available depending on location. More than 900 E85 fueling	Adverse: No Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Use of and/or provide ULEV that are 50% cleaner than average new model cars (e.g., natural gas, ethanol, electric).

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
					stations in the U.S., 5 in CA. Vehicles available in select regions only			
MM T-21: Flex Fuel Vehicles	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	5466.97 lb GHG/year/Low (DOE Fuel Economy)	Yes: E85 costs less than gasoline per gallon, but results in lower fuel economy.	Yes	Yes: More than 900 E85 fueling stations in the U.S., 5 in CA. Vehicles available in select regions only	Adverse: Yes Issues with the energy intensive ethanol production process (e.g., wastewater treatment requirements). Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., SJVAPCD).	Use of and/or provide vehicles that utilize gasoline/ethanol blends (e.g., E85).
Design								
Commercial & Residential Building Design Measures								
MM D-1: Office/Mixed Use Density	LD (C, M), SP, TP, AQP, RR, P/Mobile	0.05%-2%/Moderate: This range is from SMAQMD, depending	Yes	Yes (VTPI 2007)	Yes (VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties	Project provides high density office or mixed-use proximate to transit. Project must provide

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		on FAR and headway frequencies (Nelson/Nygaard Consulting Associates 2005, EDAW 2006, SMAQMD 2007).					(e.g., SMAQMD).	safe and convenient pedestrian and bicycle access to all transit stops within one-quarter mile.
MM D-2: Orientation to Existing/Planned Transit, Bikeway, or Pedestrian Corridor	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	0.4%-1%/Moderate: CCAP attributes a 0.5% reduction per 1% improvement in transit frequency (Dierkers et al. 2007). SMAQMD presents a range of 0.25%-5% (JSA 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007)	Yes (Dierkers et al. 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project is oriented towards existing transit, bicycle, or pedestrian corridor. Setback distance between project and existing or planned adjacent uses is minimized or nonexistent. Setback distance between different buildings on project site is minimized. Setbacks between project buildings and planned or existing sidewalks are minimized. Buildings are oriented towards existing or planned street frontage. Primary entrances to buildings are located along planned or existing public street frontage. Project provides bicycle access to any planned bicycle corridor(s). Project provides pedestrian access to any planned pedestrian corridor(s).
MM D-3: Services Operational	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	0.5%-5%/Moderate	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides on-site shops and services for employees.

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MM D-4: Residential Density (Employ Sufficient Density for New Residential Development to Support the Use of Public Transit)	LD (R, M), SP, TP, AQP, RR, P/Mobile	1%-40%/High: #7, EPA presents a range of 32%-40% (EPA 2006). SMAQMD presents a range of 1%-12% depending on density and headway frequencies (Nelson/Nygaard Consulting Associates 2005, JSA 2005, EDAW 2006, SMAQMD 2007). Nelson/Nygaard presents a trip reduction formula: Trip Reduction = 0.6*(1-(19749*((4.814+ households per residential acre)/(4.814+7.14))^-06.39)/25914).	Yes	Yes (VTPI 2007, Holtzclaw 2007)	Yes (VTPI 2007, Holtzclaw 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides high-density residential development. Transit facilities must be within one-quarter mile of project border. Project provides safe and convenient bicycle/pedestrian access to all transit stop(s) within one-quarter mile of project border.
MM D-5: Street Grid	LD (R, C, M), I, SP, TP, AQP, RR,	1%/Moderate: SMAQMD presents this % reduction (JSA	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007,	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties	Multiple and direct street routing (grid style). This measure only applies to projects

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	P/Mobile	2005, EDAW 2006, SMAQMD 2007).			VTPI 2007)		(e.g., SMAQMD).	with an internal CF >/= 0.80, and average of one-quarter mile or less between external connections along perimeter of project. [CF= # of intersections / (# of cul-de-sacs + intersections)]. Cul-de-sacs with bicycle/pedestrian through access may be considered "complete intersections" when calculating the project's internal connectivity factor. External connections are bike/pedestrian pathways and access points, or streets with safe and convenient bicycle and pedestrian access that connect the project to adjacent streets, sidewalks, and uses. If project site is adjacent to undeveloped land; streets, pathways, access points, and right-of-ways that provide for future access to adjacent uses may count for up to 50% of the external connections. Block perimeter (the sum of the measurement of the length of all block sides) is limited to no more than 1,350 feet. Streets internal to the project should connect to streets external to the project whenever possible.

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MM D-6: NEV Access	LD (R, C, M), SP, TP, AQP, RR, P/Mobile	0.5%-1.5%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (Litman 1999, Sperling 1994)	Yes (Litman 1999, Sperling 1994)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Make physical development consistent with requirements for neighborhood electric vehicles. Current studies show that for most trips, NEVs do not replace gas-fueled vehicles as the primary vehicle.
MM D-7: Affordable Housing Component	LD (R, M), SP, TP, AQP, RR, P/Mobile	0.4%-6%/Moderate: SMAQMD presents this % reduction (Nelson/Nygaard Consulting Associates 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Residential development projects of five or more dwelling units provide a deed-restricted low-income housing component on-site (or as defined in the code). Developers who pay into In-Lieu Fee Programs are not considered eligible to receive credit for this measure. The award of emission reduction credit shall be based only on the proportion of affordable housing developed on-site because in-lieu programs simply induce a net increase in development. Percentage reduction shall be calculated according to the following formula:

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								% reduction = % units deed-restricted below market rate housing * 0.04
MM D-8: Recharging Area	LD (R, M), SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Provide residential buildings with a "utility" room or space for recharging batteries, whether for use in a car, electric lawnmower, other electric landscaping equipment, or even batteries for small items such as flashlights.
Mixed-Use Development Measures								
MM D-9: Urban Mixed-Use	LD (M), SP, TP, AQP, RR, P/Mobile	3%-9%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Development of projects predominantly characterized by properties on which various uses, such as office, commercial, institutional, and residential, are combined in a single building or on a single site in an integrated development project with functional interrelationships and a coherent physical design.
MM D-10: Suburban Mixed-Use	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	3%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Have at least three of the following on site and/or offsite within one-quarter mile: Residential Development, Retail Development, Park, Open Space, or Office.
MM D-11: Other Mixed-Use	LD (R, M), SP, TP, AQP, RR, P/Mobile	1%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	All residential units are within one-quarter mile of parks, schools or other civic uses.

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		2006, SMAQMD 2007).						
MM D-12: Infill Development	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	3%-30%/High: Infill development reduces vehicle trips and VMT by 3% and 20%, respectively (Fehr & Peers 2007). CCAP identifies a site level VMT reduction range of 20%-30% (Dierkers et al. 2007).	Yes	Yes (Dierkers et al. 2007)	Yes (Dierkers et al. 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project site is on a vacant infill site, redevelopment area, or brownfield or greyfield lot that is highly accessible to regional destinations, where the destinations rating of the development site (measured as the weighted average travel time to all other regional destinations) is improved by 100% when compared to an alternate greenfield site.
Miscellaneous Measures								
MM D-13: Electric Lawnmower	LD (R, M), SP, AQP, RR, P/Area	1%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Provide a complimentary electric lawnmower to each residential buyer.

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MM D-14: Enhanced Recycling/Waste Reduction, Reuse, Composting	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Low	Yes	Yes	Yes: Association with social awareness.	Adverse: No Beneficial: CAPs, TACs	CIWMB	Provide infrastructure/education that promotes the avoidance of products with excessive packaging, recycle, buying of refills, separating of food and yard waste for composting, and using rechargeable batteries.
MM D-15: LEED Certification	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Moderate	Yes: Receive tax rebates, incentives (e.g., EDAW San Diego office interior remodel cost $1,700,000 for 32,500 square feet) (USGBC 2007)	Yes	Yes: More than 700 buildings of different certifications in CA (USGBC 2007).	Adverse: No Beneficial: CAPs, TACs	USGBC, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.
MM D-16: Retro-Commissioning	LD (C, M), I, SP, AQP, RR, P/Stationary & Area	8%-10% reduction in energy usage/Moderate: (Mills et al. 2004)	Yes: Average $0.28/square feet, varies with building size (Haasl and Sharp 1999).	Yes	Yes: 27 projects underway in CA, 21 more to be completed in 2007, mostly state buildings owned by DGS (DGS 2007).	Adverse: No Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	The process ensures that all building systems perform interactively according to the contract documents, the design intent and the owner's operational needs to optimize energy performance.
MM D-17 Landscaping	LD (R, C, M), I, SP, AQP, RR,	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	Alliance for the Chesapeake Bay, EPA Green Landscaping	Project shall use drought resistant native trees, trees with low emissions and high carbon

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	P/Stationary & Area						Resources	sequestration potential. Evergreen trees on the north and west sides afford the best protection from the setting summer sun and cold winter winds. Additional considerations include the use of deciduous trees on the south side of the house that will admit summer sun; evergreen plantings on the north side will slow cold winter winds; constructing a natural planted channel to funnel summer cooling breezes into the house. Neighborhood CCR's not requiring that front and side yards of single family homes be planted with turf grass. Vegetable gardens, bunch grass, and low-water landscaping shall also be permitted, or even encouraged.
MM D-18: Local Farmers' Market	LD (M), SP/Mobile, Stationary, &	NA/Low	Yes	Yes	Yes: Associated with social	Adverse: No Beneficial: CAPs, TACs	Cities/counties (e.g., Davis, Sacramento)	Project shall dedicate space in a centralized, accessible location for a weekly farmers' market.

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	Area				choice and public awareness.			
MM D-19: Community Gardens	LD (M), SP/Mobile, Stationary, & Area	NA/Low	Yes	Yes	Yes: Associated with social choice and public awareness.	Adverse: No Beneficial: CAPs, TACs	Cities/counties (e.g., Davis)	Project shall dedicate space for community gardens.
Energy Efficiency/Building Component								
MM E-1: High-Efficiency Pumps	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Project shall use high-efficiency pumps.
MM E-2: Wood Burning Fireplaces/Stoves	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low: EDAW 2006	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project does not feature fireplaces or wood burning stoves.
MM E-3: Natural Gas Stove	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low: EDAW 2006	Yes: Cost of stove—$350 (gas) and $360 (electric) same brand, total yearly cost of $42.17 as opposed to $56.65 for electric (Saving Electricity 2006).	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project features only natural gas or electric stoves in residences.

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MM E-4: Energy Star Roof	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	0.5%-1%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes: 866 Energy Star labeled buildings in California (Energy Star 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project installs Energy Star labeled roof materials.
MM E-5: On-site Renewable Energy System	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	1%-3%/Moderate: SMAQMD presents this % reduction (USGBC 2002 and 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides onsite renewable energy system(s). Nonpolluting and renewable energy potential includes solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies. When applying these strategies, projects may take advantage of net metering with the local utility.

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MM E-6: Exceed Title 24	LD (R, C, M), I, GSP, AQP, RR, P/Stationary & Area	1%/Moderate: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (PG&E 2002, SMUD 2006)	Yes (PG&E 2002, SMUD 2006)	Adverse: No Beneficial: CAPs, TACs	PG&E, SMUD, CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project exceeds title 24 requirements by 20%.
MM E-7: Solar Orientation	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	0.5%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project orients 75% or more of homes and/or buildings to face either north or south (within 30° of N/S). Building design includes roof overhangs that are sufficient to block the high summer sun, but not the lower winter sun, from penetrating south facing windows. Trees, other landscaping features and other buildings are sited in such a way as to maximize shade in the summer and maximize solar access to walls and windows in the winter.
MM E-8: Nonroof Surfaces	LD (R, C, M), I, GSP, AQP, RR, P/Stationary & Area	1.0%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Provide shade (within 5 years) and/or use light-colored/high-albedo materials (reflectance of at least 0.3) and/or open grid pavement for at least 30% of the site's nonroof impervious surfaces, including parking lots, walkways, plazas, etc.; OR place a minimum of 50% of parking spaces underground or covered by structured parking; OR use an open-grid pavement system (less than 50% impervious) for a minimum of

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							50% of the parking lot area. The mitigation measure reduces heat islands (thermal gradient differences between developed and undeveloped areas to minimize impact on microclimate and human and wildlife habitats. This measure requires the use of patented or copyright protected methodologies created by the ASTM. The SRI is a measure of the constructed surface's ability to reflect solar heat, as shown by a small rise in temperature. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is "0" and a standard white (reflectance 0.80, emittance 0.90) is 100. To calculate SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980-01. Reflectance is measured

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								according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371. Default values for some materials will be available in the LEED-NC v2.2 Reference Guide.
MM E-9: Low-Energy Cooling	LD (C, M), I, SP, AQP, RR, P/Stationary & Area	1%-10%/Low: EDAW presents this percent reduction range (EDAW 2006).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project optimizes building's thermal distribution by separating ventilation and thermal conditioning systems.
MM E-10: Green Roof	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	1.0%/Moderate: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: Increased Water Consumption Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Install a vegetated roof that covers at least 50% of roof area. The reduction assumes that a vegetated roof is installed on a least 50% of the roof area or that a combination high albedo and vegetated roof surface is installed that meets the following standard: (Area of SRI Roof/0.75)+(Area of vegetated roof/0.5) >= Total Roof Area. Water consumption reduction measures shall be considered in the design of the green roof.
MM E-11: EV Charging Facilities	LD (C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: $500-$5000/ vehicle site (PG&E 1999)	Yes	Yes: 381 facilities in CA (Clean Air Maps 2007).	Adverse: No Beneficial: CAPs, TACs	DOE, EERE, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Project installs EV charging facilities.
MM E-12:	LD (R, C, M),	NA/Low: Increasing	Yes: Light	Yes	Yes: Apply	Adverse: No		Project provides light-colored

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Light-Colored Paving	I, SP, AQP, RR, P/Stationary & Area	the albedo of 1,250 km of pavement by 0.25 would save cooling energy worth $15M per year.	colored aggregates and white cement are more expensive than gray cement. Certain blended cements are very light in color and may reflect similarly to white cement at an equivalent cost to normal gray cement.		natural sand or gravel colored single surface treatments to asphalt (EOE 2007).	Beneficial: CAPs, TACs		paving (e.g., increased albedo pavement).
MM E-13: Cool Roofs	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: 0.75–1.5/square feet coating (EPA 2007a)	Yes	Yes: Over 90% of the roofs in the United States are dark colored	Adverse: No Beneficial: CAPs, TACs	CEC	Project provides cool roofs. Highly reflective, highly emissive roofing materials that stay 50-60°F cooler than a normal roof under a hot summer sun. CA's Cool Savings

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
					(EPA 2007a).			Program provided rebates to building owners for installing roofing materials with high solar reflectance and thermal emittance. The highest rebate went to roofs on air conditioned buildings, while buildings with rooftop ducts and other nonresidential buildings were eligible for slightly less. The program aimed to reduce peak summer electricity demand and was administered by the CEC.
MM E-14: Solar Water Heaters	LD (R, M), SP, AQP, RR, P/Stationary & Area	20%–70% reduction in cooling energy needs/Moderate	Yes: $1675/20 square feet, requires a 50 gallon tank, annual operating cost of $176 (DOE 2007).	Yes	Yes: Based on solar orientation, building codes, zoning ordinances.	Adverse: No Beneficial: CAPs, TACs	Europe	Project provides solar water heaters.
MM E-15: Electric Yard Equipment Compatibility	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: $75–$250/outlet from existing circuit (Cost Helper 2007).	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Project provides electrical outlets at building exterior areas.
MM E-16: Energy Efficient Appliance Standards	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: Varies for each appliance—higher capital costs, lower operating costs (Energy	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Project uses energy efficient appliances (e.g., Energy Star).

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			Star 2007).					
MM E-17: Green Building Materials	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low: 25-30% more efficient on average.	Yes	Yes: BEES software allows users to balance the environmental and economic performance of building products; developed by NIST (NIST 2007).	Yes	Adverse: No Beneficial: CAPs, TACs		Project uses materials which are resource efficient, recycled, with long life cycles and manufactured in an environmentally friendly way.
MM E-18: Shading Mechanisms	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: Up to $450 annual energy savings (Energy Star 2007).	Yes: Higher capital costs, lower operating and maintenance costs (Energy Star 2007).	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing shading mechanisms for windows, porch, patio and walkway overhangs.

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MM E-19: Ceiling/Whole-House Fans	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: 50% more efficient than conventional fans (Energy Star 2007).	Yes: $45-$200/fan, installation extra (Lowe's 2007).	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing ceiling/whole-house fans.
MM E-20: Programmable Thermostats	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: $100 annual savings in energy costs (Energy Star 2007).	Yes: $60/LCD display and 4 settings for typical residential use (Lowe's 2007).	Yes	Yes: Major retail stores.	Adverse: Yes, Mercury Beneficial: CAPs, TACs		Install energy-reducing programmable thermostats that automatically adjust temperature settings.
MM E-21: Passive Heating and Cooling Systems	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low	Yes: $800 (wall heaters) to $4,000+ (central systems)	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing passive heating and cooling systems (e.g., insulation and ventilation).
MM E-22: Day Lighting Systems	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low	Yes: $1,300 to $1,500 depending upon the kind of roof (Barrier 1995), installation extra.	Yes	Yes: Work well only for space near the roof of the building, little benefit in multi-floor buildings.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing day lighting systems (e.g., skylights, light shelves and interior transom windows).
MM E-23: Low-Water Use Appliances	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: Avoided water agency cost for using water-efficient kitchen pre-rinse spray valves of $65.18 per acre-foot.	Yes: Can return their cost through reduction in water consumption,	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Require the installation of low-water use appliances.

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			pumping, and treatment.					
MM E-24: Goods Transport by Rail	LD (C, M), I, SP, AQP, RR, P/Mobile	NA/Moderate	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	ARB Goods Movement Plan (ARB 2007)	Provide a spur at nonresidential projects to use nearby rail for goods movement.
Social Awareness/Education								
MM S-1: GHG Emissions Reductions Education	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Mobile	NA/Low	Yes	Yes	Yes: Similar programs currently exist in CA.	Adverse: No Beneficial: CAPs, TACs		Provide local governments, businesses, and residents with guidance/protocols/information on how to reduce GHG emissions (e.g., energy saving, food miles).
MM S-2: School Curriculum	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Mobile	NA/Low	Yes	Yes	Yes: Similar programs currently exist in CA.	Adverse: No Beneficial: CAPs, TACs		Include how to reduce GHG emissions (e.g., energy saving, food miles) in the school curriculum.
Construction								
MM C-1: ARB-Certified Diesel Construction Equipment	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes: Oxidation Catalysts, $1,000-	Yes	Yes	Adverse: Yes, NO_x Beneficial: CAPs, TACs	AG, EPA, ARB, and CA air quality management and pollution control districts.	Use ARB-certified diesel construction equipment. Increases CO_2 emissions when trapped CO and carbon particles

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			$2,000. DPF, $5000-$10,000; installation extra (EPA 2007b).					are oxidized (Catalyst Products 2007, ETC 2007).
MM C-2: Alternative Fuel Construction Equipment	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: Yes, THC, NO_x Beneficial: CO, PM, SO_x	AG, EPA, ARB, and CA air quality management and pollution control districts.	Use alternative fuel types for construction equipment. At the tailpipe biodiesel emits 10% more CO_2 than petroleum diesel. Overall lifecycle emissions of CO_2 from 100% biodiesel are 78% lower than those of petroleum diesel (NREL 1998, EPA 2007b).
MM C-3: Local Building Materials	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes: Depends on location of building material manufacture sites.	Adverse: No Beneficial: CAPs, TACs		Use locally made building materials for construction of the project and associated infrastructure.
MM C-4: Recycle Demolished Construction Material	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Recycle/Reuse demolished construction material. Use locally made building materials for construction of the project and associated infrastructure.

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Miscellaneous								
MM M-1: Off-Site Mitigation Fee Program	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile & Area	NA/Moderate-High: Though there is currently no program in place, the potential for real and quantifiable reductions of GHG emissions could be high if a defensible fee program were designed.	Yes	Yes	No: Program does not exist in CA, but similar programs currently exist (e.g., Carl Moyer Program, SJVAPCD Rule 9510, SMAQMD Off-Site Construction Mitigation Fee Program).	Adverse: No Beneficial: CAPs, TACs		Provide/Pay into an off-site mitigation fee program, which focuses primarily on reducing emissions from existing development and buildings through retro-fit (e.g., increased insulation).
MM M-2: Offset Purchase	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Area	NA/Low	Yes	Yes	No: ARB has not adopted official program, but similar programs	No		Provide/purchase offsets for additional emissions by acquiring carbon credits or engaging in other market "cap and trade" systems.

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					currently exist.			
Regional Transportation Plan Measures								
MM RTP-1: Dedicate High Occupancy Vehicle (HOV) lanes prior to adding capacity to existing highways.	RTP		Yes	Yes	Yes	Adverse: possible local CO Beneficial: regional CAPs, TACs	Caltrans, local government	Evaluate the trip reduction (and GHG reduction) potential of adding HOV lanes prior to adding standard lanes.
MM RTP-2: Implement toll/user fee programs prior to adding capacity to existing highways.	RTP		Yes	Yes	Yes	Adverse: possible local CO. Beneficial: regional CAPs, TACs	Caltrans	Evaluate price elasticity and associated trip reduction (and GHG reduction) potential with adding or increasing tolls prior to adding capacity to existing highways.

Note:
[1] Where LD (R, C, M) =Land Development (Residential, Commercial, Mixed-Use), I=Industrial, GP=General Plan, SP=Specific Plan, TP=Transportation Plans, AQP=Air Quality Plans, RR=Rules/Regulations, and P=Policy. It is important to note that listed project types may not be directly specific to the mitigation measure (e.g., TP, AQP, RR, and P) as such could apply to a variety of source types, especially RR and P.
[2] This score system entails ratings of high, moderate, and low that refer to the level of the measure to provide a substantive, reasonably certain (e.g., documented emission reductions with proven technologies), and long-term reduction of GHG emissions.
[3] Refers to whether the measure would provide a cost-effective reduction of GHG emissions based on available documentation.
[4] Refers to whether the measure is based on currently, readily available technology based on available documentation.
[5] Refers to whether the measure could be implemented without extraordinary effort based on available documentation.
[6] List is not meant to be all inclusive.
Source: Data complied by EDAW in 2007

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-1: Adopt a GHG reduction plan	GP/ Mobile, Stationary, & Area	City of San Bernardino	- Adopt GHG reduction targets for the planning area, based on the current legislation providing direction for state-wide targets, and update the plan as necessary. -The local government agency should serve as a model by inventorying its GHG emissions from agency operations, and implementing those reduction goals.
Circulation			
MS G-2: Provide for convenient and safe local travel	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Create a gridded street pattern with small block sizes. This promotes walkability through direct routing and ease of navigation. -Maintain a high level of connectivity of the roadway network. Minimize cul-de-sacs and incomplete roadway segments. -Plan and maintain an integrated, hierarchical and multi-modal system of roadways, pedestrian walks, and bicycle paths throughout the area. -Apply creative traffic management approaches to address congestion in areas with unique problems, particularly on roadways and intersections in the vicinity of schools in the morning and afternoon peak hours, and near churches, parks and community centers. -Work with adjacent jurisdictions to address the impacts of regional development patterns (e.g. residential development in surrounding communities, regional universities, employment centers, and commercial developments) on the circulation system. -Actively promote walking as a safe mode of local travel, particularly for children attending local schools. -Employ traffic calming methods such as median landscaping and provision of bike or transit lanes to slow traffic, improve roadway capacity, and address safety issues.
MS G-3: Enhance the regional transportation network and maintain effectiveness	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage the transportation authority to reduce fees for short distance trips. -Ensure that improvements to the traffic corridors do not negatively impact the operation of local roadways and land uses.

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Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			-Cooperate with adjacent jurisdictions to maintain adequate service levels at shared intersections and to provide adequate capacity on regional routes for through traffic. -Support initiatives to provide better public transportation. Work actively to ensure that public transportation is part of every regional transportation corridor. - Coordinate the different modes of travel to enable users to transfer easily from one mode to another. -Work to provide a strong paratransit system that promotes the mobility of all residents and educate residents about local mobility choices. - Promote transit-oriented development to facilitate the use of the community's transit services.
MS G-4: Promote and support an efficient public transportation network connecting activity centers in the area to each other and the region.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Promote increased use of public transportation and support efforts to increase bus service range and frequency within the area as appropriate. -Enhance and encourage provision of attractive and appropriate transit amenities, including shaded bus stops, to encourage use of public transportation. -Encourage the school districts, private schools and other operators to coordinate local bussing and to expand ride-sharing programs. All bussing options should be fully considered before substantial roadway improvements are made in the vicinity of schools to ease congestion.
MS G-5: Establish and maintain a comprehensive system, which is safe and convenient, of pedestrian ways and bicycle routes that provide viable options to travel by automobile.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Improve area sidewalks and rights-of-way to make them efficient and appealing for walking and bicycling safely. Coordinate with adjacent jurisdictions and regional agencies to improve pedestrian and bicycle trails, facilities, signage, and amenities. -Provide safe and convenient pedestrian and bicycle connections to and from town centers, other commercial districts, office complexes, neighborhoods, schools, other major activity centers, and surrounding communities. -Work with neighboring jurisdictions to provide well-designed pedestrian and bicycle crossings of major roadways. -Promote walking throughout the community. Install sidewalks where missing and make improvements

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			to existing sidewalks for accessibility purposes. Particular attention should be given to needed sidewalk improvement near schools and activity centers. -Encourage businesses or residents to sponsor street furniture and landscaped areas. - Strive to provide pedestrian pathways that are well shaded and pleasantly landscaped to encourage use. - Attract bicyclists from neighboring communities to ride their bicycles or to bring their bicycles on the train to enjoy bicycling around the community and to support local businesses. - Meet guidelines to become nationally recognized as a Bicycle-Friendly community. - Provide for an education program and stepped up code enforcement to address and minimize vegetation that degrades access along public rights-of-way. -Engage in discussions with transit providers to increase the number of bicycles that can be accommodated on buses
MS G-6: Achieve optimum use of regional rail transit.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Support regional rail and work with rail authority to expand services. - Achieve better integration of all transit options. -Work with regional transportation planning agencies to finance and provide incentives for multimodal transportation systems. - Promote activity centers and transit-oriented development projects around the transit station.
MS G-7: Expand and optimize use of local and regional bus and transit systems.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage convenient public transit service between area and airports. -Support the establishment of a local shuttle to serve commercial centers. -Promote convenient, clean, efficient, and accessible public transit that serves transit-dependent riders and attracts discretionary riders as an alternative to reliance on single-occupant automobiles.

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			- Empower seniors and those with physical disabilities who desire maximum personal freedom and independence of lifestyle with unimpeded access to public transportation. -Integrate transit service and amenities with surrounding land uses and buildings.
Conservation, Open Space			
MS G-8: Emphasize the importance of water conservation and maximizing the use of native, low-water landscaping.	GP/Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Reduce the amount of water used for landscaping and increase use of native and low water plants. Maximize use of native, low-water plants for landscaping of areas adjacent to sidewalks or other impermeable surfaces. -Encourage the production, distribution and use of recycled and reclaimed water for landscaping projects throughout the community, while maintaining urban runoff water quality objectives. -Promote water conservation measures, reduce urban runoff, and prevent groundwater pollution within development projects, property maintenance, area operations and all activities requiring approval. -Educate the public about the importance of water conservation and avoiding wasteful water habits. -Work with water provider in exploring water conservation programs, and encourage the water provider to offer incentives for water conservation.
MS G-9: Improve air quality within the region.	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Integrate air quality planning with area land use, economic development and transportation planning efforts. -Support programs that reduce air quality emissions related to vehicular travel. -Support alternative transportation modes and technologies, and develop bike- and pedestrian-friendly neighborhoods to reduce emissions associated with automobile use. -Encourage the use of clean fuel vehicles. -Promote the use of fuel-efficient heating and cooling equipment and other appliances, such as water

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Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			heaters, swimming pool heaters, cooking equipment, refrigerators, furnaces, and boiler units. - Promote the use of clean air technologies such as fuel cell technologies, renewable energy sources. UV coatings, and alternative, non-fossil fuels. -Require the planting of street trees along streets and inclusion of trees and landscaping for all development projects to help improve airshed and minimize urban heat island effects. - Encourage small businesses to utilize clean, innovative technologies to reduce air pollution. - Implement principles of green building. - Support jobs/housing balance within the community so more people can both live and work within the community. To reduce vehicle trips, encourage people to telecommute or work out of home or in local satellite offices.
MS G-10: Encourage and maximize energy conservation and identification of alternative energy sources.	GP/ Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage green building designs for new construction and renovation projects within the area. -Coordinate with regional and local energy suppliers to ensure adequate supplies of energy to meet community needs, implement energy conservation and public education programs, and identify alternative energy sources where appropriate. -Encourage building orientations and landscaping that enhance natural lighting and sun exposure. -Encourage expansion of neighborhood-level products and services and public transit opportunities throughout the area to reduce automobile use. - Incorporate the use of energy conservation strategies in area projects. - Promote energy-efficient design features, including appropriate site orientation, use of light color roofing and building materials, and use of evergreen trees and wind-break trees to reduce fuel consumption for heating and cooling.

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			-Explore and consider the cost/benefits of alternative fuel vehicles including hybrid, natural gas, and hydrogen powered vehicles when purchasing new vehicles. -Continue to promote the use of solar power and other energy conservation measures. - Encourage residents to consider the cost/benefits of alternative fuel vehicles. - Promote the use of different technologies that reduce use of non-renewable energy resources. -Facilitate the use of green building standards and LEED in both private and public projects. -Promote sustainable building practices that go beyond the requirements of Title 24 of the California Administrative Code, and encourage energy-efficient design elements, as appropriate. -Support sustainable building practices that integrate building materials and methods that promote environmental quality, economic vitality, and social benefit through the design, construction, and operation of the built environment. - Investigate the feasibility of using solar (photovoltaic) street lights instead of conventional street lights that are powered by electricity in an effort to conserve energy. - Encourage cooperation between neighboring development to facilitate on-site renewable energy supplies or combined heat and power co-generation facilities that can serve the energy demand of contiguous development.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-11: Preserve unique community forests, and provide for sustainable increase and maintenance of this valuable resource.	GP/Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Develop a tree planting policy that strives to accomplish specific % shading of constructed paved and concrete surfaces within five years of construction. -Provide adequate funding to manage and maintain the existing forest, including sufficient funds for tree planting, pest control, scheduled pruning, and removal and replacement of dead trees. -Coordinate with local and regional plant experts in selecting tree species that respect the natural region in which Claremont is located, to help create a healthier, more sustainable urban forest. - Continue to plant new trees (in particular native tree species where appropriate), and work to preserve mature native trees. -Increase the awareness of the benefits of street trees and the community forest through a area wide education effort. -Encourage residents to properly care for and preserve large and beautiful trees on their own private property.
Housing			
MS G-12: Provide affordability levels to meet the needs of community residents.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage development of affordable housing opportunities throughout the community, as well as development of housing for elderly and low and moderate income households near public transportation services. -Ensure a portion of future residential development is affordable to low and very low income households.
Land Use			
MS G-13: Promote a visually-cohesive urban form and establish connections between the urban core and outlying portions of the	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Preserve the current pattern of development that encourages more intense and higher density development at the core of the community and less intense uses radiating from the central core. -Create and enhance landscaped greenway, trail and sidewalk connections between neighborhoods and to commercial areas, town centers, and parks.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
community.			-Identify ways to visually identify and physically connect all portions of the community, focusing on enhanced gateways and unifying isolated and/or outlying areas with the rest of the area. -Study and create a diverse plant identity with emphasis on drought-resistant native species.
MS G-14: Provide a diverse mix of land uses to meet the future needs of all residents and the business community.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Attract a broad range of additional retail, medical, and office uses providing employment at all income levels. -Support efforts to provide beneficial civic, religious, recreational, cultural and educational opportunities and public services to the entire community. -Coordinate with public and private organizations to maximize the availability and use of parks and recreational facilities in the community. -Support development of hotel and recreational commercial land uses to provide these amenities to local residents and businesses.
MS G-15: Collaborate with providers of solid waste collection, disposal and recycling services to ensure a level of service that promotes a clean community and environment.	GP/ Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Require recycling, composting, source reduction and education efforts throughout the community, including residential, businesses, industries, and institutions, within the construction industry, and in all sponsored activities.
MS G-16: Promote construction, maintenance and active use of publicly- and privately-operated parks, recreation programs, and a community center.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Work to expand and improve community recreation amenities including parks, pedestrian trails and connections to regional trail facilities. -As a condition upon new development, require payment of park fees and/or dedication and provision of parkland, recreation facilities and/or multi-use trails that improve the public and private recreation system. -Research options or opportunities to provide necessary or desired community facilities.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-17: Promote the application of sustainable development practices.	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Encourage sustainable development that incorporates green building best practices and involves the reuse of previously developed property and/or vacant sites within a built-up area. - Encourage the conservation, maintenance, and rehabilitation of the existing housing stock. -Encourage development that incorporates green building practices to conserve natural resources as part of sustainable development practices. -Avoid development of isolated residential areas in the hillsides or other areas where such development would require significant infrastructure investment, adversely impact biotic resources. - Provide land area zoned for commercial and industrial uses to support a mix of retail, office, professional, service, and manufacturing businesses.
MS G-18: Create activity nodes as important destination areas, with an emphasis on public life within the community.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide pedestrian amenities, traffic-calming features, plazas and public areas, attractive streetscapes, shade trees, lighting, and retail stores at activity nodes. -Provide for a mixture of complementary retail uses to be located together to create activity nodes to serve adjacent neighborhoods and to draw visitors from other neighborhoods and from outside the area.
MS G-19: Make roads comfortable, safe, accessible, and attractive for use day and night.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide crosswalks and sidewalks along streets that are accessible for people with disabilities and people who are physically challenged. -Provide lighting for walking and nighttime activities, where appropriate. -Provide transit shelters that are comfortable, attractive, and accommodate transit riders.
MS G-20: Maintain and expand where possible the system of neighborhood connections that attach neighborhoods to larger roadways.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Provide sidewalks where they are missing, and provide wide sidewalks where appropriate with buffers and shade so that people can walk comfortably. -Make walking comfortable at intersections through traffic-calming, landscaping, and designated crosswalks.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			-Look for opportunities for connections along easements & other areas where vehicles not permitted.
MS G-21: Create distinctive places throughout the area.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide benches, streetlights, public art, and other amenities in public areas to attract pedestrian activities. -Encourage new developments to incorporate drought tolerant and native landscaping that is pedestrian friendly, attractive, and consistent with the landscaped character of area. -Encourage all new development to preserve existing mature trees. -Encourage streetscape design programs for commercial frontages that create vibrant places which support walking, bicycling, transit, and sustainable economic development. -Encourage the design and placement of buildings on lots to provide opportunities for natural systems such as solar heating and passive cooling. - Ensure that all new industrial development projects are positive additions to the community setting, provide amenities for the comfort of the employees such as outdoor seating area for breaks or lunch, and have adequate landscape buffers.
MS G-22: Reinvest in existing neighborhoods and promote infill development as a preference over new, greenfield development	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Identify all underused properties in the plan area and focus development in these opportunity sites prior to designating new growth areas for development. - Implement programs to retro-fit existing structures to make them more energy-efficient. -Encourage compact development, by placing the desired activity areas in smaller spaces.

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
Public Safety			
MS G-23: Promote a safe community in which residents can live, work, shop, and play.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Foster an environment of trust by ensuring non-biased policing, and by adopting policies and encouraging collaboration that creates transparency. - Facilitate traffic safety for motorists and pedestrians through proper street design and traffic monitoring.

Note:
[1] Where GP=General Plan.
[2] List is not meant to be all inclusive.
Source: Data complied by EDAW in 2007

Appendix C

Rule and Regulation Summary

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Low Carbon Fuel Standard	10-20 MMT CO_2e by 2020	January 1, 2010	ARB	This rule/regulation will require fuel providers (e.g., producers, importers, refiners and blenders) to ensure that the mix of fuels they sell in CA meets the statewide goal to reduce the carbon intensity of CA's transportation fuels by at least 10% by the 2020 target.	ARB Early Action Measure
Reduction of HFC-134a Emissions from Nonprofessional Servicing of Motor Vehicle Air Conditioning Systems	1-2 MMT CO_2e by 2020	January 1, 2010	ARB	This rule/regulation will restrict the use of high GWP refrigerants for nonprofessional recharging of leaky automotive air conditioning systems.	ARB Early Action Measure
Landfill Gas Recovery	2-4 MMT CO_2e by 2020	January 1, 2010	IWMB, ARB	This rule/regulation will require landfill gas recovery systems on small to medium landfills that do not have them and upgrade the requirements at landfills with existing systems to represent best capture and destruction efficiencies.	ARB Early Action Measure
Vehicle Climate Change Standards (AB 1493 Pavley, Chapter 200, Statutes of 2002)	30 MMT CO_2e by 2020	2009	ARB	This rule/regulation will require ARB to achieve the maximum feasible and cost effective reduction of GHG emissions from passenger vehicles and light-duty trucks.	ARB Early Action Measure
Reduction of PFCs from the Semiconductor Industry	0.5 MMT CO_2e by 2020	2007–2009	ARB	This rule/regulation will reduce GHG emissions by process improvements/source reduction, alternative chemicals capture and beneficial reuse, and destruction technologies	Underway or to be initiated by CAT members in 2007-2009 period

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Restrictions on High GWP Refrigerants	9 MMT CO_2e by 2020	2010	ARB	This rule/regulation will expand and enforce the national ban on release of high GWP refrigerants during appliance lifetime.	ARB Early Action Measure
Cement Manufacture	<1 MMT CO_2e per year (based on 2004 production levels)	2010	Caltrans	This rule/regulation will allow 2.5% interground limestone concrete mix in cement use.	CAT Early Action Measure
Hydrogen Fuel Standards (SB 76 of 2005)	TBD	By 2008	CDFA	This rule/regulation will develop hydrogen fuel standards for use in combustion systems and fuel cells.	CAT Early Action Measure
Regulation of GHG from Load Serving Entities (SB 1368)	15 MMT CO_2e by 2020	May 23, 2007	CEC, CPUC	This rule/regulation will establish a GHG emission performance standard for baseload generation of local publicly owned electric utilities that is no higher than the rate of emissions of GHG for combined-cycle natural gas baseload generation.	CAT Early Action Measure
Energy Efficient Building Standards	TBD	In 2008	CEC	This rule/regulation will update of Title 24 standards.	CAT Early Action Measure
Energy Efficient Appliance Standards	TBD	January 1, 2010	CEC	This rule/regulation will regulate light bulb efficiency	CAT Early Action Measure
Tire Efficiency (Chapter 8.7 Division 15 of the Public Resources Code)	<1 MMT CO_2e by 2020	January 1, 2010	CEC & IWMB	This rule/regulation will ensure that replacement tires sold in CA are at least as energy efficient, on average, as tires sold in the state as original equipment on these vehicles.	CAT Early Action Measure
New Solar Homes Partnership	TBD	January 2007	CEC	Under this rule/regulation, approved solar systems will receive incentive funds based on system performance above building standards.	CAT Early Action Measure

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Water Use Efficiency	1 MMT CO_2e by 2020	2010	DWR	This rule/regulation will adopt standards for projects and programs funded through water bonds that would require consideration of water use efficiency in construction and operation.	CAT Early Action Measure
State Water Project	TBD	2010	DWR	This rule/regulation will include feasible and cost effective renewable energy in the SWP's portfolio.	CAT Early Action Measure
Cleaner Energy for Water Supply	TBD	2010	DWR	Under this rule/regulation, energy supply contracts with conventional coal power plants will not be renewed.	CAT Early Action Measure
IOU Energy Efficiency Programs	4 MMT CO_2e by 2020	2010	CPUC	This rule/regulation will provide a risk/reward incentive mechanism for utilities to encourage additional investment in energy efficiency; evaluate new technologies and new measures like encouraging compact fluorescent lighting in residential and commercial buildings	CAT Early Action Measure
Solar Generation	TBD	2007–2009	DGS	3 MW of clean solar power generation implemented in CA last year, with another 1 MW coming up. The second round is anticipated to total additional 10 MW and may include UC/CSU campuses and state fairgrounds.	Underway or to be initiated by CAT members in 2007-2009 period

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Transportation Efficiency	9 MMT CO_2e by 2020	2007–2009	Caltrans	This rule/regulation will reduce congestion, improve travel time in congested corridors, and promote coordinated, integrated land use.	Underway or to be initiated by CAT members in 2007-2009 period
Smart Land Use and Intelligent Transportation	10 MMT CO_2e by 2020	2007–2009	Caltrans	This rule/regulation will integrate consideration of GHG reduction measures and energy efficiency factors into RTPs, project development etc.	Underway or to be initiated by CAT members in 2007-2009 period
Cool Automobile Paints	1.2 to 2.0 MMT CO_2e by 2020	2009	ARB	Cool paints would reduce the solar heat gain in a vehicle and reduce air conditioning needs.	ARB Early Action Measure
Tire Inflation Program	TBD	2009	ARB	This rule/regulation will require tires to be checked and inflated at regular intervals to improve fuel economy.	ARB Early Action Measure
Electrification of Stationary Agricultural Engines	0.1 MMT CO_2e by 2020	2010	ARB	This rule/regulation will provide incentive funding opportunities for replacing diesel engines with electric motors.	ARB Early Action Measure
Desktop Power Management	Reduce energy use by 50%	2007–2009	DGS, ARB	This rule/regulation will provide software to reduce electricity use by desktop computers by up to 40%.	Currently deployed in DGS
Reducing CH_4 Venting/Leaking from Oil and Gas Systems (EJAC-3/ARB 2-12)	1 MMT CO_2e by 2020	2010	ARB	This rule/regulation will reduce fugitive CH_4 emissions from production, processing, transmission, and distribution of natural gas and oil.	ARB Early Action Measure
Replacement of High GWP Gases Used in Fire Protection Systems with Alternate Chemical (ARB 2-10)	0.1 MMT CO_2e by 2020	2011	ARB	This rule/regulation will require the use of lower GWP substances in fire protection systems.	ARB Early Action Measure
Contracting for Environmentally Preferable Products	NA	2007–2009	DGS	New state contracts have been or are being created for more energy and resource efficient IT goods, copiers, low mercury fluorescent lamps, the CA Gold Carpet Standard and office furniture.	Underway or to be initiated by CAT members in 2007-2009 period
Hydrogen Fuel Cells	NA	2007–2009	DGS	This rule/regulation will incorporate clean hydrogen fuel cells in stationary applications	Underway or to be initiated by CAT members in 2007-2009

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
				at State facilities and as back-up generation for emergency radio services.	period
High Performance Schools	NA	2007–2009	DGS	New guidelines adopted for energy and resource efficient schools; up to $100 million in bond money for construction of sustainable, high performance schools.	Underway or to be initiated by CAT members in 2007-2009 period
Urban Forestry	1 MMT CO_2e by 2020	2007–2009	Calfire, CUFR	This rule/regulation will provide five million additional trees in urban areas by 2020.	Underway or to be initiated by CAT members in 2007-2009 period
Fuels Management/Biomass	3 MMT CO_2e by 2020	2007–2009	Calfire	This rule/regulation will provide biomass from forest fuel treatments to existing biomass utilization facilities.	Underway or to be initiated by CAT members in 2007-2009 period
Forest Conservation and Forest Management	10 MMT CO_2e by 2020	2007–2009	Calfire, WCB	This rule/regulation will provide opportunities for carbon sequestration in Proposition 84 forest land conservation program to conserve an additional 75,000 acres of forest landscape by 2010.	Underway or to be initiated by CAT members in 2007-2009 period
Afforestation/Reforestation	2 MMT CO_2e by 2020	2007–2009	Calfire	This rule/regulation will subsidize tree planting.	Underway or to be initiated by CAT members in 2007-2009 period
Dairy Digesters	TBD	January 1, 2010	CDFA	This rule/regulation will develop a dairy digester protocol to document GHG emission reductions from these facilities.	ARB Early Action Measure

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Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Conservation Tillage and Enteric Fermentation	1 MMT CO_2e by 2020	2007–2009	CDFA	This rule/regulation will develop and implement actions to quantify and reduce enteric fermentation emissions from livestock and sequester soil carbon using cover crops and conservation tillage.	Underway or to be initiated by CAT members in 2007-2009 period
ULEV	TBD	2007–2009	DGS	A new long term commercial rental contract was released in March 2007 requiring a minimum ULEV standard for gasoline vehicles and requires alternative fuel and hybrid-electric vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Flex Fuel Vehicles	370 metric tons CO_2, 0.85 metric tons of CH_4, and 1.14 metric tons of N_2O	2007–2009	DGS	Under this rule/regulation, DGS is replacing 800 vehicles with new, more efficient vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Climate Registry	TBD	2007–2009	DGS	Benchmarking and reduction of GHG emissions for state owned buildings, leased buildings and light duty vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Municipal Utilities Electricity Sector Carbon Policy	Included in SB 1368 reductions	2007–2009	CEC, CPUC, ARB	Under this rule/regulation, GHG emissions cap policy guidelines for CA's electricity sector (IOUs and POUs).	Underway or to be initiated by CAT members in 2007-2009 period
Alternative Fuels: Nonpetroleum Fuels	TBD	2007–2009	CEC	State plan to increase the use of alternative fuels for transportation; full fuel cycle assessment.	Underway or to be initiated by CAT members in 2007-2009 period
Zero Waste/High Recycling Strategy	5 MMT CO_2e by 2020	2007–2009	IWMB	This rule/regulation will identify materials to focus on to achieve GHG reduction at the lowest possible cost; Builds on the success of 50% Statewide Recycling Goal.	Underway or to be initiated by CAT members in 2007-2009 period
Organic Materials Management	TBD	2007–2009	IWMB	This rule/regulation will develop a market incentive program to increase organics diversion to the agricultural industry.	Underway or to be initiated by CAT members in 2007-2009 period
Landfill Gas Energy	TBD	2007–2009	IWMB	Landfill Gas to Energy & LNG/biofuels	Underway or to be initiated by CAT members in 2007-2009 period

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Target Recycling	TBD	2007–2009	IWMB	This rule/regulation will focus on industry/public sectors with high GHG components to implement targeted commodity recycling programs.	Underway or to be initiated by CAT members in 2007-2009 period
Accelerated Renewable Portfolio Standard	Included in SB 1368 reductions	2007–2009	CPUC	This rule/regulation will examine RPS long term planning and address the use of tradable renewable energy credits for RPS compliance.	Underway or to be initiated by CAT members in 2007-2009 period
CA Solar Initiative	1 MMT CO_2e by 2020	2007–2009	CPUC	Initiative to deliver 2000 MWs of clean, emissions free energy to the CA grid by 2016.	Underway or to be initiated by CAT members in 2007-2009 period
Carbon Capture and Sequestration	TBD	2007–2009	CPUC	Proposals for power plants with IGCC and/or carbon capture in the next 18 months.	Underway or to be initiated by CAT members in 2007-2009
Source: Data complied by EDAW in 2007					

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

California Environmental Quality Act Guidelines Update

Proposed Thresholds of Significance

December 7, 2009

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Bay Area Air Quality Management District

Proposed Air Quality CEQA Thresholds of Significance

1 INTRODUCTION

Bay Area Air Quality Management District (BAAQMD or Air District) staff analyzed various options for California Environmental Quality Act (CEQA) air quality thresholds of significance for use within BAAQMD's jurisdiction. The analysis and evaluation undertaken by Air District staff is documented in the *Revised Draft Options and Justification Report – California Environmental Quality Act Thresholds of Significance* (Draft Options Report) (BAAQMD October 2009).

Air District staff hosted public workshops in February, April, September and October 2009 at several locations around the Bay Area. In addition, Air District staff met with regional stakeholder groups to discuss and receive input on the threshold options being evaluated. Throughout the course of the public workshops and stakeholder meetings Air District staff received many comments on the various options under consideration. Based on comments received and additional staff analysis, the threshold options and staff-recommended thresholds were further refined. The culmination of this year-long effort was presented in the Proposed Thresholds of Significance Report published on November 2, 2009 as the Air District staff's proposed air quality thresholds of significance.

The Air District Board of Directors (Board) held public hearings on November 18 and December 2, 2009, to receive comments on staff's Proposed Thresholds of Significance (November 2009). After public testimony and Board deliberations, the Board requested staff to present additional options for risk and hazard thresholds for Board consideration. This Report includes risks and hazards threshold options, as requested by the Board, in addition to staff's previously recommended thresholds of significance. The proposed thresholds presented herein, upon adoption by the Air District Board of Directors, are intended to replace all of the Air District's currently recommended thresholds. The proposed air quality thresholds of significance, and Board-requested risk and hazard threshold options, are provided in Table 1 at the end of this introduction.

1.1 BAAQMD/CEQA REGULATORY AUTHORITY

The BAAQMD has direct and indirect regulatory authority over sources of air pollution in the San Francisco Bay Area Air Basin (SFBAAB). CEQA requires that public agencies consider the potential adverse environmental impacts of any project that a public agency proposes to carry out, fund or approve. CEQA requires that a lead agency prepare an Environmental Impact Report (EIR) whenever it can be fairly argued (the "fair argument" standard), based on substantial evidence,[1] that a project may have a significant effect[2] on

[1] "Substantial evidence" includes facts, reasonable assumptions predicated upon facts, or expert opinions supported by facts, but does not include argument, speculation, unsubstantiated opinion or narrative, evidence that is clearly inaccurate or erroneous, or evidence of social or

the environment, even if there is substantial evidence to the contrary (CEQA Guidelines §15064). CEQA requires that the lead agency review not only a project's direct effects on the environment, but also the cumulative impacts of a project and other projects causing related impacts. When the incremental effect of a project is cumulatively considerable, the lead agency must discuss the cumulative impacts in an EIR. (CEQA Guidelines §15064).

The "fair argument" standard refers to whether a fair argument can be made that a project may have a significant effect on the environment (*No Oil, Inc. v. City of Los Angeles* (1974) 13 Cal.3d 68, 84). The fair argument standard is generally considered a low threshold requirement for preparation of an EIR. The legal standards reflect a preference for requiring preparation of an EIR and for "resolving doubts in favor of environmental review." *Meija v. City of Los Angeles* (2005) 130 Cal. App. 4th 322, 332. "The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data." (CEQA Guidelines §15064(b).

In determining whether a project may have a significant effect on the environment, CEQA Guidelines Section 15064.7 provides that lead agencies may adopt and/or apply "thresholds of significance." A threshold of significance is "an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which means the effect normally will be determined to be less than significant" (CEQA Guidelines §15064.7).

While thresholds of significance give rise to a presumption of insignificance, thresholds are not conclusive, and do not excuse a public agency of the duty to consider evidence that a significant effect may occur under the fair argument standard. *Meija*, 130 Cal. App. 4th at 342. "A public agency cannot apply a threshold of significance or regulatory standard 'in a way that forecloses the consideration of any other substantial evidence showing there may be a significant effect.'" *Id.* This means that if a public agency is presented with factual information or other substantial evidence establishing a fair argument that a project may have a significant effect on the environment, the agency must prepare an EIR to study those impacts even if the project's impacts fall below the applicable threshold of significance.

Thresholds of significance must be supported by substantial evidence. This Report provides the substantial evidence in support of the thresholds of significance developed by the BAAQMD. If adopted by the BAAQMD Board of Directors, the Air District will recommend that lead agencies within the nine counties of the BAAQMD's jurisdiction

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economic impacts that do not contribute to, or are not caused by, physical impacts on the environment. Cal. Pub. Res. C. §21080(c); *see also* CEQA Guidelines §15384.

[2] A "significant effect" on the environment is defined as a "substantial, or potentially substantial, adverse change in the environment." Cal. Pub. Res. C. §21068; *see also* CEQA Guidelines §15382.

use the thresholds of significance in this Report when considering the air quality impacts of projects under their consideration.

1.2 JUSTIFICATION FOR UPDATING CEQA THRESHOLDS

Any analysis of environmental impacts under CEQA includes an assessment of the nature and extent of each impact expected to result from the project to determine whether the impact will be treated as significant or less than significant. CEQA gives lead agencies discretion whether to classify a particular environmental impact as significant. Ultimately, formulation of a standard of significance requires the lead agency to make a policy judgment about where the line should be drawn distinguishing adverse impacts it considers significant from those that are not deemed significant. This judgment must, however, be based on scientific information and other factual data to the extent possible (CEQA Guidelines §15064(b)).

In the sense that advances in science provide new or refined factual data, combined with advances in technology and the gradual improvement or degradation of an environmental resource, the point where an environmental effect is considered significant is fluid over time. Other factors influencing this fluidity include new or revised regulations and standards, and emerging, new areas of concern.

In the ten years since BAAQMD last reviewed its recommended CEQA thresholds of significance for air quality, there have been tremendous changes that affect the quality and management of the air resources in the Bay Area. Traditional criteria air pollutant ambient air quality standards, at both the state and federal levels, have become increasingly more stringent. A new criteria air pollutant standard for fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) has been added to federal and state ambient air quality standards. We have found, through technical advances in impact assessment, that toxic air contaminants are not only worse than previously thought from a health perspective, but that certain communities experience high levels of toxic air contaminants, giving rise to new regulations and programs to reduce the significantly elevated levels of ambient toxic air contaminant concentrations in the Bay Area.

In response to the elevated levels of toxic air contaminants in some Bay Area communities, the Air District created the Community Air Risk Evaluation (CARE) Program. Phase 1 of the BAAQMD's CARE program compiled and analyzed a regional emissions inventory of toxic air contaminants (TACs), including emissions from stationary sources, area sources, and on-road and off-road mobile sources. Phase 2 of the CARE Program conducted regional computer modeling of selected TAC species, species which collectively posed the greatest risk to Bay Area residents. In both Phases 1 and 2, demographic data were combined with estimates of TAC emissions or concentrations to identify communities that are disproportionally impacted from high concentrations of TACs. Bay Area Public Health Officers, in discussions with Air District staff and in comments to the Air District's Advisory Council (February 11, 2009, Advisory Council Meeting on Air Quality and Public Health), have recommended that $PM_{2.5}$, in addition to TACs, be considered in assessments of community-scale impacts of air pollution.

Another significant issue that affects the quality of life for Bay Area residents is the growing concern with global climate change. In just the past few years, estimates of the global atmospheric temperature and greenhouse gas concentration limits needed to stabilize climate change have been adjusted downward and the impacts of greenhouse gas emissions considered more dire. Previous scientific assessments assumed that limiting global temperature rise to 2-3°C above pre-industrial levels would stabilize greenhouse gas concentrations in the range of 450-550 parts per million (ppm) of carbon dioxide-equivalent (CO_2e). Now the science indicates that a temperature rise of 2°C would not prevent dangerous interference with the climate system. Recent scientific assessments suggest that global temperature rise should be kept below 2°C by stabilizing greenhouse gas concentrations below 350 ppm CO_2e, a significant reduction from the current level of 385 ppm CO_2e.

For the reasons stated above, and to further the goals of other District programs such as encouraging transit-oriented and infill development, BAAQMD has undertaken an effort to review all of its currently-recommended CEQA thresholds, revise them as appropriate, and develop new thresholds where appropriate. The overall goal of this effort is to develop CEQA significance criteria that ensure new development implements appropriate and feasible emission reduction measures to mitigate significant air quality impacts. The Air District's recommended CEQA significance thresholds have been vetted through a public review process and will be presented to the BAAQMD Board of Directors for adoption.

Table 1 – Proposed Air Quality CEQA Thresholds of Significance

Pollutant	**Construction-Related**	**Operational-Related**	
Project-Level			
Criteria Air Pollutants and Precursors (Regional)	**Average Daily Emissions (lb/day)**	**Average Daily Emissions (lb/day)**	**Maximum Annual Emissions (tpy)**
ROG	54	54	10
NO_X	54	54	10
PM_{10} (exhaust)	82	82	15
$PM_{2.5}$ (exhaust)	54	54	10
$PM_{10}/PM_{2.5}$ (fugitive dust)	Best Management Practices	None	
Local CO	None	9.0 ppm (8-hour average), 20.0 ppm (1-hour average)	
GHGs **Projects other than Stationary Sources**	None	Compliance with Qualified Climate Action Plan OR 1,100 MT of CO_2e/yr OR 4.6 MT CO_2e/SP/yr (residents + employees)	

Table 1 – Proposed Air Quality CEQA Thresholds of Significance		
Pollutant	**Construction-Related**	**Operational-Related**
GHGs **Stationary Sources**	None	10,000 MT/yr
Risks and Hazards (Individual Project) **Staff Proposal**	Same as Operational Thresholds*	**All Areas:** Siting a New Source or Receptor Compliance with Qualified Risk Reduction Plan OR Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor
Risks and Hazards (Individual Project) **Board Option 1** **Tiered Thresholds**	Same as Operational Thresholds*	**Impacted Communities:** Siting a New Source Compliance with Qualified Risk Reduction Plan OR Increased cancer risk of >5.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.2 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor
	Same as Operational Thresholds*	**Impacted Communities:** Siting a New Receptor **All Other Areas:** Siting a New Source or Receptor Compliance with Qualified Risk Reduction Plan OR Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor
Risks and Hazards (Individual Project) **Board Option 2** **Quantitative Thresholds**	Same as Operational Thresholds*	**All Areas**: Siting a New Source or Receptor Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor

Table 1 – Proposed Air Quality CEQA Thresholds of Significance		
Pollutant	**Construction-Related**	**Operational-Related**
Risks and Hazards (Cumulative Thresholds)	Same as Operational Thresholds*	**All Areas**: Siting a New Source or Receptor Compliance with Qualified Risk Reduction Plan OR Cancer: > 100 in a million (from all local sources) Non-cancer: > 1.0 Hazard Index (from all local sources) (Chronic or Acute) $PM_{2.5}$: > 0.8 µg/m^3 annual average (from all local sources) Zone of Influence: 1,000-foot radius from fence line of source or receptor
Accidental Release of Acutely Hazardous Air Pollutants	None	Storage or use of acutely hazardous materials locating near receptors or receptors locating near stored or used acutely hazardous materials considered significant
Odors	None	Screening Level Distances and Complaint History
Plan-Level		
Criteria Air Pollutants and Precursors (Regional and Local)	None	1. Consistency with Current Air Quality Plan control measures 2. Projected VMT or vehicle trip increase is less than or equal to projected population increase
GHGs	None	Compliance with Qualified Climate Action Plan (or similar criteria included in a General Plan) OR 6.6 MT CO2e/ SP/yr (residents + employees)
Risks and Hazards/Odors	None	1. Overlay zones around existing and planned sources of TACs (including adopted Risk Reduction Plan areas) and odors 2. Overlay zones of at least 500 feet (or Air District-approved modeled distance) from all freeways and high volume roadways
Accidental Release of Acutely Hazardous Air Pollutants	None	None

Notes: CO = carbon monoxide; CO_2e = carbon dioxide equivalent; GHGs = greenhouse gases; lb/day = pounds per day; MT = metric tons; NO_X = oxides of nitrogen; $PM_{2.5}$= fine particulate matter with an aerodynamic resistance diameter of 2.5 micrometers or less; PM_{10} = respirable particulate matter with an aerodynamic resistance diameter of 10 micrometers or less; ppm = parts per million; ROG = reactive organic gases; SO_2 = sulfur dioxide; SP = service population; TACs = toxic air contaminants; TBP = toxic best practices; tons/day = tons per day; tpy = tons per year; yr= year.

* Note: The Air District recommends that for construction projects that are less than one year duration, Lead Agencies should annualize impacts over the scope of actual days that peak impacts are to occur, rather than the full year.

2 GREENHOUSE GAS THRESHOLDS

BAAQMD does not currently have an adopted threshold of significance for GHG emissions. BAAQMD currently recommends that lead agencies quantify GHG emissions resulting from new development and apply all feasible mitigation measures to lessen the potentially adverse impacts. One of the primary objectives in updating the current CEQA Guidelines is to identify a GHG significance threshold, analytical methodologies, and mitigation measures to ensure new land use development meets its fair share of the emission reductions needed to address the cumulative environmental impact from GHG emissions. GHG emissions contribute, on a cumulative basis, to the significant adverse environmental impacts of global climate change. As reviewed herein, climate change impacts include an increase in extreme heat days, higher ambient concentrations of air pollutants, sea level rise, impacts to water supply and water quality, public health impacts, impacts to ecosystems, impacts to agriculture, and other environmental impacts. No single land use project could generate enough GHG emissions to noticeably change the global average temperature. The combination of GHG emissions from past, present, and future projects contribute substantially to the phenomenon of global climate change and its associated environmental impacts.

2.2 PROPOSED THRESHOLDS OF SIGNIFICANCE

Project Type	Proposed Thresholds
Projects other than Stationary Sources	Compliance with Qualified Climate Action Plan OR 1,100 MT of CO_2e/yr OR 4.6 MT CO_2e/SP/yr* (residents + employees)
Stationary Sources	10,000 MT of CO_2e/yr
Plans	Compliance with Qualified Climate Action Plan (or similar criteria included in a General Plan) OR 6.6 MT CO_2e/SP/yr (residents + employees)

* Staff notes that the efficiency-based thresholds should be applied to individual projects with caution. As explained herein, lead agencies may determine that the efficiency-based GHG thresholds for individual land use projects may not be appropriate for very large projects. If there is a fair argument that the project's emissions on a mass level will have a cumulatively considerable impact on the region's GHG emissions, the insignificance presumption afforded to a project that meets an efficiency-based GHG threshold would be overcome.

2.3 JUSTIFICATION AND SUBSTANTIAL EVIDENCE SUPPORTING THRESHOLDS

BAAQMD's approach to developing a threshold of significance for GHG emissions is to identify the emissions level for which a project would not be expected to substantially conflict with existing California legislation adopted to reduce statewide GHG emissions.

If a project would generate GHG emissions above the threshold level, it would be considered to contribute substantially to a cumulative impact, and would be considered significant. If mitigation can be applied to lessen the emissions such that the project meets its share of emission reductions needed to address the cumulative impact, the project would normally be considered less than significant.

As explained in the District's *Revised Draft Options and Justifications Report* (BAAQMD 2009), there are several types of thresholds that may be supported by substantial evidence and be consistent with existing California legislation and policy to reduce statewide GHG emissions. In determining which thresholds to recommend, Staff studied numerous options, relying on reasonable, environmentally conservative assumptions on growth in the land use sector, predicted emissions reductions from statewide regulatory measures and resulting emissions inventories, and the efficacies of GHG mitigation measures. The thresholds recommended herein were chosen based on the substantial evidence that such thresholds represent quantitative and/or qualitative levels of GHG emissions, compliance with which means that the environmental impact of the GHG emissions will normally not be cumulatively considerable under CEQA. Compliance with such thresholds will be part of the solution to the cumulative GHG emissions problem, rather than hinder the state's ability to meet its goals of reduced statewide GHG emissions. Staff notes that it does not believe there is only one threshold for GHG emissions that can be supported by substantial evidence.

GHG CEQA significance thresholds recommended herein are intended to serve as interim levels during the implementation of the AB 32 Scoping Plan and SB 375, which will occur over time. Until AB 32 has been fully implemented in terms of adopted regulations, incentives, and programs and until SB 375 required plans have been fully adopted, or the California Air Resources Board (ARB) adopts a recommended threshold, the BAAQMD recommends that local agencies in the Bay Area apply the GHG thresholds recommended herein.

If left unchecked, GHG emissions from new land use development in California will result in a cumulatively considerable amount of GHG emissions and a substantial conflict with the State's ability to meet the goals within AB 32. Thus, BAAQMD proposes to adopt interim GHG thresholds for CEQA analysis, which can be used by lead agencies within the Bay Area. This would help lead agencies navigate this dynamic regulatory and technological environment where the field of analysis has remained wide open and inconsistent. BAAQMD's framework for developing a GHG threshold for land development projects that is based on policy and substantial evidence follows.

2.3.1 SCIENTIFIC AND REGULATORY JUSTIFICATION

Climate Science Overview

Prominent GHGs contributing to the greenhouse effect are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, chlorofluorocarbons, and sulfur hexafluoride. Human-caused emissions of these GHGs in excess of natural ambient concentrations are responsible for intensifying the greenhouse effect and have led to a

trend of unnatural warming of the earth's climate, known as global climate change or global warming. It is *extremely unlikely* that global climate change of the past 50 years can be explained without the contribution from human activities (IPCC 2007a).

According to Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC), "Avoiding Dangerous Climate Change" means: *"stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."* Dangerous climate change defined in the UNFCCC is based on several key indicators including the potential for severe degradation of coral reef systems, disintegration of the West Antarctic Ice Sheet, and shut down of the large-scale, salinity- and thermally-driven circulation of the oceans. (UNFCCC 2009). The global atmospheric concentration of carbon dioxide has increased from a pre-industrial value of about 280 ppm to 379 ppm in 2005 (IPCC 2007a). "Avoiding dangerous climate change" is generally understood to be achieved by stabilizing global average temperatures between 2 and 2.4°C above pre-industrial levels. In order to limit temperature increases to this level, ambient global CO_2 concentrations must stabilize between 350 and 400 ppm (IPCC 2007b).

Executive Order S-3-05

Executive Order S-3-05, which was signed by Governor Schwarzenegger in 2005, proclaims that California is vulnerable to the impacts of climate change. It declares that increased temperatures could reduce the Sierra's snowpack, further exacerbate California's air quality problems, and potentially cause a rise in sea levels. To combat those concerns, the Executive Order established total GHG emission targets. Specifically, emissions are to be reduced to the 2000 level by 2010, the 1990 level by 2020, and to 80 percent below the 1990 level by 2050.

Assembly Bill 32, the California Global Warming Solutions Act of 2006

In September 2006, Governor Arnold Schwarzenegger signed Assembly Bill 32, the California Global Warming Solutions Act of 2006, which set the 2020 greenhouse gas emissions reduction goal into law. AB 32 finds and declares that "Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California." AB 32 requires that statewide GHG emissions be reduced to 1990 levels by 2020, and establishes regulatory, reporting, voluntary, and market mechanisms to achieve quantifiable reductions in GHG emissions to meet the statewide goal.

In December of 2008, ARB adopted its *Climate Change Scoping Plan* (*Scoping Plan*), which is the State's plan to achieve GHG reductions in California, as required by AB 32 (ARB 2008). The Scoping Plan contains strategies California will implement to achieve a reduction of 169 MMT CO_2e emissions, or approximately 28 percent from the state's projected 2020 emission level of 596 MMT of CO_2e under a business-as-usual scenario (this is a reduction of 42 MMT of CO_2e, or almost 10 percent, from 2002-2004 average emissions), so that the state can return to 1990 emission levels, as required by AB 32.

While the Scoping Plan establishes the policy intent to control numerous GHG sources through regulatory, incentive, and market means, given the early phase of implementation and the level of control that local CEQA lead agencies have over numerous GHG sources, CEQA is an important and supporting tool in achieving GHG reductions overall in compliance with AB 32. In this spirit, BAAQMD is considering the adoption of thresholds of significance for GHG emissions for stationary source and land use development projects.

Senate Bill 375

Senate Bill (SB) 375, signed in September 2008, aligns regional transportation planning efforts, regional GHG reduction targets, and land use and housing allocation. SB 375 requires Metropolitan Planning Organizations (MPOs) to adopt a Sustainable Communities Strategy (SCS) or Alternative Planning Strategy (APS), which will prescribe land use allocation in that MPO's Regional Transportation Plan (RTP). ARB, in consultation with MPOs, will provide each affected region with reduction targets for GHGs emitted by passenger cars and light trucks in the region for the years 2020 and 2035. These reduction targets will be updated every eight years, but can be updated every four years if advancements in emission technologies affect the reduction strategies to achieve the targets. ARB is also charged with reviewing each MPO's SCS or APS for consistency with its assigned targets. If MPOs do not meet the GHG reduction targets, transportation projects would not be eligible for State funding programmed after January 1, 2012. New provisions of CEQA would incentivize qualified projects that are consistent with an approved SCS or APS, categorized as "transit priority projects."

While SB 375 is considered in the development of these thresholds, given that the Association of Bay Area Governments (ABAG) and the Metropolitan Transportation Commission (MTC) development of the SCS for the Bay Area is in its early stages and the ARB GHG reduction target for light duty and passenger vehicles in the Bay Area has not yet been proposed, it is not appropriate from a CEQA perspective to expect SB 375 to completely address the emission reductions needed from this transportation sector in meeting AB 32 goals. In the future, as SB 375 implementation progresses, BAAQMD may need to revisit GHG thresholds.

2.3.2 PROJECT-LEVEL GHG THRESHOLDS

Staff recommends setting GHG significance thresholds based on AB 32 GHG emission reduction goals while taking into consideration emission reduction strategies outlined in ARB's Scoping Plan. Staff proposes two quantitative thresholds for land use projects: a bright line threshold based on a "gap" analysis and an efficiency threshold based on emission levels required to be met in order to achieve AB 32 goals.

Staff also proposes one qualitative threshold for land use projects: if a project complies with a Qualified Climate Action Plan (as defined in Section 2.3.4 below) that addresses the project it would be considered less than significant. As explained in detail in Section 2.3.4 below, compliance with a Qualified Climate Action Plan (or similar adopted policies, ordinances and programs), would provide the evidentiary basis for making

CEQA findings that development consistent with the plan would result in feasible, measureable, and verifiable GHG reductions consistent with broad state goals such that projects approved under qualified Climate Action Plans or equivalent demonstrations would achieve their fair share of GHG emission reductions.

2.3.2.1 LAND USE PROJECTS "GAP-BASED" THRESHOLD

Staff took eight steps in developing this threshold approach, which are summarized here and detailed in the sections that follow. It should be noted that the "gap-based approach" used for threshold development is a conservative approach that focuses on a limited set of state mandates that appear to have the greatest potential to reduce land use development-related GHG emissions at the time of this writing. It is also important to note that over time, as the effectiveness of the State's implementation of AB 32 (and SB 375) progresses, BAAQMD will need to reconsider the extent of GHG reductions needed over and above those from the implementation thereof for the discretionary approval of land use development projects. Although there is an inherent amount of uncertainty in the estimated capture rates (i.e., frequency at which project-generated emissions would exceed a threshold and would be subject to mitigation under CEQA) and the aggregate emission reductions used in the gap analysis, they are based on BAAQMD's expertise, the best available data, and use conservative assumptions for the amount of emission reductions from legislation in derivation of the gap (e.g., only adopted legislation was relied upon). This approach is intended to attribute an appropriate share of GHG emission reductions necessary to reach AB 32 goals to new land use development projects in BAAQMD's jurisdiction that are evaluated pursuant to CEQA.

Step 1 Estimate from ARB's statewide GHG emissions inventory the growth in emissions between 1990 and 2020 attributable to "land use-driven" sectors of the emission inventory as defined by OPR's guidance document (*CEQA and Climate Change*). Land use-driven emission sectors include Transportation (On-Road Passenger Vehicles; On-Road Heavy Duty), Electric Power (Electricity; Cogeneration), Commercial and Residential (Residential Fuel Use; Commercial Fuel Use) and Recycling and Waste (Domestic Waste Water Treatment).

Result: 1990 GHG emissions were 295.53 MMT CO_2e/yr and projected 2020 business-as-usual GHG emissions would be 400.22 MMT CO_2e/yr; thus a 26.2 percent reduction from statewide land use-driven GHG emissions would be necessary to meet the AB 32 goal of returning to 1990 emission levels by 2020. (See Table 2)

Step 2 Estimate the anticipated GHG emission reductions affecting the same land use-driven emissions inventory sectors associated with adopted statewide regulations identified in the AB 32 Scoping Plan.

Result: Estimated a 23.9 percent reduction can be expected in the land use-driven GHG emissions inventory from adopted Scoping Plan regulations, including AB 1493 (Pavley), LCFS, Heavy/Medium Duty Efficiency, Passenger Vehicle Efficiency, Energy-Efficiency

Measures, Renewable Portfolio Standard, and Solar Roofs. (See Table 3)

Step 3 Determine any short fall or "gap" between the 2020 statewide emission inventory estimates and the anticipated emission reductions from adopted Scoping Plan regulations. This "gap" represents additional GHG emission reductions needed statewide from the land use-driven emissions inventory sectors, which represents new land use development's share of the emission reductions needed to meet statewide GHG emission reduction goals.

Result: With the 23.9 percent reductions from AB 32 Scoping Measures, there is a "gap" of 2.3 percent in necessary additional GHG emissions reductions to meet AB 32 goals of a 26.2 percent reduction from statewide land use-driven GHG emissions to return to 1990 levels in 2020. (See Table 2)

Step 4 Determine the percent reduction this "gap" represents in the "land use-driven" emissions inventory sectors from BAAQMD's 2020 GHG emissions inventory. Identify the mass of emission reductions needed in the SFBAAB from land use-driven emissions inventory sectors.

Result: Estimated that a 2.3 percent reduction in BAAQMD's projected 2020 emissions projections requires emissions reductions of 1.6 MMT CO_2e/yr from the land use-driven sectors. (See Table 4)

Step 5 Assess BAAQMD's historical CEQA database (2001-2008) to determine the frequency distribution trend of project sizes and types that have been subject to CEQA over the past several years.

Result: Determined historical patterns of residential, commercial and industrial development by ranges of average sizes of each development type. Results were used in Step 6 below to distribute anticipated Bay Area growth among different future project types and sizes.

Step 6 Forecast new land use development for the Bay Area using DOF/EDD population and employment projections and distribute the anticipated growth into appropriate land use types and sizes needed to accommodate the anticipated growth (based on the trend analysis in Step 5 above). Translate the land use development projections into land use categories consistent with those contained in the Urban Emissions Model (URBEMIS).

Result: Based on population and employment projections and the trend analysis from Step 5 above, forecasted approximately 4,000 new development projects, averaging about 400 projects per year through 2020 in the Bay Area.

Step 7 Estimate the amount of GHG emissions from each land use development project type and size using URBEMIS and post-model manual calculation methods (for emissions not included in URBEMIS). Determine the amount of GHG emissions that can reasonably and feasibly be reduced through currently available mitigation measures ("mitigation effectiveness") for future land use development projects subject to CEQA (based on land use development projections and frequency distribution from Step 6 above).

Result: Based on the information available and on sample URBEMIS calculations, found that mitigation effectiveness of between 25 and 30 percent is feasible.

Step 8 Conduct a sensitivity analysis of the numeric GHG mass emissions threshold needed to achieve the desired emissions reduction (i.e., "gap") determined in Step 4. This mass emission GHG threshold is that which would be needed to achieve the emission reductions necessary by 2020 to meet the Bay Area's share of the statewide "gap" needed from the land use-driven emissions inventory sectors.

Result: The results of the sensitivity analysis conducted in Step 8 found that reductions between about 125,000 MT/yr (an aggregate of 1.3 MMT in 2020) and over 200,000 MT/yr (an aggregate of over 2.0 MMT in 2020) were achievable and feasible. A mass emissions threshold of 1,100 MT of CO_2e/yr would result in approximately 59 percent of all projects being above the significance threshold (e.g., this is approximately the operational GHG emissions that would be associated with a 60 residential unit subdivision) and must implement feasible mitigation measures to meet CEQA requirements. With an estimated 26 percent mitigation effectiveness, the 1,100 MT threshold would achieve 1.6 MMT CO_2e/yr in GHG emissions reductions.

2.3.2.2 DETAILED BASIS AND ANALYSIS

Derivation of Greenhouse Gas Reduction Goal

To meet the target emissions limit established in AB 32 (equivalent to levels in 1990), total GHG emissions would need to be reduced by approximately 28 percent from projected 2020 forecasts (ARB 2009a). The AB 32 Scoping Plan is ARB's plan for meeting this mandate (ARB 2008). While the Scoping Plan does not specifically identify GHG emission reductions from the CEQA process for meeting AB 32 derived emission limits, the scoping plan acknowledges that "other strategies to mitigate climate change . . . should also be explored." The Scoping Plan also acknowledges that "Some of the measures in the plan may deliver more emission reductions than we expect; others less . . . and new ideas and strategies will emerge." In addition, climate change is considered a significant environmental issue and, therefore, warrants consideration under CEQA. SB 97 represents the State Legislature's confirmation of this fact, and it directed the Governor's Office of Planning and Research (OPR) to develop CEQA Guidelines for

evaluation of GHG emissions impacts and recommend mitigation strategies. In response, OPR released the *Technical Advisory: CEQA and Climate Change* (OPR 2008), and has released proposed CEQA guidelines (April 14, 2009) for consideration of GHG emissions. It is known that new land use development must also do its fair share toward achieving AB 32 goals (or, at a minimum, should not hinder the State's progress toward the mandated emission reductions).

Foreseeable Scoping Plan Measures Emission Reductions and Remaining "Gap"

Step 1 of the Gap Analysis entailed estimating from ARB's statewide GHG inventory the growth in emissions between 1990 and 2020 attributable to land use driven sectors of the emissions inventory. As stated above, to meet the requirements set forth in AB 32 (i.e., achieve California's 1990-equivalent GHG emissions levels by 2020) California would need to achieve an approximate 28 percent reduction in emissions across all sectors of the GHG emissions inventory compared with 2020 projections. However, to meet the AB 32 reduction goals in the emissions sectors that are related to land use development (e.g., on-road passenger and heavy-duty motor vehicles, commercial and residential area sources [i.e., natural gas], electricity generation/consumption, wastewater treatment, and water distribution/consumption), staff determined that California would need to achieve an approximate 26 percent reduction in GHG emissions from these land use-driven sectors (ARB 2009a) by 2020 to return to 1990 land use emission levels.

Next, in Step 2 of the Gap Analysis, Staff determined the GHG emission reductions within the land use-driven sectors that are anticipated to occur from implementation of the Scoping Plan measures statewide, which are summarized in Table 2 and described below. Since the GHG emission reductions anticipated with the Scoping Plan were not accounted for in ARB's or BAAQMD's 2020 GHG emissions inventory forecasts (i.e., business as usual), an adjustment was made to include (i.e., give credit for) GHG emission reductions associated with key Scoping Plans measures, such as the Renewable Portfolio Standard, improvements in energy efficiency through periodic updates to Title 24, AB 1493 (Pavley) (which recently received a federal waiver to allow it to be enacted in law), the Low Carbon Fuel Standard (LCFS), and other measures. With reductions from these State regulations (Scoping Plan measures) taken into consideration and accounting for an estimated 23.9 percent reduction in GHG emissions, in Step 3 of the Gap Analysis Staff determined that the Bay Area would still need to achieve an additional 2.3 percent reduction from projected 2020 GHG emissions to meet the 1990 GHG emissions goal from the land-use driven sectors. This necessary 2.3 percent reduction in projected GHG emissions from the land use sector is the "gap" the Bay Area needs to fill to do its share to meet the AB 32 goals. Refer to the following explanation and Tables 2 through 4 for data used in this analysis.

Because the transportation sector is the largest emissions sector of the state's GHG emissions inventory, it is aggressively targeted in early actions and other priority actions in the Scoping Plan including measures concerning gas mileage (Pavley), fuel carbon intensity (LCFS) and vehicle efficiency measures.

Table 2 – California 1990, 2002-2004, and 2020 Land Use Sector GHG[1] ($MMT CO_2e/yr$)				
Sector	**1990 Emissions**	**2002-2004 Average**	**2020 BAU Emissions Projections**	**% of 2020 Total**
Transportation	**137.98**	**168.66**	**209.06**	**52%**
On-Road Passenger Vehicles	108.95	133.95	160.78	40%
On-Road Heavy Duty	29.03	34.69	48.28	12%
Electric Power	**110.63**	**110.04**	**140.24**	**35%**
Electricity	95.39	88.97	107.40	27%
Cogeneration[2]	15.24	21.07	32.84	8%
Commercial and Residential	**44.09**	**40.96**	**46.79**	**12%**
Residential Fuel Use	29.66	28.52	32.10	8%
Commercial Fuel Use	14.43	12.45	14.63	4%
Recycling and Waste[1]	**2.83**	**3.39**	**4.19**	**1%**
Domestic Wastewater Treatment	2.83	3.39	4.19	1%
TOTAL GROSS EMISSIONS	**295.53**	**323.05**	**400.22**	
% Reduction Goal from Statewide land use driven sectors (from 2020 levels to reach 1990 levels in these emission inventory sectors)			26.2%	
% Reduction from AB32 Scoping Plan measures applied to land use sectors (see Table 3)			-23.9%	
% Reduction needed statewide beyond Scoping Plan measures (Gap)			2.3%	

Notes: MMT CO_2e /yr = million metric tons of carbon dioxide equivalent emissions per year.
[1] Landfills not included. See text.
[2] Cogeneration included due to many different applications for electricity, in some cases provides substantial power for grid use, and because electricity use served by cogeneration is often amenable to efficiency requirements of local land use authorities.
Sources: Data compiled by EDAW and ICF Jones & Stokes from ARB data.

Pavley Regulations. The AB 32 Scoping Plan assigns an approximate 20 percent reduction in emissions from passenger vehicles associated with the implementation of AB 1493. The AB 32 Scoping Plan also notes that "AB 32 specifically states that if the Pavley regulations do not remain in effect, ARB shall implement alternative regulations to control mobile sources to achieve equivalent or greater reductions of greenhouse gas emissions (HSC §38590)." Thus, it is reasonable to assume full implementation of AB 1493 standards, or equivalent programs that would be implemented by ARB. While the Obama administration has proposed national CAFE standards that may be equivalent to or even surpass AB 1493, the timing for implementation of the proposed federal standards is uncertain such that development of thresholds based on currently unadopted federal standards would be premature. BAAQMD may need to revisit this methodology as the federal standards come on line, particularly if such standards are more aggressive than that forecast under state law.

Table 3 – 2020 Land Use Sector GHG Emission Reductions from State Regulations and AB 32 Measures

Affected Emissions Source	California Legislation	% Reduction from 2020 GHG inventory	End Use Sector (% of Bay Area LU Inventory)	Scaled % Emissions Reduction (credit)
Mobile	AB 1493 (Pavley)	19.7%	On road passenger/light truck transportation (45%)	8.9%
	LCFS	7.2%	On road passenger/light truck transportation (45%)	3.2%
	LCFS	7.2%	On road Heavy/Medium Duty Transportation (5%)	0.4%
	Heavy/Medium Duty Efficiency	2.9%	On road Heavy/Medium Duty Transportation (5%)	0.2%
	Passenger Vehicle Efficiency	2.8%	On road passenger/light truck transportation (45%)	1.3%
Area	Energy-Efficiency Measures	9.5%	Natural gas (Residential, 10%)	1.0%
			Natural gas (Non-residential,13%)	1.2%
Indirect	Renewable Portfolio Standard	21.0%	Electricity (excluding cogen) (17%)	3.5%
	Energy-Efficiency Measures	15.7%	Electricity (26%)	4.0%
	Solar Roofs	1.5%	Electricity (excluding cogen) (17%)	0.2%
Total credits given to land use-driven emission inventory sectors from Scoping Plan measures				**23.9%**

Notes: AB = Assembly Bill; LCFS = Low Carbon Fuel Standard; SB = Senate Bill; RPS = Renewable Portfolio Standard
Please refer to Appendix D for detailed calculations. Sources: Data compiled by ICF Jones & Stokes.

LCFS. According to the adopted LCFS rule (CARB, April 2009), the LCFS is expected to result in approximately 10 percent reduction in the carbon intensity of transportation fuels. However, a portion of the emission reductions required from the LCFS would be achieved over the life cycle of transportation fuel production rather than from mobile-source emission factors. Based on CARB's estimate of nearly 16 MMT reductions in on-road emissions from implementation of the LCFS and comparison to the statewide on-road emissions sector, the LCFS is assumed to result in a 7.2 percent reduction compared to 2020 BAU conditions (CARB 2009e).

Table 4 – SFBAAB 1990, 2007, and 2020 Land Use Sector GHG Emissions Inventories and Projections (MMT CO_2e/yr)				
Sector	**1990 Emissions**	**2007 Emissions**	**2020 Emissions Projections**	**% of 2020 Total[2]**
Transportation	**26.1**	**30.8**	**35.7**	**50%**
On-Road Passenger Vehicles	23.0	27.5	32.0	
On-Road Heavy Duty	3.1	3.3	3.7	
Electric Power	**25.1**	**15.2**	**18.2**	**26%**
Electricity	16.5	9.9	11.8	
Cogeneration	8.6	5.3	6.4	
Commercial and Residential	**8.9**	**15.0**	**16.8**	**24%**
Residential Fuel Use	5.8	7.0	7.5	
Commercial Fuel Use	3.1	8.0	9.3	
Recycling and Waste[1]	**0.2**	**0.4**	**0.4**	**1%**
Domestic Waste Water Treatment	0.2	0.4	0.4	
TOTAL GROSS EMISSIONS	**60.3**	**61.4**	**71.1**	
SFBAAB's "Fair Share" % Reduction (from 2020 levels to reach 1990 levels) with AB-32 Reductions (from Table 3)			2.3%	
SFBAAB's Equivalent Mass Emissions Land Use Reduction Target at 2020 (MMT CO2e/yr)			1.6	

Notes: MMT CO_2e /yr = million metric tons of carbon dioxide equivalent emissions per year; SFBAAB = San Francisco Bay Area Air Basin.
[1] Landfills not included.
[2] Percentages do not sum exactly to 100% in table due to rounding.
Please refer to Appendix D for detailed calculations.
Sources: Data compiled by EDAW 2009, ICF Jones & Stokes 2009, BAAQMD 2008.

Renewable Portfolio Standard, Energy Efficiency and Solar Roofs. Energy efficiency and renewable energy measures from the Scoping Plan were also included in the gap analysis. The Renewable Portfolio Standard (rules) will require the renewable energy portion of the retail electricity portfolio to be 33 percent in 2020. For PG&E, the dominant electricity provider in the Basin, approximately 12 percent of their current portfolio qualifies under the RPS rules and thus the gain by 2020 would be approximately 21 percent. The Scoping Plan also estimates that energy efficiency gains with periodic improvement in building and appliance energy standards and incentives will reach 10 to 15 percent for natural gas and electricity respectively. The final state measure included in this gap analysis is the solar roof initiative, which is estimated to result in reduction of the overall electricity inventory of 1.5 percent.

Landfill emissions are excluded from this analysis. While land use development does generate waste related to both construction and operations, the California Integrated Waste Management Board (CIWMB) has mandatory diversion requirements that will, in all probability, increase over time to promote waste reductions, reuse, and recycle. The Bay Area has relatively high levels of waste diversion and extensive recycling efforts. Further, ARB has established and proposes to increase methane capture requirements for all major landfills. Thus, at this time, landfill emissions associated with land use

development waste generation is not included in the land use sector inventory used to develop this threshold approach.

Industrial stationary sources thresholds were developed separately from the land use threshold development using a market capture approach as described below. However, mobile source and area source emissions, as well as indirect electricity emissions that derive from industrial use are included in the land use inventory above as these particular activities fall within the influence of local land use authorities in terms of the affect on trip generation and energy efficiency.

AB 32 mandates reduction to 1990-equivalent GHG levels by 2020, with foreseeable emission reductions from State regulations and key Scoping Plan measures taken into account, were applied to the land use-driven emission sectors within the SFBAAB (i.e., those that are included in the quantification of emissions from a land use project pursuant to a CEQA analysis [on-road passenger vehicles, commercial and residential natural gas, commercial and residential electricity consumption, and domestic waste water treatment], as directed by OPR in the Technical Advisory: *Climate Change and CEQA* [OPR 2008]). This translates to a 2.3 percent gap in necessary GHG emission reductions by 2020 from these sectors.

2.3.2.3 LAND USE PROJECTS BRIGHT LINE THRESHOLD

In Steps 4 and 5 of the gap analysis, Staff determined that applying a 2.3 percent reduction to these land use emissions sectors in the SFBAAB's GHG emissions inventory would result in an equivalent fair share of 1.6 million metric tons per year (MMT/yr) reductions in GHG emissions from new land use development. As additional regulations and legislation aimed at reducing GHG emissions from land use-related sectors become available in the future, the 1.6 MMT GHG emissions reduction goal may be revisited and recalculated by BAAQMD.

In order to derive the 1.6 MMT "gap," a projected development inventory for the next ten years in the SFBAAB was calculated. (See Table 4 and *Revised Draft Options and Justifications Report* (BAAQMD 2009).) CO_2e emissions were modeled for projected development in the SFBAAB and compiled to estimate the associated GHG emissions inventory. The GHG (i.e., CO_2e) CEQA threshold level was adjusted for projected land use development that would occur within BAAQMD's jurisdiction over the period from 2010 through 2020.

Projects with emissions greater than the threshold would be required to mitigate to the threshold level or reduce project emissions by a percentage (mitigation effectiveness) deemed feasible by the Lead Agency under CEQA compared to a base year condition. The base year condition is defined by an equivalent size and character of project with annual emissions using the defaults in URBEMIS and the California Climate Action Registry's General Reporting Protocol for 2008. By this method, land use project mitigation subject to CEQA would help close the "gap" remaining after application of the key regulations and measures noted above supporting overall AB 32 goals.

This threshold takes into account Steps 1-8 of the gap analysis described above to arrive at a numerical mass emissions threshold. Various mass emissions significance threshold levels (i.e., bright lines) could be chosen based on the mitigation effectiveness and performance anticipated to be achieved per project to meet the aggregate emission reductions of 1.6 MMT needed in the SFBAAB by 2020. (See Table 5 and *Revised Draft Options and Justifications Report* (BAAQMD 2009).) Staff recommends a 1,100 MT CO_2e per year threshold. Choosing a 1,100 MT mass emissions significance threshold level (equivalent to approximately 60 single-family units), would result in about 59 percent of all projects being above the significance threshold and having to implement feasible mitigation measures to meet their CEQA obligations. These projects account for approximately 92 percent of all GHG emissions anticipated to occur between now and 2020 from new land use development in the SFBAAB.

Project applicants and lead agencies could use readily available computer models to estimate a project's GHG emissions, based on project specific attributes, to determine if they are above or below the bright line numeric threshold. With this threshold, projects that are above the threshold level, after consideration of emission-reducing characteristics of the project as proposed, would have to reduce their emissions to below the threshold to be considered less than significant.

Establishing a "bright line" to determine the significance of a project's GHG emissions impact provides a level of certainty to lead agencies in determining if a project needs to reduce its GHG emissions through mitigation measures and when an EIR is required.

Table 5 – Operational GHG Threshold Sensitivity Analysis

Option	Mitigation Effectiveness Assumptions		Mass Emission Threshold Level (MT CO_2e/yr)	% of Projects Captured (>threshold)	% of Emissions Captured (> threshold)	Emissions Reduction per year (MT/yr)	Aggregate Emissions Reduction (MMT) at 2020	Threshold Project Size Equivalent (single family dwelling units)
	Performance Standards Applied to All Projects with Emissions < Threshold Level	Mitigation Effectiveness Applied to Emissions > Threshold Level						
1A	N/A	30%	975	60%	93%	201,664	2.0	53
1A	N/A	25%	110	96%	100%	200,108	2.0	66
1A	N/A	30%	1,225	21%	67%	159,276	1.6	67
1A	N/A	26%	1,100	59%	92%	159,877	1.6	60
1A	N/A	30%	2,000	14%	61%	143,418	1.4	109
1A	N/A	25%	1,200	58%	92%	136,907	1.4	66
1A	N/A	30%	3,000	10%	56%	127,427	1.3	164
1A	N/A	25%	1,500	20%	67%	127,303	1.3	82
1B	26%	N/A	N/A	100%	100%	208,594	2.1	N/A[1]
1C	5%	30%	1,900	15%	62%	160,073	1.6	104
1C	10%	25%	1,250	21%	67%	159,555	1.6	68
1C	5%	30%	3,000	10%	56%	145,261	1.5	164
1C	10%	25%	2,000	4%	61%	151,410	1.5	109
1C	10%	30%	10,000	2%	33%	125,271	1.3	547

Notes: MMT = million metric tons per year; MT CO_2e/yr = metric tons of carbon dioxide equivalent emissions per year; MT/yr = metric tons per year; N/A = not applicable.

[1] Any project subject to CEQA would trigger this threshold.

Please refer to Appendix E for detailed calculations.

Source: Data modeled by ICF Jones & Stokes.

2.3.2.4 LAND USE PROJECTS EFFICIENCY-BASED THRESHOLD

GHG efficiency metrics can also be utilized as thresholds to assess the GHG efficiency of a project on a per capita basis (residential only projects) or on a "service population" basis (the sum of the number of jobs and the number of residents provided by a project) such that the project will allow for consistency with the goals of AB 32 (i.e., 1990 GHG emissions levels by 2020). GHG efficiency thresholds can be determined by dividing the GHG emissions inventory goal (allowable emissions), by the estimated 2020 population and employment. This method allows highly efficient projects with higher mass emissions to meet the overall reduction goals of AB 32. Staff believes it is more appropriate to base the land use efficiency threshold on the service population metric for the land use-driven emission inventory. This approach is appropriate because the threshold can be applied evenly to all project types (residential or commercial/retail only and mixed use) and uses only the land use emissions inventory that is comprised of all land use projects. Staff will provide the methodology to calculate a project's GHG emissions in the revised CEQA Guidelines, such as allowing infill projects up to a 50 percent or more reduction in daily vehicle trips if the reduction can be supported by close proximity to transit and support services, or a traffic study prepared for the project.

Table 6 – California 2020 GHG Emissions, Population Projections and GHG Efficiency Thresholds - Land Use Inventory Sectors

Land Use Sectors Greenhouse Gas Emissions Target	295,530,000
Population	44,135,923
Employment	20,194,661
California Service Population (Population + Employment)	64,330,584
AB 32 Goal GHG emissions (metric tons CO_2e)/SP[1]	**4.6**

Notes: AB = Assembly Bill; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; SP = service population.
[1] Greenhouse gas efficiency levels were calculated using only the "land use-related" sectors of ARB's emissions inventory.
Please refer to Appendix D for detailed calculations.
Sources: Data compiled by EDAW 2009, ARB 2009a, DOF 2009, EDD 2009, ICF Jones & Stokes 2009.

Staff proposes a project-level efficiency threshold of 4.6 MT CO_2e/SP, the derivation of which is shown Table 6. This efficiency-based threshold reflects very GHG-efficient projects. As stated previously and below, staff anticipates that significance thresholds (rebuttable presumptions of significance at the project level) will function on an interim basis only until adequate programmatic approaches are in place at the city, county, and regional level that will allow the CEQA streamlining of individual projects. (See Draft CEQA Guidelines, proposed section 15183.5 ["Tiering and Streamlining the Analysis of Greenhouse Gas Emissions"]). In advance of such programmatic approaches, local agencies may wish to apply this efficiency-based recommended threshold with some discretion, taking into account not only the project's efficiency, but also its total GHG emissions. Even where a project is relatively GHG-efficient as compared to other projects, in approving the project, the lead agency is committing to use what is essentially

its GHG "budget" in a given way. Expending this "budget" on the proposed project may affect other development opportunities and associated obligations to mitigate or conflict with other actions that the community may wish to take to reduce its overall GHG emissions after it has conducted its programmatic analysis.

Accordingly, in applying the efficiency-based threshold of 4.6 MT CO_2e/SP, the lead agency might also wish to consider the project's total emissions. Where a project meets the efficiency threshold but would still have very large GHG emissions, the lead agency may wish to consider whether the project's contributions to climate change might still be cumulatively considerable and whether additional changes to the project or mitigation should be required. Staff notes that even where the project may be significant as it relates to climate change, the lead agency may find that the project should nonetheless be approved in light of its benefits; in that case, the lead agency may wish to note the project's efficiency and any innovative design features in the Statement of Overriding Considerations.

2.3.3 PLAN-LEVEL GHG THRESHOLDS

Staff proposes using a two step process for determining the significance of proposed plans and plan amendments for GHG. As a first step in assessing plan-level impacts, Staff is proposing that agencies that have adopted a qualified climate action plan (or have incorporated similar criteria in their General Plan) and the General Plan or Transportation Plan are consistent with the climate action plan, the General Plan or Transportation Plan would be considered less than significant. In addition, as discussed above for project-level GHG impacts, Staff is proposing an efficiency threshold to assess plan-level impacts. Staff believes a programmatic approach to limiting GHG emissions is appropriate at the plan-level. Thus, as projects consistent with the climate action plan are proposed, they may be able to tier off the plan and its environmental analysis.

2.3.3.1 GHG EFFICIENCY METRICS FOR PLANS

For local land use plans, a GHG-efficiency metric (e.g., GHG emissions per unit) would enable comparison of a proposed general plan to its alternatives and to determine if the proposed general plan meets AB 32 emission reduction goals.

AB 32 identifies local governments as essential partners in achieving California's goal to reduce GHG emissions. Local governments have primary authority to plan, zone, approve, and permit how and where land is developed to accommodate population growth and the changing needs of their jurisdiction. ARB has developed the Local Government Operations Protocol and is developing a protocol to estimate community-wide GHG emissions. ARB encourages local governments to use these protocols to track progress in reducing GHG emissions. ARB encourages local governments to institutionalize the community's strategy for reducing its carbon footprint in its general plan. SB 375 creates a process for regional integration of land development patterns and transportation infrastructure planning with the primary goal of reducing GHG emissions from the largest sector of the GHG emission inventory, light duty vehicles.

If the statewide AB 32 GHG emissions reduction context is established, GHG efficiency can be viewed independently from the jurisdiction in which the plan is located. Expressing projected 2020 mass of emissions from land use-related emissions sectors by comparison to a demographic unit (e.g., population and employment) provides evaluation of the GHG efficiency of a project in terms of what emissions are allowable while meeting AB 32 targets.

Two approaches were considered for efficiency metrics. The "service population" (SP) approach would consider efficiency in terms of the GHG emissions compared to the sum of the number of jobs and the number of residents at a point in time. The per capita option would consider efficiency in terms of GHG emissions per resident only. Staff recommends that the efficiency threshold for plans be based on all emission inventory sectors because, unlike land use projects, community-wide or regional plans comprise more than just land use related emissions (e.g. industrial). Further, Staff recommends that plan threshold be based on the service population metric as community-wide plans or regional plans include a mix of residents and employees. The Service Population metric would allow decision makers to compare GHG efficiency of general plan alternatives that vary residential and non-residential development totals, encouraging GHG efficiency through improving jobs/housing balance. This approach would not give preference to communities that accommodate more residential (population-driven) land uses than non-residential (employment driven) land uses which could occur with the per capita approach.

A SP-based GHG efficiency metric (see Table 7) was derived from the emission rates at the State level that would accommodate projected population and employment growth under trend forecast conditions, and the emission rates needed to accommodate growth while allowing for consistency with the goals of AB 32 (i.e., 1990 GHG emissions levels by 2020).

Table 7 – California 2020 GHG Emissions, Population Projections and GHG Efficiency Thresholds - All Inventory Sectors

All Inventory Sectors Greenhouse Gas Emissions Target	426,500,000
Population	44,135,923
Employment	20,194,661
California Service Population (Population + Employment)	64,330,584
AB 32 Goal GHG emissions (metric tons CO_2e)/SP[1]	**6.6**

Notes: AB = Assembly Bill; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; SP = service population.
[1] Greenhouse gas efficiency levels were calculated using only the "land use-related" sectors of ARB's emissions inventory.
Please refer to Appendix D for detailed calculations.
Sources: Data compiled by EDAW 2009, ARB 2009a, DOF 2009, EDD 2009, ICF Jones & Stokes 2009.

If a general plan demonstrates, through dividing the emissions inventory projections (MT CO_2e) by the amount of growth that would be accommodated in 2020, that it could meet the GHG efficiency metrics proposed in this section (6.6 MT CO_2e/SP from all emission

sectors, as noted in Table 7), then the amount of GHG emissions associated with the general plan would be considered less than significant, regardless of its size (and magnitude of GHG emissions). In other words, the general plan would accommodate growth in a manner that would not hinder the State's ability to achieve AB 32 goals, and thus, would be less than significant for GHG emissions and their contribution to climate change. The efficiency metric would not penalize well-planned communities that propose a large amount of development. Instead, the SP-based GHG efficiency metric acts to encourage the types of development that BAAQMD and OPR support (i.e., infill and transit-oriented development) because it tends to reduce GHG and other air pollutant emissions overall, rather than discourage large developments for being accompanied by a large mass of GHG emissions. Plans that are more GHG efficient would have no or limited mitigation requirements to help them complete the CEQA process more readily than plans that promote GHG inefficiencies, which will require detailed design of mitigation during the CEQA process and could subject a plan to potential challenge as to whether all feasible mitigation was identified and adopted. This type of threshold can shed light on a well-planned general plan that accommodates a large amount of growth in a GHG-efficient way.

When analyzing long-range plans, such as general plans, it is important to note that the planning horizon will often surpass the 2020 timeframe for implementation of AB 32. Executive Order S-3-05 establishes a more aggressive emissions reduction goal for the year 2050 of 80 percent below 1990 emissions levels. The year 2020 should be viewed as a milestone year, and the general plan should not preclude the community from a trajectory toward the 2050 goal. However, the 2020 timeframe is examined in this threshold evaluation because doing so for the 2050 timeframe (with respect to population, employment, and GHG emissions projections) would be too speculative. Advances in technology and policy decisions at the state level will be needed to meet the aggressive 2050 goals. It is beyond the scope of the analysis tools available at this time to examine reasonable emissions reductions that can be achieved through CEQA analysis in the year 2050. As the 2020 timeframe draws nearer, BAAQMD will need to reevaluate the threshold to better represent progress toward 2050 goals.

2.3.4 CLIMATE ACTION PLANS

Finally, many local agencies have already undergone or plan to undergo efforts to create general or other plans that are consistent with AB 32 goals. The Air District encourages such planning efforts and recognizes that careful upfront planning by local agencies is invaluable to achieving the state's GHG reduction goals. If a project is consistent with an adopted Qualified Climate Action Plan that addresses the project's GHG emissions, it can be presumed that the project will not have significant GHG emission impacts. This approach is consistent with CEQA Guidelines Section 15064(h)(3), which provides that a "lead agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project will comply with the requirements in a previously approved plan or mitigation program which provides specific requirements that will avoid or substantially lessen the cumulative problem."

A qualified Climate Action Plan (or similar adopted policies, ordinances and programs) is one that is consistent with all of the AB 32 Scoping Plan measures and goals. The Climate Action Plan should identify a land use design, transportation network, goals, policies and implementation measures that would achieve AB 32 goals. Plans with horizon years beyond 2020 should consider continuing the downward reduction path set by AB 32 and move toward climate stabilization goals established in Executive Order S-3-05.

Qualified Climate Action Plans

A qualified Climate Action Plan adopted by a local jurisdiction should include the following. The District's revised CEQA Guidelines will provide the methodology to determine if a Climate Action Plan meets these requirements.

- GHG Inventory for Current Year and Forecast for 2020 (and for 1990 if the reduction goal is based on 1990 emission levels).
- An adopted GHG Reduction Goal for 2020 for the jurisdiction from all sources (existing and future) which is at least one of the following: 1990 GHG emission levels, 15 percent below 2008 emission levels, or 28 percent below BAU Forecasts for 2020 (if including non-land use sector emissions in the local inventory; otherwise can use 26.2 percent if only including land use sector emissions).
- Identification of feasible reduction measures to reduce GHG emissions for 2020 to the identified target.
- Application of relevant reduction measures included in the AB 32 Scoping Plan that are within the jurisdiction of the local land use authority (such as building energy efficiency, etc.).
- Quantification of the reduction effectiveness of each of the feasible measures identified including disclosure of calculation method and assumptions.
- Identification of implementation steps and financing mechanisms to achieve the identified goal by 2020.
- Procedures for monitoring and updating the GHG inventory and reduction measures at least twice before 2020 or at least every five years.
- Identification of responsible parties for Implementation.
- Schedule of implementation.
- Certified CEQA document, or equivalent process (see below).

Local Climate Action Policies, Ordinances and Programs

Air District staff recognizes that many communities in the Bay Area have been proactive in planning for climate change but have not yet developed a stand-alone Climate Action

Plan that meets the above criteria. Many cities and counties have adopted climate action policies, ordinances and program that may in fact achieve the goals of a qualified climate action plan. Staff recommends that if a local jurisdiction can demonstrate that its collective set of climate action policies, ordinances and other programs is consistent with AB 32, includes requirements or feasible measures to reduce GHG emissions and achieves one of the following GHG emission reduction goals,[3] the AB 32 consistency demonstration should be considered equivalent to a qualified climate action plan:

- 1990 GHG emission levels,
- 15 percent below 2008 emission levels, or
- 28 percent below BAU Forecasts for 2020 (if including non-land use sector emissions in the local inventory; otherwise can use 26.2 percent if only including land use sector emissions).

Qualified Climate Action Plans that are tied to the AB 32 reduction goals would promote reductions on a plan level without impeding the implementation of GHG-efficient development, and would recognize the initiative of many Bay Area communities who have already developed or are in the process of developing a GHG reduction plan. The details required above for a qualified Climate Action Plan (or similar adopted policies, ordinances and programs) would provide the evidentiary basis for making CEQA findings that development consistent with the plan would result in feasible, measureable, and verifiable GHG reductions consistent with broad state goals such that projects approved under qualified Climate Action Plans or equivalent demonstrations would achieve their fair share of GHG emission reductions.

2.3.5 STATIONARY SOURCE GHG THRESHOLD

Staff's recommended threshold for stationary source GHG emissions is based on estimating the GHG emissions from combustion sources for all permit applications submitted to the Air District in 2005, 2006 and 2007. The analysis is based only on CO_2 emissions from stationary sources, as that would cover the vast majority of the GHG emissions due to stationary combustion sources in the SFBAAB. The estimated CO_2 emissions were calculated for the maximum permitted amount, i.e. emissions that would be emitted if the sources applying for a permit application operate at maximum permitted load and for the total permitted hours. All fuel types are included in the estimates. For boilers burning natural gas, diesel fuel is excluded since it is backup fuel and is used only if natural gas is not available. Emission values are estimated before any offsets (i.e., Emission Reduction Credits) are applied. GHG emissions from mobile sources, electricity use and water delivery associated with the operation of the permitted sources are not included in the estimates.

[3] Lead agencies using consistency with their jurisdiction's climate action policies, ordinances and programs as a measure of significance under CEQA Guidelines section 15064(h)(3) should ensure that the policies, ordinances and programs satisfy all of the requirements of that subsection before relying on them in a CEQA analysis.

It is projected that a threshold level of 10,000 metric tons of CO_2e per year would capture approximately 95 percent of all GHG emissions from new permit applications from stationary sources in the SFBAAB. That threshold level was calculated as an average of the combined CO_2 emissions from all stationary source permit applications submitted to the Air District during the three year analysis period.

Staff recommends this 10,000 MT of CO_2/yr as it would address a broad range of combustion sources and thus provide for a greater amount of GHG reductions to be captured and mitigated through the CEQA process. As documented in the Scoping Plan, in order to achieve statewide reduction targets, emissions reductions need to be obtained through a broad range of sources throughout the California economy and this threshold would achieve this purpose. While this threshold would capture 95 percent of the GHG emissions from new permit applications, the threshold would do so by capturing only the large, significant projects. Permit applications with emissions above the 10,000 MT of CO_2/yr threshold account for less than 10 percent of stationary source permit applications which represent 95 percent of GHG emissions from new permits analyzed during the three year analysis period.

This threshold would be considered an interim threshold and Air District staff will reevaluate the threshold as AB 32 Scoping Plan measures such as cap and trade are more fully developed and implemented at the state level.

2.3.6 SUMMARY OF JUSTIFICATION FOR GHG THRESHOLDS

The bright-line numeric threshold of 1,100 MT CO_2e/yr is a numeric emissions level below which a project's contribution to global climate change would be less than "cumulatively considerable." This emissions rate is equivalent to a project size of approximately 60 single-family dwelling units, and approximately 59 percent of all future projects and 92 percent of all emissions from future projects would exceed this level. For projects that are above this bright-line cutoff level, emissions from these projects would still be less than cumulatively significant if the project as a whole would result in an efficiency of 4.6 MT CO_2e per service population or better for mixed-use projects. Projects with emissions above 1,100 MT CO_2e/yr would therefore still be less than significant if they achieved project efficiencies below these levels. If projects as proposed exceed these levels, they would be required to implement mitigation measures to bring them back below the 1,100 MT CO_2e/yr bright-line cutoff or within the 4.6 MT CO_2e Service Population efficiency threshold. If mitigation did not bring a project back within the threshold requirements, the project would be cumulatively significant and could be approved only with a Statement of Overriding Considerations and a showing that all feasible mitigation measures have been implemented. Projects' GHG emissions would also be less than significant if they comply with a Qualified Climate Action Plan.

As explained in the preceding analyses of these thresholds, the greenhouse gas emissions from land use projects expected between now and 2020 built in compliance with these thresholds would be approximately 26 percent below BAU 2020 conditions and thus would be consistent with achieving an AB 32 equivalent reduction. The 26 percent

reduction from BAU 2020 from new projects built in conformance with these proposed thresholds would achieve an aggregate reduction of approximately 1.6 MMT CO_2e/yr, which is the level of emission reductions from new Bay Area land use sources needed to meet the AB 32 goals, per ARB's Scoping Plan as discussed above.

Projects with greenhouse gas emissions in conformance with these proposed thresholds would therefore not be considered significant for purposes of CEQA. Although the emissions from such projects would add an incremental amount to the overall greenhouse gas emissions that cause global climate change impacts, emissions from projects consistent with these thresholds would not be a "cumulatively considerable" contribution under CEQA. Such projects would not be "cumulatively considerable" because they would be helping to solve the cumulative problem as a part of the AB 32 process.

California's response to the problem of global climate change is to reduce greenhouse gas emissions to 1990 levels by 2020 under AB 32 as a near-term measure and ultimately to 80 percent below 1990 levels by 2050 as the long-term solution to stabilizing greenhouse gas concentrations in the atmosphere at a level that will not cause unacceptable climate change impacts. To implement this solution, the Air Resources Board has adopted a Scoping Plan and budgeted emissions reductions that will be needed from all sectors of society in order to reach the interim 2020 target.

The land-use sector in the Bay Area needs to achieve aggregate emission reductions of approximately 1.6 MMT CO_2e/yr from new projects between now and 2020 to achieve this goal, as noted above, and each individual new project will need to achieve its own respective portion of this amount in order for the Bay Area land use sector as a whole to achieve its allocated emissions target. Building all of the new projects expected in the Bay Area between now and 2020 in accordance with the thresholds that District staff are proposing will achieve the overall appropriate share for the land use sector, and building each individual project in accordance with the proposed thresholds will achieve that individual project's respective portion of the emission reductions needed to implement the AB 32 solution. For these reasons, projects built in conformance with the proposed thresholds will be part of the solution to the cumulative problem, and not part of the continuing problem. They will allow the Bay Area's land use sector to achieve the emission reductions necessary from that sector for California to implement its solution to the cumulative problem of global climate change. As such, even though such projects will add an incremental amount of greenhouse gas emissions, their incremental contribution will be less than "cumulatively considerable" because they are helping to achieve the cumulative solution, not hindering it. Such projects will therefore not be "significant" for purposes of CEQA. (*See* CEQA Guidelines §15064(h)(1).)

The conclusion that land use projects that comply with these proposed thresholds is also supported by CEQA Guidelines Section 15030(a)(3), which provides that a project's contribution to a cumulative problem can be less that cumulatively considerable "if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact." In the case of greenhouse gas emissions associated with land use projects, achieving the amount of emission reductions below BAU that will be required to achieve the AB 32 goals is the project's "fair share" of the

overall emission reductions needed under ARB's scoping plan to reach the overall statewide AB 32 emissions levels for 2020. If a project is designed to implement greenhouse gas mitigation measures that achieve a level of reductions consistent with what is required from all new land use projects to achieve the land use sector "budget" – *i.e.*, keeping overall project emissions below 1,100 MT CO_2e/yr or ensuring that project efficiency is better than 4.6 MT CO_2e/service population – then it will be implementing its share of the mitigation measures necessary to alleviate the cumulative impact, as shown in the analyses set forth above.

It is also worth noting that this "fair share" approach is flexible and will allow a project's significance to be determined by how well it is designed from a greenhouse-gas efficiency standpoint, and not just by the project's size. For example, a large high-density infill project located in an urban core nearby to public transit and other alternative transportation options, and built using state-of-the-art energy efficiency methods and improvements such as solar panels, as well as all other feasible mitigation measures, would not become significant for greenhouse gas purposes (and thus require a Statement of Overriding Considerations in order to be approved) simply because it happened to be a large project. Projects such as this hypothetical development with low greenhouse-gas emissions per service population are what California will need in the future in order to do its part in achieving a solution to the problem of global climate change. The determination of significance under CEQA should therefore take these factors into account, and staff's proposed significance thresholds would achieve this important policy goal. In all, land use sector projects that comply with the GHG thresholds would not be "cumulatively considerable" because they would be helping to solve the cumulative problem as a part of the AB 32 process.

Likewise, new Air District permit applications for stationary sources that comply with the quantitative threshold of 10,000 MT CO_2e/yr would not be "cumulatively considerable" because they also would not hinder the state's ability to solve the cumulative greenhouse gas emissions problem pursuant to AB 32. Unlike the land use sector, the AB 32 Scoping Plan measures, including the cap-and-trade program, provide for necessary emissions reductions from the stationary source sector to achieve AB 32 2020 goals.

While stationary source projects will need to comply with the cap-and-trade program once it is enacted and reduce their emissions accordingly, the program will be phased in over time starting in 2012 and at first will only apply to the very largest sources of GHG emissions. In the mean time, certain stationary source projects, particularly those with large GHG emissions, still will have a cumulatively considerable impact on climate change. The 10,000 MT CO_2e/yr threshold will capture 95 percent of the stationary source sector GHG emissions in the Bay Area. The five percent of emissions that are from stationary source projects below the 10,000 MT CO_2e/yr threshold account for a small portion of the Bay Area's total GHG emissions from stationary sources and these emissions come from very small projects. Such small stationary source projects will not significantly add to the global problem of climate change, and they will not hinder the Bay Area's ability to reach the AB 32 goal in any significant way, even when considered cumulatively. In Air District's staff's judgment, the potential environmental benefits from

requiring EIRs and mitigation for these projects would be insignificant. In all, based on staff's expertise, stationary source projects with emissions below 10,000 MT CO_2e/yr will not provide a cumulatively considerable contribution to the cumulative impact of climate change.

3 COMMUNITY RISK AND HAZARD THRESHOLDS

To address community risk from air toxics, the Air District initiated the Community Air Risk Evaluation (CARE) program in 2004 to identify locations with high levels of risk from ambient toxic air contaminants (TAC) co-located with sensitive populations and use the information to help focus mitigation measures. Through the CARE program, the Air District developed an inventory of TAC emissions for 2005 and compiled demographic and heath indicator data. According to the findings of the CARE Program, diesel PM—mostly from on and off-road mobile sources—accounts for over 80 percent of the inhalation cancer risk from TACs in the Bay Area (BAAQMD 2006).

The Air District applied a regional air quality model using the 2005 emission inventory data to estimate excess cancer risk from ambient concentrations of important TAC species, including diesel PM, 1,3-butadiene, benzene, formaldehyde and acetaldehyde. The highest cancer risk levels from ambient TAC in the Bay Area tend to occur in the core urban areas, along major roadways and adjacent to freeways and port activity. Cancer risks in areas along these major freeways are estimated to range from 200 to over 500 excess cases in a million for a lifetime of exposure. Priority communities within the Bay Area – defined as having higher emitting sources, highest air concentrations, and nearby low income and sensitive populations – include the urban core areas of Concord, eastern San Francisco, western Alameda County, Redwood City/East Palo Alto, Richmond/San Pablo, and San Jose.

Fifty percent of BAAQMD's population was estimated to have an ambient background inhalation cancer risk of less than 500 cases in one million, based on emission levels in 2005. Table 8 presents a summary of percentages of the population exposed to varying levels of cancer risk from ambient TACs. Approximately two percent of the SFBAAB population is exposed to background risk levels of less than 200 excess cases in one million. This is in contrast to the upper percentile ranges where eight percent of the SFBAAB population is exposed to background risk levels of greater than 1,000 excess cases per one million. To identify and reduce risks from TAC, this chapter presents thresholds of significance for both cancer risk and non-cancer health hazards.

Table 8 – Statistical Summary of Estimated Population-Weighted Ambient Cancer Risk in 2005	
Percentage of Population (Percent below level of ambient risk)	**Ambient Cancer Risk (inhalation cancer cases in one million)**
92	1,000
90	900
83	800
77	700
63	600
50	500
32	400
13	300
2	200
<1	100
Source: Data compiled by EDAW 2009.	

Many scientific studies have linked fine particulate matter and traffic-related air pollution to respiratory illness (Hiltermann et al. 1997, Schikowski et al 2005, Vineis et al. 2007) and premature mortality (Dockery 1993, Pope et al. 1995, Jerrett et al. 2005). Traffic-related air pollution is a complex mix of chemical compounds (Schauer et al. 2006), often spatially correlated with other stressors, such as noise and poverty (Wheeler and Ben-Shlomo 2005). While such correlations can be difficult to disentangle, strong evidence for adverse health effects of fine particulate matter ($PM_{2.5}$) has been developed for regulatory applications in a recent consensus-based study by the California Air Resources Board. This study found that a 10 percent increase in $PM_{2.5}$ concentrations increased the non-injury death rate by 10 percent (ARB 2008).

Public Health Officers for four counties in the San Francisco Bay Area in 2009 provided testimony to the Air District's Advisory Council (February 11, 2009, Advisory Council Meeting on Air Quality and Public Health). Among the recommendations made, was that $PM_{2.5}$, in addition to TACs, be considered in assessments of community-scale impacts of air pollution. In consideration of the scientific studies and recommendations by the Bay Area Health Directors, it is apparent that, in addition to the significance thresholds for local-scale TAC, thresholds of significance are required for near-source, local-scale concentrations of $PM_{2.5}$.

3.2 PROPOSED THRESHOLDS OF SIGNIFICANCE

Proposed thresholds of significance and Board-requested options are presented in this section:

- The **Staff Proposal** includes thresholds for cancer risk, non-cancer health hazards, and fine particulate matter.

- **Board Option 1** includes tiered thresholds for new sources in impacted communities. Thresholds for receptors and cumulative impacts are the same as the Staff Proposal.
- **Board Option 2** removes the option for a qualified Community Risk Reduction Plan from the Staff Proposal.

Proposal/Option	Construction-Related	Operational-Related
Project-Level – Individual Project		
Risks and Hazards (Individual Project) **Staff Proposal**	Same as Operational Thresholds*	**All Areas:** Siting a New Source or Receptor Compliance with Qualified Risk Reduction Plan OR Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor
Risks and Hazards (Individual Project) **Board Option 1** **Tiered Thresholds**	Same as Operational Thresholds*	**Impacted Communities:** Siting a New Source Compliance with Qualified Risk Reduction Plan OR Increased cancer risk of >5.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.2 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor
	Same as Operational Thresholds*	**Impacted Communities:** Siting a New Receptor **All Other Areas:** Siting a New Source or Receptor Compliance with Qualified Risk Reduction Plan OR Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor

Proposal/Option	Construction-Related	Operational-Related
Risks and Hazards (Individual Project) **Board Option 2** **Quantitative Thresholds**	Same as Operational Thresholds*	**All Areas**: Siting a New Source or Receptor Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average Zone of Influence: 1,000-foot radius from fence line of source or receptor
Accidental Release of Acutely Hazardous Air Pollutants	None	Storage or use of acutely hazardous materials locating near receptors or receptors locating near stored or used acutely hazardous materials considered significant
Project-Level – Cumulative		
Risks and Hazards (Cumulative Thresholds)	Same as Operational Thresholds*	**All Areas**: Siting a New Source or Receptor Compliance with Qualified Risk Reduction Plan OR Cancer: > 100 in a million (from all local sources) Non-cancer: > 1.0 Hazard Index (from all local sources) (Chronic or Acute) $PM_{2.5}$: > 0.8 µg/m^3 annual average (from all local sources) Zone of Influence: 1,000-foot radius from fence line of source or receptor
Plan-Level		
Plans	None	1. Overlay zones around existing and planned sources of TACs (including adopted Risk Reduction Plan areas) and odors. 2. Overlay zones of at least 500 feet (or Air District-approved modeled distance) from all freeways and high volume roadways.
Accidental Release of Acutely Hazardous Air Pollutants	None	None

* Note: The Air District recommends that for construction projects that are less than one year duration, Lead Agencies should annualize impacts over the scope of actual days that peak impacts are to occur, rather than the full year.

3.3 JUSTIFICATION AND SUBSTANTIAL EVIDENCE SUPPORTING THRESHOLDS

The goal of the proposed thresholds is to ensure that no source creates, or receptor endures, a significant adverse impact from any individual project, and that the total of all nearby directly emitted risk and hazard emissions is also not significantly adverse. The thresholds for local risks and hazards from TAC and $PM_{2.5}$ are intended to apply to all sources of emissions, including both permitted stationary sources and on- and off-road mobile sources, such as sources related to construction, busy roadways, or freight movement.

Thresholds for an individual new source are designed to ensure that the source does not contribute a cumulatively significant impact. Cumulative thresholds for sources recognize that some areas are already near or at levels of significant impact. If within such an area there are receptors, or it can reasonably be foreseen that there will be receptors, then a cumulative significance threshold sets a level beyond which any additional risk is significant.

For new receptors – sensitive populations or the general public – thresholds of significance are designed to identify levels of contributed risk or hazards from existing local sources that pose a significant risk to the receptors. Single-source thresholds for receptors are provided to recognize that within the area defined there can be variations in risk levels that may be significant. Single-source thresholds assist in the identification of significant risks, hazards, or concentrations in a subarea, within the area defined by the selected radius. Cumulative thresholds for receptors are designed to account for the effects of all sources within the defined area.

Cumulative thresholds, for both sources and receptors, must consider the size of the source area, defined by a radius from the proposed project. To determine cumulative impacts from a prescribed zone of influence requires the use of modeling. The larger the radius, the greater the number of sources considered that may contribute to the modeled risk and, until the radius approaches a regional length scale, the greater the expected modeled risk increment. If the area of impact considered were grown to the scale of a city, the modeled risk increment would approach the risk level present in the ambient air.

3.3.1 SCIENTIFIC AND REGULATORY JUSTIFICATION

Regulatory Framework for TACs

Prior to 1990, the Clean Air Act required EPA to list air toxics it deemed hazardous and to establish control standards which would restrict concentrations of hazardous air pollutants (HAP) to a level that would prevent any adverse effects “with an ample margin of safety.” By 1990, EPA had regulated only seven such pollutants and it was widely acknowledged by that time that the original Clean Air Act had failed to address toxic air emissions in any meaningful way. As a result, Congress changed the focus of regulation in 1990 from a risk-based approach to technology-based standards. Title III, Section 112(b) of the 1990 Clean Air Act Amendment established this new regulatory approach.

Under this framework, prescribed pollution control technologies based upon maximum achievable control technology (MACT) were installed without the a priori estimation of the health or environmental risk associated with each individual source. The law listed 188 HAPs that would be subject to the MACT standards. EPA issued 53 standards for 89 different types of major industrial sources of air toxics and eight categories of smaller sources such as dry cleaners. These requirements took effect between 1996 and 2002. Under the federal Title V Air Operating Permit Program, a facility with the potential to emit 10 tons of any toxic air pollutant, or 25 tons per year of any combination of toxic air pollutants, is defined as a major source HAPs. Title V permits include requirements for these facilities to limit toxic air pollutant emissions.

Several state and local agencies adopted programs to address gaps in EPA's program prior to the overhaul of the national program in 1990. California's program to reduce exposure to air toxics was established in 1983 by the Toxic Air Contaminant Identification and Control Act (AB 1807, Tanner 1983) and the Air Toxics "Hot Spots" Information and Assessment Act (AB 2588, Connelly 1987). Under AB 1807, ARB and the Office of Environmental Health Hazard Assessment (OEHHA) determines if a substance should be formally identified as a toxic air contaminant (TAC) in California. OEHHA also establishes associated risk factors and safe concentrations of exposure.

AB 1807 was amended in 1993 by AB 2728, which required ARB to identify the 189 federal hazardous air pollutants as TACs. AB 2588 (Connelly, 1987) supplements the AB 1807 program, by requiring a statewide air toxics inventory, notification of people exposed to a significant health risk, and facility plans to reduce these risks. In September 1992, the "Hot Spots" Act was amended by Senate Bill 1731 which required facilities that pose a significant health risk to the community to reduce their risk through a risk management plan.

Cancer Risk

Cancer risk from TACs is typically expressed in numbers of excess cancer cases per million persons exposed over a defined period of exposure, for example, over an assumed 70 year lifetime. The Air District is not aware of any agency that has established an acceptable level of cancer risk for TACs. However, a range of what constitutes a significant increment of cancer risk from any compound has been established by the U.S. EPA. EPA's guidance for conducting air toxics analyses and making risk management decisions at the facility- and community-scale level considers a range of acceptable cancer risks from one in a million to one in ten thousand (100 in a million). The guidance considers an acceptable range of cancer risk increments to be from one in a million to one in ten thousand. In protecting public health with an ample margin of safety, EPA strives to provide maximum feasible protection against risks to health from HAPs by limiting additional risk to a level no higher than the one in ten thousand estimated risk that a person living near a source would be exposed to at the maximum pollutant concentrations for 70 years. This goal is described in the preamble to the benzene National Emissions Standards for Hazardous Air Pollutants (NESHAP) rulemaking (54 Federal Register 38044, September 14, 1989) and is incorporated by Congress for EPA's residual risk program under Clean Air Act section 112(f).

Regulation 2, Rule 5 of the Air District specifies permit requirements for new and modified stationary sources of TAC. The Project Risk Requirement (2-5-302.1) states that the Air Pollution Control Officer shall deny an Authority to Construct or Permit to Operate for any new or modified source of TACs if the project cancer risk exceeds 10.0 in one million.

Hazard Index for Non-cancer Health Effects

Non-cancer health hazards for chronic and acute diseases are expressed in terms of a hazard index (HI), a ratio of TAC concentration to a reference exposure level (REL), below which no adverse health effects are expected, even for sensitive individuals. As such, OEHHA has defined acceptable concentration levels, and also significant concentration increments, for compounds that pose non-cancer health hazards. If the HI for a compound is less than one, non-cancer chronic and acute health impacts have been determined to be less than significant.

State and Federal Ambient Air Quality Standards for $PM_{2.5}$

The Children's Environmental Health Protection Act (Senate Bill 25), passed by the California state legislature in 1999, requires ARB, in consultation with OEHHA, to "review all existing health-based ambient air quality standards to determine whether, based on public health, scientific literature and exposure pattern data, these standards adequately protect the public, including infants and children, with an adequate margin of safety." As a result of the review requirement, in 2002 ARB adopted an annual average California Ambient Air Quality Standard (CAAQS) for $PM_{2.5}$ of 12 ug/m^3 that is not to be exceeded (California Code of Regulations, Title 17 § 70200, Table of Standards.) The National Ambient Air Quality Standard (NAAQS) established an annual standard for $PM_{2.5}$ (15 ug/m^3) that is less stringent that the CAAQS, but also set a 24-hour average standard (35 ug/m^3), which is not included in the CAAQS (Code of Federal Regulations, Title 40, Part 50.7).

Significant Impact Levels for $PM_{2.5}$

EPA recently proposed and documented alternative options for $PM_{2.5}$ Significant Impact Levels (SILs) (Federal Register 40 CFR Parts 51 and 52, September 21, 2007). The EPA is proposing to facilitate implementation of a $PM_{2.5}$ Prevention of Significant Deterioration (PSD) program in areas attaining the $PM_{2.5}$ NAAQS by developing $PM_{2.5}$ increments, or SILs. These "increments" are maximum increases in ambient $PM_{2.5}$ concentrations ($PM_{2.5}$ increments) allowed in an area above the baseline concentration.

The SIL is a threshold that would be applied to individual facilities that apply for a permit to emit a regulated pollutant in an area that meets the NAAQS. The State and EPA must determine if emissions from that facility will cause the air quality to worsen. If an individual facility projects an increase in emissions that result in ambient impacts greater than the established SIL, the permit applicant would be required to perform additional analyses to determine if those impacts will be more than the amount of the PSD increment. This analysis would combine the impact of the proposed facility when added to all other sources in the area.

The EPA is proposing such values for $PM_{2.5}$ that will be used as screening tools by a major source subject to PSD to determine the subsequent level of analysis and data gathering required for a PSD permit application for emissions of $PM_{2.5}$. The SIL is one element of the EPA program to prevent deterioration in regional air quality and is utilized in the new source review (NSR) process. New source review is required under Section 165 of the Clean Air Act, whereby a permit applicant must demonstrate that emissions from the proposed construction and operation of a facility "will not cause, or contribute to, air pollution in excess of any maximum allowable increase or maximum allowable concentration for any pollutant." The purpose of the SIL is to provide a screening level that triggers further analysis in the permit application process.

For the purpose of NSR, SILs are set for three types of areas: Class I areas where especially clean air is most desirable, including national parks and wilderness areas; Class II areas where there is not expected to be substantial industrial growth; and Class III areas where the highest relative level of industrial development is expected. In Class II and Class III areas, a $PM_{2.5}$ concentration of 0.3, 0.8, and 1 $\mu g/m^3$ has been proposed as a SIL. To arrive at the SIL $PM_{2.5}$ option of 0.8 $\mu g/m^3$, EPA scaled an established PM_{10} SILs of 1.0 $\mu g/m^3$ by the ratio of emissions of $PM_{2.5}$ to PM_{10} using the EPA's 1999 National Emissions Inventory. To arrive at the SIL option of 0.3 $\mu g/m^3$, EPA scaled the PM_{10} SIL of 1.0 $\mu g/m^3$ by the ratio of the current Federal ambient air quality standards for $PM_{2.5}$ and PM_{10} (15/50). These options represent what EPA currently considers as a range of appropriate SIL values.

EPA interprets the SIL to be the level of $PM_{2.5}$ increment that represents a "significant contribution" to regional non-attainment. While SIL options were not designed to be thresholds for assessing community risk and hazards, they are being considered to protect public health at a regional level by helping an area maintain the NAAQS. Furthermore, since it is the goal of the Air District to achieve and maintain the NAAQS and CAAQS at both regional and local scales, the SILs may be reasonably be considered as thresholds of significance under CEQA for local-scale increments of $PM_{2.5}$.

Roadway Proximity Health Studies

Several medical research studies have linked near-road pollution exposure to a variety of adverse health outcomes impacting children and adults. Kleinman et al. (2007) studied the potential of roadway particles to aggravate allergic and immune responses in mice. Using mice that were not inherently susceptible, the researchers placed these mice at various distances downwind of State Road 60 and Interstate 5 freeways in Los Angeles to test the effect these roadway particles have on their immune system. They found that within five meters of the roadway, there was a significant allergic response and elevated production of specific antibodies. At 150 meters (492 feet) and 500 meters (1,640 feet) downwind of the roadway, these effects were not statistically significant.

Another significant study (Ven Hee et al. 2009) conducted a survey involving 3,827 participants that aimed to determine the effect of residential traffic exposure on two preclinical indicators of heart failure; left ventricular mass index (LVMI), measured by the cardiac magnetic resonance imaging (MRI), and ejection fraction. The studies

classified participants based on the distance between their residence and the nearest interstate highway, state or local highway, or major arterial road. Four distance groups were defined: less than 50 meters (165 feet), 50-100 meters, 101-150 meters, and greater than 150 meters. After adjusting for demographics, behavioral, and clinical covariates, the study found that living within 50 meters of a major roadway was associated with a 1.4 g/m^2 higher LVMI than living more than 150 meters from one. This suggests an association between traffic-related air pollution and increased prevalence of a preclinical predictor of heart failure among people living near roadways.

To quantify the roadway concentrations of $PM_{2.5}$ that contributed to the health impacts reported by Kleinman et al (2007), the Air District modeled the emissions and associated particulate matter concentrations for the roadways studied. To perform the modeling, emissions were estimated for Los Angeles using the EMFAC model and annual average vehicle traffic data taken from Caltrans was used in the roadway model (CAL3QHCR) to estimate the downwind $PM_{2.5}$ concentrations at 50 meters and 150 meters. Additionally, emissions were assumed to occur from 10:00 a.m. to 2:00 p.m. corresponding to the time in which the mice were exposed during the study. The results of the modeling indicate that at 150 meters, where no significant health effects were found, the downwind concentration of $PM_{2.5}$ was 0.78 $\mu g/m^3$, consistent with the proposed EPA SIL option of 0.8 $\mu g/m^3$.

Concentration-Response Function for $PM_{2.5}$

In a recent report, ARB reevaluated the relative risk of premature death associated with $PM_{2.5}$ exposure based on a review of all relevant scientific literature available, and a new relative risk factor was developed (ARB 2008). This consensus-based review found that a 10 $\mu g/m^3$ increase in $PM_{2.5}$ concentrations increased the risk of premature death by 10 percent (uncertainty interval: 3 percent to 20 percent) and provides a basis for determining the risk increment from an increase in $PM_{2.5}$ concentration. Twelve experts participated in the study to review the literature and develop the concentration response function. The experts were selected through a two-part peer nomination process, designed to obtain a balanced set of views and included experts in epidemiology, toxicology, and medicine.

The methodologies and results presented in this report were endorsed by scientific advisors from Harvard University, OEHHA, and Brigham Young University. The report underwent an external peer review by experts selected through an independent process involving the University of California at Berkeley, Institute of the Environment. The results of the peer review process were incorporated into the report. Subsequent to the peer review, Schwartz et al. (2008) examined the linearity of the concentration-response function of $PM_{2.5}$-mortality and showed that the response function is in agreement with Laden et al. (2006) and, moreover, found that this response function was linear down to background levels.

San Francisco Ordinance on Roadway Proximity Health Effects

In 2008, the City and County of San Francisco adopted an ordinance (San Francisco Health Code, Article 38 - Air Quality Assessment and Ventilation Requirement for Urban

Infill Residential Development, Ord. 281-08, File No. 080934, December 5, 2008) requiring that public agencies in San Francisco take regulatory action to prevent future air quality health impacts from new sensitive uses proposed near busy roadways (SFDPH 2008). The regulation requires that developers screen sensitive use projects for proximity to traffic and calculate the concentration of $PM_{2.5}$ from traffic sources where traffic volumes suggest a potential hazard. If modeled levels of traffic-attributable $PM_{2.5}$ at a project site exceed an action level (currently set at 0.2 $\mu g/m^3$) developers would be required to incorporate ventilation systems to remove 80 percent of $PM_{2.5}$ from outdoor air. The regulation does not place any requirements on proposed sensitive uses if modeled air pollutant levels fall below the action threshold. This ordinance only considers impacts from on-road motor vehicles, not impacts related to construction equipment or stationary sources.

A report with supporting documentation for the ordinance (SFPHD 2008) provided a threshold to trigger action or mitigation of 0.2 $\mu g/m^3$ of $PM_{2.5}$ annual average exposure from roadway vehicles within a 150 meter (492 feet) maximum radius of a sensitive receptor. The report applied the concentration-response function from Jerrett et al. (2005) that attributed 14 percent increase in mortality to a 10 $\mu g/m^3$ increase in $PM_{2.5}$ to estimate an increase in non-injury mortality in San Francisco of about 21 excess deaths per year from a 0.2 $\mu g/m^3$ increment of annual average $PM_{2.5}$.

Distance for Significant Impact

The distance used for the radius around the project boundary should reflect the zone or area over which sources may have a significant influence. For cumulative thresholds, for both sources and receptors, this distance also determines the size of the source area, defined. To determine cumulative impacts from a prescribed zone of influence requires the use of modeling. The larger the radius, the greater the number of sources considered that may contribute to the risk and the greater the expected modeled risk increment. If the area of impact considered were grown to approach the scale of a city, the modeled risk increment would approach the risk level present in the ambient air.

A summary of research findings in ARB's Land Use Compatibility Handbook (ARB 2005) indicates that traffic-related pollutants were higher than regional levels within approximately 1,000 feet downwind and that differences in health-related effects (such as asthma, bronchitis, reduced lung function, and increased medical visits) could be attributed in part to the proximity to heavy vehicle and truck traffic within 300 to 1,000 feet of receptors. In the same summary report, ARB recommended avoiding siting sensitive land uses within 1,000 feet of a distribution center and major rail yard, which supports the use of a 1,000 feet evaluation distance in case such sources may be relevant to a particular project setting. A 1,000 foot zone of influence is also supported by Health & Safety Code §42301.6 (Notice for Possible Source Near School).

Some studies have shown that the concentrations of particulate matter tend to be reduced substantially or can even be indistinguishable from upwind background concentrations at a distance 1,000 feet downwind from sources such as freeways or large distribution centers. Zhu et al. (2002) conducted a systematic ultrafine particle study near Interstate

710, one of the busiest freeways in the Los Angeles Basin. Particle number concentration and size distribution were measured as a function of distances upwind and downwind of the I-710 freeway. Approximately 25 percent of the 12,180 vehicles per hour are heavy duty diesel trucks based on video counts conducted as part of the research. Measurements were taken at 13 feet, 23 feet, 55 feet, 252 feet, 449 feet, and 941 feet downwind and 613 feet upwind from the edge of the freeway. The particle number and supporting measurements of carbon monoxide and black carbon decreased exponentially and all constituents simultaneously tracked with each other as one moves away from the freeway. Ultrafine particle size distribution changed markedly and its number concentrations dropped dramatically with increasing distance. The study found that ultrafine particle concentrations measured 941 feet downwind of I-710 were indistinguishable from the upwind background concentration.

Impacted Communities

Starting in 2006, the Air District's CARE program developed gridded TAC emissions inventories and compiled demographic information that were used to identify communities that were particularly impacted by toxic air pollution for the purposes of distributing grant and incentive funding. In 2009, the District completed regional modeling of TAC on a one kilometer by one kilometer grid system. This modeling was used to estimate cancer risk and TAC population exposures for the entire District. The information derived from the modeling was then used to update and refine the identification of impacted communities. One kilometer modeling yielded estimates of annual concentrations of five key compounds – diesel particulate matter, benzene, 1,3-butadiene, formaldehyde, and acetaldehyde – for year 2005. These concentrations were multiplied by their respective unit cancer risk factors, as established by OEHHA, to estimate the expected excess cancer risk per million people from these compounds.

Sensitive populations from the 2000 U.S. Census database were identified as youth (under 18) and seniors (over 64) and mapped to the same one kilometer grid used for the toxics modeling. Excess cancers from TAC exposure were determined by multiplying these sensitive populations by the model-estimated excess risk to establish a data set representing sensitive populations with high TAC exposures. TAC emissions (year 2005) were mapped to the one kilometer grid and also scaled by their unit cancer risk factor to provide a data set representing source regions for TAC emissions. Block-group level household income data from the U.S. Census database were used to identify block groups with family incomes where more than 40 percent of the population was below 185 percent of the federal poverty level (FPL). Poverty-level polygons that intersect high (top 50 percent) exposure cells and are within one grid cell of a high emissions cell (top 25 percent) were used to identify impacted areas. Boundaries were constructed along major roads or highways that encompass nearby high emission cells and low income areas. This method identified the following six areas as priority communities: (1) portions of the City of Concord; (2) Western Contra Costa County (including portions of the Cities of Richmond and San Pablo); (3) Western Alameda County along the Interstate-880 corridor (including portions of the Cities of Berkeley, Oakland, San Leandro, San Lorenzo, Hayward; (4) Portions of the City of San Jose. (5) Eastern San Mateo County

(including portions of the Cities of Redwood City and East Palo Alto); and (6) Eastern portions of the City of San Francisco.

3.3.2 CONSTRUCTION, LAND USE AND STATIONARY SOURCE RISK AND HAZARD THRESHOLDS

The proposed options for local risk and hazards thresholds of significance are based on U.S. EPA guidance for conducting air toxics analyses and making risk management decisions at the facility and community-scale level. The thresholds consider reviews of recent health effects studies that link increased concentrations of fine particulate matter to increased mortality. The proposed thresholds would apply to both siting new sources and siting new receptors.

For new sources of TACs, thresholds of significance for a single source are designed to ensure that emissions do not raise the risk of cancer or non-cancer health impacts to cumulatively significant levels. For new sources of $PM_{2.5}$, thresholds are designed to ensure that $PM_{2.5}$ concentrations are maintained below state and federal standards in all areas where sensitive receptors or members of the general public live or may foreseeably live, even if at the local- or community-scale where sources of TACs and PM may be nearby.

Project Radius for Assessing Impacts

For a project proposing a new source or receptor it is recommended to assess impacts within 1,000 feet, taking into account both its individual and nearby cumulative sources (i.e. proposed project plus existing and foreseeable future projects). Cumulative sources are the combined total risk values of each individual source within the 1,000-foot evaluation zone. A lead agency should enlarge the 1,000-foot radius on a case-by-case basis if an unusually large source or sources of risk or hazard emissions that may affect a proposed project is beyond the recommended radius.

The 1,000 foot radius is consistent with findings in ARB's Land Use Compatibility Handbook (ARB 2005), the Health & Safety Code §42301.6 (Notice for Possible Source Near School), and studies such as that of Zhu et al (2002) which found that concentrations of particulate matter tend to be reduced substantially at a distance 1,000 feet downwind from sources such as freeways or large distribution centers.

Qualified Community Risk Reduction Plan

Within the framework of these thresholds, proposed projects would be considered to be less than significant if they are consistent with a qualified Community Risk Reduction Plan (CRRP) adopted by the local jurisdiction with enforceable measures to reduce the community risk. Board Option 2 does not include the CCRP as a significance threshold.

Project proposed in areas where a CRRP has been adopted that are not consistent with the CRRP would be considered to have a significant impact.

Projects proposed in areas where a CRRP has not been adopted and that have the potential to expose sensitive receptors or the general public to emissions-related risk in excess of the thresholds below from any source would be considered to have a significant air quality impact.

The conclusion that land use projects that comply with qualified Community Risk Reduction Plans are less than significant is supported by CEQA Guidelines Sections 15030(a)(3) and 15064(h)(3), which provides that a project's contribution to a cumulative problem can be less that cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact.

Increased Cancer Risk to Maximally Exposed Individual (MEI)

Emissions from a new source or emissions affecting a new receptor would be considered significant where ground-level concentrations of carcinogenic TACs from any source result in an increased cancer risk greater than 10.0 in one million, assuming a 70 year lifetime exposure. Under Board Option 1, within Impacted Communities as defined through the CARE program, the significance level for cancer would be reduced to 5.0 in one million for new sources.

The 10.0 in one million cancer risk threshold for a single source is supported by EPA's guidance for conducting air toxics analyses and making risk management decisions at the facility and community-scale level. It is also the level set by the Project Risk Requirement in the Air District's Regulation 2, Rule 5 new and modified stationary sources of TAC, which states that the Air Pollution Control Officer shall deny an Authority to Construct or Permit to Operate for any new or modified source of TACs if the project risk exceeds a cancer risk of 10.0 in one million.

This threshold for an individual new source is designed to ensure that the source does not contribute a cumulatively significant impact. The justification for the Board Option 1 threshold of 5.0 in one million for new sources in an impacted community is that in these areas the cancer risk burden is higher than in other parts of the Bay Area; the threshold at which an individual source becomes significant is lower for an area that is already at or near unhealthy levels. However, even without a tiered approach, the recommended thresholds already address the burden of impacted communities via the cumulative thresholds: specifically, if an area has many existing TAC sources near receptors, then the cumulative threshold will be reached sooner than it would in another area with fewer TAC sources.

The single-source threshold for receptors is provided to address the possibility that within the area defined by the 1,000 foot radius there can be variations in risk levels that may be significant, below the corresponding cumulative threshold. Single-source thresholds assist in the identification of significant risks, hazards, or concentrations in a subarea, within the 1,000 foot radius.

Increased Non-Cancer Risk to MEI

Emissions from a new source or emissions affecting a new receptor would be considered significant where ground-level concentrations of non-carcinogenic TACs result in an increased chronic or acute Hazard Index (HI) from any source greater than 1.0. This threshold is unchanged under Board Option 1.

A HI less than 1.0 represents a TAC concentration, as determined by OEHHA that is at a health protective level. While some TACs pose non-carcinogenic, chronic and acute health hazards, if the TAC concentrations result in a HI less than one, those concentrations have been determined to be less than significant.

Increased Ambient Concentration of $PM_{2.5}$

Emissions from a new source or emissions affecting a new receptor would be considered significant where ground-level concentrations of $PM_{2.5}$ from any source would result in an average annual increase greater than 0.3 $\mu g/m^3$. Under Board Option 1, within Impacted Communities as defined through the CARE program, the significance level for a $PM_{2.5}$ increment is 0.2 $\mu g/m^3$.

If one applies the concentration-response function from the ARB consensus review (ARB 2008) and attribute a 10 percent increase in mortality to a 10 $\mu g/m^3$ increase in $PM_{2.5}$, one finds an increase in non-injury mortality in the Bay Area of about 20 excess deaths per year from a 0.3 $\mu g/m^3$ increment of $PM_{2.5}$. This is consistent with the impacts reported and considered significant by SFDPH (2008) using an earlier study (Jerrett et al. 2005) to estimate the increase in mortality from a 0.2 $\mu g/m^3$ $PM_{2.5}$ increment.

The SFDPH recommended a lower threshold of significance for multiple sources but only considered roadway emissions within a 492 foot radius. This recommendation applies to a single source but considers all types of emissions within 1,000 feet. On balance, the Air District estimates that the SFDPH threshold and this proposed one, in combination with the cumulative threshold for $PM_{2.5}$, will afford similar levels of health protection.

The proposed $PM_{2.5}$ threshold represents the lower range of an EPA proposed Significant Impact Level (SIL). EPA interprets the SIL to be the level of ambient impact that is considered to represent a "significant contribution" to regional non-attainment. While this threshold was not designed to be a threshold for assessing community risk and hazards, it was designed to protect public health at a regional level by helping an area maintain the NAAQS. Since achieving and maintaining state and federal AAQS is a reasonable goal at the local scale, the SIL provides a useful reference for comparison.

This threshold for an individual new source is designed to ensure that the source does not contribute a cumulatively significant impact. The justification for the Board Option 1 threshold of 0.2 $\mu g/m^3$ for new sources in an impacted community is that these areas have higher levels of diesel particulate matter than do other parts of the Bay Area; the threshold at which an individual source becomes significant is lower for an area that is already at or near unhealthy levels. However, even without a tiered approach, the recommended thresholds already address the burden of impacted communities via the

cumulative thresholds: specifically, if an area has many existing $PM_{2.5}$ sources near receptors, then the cumulative threshold will be reached sooner than it would in another area with fewer $PM_{2.5}$ sources.

The single-source threshold for receptors is provided to address the possibility that within the area defined by the 1,000 foot radius there can be variations in risk levels that may be significant, below the corresponding cumulative threshold. Single-source thresholds assist in the identification of significant risks, hazards, or concentrations in a subarea, within the 1,000 foot radius.

3.3.2.1 ACCIDENTAL RELEASE OF ACUTELY HAZARDOUS AIR EMISSIONS

The BAAQMD currently recommends, at a minimum, that the lead agency, in consultation with the administering agency of the Risk Management Prevention Program (RMPP), find that any project resulting in receptors being within the Emergency Response Planning Guidelines (ERPG) exposure level 2 for a facility has a significant air quality impact. ERPG exposure level 2 is defined as "the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action."

Staff proposes continuing with the current threshold for the accidental release of hazardous air pollutants. Staff recommends that agencies consult with the California Emergency Management Agency for the most recent guidelines and regulations for the storage of hazardous materials. Staff proposes that projects using or storing acutely hazardous materials locating near existing receptors, and projects resulting in receptors locating near facilities using or storing acutely hazardous materials be considered significant.

The current Accidental Release/Hazardous Air Emissions threshold of significance could affect all projects, regardless of size, and require mitigation for Accidental Release/Hazardous Air Emissions impacts.

3.3.3 CUMULATIVE RISK AND HAZARD THRESHOLDS

Qualified Community Risk Reduction Plan

Proposed projects would be considered to be less than significant if they are consistent with a qualified Community Risk Reduction Plan (CRRP) adopted by the local jurisdiction with enforceable measures to reduce the community risk. Board Option 2 does not include the CCRP as a significance threshold.

Project proposed in areas where a CRRP has been adopted that are not consistent with the CRRP would be considered to have a significant impact.

Projects proposed in areas where a CRRP has not been adopted and that have the potential to expose sensitive receptors or the general public to emissions-related risk in

excess of the following thresholds from the aggregate of cumulative sources would be considered to have a significant air quality impact.

The conclusion that land use projects that comply with qualified Community Risk Reduction Plans are less than significant is supported by CEQA Guidelines Sections 15030(a)(3) and 15064(h)(3), which provides that a project's contribution to a cumulative problem can be less that cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact.

Increased Cancer Risk to Maximally Exposed Individual (MEI)

Emissions from a new source or emissions affecting a new receptor would be considered significant where ground-level concentrations of carcinogenic TACs from any source result in an increased cancer risk greater than 100.0 in one million.

The significance threshold of 100 in a million increased excess cancer risk would be applied to the cumulative emissions. The 100 in a million threshold is based on EPA guidance for conducting air toxics analyses and making risk management decisions at the facility and community-scale level. In protecting public health with an ample margin of safety, EPA strives to provide maximum feasible protection against risks to health from hazardous air pollutants (HAPs) by limiting risk to a level no higher than the one in ten thousand (100 in a million) estimated risk that a person living near a source would be exposed to at the maximum pollutant concentrations for 70 years (NESHAP 54 Federal Register 38044, September 14, 1989; CAA section 112(f)). One hundred in a million excess cancer cases is also consistent with the ambient cancer risk in the most pristine portions of the Bay Area based on the District's recent regional modeling analysis.

Increased Non-Cancer Risk to MEI

Emissions from a new source or emissions affecting a new receptor would be considered significant where ground-level concentrations of non-carcinogenic TACs result in an increased chronic or acute Hazard Index from any source greater than 1.0.

OEHHA has defined acceptable concentration levels for compounds that pose non-cancer health hazards. If the HI for a compound is less than one, non-cancer chronic and acute health impacts have been determined to be less than significant.

Increased Ambient Concentration of $PM_{2.5}$

Emissions from a new source or emissions affecting a new receptor would be considered significant where ground-level concentrations of $PM_{2.5}$ from any source would result in an average annual increase greater than 0.8 $\mu g/m^3$.

If one applies the concentration-response function from the ARB consensus review (ARB 2008) and attributes a 10 percent increase in mortality to a 10 $\mu g/m^3$ increase in $PM_{2.5}$, one finds an increase in non-injury mortality in the Bay Area of about 50 excess deaths per year from a 0.8 $\mu g/m^3$ increment of $PM_{2.5}$. This is greater the impacts reported and considered significant by SFDPH (2008) using an earlier study (Jerrett et al. 2005) to

estimate the increase in mortality from a 0.2 μg/m^3 $PM_{2.5}$ increment (SFDPH reported 21 excess deaths per year). However, SFDPH only considered roadway emissions within a 492 foot radius. This proposed threshold applies to all types of emissions within 1,000 feet. In modeling applications for proposed projects, a larger radius results in a greater number of sources considered and higher modeled concentrations. On balance, the Air District estimates that the SFDPH threshold and this proposed one, in combination with the individual source threshold for $PM_{2.5}$, will afford similar levels of health protection.

The proposed cumulative $PM_{2.5}$ threshold represents the middle range of an EPA proposed Significant Impact Level (SIL). EPA interprets the SIL to be the level of ambient impact that is considered to represent a "significant contribution" to regional non-attainment. While this threshold was not designed to be a threshold for assessing community risk and hazards, it was designed to protect public health at a regional level by helping an area maintain the NAAQS. Since achieving and maintaining state and federal AAQS is a reasonable goal at the local scale, the SIL provides a useful reference for comparison. Furthermore, the 0.8 μg/m^3 threshold is consistent with studies (Kleinman et al 2007) that examined the potential health impacts of roadway particles.

3.3.4 PLAN-LEVEL RISK AND HAZARD THRESHOLDS

Staff proposes plan-level thresholds that will encourage a programmatic approach to addressing the overall adverse conditions resulting from risks and hazards that many Bay Area communities experience. By designating overlay zones in land use plans, local land use jurisdictions can take preemptive action before project-level review to reduce the potential for significant exposures to risk and hazard emissions. While this will require more up-front work at the general plan level, in the long-run this approach is a more feasible approach consistent with Air District and CARB guidance about siting sources and sensitive receptors that is more effective than project by project consideration of effects that often has more limited mitigation opportunities. This approach would also promote more robust cumulative consideration of effects of both existing and future development for the plan-level CEQA analysis as well as subsequent project-level analysis.

For local plans to have a less-than-significant impact with respect to potential risks and hazards, overlay zones would have to be established around existing and proposed land uses that would emit these air pollutants. Overlay zones to avoid risk impacts should be reflected in local plan policies, land use map(s), and implementing ordinances (e.g., zoning ordinance). The overlay zones around existing and future risk sources would be delineated using the quantitative approaches described above for project-level review and the resultant risk buffers would be included in the General Plan (or the EIR for the General Plan) to assist in site planning. BAAQMD will provide guidance as to the methods used to establish the TAC buffers and what standards to be applied for acceptable exposure level in the updated CEQA Guidelines document. Special overlay zones of at least 500 feet (or an appropriate distance determined by modeling and approved by the Air District) on each side of all freeways and high volume roadways would be included in this proposed threshold.

The threshold of significance for plan impacts could affect all plan adoptions and amendments and require mitigation for a plan's air quality impacts. Where sensitive receptors would be exposed above the acceptable exposure level, the plan impacts would be considered significant and mitigation would be required to be imposed either at the plan level (through policy) or at the project level (through project level requirements).

3.3.5 COMMUNITY RISK REDUCTION PLANS

The goal of a Community Risk Reduction Plan would be to bring TAC and $PM_{2.5}$ concentrations for the entire community covered by the Plan down to acceptable levels as identified by the local jurisdiction and approved by the Air District. This approach provides local agencies a proactive alternative to addressing communities with high levels of risk on a project-by-project approach. This approach is supported by CEQA Guidelines Section 15030(a)(3), which provides that a project's contribution to a cumulative problem can be less than cumulatively considerable "if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact." This approach is also further supported by CEQA Guidelines Section 15064(h)(3), which provides that a project's contribution to a cumulative effect is not considerable "if the project will comply with the requirements in a previously approved plan or mitigation program which provides specific requirements that will avoid or substantially lessen the cumulative problem."

Qualified Community Risk Reduction Plans

A qualified Community Risk Reduction Plan adopted by a local jurisdiction should:

- Include a defined CRRP planning area.
- Include base year and future year emissions inventories of TACs and $PM_{2.5}$.
- Establish risk and exposure reduction targets for the community.
- Identify measures to reduce emissions and exposures.
- Include Air District–approved risk modeling.
- Include procedures for monitoring and updating the TAC inventory, modeling and reduction measures, in coordination with Air District staff.
- Include public participation processes to facilitate community input into goals and strategies.

4 CRITERIA POLLUTANT THRESHOLDS

4.2 PROPOSED THRESHOLDS OF SIGNIFICANCE

Project Construction	
Pollutant	**Average Daily (pounds/day)**
ROG (reactive organic gases)	54
NO_X (nitrogen oxides)	54
PM_{10} (exhaust) (particulate matter-10 microns)	82
$PM_{2.5}$ (exhaust) (particulate matter-2.5 microns)	54
$PM_{10}/PM_{2.5}$ (fugitive dust)	Best Management Practices
Local CO (carbon monoxide)	None

Project Operations		
Pollutant	**Average Daily (pounds/day)**	**Maximum Annual (tons/year)**
ROG	54	10
NO_X	54	10
PM_{10}	82	15
$PM_{2.5}$	54	10
Local CO	9.0 ppm (8-hour average), 20.0 ppm (1-hour average)	

Plans
1. Consistency with Current Air Quality Plan control measures 2. Projected VMT or vehicle trip increase is less than or equal to projected population increase

4.3 JUSTIFICATION AND SUBSTANTIAL EVIDENCE SUPPORTING THRESHOLDS

4.3.1 PROJECT CONSTRUCTION CRITERIA POLLUTANT THRESHOLDS

Staff proposes criteria pollutant construction thresholds that add significance criteria for exhaust emissions to the existing fugitive dust criteria employed by the Air District. While our current Guidelines considered construction exhaust emissions controlled by the overall air quality plan, the implementation of new and more stringent state and federal standards over the past ten years now warrants additional control of this source of emissions.

The average daily criteria air pollutant and precursor emission levels shown above are recommended as the thresholds of significance for construction activity for exhaust emissions. These thresholds represent the levels above which a project's individual

emissions would result in a considerable contribution (i.e., significant) to the SFBAAB's existing non-attainment air quality conditions and thus establish a nexus to regional air quality impacts that satisfies CEQA requirements for evidence-based determinations of significant impacts.

For fugitive dust emissions, staff recommends following the current best management practices approach which has been a pragmatic and effective approach to the control of fugitive dust emissions. Studies have demonstrated (Western Regional Air Partnership, U.S.EPA) that the application of best management practices at construction sites have significantly controlled fugitive dust emissions. Individual measures have been shown to reduce fugitive dust by anywhere from 30 percent to more than 90 percent. In the aggregate best management practices will substantially reduce fugitive dust emissions from construction sites. These studies support staff's recommendation that projects implementing construction best management practices will reduce fugitive dust emissions to a less than significant level.

4.3.2 PROJECT OPERATION CRITERIA POLLUTANT THRESHOLDS

The proposed thresholds for project operations are the average daily and maximum annual criteria air pollutant and precursor levels shown above. These thresholds are based on the federal BAAQMD Offset Requirements to ozone precursors for which the SFBAAB is designated as a non-attainment area which is an appropriate approach to prevent further deterioration of ambient air quality and thus has nexus and proportionality to prevention of a regionally cumulative significant impact (e.g. worsened status of non-attainment). Despite non-attainment area for state PM_{10} and pending nonattainment for federal $PM_{2.5}$, the federal NSR Significant Emission Rate annual limits of 15 and 10 tons per year, respectively, are proposed thresholds as BAAQMD has not established an Offset Requirement limit for $PM_{2.5}$ and the existing limit of 100 tons per year is much less stringent and would not be appropriate in light of our pending nonattainment designation for the federal 24-hour $PM_{2.5}$ standard. These thresholds represent the emission levels above which a project's individual emissions would result in a cumulatively considerable contribution to the SFBAAB's existing air quality conditions. The thresholds would be an evaluation of the incremental contribution of a project to a significant cumulative impact. These threshold levels are well-established in terms of existing regulations as promoting review of emissions sources to prevent cumulative deterioration of air quality. Using existing environmental standards in this way to establish CEQA thresholds of significance under Guidelines section 15067.4 is an appropriate and effective means of promoting consistency in significance determinations and integrating CEQA environmental review activities with other areas of environmental regulation. (*See Communities for a Better Environment v. California Resources Agency* (2002) 103 Cal. App. 4th 98, 111.[4])

[4] The Court of Appeal in the *Communities for a Better Environment* case held that existing regulatory standards could not be used as a definitive determination of whether a project would be significant under CEQA where there is substantial evidence to the contrary. Staff's proposed thresholds would not do that. The thresholds are levels at which a project's emissions would normally be significant, but would not be binding on a lead agency if there is contrary evidence in the record.

4.3.3 LOCAL CARBON MONOXIDE THRESHOLDS

The proposed carbon monoxide thresholds are based solely on ambient concentration limits set by the California Clean Air Act for Carbon Monoxide and Appendix G of the State of California CEQA Guidelines.

Since the ambient air quality standards are health-based (i.e., protective of public health), there is substantial evidence (i.e., health studies that the standards are based on) in support of their use as CEQA significance thresholds. The use of the ambient standard would relate directly to the CEQA checklist question. By not using a proxy standard, there would be a definitive bright line about what is or is not a significant impact and that line would be set using a health-based level.

The CAAQS of 20.0 ppm and 9 ppm for 1-hour and 8-hour CO, respectively, would be used as the thresholds of significance for localized concentrations of CO. Carbon monoxide is a directly emitted pollutant with primarily localized adverse effects when concentrations exceed the health based standards established by the California Air Resources Board (ARB).

In addition, Appendix G of the State of California CEQA Guidelines includes the checklist question: Would the project violate any air quality standard or contribute substantially to an existing or projected air quality violation? Answering yes to this question would indicate that the project would result in a significant impact under CEQA. The use of the ambient standard would relate directly to this checklist question.

4.3.4 PLAN-LEVEL CRITERIA POLLUTANT THRESHOLDS

This proposed threshold achieves the same goals as the Air District's current approach while alleviating the existing analytical difficulties and the inconsistency of comparing a plan update with AQP growth projections that may be up to several years old. Eliminating the analytical inconsistency provides better nexus and proportionality for evaluating air quality impacts for plans.

Over the years staff has received comments on the difficulties inherent in the current approach regarding the consistency tests for population and VMT growth. First, the population growth estimates used in the most recent AQP can be up to several years older than growth estimates used in a recent plan update, creating an inconsistency in this analysis. Staff recommends that this test of consistency be eliminated because the Air District and local jurisdictions all use regional population growth estimates that are disaggregated to local cities and counties. In addition, the impact to air quality is not necessarily growth but where that growth is located. The second test, rate of increase in vehicle use compared to growth rate, will determine if planned growth will impact air quality. Compact infill development inherently has less vehicle travel and more transit opportunities than suburban sprawl.

Second, the consistency test of comparing the rate of increase in VMT to the rate of increase in population has been problematic at times for practitioners because VMT is not always available with the project analysis. Staff recommends that either the rate of increase in VMT or vehicle trips be compared to the rate of increase in population. Staff also recommends that the growth estimates used in this analysis be for the years covered by the plan. Staff also recommends that the growth estimates be obtained from the Association of Bay Area Governments since the Air District uses ABAG growth estimates for air quality planning purposes.

5 ODOR THRESHOLDS

5.2 PROPOSED THRESHOLDS OF SIGNIFICANCE

Project Operations – Source or Receptor	Plans
1. More than one confirmed complaint per year averaged over a three year period; or 2. More than three unconfirmed complaints per year averaged over a three year period	Identify (Overlay Zones) and include policies to reduce the impacts of existing or planned sources of odors

5.3 JUSTIFICATION AND SUBSTANTIAL EVIDENCE SUPPORTING THRESHOLDS

Staff proposes continuing the current CEQA significance threshold for odors (based on complaint history). The current approach has proven adaptable to different projects and locations and thus continuation of the current approach with more qualitative guidance is considered an appropriate approach to CEQA evaluation.

Odors are generally considered a nuisance, but can result in a public health concern. Some land uses that are needed to provide services to the population of an area can result in offensive odors, such as filling portable propane tanks or recycling center operations. When a proposed project includes the siting of sensitive receptors in proximity to an existing odor source, or when siting a new source of potential odors, the following qualitative evaluation should be performed.

When determining whether potential for odor impacts exists, it is recommended that Lead Agencies consider the following factors and make a determination based on evidence in each qualitative analysis category:

- **Distance**: Use the screening-level distances in Table 9.

- **Wind Direction:** Consider whether sensitive receptors are located upwind or downwind from the source for the most of the year. If odor occurrences associated with the source are seasonal in nature, consider whether sensitive receptors are located downwind during the season in which odor emissions occur.

- **Complaint History:** Consider whether there is a history of complaints associated with the source. If there is no complaint history associated with a particular source (perhaps because sensitive receptors do not already exist in proximity to the source), consider complaint-history associated with other similar sources in BAAQMD's jurisdiction with potential to emit the same or similar types of odorous chemicals or compounds, or that accommodate similar types of processes.

- **Character of Source:** Consider the character of the odor source, for example, the type of odor events according to duration of exposure or averaging time (e.g., continuous release, frequent release events, or infrequent events).

- **Exposure:** Consider whether the project would result in the exposure of a substantial number of people to odorous emissions.

Table 9 – Screening Distances for Potential Odor Sources

Type of Operation Project Screening	Distance
Wastewater Treatment Plant	2 miles
Wastewater Pumping Facilities	1 mile
Sanitary Landfill	2 miles
Transfer Station	1 mile
Composting Facility	1 mile
Petroleum Refinery	2 miles
Asphalt Batch Plant	2 miles
Chemical Manufacturing	2 miles
Fiberglass Manufacturing	1 mile
Painting/Coating Operations	1 mile
Rendering Plant	2 miles
Food Processing Facility	1 mile
Confined Animal Facility/Feed Lot/Dairy	1 mile
Green Waste and Recycling Operations	1 mile
Coffee Roaster	1 mile

California Integrated Waste Management Board (CIWMB). Facilities that are regulated by the CIWMB (e.g. landfill, composting, etc.) are required to have Odor Impact Minimization Plans (OIMP) in place and have procedures that establish fence line odor detection thresholds. The Air District recognizes a Lead Agency's discretion under CEQA to use established odor detection thresholds as thresholds of significance for CEQA review for CIWMB regulated facilities with an adopted OIMP.

REFERENCES

ARB. *See* California Air Resources Board.

BAAQMD. *See* Bay Area Air Quality Management District.

Bay Area Air Quality Management District. 1999 (December). *BAAQMD CEQA Guidelines*. San Francisco, CA.

_____. 2005. Regulation 2, Rule 2. New Source Review. Available: <http://www.baaqmd.gov/dst/regulations/rg0202.pdf>. Accessed February 2009.

_____. 2006. CARE Phase 1 Findings and Policy Recommendations. Available: <http://baaqmd.gov/CARE/documents/care_p1_findings_recommendations_v2.pdf>. Accessed March 2009.

_____. 2008. Source Inventory of Bay Area Greenhouse Gas Emissions. San Francisco, CA.

_____. 2009. *Revised Draft Options and Justifications Report – California Environmental Quality Act Thresholds of Significance* (http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/Revised%20Draft%20CEQA%20Thresholds%20%20Justification%20Report%20Oct%202009.ashx)

California Air Pollution Control Officers Association. 2008 (January). *CEQA and Climate Change*. Sacramento, CA. Available: <http://www.capcoa.org/CEQA/CAPCOA%20White%20Paper.pdf>. Accessed April 10, 2009.

California Air Resources Board. 2000. Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles. Stationary Source Division. Mobile Source Control Division. October.

_____. 2002. Staff Report: Public Hearing to Consider Amendments to the Ambient Air Quality Standards for Particulate Matter and Sulfates. Available: http://www.arb.ca.gov/research/aaqs/std-rs/pm-final/pm-final.htm.

_____. 2005. *Land Use Compatibility Handbook. A Community Health Perspective*. Sacramento, CA.

_____. 2008a. *Climate Change Proposed Scoping Plan*. Sacramento, CA. Adopted in December 2008Available: <http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm>. Accessed March 2009.

_____. 2008b. *Methodology for Estimating Premature Deaths Associated with Long-term Exposure to Fine Airborne Particulate Matter in California*. Staff

Report. Sacramento, CA. October 24. Available: <http://www.arb.ca.gov/research/health/pm-mort/pm-mort.htm#NEW>. Accessed November 2009.

Climate Change Proposed Scoping Plan. Sacramento, CA. Adopted in December 2008Available: <http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm>. Accessed March 2009.

_____. 2009a. Greenhouse Gas Inventory and Forecast. Available: <http://www.arb.ca.gov/cc/inventory/data/tables/arb_ghg_inventory_forecast_2008_06_26.xls>. Accessed March 2009.

_____. 2009b. *Preliminary Draft Staff Proposal: Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the California Environmental Quality Act*. Available: <http://www.arb.ca.gov/cc/localgov/ceqa/meetings/10270prelimdraftproposal102408.pdf>. Accessed March 2009.

_____. 2009c. *Area Designations and Maps*. Available: <http://www.arb.ca.gov/desig/desig.htm>, Accessed April 10.

_____. 2009d. Proposed Regulation to Implement the Low Carbon Fuel Standard, Staff Report Initial Statement Reasons. March 5. Available: http://www.arb.ca.gov/fuels/lcfs/lcfs.htm. Accessed, August 20, 2009.

CEC. *See* California Energy Commission.

CEC. 2007. Impact Analysis 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available: <http://www.energy.ca.gov/title22008standards/rulemaking/documents/2007-11-07_IMPACT_ANALYSIS.PDF>. Accessed March 2009.

California Department of Finance. 2009. Residential Development Data: E5 – City and County Population Estimates. 2000-2050 - Race and Ethnic Populations Totals. Available: <http://www.labormarketinfo.edd.ca.gov/?pageid=145 >. Accessed February 2009.

California Economic Development Department. 2009. Commercial/Industrial Employment Data: Projections of Employment by Industry and Occupation. Available: <http://www.labormarketinfo.edd.ca.gov/?pageid=145>. Accessed February 2009.

City and County of San Francisco Department of Public Health. 2008. Assessment and Mitigation of Air Pollutant Health Effects from Intra-urban Roadways: Guidance for Land Use Planning and Environmental Review. Program on Health, Equity, & Sustainability. Occupational & Environmental Health Section. Prepared by Rajiv Bhatia and Thomas Rivard. May 6.

Dockery D. 1993. An association between air pollution and mortality in six U.S. cities. N Engl J Med 329:1753–1759.

EPA. *See* U.S. Environmental Protection Agency.

Governor's Office of Planning and Research. 2008 (June 19). *Technical Advisory: CEQA and Climate Change: Addressing Climate Change Through California Environmental Quality Act (CEQA) Review*. Sacramento, CA. Available: <http://opr.ca.gov/ceqa/pdfs/june08-ceqa.pdf>. Accessed February 2009.

Hiltermann T, Bruijne Cd, Stolk J, Zwinderman A, Spieksma F, Roemer W, et al. 1997. Effects of photochemical air pollution and allergen exposure on upper respiratory tract inflammation in asthmatics. Am J Respir Crit Care Med 156(6):1765–1772.

Intergovernmental Panel on Climate Change. 2007a (February). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC.* Geneva, Switzerland.

_____. 2007a (February). *Climate Change 2007: Climate Change 2007:Synthesis Report*
Summary for Policymakers. Geneva, Switzerland.

IPCC. *See* Intergovernmental Panel on Climate Change.

Jerrett M et al. 2005. Spatial Analysis of Air Pollution and Mortality in Los Angeles. Epidemiology. 16: 727-736

Kleinman, M.T., Sioutas, C., Froines, J.R., Fanning, E., Hamade, A., Mendez, L., Meacher, D., Oldham, M. Inhalation of Concentrated Ambient Particulate Matter Near a Heavily Trafficked Road Simulates Antigen-Induced Airway Responses in Mice; Inhal. Toxicol. 2007, 19 (Supp. 1), 117-126.

Laden, F.; Schwartz, J.; Speizer, F.E.; Dockery, D.W. Reduction in Fine Particulate Air Pollution and Mortality: Extended Follow-Up of the Harvard Six Cities Study. *Am. J. Respir. Crit. Care Med.* (2006), *173,* 667-672.

OPR. *See* Governor's Office of Planning and Research.

Pope C III, Thun M, Namboordiri M, Dockery D, Evans J, Speizer F. 1995. Particulate air pollution as a predictor of mortality in a prospective study of U.S. adults. Am J Respir Crit Care Med 151(3):669–6

Rimpo and Associates. 2009. BAAQMD CEQA Projects Database. Orangevale, CA.

Schauer JJ, Lough GC, Schafer MM, Christensen WF, Arndt MF, DeMinter JT, et al. 2006. Characterization of metals emitted from motor vehicles. Res Rep Health Eff Inst 133:1–7.

Schikowski T, Sugiri D, Ranft U, Gehring U, Heinrich J, Wichmann E, et al. 2005. Long-term air pollution exposure and living close to busy roads are associated with COPD in women. Respir Res 6(1):152.

Schwartz, J.; Coull, B.; Laden, F.; Ryan, L. The Effect of Dose and Timing of Dose on the Association between Airborne Particles and Survival. Env Health Persp (2008) 116, 1: 64-69.

SFDPH. See City and County of San Francisco Department of Public Health.

UNFCCC. *See* United Nations Framework Convention on Climate Change.

United Nations Framework Convention on Climate Change. 2009. *Article 1 of the UNFCCC.* Available: http://unfccc.int/essential_background/convention/background/items/2536.php. Accessed April 8, 2009.

U.S. Environmental Protection Agency. 2008. Federal Register: Implementation of the New Source Review (NSR) Program for Particulate Matter ($PM_{2.5}$) less than 2.5 Micrometers. Available: <http://www.epa.gov/fedrgstr/EPA-AIR/200May/Day-1a10768.pdf>. Accessed February 2009.

_____. 2009. Monitor Values Report Data. Available: <http://www.epa.gov/air/data/index.html>. Accessed April 8, 2009.

_____. 1988. C. Cowherd, et al., *Control of Open Fugitive Dust Sources*, EPA-450/3-88-008, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1988.

Van Hee, V.C., Adar, S.D., Szpiro, A.A., Barr, R.G., Bluemke, D.A., Diez Roux, A.V., Gill, E.A., Sheppard, L., Kaufman, J.D. Exposure to Traffic and Left Ventricular Mass and Function; Am. J. Respir. Crit. Care Med. 2009, 179 (9), 827-834.

Vineis P, Hoek G, Krzyzanowski M, Vigna-Taglianti F, Veglia F, Airoldi L, et al. 2007. Lung cancers attributable to environmental tobacco smoke and air pollution in non-smokers in different European countries: a prospective study. Environ Health 6:7; doi:10.1186/1476-069X-6-7 [Online 15 February 2007]

Western Regional Air Partnership. 2006. *WRAP Fugitive Dust Handbook.* September 7, 2006. Available: http://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf. Accessed September 2009.

Zhu, Y. Hinds, W.C., Kim S, and Sioutas, C. 2002. Concentration and size distribution of ultrafine particles near a major highway. Journal of Air and Waste Management Association. 2002 Sep; 52 (9): 1032-42.

Construction Noise Handbook

4.0 Construction Noise Criteria and Descriptors

4.1 Criteria

Construction noise levels may be evaluated in terms of human response and considered in the assessment of effects on wildlife and other non-human species. Noise levels and criteria are expressed in English, metric, or both conventions, depending upon the geographic area or the policies of the controlling agency. Typically, the English convention is used mostly in the United States, with the metric convention used in Canada and other countries.

While the issue of construction noise must be addressed as part of the planning of any transportation project, there are no standardized criteria on the federal level for assessing construction noise impacts related to transportation projects. Where project-specific construction noise criteria have been developed by individual agencies or municipalities, they typically consider the following factors which form the fundamentals for defining construction noise impact:

- Difference between existing noise levels prior to construction startup and expected noise levels during construction: This takes into account specific construction operations and/or individual pieces of equipment.
- Absolute level of expected construction noise: This may constitute the combined levels of all equipment and operations at a given time or be specifically related to the absolute noise level of a specific operation and/or piece of equipment.
- Adjacent land uses: Consideration of this factor provides an indicator of the degree of sensitivity that may be expected and will likely have a major effect on the operational time restraints and the noise level increases tolerated. For example, residential areas may typically have a restriction on night operations and possibly a noise level restriction during the day. Industrial areas may have no restrictions at all, and offices may or may not have a restriction on the noise levels during the day, with possibly no restriction for night operations. Examples of absolute and relative construction noise level criteria are provided in Table 7.1.
- Duration of construction/operation: The duration of high noise levels may play a significant role in how a noise impact is perceived and/or mitigated. If the levels are of a brief nature, possibly only occurring once or twice during the project, the perceived impact could be quite different than that associated with a constant noise source. Similarly, any related noise mitigation techniques employed could be substantially different in terms of type and/or duration of application.

4.1.1 History of Construction Noise Criteria

4.1.1.1 United States

While noise impact and abatement criteria have been established for the operation of transportation facilities in the United States, standardized criteria have not yet been established related to noise associated with the construction of such facilities. However, since the publication of the original 1977 Report[ref001], additional guidance has been disseminated (through agencies such as FHWA and FTA) and analysis tools developed to better address construction noise. For example, the FTA Transit Noise and Vibration Impact Assessment document[ref014] presents guidelines that "can be considered reasonable criteria for assessment" of construction noise impacts. In addition, a number of agencies, municipalities, and other entities have developed procedures for addressing construction noise impacts and implementing related noise mitigation for their areas of jurisdiction or on a project-specific basis.

Figure 4.1 Local noise ordinance (Photo #314)

In some instances, local entities may have developed noise ordinances that contain restrictions associated with construction noise levels. Noise practitioners and others involved in the project development process are encouraged to become familiar with such ordinances and their relationship to other State and/or municipal ordinances. In certain instances, the State jurisdiction may supersede any local noise ordinances.

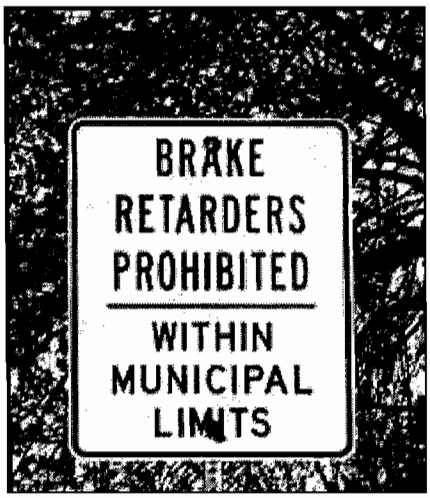

Figure 4.2 Local noise restrictions
(Photo #1206)

Noise restrictions may also be imposed by local and/or State authorities to deal with specific activities or operations. An example is the growing practice of restricting the use of engine compression brakes on heavy trucks in residential areas.

Noise restrictions may also be applied within the workplace associated with employee/worker exposure to noise levels over varying durations. These criteria have been established by OSHA. However, such criteria are typically not relevant or applicable to the transportation-related project construction noise levels experienced by people residing or working in areas adjacent to such projects. As such, they are not discussed within this Handbook.

Construction noise criteria within the United States vary considerably in terms of both scope and specificity and can be broadly categorized as follows, in order of complexity:

- No criteria specified;
- Qualitative criteria, e.g. "Noise levels shall not cause a disturbance";
- Relative criteria, e.g. "Noise levels shall not exceed existing (or ambient, or background) noise levels by more than x dB";
- Absolute criteria, e.g. "Maximum noise levels shall not exceed xx dB";
- Criteria containing a combination absolute and relative noise level limits; and
- Combinations of the above criteria elements with additional restrictions placed on time periods and types of land uses or activities.

An example of more complex criteria is that associated with the Central Artery/Tunnel Project in Boston, MA. Data related to these criteria are discussed in Reference 023 and illustrated in Table 7.1 of this Handbook. This project established criteria that include both L_{10} and L_{max} absolute noise level limits for defined noise sensitive locations (residences, institutions, hotels, etc.) for daytime, evening, and nighttime periods. In addition, the criteria established maximum noise level increases relative to established baseline noise levels. Relative and absolute noise level limits were also established for commercial and industrial areas.

From the standpoint of construction noise criteria, the intent of this Handbook is not to address all State and local noise ordinances and/or criteria, but rather, to address the approaches and techniques that may be contained in such criteria. As such, the discussions contained within this Handbook are meant to provide a summary of considerations related to all aspects of construction noise. The reader is encouraged to refer to specific references in Table 10.1 for more detailed information on noise criteria and other factors related to construction noise.

4.1.1.2 Canada

Similar to the United States, no standardized Canadian criteria exist related to transportation project construction noise. Where project-specific analysis techniques have been employed to address and/or mitigate construction-related noise and its impacts, such methods have been similar to those employed in the United States. Examples of such efforts may be found in References 010 and 019.

4.1.1.3 Other International

While an exhaustive survey of international criteria was not conducted, several criteria are discussed here for informational use only. More specifics may be found by accessing the relative links found in the Reference Database in Chapter 10.

- The Official Journal of the European Communities' Directive 2000/14/EC of the European Parliament and of the Council of 8 May 2000[ref017] establishes legislation dictating specific noise levels for individual pieces of construction equipment. It also contains specifics related to the measurement locations and equipment operating conditions relative to the testing of individual pieces of equipment.
- The Australian EPA's Environmental Noise Control Manual[ref015] establishes the following criteria which officers may specify related to construction noise:
  - For a construction period of four (4) weeks or less, the maximum L_{10} noise level measured over a period of not less than 15 minutes when the construction site is operating must not exceed the background noise level by more than 20 dBA;
  - For a construction period greater than four (4) weeks, the maximum L_{10} noise level measured over a period of not less than 15 minutes when the construction site is operating must not exceed the background noise level by more than 10 dBA;
  - Construction limited to 0700 to 1800 time period on Monday through Friday;
  - Construction limited on Saturdays to 0700 to 1300 time period if inaudible on residential premises; otherwise, 0800 to 1300;
  - No construction work may take place on Sundays or public holidays; and
  - All possible steps should be taken to silence construction site equipment. It is particularly important that silenced equipment should be used on road or rail works where 24-hour operation is necessary.

4.2 Descriptors

While it is not the intent of this Handbook to establish criteria for evaluating construction noise impacts, it is important to stress that reasonable and defensible noise descriptors must be used to describe construction noise levels. The following are important elements related to selecting a workable noise descriptor for use in measuring and analyzing construction noise:

- Suitable for practical measuring methods;
- Accounts for temporal variations in equipment noise levels;
- Accounts for temporal variations in overall site noise level;
- Suitable for prediction modeling;
- Suitable for combining noise levels from various source types; and
- Relative to subjective responses.

The descriptor most commonly chosen for use is the A-weighted equivalent sound level (energy basis), L_{Aeq}. In many cases, the time average period applied to the L_{Aeq} value is one hour (designated L_{Aeq1h}). For certain projects and operations, the time period over which the L_{Aeq} is applied may need to be examined on a case-by-case basis. For several major construction projects in the United States and Canada, the L_{10} (applied generally during daytime periods) and L_{max} (applied for specific equipment and/or nighttime operations) descriptors have been used over varying time periods.

The L_{dn} descriptor has been used to assess annoyance and community reaction to construction noise. L_{dn} is an L_{Aeq}-based descriptor that applies a 10 dBA penalty to nighttime noise levels.

The L_{Aeq}-based and L_{10}-based descriptors satisfy the first four elements listed above. The L_{Aeq} satisfies the fifth element and may also satisfy the sixth element (relative to subjective responses). However, the L_{Aeq}, L_{10}, and L_{max} descriptors may not be suited for determining responses by some aquatic wildlife (where using an un-weighted sound pressure level may be more suitable) or for owls (where use of a different weighting category such as dBO or a descriptor such as SEL may be more suitable to account for effects such as air blasts associated with blasting). More detailed information related to these specific conditions might be found in documents listed in Section 3.2.6 of this document.

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Construction Noise Handbook

9.0 Construction Equipment Noise Levels and Ranges

9.1 Equipment Type Inventory and Related Emission Levels

Noise levels generated by individual pieces of construction equipment and specific construction operations form the basis for the prediction of construction-related noise levels. A variety of information exists related to sound emissions related to such equipment and operations. This data transcends the period beginning in the 1970s thru 2006. This information exists for both stationary and mobile sources and for steady, intermittent, and impulse type generators of noise.

9.1.1 Stationary Equipment

Stationary equipment consists of equipment that generates noise from one general area and includes items such as pumps, generators, compressors, etc. These types of equipment operate at a constant noise level under normal operation and are classified as non-impact equipment. Other types of stationary equipment such as pile drivers, jackhammers, pavement breakers, blasting operations, etc., produce variable and sporadic noise levels and often produce impact-type noises. Impact equipment is equipment that generates impulsive noise, where impulsive noise is defined as noise of short duration (generally less than one second), high intensity, abrupt onset, rapid decay, and often rapidly changing spectral composition. For impact equipment, the noise is produced by the impact of a mass on a surface, typically repeating over time.

9.1.2 Mobile Equipment

Mobile equipment such as dozers, scrapers, graders, etc., may operate in a cyclic fashion in which a period of full power is followed by a period of reduced power. Other equipment such as compressors, although generally considered to be stationary when operating, can be readily relocated to another location for the next operation.

9.2 Sources of Information

Construction-related equipment and operation noise level data may be provided by numerous sources, including suppliers, manufacturers, agencies, organizations, etc. Some information is included in this document, and many web-based links are given for equipment manufacturers.

9.3 Specifics of Construction Equipment and Operation Noise Inventories

Details included in each specific inventory of construction equipment and operation noise emission levels are often variable in terms of how data is represented. Some inventories include ranges of noise levels while others present single numbers for each equipment type.

Others provide levels for specific models of each type of construction equipment. Often, different noise descriptors are used, such as L_{Aeq}, L_{max}, L_{10}, sound power level, etc. As such, the array of data does not readily lend itself to being combined into a single table or easily compared. As such, this Handbook attempts to summarize a variety of such inventories and provide links to each, thereby providing the reader with a variety of sources from which to choose the appropriate levels for use in his or her respective analysis.

9.4 Summaries of Referenced Inventories

Included below are examples of several inventories of construction-related noise emission values. These and additional inventories are included on the companion CD-ROM.

9.4.1 RCNM Inventory

Equipment and operation noise levels in this inventory are expressed in terms of L_{max} noise levels and are accompanied by a usage factor value. They have been recently updated and are based on extensive measurements taken in conjunction with the Central Artery/Tunnel (CA/T) Project. Table 9.1 summarizes the equipment noise emissions database used by the CA/T Project. While these values represent the "default" values for use in the RCNM, user-defined equipment and corresponding noise levels can be added.

Table 9.1 RCNM Default Noise Emission Reference Levels and Usage Factors.

Equipment Description	Impact Device?	Acoustical Usage Factor (%)	Spec. 721.560 L_{max} @ 50 feet (dBA, slow)	Actual Measured L_{max}@ 50 feet (dBA, slow) (Samples Averaged)	Number of Actual Data Samples (Count)
All Other Equipment > 5 HP	No	50	85	N/A	0
Auger Drill Rig	No	20	85	84	36
Backhoe	No	40	80	78	372
Bar Bender	No	20	80	N/A	0
Blasting	Yes	N/A	94	N/A	0
Boring Jack Power Unit	No	50	80	83	1
Chain Saw	No	20	85	84	46
Clam Shovel (dropping)	Yes	20	93	87	4
Compactor (ground)	No	20	80	83	57
Compressor (air)	No	40	80	78	18
Concrete Batch Plant	No	15	83	N/A	0
Concrete Mixer Truck	No	40	85	79	40

Concrete Pump Truck	No	20	82	81	30
Concrete Saw	No	20	90	90	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Drill Rig Truck	No	20	84	79	22
Drum Mixer	No	50	80	80	1
Dump Truck	No	40	84	76	31
Excavator	No	40	85	81	170
Flat Bed Truck	No	40	84	74	4
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Generator (<25KVA, VMS Signs)	No	50	70	73	74
Gradall	No	40	85	83	70
Grader	No	40	85	N/A	0
Grapple (on backhoe)	No	40	85	87	1
Horizontal Boring Hydraulic Jack	No	25	80	82	6
Hydra Break Ram	Yes	10	90	N/A	0
Impact Pile Driver	Yes	20	95	101	11
Jackhammer	Yes	20	85	89	133
Man Lift	No	20	85	75	23
Mounted Impact Hammer (hoe ram)	Yes	20	90	90	212
Pavement Scarifier	No	20	85	90	2
Paver	No	50	85	77	9
Pickup Truck	No	40	55	75	1
Pneumatic Tools	No	50	85	85	90
Pumps	No	50	77	81	17

Refrigerator Unit	No	100	82	73	3
Rivit Buster/Chipping Gun	Yes	20	85	79	19
Rock Drill	No	20	85	81	3
Roller	No	20	85	80	16
Sand Blasting (single nozzle)	No	20	85	96	9
Scraper	No	40	85	84	12
Sheers (on backhoe)	No	40	85	96	5
Slurry Plant	No	100	78	78	1
Slurry Trenching Machine	No	50	82	80	75
Soil Mix Drill Rig	No	50	80	N/A	0
Tractor	No	40	84	N/A	0
Vacuum Excavator (Vac-Truck)	No	40	85	85	149
Vacuum Street Sweeper	No	10	80	82	19
Ventilation Fan	No	100	85	79	13
Vibrating Hopper	No	50	85	87	1
Vibratory Concrete Mixer	No	20	80	80	1
Vibratory Pile Driver	No	20	95	101	44
Warning Horn	No	5	85	83	12
Welder/Torch	No	40	73	74	5

For each generic type of equipment listed in Table 9.1, the following information is provided:

- an indication as to whether or not the equipment is an impact device;
- the acoustical usage factor to assume for modeling purposes;
- the specification "Spec" limit for each piece of equipment expressed as an L_{max} level in dBA "slow" at a reference distance of 50 foot from the loudest side of the equipment;
- the measured "Actual" emission level at 50 feet for each piece of equipment based on hundreds of emission measurements performed on CA/T work sites; and

- the number of samples that were averaged together to compute the "Actual" emission level.

A comparison of the "Spec" emission limits against the "Actual" emission levels reveals that the Spec limits were set, in general, to realistically obtainable noise levels based on the equipment used by contractors on the CA/T Project. When measured in the field, some equipment such as pile drivers, sand blasting, demolition shears, and pumps tended to exceed their applicable emission limit. As such, these noisy devices needed to have some form of noise mitigation in place in order to comply with the Spec emission limits. Other equipment, such as clamshell shovels, concrete mixer trucks, truck-mounted drill rigs, man-lifts, chipping guns, ventilation fans, pavers, dump trucks, and flatbed trucks, easily complied. Therefore, the Spec emission limits for these devices could have been reduced somewhat further. It is recommended that the user review the RCNM User's Guide contained in Appendix A for detailed guidance regarding application of values contained in Table 9.1.

9.4.2 FHWA Special Report Inventories

Appendix A of the 1977 Handbook provides tables of construction equipment noise levels and ranges. The majority of the data were provided by the American Road Builders Association. These data were taken during a 1973 survey in which member contractors were asked to secure readings of noise exposure to operators of various types of equipment. Additionally, the contractors were asked to take readings at 50 feet from the machinery. These 50-foot peak readings are provided in Tables 9.2 through 9.8. Though the data were produced under varying conditions and degrees of expertise, the values are relatively consistent.

Table 9.2 Construction Equipment Noise Levels Based on Limited Data Samples - Cranes.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Northwestern	80D	77	Within 15m 1958 mod
Northwestern	8	84	Within 15m 1940 mod
Northwestern	6	72	Within 15m 1965 mod
American	7260	82	Within 15m 1967 mod
American	599	76	Within 15m 1969 mod
American	5299	70	Within 15m 1972 mod
American	4210	82	Within 15m 1968 mod
Buck Eye	45C	79	Within 15m 1972 mod
Buck Eye	308	74	Within 15m 1968 mod
Buck Eye	30B	73	Within 15m 1965 mod
Buck Eye	30B	70	Within 15m 1959 mod

Link Belt	LS98	76	Within 15m 1956 mod
Manitowoc	4000	94	Within 15m 1956 mod
Grove	RF59	82	Within 15m 1973 mod
Koehr	605	76	Within 15m 1967 mod
Koehr	435	86	Within 15m 1969 mod
Koehr	405	84	Within 15m 1969 mod

Table 9.3 Construction Equipment Noise Levels Based on Limited Data Samples - Backhoes.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Link Belt	4000	92	Within 15m 1971 mod
John Deere	609A	85	Within 15m 1971 mod
Case	680C	74	Within 15m 1973 mod
Drott	40 yr.	82	Within 15m 1971 mod
Koehr	1066	81 & 84	Within 15m 2 tested

Table 9.4 Construction Equipment Noise Levels Based on Limited Data Samples - Front Loaders.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	980	84	Within 15m 1972 mod
Caterpillar	977K	79	Within 15m 1969 mod
Caterpillar	977	87	Within 15m 1971 mod
Caterpillar	977	94	Within 15m 1967 mod
Caterpillar	966C	84	Within 15m 1973 mod
Caterpillar	966C	85	Within 15m 1972 mod
Caterpillar	966	81	Within 15m 1972 mod
Caterpillar	966	77	Within 15m 1972 mod
Caterpillar	966	85	Within 15m 1966 mod
Caterpillar	955L	90	Within 15m ;1973 mod
Caterpillar	955K	79	Within 15m 1969 mod
Caterpillar	955H	94	Within 15m 1963 mod
Caterpillar	950	78 & 80	Within 15m 1972 mod
Caterpillar	950	75	Within 15m 1968 mod

Caterpillar	950	88	Within 15m 1967 mod
Caterpillar	950	86	Within 15m 1965 mod
Caterpillar	944A	80	Within 15m 1965 mod
Caterpillar	850	82	Within 15m 1968 mod
Michigan	75B	90	Within 15m 1969 mod
Michigan	475A	96	Within 15m 1967 mod
Michigan	275	85	Within 15m 1971 mod
Michigan	125	87	Within 15m 1967 mod
Hough	65	82	Within 15m 1971 mod
Hough	60	91	Within 15m 1961 mod
Hough	400B	94	Within 15m 1961 mod
Hough	H90	86	Within 15m 1961 mod
Trojan	3000	85	Within 15m 1956 mod
Trojan	RT	82	Within 15m 1965 mod
Payloader	H50	85	Within 15m 1963 mod

Table 9.5 Construction Equipment Noise Levels Based on Limited Data Samples - Dozers.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	D5	83	Within 15m 1967 mod
Caterpillar	D6	85	Within 15m 1967 mod
Caterpillar	D6	86	Within 15m 1964 mod
Caterpillar	D6	81	Within 15m 1967 mod
Caterpillar	D6B	83	Within 15m 1967 mod
Caterpillar	D6C	82	Within 15m 1962 mod
Caterpillar	D7	85	Within 15m 1956 mod
Caterpillar	D7	86	Within 15m 1969 mod
Caterpillar	D7	84	Within 15m 1969 mod
Caterpillar	D7	78	Within 15m 1970 mod
Caterpillar	D7	78	Within 15m 1972 mod
Caterpillar	D7E	86	Within 15m 1965 mod

Caterpillar	D7E	78	Within 15m 1970 mod
Caterpillar	D7E	84	Within 15m 1973 mod
Caterpillar	D7F	80	Within 15m 1972 mod
Caterpillar	D8	92	Within 15m 1954 mod
Caterpillar	D8	95	Within 15m 1968 mod
Caterpillar	D8	86	Within 15m 1972 mod
Caterpillar	D8H	88	Within 15m 1966 mod
Caterpillar	D8H	82	Within 15m 1972 mod
Caterpillar	D9	85	Within 15m 1972 mod
Caterpillar	D9	94	Within 15m 1972 mod
Caterpillar	D9	90	Within 15m 1963 mod
Caterpillar	D9	87	Within 15m 1965 mod
Caterpillar	D9	90	Within 15m 1965 mod
Caterpillar	D9	88	Within 15m 1968 mod
Caterpillar	D9	92	Within 15m 1972 mod
Caterpillar	D9G	85	Within 15m 1965 mod
Allis Chambers	HD41	93	Within 15m 1970 mod
International	TD15	79	Within 15m 1970 mod
International	TD20	87	Within 15m 1970 mod
International	TD25	90	Within 15m 1972 mod
International	TD8	83	Within 15m 1970 mod
Case	1150	82	Within 15m 1972 mod
John Deer	350B	77	Within 15m 1971 mod
John Deer	450B	65	Within 15m 1972 mod
Terex	8230	70	Within 15m 1972 mod
Terex	8240	93	Within 15m 1969 mod
Michigan	280	85	Within 15m 1961 mod
Michigan	280	90	Within 15m 1962 mod
Caterpillar	824	90	Within 15m 1968 mod

Table 9.6 Construction Equipment Noise Levels Based on Limited Data Samples - Graders.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	16	91	Within 15m 1969 mod
Caterpillar	16	86	Within 15m 1968 mod
Caterpillar	140	83	Within 15m 1970 mod
Caterpillar	14E	84	Within 15m 1972 mod
Caterpillar	14E	85	Within 15m 1971 mod
Caterpillar	14C	85	Within 15m 1971 mod
Caterpillar	14B	84	Within 15m 1967 mod
Caterpillar	12F	82	Within 15m 1961-72 mod
Caterpillar	12F	72-92	Within 15m 1961-72 mod
Caterpillar	12E	81.3	Within 15m 1959-67 mod
Caterpillar	12E	80-83	Within 15m 1959-67 mod
Caterpillar	12	84.7	Within 15m 1960-67 mod
Caterpillar	12	82-88	Within 15m 1960-67 mod
Gallon	T500	84	Within 15m 1964 mod
Allis Chambers		87	Within 15m 1964 mod

Table 9.7 Construction Equipment Noise Levels Based on Limited Data Samples - Scrapers.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	660	92	Within 15m
Caterpillar	641B	85	Within 15m 1972 mod
Caterpillar	641B	86	Within 15m 1972 mod
Caterpillar	641	80 & 84	Within 15m 1972 mod
Caterpillar	641	83 & 89	Within 15m 1965 mod
Caterpillar	637	87	Within 15m 1971 mod
Caterpillar	633	87	Within 15m 1972 mod
Caterpillar	631C	89	Within 15m 1973 mod
Caterpillar	631C	83	Within 15m 1972 mod
Caterpillar	631B	94	Within 15m 1969 mod

Caterpillar	631B	84-87	Within 15m 1968 mod
Caterpillar		85 avg.	Within 15m 1968 mod
Caterpillar	621	90	Within 15m 1970 mod
Caterpillar	621	86	Within 15m 1967 mod
Caterpillar	613	76	Within 15m 1972 mod
Terex	TS24	87	Within 15m 1972 mod
Terex	TS24	84-91	
Terex	TS24	82	Within 15m 1971 mod
Terex	TS24	81-83	Within 15m 1971 mod
Terex	TS24	94	Within 15m 1966 mod
Terex	TS24	92-98	Within 15m 1966 mod
Terex	TS24	94.7	Within 15m 1963 mod
Terex	TS24	94-95	Within 15m 1963 mod
Terex	TS14	82	Within 15m 1969 mod
Terex	S35E	84	Within 15m 1971 mod

Table 9.8 Noise Levels of Standard Compressors.

Manufacturer	Model	Silenced or Standard	Type Eng.	Type Comp.	Test Avg. Cond. (cfm.psi)	Avg. Cond. Noise Lev. (cfm.psi) (dBA) at 7m*
Atlas	ST-48	Standard	Diesel	Reciprocal	160,100	83.6
Atlas	ST-95	Standard	Diesel	Reciprocal	330,105	80.2
Atlas	VSS-170Dd	Silenced	Diesel	Reciprocal	170,850	70.2
Atlas	VT-85M	Standard	Gas	Reciprocal	85,100	81.4
Atlas	VS-85Dd	Silenced	Gas	Reciprocal	85,100	75.5
Atlas	VSS-125Dd	Silenced	Diesel	Reciprocal	125,100	70.1
Atlas	STS-35Dd	Silenced	Diesel	Reciprocal	125,100	73.5
Atlas	VSS-170Dd	Silenced	Diesel	Reciprocal	170,100	
Gardner-Denver	SPWDA/2	Silenced	Diesel	Rotary-Screw	1200,000	73.3
Gardner-Denver	SPQDA/2	Silenced	Diesel	Rotary-Screw	750,000	78.2

Gardner-Denver	SPHGC	Silenced	Gas	Rotary-Screw	185,000	77.1
Ingersoll-Rand	DXL 1200	Standard	Diesel	Rotary-Screw	1200,125	92.6
Ingersoll-Rand	DXL 1200 (doors open)	Standard	Diesel	Rotary-Screw	1200,125	
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	76.0
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	75.1
Ingersoll-Rand	DXLCU1050	Standard	Diesel	Rotary-Screw	1050,125	90.2
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	75.3
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	75.0
Ingersoll-Rand	DXL 900	Standard	Diesel	Rotary-Screw	900,125	89.9
Ingersoll-Rand	DXL 750	Standard	Diesel	Rotary-Screw	750,125	87.7
Jaeger	A	Standard	Gas	Rotary-Screw	175,100	88.2
Jaeger	A(doors open)	Standard	Gas	Rotary-Screw	175,100	
Jaeger	E	Standard	Gas	Vane	85,100	81.5
Jaeger	E(doors open)	Standard	Gas	Vane	85,100	
Worthington	60 G/2Qt	Silenced	Gas	Vane	160,100	74.2
Worthington	750-QTEX	Silenced	Diesel	Rotary-Screw	750,100	74.7

*Data taken from EPA Report - EPA 550/9-76-004.

9.4.3 FTA Noise and Vibration Assessment Procedure

Chapter 12 of the FTA Transit Noise and Vibration Guidance Handbook discusses construction noise evaluation methodology and contains the noise emission levels for construction equipment displayed in Table 9.9.

Table 9.9 FTA Construction Equipment Noise Emission Levels.

Equipment	Typical Noise Level (dBA) 50 ft from Source*

Air Compressor	81
Backhoe	80
Ballast Equalizer	82
Ballast Tamper	83
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane Derrick	88
Crane Mobile	83
Dozer	85
Generator	81
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	85
Paver	89
Pile Driver (Impact)	101
Pile Driver (Sonic)	96
Pneumatic Tool	85
Pump	76
Rail Saw	90
Rock Drill	98
Roller	74
Saw	76
Scarifier	83
Scraper	89
Shovel	82
Spike Driver	77

Tie Cutter	84
Tie Handler	80
Tie Inserter	85
Truck	88

*Table based on EPA Report, measured data from railroad construction equipment taken during Northeast Corridor improvement project and other measured data.

9.5 Links to Equipment Manufacturers

Table 9.10 contains web-based links to manufacturers of construction equipment. While few of these links contain noise-related data associated with the equipment, they provide descriptions and/or specifications related to the equipment, as well as sources for possibly obtaining additional information related to the equipment. Information in this table is by no means all-inclusive and does not represent any type of endorsement of the manufacturers, suppliers, or equipment. Users are hereby advised that the referenced websites may have certain restrictions, copyrights, etc., associated with any use of data contained therein.

Table 9.10 Equipment Manufacturers and Websites.

Equipment	Manufacturer	Website Address
Arrow Boards		
	North Star	http://northstar-traffic.com/index.cfm?SC=14&PT=1
	Trafcom	http://www.trafcon.com
	Allmand	http://www.allmand.com/MB%20AB%20page.htm
Articulated Trucks		
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=196
	Hitachi	http://www.hitachi-c-m.com/global/products/articulate/index.html
	Terex	http://www.terex.com/main.php
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/articulatedhaulers/
Asphalt Saws		
	Allied	http://www.alliedcp.com/products/rotocut.asp
Augers - See Drills / Augers		
Backhoes - See Loaders/Backhoes		
Boring Equipment - See Pile Drivers/Boring Equipment		
Compaction Equipment		

	Allied	http://www.alliedcp.com/products/compactor.asp
Compressors		
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5714,00.html
	Compair	http://www.compair.com/Products/Portable_Compressors.aspx
Concrete and Asphalt Batch/Mixing Plants and Equipment		
	Con-E-Co	http://www.con-e-co.com/products.cfm
	Terex	http://www.terex.com/main.php
	Gunter & Zimmerman	http://www.guntert.com/concrete_mobilebatching.asp
	Rex Con	http://www.rexcon.com
Concrete Breakers/ Hydraulic Hammers/Hydraulic Breakers		
	Drillman	http://www.drillmanindia.com/concrete-breaker.html
	Hydro Khan	http:/www.sangi.co.kr/english/e_product1_2.php
	Stanley	http://www.stanley-hydraulic-tools.com/Hand%20Held/NoAmbreakers.htm
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/breakers.htm
Concrete Chain Saws		
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/concrete-saws.htm
Concrete Core Drilling Machines		
	Multiquip	http://www.multiquip.com/multiquip/318_ENU_HTML.htm
Concrete Cutters		
	Vermeer	http://www.vermeermfg.com/vcom/TrenchingEquipment/Line.jsp?PrdlnID=3618
Concrete/Material Pumps		
	Multiquip	http://www.multiquip.com/multiquip/309_ENU_HTML.htm
	Reed	http://www.reedpumps.com/
Concrete Mixer Trucks		
	Oshkosh	http://www.oshkoshtruck.com/concrete/products~overview~home.cfm
	London	http://www.lmi.ca/mixers.cfm
	Terex/Advance	http://www.advancemixer.com
Concrete Saws		

	Multiquip	http://www.multiquip.com/multiquip/315_ENU_HTML.htm
	Diamond Core Cut	http://www.diamondproducts.com/dp_home.htm
Concrete Screeds		
	Multiquip	http://www.multiquip.com/multiquip/317_ENU_HTML.htm
Concrete Vibrators		
	Multiquip	http://www.multiquip.com/multiquip/313_ENU_HTML.htm
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5722,00.html
Cranes		
	Malcolm Drilling	www.malcolmdrilling.com
	Link-Belt	http://www.linkbelt.com/lit/products/frameproducthome.htm
	Casagrande	http://www.casagrandegroup.com
	Liebherr	http://www.liebherr.com/em/en/35381.asp
	Terex	http://www.terex.com/main.php
Crawler Tractors - See Dozers/Crawler Tractors		
Crushing and Screening Equipment		
	Cedarapids	http://www.cedarapids.com/crushscr.htm
	Hitachi	http://www.hitachi-c-m.com/
	Komatsu	http://www.komatsu.com/ce/products/mobile_crushers.html
	Terex	http://www.terex.com/main.php
Crushers/Pulverizers		
	Hydro Khan	http://www.sangi.co.kr/english/e_product3.php
Cutoff Saws		
	Multiquip	http://www.multiquip.com/multiquip/309_ENU_HTML.htm
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/cutoff%20saw.htm
Dozers/CrawlerTractors		
	John Deere	http://www.deere.com/en_US/cfd/construction/deere_const/crawlers/deere_dozer_selection.html
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7

	Case	http://www.casece.com/products/products.asp?RL=NAE&id=2
	Komatsu	http://www.komatsu.com/ce/products/crawler_dozers.html
Dewatering Pumps		
	Multiquip	http://www.multiquip.com/multiquip/371_ENU_HTML.htm
Drills / Augers		
	Malcolm Drilling	www.malcolmdrilling.com
	Casagrande	www.casagrandegroup.com
	Soilmec	http://www.soilmec.com/_vti_g1_techno.aspx?rpstry=4_
	Terex	http://www.terex.com/main.php
Excavators		
	Hitachi	http://www.hitachi-c-m.com/global/products/excavator/index.html
	Caterpiller	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/compactexcavators/
		http://www.volvo.com/constructionequipment/na/en-us/products/wheeledexcavators/
		http://www.volvo.com/constructionequipment/na/en-us/products/crawlerexcavators/
	John Deere	http://www.deere.com/en_US/cfd/construction/deere_const/excavators/deere_excavator_selection.html
	Liebherr	http://www.liebherr.com/em/en/18891.asp
	Soilmec	http://www.soilmec.com/_vti_g1_t02.aspx?rpstry=29_
	Gehl	http://www.gehl.com
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=216
	Komatsu	http://www.komatsu.com/ce/products/crawler_excavators.html
		http://www.komatsu.com/ce/products/wheel_excavators.html
	Terex	http://www.terex.com/main.php
	Link-Belt	http://www.lbxco.com/lx_series.asp
	Gradall	http://www.gradall.com/
	Badger Daylighting	http://www.badgerinc.com/
Fork Lifts - See Lifts / Variable Reach Fork Lifts/ Material Handlers		

Generators		
	Terex	http://www.terex.com/main.php
	Multiquip	http://www.multiquip.com/multiquip/212_ENU_HTML.htm
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5714,00.html
	Baldor	http://www.baldor.com/products/generators/ts.asp
Graders		
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=190
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/MotorGraders/
	Komatsu	http://www.komatsu.com/ce/products/motor_graders.html
	Terex	http://www.terex.com/main.php
Hand Compaction Equipment		
	Terex	http://www.terex.com/main.php
	Multiquip	http://www.multiquip.com/multiquip/56_ENU_HTML.htm
Hydraulic Hammers/Hydraulic Breakers - See Concrete Breakers/ Hydraulic Hammers/Hydraulic Breakers		
Jackhammers - See Rock Drilling Equipment/Jackhammers		
Lifts / Variable Reach Fork Lifts/ Material Handlers		
	Genie Lift	www.genielift.com
	Sky Track	www.kirby-smith.com/
	Ingersol-Rand	www.ingersollrand.com
	Terex	http://www.terex.com/main.php
	Roadtec	http://www.roadtec.com/www/docs/102/mtv-material-transfer-vehicle/
Light Towers		
	Baldor	http://www.baldor.com/products/generators/mlt.asp
	Multiquip	http://www.multiquip.com/multiquip/293_ENU_HTML.htm
	Allmand	http://www.allmand.com/Night%20Lite%20Pro%20page.htm
Loaders/Backhoes		
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=54
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/backhoeloaders/

	John Deere	http://www.deere.com/en_US/cfd/construction/deere_const/backhoes/deere_backhoe_selection.html
	Komatsu	http://www.komatsu.com/ce/products/backhoe_loaders.html
Material Handlers - See Lifts / Variable Reach Fork Lifts/ Material Handlers		
Milling Machines		
	Wirtgen	http://www.wirtgenamerica.com/us/
Mining Trucks - See Rigid Dump Trucks/Mining Trucks		
Pans - See Scrapers/Pans		
Pavers/Paving Equipment		
	Caterpillar/ Barber Greene	http://www.cat.com/cda/layout?m=37840&x=7
	Rosco	http://www.leeboy.com/rosco/
	Bomag	http://www.bomag.com/americas/index.aspx?&Lang=478
	Gehl	http://www.gehl.com/const/prodpg_ap.html
	Leeboy	http://www.leeboy.com/leeboy/
	Terex	http://www.terex.com/main.php
	Ingersoll-Rand	http://www.road-development.irco.com/Default.aspx?MenuItemID=12
	Vogele	http://www.vogeleamerica.com/noflash.html
	GOMACO	http://www.gomaco.com/index.html
	Roadtec	http://www.roadtec.com
Pile Drivers/Boring Equipment		
	Soilmec	http://www.soilmec.com/_vti_g1_t09.aspx?rpstry=29_
	Leffer	http://www.leffer.com/hme.html
	Bauer	http://www.bauer.de/en/maschinenbau/produkte/drehbohrgeraete/bg_reihe/usbg15h.htm
Pipelayers/Trenchers		
	Liebherr	http://www.liebherr.com/em/en/18908.asp
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=28&archived=1

	Vermeer	http://www.vermeermfg.com/vcom/TrenchingEquipment/trenching-equipment.htm
	Ditchwitch	http://www.ditchwitch.com/dwcom/Product/ProductView/115
	Eagle	http://www.guntert.com/trenchers_home.asp
Profilers - See Roadway Planers/Profilers		
Rammers		
	Multiquip	http://www.multiquip.com/multiquip/56_ENU_HTML.htm
Rebar Benders/Cutters		
	Multiquip	http://www.multiquip.com/multiquip/1316_ENU_HTML.htm
Recyclers - See Stabilizers/Recyclers		
Rigid Dump Trucks/Mining Trucks		
	Hitachi	http://www.hitachi-c-m.com/global/products/rigid/index.html
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Liebherr	http://www.liebherr.com/em/en/18898.asp
	Komatsu	http://www.komatsu.com/ce/products/dump_trucks.html
	Terex	http://www.terex.com/main.php
Roadway Planers/Profilers		
	Terex	http://www.terex.com/main.php
	Roadtec	http://www.roadtec.com/products/cold_planers/default.htm
Rock Drilling Equipment/Jackhammers		
	Drillman	http://www.drillmanindia.com/rock-drilling-machine.html
	Whaker	http://www.wackergroup.com/webapp/wcs/stores/servlet/
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5721,00.html
	Allied	http://www.alliedcp.com/products/hammers.asp
Rollers - See Tampers/Rollers		
Scrapers/Pans		
	Terex	http://www.terex.com/main.php
Screening Equipment - See Crushing and Screening Equipment		
Slabbuster		
	Allied	http://www.alliedcp.com/products/slabbuster.asp

Slip Form Pavers		
	Huron	http://www.huronmanufacturing.com/
	Guntert & Zimmerman	http://www.guntert.com/concreteSlipformPavers.asp
Stabilizers/Recyclers		
	Bomag	http://www.bomag.com/americas/index.aspx?&Lang=478
	Komatsu	http://www.komatsu.com/ce/products/mobile_crushers.html
	Terex	http://www.terex.com/main.php
	Wirtgen	http://www.wirtgenamerica.com/us/
	Roadtec	http://www.roadtec.com
Sweepers		
	Elgin	http://www.elginsweeper.com
	Johnston	http://www.johnstonsweepers.com/
Tampers/ Rollers		
	Bomag	http://www.bomag.com/americas/index.aspx?&Lang=478
	Komatsu	http://www.komatsu.com/ce/products/vibratory_rollers.html
	Whaker	http://www.wackergroup.com/webapp/wcs/stores/servlet/
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/tamper.htm
	Multiquip	http://www.multiquip.com/multiquip/181_ENU_HTML.htm
	Ingersoll-Rand	http://www.road-development.irco.com/Default.aspx?MenuItemID=15
Trenchers - See Pipelayers/Trenchers		
Trucks - See Articulated Trucks, Concrete Mixer Trucks, Rigid Dump Trucks/Mining Trucks		
Vacuum Units		
	Advanced Recycling Systems	www.arsrecycling.com/
	Vacmasters	http://www.vacmasters.com/airsystm.htm
	Vector	http://www.vector-vacuums.com/
Variable Message Signs		
	Allmand	http://www.allmand.com/MB%20only%20page.htm

	North Star	http://northstar-traffic.com/index.cfm?SC=13&PT=1
	Trafcom	http://www.trafcon.com
	Daktronics	http://www.daktronics.com/vms_prod/dak_vms_products.cfm
Vibratory Rammers		
	Whaker	http://www.wackergroup.com/webapp/wcs/stores/servlet/
Welders/Welding Equipment		
	Airgas	www.airgas.com
	Multiquip	http://www.multiquip.com/multiquip/408_ENU_HTML.htm
	Miller	http://www.millerwelds.com/products/
	Lincoln	http://www.mylincolnelectric.com/Catalog/equipmentseries.asp?browse=101|400|
Wheel Loaders		
	Hitachi	http://www.hitachi-c-m.com/global/products/loader/index.html
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=30
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/wheelloaders/
	Terex	http://www.terex.com/main.php
	Komatsu	http://www.komatsu.com/ce/products/wheel_loaders.html
	TCM	http://www.tcmglobal.net/products/main02.html

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U.S. Department of Housing and Urban Development
Office of Community Planning and Development

The Noise Guidebook

The Noise Guidebook

A Reference Document for Implementing the Department of Housing and Urban Development's Noise Policy

Prepared By The Environmental Planning Division,
Office of Environment and Energy

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Preface

Introduction

This *Noise Guidebook* has been prepared to serve as the basic reference document for all HUD field staff who are responsible for implementing the Department's noise policy. It brings together in one place all the various reports, informational papers and other items that have been put out by the Department over the past several years. It also contains several new items designed to make your job easier.

This *Guidebook* is designed to serve not only the experienced HUD staff member but also the new employee or the old employee who is new to the noise field. Because of this, the *Guidebook* contains some fairly basic background material as well as quizzes and other material specifically geared for the "learner."

Chapter 1

Basic Overview of the Environmental Noise Problem

Introduction

Background

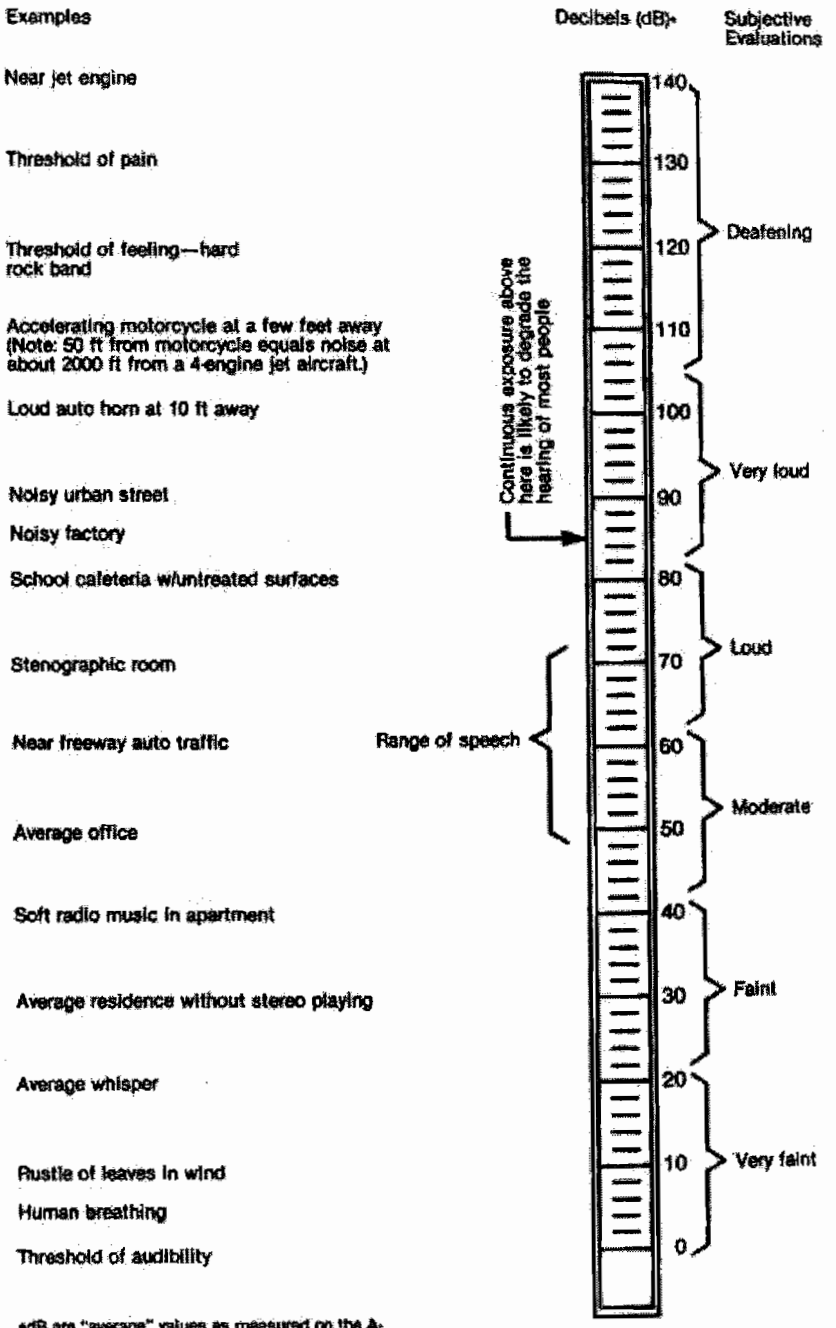
Definition and Scope of the Noise Problem

The air around us is constantly filled with sounds, yet most of us would probably not say we are surrounded by noise. What then is the difference between ordinary sound and what we call noise? The traditional definition of noise is that it is "unwanted sound." Sound becomes unwanted when it either interferes with our normal activities such as sleeping, conversation or recreation, when it causes actual physical harm such as hearing loss or has adverse effects on mental health. As we have become a more urbanized country and as technology has advanced, the level of sound in our environment has reached the point when it sometimes does cause interference and does cause physical and psychological harm, and thus we have developed a noise problem. (See Figure 1 for a listing of common sounds.)

The dimensions of the noise problem have grown larger and larger over the past few decades. In its 1979 Annual Report, The Council on Environmental Quality stated that "nearly half the US population is regularly exposed to levels of noise that interfere with ...normal activities" and about "1 in 10 ...are exposed to noises of duration and intensity sufficient to cause a permanent reduction in their ability to hear."

Figure 1
Common Sounds
Basic Theory: Common Sounds in Decibels (dB)

Some common, easily recognized sounds are listed below in order of increasing sound intensity levels in decibels. The sound levels shown for occupied rooms are typical general activity levels only and do *not* represent criteria for design.



*dB are "average" values as measured on the A-scale of a sound-level meter
(From *Concepts in Architectural Acoustics*: M. David Egan, McGraw Hill, 1972.)

The Dynamics of the Noise Problem

There are basically two types of noise problems. There is the specific, job related, occupational noise problem created by extremely loud machinery. Then there is the community noise problem where the combined effect of many individual noise sources creates an overall noise level that is unacceptable. In the following pages we will be addressing the community noise problem only.

The main contributors to a community noise problem are transportation sources such as highways, railroads and airports. These sources are the most pervasive and continuing of the noise sources within the community. Of course, at any given site, there may be other noise sources which add to the problem, sources such as jackhammers at a construction site. But in general, and for the purposes of this section, the main concern is with the transportation sources.

The dynamics of a noise problem are based on the relationship between the noise source, the person or place exposed to the noise (hereafter called the receiver) and the path the noise will travel from source to receiver.

The source generates a given amount of noise which travels along the path and arrives at the receiver. The amount of noise will be reduced to some extent as a result of how long that path is or whether there are any barriers along the path. The severity of the impact on the receiver is a function of what type of activity is taking place, whether it is indoors or outdoors, and what type of building it is in if the activity is indoors. Figure 3 contains some basic compatibility guidelines.

The impact of the noise can be altered or mitigated by changing the characteristics of any of the three elements: source, path or receiver. Later on we will look at the various mitigation measures that are possible. Our concern however will be primarily with the receiver and the path. Control of the sources themselves is the specific responsibility of agencies such as the Environmental Protection Agency (EPA) or the Federal Aviation Administration (FAA).

Figure 2
Dynamics of a Noise Problem

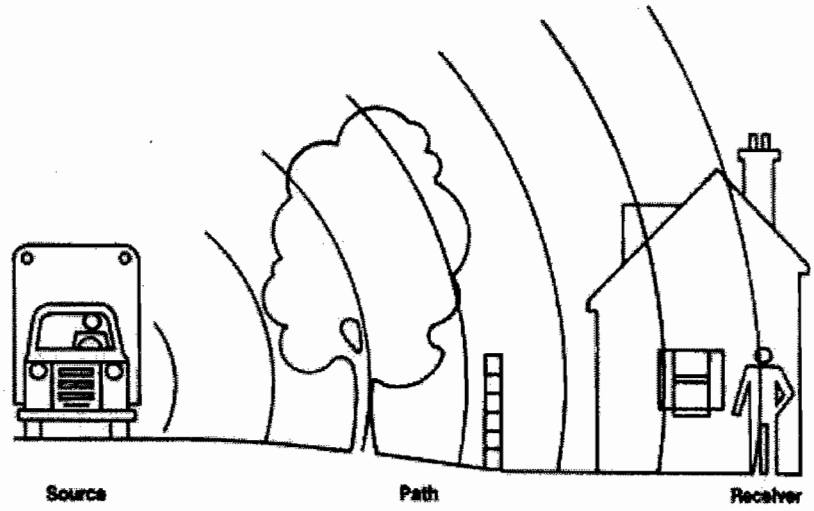


Figure 3
Land Use Compatibility Guidelines

LAND USE CATEGORY	LAND USE INTERPRETATION FOR NEF VALUE* 20 30 40 50
Residential — Single Family, Duplex, Mobile Homes	
Residential — Multiple Family, Dormitories, etc.	
Transient Lodging	
School Classrooms, Libraries, Churches	
Hospitals, Nursing Homes	
Auditoriums, Concert Halls, Music Shells	
Sports Arena, Outdoor Spectator Sports	
Playgrounds, Neighborhood Parks	
Golf Courses, Riding Stables, Water Rec., Cemeteries	
Office Buildings, Personal, Business and Professional	
Commercial — Retail, Movie Theaters, Restaurants	
Commercial — Wholesale, Some Retails, Ind., Mfg., Util.	
Manufacturing, Communication (Noise Sensitive)	
Livestock Farming, Animal Breeding	
Agriculture (except Livestock), Mining, Fishing	
Public Right-of-Way	
Extensive Natural Recreation Areas	

*Ldn = NEF Value + 35

65 75 85
Ldn VALUES

Clearly Acceptable
Normally Unacceptable
Normally Acceptable
Clearly Unacceptable

The ideal solution to a potential problem is to reduce the noise being produced by the source. The best solution available to HUD, or the community, however, is to make sure that noise sensitive uses are located where they will not be exposed to high noise levels. The next best approach to mitigating noise impact is to attempt to reduce the amount of noise that reaches the receiver. This can be accomplished through the use of barriers such as walls or earthen berms, or combinations of both, along the noise path. If the use of barriers is not possible then the only alternative available is to provide noise reduction measures in any structures associated with the activity so that at least the interior spaces are not exposed to high noise levels. This approach is considered the least desirable because most of the land uses we are concerned about, such as residential, do have outdoor areas and activities associated with them which would remain exposed to high noise levels.

A Note on Descriptors

A key factor in the growth of our ability to evaluate and reduce noise impacts has been the development of better tools to measure and describe the noise levels generated by various sources. The development of better tools (called noise descriptors or metrics) has been particularly important for dealing with community noise problems. Many of the older descriptor systems could only be used for one or two sources such as cars and railroads, but not airplanes. Since the community noise problem very often includes noise from all these sources the lack of an adequate descriptor made it difficult to do an adequate evaluation.

The most advanced descriptor currently in general use is the day night average sound level system, abbreviated as DNL and symbolized mathematically as L_{dn}. The day night average sound level is the 24 hour average sound level, expressed in decibels, obtained after the addition of a 10 decibel penalty for sound levels which occur at night between 10 PM and 7 AM. This nighttime penalty is based on the fact that many studies have shown that people are much more disturbed by noise at night than at any other time. This is not unusual in that background noise is often much less at night and also people tend to be doing very noise sensitive things at night, such as trying to sleep.

Another feature of the DNL system that is very important is that it can be used to describe noise from all sources. Thus, using the DNL system, we can describe the total noise exposure at a site, something many other descriptor systems couldn't do.

The DNL system has been adopted by the EPA, the Department of Defense (DOD) and HUD, and more recently by the FAA, specifically for describing environmental impacts for airport actions. We expect that very soon it will be in almost universal use in the U.S.

Issues

The main issues involved in any noise analysis can be summarized briefly.

- How much noise is a site exposed to
- What types of activities are being affected and how severely
- Is it reasonable to redesign the site to relocate noise sensitive activities
- And, if not, how much protection can be provided through various attenuation measures.

Your approach to these issues will be affected in many ways by the location of the project in question. Projects in suburban or rural areas can be approached differently because the available mitigation options are greater and often the noise exposure itself is not so severe. In urban situations, however, the noise exposure is often more severe but at the same time the options for mitigation or resiting are more limited. In the urban setting innovative design and the use of advanced attenuation measures becomes critical. Fortunately our experience has shown that good design and construction can relieve or substantially reduce major noise problems.

Legal Provisions

General Legislation and Background

The Federal legislation which addresses noise issues is somewhat different from other environmental legislation. The Clean Air Act, for example, required the Environmental Protection Agency to set up actual mandatory standards for air quality which were supposed to be met by all jurisdictions. EPA even has the authority to take punitive steps against cities which are not making "reasonable further progress" towards achieving these air quality goals. There is no similar legislation that covers noise. The approach has been to tackle the noise problem at the source by controlling the amount of noise that can be emitted by the individual airplane engine or the individual jackhammer. Agencies like HUD or the Farmers Home Administration have developed regulations which are related to the overall community noise level, but they only affect their own programs and are not binding on local communities. The Veterans Administration program only relates to aircraft noise and also only affects its own programs.

The major pieces of Federal legislation related to noise include:

The Noise Control Act of 1972 directed EPA to promote an environment for all Americans free from noise that jeopardizes their health and welfare. It also included a requirement for EPA to set a criterion for noise level adequate to protect health and welfare with an adequate margin of safety but without regard to cost or feasibility.

Quiet Communities Act of 1978 amended The Noise Control Act of 1972 to encourage noise control programs at the State and community level.

Federal Aid Highway Act of 1970 established the requirement that noise control be a part of the planning and design of all federally aided highways.

Aviation Safety and Noise Abatement Act of 1979 requires FAA to develop a single system for measuring noise at airports and under certain conditions to prepare and publish noise maps.

HUD Regulations

While the Department of Housing and Urban Development has no specific responsibility to try to reduce the noise problem at the source the way the Environmental Protection Agency and the Federal Aviation Administration do, it does have the responsibility to be aware of the noise problem and its impact on the housing environment. The most basic mandate which drives the Department's involvement with the noise issue is the Housing Act of 1949 (Public Law 81-171) which sets forth the national goal of "a decent home and suitable living environment for every American family." This goal was affirmed by the Housing and Urban Development Act of 1968 (Public Law 90-448). The Department was tasked by the Housing and Urban Development Act of 1965 (Public Law 89-117) "to determine feasible methods of reducing the economic loss and hardships suffered by homeowners as a result of the depreciation in the value of their properties following the construction of airports in the vicinity of their homes." The Noise Control Act of 1972, in addition to its specific tasking to EPA, tasked all Federal agencies to administer their programs in ways which reduce noise pollution. Finally, the Department is tasked by Federal Management Circular 75-2: *Compatible Land Uses at Federal Airfields* to make sure that its actions do not promote incompatible land uses around Federal airfields.

All of these legislative and regulatory mandates combine to create a serious requirement for the Department of Housing and Urban Development to be aware of the problem of noise and to take positive steps to protect residential and other sensitive land uses from high noise levels.

The Department of Housing and Urban Development first issued formal requirements related specifically to noise in 1971 (HUD Circular 1390.2). These requirements contained standards for exterior noise levels along with policies for approving HUD supported or assisted housing projects in high noise areas. In general the requirements established three zones: an acceptable zone where all projects could be approved, a normally unacceptable zone where mitigation measures would be required and where each project would have to be individually evaluated for approval or denial, and an unacceptable zone in which projects would not, as a rule, be approved.

In 1979, the Department issued revised regulations (24 CFR Part 51B) which kept the same basic standards but adopted new descriptor systems which were considerably advanced over those in use under the old requirements.

HUD's regulations also require that recipients of Community Development Block Grants (CDBG) and Urban Development Action Grants (UDAG) take into consideration the noise criteria and standards in the environmental review process and consider ameliorative actions when noise sensitive land developments are proposed in noise exposed areas. If CDBG or UDAG activities are planned in a noisy area, and HUD assistance is contemplated later for housing and/or other noise sensitive activities, the HUD standards must be met for those activities.

Project Analysis

General

While most of the analysis for noise focuses on noise sources located around the project site, there are some characteristics of the project itself that you should know about. These characteristics will help you to determine what is called the noise assessment location (NAL) for site analysis. (The NAL is a representative point (or points) on the site where significant noise exposure is expected. All distances, etc. are measured from the NAL). This information will also be helpful later in evaluating the potential for mitigating or reducing the impact of noise. All of this data should be available from preliminary plans and specifications. If not, a quick phone call to the developer/sponsor should get you all the information you need.

Data Required

- Location of outdoor noise sensitive uses relative to the noise source.
- Location of buildings containing noise sensitive activities.
- Location of other buildings, particularly ones which might serve to shield sensitive buildings or areas from the noise source.
- Design and construction features of buildings, particularly features such as use of central air conditioning which could provide noise reduction benefits by permitting windows to be kept closed.

Analysis of Site and Environs

General

The primary focus of this impact analysis is on noise sources and the primary item to be determined is the noise level created by those sources. In many instances, particularly with airports, data on the noise levels generated by the source will have already been prepared by another agency such as the airport operator, the local or State highway/transportation department or other similar agency. (Figure 4 shows typical airport noise contours.) In those cases no site or environs analysis is necessary and one can proceed directly to impact analysis. For those instances where there are no current data already prepared, the Department of Housing and Urban Development has developed a handbook called the *Noise Assessment Guidelines* which contains a detailed desk top methodology for use by individuals to determine noise impacts (see Chapter 5). Included in the handbook is a complete listing of the data about the site and its environs that are necessary to conduct an analysis. We don't want to repeat all the detailed requirements here, but the following are some of the types of information you would have to collect if you were to do your own analysis. You might note that most of the information is related to the noise sources themselves.

For the purpose of analysis, the *Noise Assessment Guidelines* require that you consider all military/civilian airports within 15 miles of the project, all significant roads within 1000 feet and basically all railroads within 3000 feet.

Types of Data Required

- Number and type of vehicles
- Operational data:
  - speed
  - daytime/nighttime split
- Conditions where the vehicles are operated, i.e., freely flowing traffic versus stop and go, level versus hilly, welded railroad track versus bolted railroad track.

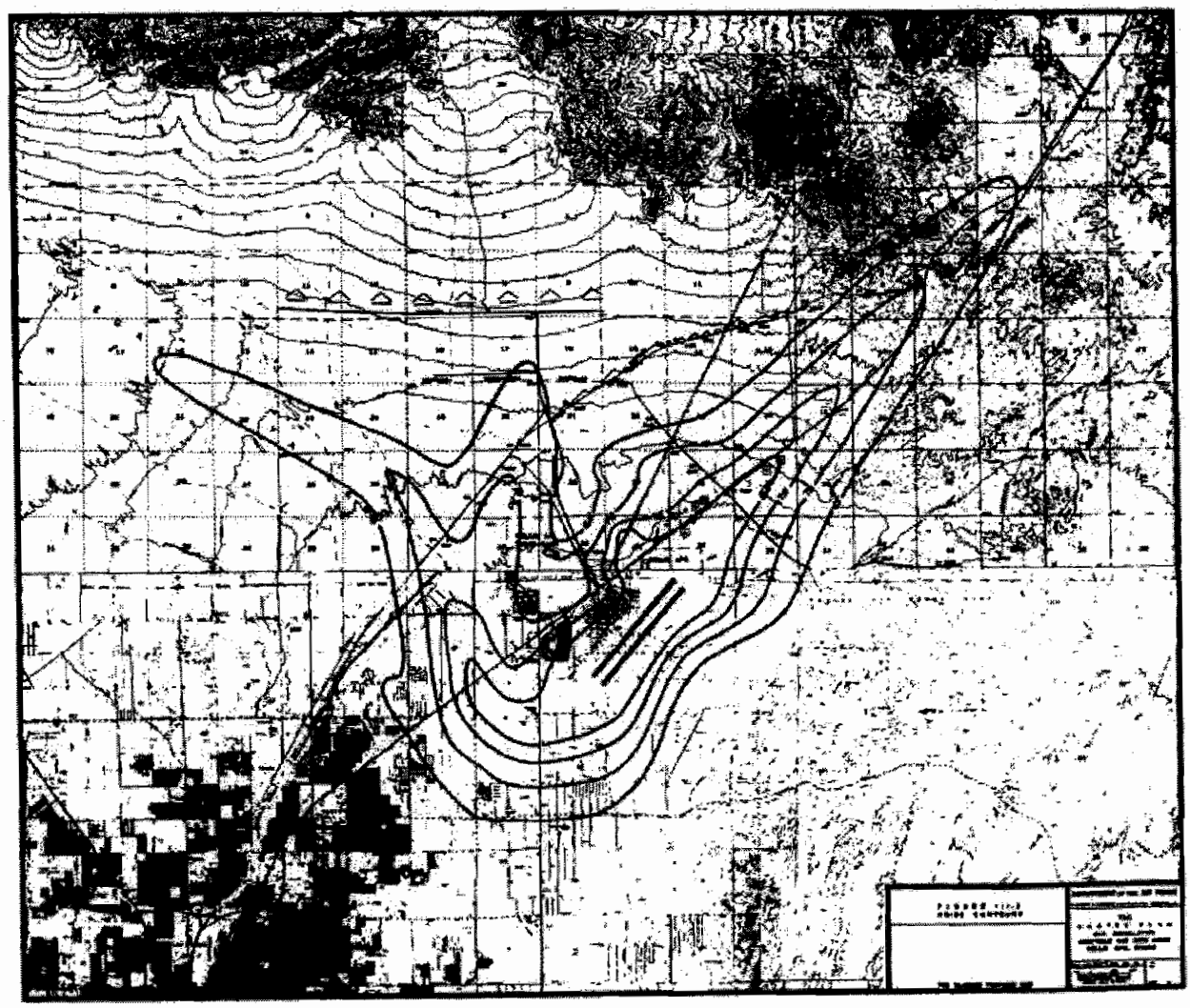
The *Noise Assessment Guidelines* contain guidance on sources for this data. Most of them are obtained from the "operator" of the transportation source. The *Guidelines* also contains model figures which can be used when actual data is unavailable. For example, if the actual number of vehicles traveling at night is not available then the *Guidelines* state that a figure of 15% should be used. Thus it is possible to make reasonably accurate noise level determinations even if some information is not available.

Determination of Impact

General

The specific procedures for determining the noise exposure levels for a site are clearly spelled out in the *Noise Assessment Guidelines*. The process is a fairly simple one in which the noise level from each source affecting the site is calculated and then combined to derive the overall exposure. If some kind of barrier exists or is proposed, the noise levels can be adjusted to reflect the mitigation provided by the barrier. The overall noise level is then compared to HUD's standards and the appropriate action, as spelled out in the regulations, is taken.

Figure 4
Noise Contours



Evaluation of Impact

HUD Regulations set forth the following exterior noise standards for new housing construction assisted or supported by the Department:

65 L_{dn} or less - Acceptable

Exceeding 65 L_{dn} but not exceeding 75 L_{dn} - Normally Unacceptable - appropriate sound attenuation measures must be provided: 5 decibels attenuation above the attenuation provided by standard construction required in 65 L_{dn} to 70 L_{dn} zone; 10 decibels additional attenuation in 70 L_{dn} to 75 L_{dn} zone.

Exceeding 75 L_{dn} - Unacceptable

HUD's regulations do not contain standards for interior noise levels. Rather a goal of 45 decibels is set forth and the attenuation requirements are geared towards achieving that goal. It is assumed that with standard construction any building will provide sufficient attenuation so that if the exterior level is 65 L_{dn} or less, the interior level will be 45 L_{dn} or less.

Once you have determined the overall noise exposure for the site you compare it to the above standards. If the overall site exposure is 65 L_{dn} or less the project is acceptable. If the exposure is between 65 L_{dn} and 75 L_{dn} you should consider alternative locations or providing adequate attenuation with the first preference, as we've noted, being for the construction of some kind of barrier to prevent noise from reaching the site. If providing adequate attenuation is impossible or impractical then the project should be considered unacceptable.

Suggested Mitigation

General Considerations

As discussed briefly earlier, there are three basic approaches for mitigating the high noise exposures. The first and best is to relocate noise sensitive uses out of the high noise area. The second is to prevent noise from reaching the noise sensitive user through some sort of barrier. And the third, and least desirable approach, is to provide attenuation for at least the interiors of any buildings located in the high noise areas.

Specific Considerations

Relocating Noise Sensitive Uses

By far the most desirable mitigation approach is to relocate noise sensitive uses out of the high noise area although. If the site is large enough it may be possible to locate non-noise sensitive uses between the source and the sensitive use, for example a parking lot might be located between a road and a park (see Figure 5). The workcharts in the *Noise Assessment Guidelines* can be used in reverse to tell you exactly how far away from the noise source you need to be.

When sites are small, very dense or when the source affects the entire site it is very difficult to mitigate by changing the site plan. Then the next option must be considered: erecting some type of barrier between the source and the receiver.

Barriers

Barriers are most effective for at or below ground level sources. They have no effect on noise from aircraft overflights and are limited in practical application with elevated sources such as elevated trains. The key to the effectiveness of a barrier is whether or not it breaks the line of sight between the source and the receiver. If a barrier does not completely break the line of sight either because it is not high enough, or not long enough then its effectiveness is greatly reduced.

Barriers can be actual walls, earthen mounds (called berms) or even other buildings. The use of other non-noise sensitive buildings as barriers is a particularly good approach in that it need not add to the cost of the project and may not create the aesthetic problem a large wall might create (see Figure 6).

Figure 5
The Audible Landscape

In cluster development, open space can be placed near the highway to reduce noise impacts on residences

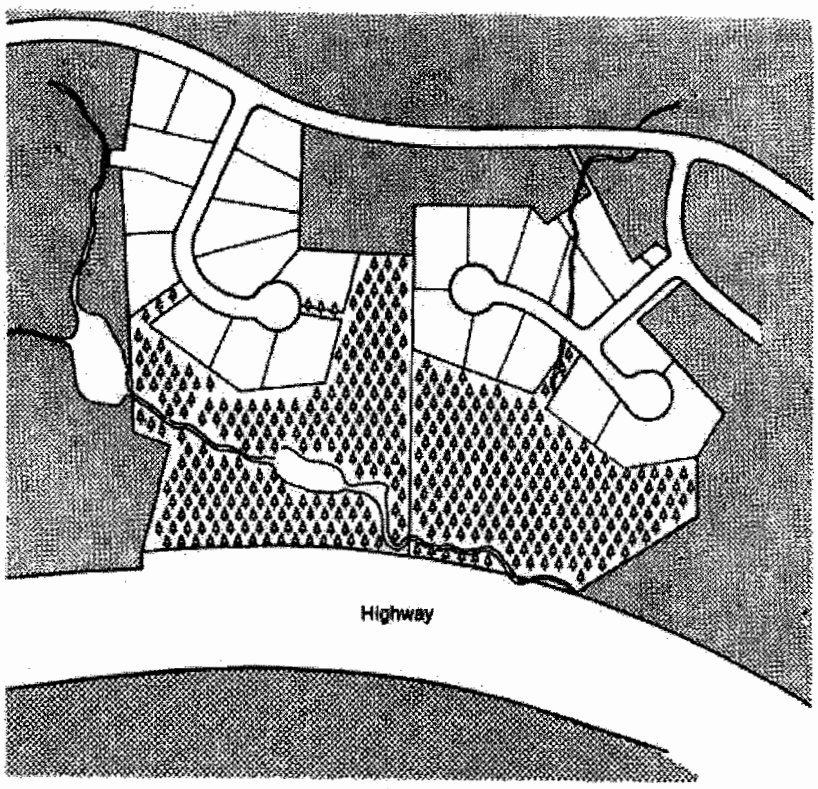


Figure 6
The Audible Landscape

Placement of noise compatible land uses near highway in Planned Unit Development

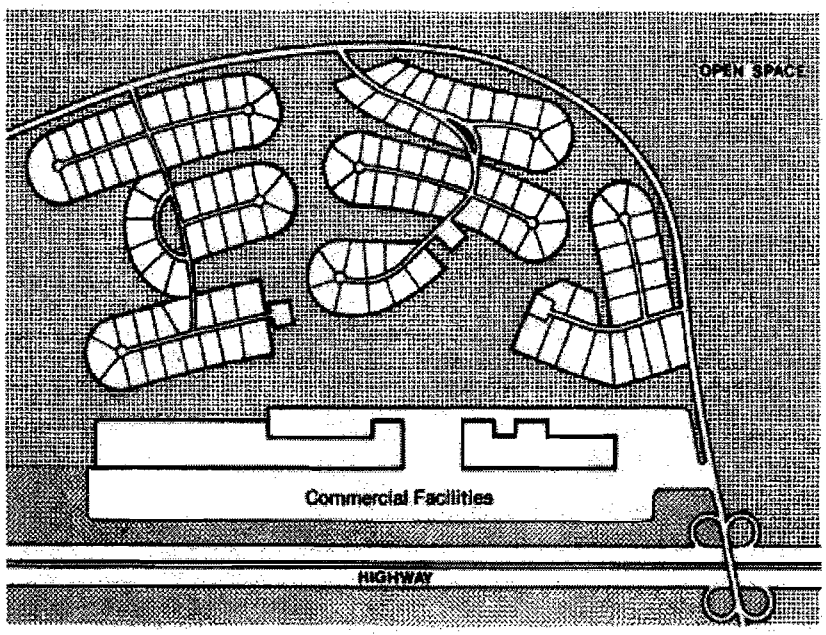
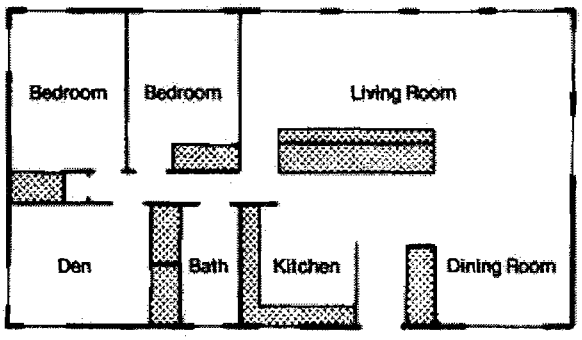


Figure 7
The Audible Landscape

Use of acoustical architectural design to reduce noise impacts on more noise sensitive living spaces



Highway

As pointed out earlier, the effectiveness of a barrier is determined in large part by its height and length. Some studies have shown that the effectiveness of a barrier can be reduced by as much as 50% if it isn't long enough. Again, the *Noise Assessment Guidelines* contain procedures for determining the effectiveness of barriers.

Incorporating Noise Attenuation Measures into the Building

If neither relocation or barriers is a reasonable noise attenuation option, the last resort is to incorporate noise attenuation measures into the buildings themselves. This is not considered the best solution because it leaves the outdoor areas, some of which may be for quiet recreation, exposed to high noise levels. But if development must take place and barriers are impossible, then the noise attenuation measures should be employed in building design and construction.

Without going into great technical detail, noise attenuation construction measures generally fall into four categories.

(1) Reducing the total area of windows or other acoustically weaker building elements

(2) Sealing off "leaks" around windows, doors, vents.

(3) Improving the actual sound attenuating properties of small building elements such as windows, doors, etc.

(4) Improving the actual sound attenuating properties of major building elements such as roof and wall construction.

In addition, noise attenuation in buildings can be provided by designing interior spaces so that "dead" spaces such as closets or corridors act as buffer zones (see Figure 7). And finally noise attenuation can be provided by reducing the need for open windows by providing air conditioning.

Many of the steps that would be taken to provide noise attenuation also help conserve energy. Good weatherstripping around windows and doors is one example. Another might be reducing window areas in walls if the noise source is to the north or west. Because many of these measures serve two purposes, they should not necessarily be considered a burdensome requirement but rather just good design and construction.

Information Resources

Publications

HUD Regulation 24 CFR Part 51 Subpart B - Noise Abatement and Control.

Noise Assessment Guidelines, HUD 1983, basic technical procedural resource.

Aircraft Noise Impact, HUD 1972, a bit dated but good overview of problem.

The Audible Landscape, DOT (FHWA) 1974, an excellent discusson of mitigation measures including land use planning and building design and construction.

Information on Levels of Environmental Noise Requisite to Protect Public health and Welfare With an Adequate margin of Safety, EPA, 1974. The "levels document" that explains basis for EPA standards.

Noise Barrier Design Handbook, Federal Highway Administration 1976. Good discussion of barriers, technical but readable.

Handbook of Noise Control, 2nd edition, 1979, McGraw Hill. A basic technical handbook covering all aspects of noise for those who wish to go into the subject further.

Experts

HUD environmental officers have been trained in the use of the *Noise Assessment Guidelines* and can help you work with them. Many architects are trained in acoustics and can help in development of noise attenuation strategies.

Quiz

Questions

1. Why is noise considered "unwanted sound"?
2. What is a community noise problem?
3. What are the three main contributors to a community noise problem?
4. What are the three components of a noise problem?
5. What are two key characteristics of the day-night average sound level descriptor system?
6. What are HUD's noise standards?
7. How do HUD's standards apply to CDBG recipients?
8. What are the three general mitigation measures available to HUD and the community and in what order of preference?
9. When are barriers effective and when are they not effective?
10. Describe how the *Noise Assessment Guidelines* can be used to determine appropriate mitigation measures.

Quiz

Answers

1. because it interferes with normal activities or causes physical or psychological damage
2. a community noise problem is where the combined effect of many individual sources creates an overall noise level that is unacceptable
3. highways, railroads and aircraft
4. the source, the path, the receiver
5. it is an average sound level and it can be used for all sources
6. 65 L_{dn} or below: Acceptable
   65 to 75 L_{dn}: Normally unacceptable, noise attenuation measures required, above 75 L_{dn}: Unacceptable
7. CDBG recipients must take into consideration the standards in their planning and environmental review, if they expect to use HUD assistance later for housing or other noise sensitive activities the standards must be met for those activities.
8. 1st relocate noise sensitive uses
   2nd reduce noise reaching receiver
   3rd redesign buildings
9. barriers are effective for at or below ground level sources. Are not effective for aircraft overflights or most elevated sources
10. can be used to determine separation distance required for relocation and the height and length of barriers required

Chapter 2

The Noise Regulation

Introduction

The basic foundation for and structure of the HUD noise program is set out in the noise regulation, 24 CFR 51B. The regulation establishes the actual standards, assigns implementation responsibilities, describes review and approval procedures, and identifies special situations which may warrant waivers of procedures or standards. Therefore, the key to your understanding and implementation of the HUD noise program is a clear understanding of the regulation.

There is no way to escape the task of sitting down and simply reading the regulations, over and over until you thoroughly understand them. We have however done two things that will help you apply the regulations. First, for quick reference, we have prepared a list of the key sections in the regulation and second we have prepared an annotated copy of the regulation.

The list of key sections was prepared to help you find the specific section you need for a specific question or issue. While the regulation itself is not really long, an index is always useful. We caution you, however, against using the index to avoid learning the regulations. The list was prepared for your convenience in applying the regulation once you have come to understand it.

We prepared the annotated regulation because, try as we might, it was impossible to anticipate all the questions, implementation problems and special situations that might arise and to address them in the regulation. So, now that we have had a few years' experience with the regulation, we have gathered together the important questions, notes, second thoughts etc. and prepared this annotated regulation. We hope it will give you further insight into what the regulation means when it is applied in the field.

Key Sections in Noise Regulation

Section	Subject
51.101(a)(2)	Application of Policy to Block Grants
51.101(a)(3)	Policy for New Construction
51.101(a)(4)	Policy for Existing Construction
51.101(a)(5)	Policy for Modernization and Rehabilitation
51.101(a)(8)	The Exterior Noise Goal
51.101(a)(9)	The Interior Noise Goal
51.102(a)	Authority to Approve Projects
51.103(a)	Identification of DNL as *The* Noise Descriptor to be Used
51.103(b)	How to Measure Loud Impulsive Noises
51.103(c)	The Noise Standards
51.104(a)	Attenuation Requirements Discussed
51.104(b)(1)	Special Approval and Environmental Review Requirements for the Normally Unacceptable Zone
51.104(b)(2)	Special Approval and Environmental Review Requirements for the Unacceptable zone
51.105(a)	Flexibility for Non-acoustic Benefits Provisions
51.106(a)	How to Tell If Existing Data on Noise Are Acceptable
51.106(a)(4)	Specific Review and Approval Procedures For Airport Noise Contours
51.106(d)	When Noise Measurements May be Used Instead of Calculated Levels
51.106(f)	When to Give Credit for Proposed Barriers

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Part 51—Environmental Criteria and Standards

Subpart A—General Provisions

Sec.
§51.1 Purpose.
§51.2 Authority.
§51.3 Responsibilities.
§51.4 Program coverage.
§51.5 Coordination with environmental clearance requirements.
§51.6 [Reserved]

Subpart B—Noise Abatement and Control
§51.100 Purpose and authority.
§51.101 General policy.
§51.102 Responsibilities.
§51.103 Criteria and standards.
§51.104 Special requirements.
§51.105 Exceptions.
§51.106 Implementation.

Appendix to Subpart B

Authority: Sec. 7(d). Department of HUD Act (42 U.S.C. 3535(d)).

Subpart B—Noise Abatement and Control

This regulation replaces HUD Circular 1390.2, Noise Abatement and Control, 1971, which is now cancelled, along with all instructions and clarifying memoranda pertaining to the circular.

§51.100 Purpose and authority.

(a) *Purpose.* The Department of Housing and Urban Development finds that noise is a major source of environmental pollution which represents a threat to the serenity and quality of life in population centers and that noise exposure may be a cause of adverse physiological and psychological effects as well as economic losses.

It is the purpose of this Subpart to:

(1) Call attention to the threat of noise pollution;

(2) Encourage the control of noise at its source in cooperation with other Federal departments and agencies;

(3) Encourage land use patterns for housing and other noise sensitive urban needs that will provide a suitable separation between them and major noise sources;

(4) Generally prohibit HUD support for new construction of noise sensitive uses on sites having unacceptable noise exposure;

(5) Provide policy on the use of structural and other noise attenuation measures where needed; and

(6) Provide policy to guide implementation of various HUD programs.

(b) *Authority.* Specific authorities for noise abatement and control are contained in:

(1) The Noise Control Act of 1972 (Pub. L. 92-574) which directs Federal agencies to administer their programs in ways which reduce noise pollution.

(2) The Quiet Communities Act of 1978 (Pub. L. 95-609) which amended Pub. L. 92-574.

(3) The General Services Administration, Federal Management Circular 75-2: *Compatible Land Uses at Federal Airfields* prescribes the Executive Branch's general policy with respect to achieving compatible land uses on either public or privately owned property at or in the vicinity of Federal airfields.

(4) Section 1113 of the Housing and Urban Development Act of 1965 (Pub. L. 89-117) directs the Secretary "* * * to determine feasible methods of reducing the economic loss and hardships suffered by homeowners as a result of the depreciation in the value of their properties following the construction of airports in the vicinity of their homes, including a study of feasible methods of insulating such homes from the noise of aircraft."

§51.101 General policy.

(a) It is HUD's general policy to provide minimum national standards applicable to HUD programs to protect citizens against excessive noise in their communities and places of residence.

(1) *Comprehensive planning assistance.* HUD requires that grantees give adequate consideration to noise exposures and sources of noise as an integral part of the urban environment in HUD assisted comprehensive planning, as follows:

(i) Particular emphasis shall be placed on the importance of compatible land use planning in relation to airports, highways and other sources of high noise.

(ii) Applicants shall take into consideration HUD environmental standards impacting the use of land as required in 24 CFR Part 600.

(iii) Environmental studies, including noise assessments, are allowable costs.

(2) *Community Development Block Grants.* Recipients of community development block grants under the Housing and Community Development Act of 1974 (Pub. L. 93-383), as amended by the Housing and Community Development Act of 1977 (Pub. L. 95-128), must take into

consideration the noise criteria and standards in the environmental review process and consider ameliorative actions when noise sensitive land development is proposed in noise exposed areas. Grant recipients shall address deviations from the standards in their environmental reviews as required in 24 CFR Part 58.

Where CDBG activities are planned in a noisy area, and HUD assistance is contemplated later for housing and/or other noise sensitive activities, the CDBG grantee risks denial of the HUD assistance unless the HUD standards are met. Environmental studies, including noise assessments, are allowable costs.

(3) *HUD support for new construction.* HUD assistance for the construction of new noise sensitive uses is prohibited generally for projects with Unacceptable noise exposures and is discouraged for projects with Normally Unacceptable noise exposure. (Standards of acceptability are contained in §51.103(c).) This policy applies to all HUD programs providing assistance, subsidy or insurance for housing, college housing, mobile home parks, nursing homes, hospitals, and all programs providing assistance or insurance for land development, new communities, redevelopment or any other provision of facilities and services which are directed to make land available for housing or noise sensitive development. The policy does not apply to research demonstration projects which do not result in new construction or reconstruction, flood insurance, interstate land sales registration, or any action or emergency assistance under disaster assistance programs which are provided to save lives, protect property, protect public health and safety, remove debris and wreckage, or assistance provided that has the effect of restoring facilities substantially as they existed prior to the disaster.

(4) *HUD support for existing construction.* Noise exposure by itself will not result in the denial of HUD support for the resale and purchase of otherwise acceptable existing buildings. However, environmental noise is a marketability factor which HUD will consider in determining the amount of insurance or other assistance that may be given.

Existing construction means units which are either more than 1 year old or for which this is the second or subsequent purchaser.

The old definition of major or substantial rehabilitation and modernization as being any project where cost is 75% or more of replacement cost no longer applies. Now the criteria contained in individual program guidance applies.

(5) *HUD support of modernization and rehabilitation.* For modernization projects located in all noise exposed areas, HUD shall encourage noise attenuation features in alterations. For major or substantial rehabilitation projects in the Normally Unacceptable and Unacceptable noise zones, HUD actively shall seek to have project sponsors incorporate noise attenuation features, given the extent of the rehabilitation being undertaken and the level of exterior noise exposure. In Unacceptable noise zones, HUD shall strongly encourage conversion of noise-exposed sites to land uses compatible with the high noise levels.

(6) *Research, guidance and publications.* HUD shall maintain a continuing program designed to provide new knowledge of noise abatement and control to public and private bodies, to develop improved methods for anticipating noise encroachment, to develop noise abatement measures through land use and building construction practices, and to foster better understanding of the consequences of noise. It shall be HUD's policy to issue guidance documents periodically to assist HUD personnel in assigning an acceptability category to projects in accordance with noise exposure standards, in evaluating noise attenuation measures, and in advising local agencies about noise abatement strategies. The guidance documents shall be updated periodically in accordance with advances in the state-of-the-art.

(7) *Construction equipment, building equipment and appliances.* HUD shall encourage the use of quieter construction equipment and methods in population centers, the use of quieter equipment and appliances in buildings, and the use of appropriate noise abatement techniques in the design of residential structures with potential noise problems.

(8) *Exterior noise goals.* It is a HUD goal that exterior noise levels do not exceed a day-night average sound level of 55 decibels. This level is recommended by the Environmental Protection Agency as a goal for outdoors in residential areas. The levels recommended by EPA are not standards and do not take into account cost or feasibility. For the purposes of this regulation and to meet other program objectives, sites with a day-night average sound level of 65 and below are acceptable and are allowable (see Standards in §51.103(c)).

(9) *Interior noise goals.* It is a HUD goal that the interior auditory environment shall not exceed a day-night average sound level of 45 decibels. Attenuation measures to meet these interior goals shall be employed where feasible. Emphasis shall be given to noise sensitive interior spaces such as bedrooms. Minimum attenuation requirements are prescribed in §51.104(a).

(10) *Acoustical privacy in multifamily buildings.* HUD shall require the use of building design and acoustical treatment to afford acoustical privacy in multifamily buildings pursuant to requirements of the Minimum Property Standards.

§51.102 Responsibilities.

(a) *Authority to approve projects.* (1) Decisions on proposed projects with acceptable noise exposures shall be delegated to the program personnel within field offices, including projects where increased noise levels are considered acceptable because of non-acoustic benefits under §51.105(a). Field office program personnel may also approve projects in normally unacceptable noise exposed areas where adequate sound attenuation is provided and where the project does not require an Environmental Impact Statement under §51.104(b).

(2) Other approvals in normally unacceptable noise exposed areas require the concurrence of the Regional Administrator.

(3) Requests for approvals of projects or portions of projects with unacceptable noise exposures shall be referred through the Regional Office to the Assistant Secretary for Community Planning and Development for approval pursuant to §51.104(b).

The Noise Control Act of 1972 required EPA to "publish information on the levels of environmental noise. . .which. . .are requisite to protect the public health and welfare with an adequate margin of safety." EPA has interpreted this to mean that the levels should not reflect technical feasibility or economic costs. "Health and welfare" is defined as being "complete physical, mental and social well-being and not merely the absence of disease and infirmity."

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(4) In cases where the Regional Administrator determines that an important precedent or issue is involved, such cases shall be referred with recommendations to the Assistant Secretary for Community Planning and Development.

(b) *Surveillance of noise problem areas.* Appropriate field staff shall maintain surveillance of potential noise problem areas and advise local officials, developers, and planning groups of the unacceptability of sites because of noise exposure at the earliest possible time in the decision process. Every attempt shall be made to insure that applicants' site choices are consistent with the policy and standards contained herein.

(c) *Notice to applicants.* At the earliest possible stage, HUD program administrators shall:

(1) Determine the suitability of the acoustical environment of proposed projects;

(2) Notify applicants of any adverse or questionable situations; and

(3) Assure that prospective applicants are apprised of the standards contained herein so that future site choices will be consistent with these standards.

(d) *Technical assistance.* Technical assistance in the measurement, estimation, interpretation, or prediction of noise exposure is available from the Office of Community Planning and Development and the Office of Policy Development and Research. Field office questions shall be forwarded through the Regional Office to the Assistant Secretary for Community Planning and Development or his designee.

(e) *Interdepartmental coordination.* Regional Administrators shall foster appropriate coordination between field offices and other departments and agencies, particularly the Environmental Protection Agency, the Department of Transportation, Department of Defense representatives, and the Veterans Administration. HUD staff shall utilize the acceptability standards in commenting on the prospective impacts of transportation facilities and other noise generators in the Environmental Impact Statement review process.

§51.103 Criteria and standards.

These standards apply to all programs as indicated in §61.101.

(a) *Measure of external noise environments.* The magnitude of the external noise environment at a site is determined by the value of the day-night average sound level produced as the result of the accumulation of noise from all sources contributing to the external noise environment at the site. Day-night average sound level, abbreviated as DNL and symbolized as L_{dn}, is the 24-hour average sound level, in decibels, obtained after addition of 10 decibels to sound levels in the night from 10 p.m. to 7 a.m. Mathematical expressions for average sound level and day-night average sound level are stated in the Appendix.

(b) *Loud impulsive sounds.* On an interim basis, when loud impulsive sounds, such as explosions or sonic booms, are experienced at a site, the day-night average sound level produced by the loud impulsive sounds alone shall have 8 decibels added to it in assessing the acceptability of the site (see Appendix). Alternatively, the C-weighted day-night average sound level (L_{Cdn}) may be used without the 8 decibel addition, as indicated in Section 51.106(a)(3).

Methods for assessing the contribution of loud impulsive sounds to day-night average sound level at a site and mathematical expressions for determining whether a sound is classed as "loud impulsive" are provided in the Appendix.

(c) *Exterior standards.* The degree of acceptability of the noise environment at a site is determined by the sound levels external to buildings or other facilities containing noise sensitive uses. The standards shall usually apply at a location 2 meters (6.5 feet) from the building housing noise sensitive activities in the direction of the predominant noise source. Where the building location is undetermined, the standards shall apply 2 meters (6.5 feet) from the building setback line nearest to the predominant noise source. The standards shall also apply at other locations where it is determined that quiet outdoor space is required in an area ancillary to the principal use on the site.

The noise environment inside a building is considered acceptable if (a) the noise environment external to the building complies with these standards, and (b) the building is constructed in a manner common to the area or, if of uncommon construction, has at least the equivalent noise attenuation characteristics.

This is because the reverberation effect of sound waves hitting the wall will increase the noise levels at the site. You won't pick this up unless you back off from the wall to measure.

Site Acceptability Standards

	Day-night average sound level (in decibels)	Special approvals and requirements
Acceptable	Not exceeding 65 dB(1)	None
Normally Unacceptable	Above 65 dB but not exceeding 75 dB	Special Approvals (2) Environmental Review (3) Attenuation (4)
Unacceptable	Above 75 dB	Special Approvals (2) Environmental Review (3) Attenuation (5)

Notes.—(1) Acceptable threshold may be shifted to 70 dB in special circumstances pursuant to Section 51.105(a)

(2) See Section 51.104(b) for requirements.

(3) See Section 51.104(b) for requirements.

(4) 5 dB additional attenuation required for sites above 65 dB but not exceeding 70 dB and 10 dB additional attenuation required for sites above 70 dB but not exceeding 75 dB. (See Section 51.104(a).)

(5) Attenuation measures to be submitted to the Assistant Secretary for CPD for approval on a case-by-case basis.

§51.104 Special requirements.

(a) *Noise attenuation.* Noise attenuation measures are those required in addition to attenuation provided by buildings as commonly constructed in the area, and requiring open windows for ventilation. Measures that reduce external noise at a site shall be used wherever practicable in preference to the incorporation of additional noise attenuation in buildings. Building designs and construction techniques that provide more noise attenuation than typical construction may be employed also to meet the noise attenuation requirements.

(1) *Normally Unacceptable noise zone.* Approvals in this zone require a minimum of 5 decibels additional sound attenuation for buildings having noise-sensitive uses if the day-night average sound level is greater than 65 decibels but does not exceed 70 decibels, or a minimum of 10 decibels of additional sound attenuation if the day-night average sound level is greater than 70 decibels but does not exceed 75 decibels.

(2) *Unacceptable noise zone.* Noise attenuation measures require the approval of the Assistant Secretary for Community Planning and Development (See §51.104(b)(2).)

(b) *Special Approvals and Environmental Review Requirements.* Environmental clearances shall be conducted pursuant to the requirements of HUD's Departmental Policies, Responsibilities and Procedures for Protection and Enhancement of Environmental Quality (38 FR 19182 as amended) or other environmental regulations which may be issued by the Department. The Special Clearance and Environmental Impact Statement (EIS) threshold requirements are hereby modified for all projects proposed in the Normally Unacceptable and Unacceptable noise exposure zones as follows:

(1) *Normally Unacceptable noise zone.* (i) All projects located in the Normally Unacceptable Noise Zone require a Special Environmental Clearance except an EIS is required for a proposed project located in a largely undeveloped area, or where the HUD action is likely to encourage the establishment of incompatible land use in this noise zone.

Berms and barriers are our first choice because they provide protection for yards, playgrounds, etc. Since outdoor activity is often very important to residents we want to protect the outdoor areas as much as possible.

By definition a barrier must be separate from the building or area it is providing attenuation for. After all barriers are preferred because they improve exterior as well as interior levels. Non-noise sensitive buildings can, however, be used as barriers for noise sensitive buildings or exterior areas.

Assumption is that standard construction provides an average of 20 L_{dn} attenuation. At 65 L_{dn} or below this amount of attenuation would be sufficient to meet interior level of 45 L_{dn}. Additional requirements are designed to meet this goal even when exterior noise levels are higher.

Substitute Environmental Assessment (with ECO concurrence) wherever you see Special Clearance.

(ii) When an EIS is required, the concurrence of the Regional Administrator is also required before a project can be approved. For the purposes of this paragraph, an area will be considered as largely undeveloped unless the area within a 2-mile radius of the project boundary is more than 50 percent developed for urban uses and infrastructure (particularly water and sewers) is available and has capacity to serve the project.

(iii) All other projects in the Normally Unacceptable zone require a Special Environmental Clearance, except where an EIS is required for other reasons pursuant to HUD environmental policies.

(2) *Unacceptable noise zone.* An EIS is required prior to the approval of projects with unacceptable noise exposure. Projects in or partially in an Unacceptable Noise Zone shall be submitted through the Regional Administrator to the Assistant Secretary for Community Planning and Development for approval. The Assistant Secretary may waive the EIS requirement in cases where noise is the only environmental issue and no outdoor sensitive activity will take place on the site. In such cases, a Special Environmental Clearance is required.

§51.105 Exceptions.

(a) *Flexibility for non-acoustic benefits.* Where it is determined that program objectives cannot be achieved on sites meeting the acceptability standard of 65 decibels, the Acceptable Zone may be shifted to L_{dn} 70 on a case-by-case basis if all the following conditions are satisfied:

(1) The project does not require an Environmental Impact Statement under provisions of section 104(b)(1) and noise is the only environmental issue.

(2) The project has received a Special Environmental Clearance and has received the concurrence of the Environmental Clearance Officer.

(3) The project meets other program goals to provide housing in proximity to employment, public facilities and transportation.

(4) The project is in conformance with local goals and maintains the character of the neighborhood.

(5) The project sponsor has set forth reasons, acceptable to HUD, as to why the noise attenuation measures that would normally be required for new construction in the L_{dn} 65 to L_{dn} 70 zone cannot be met.

When the area in question is in a small community outside an SMSA and the application of the 2 mile radius rule would be unreasonable, an area can be considered largely developed if it is contiguous to existing development and infrastructure is available and has capacity to serve the project. The Assistant Secretary will review them on a case-by-case basis. In all other cases the 2 mile radius/50% rule still applies.

Caution—every effort should be made to get official contours—particularly for military installations and large air carrier airports rather than trying to use the *Noise Assessment Guidelines*.

What this really means is that the 5db attenuation requirement for the 65–70 L_{dn} zone is waived. Primarily intended for urban areas where alternative sites are not available. Note that *all* conditions must be met.

These requirements are very important. Be careful with design hour values.

(6) Other sites which are not exposed to noise above L_{dn} 65 and which meet program objectives are generally not available.

The above factors shall be documented and made part of the project file.

§51.106 Implementation.

(a) *Use of available data.* HUD field staff shall make maximum use of noise data prepared by others when such data are determined to be current and adequately projected into the future and are in terms of the following:

(1) *Sites in the vicinity of airports.* The noise environment around airports is described sometimes in terms of Noise Exposure Forecasts, abbreviated as NEF or, in the State of California, as Community Noise Equivalent Level, abbreviated as CNEL. The noise environment for sites in the vicinity of airports for which day-night average sound level data are not available may be evaluated from NEF or CNEL analyses using the following conversions to DNL:

DNL = NEF + 35

DNL = CNEL

(2) *Sites in the vicinity of highways.* Highway projects receiving Federal aid are subject to noise analyses under the procedures of the Federal Highway Administration.

Where such analyses are available they may be used to assess sites subject to the requirements of this standard. The Federal Highway Administration employs two alternate sound level descriptors: (a) The A-weighted sound level not exceeded more than 10 percent of the time for the highway design hour traffic flow, symbolized as L_{10}; or (b) the equivalent sound level for the design hour, symbolized as L_{eq}. The day-night average sound level may be estimated from the design hour L_{10} or L_{eq} values by the following relationships, provided heavy trucks do not exceed 10 percent of the total traffic flow in vehicles per 24 hours and the traffic flow between 10 p.m. and 7 a.m. does not exceed 15 percent of the average daily traffic flow in vehicles per 24 hours:

DNL = L_{10} (design hour)—3 decibels

DNL = L_{eq} (design hour) decibels

Where the auto/truck mix and time of day relationships as stated in this Section do not exist, the HUD Noise Assessment Guidelines or other noise analysis shall be used.

(3) *Sites in the vicinity of installations producing loud impulsive sounds.* Certain Department of Defense installations produce loud impulsive sounds from artillery firing and bombing practice ranges. Noise analyses for these facilities sometimes encompass sites that may be subject to the requirements of this standard. Where such analyses are available they may be used on an interim basis to establish the acceptability of sites under this standard.

The Department of Defense uses day-night average sound level based on C-weighted sound level, symbolized L_{Cdn}, for the analysis of loud impulsive sounds. Where such analyses are provided, the 8 decibel addition specified in 51.103(b), is not required, and the same numerical values of day-night average sound level used on an interim basis to determine site suitability for non-impulsive sounds apply to the L_{Cdn}.

(4) *Use of areawide acoustical data.* HUD encourages the preparation and use of areawide acoustical information, such as noise contours for airports. Where such new or revised contours become available for airports (civil or military) and military installations they shall first be referred to the Regional Office (Environmental Clearance Officer) for review, evaluation and decision on appropriateness for use by HUD. The Regional Office shall submit revised contours to the Assistant Secretary of Community Planning and Development for review, evaluation and decison whenever the area affected is changed by 20 percent or more, or whenever it is determined that the new contours will have a significant effect on HUD programs, or whenever the contours are not provided in a methodology acceptable under §51.106(a)(1) or in other cases where the Regional Office determines that Headquarters review is warranted. For other areawide acoustical data, review is required only where existing areawide data are being utilized and where such data have been changed to reflect changes in the measurement methodology or underlying noise source assumptions.

Contours for future noise levels based on new construction, mission changes etc. which become available as part of the Environmental Impact Statement process shall not be used until the NEPA process is complete and a decision on the proposed action is made.

When new or revised contours are approved, make sure all interested people in local area are informed that HUD will be using different contours. Make a special effort to inform the most active developers in area or developers who have worked with HUD before.

This is also required for noise studies for developers by consultants, whether to provide original data, or to contest existing data or a HUD analysis. It is particularly important to make sure the same traffic, vehicle or operational data were used for each study, when one study is being contested.

Requests for determination on usage of new or revised areawide data shall include the following:

(i) Maps showing old, if applicable, and new noise contours, along with brief description of data source and methodology.

(ii) Impact on existing and prospective urbanized areas and on development activity.

(iii) Impact on HUD-assisted projects currently in processing.

(iv) Impact on future HUD program activity. Where a field office has determined that immediate approval of new areawide data is necessary and warranted in limited geographic areas, the request for approval should state the circumstances warranting such approval. Actions on proposed projects shall not be undertaken while new areawide noise data are being considered for HUD use except where the proposed location is affected in the same manner under both the old and new noise data.

(b) *Site assessments.* Compliance with the standards contained in §51.103(c) shall, where necessary, be determined using noise assessment guidelines, handbooks, technical documents and procedures issued by the Department.

(c) *Variations in site noise levels.* In many instances the noise environment will vary across a site, with portions of the site being in an Acceptable noise environment and other portions in a Normally Unacceptable noise environment. The standards in §51.103(c) shall apply to the portions of a building or buildings used for residential purposes and for ancillary noise sensitive open spaces.

(d) *Noise measurements.* Where noise assessments result in a finding that the site is borderline or questionable, or is controversial, noise measurements may be performed. Where it is determined that noise measurements are required, such measurements will be conducted in accordance with methods and measurement criteria established by the Department. Locations for noise measurements will depend on the location of noise sensitive uses that are nearest to the predominant noise source (see §51.103(c)).

(e) *Projections of noise exposure.* In addition to assessing existing exposure, future conditions should be projected. To the extent possible, noise exposure shall be projected to be representative of conditions that are expected to exist at a time at least 10 years beyond the date of the project or action under review.

When projections for airports are based on new construction or similar actions the likelihood that such major action will actually take place should be carefully evaluated. This is particularly important if local funding is required. Check to see if initial actions such as land purchases, bonds etc. been taken. If projections are just based on expanded traffic levels make sure they are reasonable for the area. Projections for smaller communities are often overly optimistic.

(f) *Reduction of site noise by use of berms and/or barriers.* If it is determined by adequate analysis that a berm and/or barrier will reduce noise at a housing site, and if the barrier is existing or there are assurances that it will be in place prior to occupancy, the environmental noise analysis for the site may reflect the benefits afforded by the berm and/or barrier.

In the environmental review process under §51.104(b), the location height and design of the berm and/or barrier shall be evaluated to determine its effectiveness, and impact on design and aesthetic quality, circulation and other environmental factors.

This provision should be used with caution. Very clear and strong assurances that berms or barriers will be constructed should be obtained in writing before approval.

Again also note that by definition a barrier must be physically separate from the building or area it is providing attenuation for.

The *Noise Assessment Guidelines* contain procedures for evaluating barrier effectiveness.

Appendix to Subpart B—definition of acoustical quantities

1. *Sound Level.* The quantity in decibels measured with an instrument satisfying requirements of American National Standard Specification for Type 1 Sound Level Meters S1.4–1971. Fast time-averaging and A-frequency weighting are to be used, unless others are specified. The sound level meter with the A-weighting is progressively less sensitive to sounds of frequency below 1,000 hertz (cycles per second), somewhat as is the ear. With fast time averaging the sound level meter responds particularly to recent sounds almost as quickly as does the ear in judging the loudness of a sound.

(2) *Average Sound Level.* Average sound level, in decibels, is the level of the mean-square A-weighted sound pressure during the stated time period, with reference to the square of the standard reference sound pressure of 20 micropascals.

$$L_{dn} = 10 \log_{10} \left[\frac{1}{86400} \left(\int_{0000}^{0700} 10^{[L_A(t)+10]/10}\, dt + \int_{0700}^{2200} 10^{L_A(t)/10}\, dt + \int_{2200}^{2400} 10^{[L_A(t)+10]/10}\, dt \right) \right]$$

Time t is in seconds, so the limits shown in hours and minutes are actually interpreted in seconds. $L_A(t)$ is the time varying value of A-weighted sound level, the quantity in decibels measured by an instrument satisfying requirements of American National Standard Specification for Type 1 Sound Level Meters S1.4-1971.

3. *Loud Impulsive Sounds.* When loud impulsive sounds such as sonic booms or explosions are anticipated contributors to the noise environment at a site, the contribution to day-night average sound level produced by the loud impulsive sounds shall have 8 decibels added to it in assessing the acceptability of a site.

A loud impulsive sound is defined for the purpose of this regulation as one for which:

(i) The sound is definable as a discrete event wherein the sound level increases to a maximum and then decreases in a total time interval of approximately one second or less to the ambient background level that exists without the sound; and

(ii) The maximum sound level (obtained with slow averaging time and A-weighting of a Type 1 sound level meter whose characteristics comply with ANSI S1.4-1971) exceeds the sound level prior to the onset of the event by at least 6 decibels; and

(iii) The maximum sound level obtained with fast averaging time of a sound level meter exceeds the maximum value obtained with slow averaging time by at least 4 decibels.

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Patricia Roberts Harris,
Secretary of Housing and Urban Development.

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Quiz on the Noise Regulations

Questions

1. What is the HUD policy on support for existing construction in high noise areas?
2. What is the definition of "major or substantial rehabilitation"?
3. What is HUD's interior noise goal?
4. What project approval authority does the Field Office have?
5. Who approves projects in the Unacceptable Zone?
6. What noise descriptor is used to express noise levels in the regulation?
7. How are loud impulsive sounds to be evaluated?
8. At what point on a building's exterior are sound levels to be determined?
9. What is the basic assumption behind the attenuation levels required?
10. What type of attenuation measures are preferred?
11. When should building attenuation measures be considered?
12. When are EIS's required?
13. When is an area considered "largely undeveloped"?
14. What is "Flexibility for Non-Acoustic Benefits"?
15. Six conditions are listed for waiving the attenuation requirement under the Flexibility for Non-Acoustic Benefits provision, how many must be met for the waiver to be granted?
16. Who has the authority to grant the attenuation requirements waiver under the "flexibility" provision?
17. What noise descriptors other than DNL are acceptable for aircraft noise contours?
18. Who normally approves areawide noise data such as airport noise contours?
19. If a site is partially in the Unacceptable Zone and partially in the Normally Unacceptable Zone, which review and approval procedures apply?
20. When should noise measurements be used in lieu of areawide data or *Noise Assessment Guidelines* calculations?

Quiz on the Noise Regulations

Answers

1. Noise exposure can not, by itself, be the basis for denying support for resale and purchase of existing buildings. (Section 51.101(a)(4))
2. "Major or substantial rehabilitation" is defined in individual program guidance. There is no single definition. (51.101(a)(5) marginal note)
3. 45 L_{dn} (Section 51.101(a)(9))
4. projects in Acceptable Zone; also projects in Normally Unacceptable Zone provided that
   - adequate sound attenuation is provided
   - no EIS is required (Section 51.102(a)(1))
5. The Assistant Secretary for Community Planning and Development. (Section 51.102(a)(3) and 51.104(b))
6. The day night average sound level system (DNL). (Section 51.103(a))
7. Two ways:
   - If plain DNL levels have been calculated or measured, add a 8 decibel penalty.
   - Alternatively, the C weighted day night average sound level system (L_{CdN}) can be used as is. (Section 51.103(b))
8. Two meters (6.5 feet) away from the building exterior, moving towards the predominant noise source. (Section 51.103(c))
9. That current construction practices provide about 20 db attenuation. Thus in a 65 L_{dn} or lower area the interior goal of 45 L_{dn} would be met with standard construction. The additional attenuation required is the increment over that provided by standard construction necessary to achieve the interior goal of 45 L_{dn}. (Section 51.104(a) marginal note)
10. Measures which reduce exterior noise levels. (51.104(a))
11. Only after it has been determined that berms and barriers or site redesign are not practical alternatives. (Section 51.104(a))
12. When the project is located in the Unacceptable Zone or the project is located in a largely undeveloped area and the project is in the Normally Unacceptable Zone. (Section 51.104(b))
13. When the area within a 2 mile radius of the project is less than 50% developed for urban uses and infrastructure is not in place and available to serve the project. (Section 51.104(b)(1)(ii))
14. A provision in the regulations which allows the attenuation requirements for the 65-70 L_{dn} zone to be waived. (Section 51.105(a) and marginal note)
15. All six conditions must be met. (Section 51.105(a))
16. The field office. (Section 51.102(a))
17. NEF and CNEL. (Section 51.106(a)(1))
18. The Regional Office. (Section 51.106(a)(4))
19. The review and approval procedures for projects in the Unacceptable Zone apply. (Section 51.104(b)(2))
20. Only when the noise assessment indicates that the site is on the borderline between Acceptable and Unacceptable, or when the site is controversial. (Section 51.106(d))

Chapter 3

Major Policy and Implementation Questions Related to the Noise Regulation

As regulations are applied in the field, it is inevitable that questions will arise. It is, after all, very difficult to anticipate every situation when preparing a regulation. Sometimes the questions relate to specific and unique situations of limited interest to anyone but the office involved. Other questions, however, raise issues of more general concern. In this section we have brought together the most important and most relevant questions that have arisen since the noise regulation went into effect in August of 1979. We have used a question and answer format for your convenience.

The following are the topics included:

1. Noise projections for civil airports
2. Definition of infill for small towns
3. Areawide EIS waivers
4. Requirements for modernization and rehabilitation projects
5. Use of berms and barriers as attenuation measures
6. New and revised airport noise contours

Questions and Answers

1. How valid and useful are civil airport noise projections that show significant reductions in the amount of land exposed to high noise levels? Should we be suspicious?

Contours that show significant reductions in the area exposed to high noise levels may seem questionable, but, according to the Environmental Protection Agency, they may be quite accurate. The EPA does expect to see some significant reductions in the number of people exposed to high levels of aircraft noise over the next 15 years. In their report *Aviation Noise: The Next Twenty years*, EPA stated that they expected to see the number of people exposed to levels of 65 Ldn or greater to drop from a 1975 figure of 5,550,000 to about 2,650,000 in the year 2000. Much of this reduction would occur during the period 1980–1985 with more modest decreases thereafter. The reductions are expected to result from the Federal Aviation Administration's current noise certification requirements, even with up to 100% increases in aircraft operations. (Current certification requirements are for all new aircraft to achieve stage three noise levels and all older aircraft to achieve stage two levels by 1985. Progress has been good in meeting these requirements.)

In general then, you should not be surprised to see significant reductions in contour size if the following conditions are met:

- the decrease in size is no more than 50%;
- the increase in operations is no more than 100%; and
- FAR stage 3 aircraft, such as the B757 and B767, are included in the fleet mix, but not to the total exclusion of all other aircraft.

Assuming that the contours are otherwise technically correct, significantly smaller contours should be acceptable.

2. Many small towns aren't big enough for a project to meet the definition of infill contained in section 51.104 (b)(1)(ii). However, a project located in the heart of town can hardly be considered to be in a largely undeveloped area. Must an EIS be prepared?

Not necessarily. If the jurisdiction in which the project is located is not part of a standard metropolitan area, a project may be considered infill if it is within or contiguous to the already developed area and infrastructure (particularly water and sewer) is available and has the capacity to serve the project. It must also be clear that the project will not encourage the establishment of other incompatible land uses in the normally unacceptable noise zone.

If you believe a project meets these criteria, submit documentation to the Office of Environment and Energy for their review and determination.

3. What can we do to reduce the procedural burden when, for a variety of reasons, the Department expects to be considering a number of projects in an unacceptable noise zone? Most of the projects would probably qualify for an EIS waiver, but how can we avoid filling repetitive, individual requests?

While the number of cases where the Department would be seriously considering a number of projects exposed to unacceptable noise levels in the same jurisdiction is likely to be limited, there is an alternative to individual processing in those situations. The alternative is to issue an areawide waiver for the entire affected jurisdiction. Such a waiver can be useful when the unacceptable noise zone heavily impacts a substantially developed community with limited site alternatives. (In most cases we would expect that the noise source would be aircraft, but in very small towns it is possible that a heavily used rail line could create a large unacceptable noise zone.)

An areawide EIS waiver would, of course, have to have a more detailed environmental assessment than an individual project request, and there are other special processing steps.

But if you have a situation where you think the Department has a good reason to expect to process a number of projects within the unacceptable noise zone, there is an alternative to individual EIS waivers. Contact the Office of Environment and Energy for details on how to request the areawide waiver.

4. What exactly are the processing requirements and general policies for modernization and rehabilitation projects? Does secton 51.104 apply to them as well as to new construction? The noise regulation is a bit confusing on this.

Yes, the noise regulation is a bit confusing on this question. We have seen several instances where field offices have mistakenly applied the provisions of Section 51.104 to modernization and rehabilitation projects. We believe that this happens because section 51.104 is not as clearly titled as it might have been. It would be better if it read "special requirements for new construction" rather than simply "special requirements".

The only parts of the regulation that apply to modernization and rehabilitation projects are sections 51.101 (a)(5) and the definitions of normally unacceptable and unacceptable noise zones contained in the table in section 51.103. None of the other proessing or policy provisions of the table or of sections 51.102 and 51.104 apply. Therefore:

- modernization and rehabilitation projects are to be processed by the field offices regardless of the noise zone.
- EIS's are not required for modernization and rehabilitation projects unless mandated by other applicable environmental regulations.

You must however continue to encourage attenuation features in modernization and rehabilitation projects, in accordance with the general policy stated in section 51.101(a)(5).

5. We know that berms and barriers are the preferred type of noise attenuation because of the protection they provide for outdoor living areas, but we need some further guidance on when they are really the best choice.

While barriers can be an effective noise attenuation technique, they must, indeed, be used with caution and common sense because they can create more problems than they solve. Very high noise barriers can create significant aesthetic and financial problems relative to the noise benefit to be achieved. Barriers can block light, hinder natural ventilation, create an unpleasant sense of being walled in, and can be very unattractive. In addition, barriers do require continuing maintenance and can be very costly to build.

It is important to remember that the noise regulation says that "measures that reduce external noise at a site shall be used **wherever practicable.**" Is it practicable to propose a 20 foot high barrier only 15 feet from the rear of a two-story building? Granted it would certainly protect the building from noise, but what about the blocked light, the reduced ventilation, the visual impact, and the cost? The purpose of a barrier is primarily to reduce the noise levels in those outdoor areas that people use. The secondary purpose is to reduce the need for structural attenuation. Therefore, the barrier should only be as high as is necessary to protect those areas. Structural attenuation should be required for the parts of the building not protected by the barrier. And if there aren't any outdoor areas where low noise levels are important, barriers shouldn't be required unless they would be more cost effective than building attenuation measures.

6. What should we be doing once we have processed new or revised aircraft noise contours and they have been approved for use?

The most important thing you can do once new or revised aircraft noise contours have been approved for use is to tell the people who are most likely to be affected by the change. If you have a newsletter that you regularly publish, that is one way to get the word out. At the very least you should specifically notify the affected jurisdictions and the builders/developers who are known to be active in the vicinity of the noise impacted areas. Make sure you notify builders and developers who have large scale projects that you have been processing in sections. Go back and check your files to find them. Even though you should have done an overall environmental review of the project at the time the first section was submitted, the approval of individual sections is dependent on the noise levels at the time that section is submitted.

Chapter 4

Noise Attenuation

Introducton

HUD's noise policy (24 CFR 51B) clearly requires that noise attenuation measures be provided when proposed projects are to be located in high noise areas. The requirements set out in Section 51.104(a) are designed to insure that interior levels do not exceed the 45 L_{dn} level established as a goal in Section 51.101(a)(9). Thus, in effect, if the exterior noise level is 65 L_{dn} to 70 L_{dn}, 25 db of noise attenuation must be provided; if the exterior noise level is between 70 and 75 L_{dn}, then 30 db of attenuation is required. Likewise, for projects proposed for areas where noise levels exceed 75 L_{dn}, sufficient attenuaton must be provided to bring interior levels down to 45 L_{dn} or below.

There are three basic ways to provide the noise attenuation required:

1. the use of barriers or berms
2. site design
3. acoustical construction

Of these, only the first two provide any improvement in the exterior environment. Because HUD considers a quiet exterior environment to be important, we prefer the use of those measures that reduce exterior levels as well as interior levels. The use of acoustical construction by itself is, therefore, the least preferred alternative since it only affects the interior levels. While we recognize that in many cases barriers or site design cannot provide all the attenuation necessary, you should combine them with acoustical construction whenever possible.

Your responsibility as a HUD staff member is to:

- make sure the project sponsor or developer is aware of the attenuation requirements for the project.
- make the sponsor aware of the options available

and

- review attenuation proposals to make sure they are adequate.

While it is not your responsibility to provide detailed design assistance to the sponsor or developer, you should know enough about the attenuation options to give him or her a basic understanding of what must be done. In many cases, you may be able to reassure the sponsor or developer that the necessary attenuation can be achieved through the use of common construction techniques or materials. Or you may be able to point out how a simple site design change can achieve the desired result without additional cost.

The following sections are designed to provide you with the information you will need to fulfill your responsibilities. Each attenuation approach is discussed both in terms of basic concepts and in terms of what to look for in reviewing attenuation proposals. The discussion does assume that you have a working knowledge of the *Noise Assessment Guidelines*. If you have not worked with the *Guidelines* before or not recently you may want to go back and review them, particularly the section on calculating the effects of barriers.

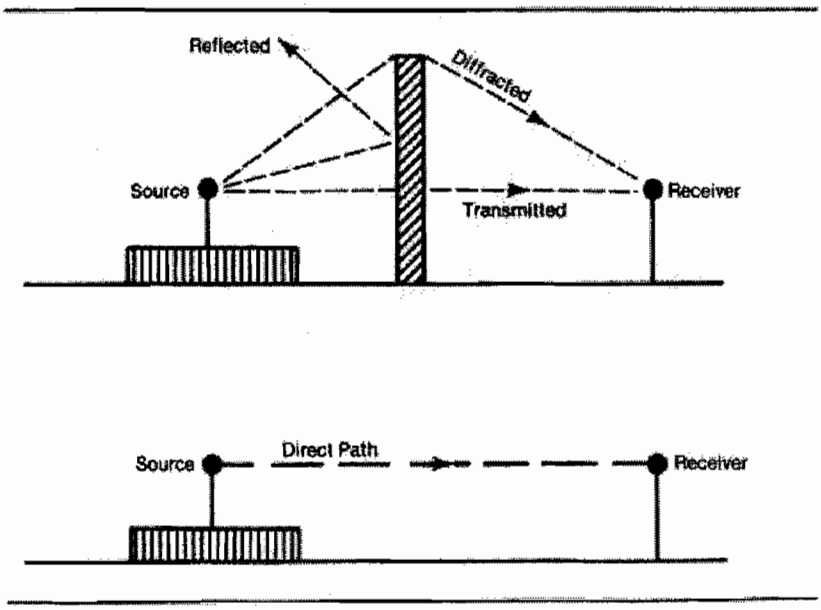
Barrier Noise Reduction Concepts

(The following, with some editing and with some additional graphics, is taken from the Federal Highway Administration's *Noise Barrier Design Handbook*.[1])

When no obstacles are present between [a source] and adjoining areas, sound travels by a **direct** path from the "sources"... to [the] "receivers"..., as shown in Figure 1. Introduction of a barrier between the source and receiver redistributes the sound energy into several [indirect] paths: a **diffracted** path, over the top of the barrier; a **transmitted** path, through the barrier; and a **reflected** path, directed away from the receiver. These paths are also illustrated in Figure 1.

[1] *Noise Barrier Design Handbook* US Department of Transportation, Federal Highway Administration, February 1976. (FHWA-RD-76-58).

Figure 1
Alteration of Noise Paths by a Barrier



Barrier Diffraction and Attenuation

Consider an infinitely long, infinitely massive noise barrier placed between a highway and the receiver. Figure 2 illustrates a cross-section through such a configuration. [In] this example, the only way that sound can reach the receiver is by bending over the top of the barrier; as shown in the figure. The bending of sound waves in this manner over an obstacle is known as diffraction. The area in which diffraction occurs behind the barrier is known as the "shadow zone." The straight path from the source over the top of the barrier forms the boundary of this zone.

All receivers located in the shadow zone will experience some sound attenuation; the amount of attenuation is directly related to the magnitude of the diffraction angle ϕ. As ϕ increases, the barrier attenuation increases. The angle ϕ will increase if the barrier height increases, or if the source or receiver are placed closer to the barrier. Clearly then the barrier attenuation is a function of the geometrical relationship between the source, receiver, and barrier. One way of relating these parameters to the barrier attenuation is to define the path-length difference as shown in Figure 3. This parameter is the difference in distance that the sound must travel in diffracting over the top of the barrier rather than passing directly through it.

In the preceding discussion it was assumed that the barrier was "infinite"; i.e., long enough to shield the receiver from all sound sources up and down the highway. For short barriers, the attenuation can be seriously limited by the sound from sections of highway beyond the barrier's ends, which are unshielded from the receiver, as shown in Figure 4. Similarly, when there are large gaps in the barrier (to permit access, for example), sound from the unshielded section of highway adjacent to the gap can greatly compromise barrier attenuation, especially for those receivers close to the opening.

Figure 2
Barrier Diffraction

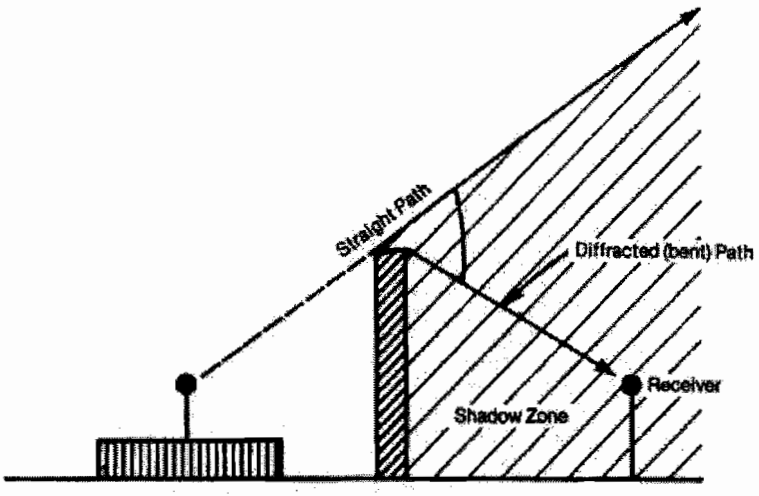


Figure 3
Path Length Difference $\delta = A + B - d$

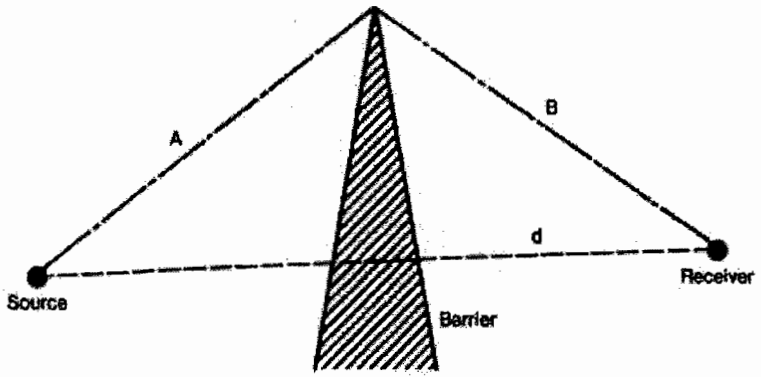
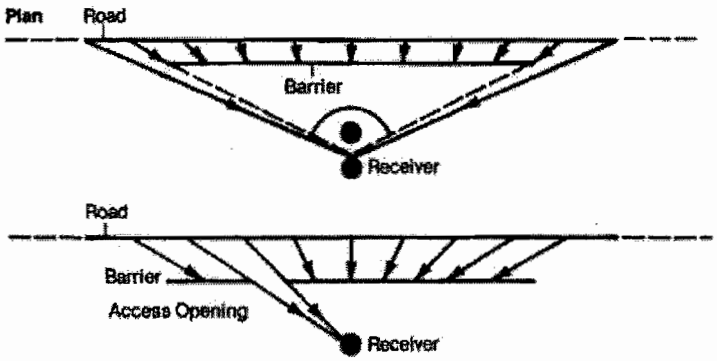


Figure 4
Short-circuit of Barrier Around Ends and Through Openings



Barrier Transmission

In addition to the sound that travels over the top of the barrier to reach the receiver, sound can travel through the barrier itself. The amount of sound "transmission" through the barrier depends upon factors relating to the barrier material (such as its weight and stiffness), the angle of incidence of the sound, and the frequency spectrum of the sound. One way of rating a material's ability to transmit noise is by the use of a quantity known as the transmission loss, TL. The TL is related to the ratio of the incident noise energy to the transmitted noise energy. Transmission loss values are normally expressed in decibels and represent the amount noise levels will be reduced when the sound waves pass through the material. The higher the TL value the less noise transmitted through the material. Typically, the TL value improves with increasing surface weight of the material.

The noise reduction provided by a barrier can be severely compromised if the TL value of the material permits too much noise to pass through the barrier. This is due to the fact that when attenuation is a function of two or more factors, the noise level at the measurement point is actually the combination of the reduced noise levels resulting from each attenuation factor. For example, with a typical barrier the noise levels are reduced by (1) sound waves being diffracted over the barrier and (2) sound waves passing through the barrier. The noise level at the receiver point is the combination of the attenuated levels resulting from each attenuation step. If the starting noise level is 65 db and the noise level is reduced 10 db when the sound waves pass through the barrier then the attenuated level reaching the receiver is 55 db. If the attenuation provided by the sound waves being diffracted over the barrier is also 10 db then the attenuated level reaching the receiver along that path is 55 db as well. Using the table in the *Noise Assessment Guidelines* to combine the two individual attenuated levels, one finds that the combined attenuated level is actually 58 db. Thus even though the attenuation value of each attenuation step was 10 db, the actual reduction for the receiver is only 7 db. It is, however, a function of the way noise levels combine that if the difference between levels is greater than 10 db it does not affect the levels. As a general rule, therefore, if the TL value is at least 10 dB above the attenuation value resulting from diffraction over the top of the barrier, the barrier noise reduction will not be significantly affected by transmission through the barrier (decreased by less than 0.5 dB). For many common materials used in barrier construction, such as concrete and masonry blocks, TL values are usually more than adequate. For less massive materials such as steel, aluminum and wood, TL values may not be adequate, particularly for those cases where large attenuations are required. (See Table 1 for a list of typical TL values.)

Even if a barrier material is massive enough to prevent significant sound transmission, the barrier noise reduction can be severely compromised if there are holes or openings in the barrier. For large openings, sound energy incident on the barrier will be directly transmitted through the opening to the receiver. When the opening is small an additional phenomenon occurs: upon striking the barrier wall the sound pressure will increase, resulting in an amplification of the transmitted sound to the receiver. Thus, the presence of openings or holes may seriously degrade the noise reduction provided by otherwise effective barriers.

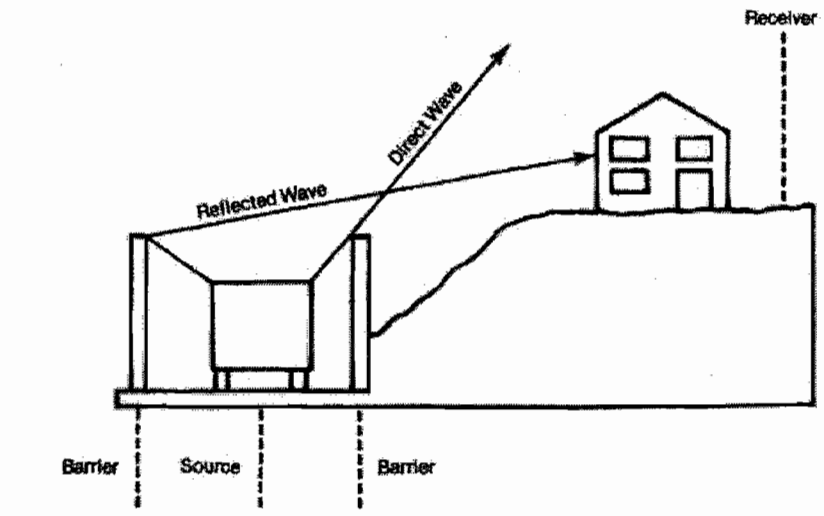
Barrier Reflections

As shown in Figure 1, sound energy can be reflected by a barrier wall. For the configuration shown in that figure, the reflected energy does not affect the receiver, but may affect receivers located to the left of the highway. However the increase in noise level for these receivers would be less than 3 dB, because this single reflection can at most double the sound energy. (Remember how you combine noise levels? The most you add is 3 db when levels are the same.)

The situation is entirely different, however, when a double barrier situation is involved (refer to Figure 5). In addition to the energy that reaches the receiver by diffraction over the top of the barrier, if the barrier walls are reflective, additional sound energy can reach the receiver by a reflection from the left wall as illustrated in the figure. The same principles apply when there is a vertical retaining wall opposite a noise barrier; similarly, in a deep vertical cut the opposite walls will create multiple reflections.

If the barrier walls are not perfectly reflecting but absorb some of the sound energy, the contributon of each reflection is decreased by an amount that depends upon the absorptive characteristics of the barrier. For very hard, reflective surfaces, the absorption characteristics are very poor. Although a serious degradation in barrier performance may result for the double barrier situation, use of materials with good absorption values will usually recover all of the lost noise reduction.

Figure 5
Reflections from an Opposing Barrier



It should be mentioned that the use of barrier walls with sloped sides (forming angles of grater than 10–15 degrees from the vertical) will also generally eliminate multiple reflections. Use of earth berms is particularly appropriate to accomplish this. Sloped barrier walls will require more material to achieve a desired height than a vertical wall, while berms will require greater right-of-way than a thin wall.

Ground Effects

Consider again the direct path of sound from the source to receiver as illustrated in Figure 1 in the absence of any obstacles. For sources and receivers located close to the ground, in addition to this direct path sound energy may reach the receiver by reflecting off the ground. When the terrain is relatively hard and flat, such a reflection will add to the noise from the direct path to increase the level at the receiver. However, when the ground is soft, there may be a phase reversal upon reflection such that the noise from the ground reflection path will destructively interfere with the noise from the direct path resulting in a significant reduction in noise levels at the receiver.

This reduction in level, known as ground-effect attenuation, is in excess of the 3 dB per doubling of distance propagation loss for a line source of noise and occurs only above soft absorptive ground (such as normal earth and most ground with vegetation). Over hard ground (such as concrete, stone and very hard-packed earth) these effects do not occur. These effects are most apparent for receivers on the ground floor, and decrease rapidly as receiver height above ground increases.

While ground absorption effects are not completely understood, it is generally believed that these effects account for the 4.5 dB per doubling of distance propagation loss observed over soft ground, as compared to the 3 dB propagation loss observed over hard ground. The implication with regard to barrier design is that placement of a barrier over soft ground between source and receiver will re-direct the sound over the top of the barrier, thus destroying the ground reflection and the additional 1.5 dB per doubling of distance attenuation. Thus, the barrier must be designed to provide more reduction than would otherwise be necessary, to compensate for the lost ground effects over absorptive ground.

Summary

(From: *Design Guide*, National Bureau of Standards[1])

In summary, the following can be said about noise barriers.

- If a barrier does not block the line-of-sight between the source and receiver, the barrier will provide little or no attenuation.
- If a barrier is constructed of a material with a surface weight density greater than 4 lb/ft^2 and there are no openings through the barrier, transmitted sound will usually be negligible.
- If there are openings totaling over 10 percent or more of the barrier area, barrier attenuation will be negligible.
- Diffracted sound is usually the most important aspect in estimating barrier attenuation.
- Reflected sound can be important for receivers on the source side of a barrier, but it normally is not a factor for receivers on the side opposite from the source. Hence reflected sound is usually not important to your building and site.
- Transmission of sound around the ends of the barrier can be critical if the barrier included angle is less than 170°.
- Barrier attenuations greater than an A-weighted sound level difference of 10 dB are difficult to obtain.
- For two or more barriers "in series," consider only the "dominant" barrier.
- Assume no attenuation for a receiver located beyond the end of a barrier.

Reviewing Barrier Proposals

An effective barrier is one which reduces the noise level behind the barrier to 65 L_{dn} or lower. If a barrier can reduce the exterior noise level to 65 L_{dn}, then standard construction techniques should be sufficient to insure an interior level of 45 L_{dn} or below. Therefore, if you determine that a proposed barrier is adequate to reduce the exterior noise level to 65 L_{dn} then no additional attenuation measures should be necessary.

[1] *Design Guide for Reducing Transportation Noise in and Around Buildings*, US Department of Commerce, National Bureau of Standards, April 1978. (Building Science Series 84)

There are four things to check when determining the adequacy of a proposed barrier:

1. Is it high enough?
2. Is it long enough?
3. Is it made of the right materials?
4. Is it properly constructed?

Is It High Enough?

In order for a barrier to be effective it must be at least high enough to break the line of sight between the source and the receiver. In the *Noise Assessment Guidelines* you will find the procedure for determining how much attenuation is provided by a barrier of a given height.

In general, barriers and berms are most effective for one and two story buildings because a relatively low barrier can often provide the attenuation needed. The height that might be required to provide attenuation for much taller buildings is often not feasible for either cost or aesthetic reasons. However, even if a barrier can not be made high enough to attenuate the upper floors of a multistory building, it may still be able to provide some protection for outdoor recreational areas. Before discarding the barrier idea check for this possibility.

If you find that the barrier as proposed is too short to be effective but the sponsor or developer tells you that he or she can not make the barrier any higher, there are some alternatives you can suggest. There are ways to get more attenuation out of each foot of overall height.

As a general rule, barriers work better the closer they are to the source. Figure 6 shows a barrier that does not block the line of sight at all when it is located next to the receiver, yet is quite tall enough when located next to the source. Thus, if the sponsor or developer can not make the barrier any taller, perhaps he or she can move it closer to the source.

Another way to get more attenuation without increasing overall barrier height is to bend the top of the barrier towards the source. Figure 7 shows a case where a barrier built perfectly straight provides 8 dB of attenuation. A barrier with the same overall height but with a 45 degree bend towards the source provides 9.5 dB of attenuation. Thus if the project sponsor or developer wants to keep the overall height of the barrier down, he or she can still increase the attenuation provided simply by bending the top.

Figure 6
Effect of Moving the Barrier Closer to the Source

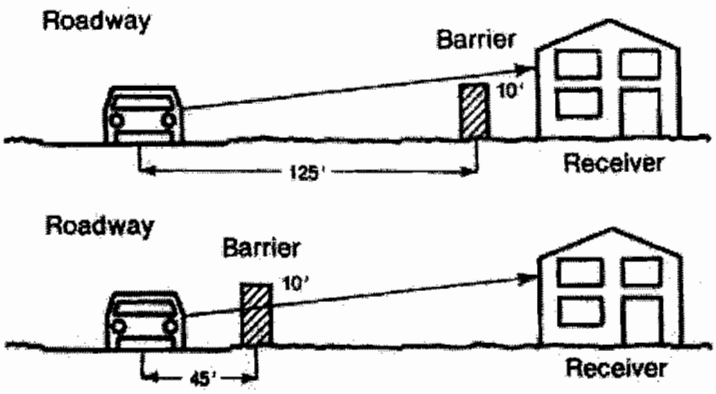
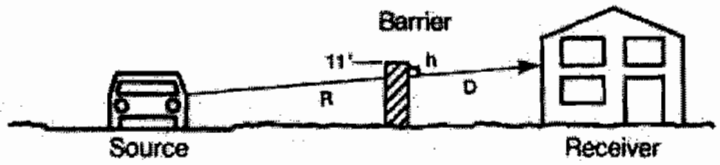
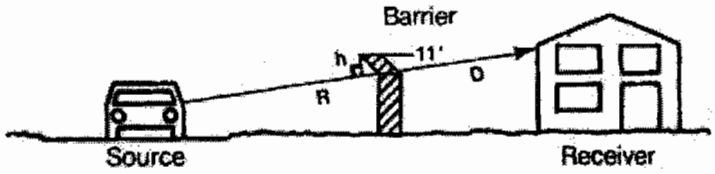


Figure 7
Effect of Bending the Top of the Barrier Towards the Source



Barrier Attenuation Value: 8db
h equals 3'
R equals 45.5'
D equals 40.0



Barrier Attenuation Value: 9.5db
h equals 4'
R equals 42.0'
D equals 43.5'

Thus, if your review of a proposed barrier shows it to be too short, but it can not be made any higher, suggest that the barrier be moved closer to the source or that it be bent at the top, or both.

Is It Long Enough?

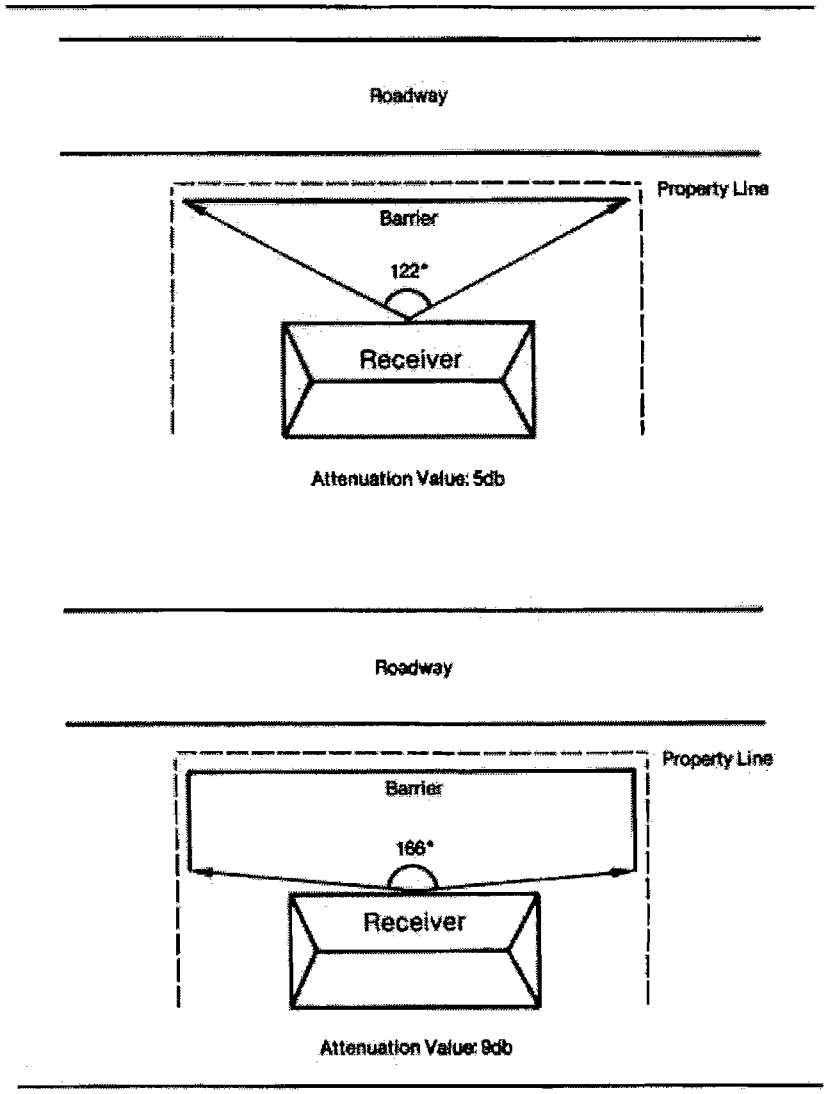
Once you have established how much attenuation the barrier provides due to its height, you must determine if the length of the barrier compromises that attenuation level. Again, *the Noise Assessment Guidelines* contain a procedure for calculating the effect of barrier length.

If you find that the barrier is too short but that there are limitations on how long it can be made, there are, as there were with barrier heights, some recommendations you can make on how to improve the effectiveness of the barrier.

Again, if you bend the edges of the barrier, this time towards the **receiver** not the source, you will increase the effectiveness of the barrier. Figure 8 shows how much a barrier's effectiveness can be improved by bending the edges.

You can also improve the effectiveness of the barrier by moving it closer to the receiver. Figure 9 shows how much a barrier's effectiveness can be increased by moving it closer to the receiver. Now obviously, this creates a conflict with what we said earlier about moving the barrier closer to the source. Clearly each case will require a different compromise. If height is not a limiting factor but length is, you might recommend to the project sponsor or developer that the barrier be moved closer to receiver and the height increased as necessary. If the reverse is true, you would want to recommend the opposite. If both height and length are limited, then the sponsor or developer must find that optimum point where the effectiveness of both the barrier height and the barrier length is as high as possible.

Figure 8
Effect of Bending the Edges of Barrier Towards Receiver
(Both Barriers have Potential Value of 10db)



Is It Made of The Right Materials?

Even if a barrier is high enough and long enough, its effectiveness can be severely reduced if it is made up of lightweight materials that easily transmit sound waves. In the preceding section on barrier concepts we talked about how if the transmission loss value for the barrier material was not at least 10 db higher than the attenuation value of the barrier based on length and height there would be a significant reduction in the effectiveness of the barrier.

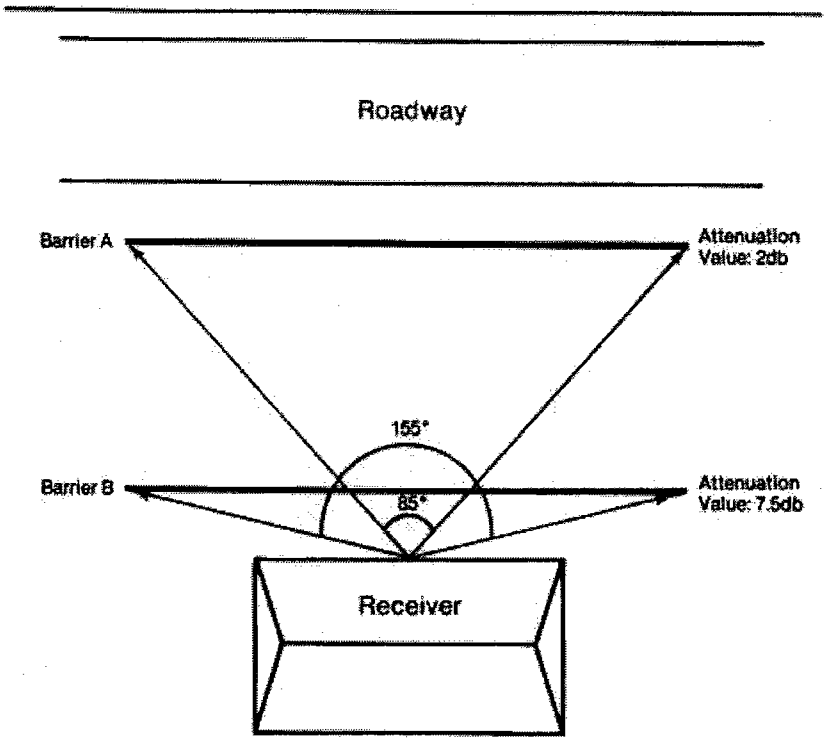
Therefore, once you have calculated the basic attenuation potential of the barrier, you must check to make sure the proper material is being used to build the barrier. Table 1 lists the transmission loss values for materials commonly used in barrier construction. Once you have found the transmission loss value for the material being used, go to Table 2. Read down the column with the transmission loss for the material at its top and across the line that has the attenuation potential for the barrier listed. Where the two intersect you will find the actual attenuation capability of the barrier.

If you find that the choice of material has severely reduced the effectiveness of the barrier, you should recommend that the sponsor or developer select another material.

Is It Properly Constructed?

Holes or openings can substantially reduce the effectiveness of a barrier. A barrier that has openings totaling 50% or more of its total area will provide no attenuation. A barrier that has openings totaling 10% of its total area has a maximum attenuation value of approximately 4db. That is 4db no matter how high, how long or how thick the barrier. So you can see that it is very important that the barrier is made of solid materials and that it is tightly constructed. In general the intended openings in a barrier should equal no more than 1% of total area and the construction specifications should require that all joints are tightly sealed.

Figure 9
Effect of Moving Barrier Closer to Receiver



A Final Note

One thing should have become clear to you as you have been reading this section, and that is that in order for you to adequately review a project sponsor or developer's proposed barrier you must be given fairly specific information about the exact dimensions of the proposed barrier, the type and thickness of the barrier material, and the exact design of the barrier including construction specifications. Without this information you will be unable to do any more than a cursory evaluation, an evaluation that could be far from accurate. Make sure you make it clear to the developer or sponsor what you need to have.

Table 1
Transmission Loss Value for Common Barrier Materials

Material	Thickness, (Inches)	Transmission Loss, dBA (1)
Woods		
Fir	1/2	17
	1	20
	2	24
Pine	1/2	16
	1	19
	2	23
Redwood	1/2	16
	1	19
	2	23
Cedar	1/2	15
	1	18
	2	22
Plywood	1/2	20
	1	23
Particle Board	1/2	20
Metals		
Aluminum	1/16	23
	1/8	25
	1/4	27
Steel	24 ga	18
	20 ga	22
	16 ga	15
Lead	1/16	28
Concrete, Masonry, etc.		
Light Concrete	4	36
	6	39
Dense Concrete	4	40
Concrete Block	4	32
	6	36
Cinder Block (Hollow Core)	6	28
Brick	4	33
Granite	4	40
Composites		
Aluminum Faced Plywood	3/4	21-23
Aluminum Faced Particle Board	3/4	21-23
Plastic Lamina on Plywood	3/4	21-23
Plastic Lamina on Particle Board	3/4	21-23
Miscellaneous		
Glass (Safety Glass)	1/8	22
	1/4	26
Plexiglass (Shatterproof)		22-25
Masonite	1/2	20
Fiberglass/ Resin	1/8	20
Stucco on Metal Lath	1	32
Polyester with Aggregate Surface	3	20-30

[1]A-weighted TL based on generalized truck spectrum. Source: *Noise Barrier Design Handbook*, FHWA

Table 2
Noise Reduction of a Barrier as a Function of Its Transmission Loss

Designed Attenuation, dB (from height) and length)	Tramission Loss, dB of Materials				
	10	15	20	25	30
5	3.8	4.6	4.9	5.0	5.0
6	4.5	5.5	5.8	6.0	6.0
7	5.2	6.4	6.8	6.9	7.0
8	5.9	7.2	7.7	7.9	8.0
9	6.5	8.0	8.7	8.9	9.0
10	7.0	8.8	9.6	9.9	10.0
11	7.5	9.5	10.5	10.8	11.0
12	7.9	10.2	11.4	11.8	11.9
13	8.2	10.9	12.2	12.7	12.9
14	8.5	11.5	13.0	13.7	13.9
15	8.8	12.0	13.8	14.6	14.9
16	9.0	12.5	14.5	15.5	15.8
17	9.2	12.9	15.2	16.7	16.8
18	9.4	13.2	15.9	17.2	17.7
19	9.5	13.5	16.5	18.0	18.7
20	9.6	13.8	17.0	18.8	19.6

Source: *Noise Barrier Design Handbook, FHWA*

Acoustical Site Planning Concepts

(This section, with some editing, is from *The Audible Landscape*, FHWA.[1])

The arrangement of buildings on a site can be used to minimize noise impacts. If incompatible land uses already exist, or if a noise sensitive activity is planned, acoustical site planning often provides a successful technique for noise impact reduction.

Many site planning techniques can be employed to shield a residential development from noise. These can include:

1. increasing the distance between the noise source and the receiver;
2. placing noise compatible land uses such as parking lots, maintenance facilities, and utility areas between the source and the receivers. Playgrounds and parks are not necessarily noise compatible activities.
3. locating barrier-type buildings parallel to the noise source or the highway; and
4. orienting the residences away from the noise.

The implementation of many of the above site planning techniques can be combined through the use of cluster and planned unit development techniques.

Distance

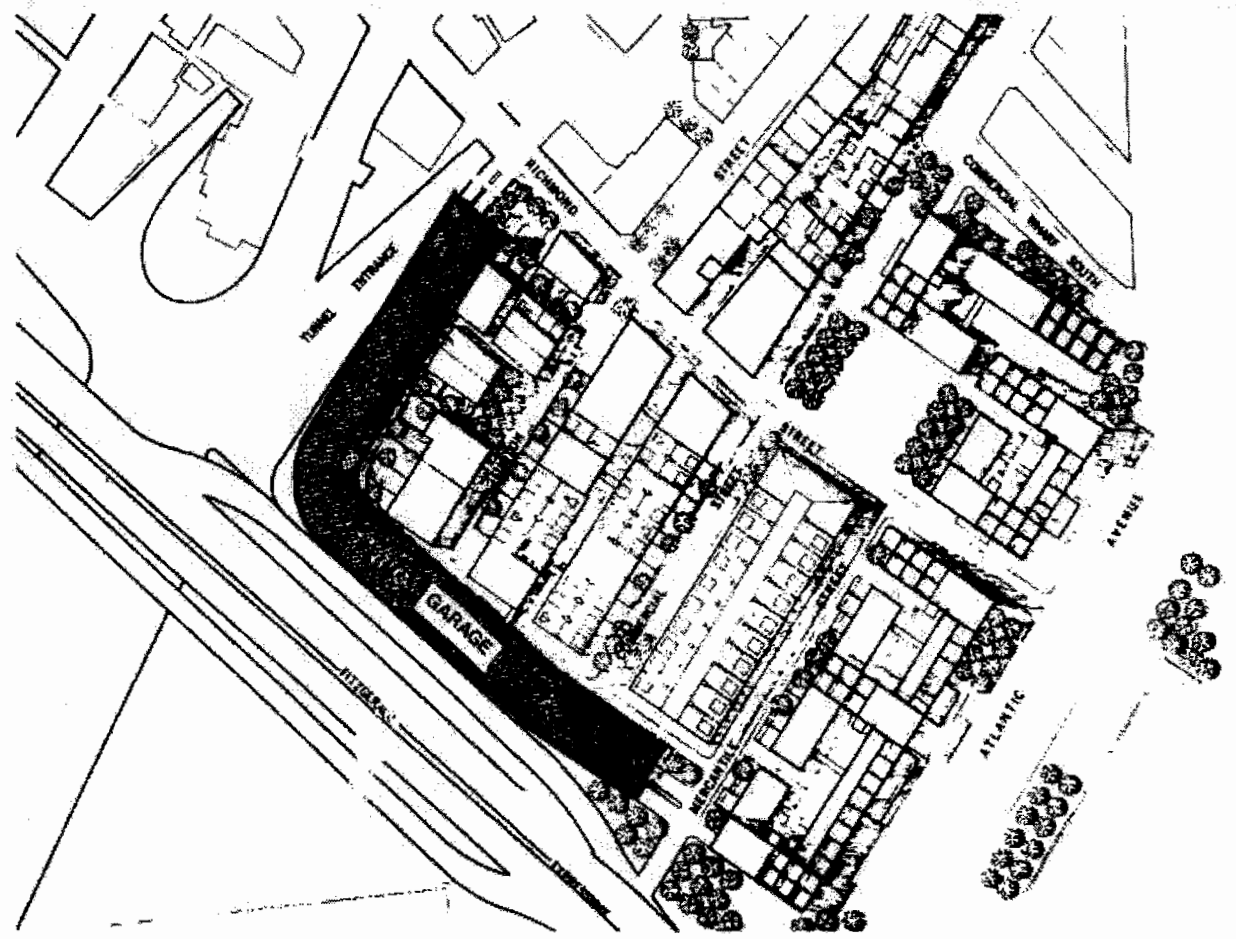
Noise can be effectively reduced by increasing the distance between a residential building and a highway. Distance itself reduces sound: doubling the distance from a noise source can reduce its intensity by as much as 3 dBA. In the case of highrise buildings, distance may be the only means, besides acoustical design and construction, of reducing noise impacts. This is because it is nearly impossible to provide physical shielding for the higher stories from adjacent noise.

Noise Compatible Land Uses as Buffers

Noise protection can be achieved by locating noise-compatible land uses between the highway and residential units. Whenever possible, compatible uses should be nearest the noise source. Figure 10 shows a proposed parking garage along two sides of a development in Boston. Both the

[1] *The Audible Landscape: A Manual for Highway Noise and Land Use*, US Department of Transportation, The Federal Highway Administration, November 1974. (GPO Stock Number: 5000-00079.)

Figure 10
Use of a Parking Garage to Shield a Residential Area



Fitzgerald Expressway and the entrance to the Callahan Tunnel which are shown on the site plan are major and noisy traffic routes. In addition to protecting the residential development from the noise and dirt of highway traffic, the parking garage provides needed facilities for the residents.

Buildings as Noise Shields

Additional noise protection can be achieved by arranging the site plan to use buildings as noise barriers. A long building, or a row of buildings parallel to a highway can shield other more distance structures or open areas from noise.

If the building being used as a barrier is sensitive to highway noise, the building itself must first be soundproofed. This technique was used in a housing project in England where a 3,900 foot long, 18 foot wide and 45-70 foot high wall (depending on the terrain) serves as both residence and a sound shield. The wall/building will contain 387 apartments in which the kitchens and bathrooms are placed towards the noise, and the bedrooms and living rooms face away from the highway. The wall facing the highway will be soundproofed and windows, when they exist, are sealed. Substantial noise reductions are expected.

Orientation

The orientation of buildings or activities on a site affects the impact of noise, and the building or activity area may be oriented in such a way as to reduce this impact.

Noise impacts can be severe for rooms facing the roadway since they are closest to the noise source. The noise impact may also be great for rooms perpendicular to the roadway because (a) the noise pattern can be more annoying in perpendicular rooms and (b) windows on perpendicular walls do not reduce noise as effectively as those on parallel walls because of the angle of the sound. Road noise can be more annoying in perpendicular rooms because it is more extreme when it suddenly comes in and out of earshot as the traffic passes around the side of the building, rather than rising and falling in a continuous sound, as it would if the room were parallel to passing vehicles.

Whether the noise impact is greater on the perpendicular or the parallel wall will depend on the specific individual conditions. Once the most severely impacted wall or walls are determined, noise impacts may be minimized by reducing or eliminating windows from these walls.

Buildings can also be oriented on a site in such a way as to exploit the site's natural features. With reference to noise, natural topography can be exploited and buildings placed in low noise pockets if they exist. If no natural noise pockets exist, it is possible to create them by excavating pockets for buildings and piling up earth mounds between them and the noise. Such a structure would obstruct the sound paths and reduce the noise impacts on the residences.

Cluster and Planned Unit Development

A cluster subdivision is one in which the densities prescribed by the zoning ordinance are adhered to but instead of applying to each individual parcel, they are aggregated over the entire site, and the land is developed as a single entity. A planned unit development, or P.U.D., is similar but changes in land use are included, such as apartments and commercial facilities in what would otherwise be a single-family district.

From Figure 11 it can be seen how the conventional grid subdivision affords no noise protection from the adjacent highway. The first row of houses bears the full impact of the noise. In contrast, the cluster and P.U.D. techniques enable open space and commercial uses respectively to serve as noise buffers. Examples of this are shown in Figures 12 and 13. A word of caution is necessary: In a cluster development, the required open space can be located near the highway to minimize noise to the residences. However, many recreation uses are noise sensitive, and when one takes advantage of the flexibility of cluster development to minimize noise, care must be taken not to use all of the available open space in

Figure 11
Conventional Grid Subdivision

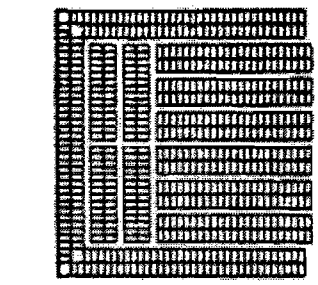
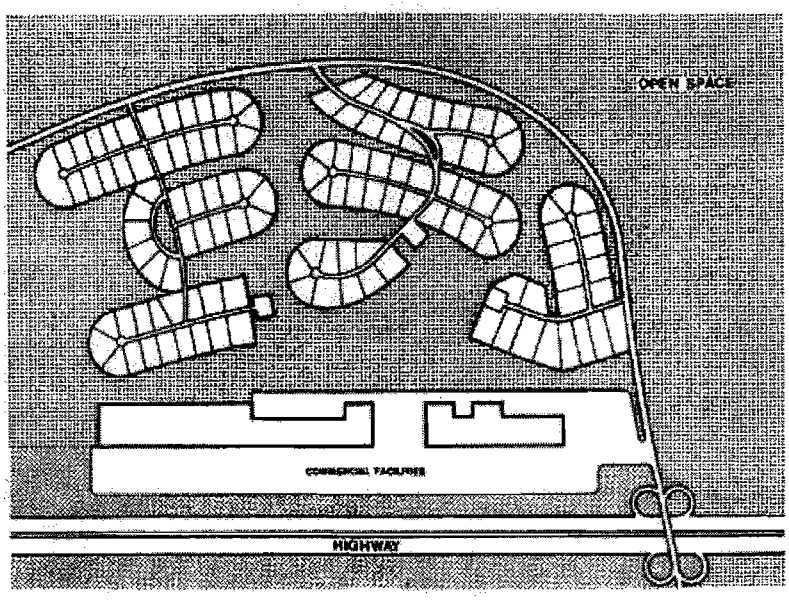


Figure 12
Placement of Noise Compatible Uses Near a Highway in a PUD



buffer strips, thus depriving the development of a significant open space area. Where high noise levels exist, a combination of buffer strips and other techniques (such as berms and acoustical sound proofing) can be employed.

The flexibility of the cluster and planned unit development techniques allows many of the above site planning techniques to be realized and effective noise reduction achieved.

Reviewing Site Plans

There are two main things to check when reviewing site plan changes to determine if the revised site plan provides adequate attenuation for the noise sensitive uses:

1. Is the separation between the source and the receiver great enough?
2. If noise-compatible buildings are being used as barriers for other buildings, are they adequate barriers, i.e., are they long enough and are they high enough? (And, if the buildings being used as barriers contain noise sensitive activities, have the buildings been properly soundproofed.)

In order to determine whether the proposed site plan changes will provide adequate separation between the source and the receiver, you simply go back to the *Noise Assessment Guidlines* procedures. You can use the *Guidelines* both to determine if the proposed separation distance is sufficient or to determine the necessary separation distance. You should at this point check to make sure that the uses being located in the "buffer zone" between the source and the receiver are indeed noise compatible uses. If parks or playgrounds are located in the buffer zone, make sure they are not the only ones associated with the project.

To determine whether the noise compatible buildings being proposed as barriers are adequate, you simply use the procedures outlined in the preceding section. Determine whether the building is high enough to properly break the line of sight between the receiver and the source. Then determine if the building is long enough. It is not necessary to check to make sure it is made of the proper materials or that it is properly constructed since the building will be inherently thick enough not to have any problems. Again, however, if the building being proposed as a barrier contains noise sensitive uses you must first verify that it is properly soundproofed. (See the next section for guidance on acoustical construction.) If the building is not properly soundproofed then it can not be used as a barrier for other buildings.

As you review the site plan check to see that the building locations will not aggravate noise problems. Figure 14 shows how building arrangement can make the noise problem worse.

Figure 13
Open Space Placed Near a Highway in a Cluster Development

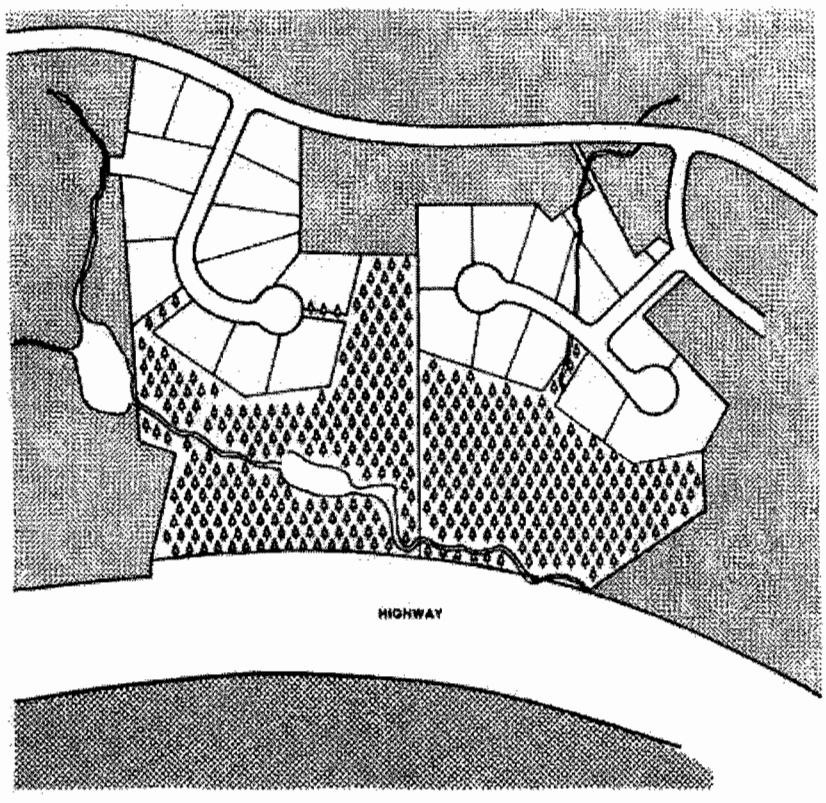
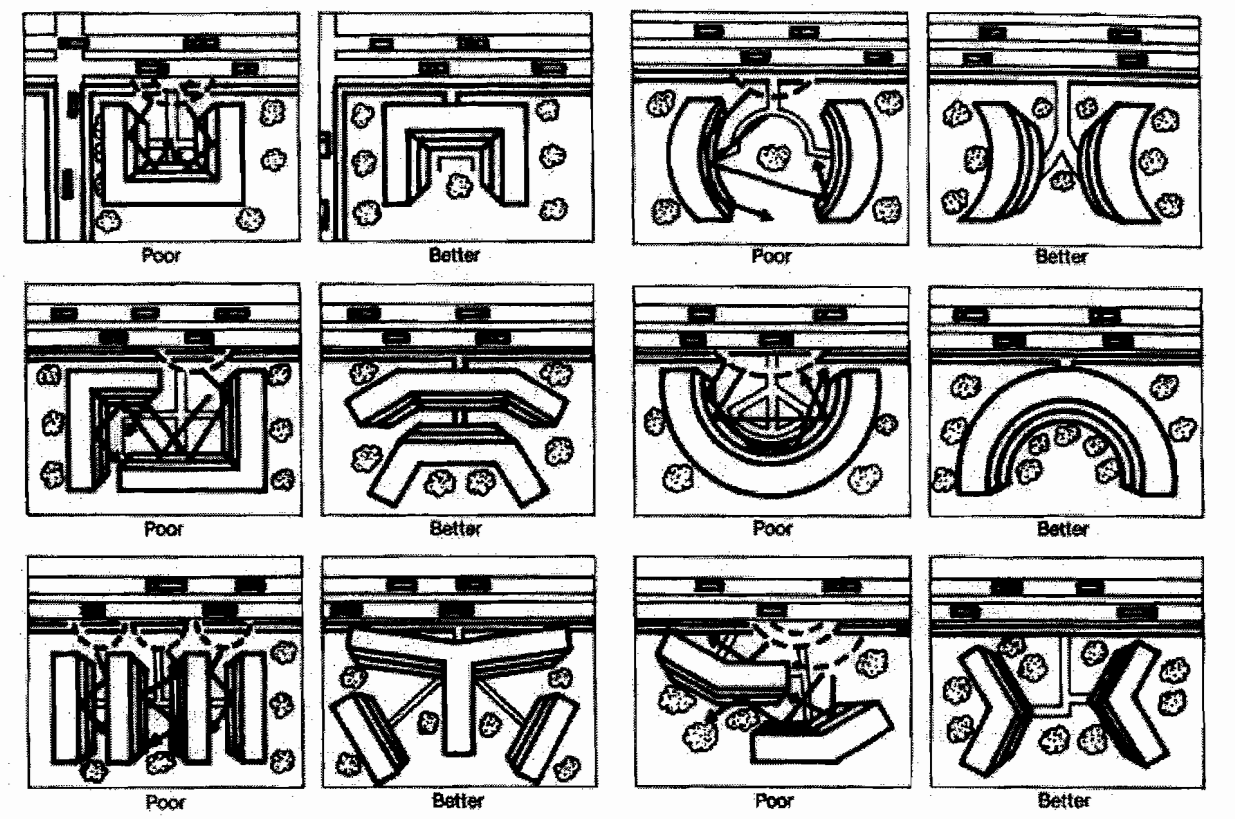


Figure 14
Orientation of Buildings on Sites



Acoustical Construction Concepts

(This section, with some editing is taken from the *Audible Landscape, FHWA.*[1])

Noise can be intercepted as it passes through the walls, floors, windows, ceilings, and doors of a building. Examples of noise reducing materials and construction techniques are described in the pages that follow.

To compare the insulation performance of alternative constructions, the Sound Transmission Class (STC) is used as a measure of a material's ability to reduce sound. Sound Transmission Class is equal to the number of decibels a sound is reduced as it passes through a material. Thus, a high STC rating indicates a good insulating material. It takes into account the influence of different frequencies on sound transmission, but essentially the STC is the difference between the sound levels on the side of the partition where the noise originates and the side where it is received. For example, if the external noise level is 85 dB and the desired internal level is 45 dB, a partition of 40 STC is required. The Sound Transmission Class rating is the official rating endorsed by the American Society of Testing and Measurement. It can be used as a guide in determining what type of construction is needed to reduce noise.

The use of the STC rating system for transportation noise is a subject of some debate. The STC rating was originally intended primarily for use with interior partitions and relates to the "subjective impressions of the sound insulation provided against the sounds of speech, radio, television, music, and similar sources of noise in offices and dwellings."[2] However, since it remains the only widely used noise reduction rating system for materials the STC system is very often used even with transportation noise. When STC ratings are used for transportation noise you should be aware that the STC ratings may be a few dB too high. For example, the STC rating for a standard frame 2 × 4 wall with exterior siding, and sheathing and interior sheetrock may be 37 dB.[3] If rated specifically for transportation noise the dB reduction rating might drop to 34 dB.[4] All this really means, however, is that you should use the STC ratings with a bit of caution and remain aware of the possible 2-3 dB overstating that you may get with the STC rating system. Throughout this text we will be talking in terms of STC ratings for materials and assemblies.

[1] *The Audible Landscape: A Manual for Highway Noise and Land Use*, US Department of Transportation, the Federal Highway Administration, November 1974, (GPO Stock #5000-00079).

[2] *Acoustical and Thermal Performance of Exterior Residential Walls, Doors, and Windows*, US Department of Commerce, National Bureau of Standards, November 1975. (NBS Building Science Series 77) page 21.

[3] Ibid., p. 29

[4] *Design Guide for Reducing Transportation Noise in and Around Buildings*, p. 137.

Walls

Walls provide building occupants with the most protection from exterior noise. Different wall materials and designs vary greatly in their sound insulating properties. Figure 15 provides a visual summary of some ways in which the acoustical properties can be improved:

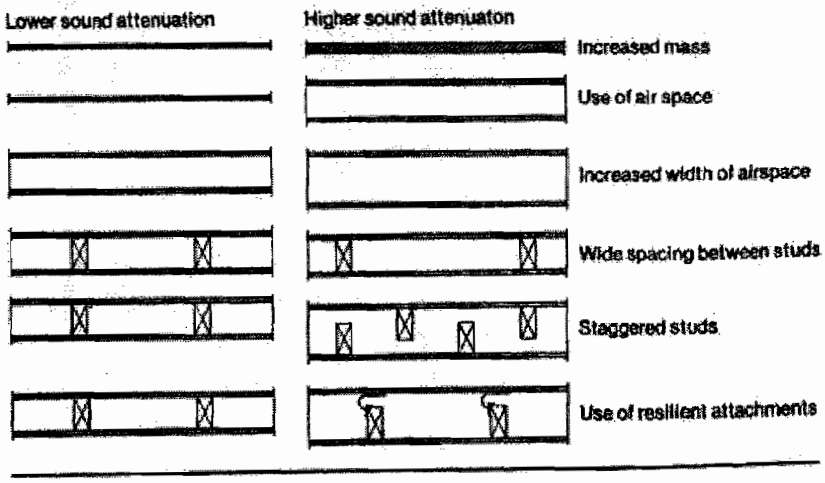
Increase the mass and stiffness of the wall. In general, the denser the wall material, the more it will reduce noise. Thus, concrete walls are better insulators than wood walls of equal thickness. Increasing the thickness of a wall is another way to increase mass and improve sound insulation. Doubling the thickness of a partition can result in as much as a 6 dB reduction in sound.[1] However, the costs of construction tend to limit the feasibility of large increases in wall mass.

The relative stiffness of the wall material can influence its sound attenuation value. Care must be taken to avoid wall constructions that can vibrate at audible frequencies and transmit exterior sounds.

[1] R. K. Cooke and P. Chrzanowski, "Transmission of Noise Through Walls and Floors," Cyril Harris, ed., Handbook of Noise Control, McGraw-Hill Book Company, Inc. (New York, 1957).

Figure 15
The Audible Landscape

Factors which influence sound attenuation of walls



Use cavity partitions. A cavity wall is composed of two or more layers separated by an airspace. The airspace makes the cavity wall a more effective sound insulator than a single wall of equal weight, leading to cost savings.

Increase the width of the airspace. A three inch airspace provides significant noise reduction, but increasing the spacing to six inches can reduce noise levels by an additional 5 dBA. Extremely wide airspaces are difficult to design.

Increase the spacing between studs. In a single stud wall, 24 inch stud spacing gives a 2-5 dB increase in STC over the common 16 inch spacing.[2]

Use staggered studs. Sound transmission can be reduced by attaching each stud to only one panel and alternating between the two panels.

[2]Leslie T. Doelle, Environmental Acoustics (New York, McGraw-Hill Book Company, 1972), pp. 232-233.

Use resilient materials to hold the studs and panels together. Nails severely reduce the wall's ability to reduce noise. Resilient layers such as fiber board and glass fiber board, resilient clips, and semi-resilient attachments are relatively inexpensive, simple to insert, and can raise the STC rating by 2-5 dB.[1]

Use dissimilar layers. If the layers are made of different materials and/or thickness, the sound reduction qualities of the wall are improved.[2]

Add acoustical blankets. Also known as isolation blankets, these can increase sound attenuation when placed in the airspace. Made from sound absorbing materials such as mineral or rock wool, fiberglass, hair felt or wood fibers, these can attenuate noise as much as 10 dB.[3] They are mainly effective in relatively lightweight construction.

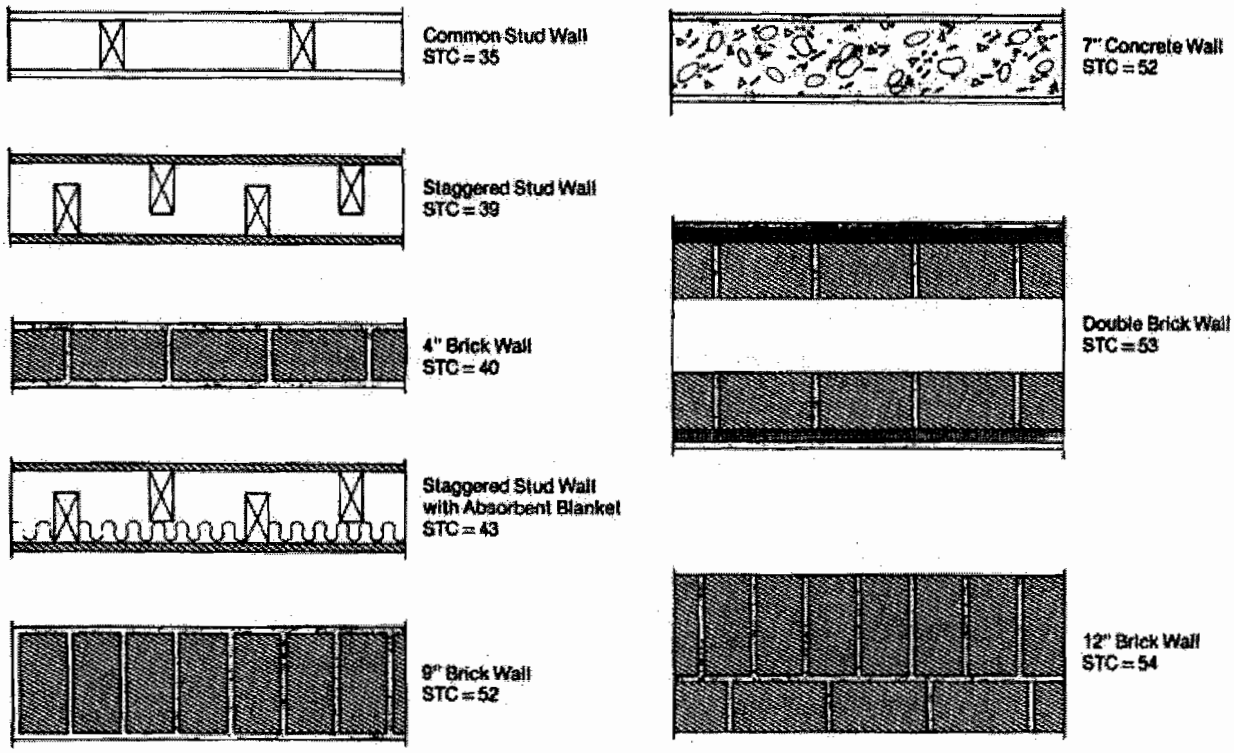
Seal cracks and edges. If the sound insulation of a high performance wall is ever to be realized, the wall must be well sealed at the perimeter. Small holes and cracks can be devastating to the insulation value of a wall. A one-inch square hole or a 1/16 inch crack 16 inches long will reduce a 50 STC wall to 40.[4]

Figure 16 shows a sample of wall types ranging from the lowest to the highest sound insulation values.

Remember that the effectiveness of best wall construction will be substantially reduced if you permit vents, mail slots or similar openings in the walls. If vents are permitted the ducts must be specially designed and insulated to make sure noise does not reach the inside. The best approach is simply to eliminate all such openings on impacted walls.

[1]Ibid, p. 172
[2]Ibid, p. 162
[3]Doelle, p. 20
[4]United States Gypsum, Sound Control Construction, Principles and Performance (Chicago, 1972), p. 66

Figure 16
Walls



Windows

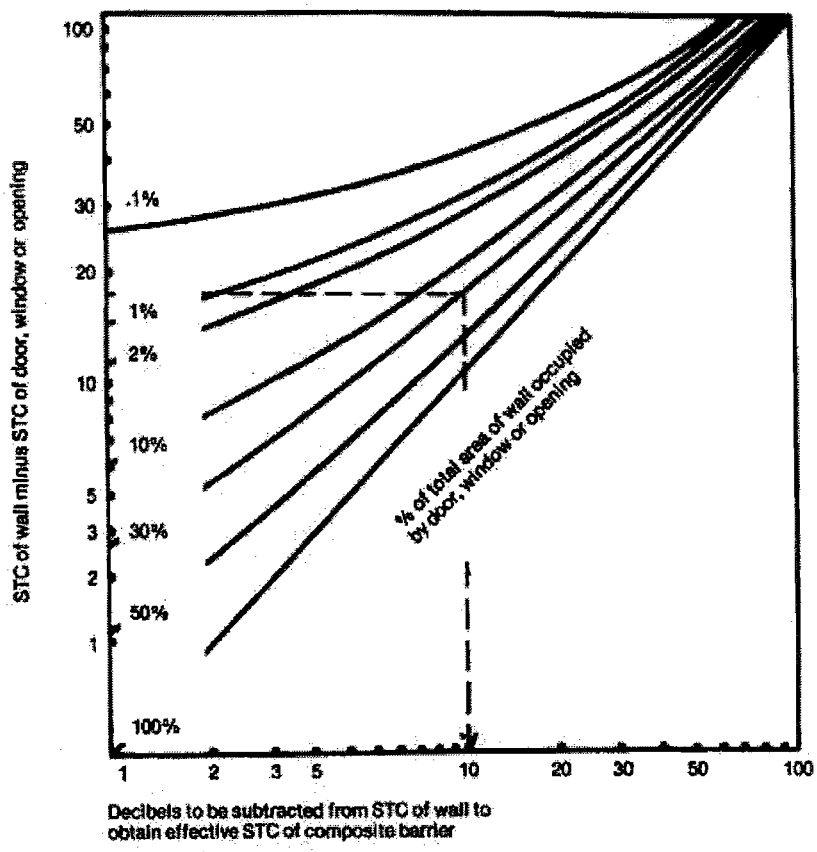
Sound enters a building through its acoustically weakest points, and windows are one of the weakest parts of a wall. An open or weak window will severely negate the effect of a very strong wall. Whenever windows are going to be a part of the building design, they should be given acoustical consideration. Figure 17 illustrates the effects of windows on the sound transmission of walls. For example, if a wall with an STC rating of 45 contains a window with an STC rating of 26 covering 30% of its area, the overall STC of the composite partition will be 35, a reduction of 10 dB.

The following is a discussion of techniques that can be used to reduce noise in a building by means of its windows. These techniques range from a blocking of the principal paths of noise entry to a blocking of the most indirect paths.

Close windows. The first step in reducing unwanted sound is to close and seal the windows. The greatest amount of sound insulation can be achieved if windows are permanently sealed. However, openable acoustical windows have been developed which are fairly effective in reducing sound.[1] Whether or not the sealing is permanent, keeping windows closed necessitates the installation of mechanical ventilation systems. If you are dealing with single family houses and some of the windows are facing away from all noise sources, a whole house fan may be better and cheaper than air conditioning. In multifamily housing or where all windows are exposed to the noise sources you will have to go with the air conditioning. If windows must be openable, special seals are available which allow windows to be opened.[2]

Reduce window size. The smaller the windows, the greater the transmission loss of the total partition of which the window is a part. Reducing the window size is a technique that is used because (a) it precludes the cost of expensive acoustical windows, and (b) it saves money by cutting down the use of glass. The problems with this technique are (a) it is not very effective in reducing noise; e.g., reducing the proportion of window to wall size from 50% to 20% reduces noise by only 3 decibels; and (b) many building codes require a minimum window to wall size ratio.

Figure 17
STC



Instructions on use of graph

1. Subtract the STC value of the door, window or opening from the STC value of the wall.
2. Enter the vertical axis of the graph at the point that matches the value from step 1.
3. Read across to the curve that represents the percentage of the total area of the wall that is taken up by the door, window, or opening.
4. Read down to the horizontal axis.
5. Subtract the value on the horizontal axis from the original STC value of the wall. The result is the composite STC value of the wall and the door, window or opening.

Increase glass thickness. If ordinary windows are insufficient in reducing noise impacts in spite of sealing techniques, then thicker glass can be installed. In addition, this glass can be laminated with a tough transparent plastic which is both noise and shatter resistant. Glass reduces noise by the mass principle; that is, the thicker the glass, the more noise resistant it will be. A 1/2-inch thick glass has a maximum STC rating of 35 dB compared to a 25 dB rating for ordinary 3/16 inch glass.

[1]U.S. Department of Housing and Urban Development, A Study of Techniques to Increase the Sound Insulation of Building Elements, Report No. WR 73-5, Washington, D.C., June 1973.

[2]Los Angeles Department of Airports, *Guide to the Soundproofing of Existing Homes Against Exterior Noise*. Report No. WRC 70-2, March 1970, pp. 9-11, 22-30. In this report, the function and performance of a number of operable seals are described.

However, glass thicknesses are only practical up to a certain point, when STC increases become too insignificant to justify the cost. For example, a 1/2 inch thick glass can have an STC of 35; increasing the thickness to 3/4 inch only raises the STC to 37. However, a double glass acoustical window consisting of two 3/16 inch thick panes separated by an airspace will have an STC of 51 and can cost less than either solid window.

In addition to thickness, proper sealing is crucial to the success of the window. To prevent sound leaks, single windows can be mounted in resilient material such as rubber, cork, or felt.

Install Double-Glazed Windows. Double-glazed windows are paired panes separated by an airspace or hung in a special frame. Generally, the performance of the double-glazed window may be increased with:

- increased airspace width
- increased glass thickness
- proper use of sealings
- slightly dissimilar thicknesses of the panes
- slightly non-parallel panes

In general the airspace between the panes should not be less than 2-4 inches if an STC above 40 is desired. If this is not possible, a heavy single-glazed window can be used. The use of slightly non-parallel panes is a technique employed when extremely high sound insulation is required, such as in control rooms of television studios.

The thickness of double-glazed panes may vary from 1/8 to 1/4 inch or more per pane. Although thickness is important, the factors which most determine the noise resistance of the window is the use of sealant and the width of the airspace.

As in the case of all windows, proper sealing is extremely important. To achieve an STC above 43, double-glazed windows should be sealed permanently. If the windows must be openable, there are available special frames and sealers for openable windows which allow a maximum STC of 43.[1]

Permanently sealed double-glazed windows often require an air pressure control system to maintain a constant air pressure and minimal moisture in the airspace. Without this system, the panes may deflect, and, in extremely severe cases, pop out of the frames.

[1]Ibid.

To further insure isolation of noise between double-glazed panes, the panes could be of different thicknesses, different weights, and slightly non-parallel to each other. This prevents acoustical coupling and resonance of sound waves.

Doors

Acoustically, doors are even weaker than windows, and more difficult to treat. Any door will reduce the insulation value of the surrounding wall. The common, hollow core wood door has an STC rating of 17 dB. Taking up about 20% of the wall, this door will reduce a 48 STC wall to 24 STC. To strengthen a door against noise, the hollow core door can be replaced by a heavier solid core wood door that is well sealed[1] and is relatively inexpensive. A solid core wood door with vinyl seal around the edges and carpeting on the floor will reduce the same 48 STC wall to only 33 dB.[2] An increased sound insulation value can be achieved if gasketed stops or drop bar threshold closers are installed at the bottom edge of the door. (See Figure 18)

The alternative solution to doors is to eliminate them whenever possible from the severely impacted walls and place them in more shielded walls.

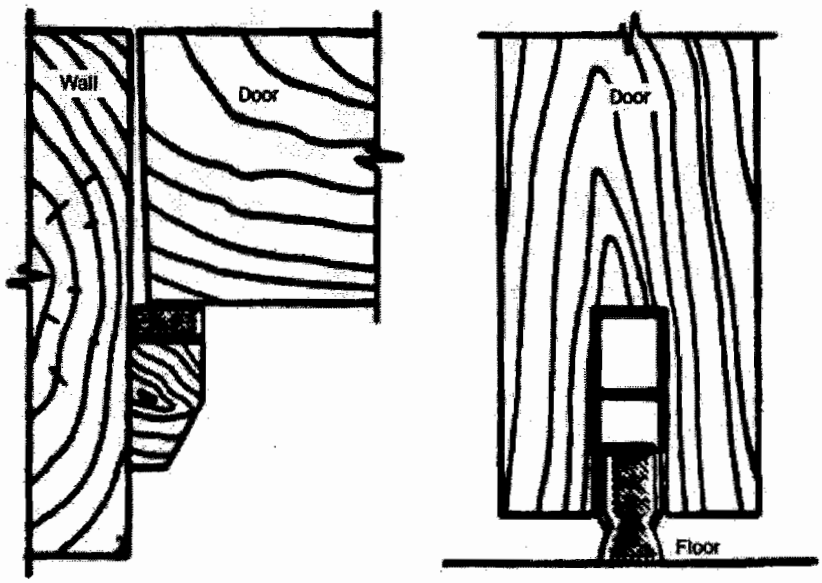
In any case no mail slots or similar openings should be allowed in exterior doors.

Roofs

Acoustical treatment of roofs is not usually necessary unless the noise is extremely severe or the noise source is passing over the building. The ordinary plaster ceiling should provide adequate sound insulation except in extremely severe cases. An acoustically weak roof which is likely to require treatment is the beamed ceiling.[3] Beamed ceilings may be modified by the addition of a layer of fiberglass or some other noise resistent material. Suspended ceilings are the most effective noise reducers but they are also the most expensive.

[1]D.E. Bishop and P.W. Hirtle, "Notes on the Sound Transmission Loss of Residential-Type Windows and Doors," Journal of the Acoustical Society of America, 43:4 (1968).
[2]U.S. Gypsum, Sound Control... p. 100.
[3]Ibid p. 15.

Figure 18



Gasketed door stop

Drop bar threshold closer

Floors

In the case of highway noise, floors would only require acoustical treatment if the highway were passing under the building. In this case, flooring would have to provide protection against structural vibrations as well as airborne sound.

Two ways to insulate a floor from noise are to install a solid concrete slab at least 6 inches thick or install a floating floor. In general, the floating floor gives the greatest amount of sound and vibration insulation; however, it is extremely expensive. Basically, a floating floor consists of a wood or concrete slab placed over the structural slab, but separated by a resilient material. The resilient material isolates the surface slab from the structural slab and the surrounding walls.

What to Look for When Reviewing Plans

The number of possible combinations of the building materials that go into walls, ceilings, windows and doors, is, no doubt, considerably short of infinite. It is however still a very large number, large enough that it would be impossible to compile a list of all the possible combinations. Therefore, do not expect to find in this section, or anywhere else for that matter, a neat table showing the STC ratings for all the types of construction you may encounter. In fact, it is not really your responsibility to determine the precise STC ratings for the walls, ceilings, windows and doors in the projects you review. Your job is simply to review the attenuation levels claimed by the sponsor/developer and determine whether or not they are reasonable.

To enable you to perform the above described task, we have prepared a list of the most common types of construction for which we have STC ratings. By comparing the type of construction proposed to one of these "model" types you should be able to tell whether the claimed STC rating is reasonable. For example, the sponsor/developer submits a description of his building stating that a 2 x 6 stud wall with standard sheathing, insulation, wood siding, and 1/2" gypsum board achieves a STC rating of 48. You look at Table 3 and find that the closest "model" wall is a 2 x 4 stud wall with wood siding, sheathing, insulation, and 1/2" gypsum board. This wall has a STC rating of 39. An 9 dB difference is quite significant considering that the walls are really quite similar. You would probably want to go back to the developer/sponsor and ask for some supporting data that proves that the 2 x 6 wall he proposes will indeed provide 48 dB of noise attenuation.

In order to make it easier to review the attenuation levels provided by the proposed construction, we suggest that you ask the developer/sponsor to complete a form such as shown in Figure 19. Such a form will give you all the information you need in a properly organized format that will facilitate your review. You could fill in the first part and simply have the developer/sponsor fill out the second part and return it with the developer certification or other project documents.

As you will recall from the previous section, most walls provide pretty good attenuation by themselves. It is the presence of windows and doors and openings such as vents that reduces the attenuation capability of the wall. Thus, after you have determined whether the basic wall itself has a reasonable STC, you must review the impact of the windows and doors. You do this by using Figure 17. First you determine the difference between the STC ratings for the wall and the windows. You enter the vertical axis of Figure 17 with that number. You read across until you intersect the line that represents the percentage of the wall taken up by the windows. Then you read down to the horizontal axis where you wil find the value to be subtracted from the basic STC value of the wall. The resulting number is the combined STC value for the wall. If the wall also contains a door, repeat the same procedure, only start out with the modified STC rating for the wall. If the wall has doors only, then obviously you start with the basic wall STC rating. Finally you compare the number you have derived with that listed by the developer/sponsor. If they are fairly close, you need not pursue it further. If there is a substantial difference, you should ask for an explanation or documentation from the developer.

Once again, we caution you about borderline cases. If the attenuation required is 30 dB and the STC rating for the proposed construction is exactly 30 dB, you may want to ask the developer to provide even more attenuation. Remember that we discussed how the STC rating may overstate the actual attenuation provided by as much as 3 dB. If an additional 3 dB can be achieved at minimum cost, we would strongly urge that you seek it from the developer/sponsor.

Finally check to make sure the developer has provided some form of mechanical ventilation. If it's a single family house and a whole house fan is the means of ventilation being provided make sure that there are operable windows on walls which do not face the noise source(s) nor are perpendicular to the source(s). Otherwise the residents will have to open windows on the exposed wall, thus cancelling out much of the attenuation achieved.

Table 3
STC Ratings for Typical Building Components[1]

Building Component	Description	STC Rating
Frame Wall	a. 5/8" x 10" Redwood Siding b. 1/2" Insulation Board Sheathing c. 2 x 4 studs 16" o.c. d. Fiberglass Building Insulation e. 1/2" Gypsum Board attached directly to studs	39 dB
Stucco/Frame Wall	a. 7/8" Stucco b. No. 15 felt Building Paper and 1" Wire Mesh c. 2 x 4 Studs 16" o.c. d. Fiberglass Building Insulation e. 1/2" Gypsum Board attached directly to studs	46
Brick Veneer Wall	a. Face Brick b. 1/2" Airspace with metal ties c. 3/4" Insulation Board Sheathing d. 2 x 4 Studs 16" o.c. e. Fiberglass Building Insulation f. 1/2" Gypsum Board attached directly to studs	56
Masonry Wall	a. 1" Stucco b. 8" thick Hollow Concrete Block c. 1/2" Gypsum Board attached to furring strips	49 (estimated)
Windows	Wood double hung, closed but unlocked, single glazing	23
	Aluminum sliding, latched, single glazing	24
	Wood double hung, closed but unlocked, glazed with 7/16" insulating glass	22
	Aluminum single hung, closed, glazed with 7/16" insulating glass	25
	Wood, double hung, sealed, glazed with 7/16" insulating glass with single glazed storm sash–2 1/8" separation	35
	Aluminum sliding, closed, single glazed with single glazed storm sash, 1/8" separation	22
Exterior Doors	Wood, flush solid core, with brass weather stripping	27
	Wood, flush solid core, plastic weather stripping, aluminum storm door	34
	Wood, French door, brass weather stripping	26
	Steel, flush, with urethane foam core, with magnetic weather stripping	28
Roof	Shingle Roof with attic, 1/2" gypsum wall board ceiling framed independently of roof	43 (estimated)

[1]Except as noted, all STC ratings are from: *Acoustical and Thermal Performance of Exterior Residential Walls, Doors and Windows*, National Bureau of Standards.

Figure 19
Description of Noise Attenuation Measures
(Acoustical Construction)

Part I

Project Name _____

Location _____

Sponsor/Developer _____

Noise Level (From NAG) _____ Attenuation Required _____

Primary Noise Source(s) _____

Part II

1. For Walls (s) facing and parallel to the noise source(s) (or closest to parallel):
   a. Description of wall construction* _____

   _____

   b. STC rating for wall (rated for no windows or doors): _____

   c. Description of Windows: _____

   _____

   d. STC rating for window type _____

   e. Description of doors _____

   _____

   f. STC rating for doors _____

   g. Percentage of wall (per wall, per dwelling unit) composed of windows _____ and doors _____

   h. Combined STC rating for wall component _____

2. For walls perpendicular to noise source(s):
   a. Description of wall construction* _____

   _____

   b. STC rating for wall (rated for no windows or doors) _____

   c. Description of windows _____

   _____

   d. STC rating for windows _____

   e. Description of doors _____

   _____

f. STC rating for doors _____

g. Percentage of wall (per wall, per dwelling unit) composed of windows _____ and doors _____

h. Combined STC rating for wall component _____

3. Roofing component (if overhead attenuation is required due to aircraft noise):
   a. Description of roof construction _____

   _____

   b. STC rating (rated as if no skylights or other openings) _____

   c. Descripton of skylights or overhead windows _____

   _____

   d. STC rating for skylights or overhead windows _____

   e. Percentage of roof composed of skylights or windows (per dwelling unit) _____

   f. Percentage of roof composed of large uncapped openings such as chimneys _____

   g. Combined STC rating for roof component _____

4. Description of type of mechanical ventilation provided _____

   _____

Prepared by _____

Date: _____

*If walls contain vents or similar openings, attach a description of duct arrangement and insulation and a statement of how much the wall STC is reduced by the presence of the vent.

Figure 19
Description of Noise Attenuation Measures
(Acoustical Construction)

Part I

Project Name PARADISE HOMES

Location ANYTOWN

Sponsor/Developer JOHN DOE + ASSOC. INC.

Noise Level (From NAG) 73 Attenuation Required 30d6

Primary Noise Source(s) HIGHWAY

Part II

1. For Walls (s) facing and parallel to the noise source(s) (or closest to parallel):
   a. Description of wall construction* 3/8" FIR PLYWOOD SIDING, 2x4 STUDS 16" o.c. 3½" FIBERGLASS INSULATION
   b. STC rating for wall (rated for no windows or doors): 37
   c. Description of Windows: WOOD DOUBLE HUNG, INSULATING GLASS
   d. STC rating for window type 22
   e. Description of doors WOOD, FLUSH, SOLID CORE
   f. STC rating for doors 30
   g. Percentage of wall (per wall, per dwelling unit) composed of windows 10% and doors 5%
   h. Combined STC rating for wall component 30d6
2. For walls perpendicular to noise source(s):
   a. Description of wall construction* SAME AS ABOVE
   b. STC rating for wall (rated for no windows or doors) 37
   c. Description of windows SAME AS ABOVE
   d. STC rating for windows 22
   e. Description of doors NO DOORS

SAMPLE

f. STC rating for doors —

g. Percentage of wall (per wall, per dwelling unit) composed of windows 10% and doors 0

h. Combined STC rating for wall component 30

3. Roofing component (if overhead attenuation is required due to aircraft noise):
   a. Description of roof construction N/A

   b. STC rating (rated as if no skylights or other openings)

   c. Descripton of skylights or overhead windows

   d. STC rating for skylights or overhead windows

   e. Percentage of roof composed of skylights or windows (per dwelling unit)

   f. Percentage of roof composed of large uncapped openings such as chimneys

   g. Combined STC rating for roof component

4. Description of type of mechanical ventilation provided CENTRAL AIR Conditioning

Prepared by

Date:

*If walls contain vents or similar openings, attach a description of duct arrangement and insulation and a statement of how much the wall STC is reduced by the presence of the vent.

SAMPLE

Quiz on Noise Attenuation

Questions

1. What are the three basic ways to provide noise attenuation?
2. What are the responsibilities of HUD personnel regarding noise attenuation?
3. When a barrier is introduced between a source and a receiver the sound energy is redistributed along 3 indirect paths. What are these three paths?
4. What is "Path Length Difference" and how does it affect the attenuation level provided by a barrier?
5. What are "Transmission Loss Values?"
6. How does the transmission loss value of barrier material affect the attenuation capability of the barrier?
7. As a general rule, what transmission loss values should you look for?
8. If you have more than one barrier between the source and the receiver is the amount of attenuation increased substantially?
9. What are the four things to check when reviewing a proposed barrier?
10. List 3 ways to make a barrier more effective without increasing its overall height.
11. List 3 ways to make a barrier more effective without increasing its overall length.
12. What is the maximum percentage of the total area of a barrier that can be made up of openings without a significant loss in barrier effectiveness?
13. List 3 site planning techniques that are used to shield residential developments.
14. When are parks and playgrounds not noise compatible uses that can be employed as buffers?
15. What are the two main things to look for when reviewing site plan changes?
16. What are some of the building orientations which can aggravate noise problems?
17. What is the Sound Transmission Class (STC) rating?
18. Which is better a high STC or a low STC rating?
19. What kinds of conditions were STC ratings originally developed for?
20. What should you do when using STC ratings in a transportation noise situation?
21. List 5 ways to improve the attenuation capability of a wall.
22. Windows are one of the acoustically weakest components in a wall. List 3 ways to reduce the negative effects of windows.
23. What is the best way to reduce the effect of doors?

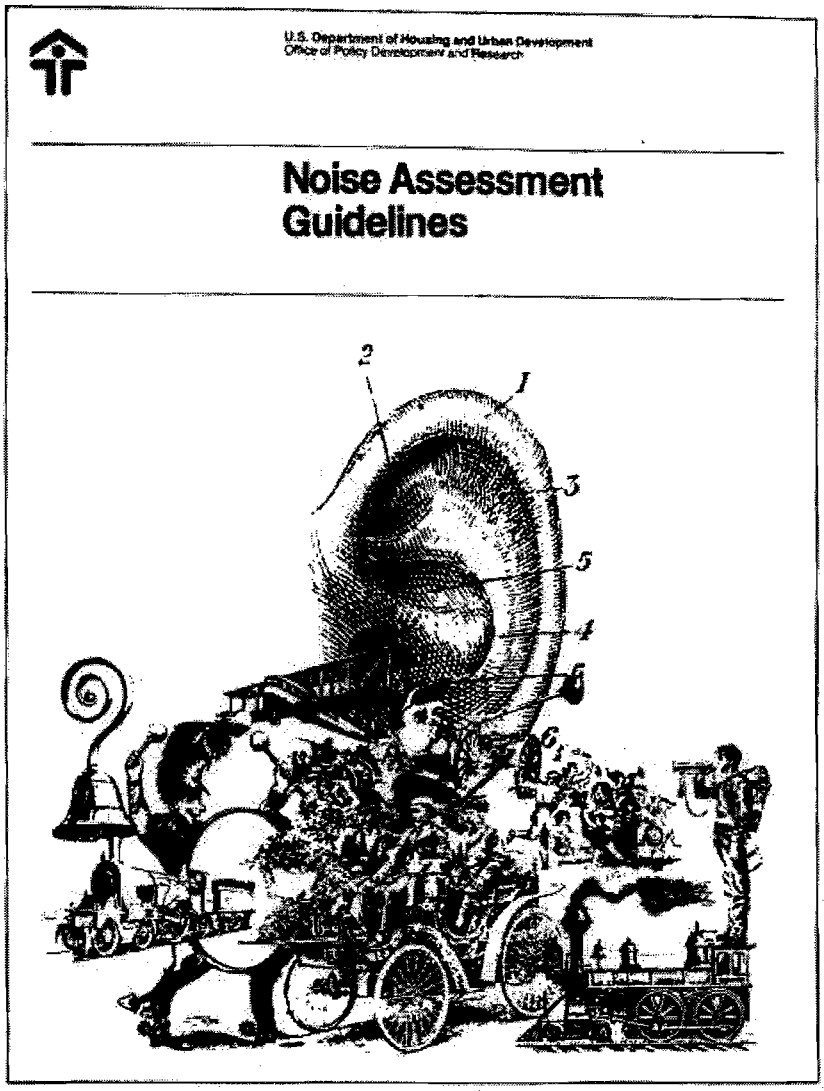
Quiz on Noise Attenuation

Answers

1. a. barriers or berms
   b. site design
   c. acoustical construction
2. a. to make sure the project sponsor/developer is aware of the attenuation requirements
   b. provide sponsor/developer with an overview of available options
   c. review attenuation proposals to make sure they are adequate
3. a. A **diffracted** path over the top of the barrier
   b. A **transmitted** path through the barrier
   c. A **reflected** path away from the receiver
4. "Path Length Difference" is the difference in distance that sound must travel diffracting over the barrier rather than passing directly through it. Since sound energy decreases over distance, the greater the path length distance the greater the attenuation.
5. "Transmission Loss Values" represent the amount noise levels will be reduced when the sound waves pass through a barrier.
6. Since the attenuation provided by a barrier is a function of both the sound energy that goes over the top and the energy that goes through the barrier, if the transmission loss value is low then the effectiveness of the barrier will be greatly reduced.
7. If the transmission loss value of the barrier material is at least 10dB greater than the attenuation level provided by diffraction (i.e. barrier height) there shouldn't be any problem.
8. No. The combined effect of multiple barriers does not normally provide significantly greater attenuation than a single barrier. For design purposes, the general procedure is to assume the attenuation of the most effective barrier.
9. a. Is it high enough?
   b. Is it long enough?
   c. Is it made of the right material?
   d. Is it properly constructed?
10. a. move the barrier closer to the source
    b. bend the top of the barrier towards the source
    c. do both
11. a. move it closer to the receiver
    b. bend the ends toward the receiver
    c. do both
12. 1 percent
13. Any 3 of the below:
    a. increasing the distance between the source and the receiver
    b. placing noise compatible land uses between the source and the receiver
    c. locating barrier type buildings parallel to the source
    d. orienting residences away from the noise
14. when they are the only ones associated with the project
15. a. is the separation between the source and receiver great enough
    b. If a noise compatible building is being used as a barrier is it tall and long enough?
16. Building orientations which trap noise and cause it to reverberate off building walls. This would include shapes where a court is open to the source or where a series of buildings are arranged perpendicular to the source.
17. The STC rating is equal to the number of decibels a sound is reduced as it passes through a material.
18. A high STC rating is better.
19. The STC ratings were originally intended primarily for use with interior partitions and for noise such as speech, radios, television.
20. Recognize that the STC rating may overstate the effectiveness of the materials by 2-3db.
21. Any of the 9 below:
    a. increase the mass and stiffness of the wall
    b. use cavity partitions
    c. increase the width of the airspace
    d. increase the spacing between studs
    e. use staggered studs
    f. use resilient materials to hold the studs and finish materials together
    g. use of dissimilar layers (leaves)
    h. add acoustical blankets
    i. seal cracks and edges
22. Any of the 4 below:
    a. close the windows and provide mechanical ventilation
    b. reduce window size
    c. increase glass thickness
    d. install double glazed windows
23. Eliminate them from severely impacted walls

Chapter 5

Noise Assessment Guidelines

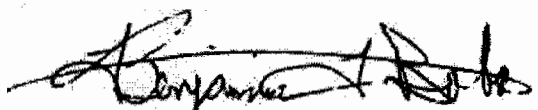


Noise Assessment Guidelines

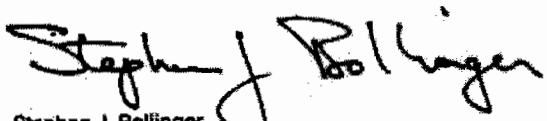
Foreword

In choosing among alternative sites for housing, potential noise problems are prominent among the issues that must be examined. These Noise Assessment Guidelines were developed to provide HUD field staff, interested builders, developers, and local officials with an easy-to-use method of evaluating noise problems with a minimum of time and effort.

We believe that this set of tools will simplify the process of balancing the goal of environmental protection with those of efficiency and reduced housing costs. We hope you will find them useful, and invite your comments.



Benjamin F. Bobo
Acting Assistant Secretary for
Policy Development and Research



Stephen J. Bollinger
Assistant Secretary for
Community Planning and
Development

Preface

The Department of Housing and Urban Development, in its efforts to provide decent housing and a suitable living environment, is concerned with noise as a major source of environmental pollution and has issued Subpart B on Noise Abatement and Control to Part 51 of Title 24 of the Code of Federal Regulations.

The policy established by Subpart B embodies HUD objectives to make the assessment of the suitability of the noise environment at a site: (1) easy to perform; (2) uniformly applicable to different noise sources; and (3) as consistent as possible with the assessment policies of other Federal departments and agencies. In furtherance of these objectives, the Office of Policy Development and Research has sponsored research to provide site analysis techniques. These *Noise Assessment Guidelines* do not constitute established policy of the Department but do provide a methodology whose use is encouraged by HUD as being consistent with its objectives. The *Guidelines* provide a means for assessing separately the noise produced by airport, highway, and railroad operations, as well as the means for aggregating their combined effect on the overall noise environment at a site.

This booklet has been prepared by Bolt Beranek and Newman Inc., under Contract No. H-2243R for the U.S. Department of Housing and Urban Development. It is a revision of an earlier edition published in August 1971. With the exception of changes made by the Department, the contractor is solely responsible for the accuracy and completeness of the data and information contained herein.

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Introduction

These guidelines are presented as part of a continuing effort by the Department of Housing and Urban Development to provide decent housing and a suitable living environment for all Americans.

The procedures described here have been developed so that people without technical training will be able to assess the exposure of a housing site to present and future noise conditions. In this context, the site may hold only one small building, in which case the noise assessment is straightforward. Larger sites may hold larger buildings, or many buildings, and the noise level may be different at different parts of the site (or building). Assessments of the noise exposure should be made at representative locations around the site where significant noise is expected. These are designated as "Noise Assessment Locations," abbreviated NAL in the following text.

The only materials required are a map of the area, a ruler (straight edge), a protractor and a pencil. Worksheets and working figures are provided separately.

All of the information you need can be easily obtained – usually by telephone. For convenience, this information is listed at the beginning of each section under headings that indicate the most likely source. While you are obtaining this information, be sure to ask about any approved plans for future changes that may affect noise levels at the site – for example: land-use changes, changes in airport runway traffic, widening of roads, and so forth. In all evaluations, you should assess the condition that will have the most severe or most lasting effect on the use of the site.

Wherever possible, you should try to assess noise environments expected at least ten years in the future.

The degree of acceptability of the noise environment at a site is determined by the outdoor day-night average sound level (DNL) in decibels (dB). The assessment of site acceptability is presented first as an evaluation of the site's exposure to three major sources of noise – aircraft, roadways, and railways. These are then combined to assess the total noise at a site. Worksheets are provided at the back of these Guidelines to use in summarizing your evaluations.

The noise environment at a site will come under one of three categories:

Acceptable (DNL not exceeding 65 decibels) The noise exposure may be of some concern but common building constructions will make the indoor environment acceptable and the outdoor environment will be reasonably pleasant for recreation and play.

Normally Unacceptable (DNL above 65 but not exceeding 75 decibels) The noise exposure is significantly more severe; barriers may be necessary between the site and prominent noise sources to make the outdoor environment acceptable; special building constructions may be necessary to ensure that people indoors are sufficiently protected from outdoor noise.

Unacceptable (DNL above 75 decibels) The noise exposure at the site is so severe that the construction cost to make the indoor noise environment acceptable may be prohibitive and the outdoor environment would still be unacceptable.

When measuring the distance from the site to any noise source, measure from the source to the nearest points on the site where buildings having noise-sensitive uses are located. These points define the Noise Assessment Locations for the site. The relevant measurement location for buildings is a point 2 meters (6.5 feet) from the facade.

If at any point during the assessment the site's exposure to noise is found to be Unacceptable or Normally Unacceptable, every effort should be made to improve the condition, e.g., the location of the proposed dwellings can be changed or some shielding can be provided to block the noise from that source.

Where quiet outdoor space is desired at a site, distances should be measured from the important noise sources to the outdoor area in question and the combined noise exposure should be assessed.

Frequently, the locations of dwellings have not yet been specified at the time the noise assessment of a site is made. In these instances, distances used in the noise assessment should be measured as 2 meters less than the distance from the building setback line to the major sources of noise.

Combining Sound Levels in Decibels

The noise environment at a site is determined by combining the contributions of different noise sources. In these Guidelines, Workcharts are provided to estimate the contribution of aircraft, automobile, truck, and train noise to the total day-night average sound level (DNL) at a site. The DNL contributions from each source are expressed in decibels and entered on Worksheet A. The combined DNL from all the sources is the DNL for the site and is the value used to determine the acceptability of the noise environment.

Sound levels in decibels *are not combined by simple addition!* The following table shows how to combine sound levels:

Table

Difference in Sound Level	Add to Larger Level
0	3.0
1	2.5
2	2.1
3	1.8
4	1.5
5	1.2
6	1.0
7	0.8
8	0.6
9	0.5
10	0.4
12	0.3
14	0.2
16	0.1
greater than 16	0

Use the table by first finding the numerical difference in sound level between two levels being combined. Entering the table with this value, find the value to be added to the larger of the two levels, add this value to the larger level to determine the total. Where more than two levels are to be combined, use the same procedure to combine any two levels; then use this subtotal and combine it with any other level, and so on. Fractional numerical values may be interpolated from the table; however, the final result should be rounded to the nearest whole number.

Example 1: In performing a site evaluation, the separate DNL values for airports, road traffic, and railroads have been listed on Worksheet A as 56, 63, and 61 decibels. In order to complete the final evaluation of the site, these separate DNL values must be combined. The difference between 63 and 56 is 7; from the table you find that 0.8 should be added to 63, for a subtotal of 63.8. The difference between 63.8 and 61 is 2.8; from the table you interpolate that approximately 1.9 should be added to 63.8 for a total of 65.7 or 66 dB when rounded to whole numbers. This example shows how noise from different sources may be Acceptable, individually, at a site, but when combined, the total noise environment may exceed the Acceptable DNL limit of 65 decibels.

Aircraft

Necessary Information

To evaluate a site's exposure to aircraft noise, you will need to consider all airports (civil and military) within 15 miles of the site. The information required for this evaluation is listed below under headings that indicate the most likely source. Before beginning the evaluation, you should record the following information on Worksheet B:

From the FAA Area Office or the Military Agency in charge of the airport:

- Are current DNL or NEF (Noise Exposure Forecast) contours available? Noise contours are available for almost all military airports. These contours have been developed and published as part of the Air Installation Compatible Use Zone (AICUZ) program of the Department of Defense. The contours are published normally as part of an AICUZ report. Noise contours are also available for many civil airports. When available, they are superimposed on a map with an appropriately marked scale (see Figure 1, page 4).
- Any available information about approved plans for runway changes (extensions or new runways).

From the FAA Control Tower or Airport Operations (if DNL or NEF contours are *not* available):

- The number of nighttime jet operations (10 p.m. - 7 a.m.)
- The number of daytime jet operations (7 a.m. - 10 p.m.)
- The flight paths of the major runways.
- Any available information about expected changes in airport traffic, e.g., will the number of operations increase or decrease in the next 10 or 15 years.

In making your evaluation, use the data for the heaviest air traffic condition, whether present or future.

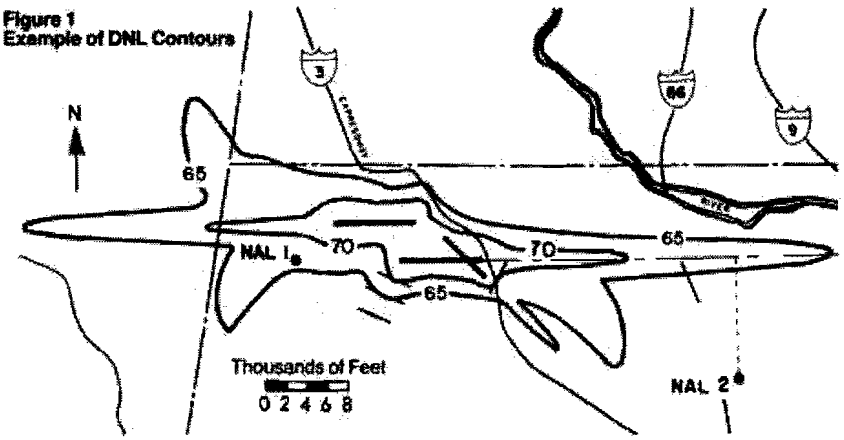
Evaluation of Site Exposure to Aircraft Noise

If current DNL (or NEF) contours are available (as in Figure 1 page 4), locate the site on the map by referring to the marked distance scale. If there are no other noise sources in the area, you do not need to do anything else. If there are other noise sources affecting the site, you will need to find the precise DNL value so you can combine it with the other sources. Obtain the DNL at the appropriate NAL on the site by interpolation between the contours on either side of the NAL. If NEF contours are used, estimate DNL by adding 35 decibels to the NEF values. Note that contours are usually provided in 5 decibel increments. (See Example 2 on page 4.) When supersonic aircraft operations are present, DNL contours are *required* for the assessment.

If DNL or NEF contours are *not* available, the DNL at a site may be estimated in several different ways:

- An FAA Handbook (Reference 1) can be used to estimate DNL contours for sites in general aviation airport vicinities. General aviation airports exclude commercial jet transports but may include business jets.
- A handbook available from EPA (Reference 2 at the back of this Guide) can be used to calculate DNL at individual points.
- A procedure for constructing approximate DNL contours for sites near commercial jet

Figure 1
Example of DNL Contours



Example 2: The illustration in Figure 1 at the top of page 4 shows the NAL's on a map that has DNL contours. We find that NAL number 1 lies between the 65 and 70 dB contours and that NAL number 2 lies outside the 65 dB contour.

We find the DNL at NAL number 1 by interpolation from the distances between the NAL and the 65 and 70 dB contours.

By scaling off the map, we find that the distance from the NAL, measured perpendicularly to the contours, is 800 feet to the 65 dB contour and 2400 feet to the 70 dB contour. The distance between the 65 and 70 dB contours is 2400 + 800 =3200 feet. We find the DNL at the NAL number 1 to be 65 decibels plus 800/3200 x 5 decibels = 66.3 decibels.

Example 3: The illustration in Figure 2 at the bottom of page 5 shows an airport for which DNL or NEF contours are not available. The airport has 10 nighttime and 125 daytime jet operations.

To construct the approximate contours, we determine the effective number of operations as follows:

10 (nighttime) x 10 = 100

Add to this the actual number of daytime operations:

100 + 125 (daytime) = 225

To determine the distances A and B in relation to the runway (see Figure 3, page 5), enter the effective number of operations on the horizontal scales of the charts in Figure 3;

airports without supersonic aircraft is as follows:

Determine the "effective" number of jet operations at the airport by first multiplying the number of nighttime jet operations by 10.

Then add the number of daytime jet operations to obtain an effective total (see Example 3, page 4).

On a map of the area showing the principal runways, mark the location of the site and, using the diagram and charts of Figure 3 on page 5, construct approximate DNL contours of 65, 70, and 75 dB for the major runways and flight paths most likely to affect the site. (see Figure 2, page 5.)

Although a site may be Acceptable for exposure to aircraft noise; exposure to other sources of noise, when combined with the aircraft noise, may make the site Unacceptable. Therefore, if necessary, values of aircraft noise exposure less than 65 dB can be estimated from Table 2. Scale the shortest distance D^2 from the NAL to the flight path, as in Figure 2. Scale the distance D^1 from the 65 dB contour to the flight path. Divide D^2 by D^1 and enter this value into the following table to find the approximate DNL at the NAL.

Table 2

D^2/D^1	DNL dB
1.00	65
1.12	64
1.26	63
1.41	62
1.58	61
1.78	60
2.00	59
2.24	58
2.51	57
2.82	56
3.16	55

Figure 2
Example of Approximate DNL Contours for an Airport with 225 Effective Number of Operations

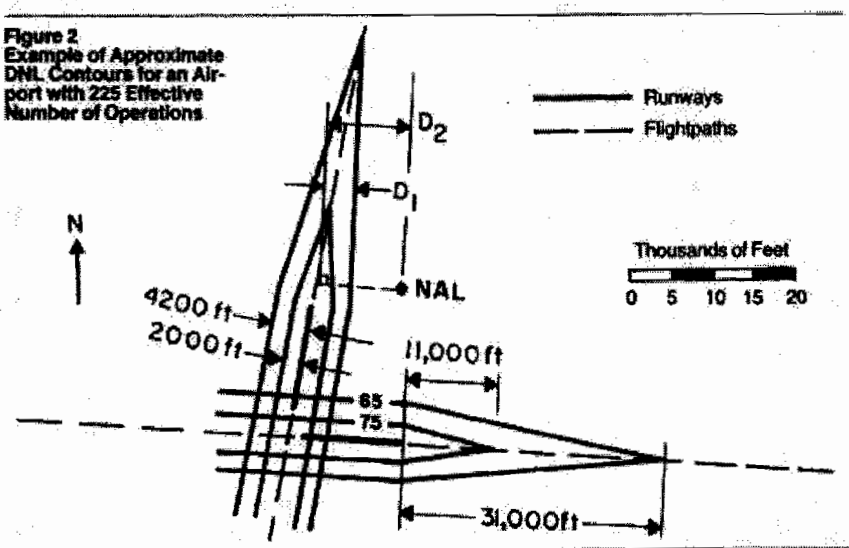
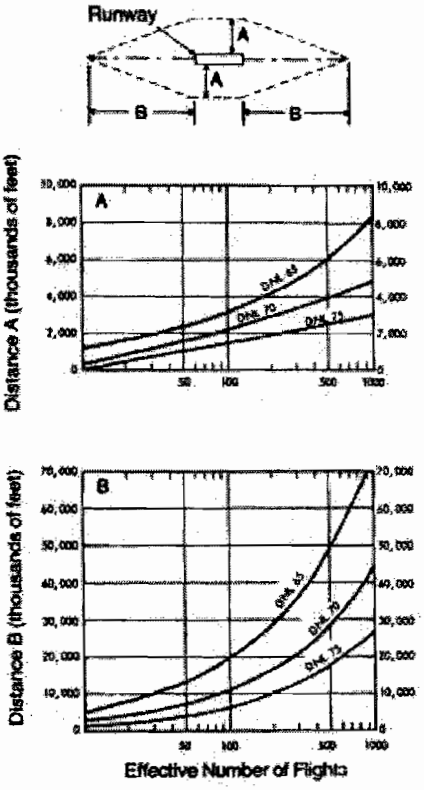


Figure 3
Charts for Estimating DNL for Aircraft Operations



read up to the DNL curves; read across the chart to the left to obtain distances A and B from the vertical scales on the charts.

We find from Figure 3, for example, that for 225 effective operations, distance A is 4200 feet for the 65 dB contour and 2000 feet for the 75 dB contour. Distance B is 31,000 feet for the 65 dB contour and 11,000 feet for the 75 dB contour.

Example 4a: The NAL shown in Figure 2 is outside the 65 dB contour. The distance D^2 from the NAL to the flight path is 9700 feet. The distance D^1 from the 65 dB contour to the flight path, measured perpendicularly from the contour, is 3700 feet. The ratio D^2/D^1 is 9700/3700 = 2.62. From Table 2 we find the DNL from the airport to be 56.6 dB. We do not know whether the site is Acceptable or not, however, since we must also assess the contribution of roadway and train noise to the total DNL at the site.

Example 4b: We observe that the perpendicular distance (D^2) from NAL number 2 (Figure 1) to the flight path is more than 3 times the distance (D^1) from the 65 dB contour to the flight path. From Table 2 we find that the contribution of the airport to the DNL at NAL number 2 is less than 55 decibels. We need not consider the airport further in accessing the noise environment at this site.

Roadways

Necessary Information

To evaluate a site's exposure to roadway noise, you will need to consider all roads that might contribute to the site's noise environment; roads farther away than 1000 feet normally may be ignored.

Before beginning the evaluation, determine if roadway noise predictions already exist for roads near the site. Also try to obtain all available information about approved plans for roadway changes (e.g., widening existing roads or building new roads) and about expected changes in road traffic (e.g., will the traffic on this road increase or decrease in the next 10 to 15 years).

If noise predictions have been made, they should be available from the City (County) Highway or Transportation Department. If not, record the following information on page 1 of Worksheet C:

- The distances from the NAL's for the site to the near edge of the nearest lane and the far edge of the farthest lane for each road.
- Distance to stop signs.
- Road gradient, if 2 percent or greater.
- Average speed.
- The total number of automobiles for both directions during an average 24-hour day. Traffic engineers refer to this as ADT, Average Daily Traffic (or sometimes AADT, meaning Annual Average Daily Traffic).
- The number of trucks during an average 24-hour day in each direction.

If possible, separate trucks into "heavy trucks" – those weighing more than 26,000 pounds with three or more axles – and "medium trucks" – those between 10,000 and 26,000 pounds. (Each medium truck is counted as equal to 10 automobiles.) Trucks under 10,000 pounds are counted as automobiles. Count buses capable of carrying more than 15 seated passengers as "heavy" trucks – others, as "medium" trucks. If it is not possible to separate the trucks into those that are heavy and those that are not, treat *all* trucks as though they are "heavy."

Note: If the road has a gradient of 2 percent of more, record the numbers for uphill and downhill traffic separately since these figures will be needed later; otherwise, simply record the total number of trucks. Most often you will have to assume that the uphill and downhill traffic are equally split.

- The fraction of ADT that occurs during nighttime (10 p.m. to 7 a.m.). If this is unknown, assume 0.15 for both trucks and autos.

Evaluation of Site Exposure to Roadway Noise

Traffic surveys show that the amount of roadway noise depends on the percentage of trucks in the total traffic volume. To account for this effect, you must evaluate automobile and truck traffic separately and then combine the results.

The noise environment at each site due to traffic noise is determined by utilizing a series of Workcharts to define the contribution of automobiles and trucks from one or more roads at that site. Each noise source yields a separate DNL value.

Workchart 1 provides a graph for assessing a site with respect to the noise from automobiles, light and medium trucks; Workchart 2 provides a similar graph for assessment of heavy truck noise. These values are combined for each road affecting the noise environment at the site to obtain the total contribution of roadway noise. Remember, the noise from aircraft and railways must also be considered before determining the suitability of this site's noise environment.

Effective Distance

Before proceeding with these separate evaluations, however, determine the "effective distance" to each road from the dwelling or outdoor residential activity (the NAL's for the site) by averaging the distances to the nearest edge of the nearest lane and to the farthest edge of the farthest lane of traffic. (See Example 5, page 6, and Figure 4, page 7.)

Note: For roads with the same number of lanes in both directions, the effective distance is the distance to the center of the roadway (or median strip, if present).

Automobile Traffic

Workchart 1 was derived with the following assumptions:

- There is line-of-sight exposure from the site to the road; i.e., there is no barrier which effectively shields the site from the noise of the road.
- There is no stop sign within 600 feet of the site; traffic lights do not count because there is usually traffic moving on one street or the other.
- The average automobile traffic speed is 55 mph.
- The nighttime portion of ADT is 0.15.

If each road meets these four conditions, proceed to Workchart 1 for the evaluation. Enter the horizontal axis with the effective distance from the roadway to the NAL; draw a vertical line upward from this point. Enter the vertical axis with the effective automobile ADT; draw a horizontal line across from this point. (The "effective" automobile ADT is the sum of automobiles, light trucks, and 10 times the number of medium trucks in a 24-hour day.) Read the DNL value from Workchart 1 where the vertical and horizontal lines intersect. Record this value in column 16, Worksheet C.

But:

If any of the four conditions is different, make

Example 5: The site shown in Figure 4 is exposed to noise from three major roads: Road No. 1 has four lanes, each 12 feet wide, and a 30-foot wide median strip which accommodates a railroad track. Road No. 2 has four lanes, each 12 feet wide. Road No. 3 has six lanes, each 15 feet wide, and a median strip 30 feet wide.

The distance from NAL No. 1 to the near edge of Road No. 1 is 300 feet. The distance to the far edge of Road No. 1 is 300 feet, plus the number of lanes times the lane width, plus the width of the median strip. Thus, the distance to the farthest edge of the road is:

$$300 + (4 \times 12) = 378 \text{ ft}$$

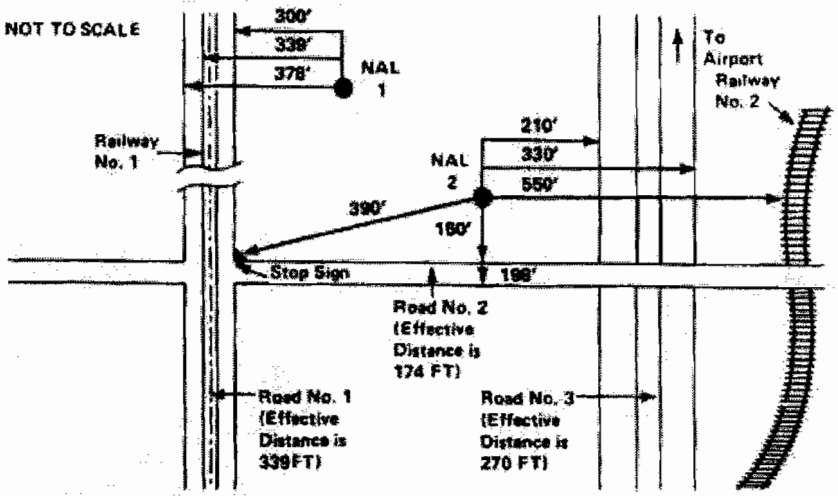
The effective distance is

$$\frac{378 + 300}{2} = 339 \text{ ft}$$

This is the value to be entered on line 1c of Worksheet C. The effective distances from the appropriate NAL's to Road No. 2 and Road No. 3 are found by the same method.

The distances shown in Figure 4 will be used for all roadway examples in this booklet.

Figure 4
Plan View of Site showing How Distance Should Be Measured from the Noise Assessment Location (NAL) of the Dwelling Nearest to the Source

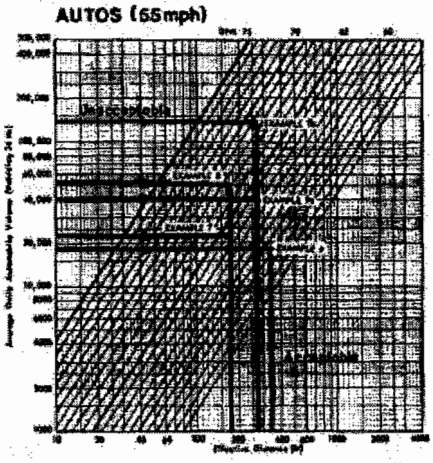


the necessary adjustments (on page 2, Worksheet C) listed below and *then* use Workchart 1 for the final evaluation.

First, a few general words about adjustments as they are applied in these Guidelines. Each Workchart has been derived for a baseline condition which is often found in practical cases. Where conditions differ from the baseline, they are accounted for by a series of one or more adjustment factors.

The adjustment factors are used as multipliers times the average number of vehicles operating during a 24-hour day. If more than one adjustment is required, it is not necessary that each be multiplied times the basic traffic flow separately; all adjustment factors are multiplied together, and them multiplied times the original traffic flow data. This will become clearer as you examine the Worksheets at the back of these Guidelines and work through the examples. After you have become familiar with the Guidelines, you will be able to work examples directly from the worksheets without referring back to the text. To simplify your work, all the adjustment factors are summarized at the back of these Guidelines.

Figure 5
Use of Workchart 1 To Evaluate Automobile Traffic Noise



Adjustments for Automobile Traffic

Stop-and-Go Traffic:
If there is a stop sign (not a traffic signal) within 600 feet of the NAL so that the flow of traffic is completely interrupted on the road under consideration, find the stop-and-go adjustment factor for automobiles from Table 3. Enter this value in column 9 on Worksheet C.

Table 3

Distance from NAL to Stop Sign In Feet	Automobile Stop-and-Go Adjustment Factor
0	0.10
100	0.25
200	0.40
300	0.55
400	0.70
500	0.85
600	1.00

Average Traffic Speed:
If the average automobile speed is other than 55 mph, enter the appropriate adjustment from Table 4 in column 10 of Worksheet C.

Table 4

Average Traffic Speed	Auto Speed Adjustment Factor
20 (mph)	0.13
25	0.21
30	0.30
35	0.40
40	0.53
45	0.67
50	0.83
55	1.00
60	1.19
65	1.40
70	1.62

Example 6: Road No. 1 meets the four conditions that allow for an immediate evaluation. In obtaining the information necessary for this evaluation, it was found that the automobile ADT is 18,000 vehicles (Line 5c of Worksheet C). On Workchart 1 we locate on the vertical scale the point representing 18,000 and on the horizontal scale the point representing 339 feet (see Figure 5). (Note that we must estimate the location of this point.) Using a straight-edge we draw lines to connect these two values and find that the NAL exposure to automobile noise from this road is a DNL of 58 dB, as read from the scale at the top of the graph.

Example 7: Road No. 2 has a stop sign at 390 feet from NAL No. 2. The automobile ADT is reported as being 32,500 vehicles (line 5c of Worksheet C). From Table 3 we interpolate between 300 and 400 feet to find the adjustment factor for stop-and-go traffic to be 0.69. The adjusted traffic ADT is

0.69 × 32,500 = 22,425 vehicles per day

and with an effective distance of 174 feet from NAL No. 2, we find from Workchart 1 that the approximate value of DNL is 64 dB.

Example 8: Suppose that the stop sign on Road No. 2 were replaced by a traffic signal for which no stop-and-go adjustment is made and that the ADT increases to 75,000 vehicles. In addition, assume that the average speed is 45 mph instead of 55 mph. You adjust the new automobile ADT of 75,000 vehicles by the Auto Speed Adjustment Factor from Table 4

0.67 × 75,000 = 50,250 vehicles

and at an effective distance of 174 feet find from Workchart 1 that the approximate value of DNL is 67 dB.

Nighttime Adjustment.

DNL values are affected by the proportion of traffic volume that occurs during "daytime" (7 a.m. to 10 p.m.) and "nighttime" (10 p.m. to 7 a.m.). The graph on Workchart 1 assumes that 15 percent of the total ADT occurs during nighttime. If a different proportion of the traffic occurs at night, find the appropriate nighttime adjustment factor from Table 5. Record your answer in column 11 of Worksheet C.

Table 5

Nighttime Fraction of ADT	Nighttime Adjustment Factor
0	0.43
0.01	0.46
0.02	0.50
0.05	0.62
0.10	0.81
0.15	1.00
0.20	1.19
0.25	1.38
0.30	1.57
0.35	1.77
0.40	1.96
0.45	2.15
0.50	2.34

Once you have selected all the appropriate adjustment factors and entered them on page 2 of Worksheet C, multiply all the factors together, then multiply by the automobile ADT (column 12) for 24 hours, found on page 1 of Worksheet C. The resulting adjusted ADT should be entered in column 13. This is the ADT value to be used, in conjunction with the effective distance from the NAL to the road, to find the DNL value from Workchart 1. Enter this DNL value in column 14 of Worksheet C. Remember this is the DNL from automobile (as well as light and medium truck) noise; you must still find the DNL contribution from heavy truck noise in order to obtain the total DNL produced by the roadway you are assessing.

Attenuation of Noise by Barriers:

This adjustment reduces the noise produced by automobiles and trucks on the same road. Instructions for this adjustment appear after the noise assessment for truck traffic below.

Truck Traffic

Wherever possible, separate the average daily volume of trucks into heavy trucks (more than 26,000 pounds vehicle weight and three or more axles); medium trucks (less than 26,000 pounds but greater than 10,000 pounds), light trucks (counted as if they are automobiles). You should already have accounted for medium and light trucks in your automobile evaluation. Do not forget that buses that can carry more than 15 seated passengers are counted as heavy trucks. Heavy trucks (including buses) must be analyzed separately because they have quite different noise characteristics. If it is not possible to separate the trucks into those that are heavy and those that are not, treat *all* trucks as though they are "heavy."

Workchart 2, which is used to evaluate the site's exposure to heavy truck noise, was derived with the following assumptions:

- There is line-of-sight exposure from the site to the road; i.e., there is no barrier which effectively shields the site from the road noise.
- The road gradient is less than 2 percent.
- There is no stop sign (traffic signals are permissible) within 600 feet of the site.
- The average truck traffic speed is 55 mph.
- The nighttime fraction of ADT is 0.15.

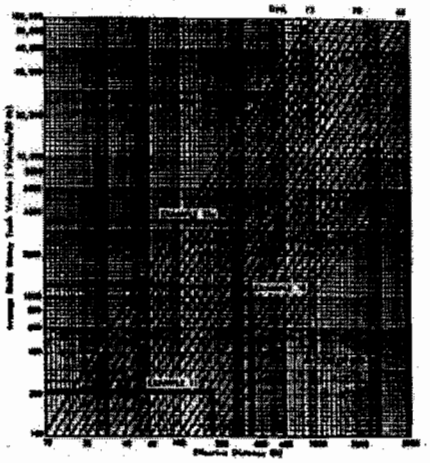
If the road meets these five conditions, proceed to Workchart 2 for an immediate evaluation of the site's exposure to heavy truck noise from that road.

But:

If any of the conditions is different, make the necessary adjustment(s) listed below and *then* use Workchart 2 for the evaluation.

Figure 6.
Use of Workchart 2 to Evaluate Heavy Truck Noise

Heavy Trucks (55 mph)



Adjustments for Heavy Trucks

Road Gradient:

If there is a gradient of 2 percent or more, find the appropriate adjustment factor, for heavy trucks going uphill only, as shown in Table 6. List this factor in column 17 of Worksheet C.

Table 6

Percent of Gradient	Adjustment Factor
2	1.4
3	1.7
4	2.0
5	2.3
6 or more	2.5

Example 9a: Road No. 3 is a limited access highway with no stop signs and the average speed is 55 mph. Current traffic data indicate an automobile ADT of 40,000 vehicles of which 15 percent occurs during nighttime hours (10 p.m. to 7 a.m.). With an effective distance of 270 feet to NAL No. 2, Workchart 1 is used to show that the DNL for existing automobile traffic is between 63 and 64 dB. Round off to 64 dB.

Example 9b: However, traffic projections estimate that in 10 years the ADT will increase to 100,000 vehicles at an average speed of 55 mph and nighttime usage will increase to 25 percent. For future traffic, you must adjust the future ADT of 100,000 for the effect of increased nighttime use. From Table 5, you find an adjustment factor of 1.38. The adjusted ADT is

$$1.38 \times 100{,}000 = 138{,}000$$

and at an effective distance of 270 feet you find from Workchart 1 that the DNL will increase to 69 dB; therefore, provision for extra noise control measures should be explored. We will examine in Example 13 the effect of terrain as a shielding barrier that provides sound attenuation.

Example 10: Road No. 1 on Figure 4 meets the four conditions that allow for an immediate evaluation. The ADT for heavy truck flow is 1200 vehicles. Workchart 2 shows that the exposure to truck noise from this road at an effective distance of 339 feet is a DNL of 63 dB at NAL No. 1.

Average Traffic Speed:

Make this adjustment if the average speed differs from 55 mph. If the average truck speed differs with direction, treat the uphill and downhill traffic separately. Select the appropriate adjustment factors from Table 7 below, entering them in column 18 of Worksheet C.

Table 7

Average Traffic Speed MPH	Heavy Truck Speed Adjustment Factor
50 or less	0.81
55	1.00
60	1.17
65	1.38

Once you have found the speed adjustment factor, you can combine the uphill and downhill traffic. For uphill traffic, multiply the gradient factor times the speed adjustment factor times uphill traffic volume (truck ADT column 19) (assuming one half the total 24-hour average number of trucks unless specific information to the contrary exists), entering the product in column 20. Multiply the speed adjustment factor for downhill traffic times the downhill traffic volume (truck ADT/2 column 19). Add the values for uphill and downhill traffic, entering this sum in column 21. You may now complete the assessment of heavy truck noise without regard to uphill and downhill traffic separation.

Stop-and-Go Traffic:

If there is a stop sign (remember, not a traffic signal) within 600 feet of an NAL for the site on the road being assessed, find the adjustment factor determined according to Table 8. Enter it in Column 22 of Worksheet C.

Table 8

Heavy Truck Traffic Volume per Day	Heavy Truck Stop-and-Go Adjustment Factor
Less than 1200	1.8
1201 to 2400	2.0
2401 to 4800	2.3
4801 to 9600	2.8
9601 to 19,200	3.8
More than 19,200	4.5

Nighttime Adjustment

After all the above adjustments are made, do not forget to adjust for nighttime operations if they are not 15 percent of the total ADT, using the factors obtained from Table 5 just as for automobiles. Enter this value in column 23 of Worksheet C.

At this point, multiply the adjustment factors for nighttime and stop-and-go traffic times the heavy truck traffic volume in column 21 to find the adjusted heavy truck ADT, entering the product in column 24. Use this value and the effective distance from the NAL to the road to find the truck DNL from Workchart 2, entering your answer in column 25 of Worksheet C. If no shielding barriers are to be considered, combine the DNL from heavy trucks with the DNL from automobiles (column 14). The result is the DNL from the road being assessed and should be entered on Worksheet C.

But:

If a shielding barrier is to be considered for the site, make the analysis described below separately for automobiles and then for heavy trucks *before* combining the DNL values. This step is necessary since barriers are far more effective for automobiles than for heavy trucks. Once you have found the amount of attenuation provided by the barrier for automobiles, enter it in column 15. Find the value of barrier attenuation for heavy trucks and enter it in column 25. Subtract these attenuation values from the DNL values obtained previously (columns 14 and 24), entering the reduced DNL values in columns 16 and 27. Combine the automobile and heavy truck DNL values, reduced by the attenuation provided by the barrier, to find the final DNL produced by the roadway at the site.

Remember to combine the contributions to DNL of *all* roads that affect the noise environment at each NAL for the site to obtain the total DNL from all roadways. Enter this DNL on both Worksheet C and the summary Worksheet A.

Attenuation of Noise by Barriers

Noise barriers are useful for shielding sensitive locations from ground level noise sources. For example, a barrier may be the best way to deal with housing sites at which the noise exposure is not acceptable because of nearby roadway traffic.

A barrier may be formed by the road profile, by a solid wall or embankment, by a continuous row of noise-compatible buildings, or by the terrain itself. To be an *effective* shield, however, the barrier must block all residential levels from line of sight to the road; it must not have any gaps that would allow noise to leak through.

Some Preliminary Matters:

In evaluating noise barrier performance, you will be working with different kinds of "distances" between the sound source, the observer, and the barrier.

Actual Distance – the existing distance that would be measured using a tape measure with no corrections or adjustments. This may mean one of two things, *depending on the application;* either the:

- *slant distance* – the actual distance,

Example 11: Road No. 2 has a stop sign at 390 feet from NAL No. 2. There is also a road gradient of 4 percent. No heavy trucks are allowed on this road, but a schedule shows an average of 12 large buses pass along the road per hour between 7 a.m. and 10 p.m., although no buses are scheduled during the remaining nighttime period. The buses are equally divided in each direction along the road. (Remember large buses, those that carry over 15 seated passengers, count as heavy trucks.)

We find the ADT for the "heavy trucks" (the buses in this case) by multiplying the average number of vehicles per hour by the number of hours between 7 a.m. and 10 p.m. That is, 12 x 15 = 180, or 90 vehicles in each direction. We find from Table 6 that the gradient adjustment factor for uphill traffic is 2.0. We find the truck volume adjusted for gradient is

uphill: $90 \times 2.0 = 180$
downhill: $= 90$
total (column 21) $= 270$ *vehicles*

From Table 8, we find the adjustment factor for stop-and-go traffic to be 1.8.

We also remember that we have no buses in the nighttime period and find the factor in Table 5 on page 8 for zero nighttime operations to be 0.43.

Our final adjusted ADT is (column 24)

$1.8 \times 0.43 \times 270 = 209$ *Vehicles*

From Workchart 2, with an effective distance of 174 feet, we find a DNL of 59 dB.

Example 12a: Road No. 3 is a depressed highway and the profile shields all residential levels of the housing from line of sight to the traffic. The average truck speed is 50 mph. The ADT for heavy trucks is 4400 vehicles. We adjust for average speed (from Table 7)

$4400 \times 0.81 = 3564$

and find from Workchart 2 that, with an effective distance of 270 feet, the DNL from truck noise would be 69 dB if no barrier existed. We proceed to analyze the barrier attenuation.

measured along the line of sight between two points; or the

- *map distance* – the actual distance, measured on a horizontal plane, between the two points, as on a map or on the project plan.

For an observer high in an apartment tower, the slant distance to the road may be much longer than the map distance.

Barrier effectiveness is expressed in terms of noise attenuation in decibels (dB), determined with the aid of Workchart 6. This numerical value is subtracted from the previously calculated DNL in order to find the resultant DNL at the Noise Assessment Location.

Note: A noise barrier can be considered as a means of protecting a site from noise even if it cannot wrap around the site to shield from view practically all of the source of noise at every sensitive location on the site. It must be recognized, however, that such a barrier is much less effective than an ideal barrier. (See Workchart 7 and Step 6 below.)

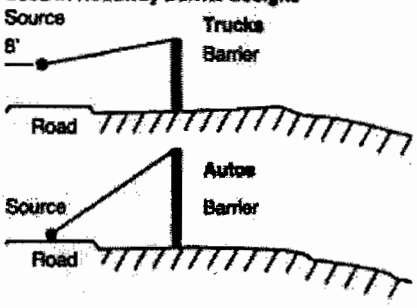
Barriers of reasonable height cannot be expected to protect housing more than a few stories above ground level. Barriers will generally protect the ground and the first two or three floors, but not the higher floors. If there are to be frequently occupied balconies on the upper levels, one solution is to move the building farther from the noise source and face the sensitive areas away from the noise.

Steps to Evaluate a Barrier

1. For the observer's position, use the mid-height of the highest residential level. For the source position, use the following heights (see Figure 7):

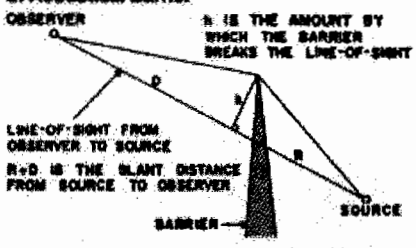
- autos, medium trucks, railway cars – the road or railway surface height
- heavy trucks – 8 feet above the road surface
- diesel locomotives or trains using horns or whistles at grade crossings – 15 feet above the rails.

Figure 7.
Source Heights to Be Used in Roadway Barrier Designs



Get accurate values for the following quantities: h, the shortest distance from the barrier top to the line of sight from source to observer; R and D, the slant distances along the line of sight from the barrier to the source and observer, respectively (see Figure 8).

Figure 8.
Generalized Geometry of Acoustical Barrier



Specifically, R and D are the two segments into which h breaks the line of sight. Note that h is *not* the height of the barrier above the ground but the distance from the barrier top to the line of sight.

2. Enter at the top of Workchart 6 with the value of h on the left-hand scale; move right to intersect the curve corresponding to R (or D, whichever is *smaller*).

3. Move down to intersect the curve corresponding to the value of D/R (or R/D, whichever is *smaller*).

4. Move right to intersect the vertical scale in order to find the barrier shielding value A in decibels.

5. Interruption of the line of sight with a barrier between the noise source and an observer reduces the amount of sound attenuation provided by the ground. Find the amount of this loss B from the table on Workchart 6 by entering the table with the value of D/R. Find the barrier attenuation value S corresponding to an ideal barrier that completely hides the noise source from view by subtracting B from the value of A obtained in Step 4.

6. If the barrier exists along only a part of the road so that unshielded sections of the road would be visible from the site, the barrier is less effective than an ideal barrier. On a plan view of the site, locate the two ends of the barrier and draw lines from these points to the Noise Assessment Location. Use a protractor to measure the angle formed at the NAL by the two lines. Enter the horizontal scale of Workchart 7 with the values of this angle; read up to the curve having the value of S determined from Step 5 (interpolating if necessary); read left across to the vertical scale labeled "actual barrier performance" to find the value of FS to use for the actual barrier in question.

7. Subtract the barrier attenuation value S (or FS if adjusted for finite barrier length according to Workchart 7) from the value of DNL previously determined to reevaluate the site with the noise barrier in place.

Example 12b: (Refer to Figure 9.) Six stories are planned for the housing where the site has an elevation of 130 feet. The effective elevation for the highest story is found by multiplying the number of stories by 10 feet, adding the site elevation, and subtracting 5 feet.

(6 × 10) + 130 - 5 = 185 feet

The barrier, which in this case is formed by the road profile, has no "height" other than the elevation of the natural terrain above the noise sources traveling on the roadway. The important dimensions are indicated in Figure 9.

Some people with a technical background will be able to fit the geometric diagram to the site situation readily, working from the project drawings and a scratch sheet.

But if you are *not* confident of your geometry, Workchart 5 gets you the values of R, D, and h from the map distances and elevations of the site. We illustrate that procedure in this example.

First, enter the elevations of the source (S), the observer (O), and the top of the barrier (H), as well as the map distances from the barrier to the source (R') and observer (D'), at the top right of Workchart 5. Then, follow the steps on that Workchart to derive the values of h, R, and D that are needed in using Workchart 6.

Entering Workchart 6 at the upper left with the value of h (5.5 feet), we move horizontally

Figure 9.
Detail of Site Showing Measurements Necessary for a Barrier Adjustment

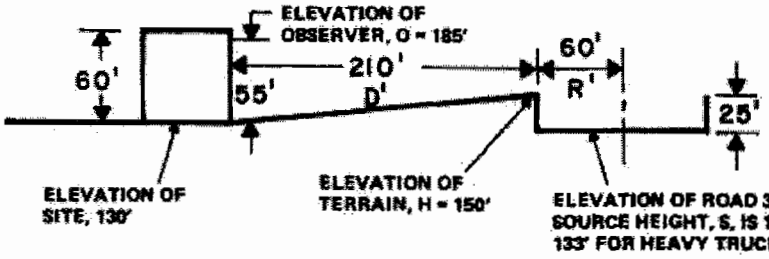


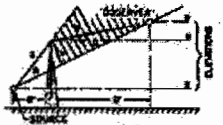
Figure 10.
Use of Workchart 5 to Determine Barrier Dimensions in Example 12b

Workchart 5
Noise Barrier

To find R, D and h from Site Elevations and Distances

Fill out the following worksheet (all quantities are in feet)

Enter the values for:
H= 150 R= 60
S= 133 D= 210
O= 185



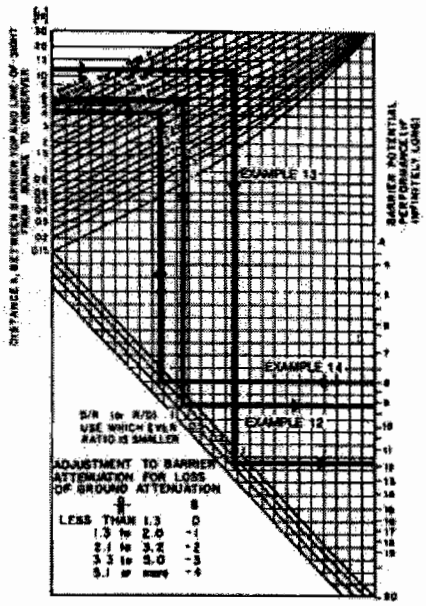
1. Elevation of barrier top minus elevation of source	[1 150] −	[2 133]	= [3 17]
2. Elevation of observer minus elevation of source	[4 185] −	[5 133]	= [6 52]
3. Map distance between source and observer (R + D)			[7 270]
4. Map distance between barrier and source (R)			[8 60]
5. Line 2 divided by line 3	[9 52] ÷	[10 270]	= [11 0.19]
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[12 0.19] ×	[13 0.19]	= [14 0.04]
7. 40% of line 6	[0.4] ×	[15 0.04]	= [16 0.016]
8. One minus line 7	[1.0] −	[17 0.016]	= [18 0.984]
9. Line 5 times line 4 (will be negative if line 3 is negative)	[19 0.19] ×	[20 60]	= [21 11.4]
10. Line 1 minus line 9	[22 17] −	[23 11.4]	= [24 5.6]
11. Line 10 times line 8	[25 5.6] ×	[26 0.984]	= [27 5.5] = A
12. Line 5 times line 10	[28 0.19] ×	[29 5.6]	= [30 1.06]
13. Line 4 divided by line 8	[31 60] ÷	[32 0.984]	= [33 61]
14. Line 13 plus line 12	[34 61] +	[35 1.06]	= [36 62] = R
15. Line 3 minus line 4	[37 270] −	[38 60]	= [39 210]
16. Line 15 divided by line 8	[40 210] ÷	[41 0.984]	= [42 213]
17. Line 16 minus line 12	[43 213] −	[44 1.06]	= [45 212] = D

(Note: the value on line 2 may be negative, in which case so will the values on lines 5,9, and 12; line 1 may also be negative. Remember, when, in lines 10, 14, and 17, first adding a negative number is the same as subtracting: x + (−y) = x − y. And subtracting a negative number is the same as adding: x − (−y) = x + y.)

Round off R and D to nearest integer. A to one decimal place.

Figure 11.
Use of Workchart 6 to Evaluate Barrier in Examples 12b, 13 and 14

Noise Barrier Workchart 6



to the right until we meet the value of R or D, whichever is smaller: in this example, R = 62 feet. From that point we drop vertically downward until we meet the value of R/D or D/R, whichever is smaller: in this case, R/D = 0.29. From that point, move horizontally to the right to find the value for A = 9 dB. Entering the table for determining loss of ground attenuation effect due to the barrier with a value for D/R of 3.5, the reduction in attenuation (B) is found to be 3 dB. Substracting 3 dB from 9 dB provides a net attenuation of 6 dB. With 6 dB of attenuation, the original DNL of 69 dB (Example 12a) is reduced to 63 dB.

Example 13: An alternative approach, which is somewhat more direct, is illustrated here for the noise of automobiles on Road No. 3.

A preliminary step is to make an accurately scaled sketch of the general geometry introduced on page 8. It must include the positions of the source (this time at the road surface), the observer, and the top of the barrier; and will show the distances h, R, and D. Such a sketch is shown superimposed on the profile of the road and its neighborhood in Figure 12.

If we carefully scale the dimensions directly from this sketch, we find the following values for h, R, and D:

R=63 feet

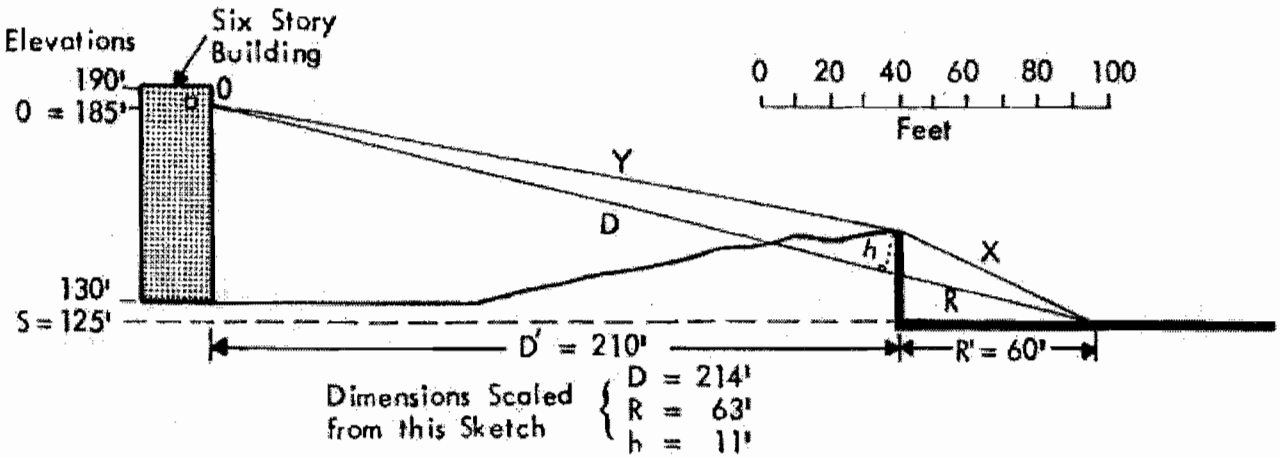
R/D=0.3

D=214 feet

h=11 feet

The barrier attenuation is found, by entering Workchart 6 with these values, to be A=12 dB. It is larger than that found for trucks because the noise source is lower and is, therefore, better shielded by the barrier. The loss from ground attenuation is again B=3 dB for a net attenuation of 12 - 3 = 9 dB. In Example 9b, we found that the DNL

Figure 12.
Sketch Showing Dimensions for Example 13



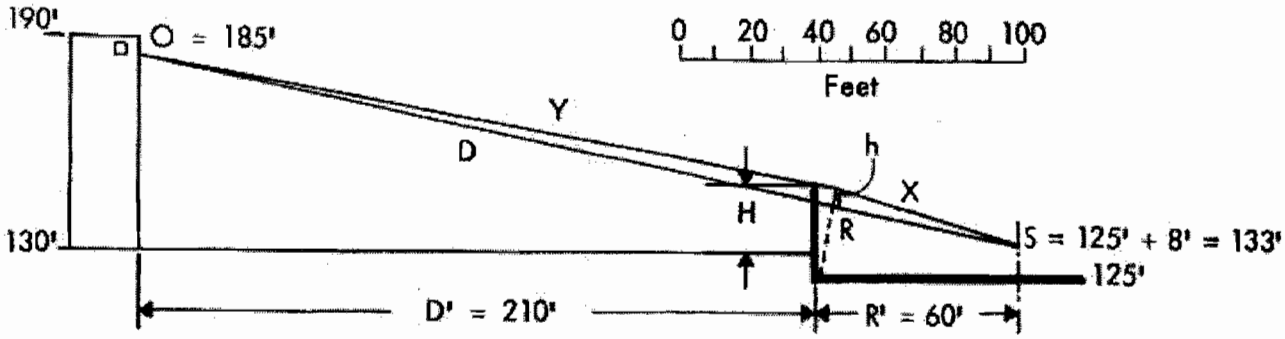
for the projected traffic volume of 100,000 vehicles per day was 69 dB if no consideration was given the shielding provided by the terrain. Subtracting the 9 dB attenuation from 69, we find the partial DNL for automobiles is 60 dB.

In order to find the combined truck and automobile noise for Road No. 3, we combine the 63 dB of truck noise with the 60 dB of automobile noise using Table 1. We find that 1.8 should be added to 63 dB, for a combined DNL of 64.8 dB, or 65 dB when rounded to the nearest whole number.

Example 14: Where no natural barrier exists, Workchart 6 can be used in reverse to estimate the height of a barrier needed to obtain a required attenuation. In example 9b we found that, without any attenuation from terrain or a barrier, the automobile traffic produced a DNL of 69 dB, and in Example 12a the heavy truck traffic produced a DNL of 69 dB. When combined, the total DNL is 72 dB. Suppose the terrain were not rising between NAL and Road No. 3, as shown in Figure 12, but instead was level between the NAL and the edge of the road, as shown in Figure 13. We want to find out how high a wall, infinite in length, would be required at the edge of the road to reduce the combined truck and automobile noise to less than 65 dB. We have found in the previous examples that a barrier of a given height will provide more attenuation for automobiles than it will for trucks. As a first step in our analysis, we will find the height of a wall that will reduce the truck noise to just below 65 dB, say 64 dB, and then find out whether the additional attenuation it provides for automobile noise will be sufficient to reduce the combined truck and automobile noise to less than 65 dB. We begin by finding the height of wall that will provide 5 dB attenuation for truck noise.

We estimate that the ratio of R/D is about the same as R'/D', the ratio of horizontal distance in Figure 13, which is equal to 0.29. Before entering Workchart 6, we find from the loss of ground attenuation table that for D/R = 3.4 we will lose 3 dB attenuation from an ideal barrier. In order to have a net attenua-

Figure 13.
Sketch Showing Dimensions for Example 14



tion of 5 dB, we must have an ideal barrier that provides 5 + 3 = 8 dB attenuation.

Entering Workchart 6 on the right side scale A at 8 decibels, we move across to the diagonal lines, finding 0.29 by interpolating between the lines marked at 0.2 and 0.5. Moving directly up to a point midway between the R lines of 50 and 70, we find our estimated R of approximately 60. Moving across to the left we find that the line of sight between the observer and the truck source height must be broken by a value of h equal to 4.5 feet.

We can determine the height of the wall H in several ways. By drawing h=4.5 feet to scale on Figure 13, we can scale the total wall height H to be approximately 20 feet. Those who feel comfortable with geometry can calculate H by using the similar triangle relationships in Figure 13 to determine that H is 19.1 feet.

Now we must find how much a wall 19 feet high will attenuate automobile noise, remembering that the source height for automobiles is at the road surface elevation of 125 feet. By scaling the drawing, or by geometry, we determine that the line of sight between the observer position and the automobile source is broken by a value of h that is approximately 13 feet. Entering Workchart 6 at 13 feet we find, for R=60 feet and R/D=0.29, that the potential barrier attenuation is 12dB. We must reduce this by 3 dB for loss of ground attenuation to find the actual shielding of automobile noise to be 9 dB. The original 69 dB of automobile noise is reduced to 69 - 9 = 60 dB.

Finally, we combine the heavy truck noise, attenuated by the wall to 69 - 5 = 64 dB, with the automobile noise reduced to 60 dB, to find a combined DNL of 65.5 dB, or 66 dB when rounded upward. Remember, however, that this is for an infinite wall. Further adjustments would have to be made once the actual length was known.

Railways

Necessary Information

To evaluate a site's exposure to railway noise, you will need to consider all rapid transit lines and railroads within 3000 feet of the site (except totally covered subways). The information required for this evaluation is listed below under headings that indicate the most likely source.

Before beginning the evaluation, you should record the following information on Worksheet D:

From the area map and/or the (County) Engineer:

- The distance from the appropriate NAL on the site to the center of the railway track carrying most of the traffic.

From the Supervisor of Customer Relations for the railway:

- The number of diesel trains and the number of electrified trains in both directions during an average 24-hour day.
- The fraction of trains that operate during nighttime (10 p.m. - 7 a.m.) If this is unknown, assume 0.15.
- The average number of diesel locomotives per train. If this is unknown, assume 2.
- The average number of railway cars per diesel train and per electrified train. If this is unknown, assume 50 for diesel trains and 8 for electrified trains.
- The average train speed. If this is unknown, assume 30 mph.
- Is the track made from welded or bolted rails?

From the Engineering Department of the railway:

- Is the site near a grade crossing that requires prolonged use of the train's horn or whistle? If so, where are the whistle posts located? (Whistle posts are signposts which tell the engineer to start blowing the horn or whistle. Every grade crossing has whistle posts and they are listed on the railroad's "track charts." If traffic on the track is one-way, there will be only one whistle post. The grade crossing itself is the other "whistle post."

Electrified rapid transit and commuter trains that do not use diesel engines should be treated the same as railway cars.

Note: Buildings closer than 100 feet to a railroad track are often subject to excessive vibration transmitted through the ground. Construction at such sites is discouraged.

Evaluation of Site Exposure to Railway Noise

Railway noise is produced by the combination of diesel engine noise and railway car noise. These Guidelines provide for the separate evaluation of diesel locomotives and railroad cars, and then the combination of the two, in order to obtain the DNL from trains. When rapid transit or electrified trains that do *not* use diesel engines are the only trains passing near a site go directly to the second part of the evaluation since these trains are treated in the same manner as railway cars.

Diesel Locomotives

Workchart 3 was derived with the following assumptions:

- A clear line of sight exists between the railway track and the Noise Assessment Location.
- There are two diesel locomotives per train.
- The average train speed is 30 mph.
- Nighttime operations are 0.15 of the 24-hour total.
- The site is not near a grade crossing requiring prolonged use of the train's horn or whistle.

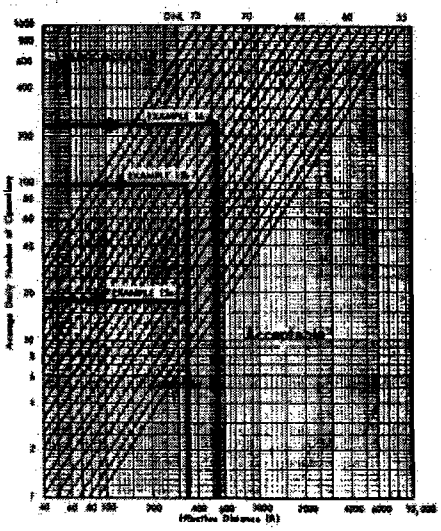
If the situation meets these conditions, proceed to Workchart 3 for an immediate evaluation of diesel locomotive noise.

But:

If any of the conditions is different, make the necessary adjustments listed below and *then* use Workchart 3 for the evaluation.

Figure 14.
Use of Workchart 3 to Evaluate Diesel Locomotive Noise

Railroads – Diesel Locomotives



Adjustments for Diesel Locomotives

Number of Locomotives:

If the average number of diesel locomotives per train is not 2, divide the average number by 2. Enter this value in column 9 of Worksheet D.

Example 15a: The distance from NAL number 1 to Railway Number 1 is 339 feet. Two percent of the 35 daily operations occur at night; there is clear line of sight between the tracks and the NAL, and no horns or whistles are used. No information is available on train size or speed, therefore we will assume 2 engines per train and a speed of 30 mph.

Since the percentage of nighttime operations is different from 15 percent, we must adjust the actual number of daily operations, multiplying by 0.50 according to Table 5.

$0.50 \times 35 = 17.5 = 18$

Entering Workchart 3 with 18 daily operations and a distance of 339 feet, we find that the contribution of diesel engine noise is a DNL of 59 dB (see Figure 14).

In order to find the total contribution of the trains to the total DNL, we must also find the noise level produced by the train's cars. Entering Workchart 4 (see Figure 15) with 18 daily operations and a distance of 339 feet, we find the DNL is below 50 on the chart, or more than 10 decibels lower than the noise level produced by the engines. Based on the chart for decibel addition, the combination of the noise from the engines and the cars adds less than 0.5 decibels to the DNL value for the engines alone, 59 dB.

Example 15b: Suppose that a forecast of train operations for Railway 1 indicates that there will still be 35 trains per day, but now 50 percent of the operations will occur at night, the average train will have 4 engines and 75 cars, and the average speed will be 50 mph.

We first find the contribution to DNL made by diesel locomotives by using the following adjustment factors:

- number of engines adjustment: 2
- speed adjustment: 0.60
- day/night adjustment: 2.34

We multiply these adjustments together with the number of trains:

$2 \times 0.60 \times 2.34 \times 35 = 98$

Entering Workchart 3 (see Figure 14) with 98 daily operations and a distance of 339

Average Train Speed:

If the average train speed is different from 30 mph, find the appropriate adjustment factor from Table 9 and list in column 10 of Worksheet D.

Table 9

Average Speed (mph)	Speed Adjustment Factor
10	3.00
20	1.50
30	1.00
40	0.75
50	0.60
60	0.50
70	0.43

Horns or Whistles:

If the NAL is perpendicular to any point on the track between the whistle posts for the grade crossing, enter the number 10 in column 11, Worksheet D.

Nighttime Adjustment:

Remember to adjust for nighttime operations, if different from 0.15 of the total, by selecting the appropriate adjustment factor from Table 5 on page 8. Enter in column 12, Worksheet D.

Multiply the adjustment factors together, times the number of diesel trains per day (you have listed this number previously on line 2a, page 1, of Worksheet D, and should enter this number again in column 13) to obtain the adjusted number of trains per day. Enter the adjusted number of diesel trains per day in column 14. Use this value, in conjunction with the distance from the NAL to the track (line 1, page 1, of Worksheet D), to find from Workchart 3 the DNL produced by diesel locomotives. List in column 15 of Worksheet D.

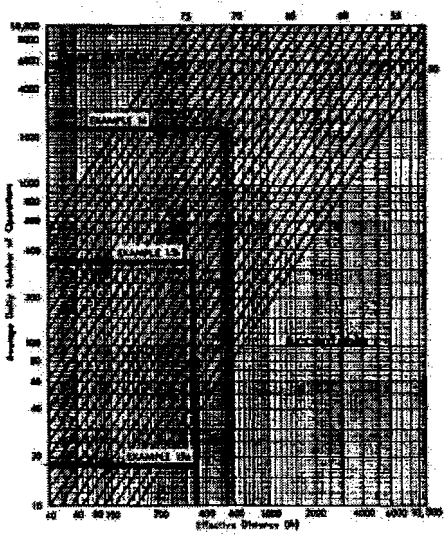
Railway Cars and Rapid Transit Systems

Workchart 4 was derived with the following assumptions:

- A clear line of sight exists between the railway and the NAL.
- There are 50 cars per train.
- The average train speed is 30 mph.
- Nighttime operations are 0.15 of the 24-hour total.
- Rails are welded together.

If the situation meets these conditions, proceed to Workchart 4 for an immediate evaluation of railway car noise. Again, if any of the conditions is different, make the necessary adjustments listed below and then use Workchart 4 for the evaluation.

Figure 15.
Use of Workchart 4 to Evaluate Railway Car Noise



Adjustments for Railway Cars and Rapid Transit Trains

Number of Cars:

Divide the average number of cars by 50 and enter this number in column 18 of Workchart D.

Average Speed:

Make this adjustment, if the average speed is not 30 mph, by selecting the appropriate value from Table 10, entering it in column 19 of Worksheet D.

Table 10

Average Speed (mph)	Speed Adjustment Factor
10	0.11
20	0.44
30	1.00
40	1.78
50	2.78
60	4.00
70	5.44
80	7.11
90	9.00
100	11.11

Bolted Rails:

Enter the number 4 in column 20 of Worksheet D.

Nighttime Adjustment:

Enter the appropriate adjustment factor from Table 5 in column 21 of Worksheet D.

---

feet, we find that the site has an engine noise contribution to DNL of 66 dB.

We next obtain the adjustment factors for the noise produced by the cars:

- number of cars adjustment: 1.50
- speed adjustment: 2.78
- day/night adjustment: 2.34

Multiplying the adjustment factors times the average daily number of trains:

1.5 X 2.78 X 2.34 X 35 = 342

Entering Workchart 4 (see Figure 15) with 342 operations and a distance of 339 feet, we find the contribution of the cars to the DNL is 60 dB. Using Table 1 for combining levels, we find that the 6 dB difference between engine noise at 66 and car noise at 60 gives a combined DNL of 67 dB for these trains.

Example 16: The distance from NAL number 2 to Railroad Number 2 is 550 feet; there are 100 operations per day, of which 30 percent occur at night. A clear line of sight exists between the site and the railroad, and no horns or whistles are used nearby. An average train on this track uses 4 engines, has 100 cars, the average speed is 40 miles per hour, and the track has bolted, not welded, rails.

We first find the adjustment factors for the diesel engines:

- number of engines adjustment: 2
- speed adjustment: 0.75
- day/night adjustment: 1.57

Multiplying the adjustments together, times the number of trains:

2 X 0.75 X 1.57 X 100 = 236

Entering Workchart 3 (see Figure 14) with 236 operations at a distance of 550 feet, we find the DNL contribution from engine noise to be 67 dB.

Next we find the adjustment factors for the railroad cars:

- number of cars adjustment: 2
- speed adjustment: 1.78
- bolted track adjustment: 4
- day/night adjustment: 1.57

Multiplying the adjustments together, times the number of trains:

2 X 1.78 X 4 X 1.57 X 100 = 2236

Entering Workchart 4 (see Figure 15) with

(Continued next page)

Figure 16.
Sketch Showing Dimensions for Example 16

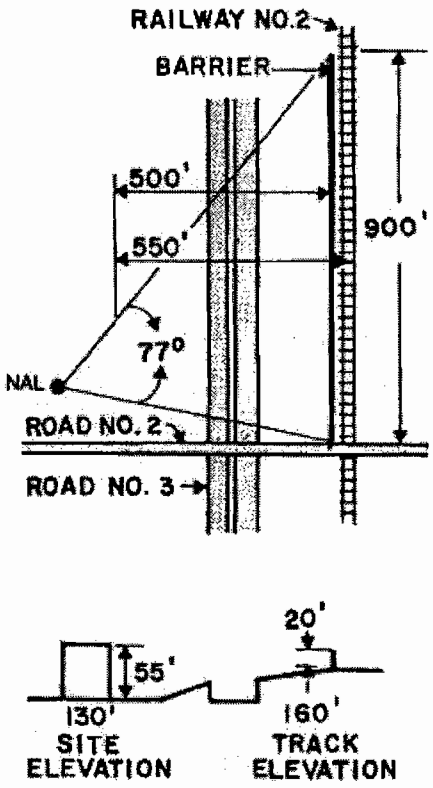


Figure 17.
Use of Workchart 6 in Example 16

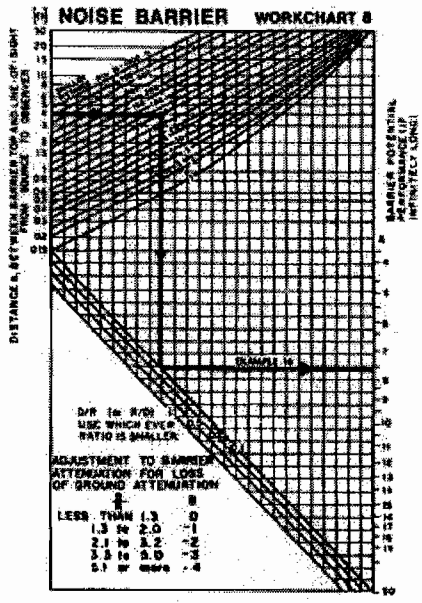
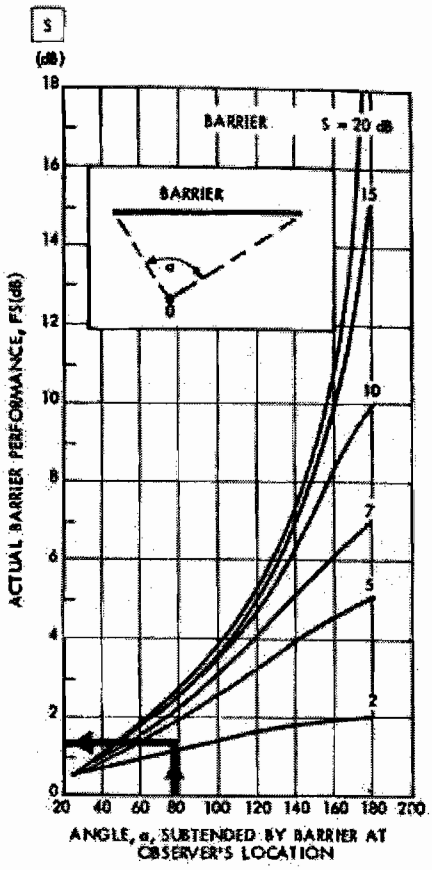


Figure 18.
Use of Workchart 7 in Example 16



2236 operations at a distance of 550 feet, we find the DNL contribution from the railroad cars to be 65 dB. Combining the engine sound levels with the car sound levels we find the total DNL from the trains to be 69 dB.

It would be possible to erect a 20-foot noise barrier, running parallel to the track at a distance of 50 feet; it could start at Road Number 2 and run 900 feet north toward the airport, as shown in Figure 16. Both the railroad track and the ground level at the barrier location are at an elevation of 160 feet. Thus, we have the following values with which to calculate the potential reduction in engine noise (using Workchart 5). (Because the distances involved are so unequal, this situation does not lend itself to direct scaling of the distances.)

H = 180 feet (20' above the ground)

S = 175 feet (15' above the track, see page 19)

0 = 285 feet (from Example 11 in the section on roadway noise)

R' = 50 feet

D' = 500 feet

We find from Worksheet 5 that the values of R and D are no different (within the accuracy of the calculation) from R' and D', a situation that will always occur when the differences in elevation are so much smaller than the distances from the site to the noise source. The value of h is 4 feet; R/D = 0.1

We can now use these numbers to enter Workchart 6 to find the *potential* barrier performance (that is, the barrier adjustment factor that would apply in the case of an infinitely long barrier). Entering Workchart 6 at h = 4 feet, with R/D = 0.1, we find the basic attenuation of the barrier to be 7.5 dB. However, with D/R = 10, we find from the table of loss-of-ground-effect attenuation that we must subtract 4 dB from the 7.5, or a net effect of 3.5 dB. However, the situation is even worse, since the barrier is finite in length.

To find the actual attenuation for this *finite* barrier, we must first find the angle subtended by the barrier to the NAL. Referring to Figure 16, we draw lines from the NAL each end of the barrier. With

References

1. D.E. Bishop, A.P. Hays, "Handbook for Developing Noise Exposure Contours for General Aviation Airports," FAA-AS-75-1, December 1975 (NTIS No. AD-A023429).

2. D.E. Bishop, et al., "Calculation of Day-Night Levels Resulting From Civil Aircraft Operations," BBN Report 3157 for Environmental Protection Agency, March 1976 (NTIS No. PB 266 165).

3. B.A. Kugler, D.E. Commins, W.J. Galloway, "Highway Noise – A Design Guide for Prediction and Control," NCHRP Report 174, Transportation Research Board, National Research Council, 1976.

4. T.J. Schultz, W.J. Galloway, "Noise Assessment Guidelines – Technical Background," Office of Policy Development and Research, U.S. Department of Housing and Urban Development," 1980.

5. M.A. Simpson, "Noise Barrier Design Handbook," FHWA-RD-76-58, Federal Highway Administration, February 1976 (NTIS No. PB 266 378).

a protractor we measure the angle between the two lines to be 77 degrees. Locate the curve on Workchart 7 corresponding to the potential barrier attenuation of 3.5 dB; it lies midway between the two lowest curves (see Figure 18). The point on this curve corresponding to a subtended angle of 77 degrees indicates that the actual barrier performance would be only 1.5 dB. With only 1.5 dB of attenuation, the barrier is clearly not cost-effective. In order to achieve a usable attenuation from the barrier, it would have to be extended beyond the other side of Road Number 2 to obtain a larger subtended angle. This extension, however, would still not be cost-effective unless the height of the barrier were increased substantially.

Summary of Adjustment Factors

Combination of Sound Levels

Table 1

Difference in Sound Level	Add to Larger Level
0	3.0
1	2.5
2	2.1
3	1.8
4	1.5
5	1.2
6	1.0
7	0.8
8	0.6
9	0.5
10	0.4
12	0.3
14	0.2
16	0.1
greater than 16	0.

Aircraft

Table 2 DNL Outside 65 dB Contour

D^1=distance from 65 dB contour to flight path
D^2=distance from site to flight path

D2 / D1	DNL dB
1.0	65
1.12	64
1.26	63
1.41	62
1.58	61
1.78	60
2.00	59
2.24	58
2.51	57
2.82	56
3.16	55

Automobile Traffic

Table 3 Stop-and-go

Distance from Site to Stop Sign feet	Automobile Stop-and-go Adjustment Factor
0	0.10
100	0.25
200	0.40
300	0.55
400	0.70
500	0.85
600	1.00

Table 4 Average Traffic Speed

Average Traffic Speed	Adjustment Factor
20 (mph)	0.13
25	0.21
30	0.30
35	0.40
40	0.53
45	0.67
50	0.83
55	1.00
60	1.19
65	1.40
70	1.62

Table 5 Nighttime (applies to all sources)

Nighttime Fraction of ADT	Nighttime Adjustment Factor
0	0.43
0.01	0.46
0.02	0.50
0.05	0.62
0.10	0.81
0.15	1.00
0.20	1.19
0.25	1.38
0.30	1.57
0.35	1.78
0.40	1.96
0.45	2.15
0.50	2.34

Medium Trucks

(less than 26,000 pounds, greater than 10,000 pounds)

Multiply adjusted automobile traffic by 10.

Heavy Trucks

Table 6 Road Gradient

Percent of Gradient	Adjustment Factor
2	1.4
3	1.7
4	2.0
5	2.2
6 or more	2.5

Table 7 Average Speed

Average Traffic Speed (mph)	Truck Speed Adjustment Factor
50 or less	0.81
55	1.00
60	1.17
65	1.38

Table 8 Stop-and-go

Heavy Truck Traffic Volume per Day	Heavy Truck Stop-and-Go Adjustment Factor
Less than 1200	1.8
1201 to 2400	2.0
2401 to 4800	2.3
4801 to 9600	2.8
9601 to 19,200	3.8
More than 19,200	4.5

Railroads - Diesel Engines

Number of Engines per Train
The number of engines divided by 2.

Table 9 Average Train Speed

Average Speed (mph)	Speed Adjustment Factor
10	3.00
20	1.50
30	1.00
40	0.75
50	0.60
60	0.50
70	0.43

Whistles or horns
Multiply number of trains by 10.

Railroads - Cars and Rapid Transit

Numbers of cars.
Number of cars per train divided by 50.

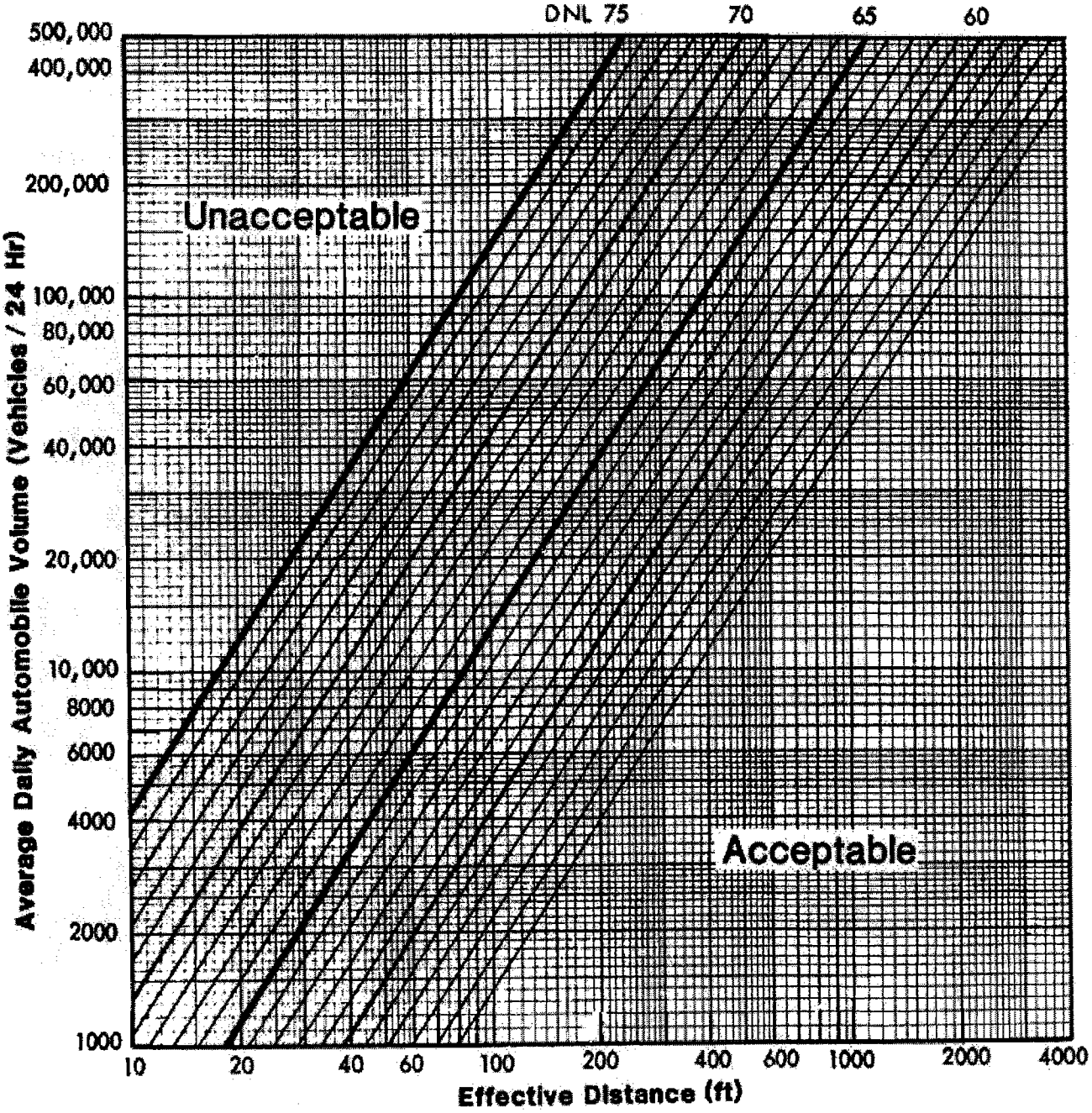
Table 10 Average Train Speed

Average Speed (mph)	Speed Adjustment Factor
10	0.11
20	0.44
30	1.00
40	1.78
50	2.78
60	4.00
70	5.44
80	7.11
90	9.00
100	11.11

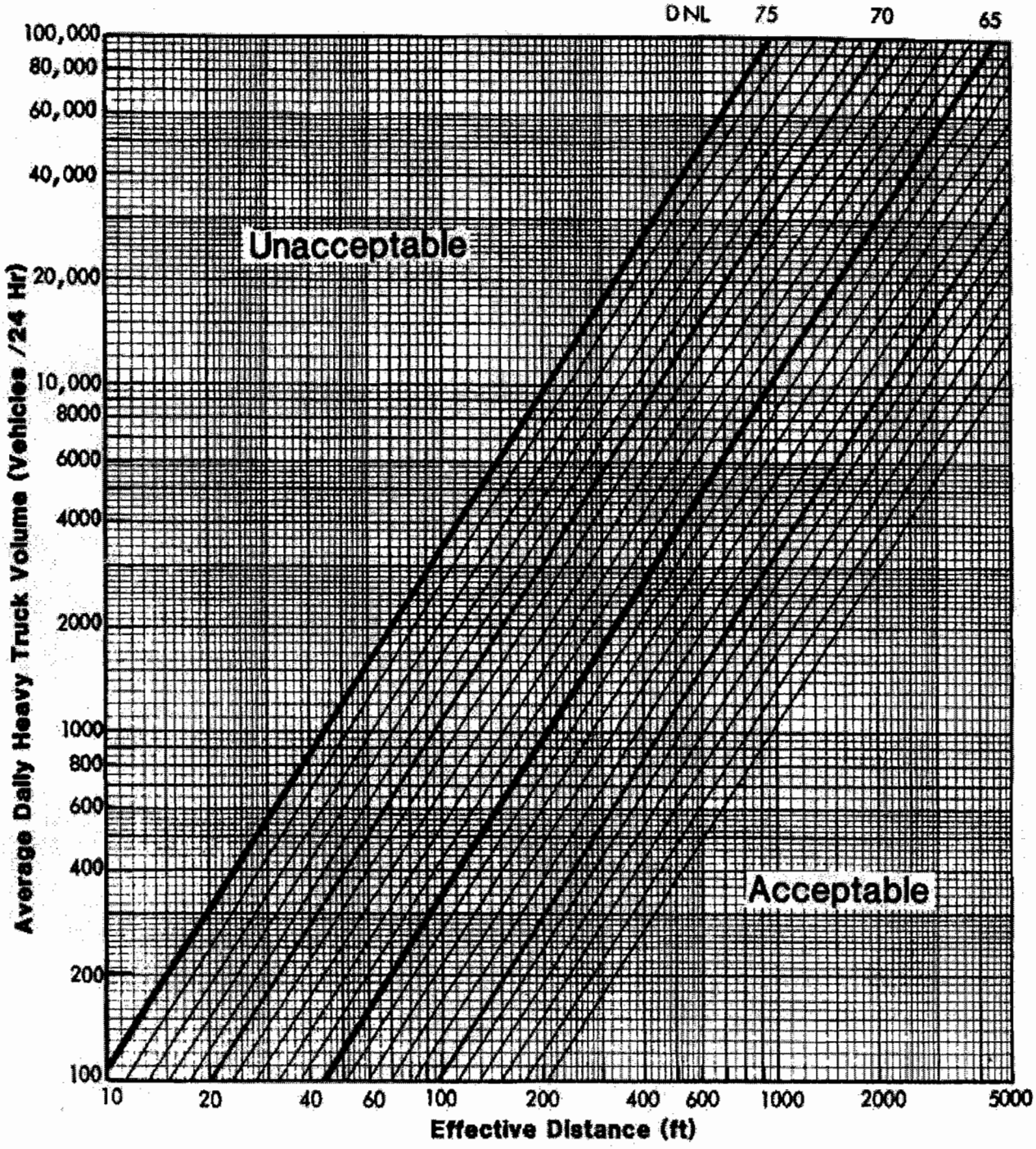
Bolted Rails
Multiply number of trains by 4.

Whistles or Horns
Multiply number of trains by 100.

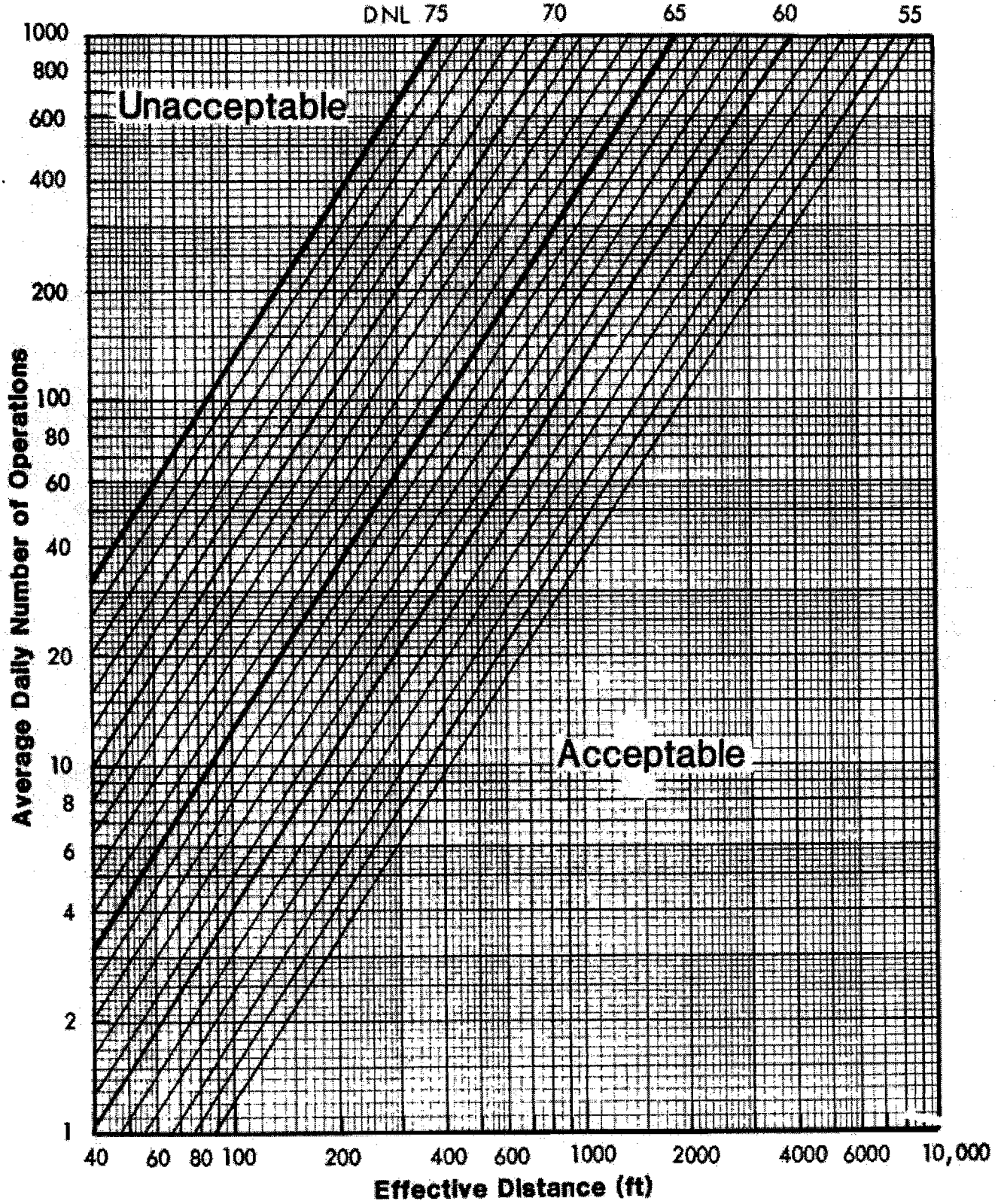
Workchart 1
Autos (55 mph)



Workchart 2
Heavy Trucks (55 mph)



Workchart 3
Railroads - Diesel Locomotives



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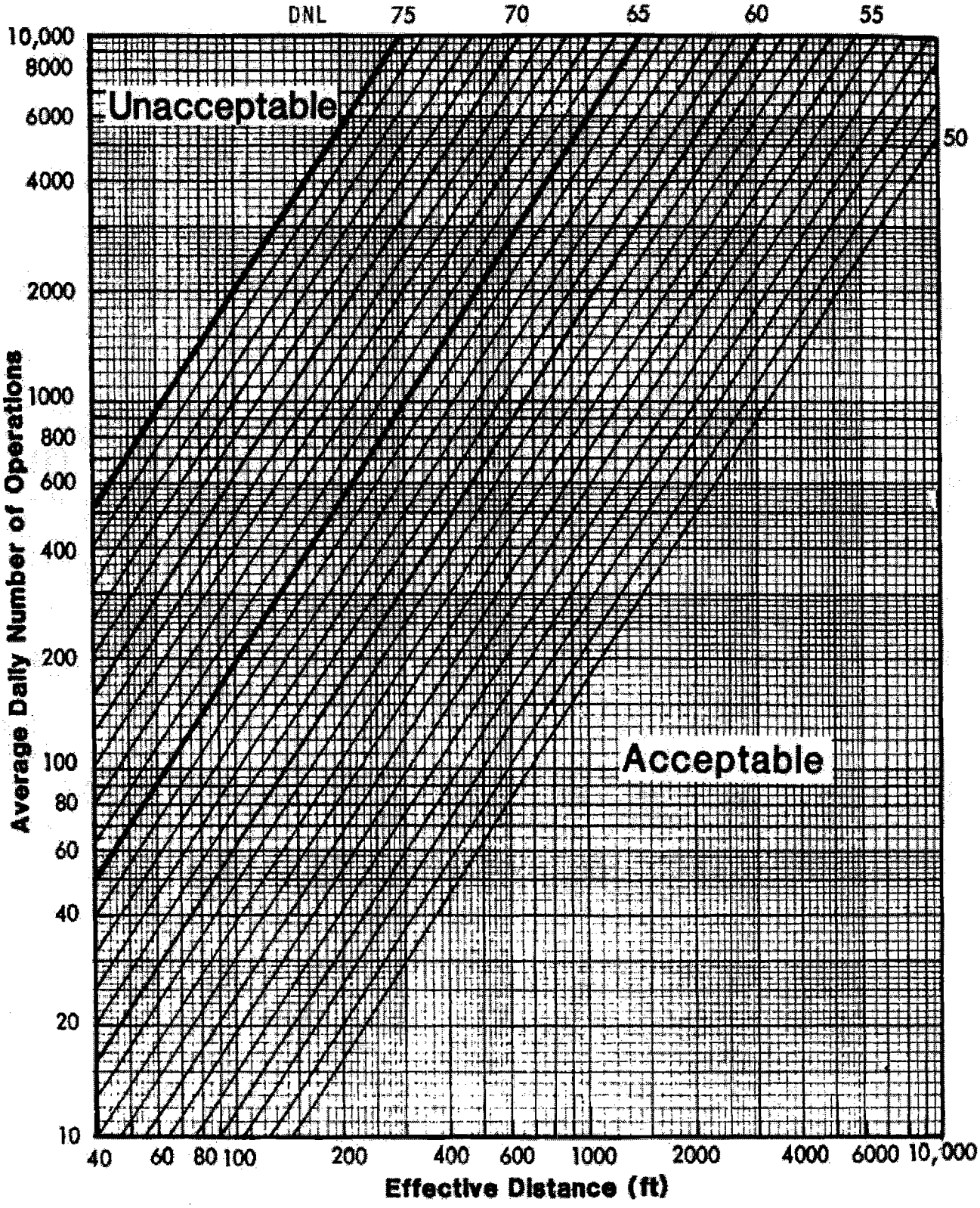
Workchart 4
Railroads - Cars and Rapid Transit



Workchart 5
Noise Barrier

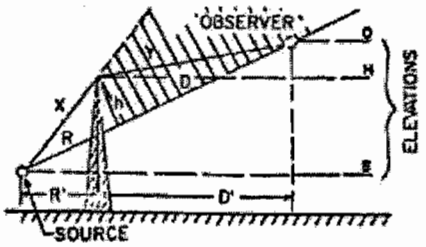
To find R, D and h from Site Elevations and Distances

Enter the values for:

H=_____ R'=_____

S=_____ D'=_____

O=_____



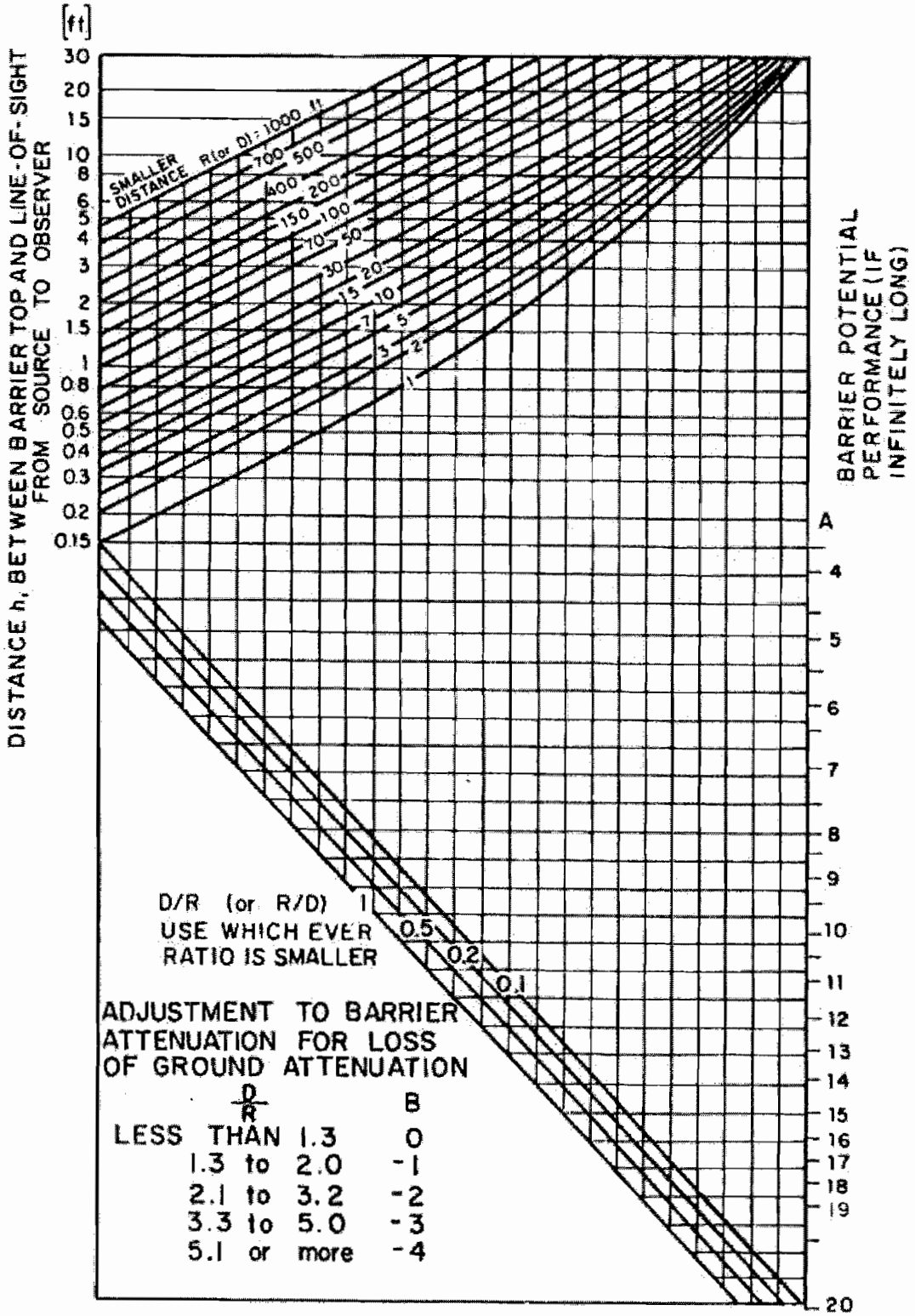
Fill out the following worksheet (all quantities are in feet):

1. Elevation of barrier top minus elevation of source	[H	]	−	[S	]	=	[1	]	
2. Elevation of observer minus elevation of source	[O	]	−	[S	]	=	[2	]	
3. Map distance between source and observer (R' + D')						=	[3	]	
4. Map distance between barrier and source (R')						=	[4	]	
5. Line 2 divided by line 3	[2	]	÷	[3	]	=	[5	]	
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[5	]	×	[5	]	=	[6	]	
7. 40% of line 6	[0.4	]	×	[6	]	=	[7	]	
8. One minus line 7	[1.0	]	−	[7	]	=	[8	]	
9. Line 5 times line 4 (will be negative if line 2 is negative)	[5	]	×	[4	]	=	[9	]	
10. Line 1 minus line 9	[1	]	−	[9	]	=	[10	]	
11. Line 10 times line 8	[10	]	×	[8	]	=	[11	]	= h
12. Line 5 times line 10	[5	]	×	[10	]	=	[12	]	
13. Line 4 divided by line 8	[4	]	÷	[8	]	=	[13	]	
14. Line 13 plus line 12	[13	]	+	[12	]	=	[14	]	= R
15. Line 3 minus line 4	[3	]	−	[4	]	=	[15	]	
16. Line 15 divided by line 8	[15	]	÷	[8	]	=	[16	]	
17. Line 16 minus line 12	[16	]	−	[12	]	=	[17	]	= D

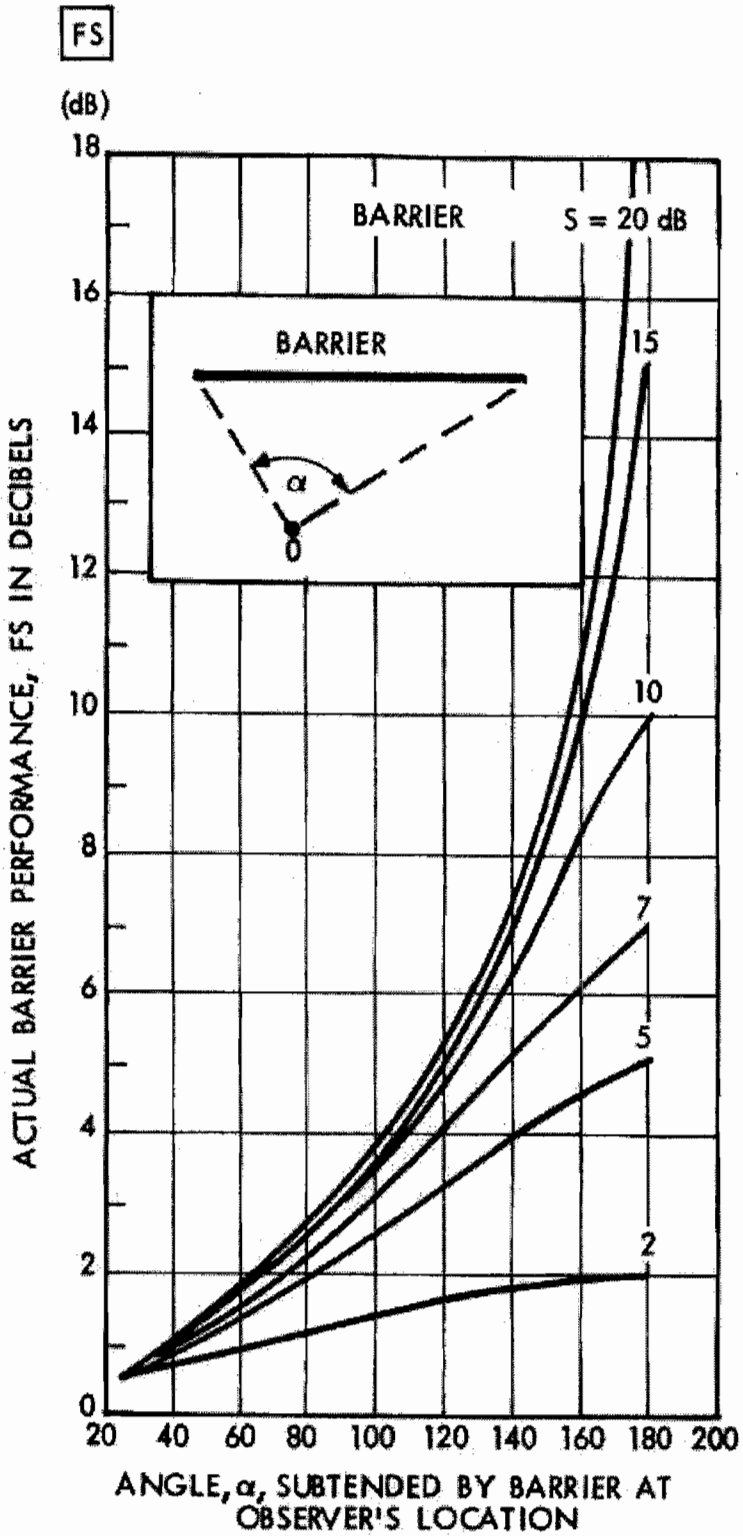
[**Note:** the value on line 2 may be negative, in which case so will the values on lines 5,9, and 12; line 1 may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: x+(-y)=x-y. And subtracting a negative number is like adding: x-(-y)=x+y.

Round off R and D to nearest integer, h to one decimal place.

Workchart 6
Noise Barrier



Workchart 7



Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

Worksheet A
Site Evaluation

Site Location

Program

Project Name

Locality

File Number

Sponsor's Name Phone

Street Address City, State

	Acceptability Category	DNL	Predicted for Operations in Year
1. Roadway Noise			
2. Aircraft Noise			
3. Railway Noise			

Value of DNL for all noise sources: (see page 3 for combination procedure)

Final Site Evaluation (circle one)

Acceptable

Normally Unacceptable

Unacceptable

Signature _____ Date _____

Clip this worksheet to the top of a package containing Worksheets B-E and Workcharts 1-7 that are used in the site evaluations

List all airports within 15 miles of the site:

1. _____

2. _____

3. _____

Necessary Information:	Airport 1	Airport 2	Airport 3
1. Are DNL, NEF or CNR contours available? (yes/no)			
2. Any supersonic aircraft operations? (yes/no)			
3. Estimating approximate contours from Figure 3:			
a. number of nighttime jet operations			
b. number of daytime jet operations			
c. effective number of operations (10 times a + b)			
d. distance A for 65 dB			
70dB			
75 dB			
e. distance B for 65 dB			
70 dB			
75 dB			
4. Estimating DNL from Table 2:			
a. distance from 65 dB contour to flight path, D^1			
b. distance from NAL to flight path, D^2			
c. D^2 divided by D^1			
d. DNL			
5. Operations projected for what year?			
6. Total DNL from all airports			

Signed _____ Date _____

List all major roads within 1000 feet of the site:

1. _____

2. _____

3. _____

4. _____

Necessary Information	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane				
b. farthest lane				
c. average (effective distance)				
2. Distance to stop sign				
3. Road gradient in percent				
4. Average speed in mph				
a. Automobiles				
b. heavy trucks - uphill				
c. heavy trucks - downhill				
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles				
b. medium trucks				
c. effective ADT (a + (10xb))				
6. 24 hour average number of heavy trucks				
a. uphill				
b. downhill				
c. total				
7. Fraction of nighttime traffic (10 p.m. to 7 a.m.)				
8. Traffic projected for what year?				

Adjustments for Automobile Traffic

	9 Stop and-go Table 3		10 Average Speed Table 4		11 Night-Time Table 5		12 Auto ADT (line 5c)		13 Adjusted Auto ADT		14 DNL (Workchart 1)		15 Barrier Attenuation		16 Partial DNL
Road No. 1	_____	X	_____	X	_____	X	_____	=	_____		_____	–	_____	=	_____
Road No. 2	_____	X	_____	X	_____	x	_____	=	_____		_____	–	_____	=	_____
Road No. 3	_____	X	_____	X	_____	X	_____	=	_____		_____	–	_____	=	_____
Road No. 4	_____	X	_____	X	_____	X	_____	=	_____		_____	–	_____	=	_____

Adjustments for Heavy Truck Traffic

	17 Gradient Table 6		18 Average Speed Table 7		19 Truck ADT 2		20	21		22 Stop and-go Table 8		23 Night-Time Table 5		24 Adjusted Truck ADT		25 DNL (Work-chart 2)		26 Barrier Attn.		27 Partial DNL
Uphill	_____	X	_____	X	_____	=															
Road No. 1								Add	_____	X	_____	X	_____	=	_____		_____	–	_____	=	_____
Downhill			_____	X	_____	=															
Uphill	_____	X	_____	X	_____	=															
Road No. 2								Add	_____	X	_____	X	_____	=	_____		_____	–	_____	=	_____
Downhill			_____	X	_____	=															
Uphill	_____	X	_____	X	_____	=															
Road No. 3								Add	_____	X	_____	X	_____	=	_____		_____	–	_____	=	_____
Downhill			_____	X	_____	=															
Uphill	_____	X	_____	X	_____	=															
Road No. 4								Add	_____	X	_____	X	_____	=	_____		_____	–	_____	=	_____
Downhill			_____	X	_____	=															

Combined Automobile & Heavy Truck DNL

Road No. 1 _____ Road No. 2 _____ Road No. 3 _____ Road No. 4 _____ Total DNL for All Roads _____

Signature _____ Date _____

List All Railways within 3000 feet of the site:

1. _____

2. _____

3. _____

Necessary Information:	**Railway No. 1**	**Railway No. 2**	**Railway No. 3**
1. Distance in feet from the NAL to the railway track:			
2. Number of trains in 24 hours:			
a. diesel			
b. electrified			
3. Fraction of operations occuring at night (10 p.m. – 7 a.m.):			
4. Number of diesel locomotives per train:			
5. Number of rail cars per train:			
a. diesel trains			
b. electrified trains			
6. Average train speed:			
7. Is track welded or bolted?			
8. Are whistles or horns required for grade crossings?			

Adjustments for Diesel Locomotives

	9 No. of Locomotives / 2	10 Average Speed Table 9	11 Horns (enter 10)	12 Night-time Table 5	13 No. of Trains (line 2a)	14 Adj. No. of Opns.	15 DNL Workchart 3	16 Barrier Attn.	17 Partial DNL
Railway No. 1	____ X	____ X	____ X	____ X	____ =	____	____ –	____ =	____
Railway No. 2	____ X	____ X	____ X	____ X	____ =	____	____ –	____ =	____
Railway No. 3	____ X	____ X	____ X	____ X	____ =	____	____ –	____ =	____

Adjustments for Railway Cars or Rapid Transit Trains

	18 Number of cars / 50	19 Average Speed Table 10	20 Bolted Rails (enter 4)	21 Night-time Table 5	22 No. of Trains (Line 2a or 2b)	23 Adj. No. of Opns.	24 DNL Work-chart 4	25 Barrier Attn.	26 Partial DNL
Railway No. 1	____ X	____ X	____ X	____ X	____ =	____	____ –	____ =	____
Railway No. 2	____ X	____ X	____ X	____ X	____ =	____	____ –	____ =	____
Railway No. 3	____ X	____ X	____ X	____ X	____ =	____	____ –	____ =	____

Combined Locomotive and Railway Car DNL

Railway No. 1 _____ Railway No. 2 _____ Railway No. 3 _____ Total DNL for all Railways _____

Signature _____ Date _____

Chapter 6

A Workbook for the Noise Assessment Guidelines

Introduction

The following problems were prepared to give you the opportunity to practice the calculations and procedures described in the *Noise Assessment Guidelines*. Because it is so rarely used, we have not included any problems dealing with the aircraft noise procedure.

We have not reproduced the charts or tables from the *Guidelines* so you will need to have it at hand to do the problems.

Noise Assessment Guidelines Workbook

Problems

Problems 1 Through 7: Combining Sound Levels in Decibels

Calculate the Combined Sound Level for the Following Sets of Individual Levels:

1. 67 LDN
   61 LDN
   _____ Combined Level

2. 63 LDN
   63 LDN
   _____ Combined Level

3. 51 LDN
   68 LDN
   _____ Combined Level

4. 62 LDN
   65 LDN
   _____ Combined Level

5. 67 LDN
   72 LDN
   _____ Combined Level

6. 59 LDN
   63 LDN
   71 LDN
   _____ Combined Level

7. 73 LDN
   72 LDN
   61 LDN
   67 LDN
   _____ Combined Level

Problems 8 and 9: Calculating Effective Distance

Calculate the Effective Distances for the Following Roads:

8. Distance in Feet from NAL to:

Near Edge of Nearest Lane	22 Feet
Far Edge of Farthest Lane	76 Feet
Effective Distance	_____

9. Distance in Feet from NAL to:

Near Edge of Nearest Lane	60 Feet
Far Edge of Farthest Lane	84 Feet
Effective Distance	_____

Problems 10 Through 15: Adjustment Factors

List The Adjustment Factors Necessary for Each of the Following Situations and the Numerical Value for Each Adjustment Factor.

10. A Roadway Where the Road Gradient is 1%, the Average Speed for Both Autos and Trucks is 30 MPH and the Fraction of Nighttime Traffic is 10%.

    Adjustment Factors Needed: _____

    _____

    _____

    Value of Adjustment Factors: _____

    _____

    _____

11. A Roadway Where There is A Stop Sign 400 Feet from the NAL. The Gradient is 1%, the Average Speed for Autos is 45 MPH (There Are No Trucks) and the Fraction of Nighttime Traffic is 15%.

    Adjustment Factors Needed: _____

    _____

    _____

    Value of Adjustment Factors: _____

    _____

    _____

12. A Roadway Where the Road Gradient Is 2%, the Average Speed for Autos Is 50 MPH and for Trucks (Both Uphill and Downhill) Is 50 MPH and the Fraction of Nighttime Traffic Is 10%.

Adjustment Factors Needed: _____

_____

_____

Value of Adjustment Factors: _____

_____

13. A Railroad Where the Fraction of Operations Occurring at Night Is 30%, the Average Train Speed Is 40 MPH, the Track Is Bolted and There Are No Whistle Or Horns Required for Grade Crossings.

Adjustment Factors Needed: _____

_____

_____

Value of Adjustment Factors: _____

_____

_____

14. A Railroad Where the Fraction of Operations Occurring at Night Is 5%, the Average Train Speed Is 10 MPH, the Tracks Are Welded and There Are No Whistles Or Horns Required for Grade Crossing.

Adjustment Factors Needed: _____

_____

_____

Value of Adjustment Factors: _____

_____

_____

15. A Railroad Where the Fraction of Operations Occurring at Night Is 20%, the Average Train Speed Is 30 MPH, the Track Is Bolted and No Whistles or Horns Are Required for Grade Crossings.

Adjustment Factors Needed: _____

_____

_____

Value of Adjustment Factors: _____

_____

_____

Problems 16 Through 21: Some Basic Problems

Calculate the Combined Noise Levels for Each of the Following Situations:

16. A Roadway Where the distance in Feet from the NAL to the Near Edge of the Nearest Lane is 310 Feet, the Distance to the Far Edge of the Farthest Lane is 358 Feet. There Is A Stop Sign 400 Feet from the NAL. The Gradient is 1%. The Average Number of Automobiles is 17,000, the 24 Hour Average Number of Medium Trucks is 1,500, the 24 Hour Average Number of Heavy Trucks is 400 Total. The Fraction of Nighttime Traffic is 20%.

    The Combined Noise Level for This Roadway is _____

17. A Site Exposed to Noise from Two Roads. For Roadway Number 1 the Distance in Feet from the NAL to the Near Edge of the Nearest Lane is 125 Feet, the Distance to the Far Edge of the Farthest Lane is 233 Feet. There is A Stop Sign 250 Feet from the NAL. The Gradient is 3%. The Average Speed for Both Autos and Trucks is 30 MPH.

    The 24 Hour Average Number of Autos is 22,000, the 24 Hour Average Number of Medium Trucks is 2,000. The 24 Hour Average Number of Heavy Trucks is 950 Total. The Fraction of Nighttime Traffic is 10%.

    For Roadway Number 2, the Distance to the Near Edge of the Nearest Lane is 45 Feet, the Distance to the Far Edge of the Farthest Lane is 93 Feet. There is A Stop Sign 100 Feet from the NAL and the Gradient is 1%. The Average Speed for Both Autos and Heavy Trucks is 30 MPH. The 24 Hour Average Number of Automobiles is 14,000, for Medium Trucks 700, and for Heavy Trucks 600 Total. The Fraction of Nighttime Traffic is 20%.

    The Combined Noise Level for This Site is _____

18. A Site Exposed to Noise from Two Railroads. For Railroad 1, the Distance in Feet from the NAL to the Railway Track is 150 Feet. There Are 35 Diesel Trains Every 24 Hours, No Electrified Trains. The Fraction of Operations Occurring at Night is 25%. There Are 3 Diesel Locomotives Per Train and 70 Cars Per Train. The Average Speed is 30 MPH and the Track is Bolted. No Whistles Or Horns Are Used.

    For Railroad 2, the Distance in Feet from the NAL to the Railway Track is 310 Feet. There Are 20 Diesel and 2 Electrified Trains Each 24 Hours. The Fraction of Operations Occurring at Night is 15%. There Are 2 Locomotives Per Diesel Train and 45 Cars for Each Diesel Train and 15 Cars Per Electrified Train. The Average Train Speed is 40 MPH and the Track is Bolted. No Horns Or Whistles Are Used.

    The Combined Noise Level for This Site is _____

19. A Site Exposed to Noise from Two Railroads. For Railroad 1, the Distance in Feet from the NAL to the Railway Track is 75 Feet. There Are 34 Diesel Trains Every 24 Hours, No Electrified Trains. Twenty Percent of the Operations Occur at Night. There Are 5 Locomotives Per Train and 75 Cars Per Train. The Average Train Speed is 35 MPH and the Track is Welded. No Horns Or Whistles.

    For Railway 2, the Distance in Feet from the NAL to the Railway Track is 120 Feet. There Are 12 Diesel Trains in 24 Hours, No Electrified Trains. Twenty-Five Percent of the Operations Occur at Night. There Are 4 Locomotives Per Train and 40 Cars Per Train. The Average Train Speed is 20 MPH and the Track is Bolted. No Horns Or Whistles Are Used.

    The Combined Noise Level for This Site is _____

20. A Site Exposed to Noise from Three Roads. For Road 1, the Distance in Feet from the NAL to the Near Edge of the Nearest Lane is 100 Feet, to the Far Edge of the Farthest Lane, 208 Feet. There Is No Stop Sign and the Gradient is 1%. The Average Speed for Autos is 55 MPH. (There Are No Trucks Allowed On This Road.) The 24 Hour Average Number of Autos is 40,000. The Fraction of Nighttime Traffic is 15%.

    For Road 2, the Distance from the NAL to the Near Edge of the Nearest Lane is 45 Feet, to the Far Edge of the Farthest Lane 75 Feet. There Is A Stop Sign 175 Feet from the NAL and the Road Gradient is 4%. The average Speed for Both Autos and Trucks is 40 MPH. The 24 Hour Average Number of Autos is 15,000, for Medium Trucks 900 and for Heavy Trucks 320 Total. The Fraction of Nighttime Traffic is 20%.

    For Road 3, the Distance from the NAL to the Near Edge of the Nearest Lane is 52 Feet, to the Far Edge of the Farthest Lane 92 Feet. There Is A Stop Sign 400 Feet from the NAL and the Gradient is 1%. The Average Speed for Both Autos and Trucks is 25 MPH. The 24 Hour Average Number of Autos is 5,000, for Medium Trucks 1,050 and for Heavy Trucks 175 Total. The Fraction of Nighttime Traffic is 20%.

    The Combined Noise Level for This Site is _____

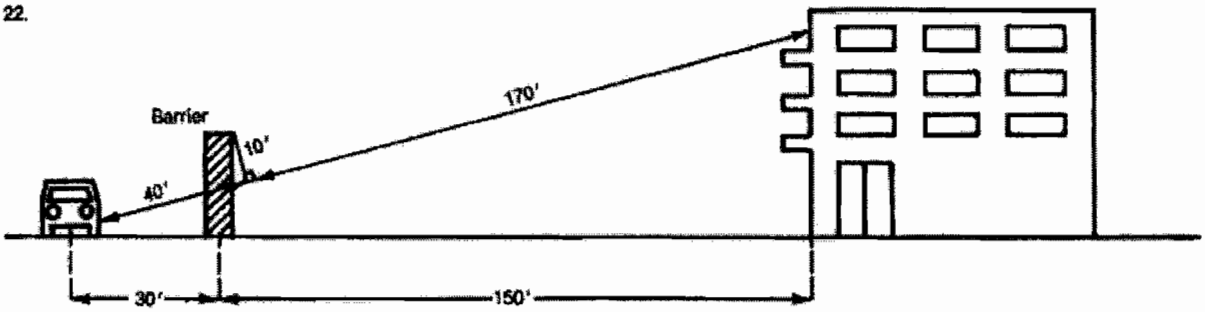
21. A Site Exposed to Noise from A Railroad. The Distance from the NAL to the Railroad Is 110 Feet. There Are 30 Diesel Trains Every 24 Hours, No Electrified Trains. Twenty Percent of the Operations Occur at Night. There Are 3 Locomotives Per Train and 50 Cars Per Train. The Average Train Speed Is 30 MPH, the Track Is Bolted and There Is A Grade Crossing Where Horns and Whistles Are Used 100 Feet from the NAL.

The Combined Noise Level at This Site Is _____.

Problems 22 Through 24: Barriers - Identifying the Values for H, R, R', D and D'

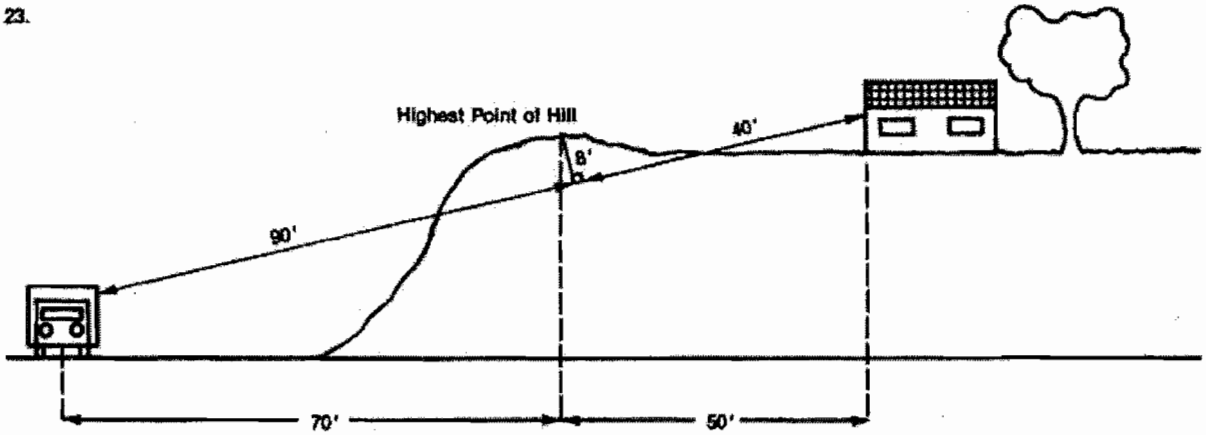
Identify the Values for H, R, R', D and D' for Each of the Following Barriers:

22.



H = _____, R = _____, R' = _____ D = _____ and D' = _____

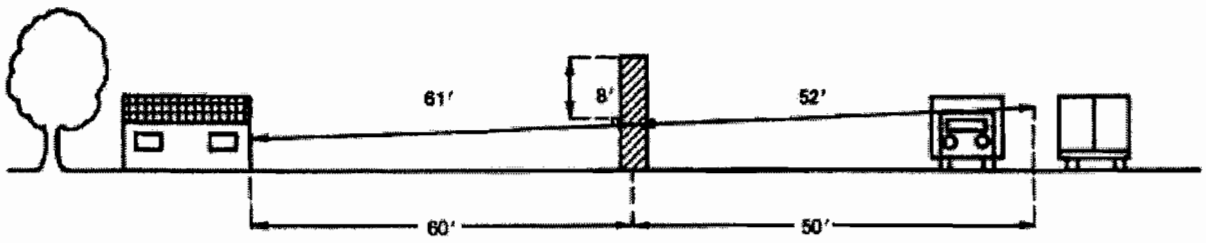
23.



H = _____, R = _____, R' = _____, D = _____ and D' = _____

Barrier	40'	10'	170'	90'	70'
Highest Point of Hill	30'	150'		8'	50'
				40'	

24.



H = _____, R = _____, R' _____, D = _____ and D' _____

Problems 25 Through 27: Barrier Calculations Using Workcharts 6 and 7.

Using Workcharts 6 and 7 Only, Calculate the Noise Attenuation Provided by the Barriers Illustrated in Problems 22 Through 24. Additional Data on the Angles Subtended by the Ends of the Barriers and the NAL for Each Location is Provided.

25. Calculate the Noise Attenuation Provided by the Barrier Described in Problem 22. The Angle Subtended by the Ends of the Barrier and the NAL is 150 Degrees.

    The Noise Attenuation Provided is _____ Decibels.

26. Calculate the Noise Attenuation Provided by the Barrier Described in Problem 23. The Angle Subtended by the Ends of the Barrier and the NAL is 90 Degrees.

    The Noise Attenuation Provided is _____ Decibels.

27. Calculate the Noise Attenuation Provided by the Barrier Described in Problem 24. The Angle Subtended by the Ends of the Barrier and the NAL is 130 Degrees.

    The Noise Attenuation Provided is _____ Decibels.

Problems 28 Through 30: Barrier Calculations Using Workcharts 5, 6 and 7

Calculate the Attenuation Provided By the Barriers in the Following Situations. Use Workcharts 5, 6 and 7.

28. A Two Story Building is Exposed to Noise Levels of 68 LDN from Automobiles. The Barrier is 15 Feet High and is Located 40 Feet from the Source and 20 Feet from the Building. The Source, Barrier, and Building Are All On Level Ground. The Angle Subtended by the Ends of the Barrier and the Noise Assessment Location is 110 Degrees.

    The Noise Attenuation Provided by This Barrier is _____ Decibels.

    Is This Sufficient? _____

29. A Three Story Building is Exposed to A Noise Level of 72 LDN from Diesel Locomotives and 60 LDN from Railroad Cars. The Barrier is 12 Feet High and is Located 40 Feet from the Source and 85 Feet from the Building. The Barrier and the Building Are on the Same Level, But the Track is Depressed 25 Feet. The Angle Subtended by the Ends Of the Barrier and the NAL is 120 Degrees.

    The Noise Attenuation Provided by This Barrier is _____ Decibels.

    Is This Sufficient? _____

30. A Three Story Building is Exposed to Noise Levels of 67 LDN from Automobiles and 71 LDN from Trucks. The Barrier is 16 Feet High and is Located 36 Feet from the Source and 56 Feet from the Building. The Source, the Barrier and the Building Are All At the Same Level. The Angle Subtended by the Barrier Ends and the NAL is 130 Degrees.

    The Noise Attenuation Provided by This Barrier is _____ Decibels.

    Is This Sufficient? _____

Noise Assessment Guidelines Workbook
Answers

Problem

1. 68 LDN (67–61 = 6, Add 1dB (From Table) to 67 = 68 LDN)
2. 66 LDN (63–63 = 0, Add 3dB (From Table) to 63 = 66 LDN)
3. 69 LDN (69–51 = 0, Add 0dB to 69 = 69 LDN)
4. 67 LDN (65–62 = 3, Add 1.8dB to 65, Round Off to Nearest Whole Number, 66.8 = 67 LDN)
5. 73 LDN (72–65 = 5, Add 1.2 = 73.2 = 73 LDN)
6. 72 LDN (63–59 = 4, Add 1.5 = 64.5, 71–64.5 = 6.5
Interpolate From Table: 6 = 1.0, 7 = .8
6.5 = .9) 71 + .9 = 71.9 = 72 LDN)

7. 76 LDN (67–61 = 6, Add 1.0 = 68, 72–68 = 4, Add 1.5 = 73.5, 73.5–73 = .5, Interpolate From Table, Add 2.75 = 76.25 = 76 LDN)

8. 49 Feet (76 + 22 = 98 – 2 = 49)
9. 72 Feet (84 + 60 = 144 – 2 = 72)

10. Adjustment Factors Needed: Speed and Night-Time Percentage

    Value of Factors: Speed = Autos .30
    Trucks .81
    Nighttime
    Percentage .81

    Note—You Must Have Different Speed Adjustments for Autos and Trucks.

11. Adjustment Factors Needed: Speed and Stop and Go Traffic
    Value of Factors: Speed .67
    Stop and Go .70

12. Adjustment Factors Needed: Gradient, Speed and Nighttime Percentage

    Value of Factors: Gradient 1.4
    Speed = Autos .30
    Trucks .81
    Nighttime
    Percentage .81

13. Adjustment Factors Needed: Nighttime Percentage, Speed, Bolted Track

    Value of Factors: Nighttime
    Percentage 1.57
    Speed = Engines .75
    Cars 1.78
    Bolted Track 4

    Note—You Must Have Different Speed Adjustments for Engines and Cars.

14. Adjustment Factors Needed: Nighttime Percentage and Speed

    Value of Factors: Nighttime
    Percentage .62
    Speed = Engines 3.0
    Cars .11

15. Adjustment Factors Needed: Nighttime Percentage and Bolted Track

    Value of Factors: Nighttime
    Percentage 1.19
    Bolted Track 4

16. Combined Noise Level = 62 LDN (If Your Answer Is Plus or Minus 1dB Its OK - Between Rounding Off and the Large Scale on the Nomographs, That's Close Enough)

Worksheet C — Page 1

1. _____
2. _____
3. _____
4. _____

	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane	340			
b. farthest lane	358			
c. average (effective distance)	334			
2. Distance to stop sign	400			
3. Road gradient in percent	1%			
4. Average speed in mph				
a. Automobiles	40			
b. Heavy trucks - uphill	40			
c. Heavy trucks - downhill	40			
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	17000			
b. medium trucks	1500			
c. effective ADT (a + 10xb)	32000			
6. 24 hour average number of heavy trucks				
a. uphill	200			
b. downhill	200			
c. total	400			
7. Fraction of nighttime traffic (10:00 p.m. to 7 a.m.)	20%			
8. Traffic projected for what year?	—			

Worksheet C — Page 2

Adjustments for Automobile Traffic

Road No. 1	.70	x .65	x 1.19	x 32000	14728	67	- 0	= 67
Road No. 2		x	x	=	-	-	+	
Road No. 3		x	x	=	-	-	+	
Road No. 4		x	x	=	-	-	+	

Adjustments for Heavy Truck Traffic

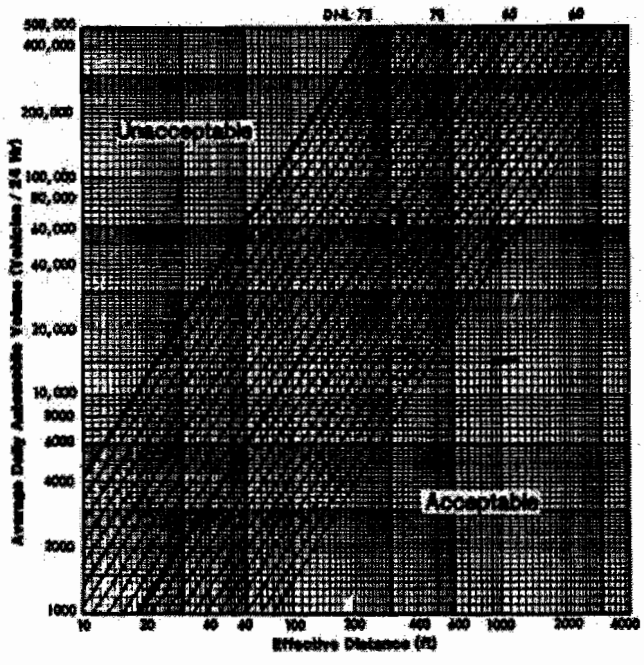
Uphill	=	x .81	x 200	= 162				
Road No. 1					324 x 1.9	x 1.19	= 69	60 - 0 = 60
Downhill		x .81	x 200	= 162				
Uphill		x	x	=				
Road No. 2					Add	+	=	- +
Downhill		x	=					
Uphill		x	x	=				
Road No. 3					Add	+	=	- +
Downhill		x	=					
Uphill		x	x	=				
Road No. 4					Add	+	=	- +
Downhill		x	=					

Combined Automobile & Heavy Truck DNL

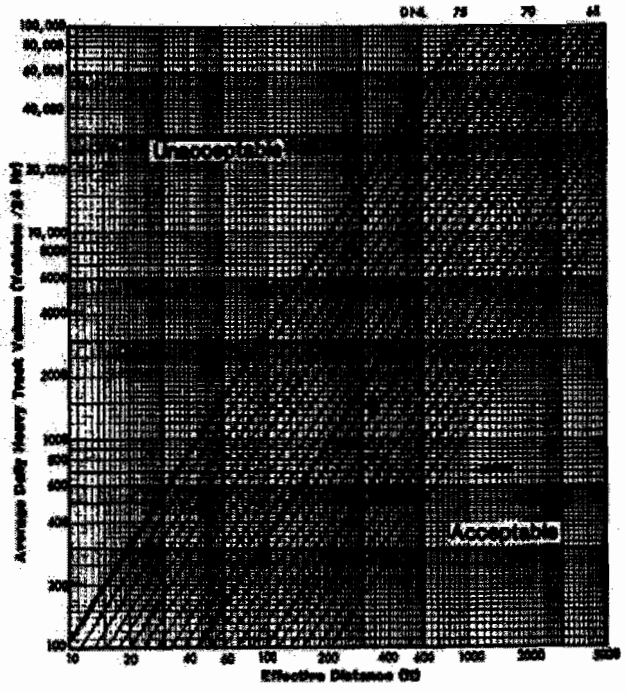
Road No. 1: 62 | Road No. 2: _____ | Road No. 3: _____ | Road No. 4: _____ | Total DNL for All Roads: 62

Signature _____ Date _____

Worksheet 1
Autos (50 mph)



Worksheet 2
Heavy Trucks (50 mph)



17. Combined Noise Level = 74 LDN (+ OR – 1 dB)

Worksheet C
Roadway Noise

Page 1

	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the ANL to the edge of the road				
a. maximum	125	45		
b. minimum	233	93		
c. average effective distance	179	69		
2. Distance to stop sign	250	100		
3. Road gradient in percent	2%	1%		
4. Average speed in mph				
a. Automobiles	30	30		
b. Heavy trucks - split	30	30		
c. Heavy trucks - downhill	30	30		
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	22000	14000		
b. medium trucks	2000	700		
c. effective ADT (a + 13b)	42000	21000		
6. 24 hour average number of heavy trucks				
a. split	475	300		
b. downhill	475	300		
c. total	950	600		
7. Percent of nighttime traffic (10:00 p.m. to 7 a.m.)	10%	20%		
8. Traffic projected for what year?	—	—		

Worksheet C
Roadway Noise

Page 2

Adjustments for Automobile Traffic

	9 Slope (Table 2)	10 Average Speed (Table 4)	11 Night Time (Table 5)	12 ADT (Step 5c)	13 Adjusted ADT	14 DNL (Nomogram 1)	15 Barrier Attenuation	16 Partial DNL
Road No. 1	.48	.30	.81	42000	4899	57	0	57
Road No. 2	.25	.30	1.19	21000	1874	59	0	59
Road No. 3								
Road No. 4								

Adjustments for Heavy Truck Traffic

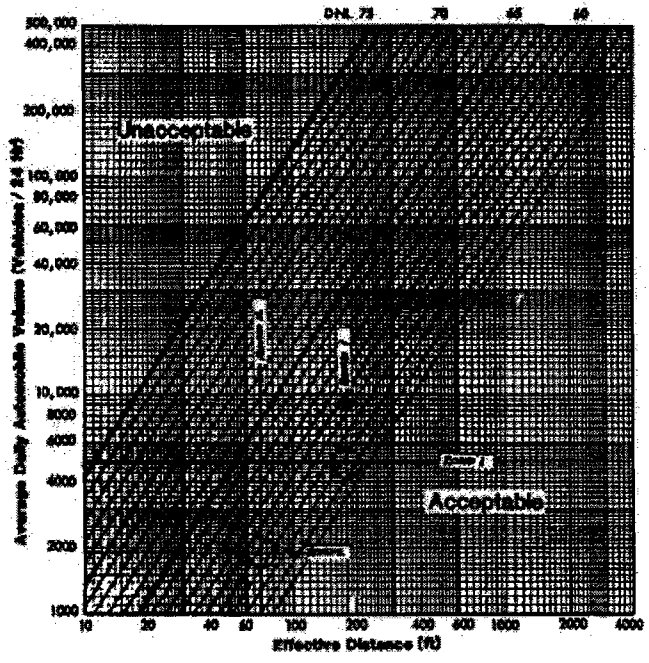
	17 Distance (Table 6)	18 Average Speed (Table 4)	19 Truck ADT	20	21	22 Slope (Table 2)	23 Night Time (Table 5)	24 Adjusted Truck ADT	25 DNL (Nomogram 2)	26 Barrier Atten	27 Partial DNL
Uphill	1.7	x .81	x 475 = 654								
Road No. 1								1039 x 1.8	x .81 . 1515	67	0 . 67
Downhill		.81	x 475 = 385								
Uphill	—	x .81	x 300 = 245								
Road No. 2								486 x 1.8	x 1.19 . 1041	72	0 . 72
Downhill		.81	x 300 = 245								
Uphill		x	x	=							
Road No. 3								Add	x	x	=
Downhill		x	=								
Uphill		x	x	=							
Road No. 4								Add	x	x	=
Downhill		x	=								

Combined Automobile & Heavy Truck DNL

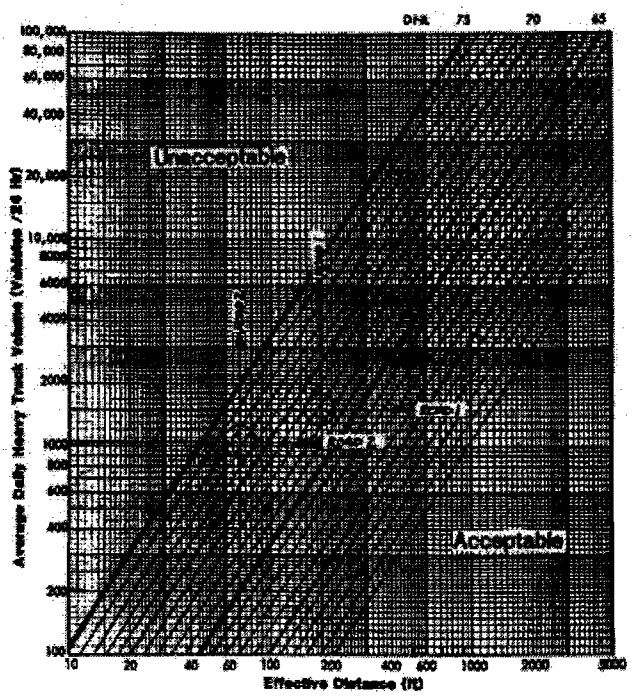
Road No. 1	Road No. 2	Road No. 3	Road No. 4	Total DNL for All Roads
69	72			74

Signature _____ Date _____

Worksheet 1
Autos (55 mph)

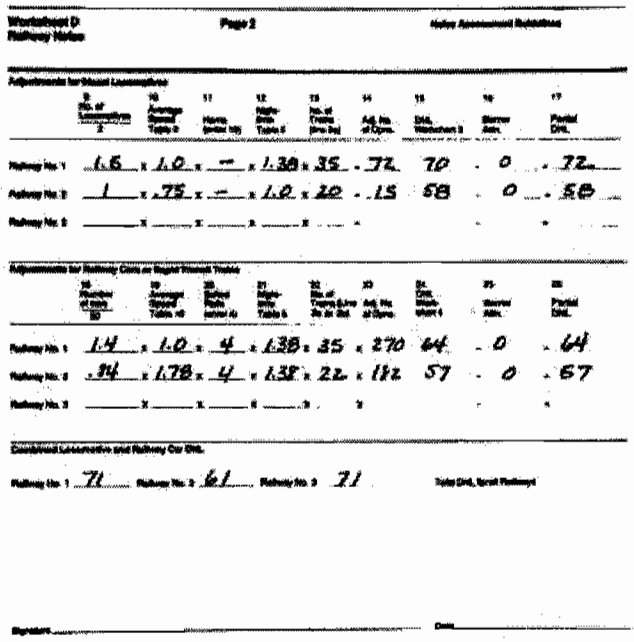


Worksheet 2
Heavy Trucks (55 mph)



18. Combined Noise Level = 71 LDN

Note—In Order to Complete Column 18 for Railway #2 You Must Find the Average Number of Cars Per Train. Multiply the Number of Diesel Trains Times the Number of Cars Per Train (20 x 45 = 900). Multiply the Number of Electrified Trains Times the Number of Cars Per Train (2 x 15 = 30). Add the Two Totals Together and Divide By the Total Number of Trains (900 + 30 = 930 – 22 = 42).



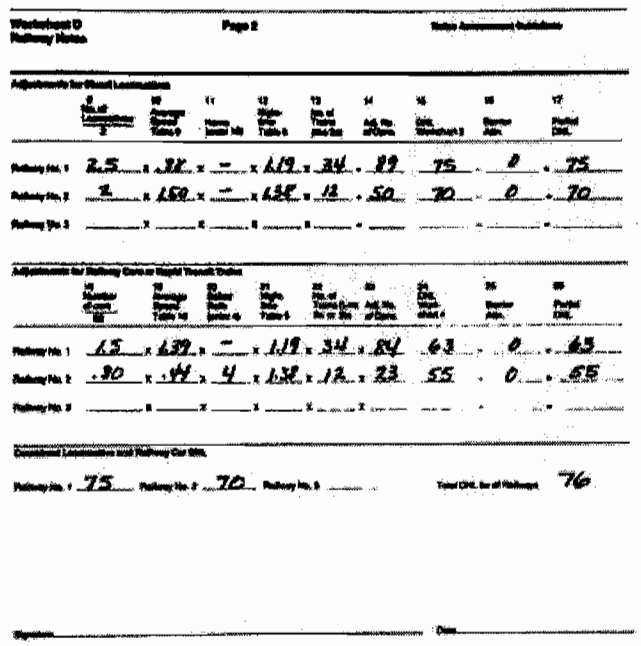
Railway No. 1	1.6	x 1.0	x —	x 1.38	x 35	. 72	70	. 0	. 72
Railway No. 2	1	x .75	x —	x 1.0	x 20	. 15	58	. 0	. 58
Railway No. 3		x	x	x	x				

Railway No. 1	14	x 1.0	x 4	x 1.38	x 35	x 270	64	. 0	. 64
Railway No. 2	.34	x 1.78	x 4	x 1.38	x 22	x 112	57	. 0	. 57
Railway No. 3		x	x	x	x				

Railway No. 1 71 Railway No. 2 61 Railway No. 3 71

Signature _____ Date _____

19. Combined Noise Level = 76 LDN



Railway No. 1	2.5	x .32	x —	x 1.19	x 34	. 89	75	. 0	. 75
Railway No. 2	1	x 1.50	x —	x 1.38	x 12	. 50	70	. 0	. 70
Railway No. 3		x	x	x	x				

Railway No. 1	15	x 1.39	x —	x 1.19	x 34	x 84	63	. 0	. 63
Railway No. 2	.30	x .44	x 4	x 1.38	x 12	x 23	55	. 0	. 55
Railway No. 3		x	x	x	x				

Railway No. 1 75 Railway No. 2 70 Railway No. 3 _____ Total DNL for all Railways 76

Signature _____ Date _____

20. Combined Noise Level = 75 LDN

Worksheet C
Roadway Noise

Page 1

	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. Autos	100	45	62	
b. Medium trks	208	75	92	
c. Heavy trks (pref/bus inclusive)	164	60	72	
2. Distance to stop sign	—	175	400	
3. Road gradient in percent	1%	4%	1%	
4. Average speed in mph				
a. Automobiles	65	40	25	
b. Heavy trucks - right	55	40	25	
c. Heavy trucks - downhill	55	40	25	
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	40000	1500	5000	
b. medium trucks	—	400	1050	
c. effective ADT (a + (10)xb)	40000	31600	15500	
6. 24 hour average number of heavy trucks				
a. right	—	160	27	
b. downhill	—	160	27	
c. total	—	320	175	
7. Fraction of nighttime traffic (10:00 p.m. to 7 a.m.)	15%	20%	20%	
8. Traffic projected for what year?	—	—	—	

Worksheet C
Roadway Noise

Page 2

	9 Day Traffic Table 8	10 Average Speed Table 9	11 Night Traffic Table 8	12 Peak ADT Line 5c	13 Adjusted Auto ADT	14 Dist. Attenuation in	15 Barrier Attenuation	16 Final DNL
Adjustments for Automobile Traffic								
Road No. 1	10	x 1.0	x 1.0	x 40000	= 40000	67	- 0	= 67
Road No. 2	.36	x .53	x 1.19	x 31600	= 6450	65	- 0	= 65
Road No. 3	.70	x .21	x 1.19	x 15500	= 2711	60	- 0	= 60
Road No. 4		x	x	x	=		-	=

	17 Distance Table 9	18 Average Speed Table 9	19 Night	20	21	22 Night Traffic Table 8	23 Night Traffic Table 9	24 Adjusted ADT	25 Dist. Attenuation in	26 Barrier Att.	27 Final DNL
Adjustments for Heavy Truck Traffic											
Lanes	—	x —	x —	x —							
Road No. 1					Add	—	x —	x —	= —		
Ground	—	x —	x —								
Lanes	20	x .21	x 160	= 259							
Road No. 2					Add	389	x 1.8	x 1.19	= 833	72	- 0	= 72
Ground	.11	x 1.0	= 130								
Lanes	10	x .21	x 27	= 70							
Road No. 3					Add	141	x 1.8	x 1.19	= 303	67	- 0	= 67
Ground	.81	x .22	= 71								
Lanes	—	x —	x —								
Road No. 4					Add	—	x —	x —	= —		
Ground	—	x —	= —								

Combined Automobile & Heavy Truck DNL

Road No. 1: 67 Road No. 2: 73 Road No. 3: 68 Road No. 4: — Total DNL for All Roads: 75

Signature _____ Date _____

21. Combined Noise Level = 81 LDN

To Solve This Problem You Must Add Some More Lines to the Workchart for Engines Because the Workchart as Set up Does Not Go High Enough. There Are A Variety of Ways to Do This But One of the Easiest Is to Take A Piece of Blank Paper (A 3 x 5 Card Does Very Well) Place the Edge of the Paper Along Either the Top Or Bottom Edge of the Workchart and Mark Where the LDN Lines Fall Along the Edge of the Blank Paper. Then Once You Have Drawn Your Distance and Operations Lines on the Work Chart, You Take Your Paper with the Line Markings and Lay It along the Line for Adjusted Operations with the Mark Farthest to the Right Lined up with the 75 LDN Line. Now Just Count over until You Reach the Intersection of the Operations and Distance Lines.

Railway No. 1: 1.5 x 1.0 x 10 x 1.19 x 30 - 535 — 81 - 0 - 81

Railway No. 2: ____ x ____ x ____ x ____ x ____ - ____ — ____ - ____ - ____

Railway No. 3: ____ x ____ x ____ x ____ x ____ - ____ — ____ - ____ - ____

Railway No. 1: 10 x 10 x 4 x 1.19 x 30 x 143 — 63 - 0 - 63

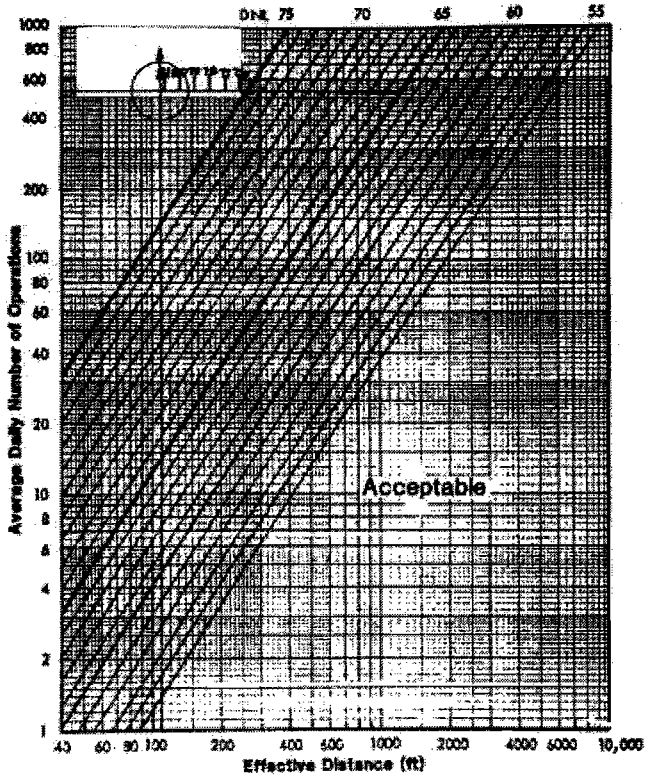
Railway No. 2: ____ x ____ x ____ x ____ x ____ — ____ - ____ - ____

Railway No. 3: ____ x ____ x ____ x ____ x ____ — ____ - ____ - ____

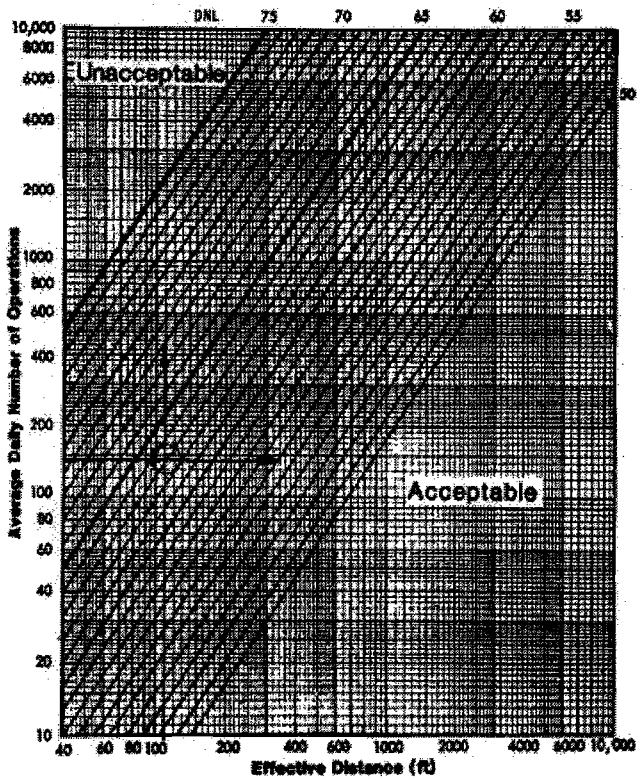
Railway No. 1: 81 Railway No. 2: ____ Railway No. 3: ____ Total DNL for all Railways: 81

Signature: ____ Date: ____

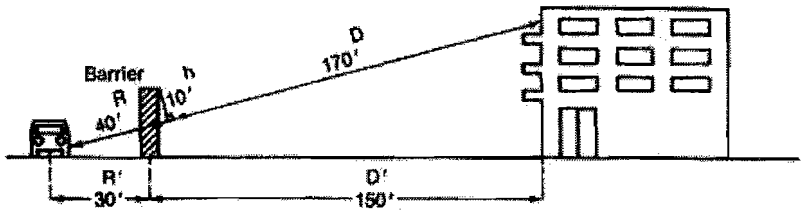
Worksheet 3
Railroads - Diesel Locomotives



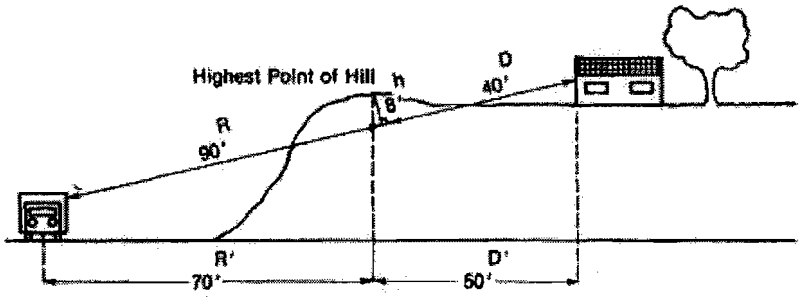
Worksheet 4
Railroads - Cars and Rapid Transit



22. H = 10 Feet, R = 40 Feet, R' = 30 Feet, D = 170 Feet, D' = 150 Feet

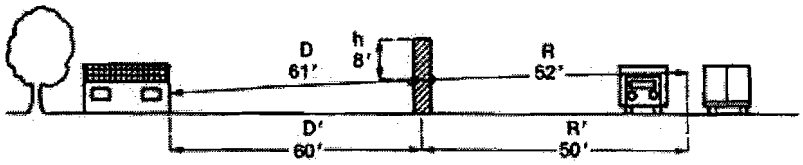


23. H = 8 Feet, R = 90 Feet, R' = 70 Feet, D = 40 Feet, D' = 50 Feet

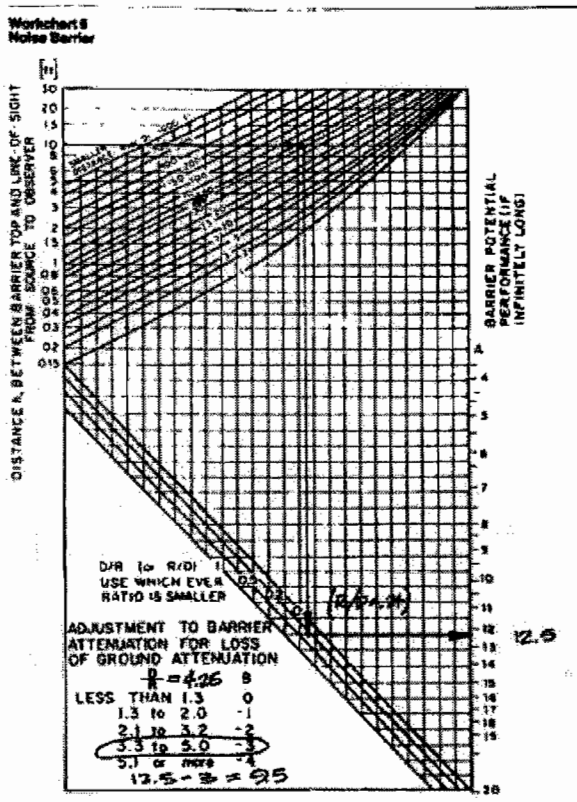


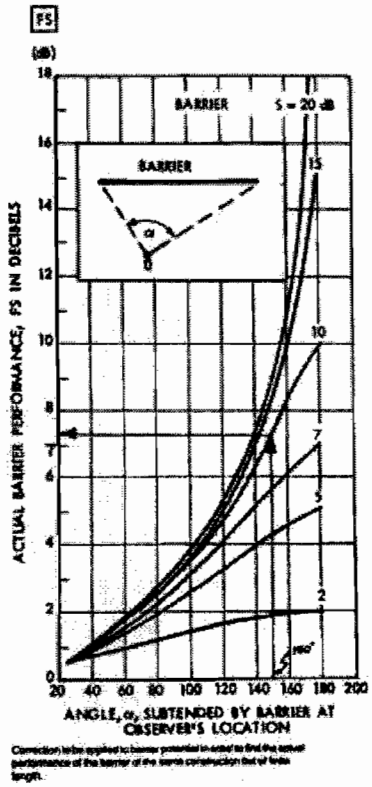
Note—The Line of Sight Line Starts Above the Road Level Because of the Trucks.

24. H = 8 Feet, R = 52 Feet, R' = 50 Feet, D = 61 Feet, D' = 60 Feet



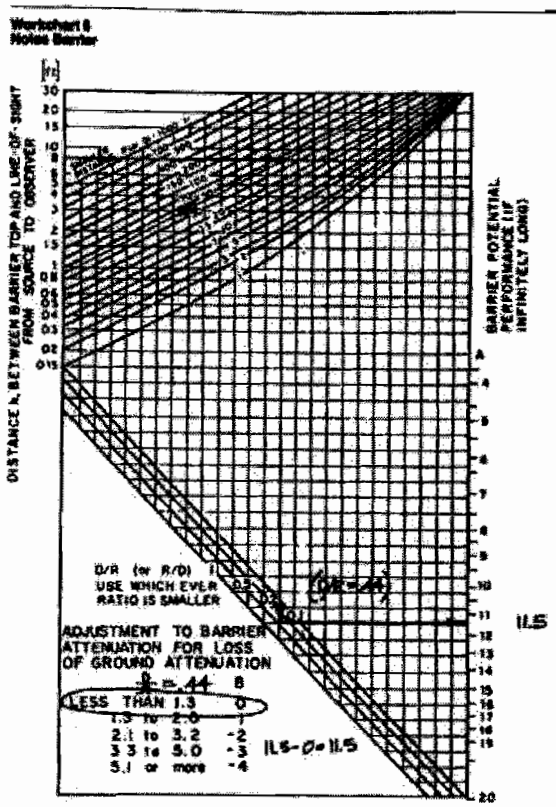
25. The Noise Attenuation Provided is 7 Decibels

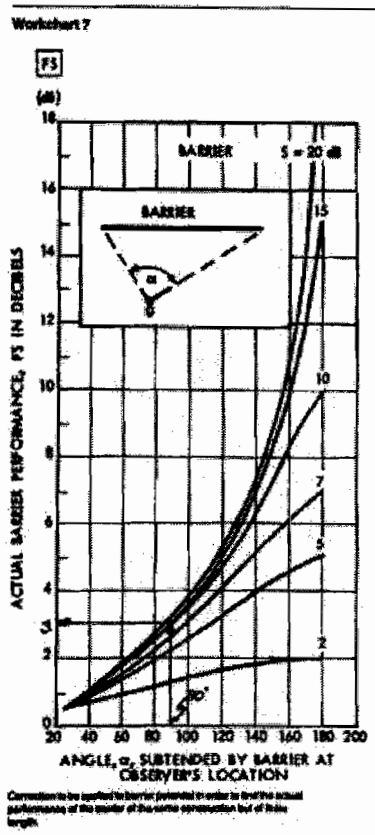




26. The Noise Attenuation Provided Is 3 Decibels

Note—When the Curves ARe So Close Together Don't Worry About Extrapolating. In This Case You Couldn't Anyway, the 15 dB and 10 dB Curves Have Merged.

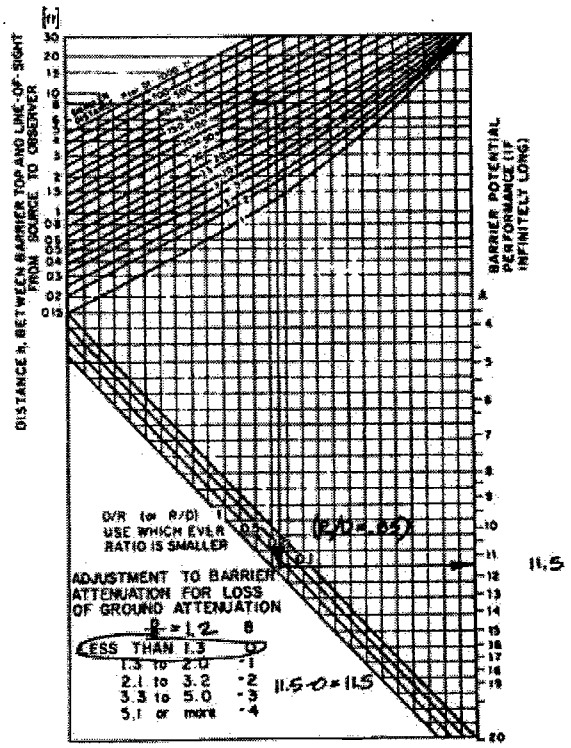




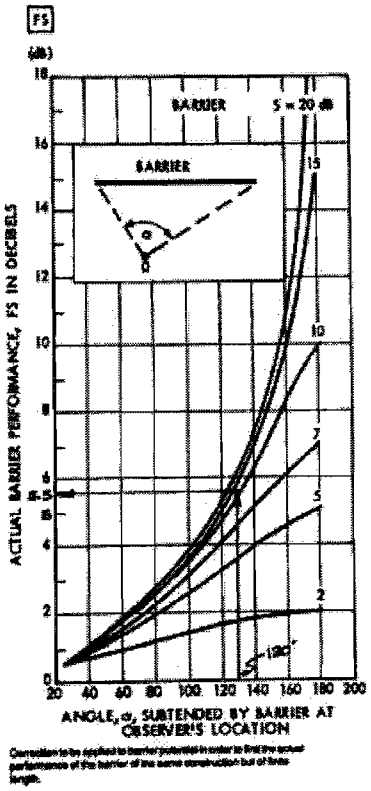
27. The Noise Attenuation Provided is 6 Decibels (5.5 Rounded Up)

Note—Again You Have Problems With Extrapolating—Don't Worry About Being Too Precise.

Worksheet 8
Noise Barrier



Worksheet 7

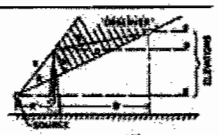


28. The Noise Attenuation Provided by This Barrier Is 4 dB. This Is Sufficient

Note—Don't Forget That the Height of the observor Is 5' Less Than the Total Height of the Building and the Height of the Building Is 10 Feet Times the Number of Stories. And Did You Remember to Make the Adjustment for Ground Attenuation Loss.

Worksheet 6
Noise Barrier

Enter the values for:
H= 15 W= 40
B= 0 H'= 20
D= 15



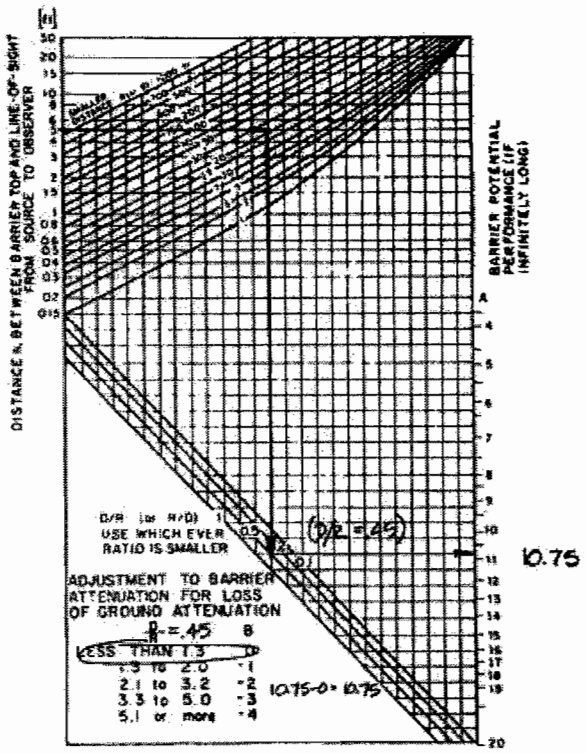
1. Elevation of barrier top minus elevation of source	[H 15]	- [' 0]	= [' 15]	
2. Elevation of observer minus elevation of source	[' 15]	- [' 0]	= [' 15]	
3. Map distance between source and observer (W + D)			[' 60]	
4. Map distance between barrier and source (W)			[' 40]	
5. Line 2 divided by line 3	[' 15]	+ [' 60]	= [' .25]	
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[' .25]	× [' .25]	= [' .0625]	
7. 40% of line 6	[ ]	× [' .0625]	= [' .025]	
8. One minus line 7	[ ]	- [' .025]	= [' .975]	
9. Line 5 times line 4 (add for negative d line 2 is negative)	[' .25]	× [' 40]	= [' 10]	
10. Line 1 minus line 9	[' 15]	- [' 10]	= [' 5]	
11. Line 10 times line 8	[' 5]	× [' .975]	= [' 4.9]	= a
12. Line 5 times line 10	[' .25]	× [' 5]	= [' 1.25]	
13. Line 4 divided by line 8	[' 40]	+ [' .975]	= [' 41]	
14. Line 13 plus line 12	[' 41]	+ [' 1.25]	= [' 42]	= n
15. Line 3 minus line 4	[' 60]	- [' 40]	= [' 20]	
16. Line 15 divided by line 8	[' 20]	+ [' .975]	= [' 20.5]	
17. Line 16 minus line 12	[' 20.5]	- [' 1.25]	= [' 19]	= b

(Make the value on line 2 may be negative, in which case so will the values on lines 5, 9, and 12. Line 1 may also be negative. Remember, from, in

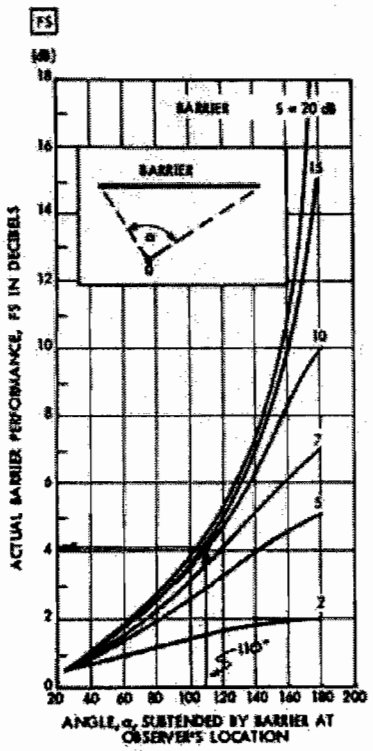
lines 10, 11, and 17, mid adding a negative number to the same as subtracting a negative number in this setting: 4+(-1)=+3)

Round off A and D to nearest integer, to one decimal place

Worksheet 6
Noise Barrier



Worksheet 7



Correction is to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

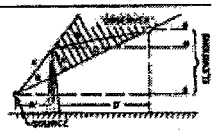
29. The Noise Attenuation Provided by This Barrier is Approximately 5 dB for Both the Engines and the Railroad Cars.

    This Is Not Sufficient.

    Note—You Were Supposed to Calculate Attenuation for Diesel Engines and Cars Separately Because the Source Heights Are Different. The Value of S for the Engines Should Have Been −10 and the Value of S for the Railroad Cars Should Have Been − 25.

Worksheet 5
Noise Barrier

Enter the values for:
A= 12 R= 40
S= −10 D= 85
D= 25

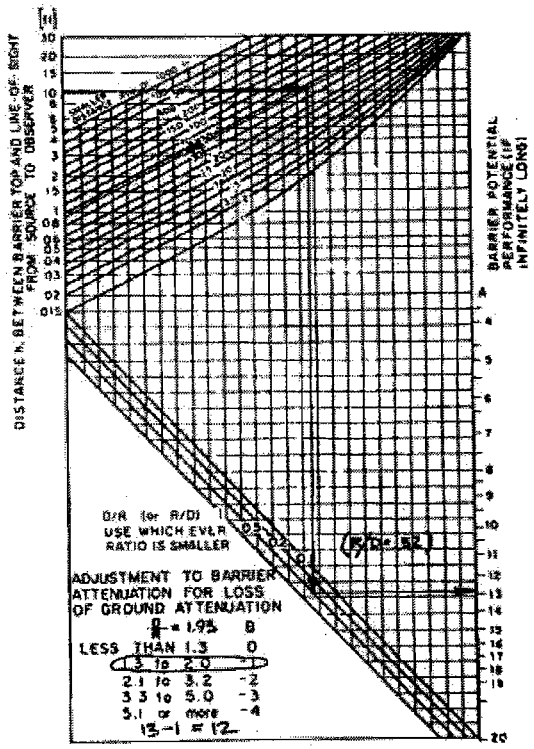


1. Elevation of barrier top minus elevation of source	[A 12]	− [S −10]	= [1 22]	
2. Elevation of observer minus elevation of source	[D 25]	− [S −10]	= [2 35]	
3. Map distance between source and observer (R × D)			[3 125]	
4. Map distance between barrier and source (R)			[4 40]	
5. Line 2 divided by line 3	[2 35]	÷ [3 125]	= [5 .28]	
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[5 .28]	× [5 .28]	= [6 .08]	
7. 40% of line 6	[40]	× [6 .08]	= [7 .03]	
8. One minus line 7	[1]	− [7 .03]	= [8 .97]	
9. Line 5 times line 4 (will be negative if line 5 is negative)	[5 .28]	× [4 40]	= [9 11.2]	
10. Line 1 minus line 9	[1 22]	− [9 11.2]	= [10 10.8]	
11. Line 10 times line 8	[10 10.8]	× [8 .97]	= [11 10.5]	= s
12. Line 5 times line 10	[5 .28]	× [10 10.8]	= [12 3]	
13. Line 4 divided by line 9	[4 40]	÷ [9 .97]	= [13 41]	
14. Line 13 plus line 12	[13 41]	+ [12 3]	= [14 44]	= a
15. Line 3 minus line 4	[3 125]	− [4 40]	= [15 85]	
16. Line 15 divided by line 8	[15 85]	÷ [8 .97]	= [16 88]	
17. Line 16 minus line 12	[16 88]	− [12 3]	= [17 85]	= o

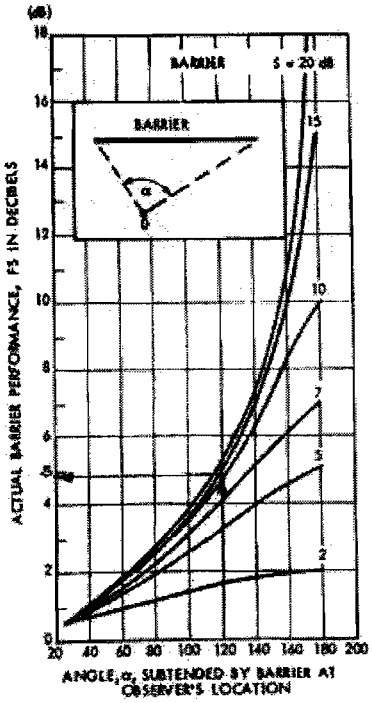
Divide the value on line 5 may be negative, in which case so will the values on lines 9,A, and 12; line 7 may also be negative. Remember, that, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: a + (−b) = a − b.

Round all R and D to nearest integer, to no one decimal place

Worksheet 6
Noise Barrier



Worksheet 7



Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

Worksheet 6
Noise Barrier

To find R, D and h from the Elevations and Distances

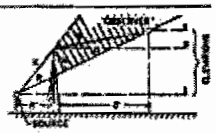
Enter the values for:

c = 12 e = 40

s = -25 d = 85

Fill out the following worksheet. (All quantities are in feet)

a = 25

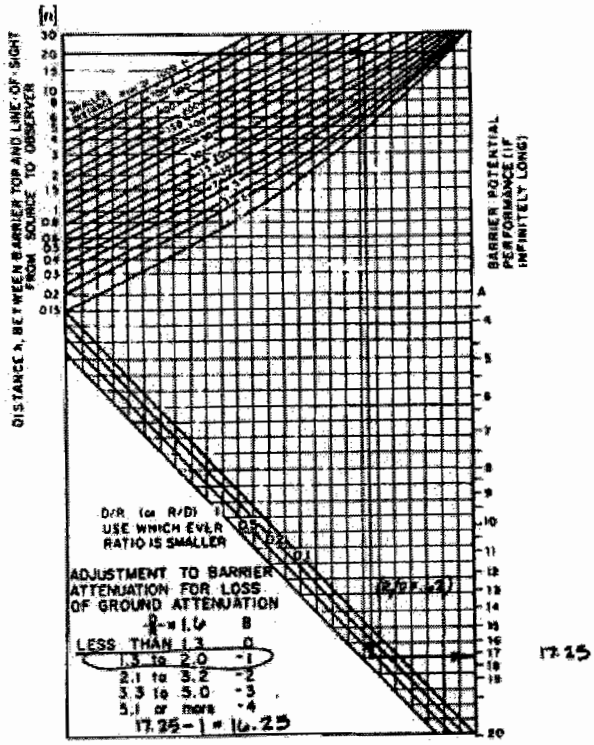


1. Elevation of barrier top minus elevation of source	[1] 12	− [2] −25	= [3] 37	
2. Elevation of observer minus elevation of source	[4] 25	− [5] −25	= [6] 50	
3. Map distance between source and observer (R + D)			[7] 125	
4. Map distance between barrier and source (R)			[8] 40	
5. Line 2 divided by line 3	[9] 50	÷ [10] 125	= [11] .4	
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[12] .4	× [13] .4	= [14] .16	
7. 40% of line 6	[15] .4	× [16] .16	= [17] .06	
8. One minus line 7	[18] 1	− [19] .06	= [20] .94	
9. Line 5 times line 4 (will be negative if line 2 is negative)	[21] .4	× [22] 40	= [23] 16	
10. Line 1 minus line 9	[24] 37	− [25] 16	= [26] 21	
11. Line 10 times line 8	[27] 21	× [28] .94	= [29] 19.7	= h
12. Line 5 times line 10	[30] .4	× [31] 21	= [32] 8.4	
13. Line 4 divided by line 8	[33] 40	÷ [34] .94	= [35] 42.6	
14. Line 13 plus line 12	[36] 42.6	+ [37] 8.4	= [38] 51	= R
15. Line 3 minus line 4	[39] 125	− [40] 40	= [41] 85	
16. Line 15 divided by line 8	[42] 85	÷ [43] .94	= [44] 90.4	
17. Line 16 minus line 12	[45] 90.4	− [46] 8.4	= [47] 82	= D

Either the value on line 2 may be negative, in which case we will use values of lines 5, 9, and 10, line 9 may also be negative. Remember, then, in lines 10, 11, and 17, that adding a negative number is the same as subtracting

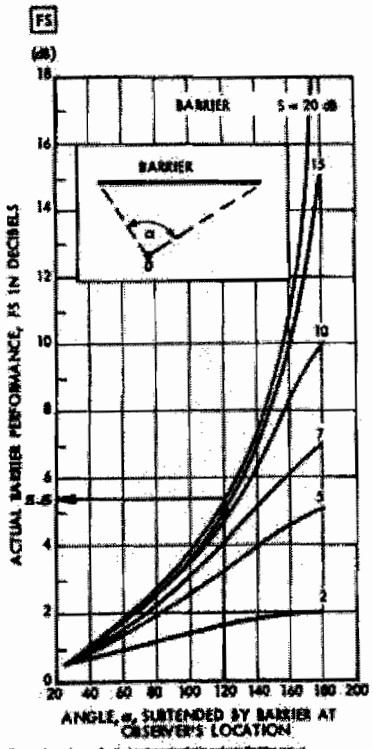
Round off R and D to nearest integer. Intermediate decimal places

Worksheet 6
Noise Barrier



17.25

Worksheet 7



Consult survey for applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

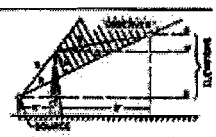
30. The Noise Attenuation Provided by This Barrier Is 3 dB for Trucks and 5 dB for Autos. The Combined Level Resulting Is 69 LDN.

    This Is Not Sufficient

    Note—You Must Calculate the Barrier Effect Separately for Autos and Trucks Because the Source Height Is Different. Then Recombine levels.

Worksheet 8
Noise Barrier

Enter the values for:
h_r = 16 h_s = 36
s = 0 d = 56
D = 25

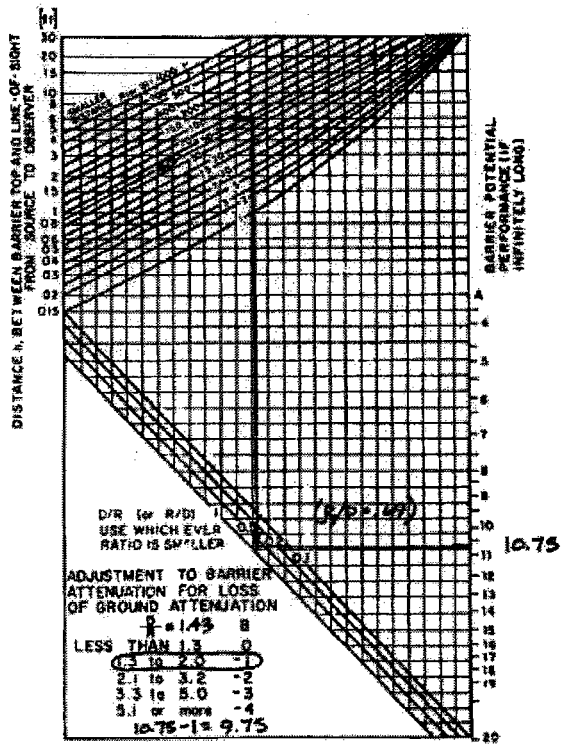


1. Elevation of barrier top minus elevation of source	[16]	− [0]	= [16]	
2. Elevation of observer minus elevation of source	[25]	− [0]	= [25]	
3. Map distance between source and observer ($R_r + D$)			[92]	
4. Map distance between barrier and source (R_s)			[36]	
5. Line 2 divided by line 3	[25]	÷ [92]	= [.27]	
6. Square the quantity on line 5 (i.e., multiply line by itself; always positive)	[.27]	× [.27]	= [.07]	
7. 40% of line 6	[40]	× [.07]	= [.03]	
8. One minus line 7	[1.0]	− [.03]	= [.97]	
9. Line 5 times line 4 (minus negative if line 2 is negative)	[.27]	× [36]	= [9.7]	
10. Line 1 minus line 9	[16]	− [9.7]	= [6.3]	
11. Line 10 times line 8	[6.3]	× [.97]	= [6.1]	= h_r
12. Line 5 times line 10	[.27]	× [6.1]	= [1.7]	
13. Line 4 divided by line 8	[36]	÷ [.97]	= [37]	
14. Line 13 plus line 12	[37]	+ [1.7]	= [39]	= h_s
15. Line 3 minus line 4	[92]	− [36]	= [56]	
16. Line 15 divided by line 8	[56]	÷ [.97]	= [58]	
17. Line 16 minus line 12	[58]	− [1.7]	= [56]	= d

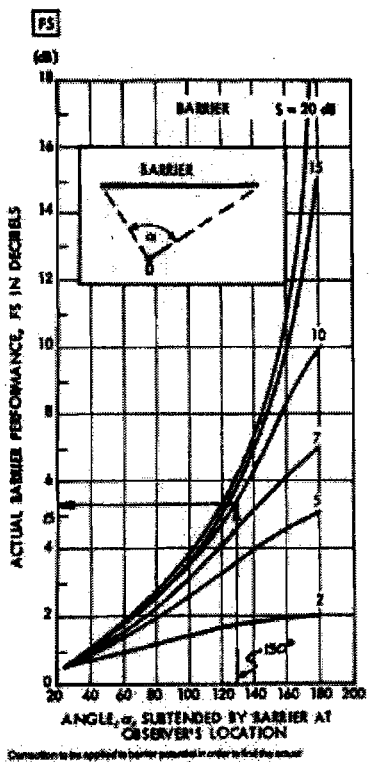
Enter the value on line 2 (may be negative, or enter zero) from the value on line 1.A, and 15. line 1 may also be negative. Remember, lines 14 and 17, then adding a negative term from line 13 the same as subtracting a negative number. Remember, lines 15, 16, and 17, then subtracting a negative number is like adding.

Round off (1) and (2) to nearest integer, in one decimal place.

Worksheet 8
Noise Barrier



Worksheet 7



Correction to be applied to barrier potential in order to find the actual performance of the barrier of the above construction but of finite length.

Worksheet 8
Noise Barrier

To find A, B and h from Site Elevations and Distances

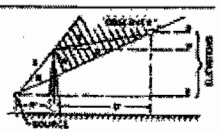
Fill out the following worksheet (all quantities are in feet)

Enter the values for:

h= 16 a= 36

b= 8 c= 56

d= 25

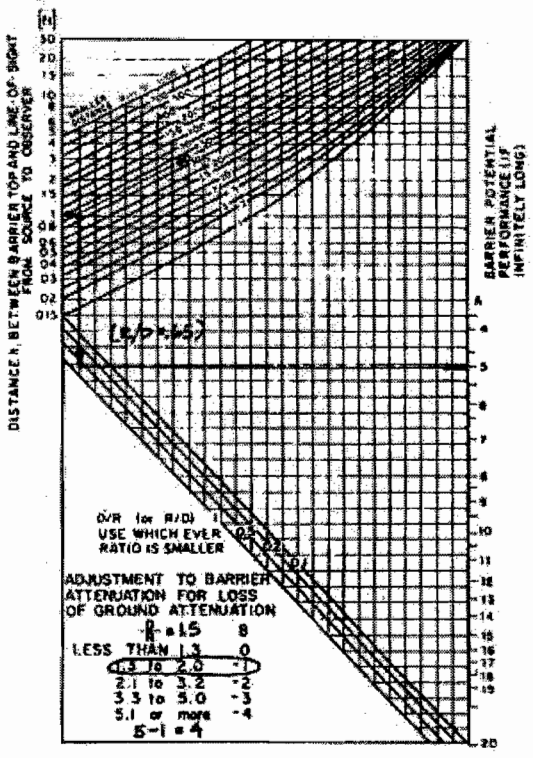


1. Elevation of barrier top minus elevation of source	[H	16	] − [H	8	] = ['	8	]	
2. Elevation of observer minus elevation of source	[D	25	] − [H	8	] = ['	17	]	
3. Map distance between source and observer (Dp = Dr)						['	92	]
4. Map distance between barrier and source (Ds)						['	36	]
5. Line 2 divided by line 3	['	17	] ÷ ['	92	] = ['	.2	]	
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	['	.2	] × ['	.2	] = ['	.04	]	
7. 40% of line 6	[	40	] × ['	.04	] = ['	.02	]	
8. One minus line 7	[	1	] − ['	.02	] = ['	.98	]	
9. Line 3 times line 4 (will be negative if line 2 is negative)	['	.2	] × ['	36	] = ['	7	]	
10. Line 1 minus line 9	['	8	] − ['	7	] = ['	1	]	
11. Line 10 times line 8	['	1	] × ['	.98	] = ['	.98	]	= A
12. Line 5 times line 10	['	.2	] × ['	1	] = ['	.2	]	
13. Line 4 divided by line 8	['	36	] ÷ ['	.98	] = ['	37	]	
14. Line 13 plus line 12	['	37	] + ['	.2	] = ['	37	]	= B
15. Line 3 minus line 4	['	92	] − ['	36	] = ['	56	]	
16. Line 15 divided by line 8	['	56	] ÷ ['	.98	] = ['	57	]	
17. Line 16 minus line 12	['	57	] − ['	.2	] = ['	57	]	= D

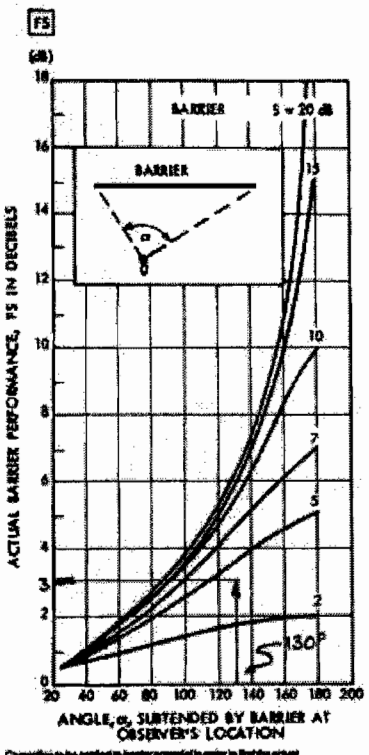
Make the value on line 3 way the negative, in which case so will the values on lines 5, 9, and 12; line 1 may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting a positive number, and subtracting a negative number is like adding; 5 + (−3) = +2.

Round off A and D to nearest integer; h to one decimal place.

Worksheet 8
Noise Barrier



Worksheet 7



Correction to be applied to barrier presented in order to find the actual performance of the barrier of the same construction but of finite length.

Chapter 7

The Use of Noise Measurements

Noise Calculations Are Best For HUD Use

There are two ways to determine noise levels for a site under review: the noise can be calculated or it can be measured. While one's first reaction might well be that it would obviously be better to go out and actually measure the noise levels at the site, calculated noise levels are really much better for implementing HUD's noise policy.

Calculated noise levels are developed using mathematical models that contain a variety of assumptions about the process of noise propagation as well as data on sound levels generated by typical sources (i.e. aircraft engines, automobile tires etc.). The model can be a complex computer model or it can be a simple desktop model such as the procedures in the *Noise Assessment Guidelines*. The models can also employ a variety of noise descriptors. (See chapter 1 for a discussion of noise descriptors.) Most noise studies done for the Federal Highway Administration, for example, use either the L_{10} or the L_{eq} noise descriptor. Many aircraft noise studies use the NEF or CNEL descriptor. All of these descriptors are compatible with the L_{dn} noise descriptor system that is preferred by HUD and the HUD noise regulation contains instructions for converting all of them into L_{dn}. (sections 51.106(a)(1) and (2))

Whether produced by a sophisticated computer model or by the desktop *Noise Assessment Guidelines*, calculated noise levels are more useful for HUD needs than measured levels for two significant reasons: The first is that with noise measurements you have no good way to take into account future changes in the future noise environment. The houses we help build today are going to be around for a long time and it is very important that we determine, to the extent we can, the noise environment that will exist throughout the life of the buildings. While there are clearly limitations on how far into the future we can reasonably project traffic levels for roads, railroads and airports, we can at least look 5 to 10 years ahead. The HUD noise regulation (24 CFR 51B) requires that "to the extent possible, noise exposure shall be projected to be representative of conditions that are expected to exist at a time at least 10 years beyond the date of the project or action under review." It is very easy to make these projections if you use the *Noise Assessment Guidelines* or a computer model to determine noise levels.

The second reason why we prefer that you calculate noise levels is that through the calculation process you can use monthly or yearly data to determine traffic levels. Thus you come up with a more typical picture of conditions. With noise measurements there is always the possibility that the day or even days chosen for measurements will not be typical and that the measurements may over or understate the problem. While the conscientious measurer will try to account for any unusual conditions, it isn't always possible. So long as cost considerations limit the number of days that measurements can be taken there will always be the problem of unrepresentative data. With calculations this isn't a problem. The computer model that generates contours for airports, for example, uses an entire years data to develop the average day. Certainly the results are more likely to be representative than the results that would be derived from just a few days measurements.

When Noise Measurements Are Useful

While it is the preferred procedure to calculate noise levels, there are a few situations where the noise models might not be accurate and it might be better to rely on measurements. One instance would be when there is insufficient or inadequate traffic data. Another case might be where you have a unique physical situation that is not accounted for in whatever mathematical model is available.

Obtaining good traffic data can be difficult. You may only be able to get gross data that simply lists total vehicles without making any distinctions between trucks and automobiles. Or you may not be able to get any reliable data on the percentage of traffic between 10 pm and 7 am. While the *Noise Assessment Guidelines* do contain some assumptions that you can use when you don't have all the data you need, there may be instances when you just don't think those assumptions would accurately portray the problem.

By the same token, there are certain physical situations that mathematical models such as the *Noise Assessment Guidelines* couldn't anticipate and therefore do not reflect in their formulas. For example, the *Guidelines* say that you don't have to calculate the noise levels for underground transit lines. Well what if the line is underground but there are large air vents that reach from the belowground tunnels to the surface? A great deal of noise can reach the surface through these vents but the *Noise Assessment Guidelines* don't have any way to take it into account. You couldn't treat it as if the subway line were aboveground because it isn't really and at least some of the noise is blocked. This would be a case where a noise measurement would probably be the best way to determine the noise levels. By the same token, the guidelines do not really take into account the sometimes significant amounts of reflected noise that can occur at urban sites surrounded by tall buildings, i.e. the canyon effect.

When Not to Use Measurements

One thing noise measurements should not be used for is to confirm or refute calculated noise levels, especially computer generated aircraft contours. Our experience with both the *Noise Assessment Guidelines* and with computer noise models is that both are quite accurate if done properly. If you are convinced that the calculations were done correctly, and if you believe that the data used were good, you should strongly discourage anyone who wants to take measurements because they think that measurements are inherently more accurate than calculations. Comparing measured noise levels to calculated levels is like comparing apples and oranges. The

calculated noise levels should include projected traffic levels, the measured ones will not. The calculated levels will be based on daily traffic counts derived by averaging months of data, the measured levels will, at best, reflect just a few days. (This is particularly true for aircraft noise contours. The day-to-day operations of an airport can vary significantly depending upon weather conditions and any one or two days worth of measurements are very likely to show different levels from those generated by a computer model employing a year of data to derive an average day.)

If you have determined that noise measurements are appropriate, you must make sure that they are done properly, otherwise the data will be useless. There are four elements to proper measurements: 1) where the measurements are taken; 2) when they are taken; 3) the type of equipment used; and 4) the actual measurement procedure.

Where measurements should be taken: The locations for noise measurements should be selected using the same criteria you would use to select a Noise Assessment Location for a *Noise Assessment Guidelines* calculation. The *Noise Assessment Guidelines* recommend that "assessments of the noise exposure should be made at representative locations around the site where significant noise is expected." Further, the *Guidelines* state that when selecting these locations you should consider those buildings containing noise sensitive uses which are closest to the predominant noise sources. Where quiet outdoor space is desired at a site, you should also select points in the outdoor area in question. Specifically, the "relevant measurement location for buildings is a point 2 meters (6.5 feet) from the facade." If there are no buildings yet the measurement point should be 2 meters from the closest point setback requirements would allow a building facade.

When measurements should be taken: Because measurements are only going to be taken for a few days at best, special care should be taken to make sure that the days selected are representative of average traffic levels. For highways, avoid both Monday and Friday, particularly before or after a holiday. In fact holiday periods, such as the Christmas/New Years season, should be avoided entirely. Highway traffic, or rather more importantly, truck traffic is likely to be down during these periods and noise levels may be significantly lower than normal. On the other hand, holiday periods are often peak travel periods for airlines and measurements taken around airports then would show unusually high noise levels.

Whoever is taking the measurements should also check to make sure that there aren't any special circumstances that might affect traffic levels. For example road construction or repair work might divert additonal traffic onto the road being measured, or divert traffic away. In both cases the noise levels measured would not be representative.

And finally, noise measurements should not be taken during extreme weather conditions both because of the possible effects on traffic levels but also because the weather conditions can exaggerate the actual noise levels.

Ideally, noise measurements should be taken over several days spread over at least a few months. But given that time and money will normally preclude this, at least make sure the one or two days you can get are as close to typical as possible.

What equipment to use: There are many sound level meters on the market which are suitable for taking noise measurements for transportation sources. They need only to meet the requirements of American National Standard Specification for Type 1 Sound Level Meters: S1.4-1971. Type 1 sound level meters are "precision" meters and provide the most accurate measurements. They are also, of course, the most expensive. Fast time-averaging and A frequency weighting are to be used. The sound level meter with the A-weighting is progressively less sensitive to sound with frequencies below 1,000 hertz, somewhat as is the ear. With fast time averaging the sound level meter responds particularly to recent sounds almost as quickly as does the ear in judging the loudness of a sound. Fast time averaging has a time constant of about 1/8 second.

While a sound level measuring system that averages decibel readouts on a short term basis such as for every minute or every hour is acceptable, it would be far better if a system that actually provides a 24 hour integrated L_{dn} readout were used. Such a system eliminates the need for calculating the L_{dn} value, an area where many inexperienced consultants go astray. These systems are more expensive however, and the consultant who doesn't do much noise work is unlikely to have one.

Measurement procedures: Detailed procedures for making sound level measurements are spelled out in the American National Standards Institute's Standard Methods ANSI S1.2-1962(R1976) *American National Standard Method for the Physical Measurement of Sound* and ANSI S1.13-1971(R1976) *American National Standard Methods for the Measurement of Sound Pressure Levels.*

Some of the basic procedures that should be followed are:

1. Measurements should normally be made over a continuous 24 hour period. If this is not possible, measurements may be made over a period of days but still must cover the entire 24 hour period. The selection of the days becomes even more critical so that they are as similar as possible. Sampling is not acceptable.
2. The sound level meter must be calibrated before each use.
3. The sound level meter should be provided with a wind screen.
4. Care should be taken to insure that there are no temporary obstructions, such as parked trucks, between the meter and the source.

The Noise Study

The noise study prepared to describe the measurement results should contain at least the following:

1. A map showing where the measurements were taken
2. A vicinity map showing the site and the major noise sources
3. A chart indicating the date, the time, and weather conditions when measurements were taken at each measurement location
4. The type of microphone used
5. Any variations from ANSI procedures
6. The results of the measurements in L_{dn} for each measurement location
7. Any unusual conditions that existed during the measurement period—i.e. construction activity, major traffic tieup, etc.
8. If an integrating sound level meter was not used, the calculations used to derive the L_{dn} value.

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U.S. Department of Housing and Urban Development
Office of Community Planning and Development

Noise Notebook

Chapter 4
Supplement

Sound Transmission Class Guidance

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Sound Transmission Class Guidance

Introduction

The Noise Guidebook, pages 33-37, provides an elementary discussion of STC, provides some STC ratings for common building materials and limited exterior and interior wall construction configurations, and describes a method to determine composite STC value of a wall containing a window or door. This update provides for an understanding of STC and provides an expanded material and construction classification for both internal and external building materials and typical construction patterns.

The intent of this chapter is not to endorse anyone building manufacturer or product over another but to keep HUD Environmental staff and other interested persons advised on the STC values of current building materials and practices which can be applied to HUD supported housing activities. Additional subsections on specific types of building materials, construction techniques and STC values will be periodically added.

As stated in the Noise Guidebook, "STC is used as a measure of a material's ability to reduce sound," and effectively mitigate any adverse noise levels that could impede a person's use of a residential or commercial structure. The higher the STC value, the greater the sound attenuation and presumably the quieter the structure's interior. In addition to STC, another interior building measuring technique to evaluate sound impact or absorption between floors is the Impact Isolation Class (IIC). Both techniques will be fully discussed after a brief explanation of the following basic principals related to sound.

What Is Sound

Sound is indicated in two ways: frequency and intensity. Frequency, the high or low pitch of sound, is expressed as the number of vibrations or cycles per second. One vibration or cycle per second is a hertz (Hz). For example on a piano the middle C note has a frequency of 262 Hz and the total range of a piano has a frequency of 27 Hz to 4186 Hz, well within the 16 to 20,000 Hz range of the human ear. The sound created by the piano is heard by the human ear by air pressure created by vibration. The greater the pressure, the greater the loudness or intensity of the sound heard by the human ear. Loudness is expressed in decibels (dB). The decibel is one-tenth of a "Bel," a unit named for Alexander Graham Bell. Since the ear is more sensitive to sound in the middle range of frequencies, loudness (intensity) is determined at a frequency of 1,000 Hz. On the decibel scale, 0 dB indicates a level of sound at 1,000 Hz, a sound just barely audible to person with normal unimpaired hearing.

The A-weighted scale of a sound meter is designed to adjust the sensitivity of a sound meter to sounds of different frequencies that closely approximate how the human ear might respond to moderate sound levels in the 1,000 to 4,000 Hz range. The A-weighted sound level is used extensively for measuring community and transportation noises.

The Sound Transmission Class (STC), measured in decibels, is used to measure building material's ability to absorb sound. The STC can be used to measure sound absorption for both external building walls and internal walls in single and multifamily structures. The STC is measured by positioning a representative sample of the building material midway in an acoustical chamber, dividing the chamber in half or into two rooms. One section of the chamber contains the sound source and the other section the sound receiving equipment. The test procedure calls for a steady sound in the source room and measuring the sound level in both the source and receiving rooms. Differences in sound levels in the rooms determines the transmission loss characteristics of the material tested. For example, if a generated sound level of 80 dB is measured in the source room and 30 dB is measured in the adjacent receiving room, the tested material has a sound reduction intensity (STC) of 5OdB.

The Impact Isolation Class (IIC), measured in decibels, is the classification system used to determine sound *impact* from floor to ceiling in a structure. The IIC is not to be used to measure airborne sound penetration or absorption in walls. The IIC numerical rating efficiency increases with improved impact isolation performance of the floor and its component sub flooring and materials. The rating scale values are generally equivalent to the airborne sound transmission loss. The impact of steps or vibrations on a floor and the reverberation of that noise in the room below is dependent upon the type, density and thickness of the floor and ceiling material, its absorption material, and quality of construction. A separate section on common floor materials and construction patterns to illustrate both the STC and IIC ratings is included.

Sound Reduction In Structures

Four general techniques for controlling noise in single-family and multifamily structures are:

1. Elimination of the cause or source of the noise,
2. Employ materials which absorb sound rather than reflect noise,

3. Use sound barriers in building layout to prevent sound from being transmitted from one adjoining area into another, and
4. Use design considerations to mask or absorb the noise.

A description of each technique and its applicability follows.

1. ELIMINATION:
The elimination of a noise source may be impractical or impossible to achieve, whether emanating from within or outside the structure. Examples include the operation of mechanical equipment within the dwelling unit, excessive corridor noise, air conditioning/heating system, elevators, exhaust fans, and outdoor transportation sounds such as automotive traffic, aircraft overflights, and commercial or industrial activities. Some noise reduction could be achieved through sound reduction or absorption techniques, but total elimination of these sounds may be impossible.

2. ABSORPTION:
Sound absorption control is the reduction of sound emanating from a source within a room. The extent of control depends upon the efficiency of the room's surfaces in absorbing rather than reflecting sound waves. A surface, which could theoretically absorb 100% of the sound would have a sound absorption coefficient of 1.0. A surface absorbing 35% of the sound would have a coefficient of 0.35. The effectiveness of wall construction as a means of sound absorption is tested in a similar manner as that of STC. If a generated sound level of 80 dB is observed in one room and 30 dB is measured in an adjacent room, the reduction in sound absorption for the intervening wall is 50 dB. In choosing the type of construction material for interior walls to absorb sound transmission, porosity and density of the material should be considered. Resistance to sound transmission increases with unit weight and decreases with porosity. For example, unpainted, open textured concrete block exhibits improved resistance to sound passage after sealing the surface with plaster or paint. The sealing of the pores result in a reduction in the sound absorption of the block. In multifamily structures using concrete block partitions to separate public areas such as stairwells and corridors from adjacent living areas, sound transmission reduction is achieved through plastering or painting the surface of the residential unit or living area on the opposite side of the partition. The sound is absorbed by the concrete masonry's unpainted side and its transmission is prevented into the residential unit or living area by the plaster or paint on the other side.

However, all of the design elements that are employed to control sound can be nullified through poor or improper construction practices. Sound leakage will occur through any opening in a wall. An improperly fitted door or window is a prime source of sound leakage, as well as openings around ducts, pipes and electrical outlets which are improperly fitted or sealed.

3. SOUND BARRIERS:
Prudent building layout can be effective in controlling noise in single-family and multifamily housing. Sound waves can be prevented from being transmitted from one adjoining area to another. Closets, stairways and corridors can be used as buffers against airborne sound transmission between apartments or bedrooms. Concrete blocks or solid partitions can be employed to separate boiler rooms, air conditioning units, work areas or noisy public areas such as stairwells, corridors or lobbies from adjacent living areas. Partitions designed to absorb sound on one side and to retain sound absorption on the other can effectively block or reduce sound transmission into living areas intended for quiet use. The barrier should have a high sound absorption coefficient on one side and an equally high sound retention coefficient on the reverse side to effective. For example, unpainted porous concrete block would have a high sound absorption coefficient and a high noise retention coefficient on the reverse side if the porous surface in the living unit was effectively sealed by plaster or paint. Similarly, noise originators such as cloths washing machines, central heaters, and other noisy major appliances can be placed in a basement or utility rooms that are physically isolated from other living areas by walls or floors to absorb or block the emitted sounds.

4. DESIGN:
Design factors is the last major element to consider in controlling noise in single-family and multifamily structures. Design considerations offer the most infinite prospects for controlling noise due to the numerous types of building designs. For example, adjacent apartments can be arranged to have quiet areas (bedrooms or living rooms) abut and have noisy areas (kitchens and bathrooms) next to similar noisy areas. Apartment door openings into the same hallway can be staggered to reduce sound penetration into the unit directly across the hall. Since sound travels in a straight line, some of the sound from one doorway would be absorbed or diffused into the wall building material of the unit directly across the hall.

Windows should be placed as far away as possible from common walls. The closer the windows are to each other, the more sound will pass from one apartment to another. Medicine cabinets in opposite bathroom partitions should be offset. Cabinets placed back-to-back will transmit almost as much noise as an opening. Heating/cooling ducts are like speaking tubes, carrying noise from one room to another. Techniques should be employed to trap or splinter

sound or have turns in the ducts to reduce noise transference.

Noise producing equipment should be kept as far as possible from living areas and especially the bedrooms. Flexible connectors should be used to couple mechanical equipment to pipes and ducts. Pipes and ducts should not be firmly connected to parts of a building that could serve as sounding boards but be supported by resilient connections to solid supports. Where pipes and ducts pass through walls and floors, they should be isolated by gaskets. The acoustical integrity of a building or a building section with an otherwise adequate STC rating can be significantly reduced by a small hole or crack in the exterior wall or any other path that allows sound to bypass the exterior or interior walls and flow into other areas of the structure.

Weather and Sound

Air will attenuate noise at high frequencies usually from 1,000 Hz upwards. Sound absorption by air changes with wind speed, temperature and humidity. For example, wind blowing at slower speeds near the ground surface than at higher elevations will produce a bending of the sound upwards, resulting in less noise at ground level. Temperature gradients have a similar effect because the velocity of sound increases with the higher temperatures. If the temperature is higher near the ground than in the upper layers (usually the case during the day), the sound waves higher above the ground will travel slower and the sound will be bent upwards resulting in quieter conditions at ground level. The reverse is true at night, the temperature is lower near the ground, sound will bend towards the ground, increasing noise at the ground level. Wind and temperature- gradient effects can also account for the occasional freak reception of sounds over long distances, especially train whistles. The sound has been bent upwards by a temperature or wind gradient and after traveling some way at high level is bent down again by a reverse gradient.

Weather conditions can produce substantial variations of as much as +- 10 dB. For example, fog causes an increase in the absorption in the air. A moderately dense fog, visibility 150 feet, gives extra attenuation of 1 to 3 dB per 300 feet, depending on frequency. Similarly, snow forms an absorbent layer on the ground, which affects ground reflection, thereby reducing the sound level.

Weather can also be a significant source of noise in a structure. Common irritants are wind and rain. Wind whistling around a building, into ventilation grilles, screens or past other external architectural or artistic features can result in disturbing noise. Similarly, the impact of rain on lightweight roofing, gutters or skylights can produce high internal noise levels.

STC Ratings for Wall, Floor and Window Materials and Assemblies

Appendix A illustrates sound transmission class ratings for wall, floor, window and door assemblies. The data used in this section is compiled from laboratory reports and various technical and trade literature publications received by this Office. Each item has an assigned STC rating, an accompanying sketch and a brief description of its composition or assembly. In addition, where possible, an Impact Isolation Class (IIC) rating has been assigned to floors to determine sound impact from floor to ceiling. Appendix A is a guide designed to aid HUD Housing and Environmental personal in determining STC values for most common housing construction practices and materials used in residential construction. The STC information can be used to supplement acoustical measurements by providing approximate interior noise levels for existing or proposed dwellings located in high noise areas by deducting the STC value from the exterior noise level. The data could also be used to advise HUD clients in determining and achieving compliance with the noise criteria stated in 24 CFR Part 51 B through the use of common construction materials and techniques to achieve noise attenuation for new construction and rehabilitation.

The appendix is divided into the following subsections:

1. WALLS
    - Exterior
    - Interior
2. FLOORS
    - Wood
    - Concrete
3. WINDOWS
4. DOORS
    - Exterior
    - Interior

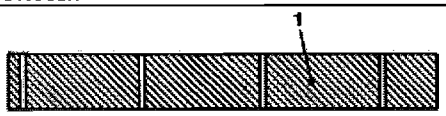
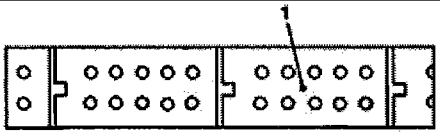
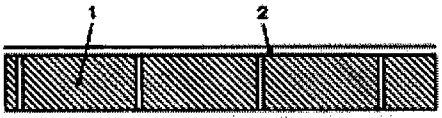
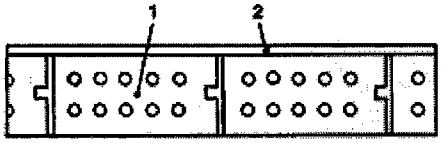
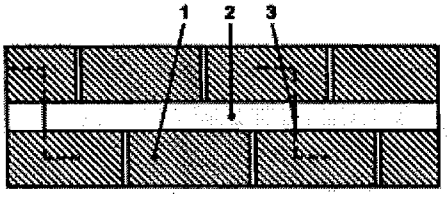
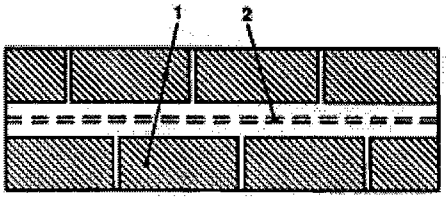
A bibliography of the reports, manufacturer's catalogs, technical papers, testing laboratories and other publications used in compiling this data is listed in the Appendix B.

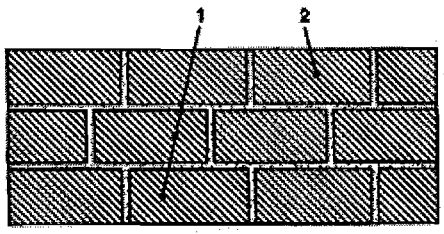
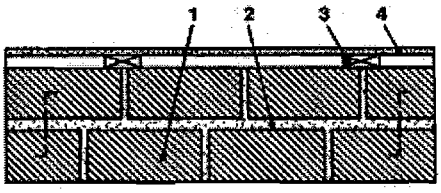
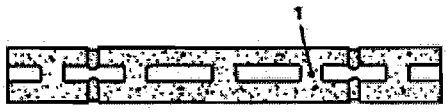
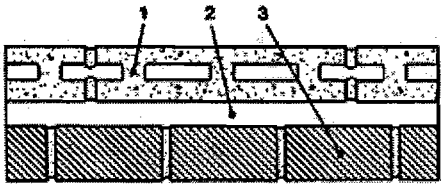
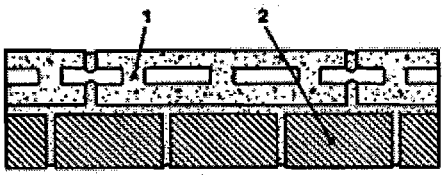
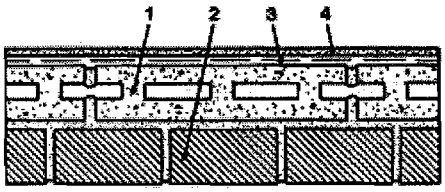
Appendix A STC Ratings

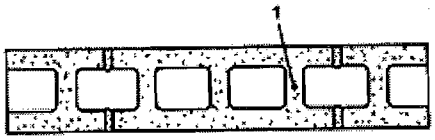
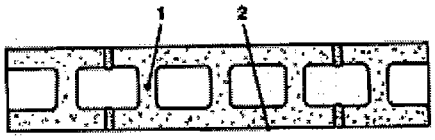
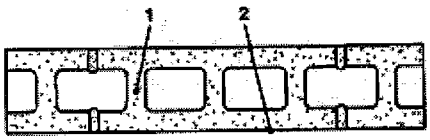
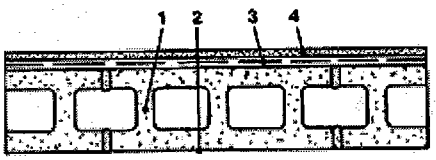
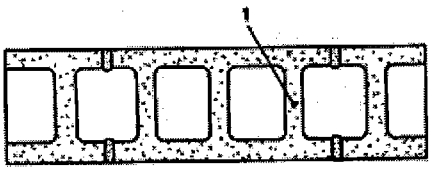
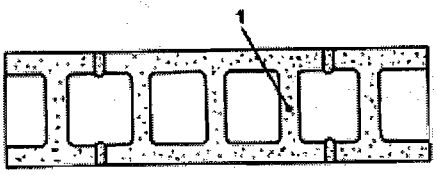
Appendix A

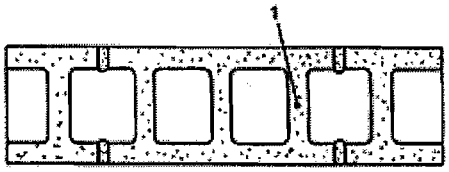
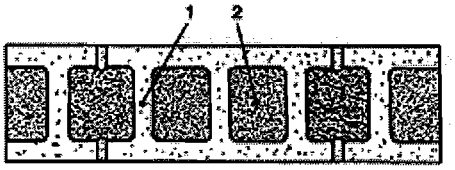
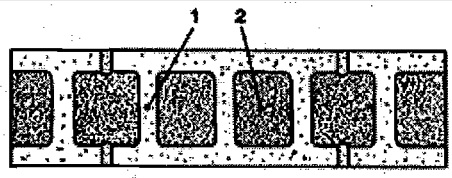
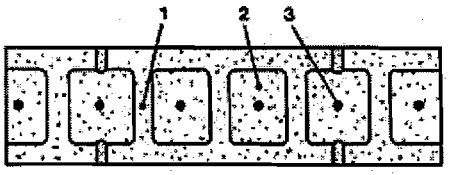
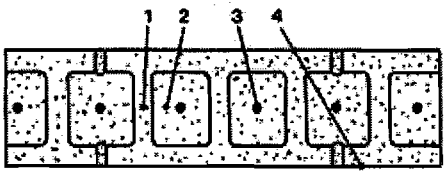
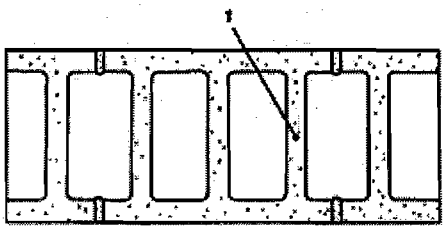
STC Ratings

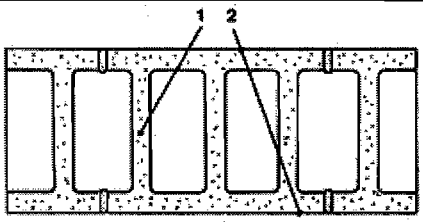
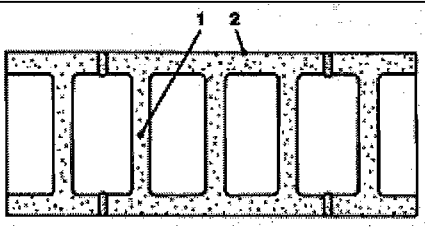
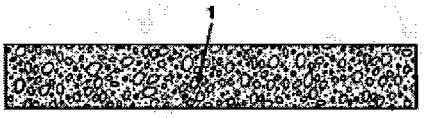
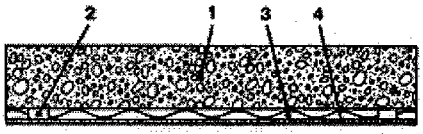
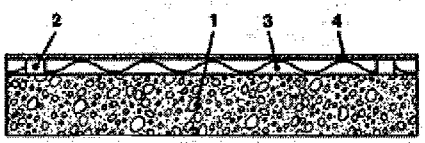
Walls: Exterior

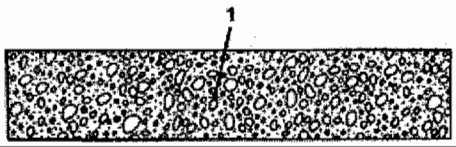
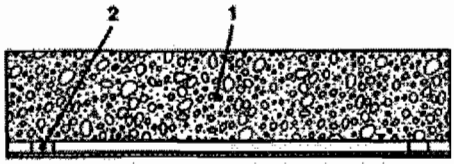
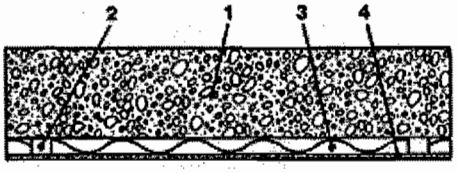
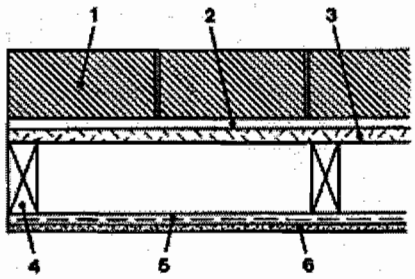
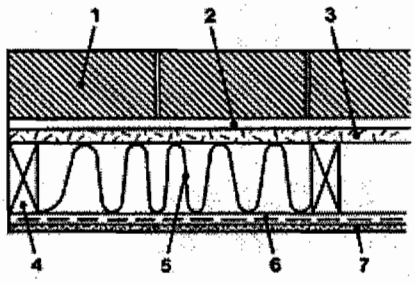
Sketch	Brief Description	STC
	1. 4" face brick, mortared together.	45
	1. Hollow core brick, mortared together.	51
	1. Common brick, mortared together. 2. ½" gypsum/sand plaster.	50
	1. Hollow core brick, mortared together. 2. ½" gypsum/sand plaster.	53
	1. Face brick, mortared together. 2. 2" air space. 3. Metal ties.	50
	1. Brick, mortared together. 2. 2 ¼" cavity filled with concrete grout and #6 bars vertically 48"o.c. and #5 bars horizontally 30"o.c.	59

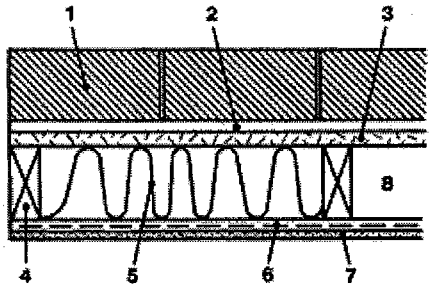
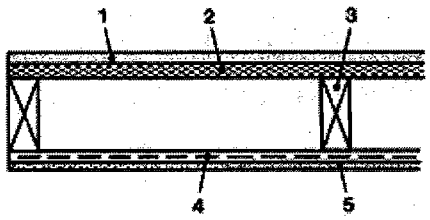
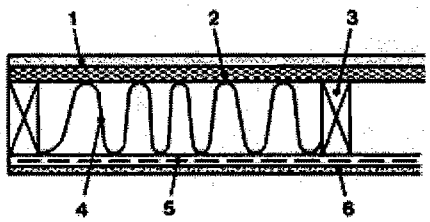
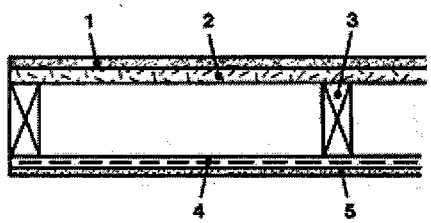
Sketch	Brief Description	STC
	1. Common brick, mortared together. 2. Face brick, mortared together.	59
	1. Common brick, mortared together. 2. ¾" mortar-filled cavity with metal Z ties 24"o.c. in both directions. 3. 1x3" furring strips 16"o.c. and nailed vertically into mortar joints 12"o.c. 4. ½" gypsum board nailed 8"o.c. along edges and 12"o.c. in field.	53
	1. 4x8x16" 3-cell lightweight concrete masonry units (17 lbs./block).	40
	1. 4x8x18" 3-cell lightweight concrete masonry units (19 lbs./block). 2. 2" air cavity. 3. Common brick, mortared together.	54
	1. 4x8x18" 3-cell lightweight concrete masonry units (19 lbs./block). 2. Common brick, mortared together. (brick headers after every second course of block to tie the withes together).	51
	1. 4x8x18" 3-cell lightweight concrete masonry units (19 lbs./block). 2. Common brick, mortared together. 3. Resilient channels. 4. ½" gypsum board screwed to channels.	56

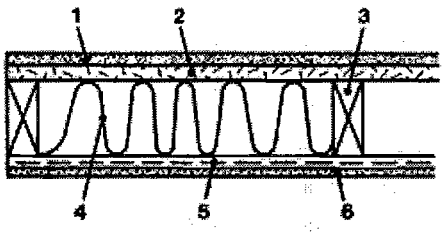
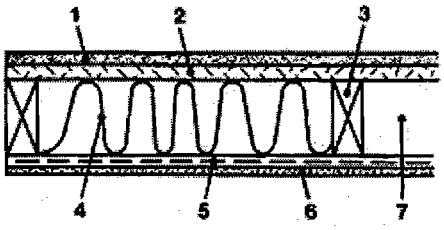
Sketch	Brief Description	STC
	1. 6x8x16" 3-cell lightweight concrete masonry units (21 lbs./block).	44
	1. 6x8x16" 3-cell lightweight concrete masonry units (21 lbs./block). 2. Paint both sides with primer-sealer coat and finish coat of latex.	46
	1. 6x8x18" 3-cell dense concrete masonry units (36 lbs./block). 2. Paint both sides with primer-sealer coat and finish coat of latex.	48
	1. 6x8x16" 3-cell lightweight concrete masonry units (21 lbs./block). 2. Paint, primer-sealer coat and finish coat of latex. 3. Resilient channels, 24"o.c. 4. ½" gypsum board screwed to channels.	53
	1. 8x8x16" 3-cell lightweight concrete masonry units (28 lbs./block).	45
	1. 8x8x18" 3-cell lightweight concrete masonry units (34 lbs./block).	49

Sketch	Brief Description	STC
	1. 8x8x18" 3-cell lightweight concrete masonry units (38 lbs./block).	49
	1. 8x8x18" 3-cell lightweight concrete masonry units (34 lbs./block). 2. Expanded mineral loose-fill insulation.	51
	1. 8x8x18" 3-cell lightweight concrete masonry units (38 lbs./block). 2. Expanded mineral loose-fill insulation.	51
	1. 8x8x18" 3-cell lightweight concrete masonry units (33 lbs./block). 2. Grout in cells. 3. #5 bar in each cell.	48
	1. 8x8x18" 3-cell lightweight concrete masonry units (33 lbs./block). 2. Grout in cells. 3. #5 bar each cell. 4. Paint two coats flat latex each side.	55
	1. 12x8x16" 3-cell lightweight concrete masonry units (43 lbs./block).	39

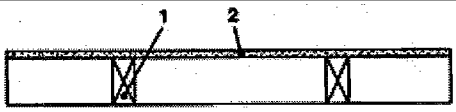
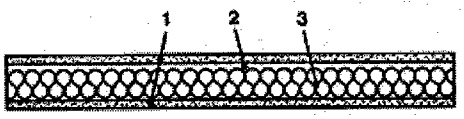
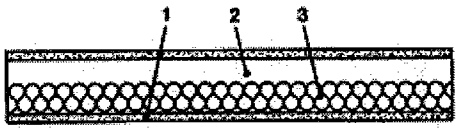
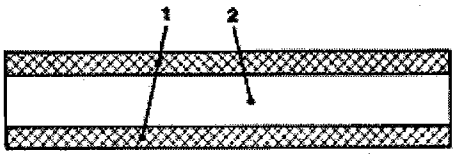
Sketch	Brief Description	STC
	1. 12x8x16. 3-cell lightweight concrete masonry units (43 lbs./block). 2. Paint both sides with 3 coats of latex block filler.	50
	1. 12x8x16" 3-cell lightweight concrete masonry units (43 lbs./block). 2. Paint one side only with 3 coats latex block filler.	51
	1. 6" cast concrete wall (71 psf).	57
	1. 6" cast concrete wall. 2. "Z" furring channels. 3. ½" gypsum board.	59
	1. 6" cast concrete wall. 2. "Z" furring channels. 3. 1", 8-pcf rockwool. 4. ½" gypsum board.	62
	1. 6" cast concrete wall. 2. 2x2" wood furring. 3. 1 ½" 4-pcf rockwool. 4. ½" gypsum board.	63

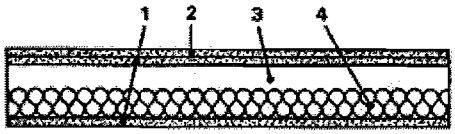
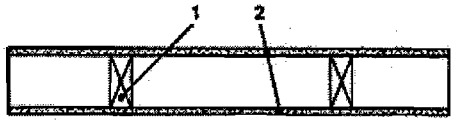
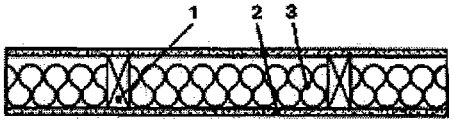
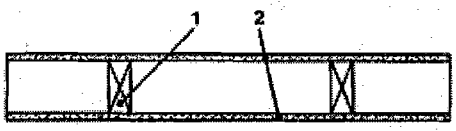
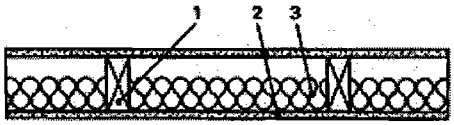
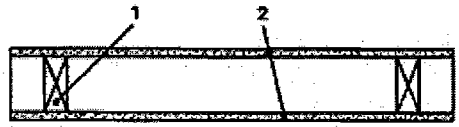
Sketch	Brief Description	STC
	1. 8" cast concrete wall (96.6 psf).	58
	1. 8" cast concrete wall. 2. 2x2" wood furring. 3. ½" gypsum board.	59
	1. 8" cast concrete wall. 2. 2x2" wood furring. 3. 1 ½", 4 psf rockwall. 4. ½" gypsum board.	63
	1. Face brick. 2. ½" air space, with metal ties. 3. ¾" insulation board sheathing. 4. 2x4" studs 16"o.c. 5. Resilient channel. 6. ½" gypsum board.	54
	1. Face brick. 2. ½" air space, with metal ties. 3. ¾" insulation board sheathing. 4. 2x4" studs 16"o.c. 5. Fiberglas building insulation (3 ½"). 6. Resilient channel. 7. ½" gypsum board.	56

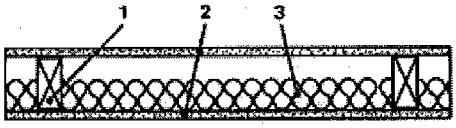
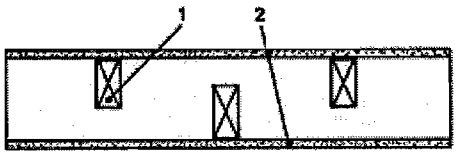
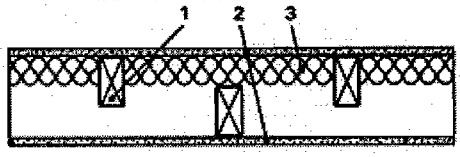
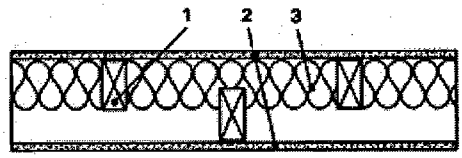
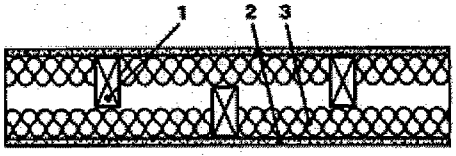
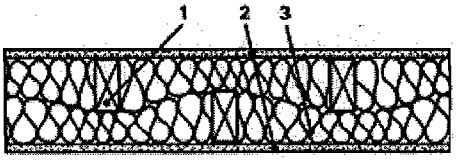
Sketch	Brief Description	STC
	1. Face brick (9x14' wall). 2. ½" air space, with metal ties. 3. ¾" insulation board sheathing. 4. 2x4" studs 16"o.c. 5. Fiberglas building insulation (3 ½"). 6. Resilient channel. 7. ½" gypsum board. 8. Wall penetrated by 6x5' picture window 1" glazed insulating glass.	39
	1. 7/8" stucco. 2. No.15 felt building paper and 1" wire mesh. 3. 2x4" studs 16"o.c. 4. Resilient channel. 5. ½" gypsum board screwed to channel.	49
	1. 7/8" stucco. 2. No.15 felt building paper and 1" wire mesh. 3. 2x4" studs 16"o.c. 4. Fiberglas building insulation (3 ½"). 5. Resilient channel. 6. ½" gypsum board screwed to channel.	57
	1. 5/8 x 10" redwood siding. 2. ½" insulation board sheathing. 3. 2x4" wood studs 16"o.c. 4. Resilient channel. 5. ½" gypsum board screwed to channel.	43

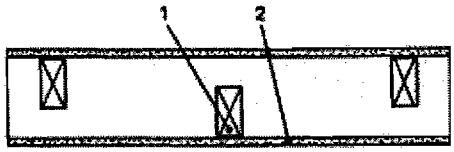
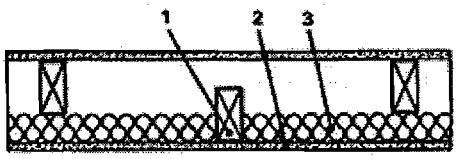
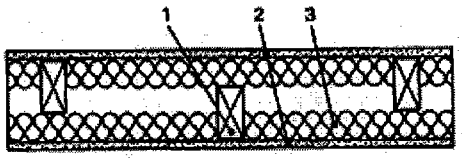
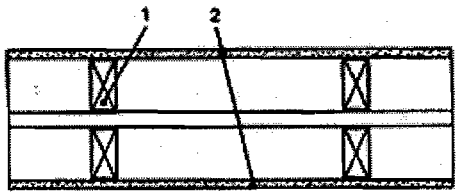
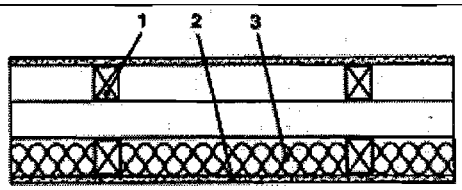
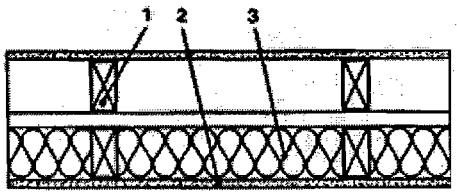
Sketch	Brief Description	STC
	1. 5/8x10" redwood siding. 2. ½" insulation board sheathing. 3. 2x4" wood studs 16"o.c. 4. Fiberglas building insulation (3 ½"). 5. Resilient channel. 6. ½" gypsum board screwed to channel.	47
	1. 5/8x10" redwood siding (9x14' wall). 2. ½" insulation board sheathing. 3. 2x4" wood studs 16.o.c. 4. Fiberglas building insulation (3 ½"). 5. Resilient channel. 6. ½" gypsum board screwed to channel. 7. a. Wall penetrated by a 6x5' picture window, 1" glazed insulating glass. b. Wall penetrated by a 6x5' 16 panel window, glazed single strength.	(a.38) (b.35)

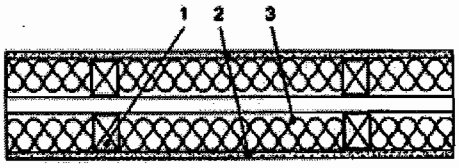
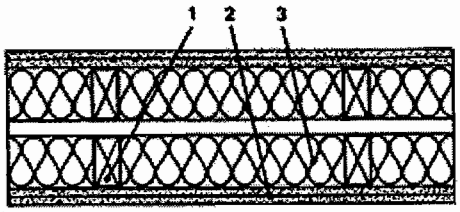
WALLS: Interior: Wooden Studs

Sketch	Brief Description	STC
	1. ½" gypsum board. 2. 3/16" plywood laminated with contact cement.	28
	1. ½" gypsum board. 2. ½" wood-fiber board laminated with gypsum joint compound.	30
	1. 2x4" studs, 16"o.c. 2. 5/8" gypsum board screwed to studs.	28
	1. ½" gypsum board, no studs. 2. 2 ½" air space.	30
	1. ½" gypsum board, no studs. 2. 2 ½" air space. 3. 2" thick sound attenuation blanket.	44
	1. ½" gypsum board, no studs. 2. 3 5/8" air space. 3. 2" thick sound attenuation blanket.	45
	1. 1 3/8" thick wood-fiber board nailed to 2x4" plates top and bottom and painted both sides. 2. 3 ½" air cavity.	44

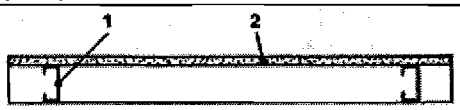
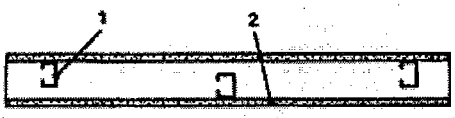
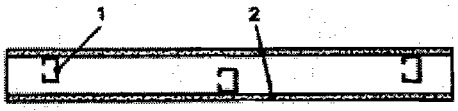
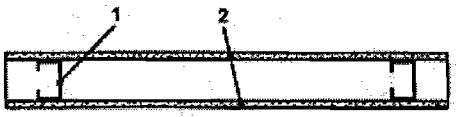
Sketch	Brief Description	STC
	1. ½" gypsum board, no studs. 2. ½" gypsum board laminated to base layer with gypsum joint compound. 3. 3 5/8" air cavity. 4. 2" thick sound attenuation blanket.	48
	1. 2x4" studs, 16"o.c. 2. 3/8" gypsum board nailed to studs.	35
	1. 2x4" studs, 16"o.c. 2. 3/8" gypsum board nailed to studs. 3. 3" thick sound attenuation blanket.	41
	1. 2x4" studs, 16"o.c. 2. ½" gypsum board screwed to studs.	34
	1. 2x4" studs, 16"o.c. 2. ½" gypsum board screwed to studs. 3. 2" thick sound attenuation blanket.	37
	1. 2x4" studs, 24"o.c. 2. ½" gypsum board screwed to studs.	36

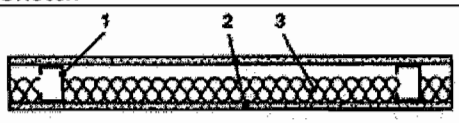
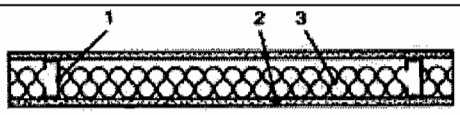
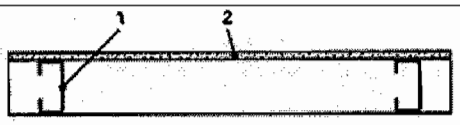
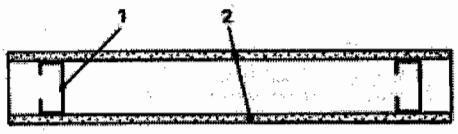
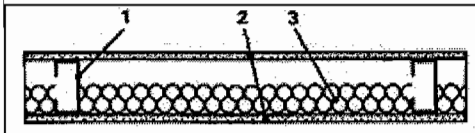
Sketch	Brief Description	STC
	1. 2x4"studs, 24"o.c. 2. ½" gypsum board screwed to studs. 3. 2" thick sound attenuation blanket.	40
	1. 2x4" studs spaced 16"o.c. and staggered 8"o.c. on 2x6" plates. 2. ½" gypsum board screwed 12"o.c.	39
	1. 2x4" studs spaced 16"o.c. and staggered 8"o.c. on 2x6" plates. 2. ½" gypsum board screwed 12"o.c. 3. 2 ¼" thick sound attenuation blanket.	48
	1. 2x4" studs spaced 16"o.c. and staggered 8"o.c. on 2x6" plates. 2. ½" gypsum board screwed 12"o.c. 3. 3 ½" thick sound attenuation blanket.	49
	1. 2x4" studs spaced 16"o.c. and staggered 8"o.c. on 2x6" plates. 2. ½" gypsum board screwed 12"o.c. 3. 2 ¼" thick sound attenuation blankets in both stud cavities.	49
	1. 2x4" studs spaced 16"o.c. and staggered 8"o.c. on 2x6" plates. 2. ½" gypsum board screwed 12"o.c. 3. 3 ½" thick sound attenuation blankets in both stud cavities.	51

Sketch	Brief Description	STC
	1. 2x4" studs spaced 24"o.c. and staggered 12"o.c. on 2x6" plates. 2. ½" type X gypsum board screwed 12"o.c.	42
	1. 2x4" studs spaced 24"o.c. and staggered 12"o.c. on 2x6" plates. 2. ½" gypsum board screwed to studs. 3. 2" thick sound attenuation blanket.	46
	1. 2x4" studs spaced 24"o.c. and staggered 12"o.c. on 2x6" plates. 2. ½" type X gypsum board screwed 12"o.c. 3. 2" thick sound attenuation blankets in both stud cavities.	48
	1. Double row of 2x4" studs 16"o.c. on separate plates spaced 1" apart. 2. ½" type X gypsum board screwed 12"o.c.	47
	1. Double row of 2x3" studs 16"o.c. on 2x3" plates spaced 2 ½" apart. 2. ½" gypsum board screwed 16"o.c. 3. 2 ¼" thick sound attenuation blanket.	55
	1. Double row of 2x4" studs 16"o.c. on separate plates spaced 1" apart. 2. ½" type X gypsum board screwed 12"o.c. 3. 3 ½" thick sound attenuation blanket.	56

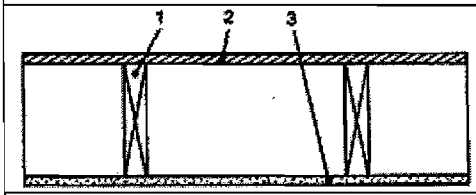
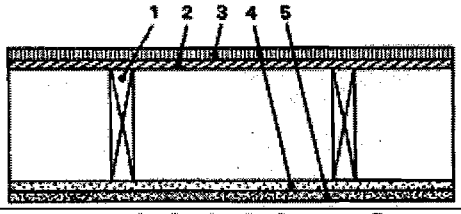
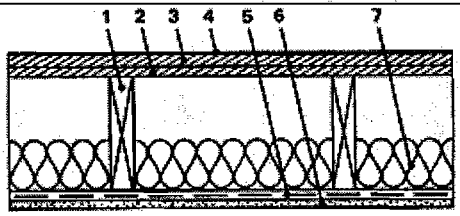
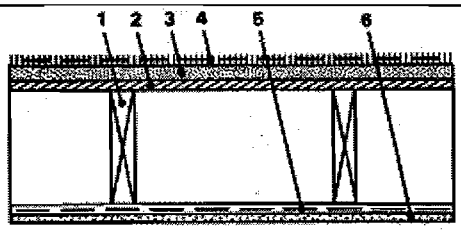
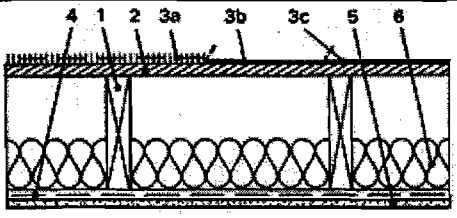
Sketch	Brief Description	STC
	1. Double row of 2x4" studs 16"o.c. on separate plates spaced 1" apart. 2. ½" gypsum board screwed 12"o.c. 3. 2 ¼" thick sound attenuation blankets in both stud cavities.	56
	1. Double row of 2x4" studs 16.o.c. on separate plates spaced 1" apart. 2. Double row of 5/8" type X gypsum board screwed 16.o.c. 3. 3 ½" thick sound attenuation blankets in both stud cavities.	63

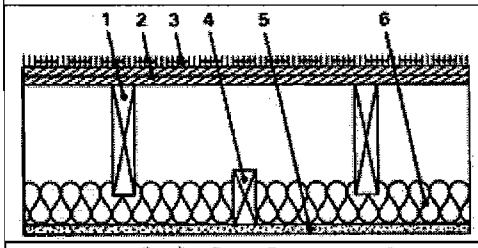
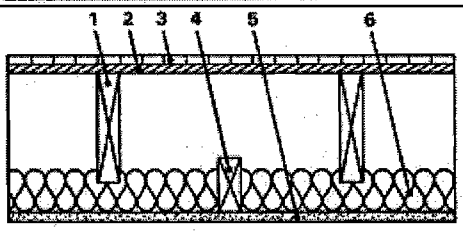
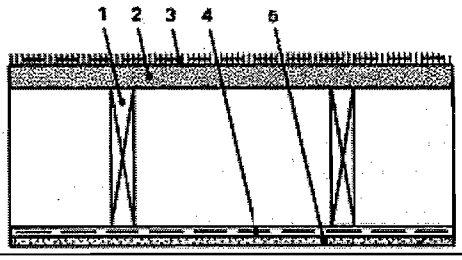
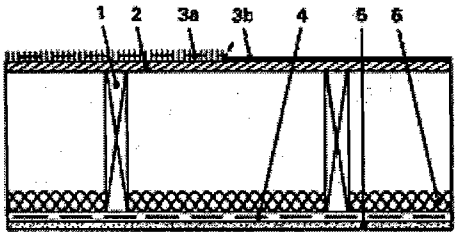
WALLS: Interior: Metal Studs

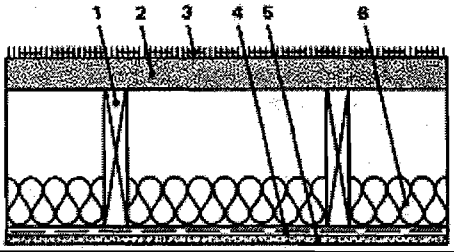
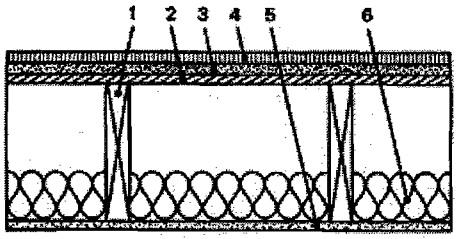
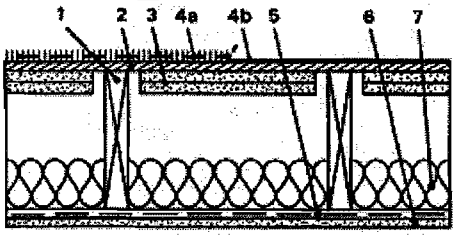
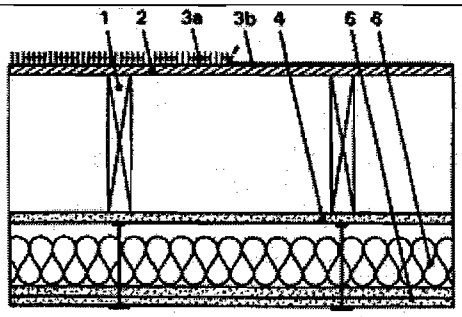
Sketch	Brief Description	STC
	1. 1 5/8" metal studs, 24"o.c. 2. 1/2. vinyl-faced gypsum board screwed to studs.	27
	1. 1 5/8" metal studs spaced 24"o.c. and staggered 12"o.c. on 2 ½" metal tracks. 2. 1/2" gypsum board screwed to studs.	34
	1. 1 5/8" metal studs, 24"o.c. 2. 5/8" gypsum board screwed 12"o.c. at edges and 24"o.c. in field.	37
	1. 1 5/8" metal studs spaced 24"o.c. and staggered 12"o.c. on 21/2" metal channels. 2. 5/8" gypsum board screwed to studs.	38
	1. 2 ½" metal studs, 24"o.c. 2. 1/2" vinyl-faced gypsum board screwed to studs.	27
	1. 2 1/2" metal studs, 24"o.c. 2. 5/8" gypsum board screwed to studs.	37

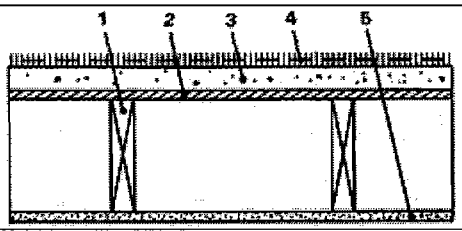
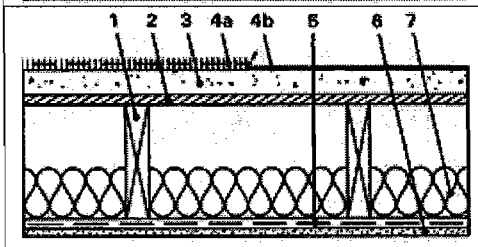
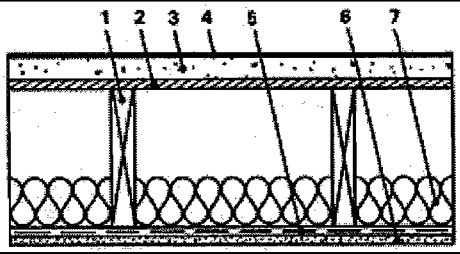
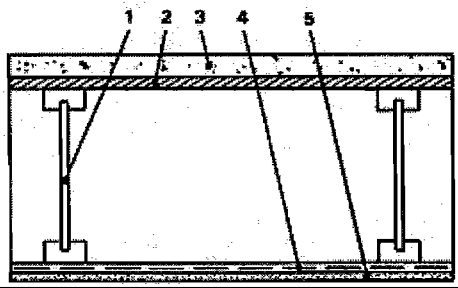
Sketch	Brief Description	STC
	1. 2 ½" metal studs, 24"o.c. 2. 5/8" gypsum board screwed 12"o.c. at edges and 24"o.c. in field. 3. 1 ½" thick sound attenuation blanket.	42
	1. 2 ½" metal studs, 24"o.c. 2. ½" gypsum board screwed to studs. 3. 2" thick sound attenuation blanket.	44
	1. 3 5/8" metal studs, 24"o.c. 2. 1/2. gypsum board screwed to studs.	27
	1. 3 5/8" metal studs, 24"o.c. 2. ½" gypsum board screwed to studs.	36
	1. 3 5/8" metal studs, 24"o.c. 2. ½" gypsum board screwed to studs. 3. 2" thick sound attenuation blanket.	44

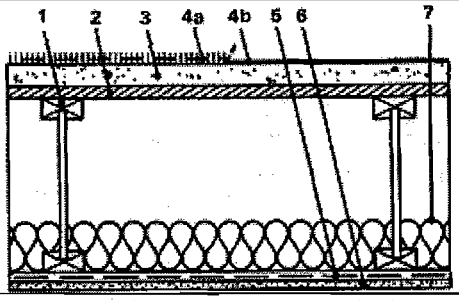
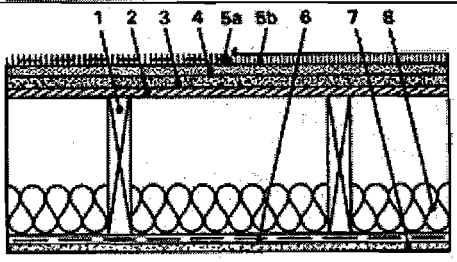
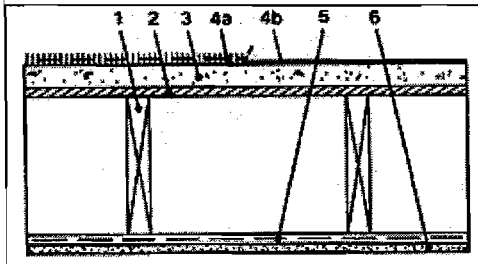
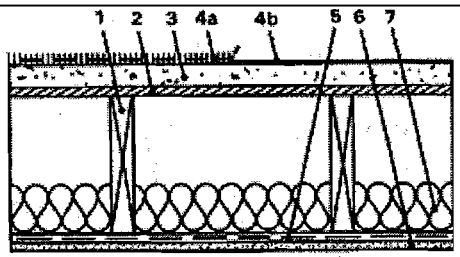
Floors: Wood

Sketch	Brief Description	STC (IIC)
	1. 2x8" wooden joists, 16"o.c. 2. 7/8" tongue and groove nailed to joints. 3. 3/8" gypsum nailed to joints.	NA (32)
	1. 2x8" wooden joists, 16"o.c. 2. ½" plywood nailed. 3. 25/32" hardwood flooring. 4. 1/2" gypsum nailed to joists. 5. Ceiling tire.	NA (37)
	1. 2x8" wooden joists, 16"o.c. 2. 5/8" tongue and groove plywood nailed with 8d nails 6"o.c. 3. 3/8" plywood stapled 3"o.c. at edges and 6"o.c. in field. 4. .075" sheet vinyl. 5. Resilient channels, 24"o.c. 6. 5/8" gypsum board screwed 12"o.c. 7. 3" thick sound attenuation blanket.	46 (44)
	1. 2x8" wooden joists, 16"o.c. 2. 5/8" plywood nailed with 8d nails. 3. ½" nominal wood-fiber board glued to plywood. 4. 44 oz. carpet on 50 oz. pad. 5. Resilient channels, 24"o.c. 6. 5/8" gypsum board screwed 12"o.c.	48 (65)
	1. 2x8" wooden joists, 16"o.c. 2. 19/32" tongue and groove plywood nailed with 8d nails 6"o.c. at edges and 10"o.c. in field. 3. a. 44 oz. carpet on 40 oz. hair pad. b. .075" sheet vinyl. c. 1/16" sheet vinyl. 4. Resilient channels, 24"o.c. 5. 5/8" gypsum board screwed 12"o.c. 6. 3" thick sound attenuation blanket.	48 (a. 69) (b. 45) (c.43)

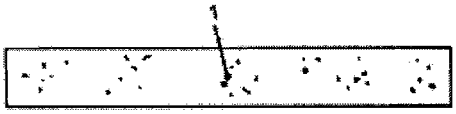
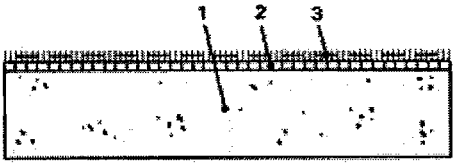
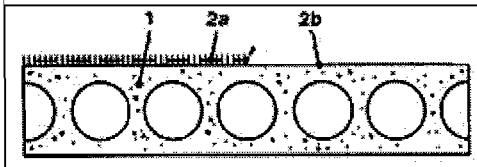
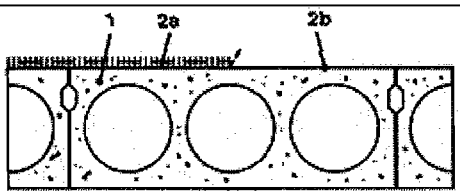
Sketch	Brief Description	STC (IIC)
	1. 2x8" wooden joists, 16"o.c. 2. 1 1/8" tongue and groove plywood nailed 6"o.c. at edges and 16"o.c. in field. 3. 44 oz. wool carpet on 40 oz. hair pad. 4. 2x4" ceiling joists, 16"o.c. and staggered between floor joists. 5. 5/8" gypsum board nailed to 2x4" joists. 6. 3" thick sound attenuation blanket.	53 (80)
	1. 2x8" wooden joists, 16"o.c. 2. 1/2" plywood nailed with 8d nails 6"o.c. at edges and 16"o.c. in field. 3. 25/32" wood strip flooring nailed to sub floor. 4. 2x4" wooden ceiling joists, 16"o.c. and staggered between floor joists. 5. 5/8" gypsum board nailed to 2x4" joists. 6. 3" thick sound attenuation blanket.	54 (45)
	1. 2x10" wooden joists, 16"o.c. 2. 1 11/32" tongue and groove wood-fiber board. 3. 44 oz. wool carpet on 40 oz. hair pad. 4. Resilient channels, 24"o.c. 5. 5/8" gypsum screwed 12"o.c.	49 (68)
	1. 2x10" wooden joists, 16"o.c. 2. 19/32" tongue and groove plywood. 3. a. Carpet and pad. b. Vinyl tile. 4. Resilient channels, 24"o.c. 5. 5/8" gypsum screwed 12"o.c. 6. 1" thick sound attenuation blanket.	51 (a. 74) (b.51)

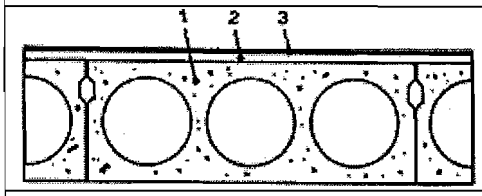
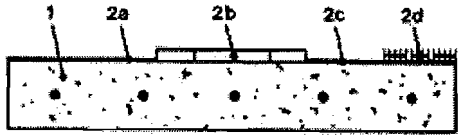
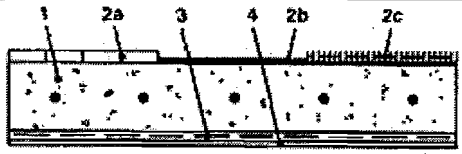
Sketch	Brief Description	STC (IIC)
	1. 2x10" wooden joists, 16"o.c. 2. 1 11/32" tongue and groove wood-fiber board. 3. 40 oz. wool carpet on 80 oz. sponge rubber pad. 4. Resilient channels, 24"o.c. 5. 1/2" gypsum board screwed 12"o.c. 6. 3" thick sound attenuation blanket.	50 (72)
	1. 2x10" wooden joists, 16"o.c. 2. 5/8" plywood sub floor glued to joists, nailed with 8d nails 12"o.c. 3. ¼" particleboard glued to plywood. 4. ½" parquet wood flooring glued to particleboard. 5. ½" type-X gypsum board screwed 12"o.c. 6. 3" thick sound attenuation blanket.	43 (NA)
	1. 2x10" wooden joists, 16"o.c. 2. 5/8" tongue and groove plywood nailed with 8d nails 6"o.c. along edges and 10"o.c. in field. 3. Two layers of 5/8" gypsum board attached with screws 12"o.c. to underside of sub floor. 4. a. 44 oz. carpet on 40 oz. hair pad. b. 1/16" vinyl asbestos tile. 5. Resilient channels, 24"o.c. 6. 5/8" gypsum board screwed 12"o.c. 7. 3 ½" thick sound attenuation blanket.	56 (a. 74) (b.50)
	1. 2x10" wooden joists, 16"o.c. 2. 5/8" tongue and groove plywood nailed with 8d nails 6"o.c. along edges and 10"o.c. in field. 3. a. 44 oz. carpet on 40 oz. hair pad. b. 1/16" vinyl asbestos tile. 4. 5/8" gypsum board nailed 7"o.c. 5. Two layers of 5/8" gypsum board suspended by wire hangers 5" long in a 2x4' heavy-duty T grid ceiling system. 6. 3 ½" thick sound attenuation blanket.	49 (a. 68) (b.47)

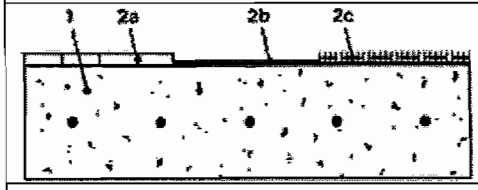
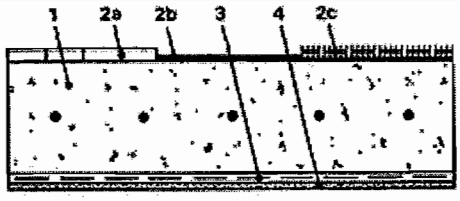
Sketch	Brief Description	STC (IIC)
	1. 2x8" wooden joists, 16"o.c. 2. 5/8" tongue and groove plywood nailed to joists with 8d nails 6"o.c. at edges and 10"o.c. in field. 3. 1 5/8" lightweight concrete over 4 mil. polyethylene film. 4. 44 oz. carpet on 40 oz. hair pad. 5. 5/8" gypsum board nailed to joists.	47 (66)
	1. 2x8" wooden joists, 16"o.c. 2. 5/8" tongue and groove plywood nailed to joists with 8d nails 6"o.c. at edges and 10"o.c. in field. 3. 1 5/8" thick lightweight concrete over 4 mil. polyethylene film. 4. a. 44 oz. carpet on 40 oz. hair pad. b. .075" sheet vinyl. 5. Resilient channels, 24"o.c. 6. 5/8" gypsum board screwed 12"o.c. 7. 3" thick sound attenuation blanket.	53 (a. 74) (b. 47)
	1. 2x10" wooden joists. 16"o.c. 2. 5/8" plywood nailed to joists. 3. 3. 1 ½" thick lightweight concrete, 13 psf. 4. Cushioned vinyl. 5. Resilient channels, 24"o.c. 6. 5/8" gypsum board screwed to channels. 7. 3 ½" thick sound attenuation blanket.	NA (51)
	1. Plywood web I-beams 12" deep and 24"o.c. 2. 3/4" plywood sub floor nailed with 6d nails 6"o.c. at edges and 10"o.c. in field. 3. 1 ½" thick lightweight concrete, 15 psf. 4. Resilient channels, 24"o.c. 5. 5/8" gypsum board screwed 12"o.c.	57 (NA)

Sketch	Brief Description	STC (IIC)
	1. Plywood web I-beams 12" deep and 24"o.c. 2. 3/4" plywood sub floor nailed with 6d nails 6"o.c. at edges and 10"o.c. in field. 3. 1 1/2" thick lightweight concrete, 15 psf. 4. a. 44 oz. carpet on 40 oz. hair pad. b. .07" vinyl tile. 5. Resilient channels, 24.o.c. 6. 5/8" gypsum board screwed 12"o.c. 7. 3" thick sound attenuation blanket.	58 (a. 77) (b. 50)
	1. 2x10" wooden joists, 16"o.c. 2. 5/8" plywood glued to joists, nailed with 8d nails 12"o.c. 3. ¼" particleboard glued to plywood. 4. ½" fiberboard glued to particleboard. 5. a. 76 oz. carpet on 50 oz. hair pad. b. 1/2" parquet wood flooring. 6. Resilient channels, 24"o.c. 7. ½" type-X gypsum board screwed 12"o.c. 8. 3" thick sound attenuation blanket.	51 (NA)
	1. 2x10" wooden joists, 16"o.c. 2. 5/8" plywood sub floor nailed with 8d nails 6"o.c. along edges, 10"o.c. in field. 3. 1 1/2" thick lightweight concrete over 15 lb. asphalt felt. 4. a. 20 oz. carpet on 40 oz. hair pad. b. 1/16" thick vinyl-asbestos tile. 5. Resilient channels, 24"o.c. 6. ½" type-X gypsum board screwed 12"o.c.	56 (NA)
	1. 2x10" wooden joists, 16"o.c. 2. 5/8" plywood sub floor nailed with 8d nails 6"o.c. along edges, 10"o.c. in field. 3. 1 ½" thick lightweight concrete over 15 lb. asphalt felt. 4. a. 20 oz. carpet on 40 oz. hair pad. b. 1/16" thick vinyl-asbestos tile. 5. Resilient channels, 24"o.c. 6. 5/8" type-X gypsum board screwed 12"o.c. 7. 3 ½" thick sound attenuation blanket.	61 (NA)

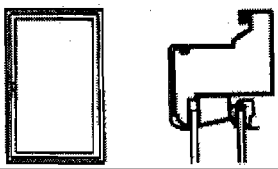
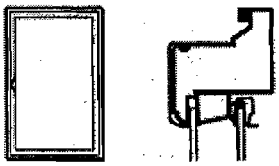
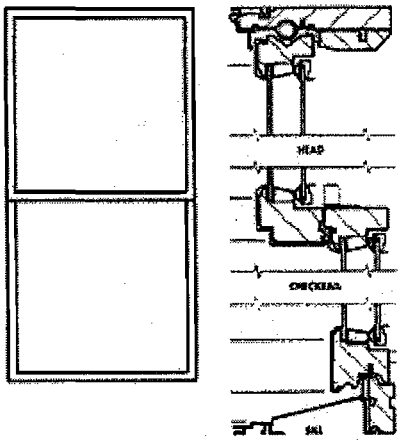
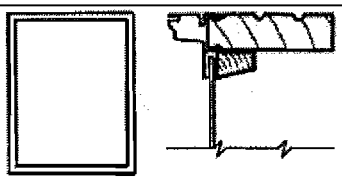
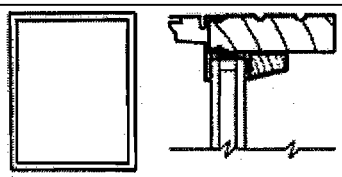
FLOORS: Concrete

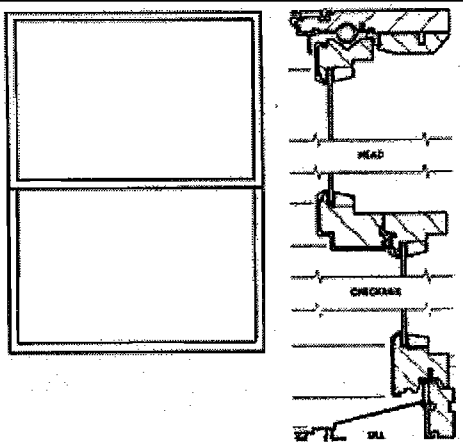
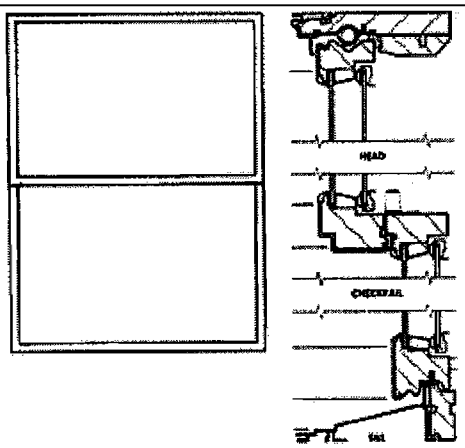
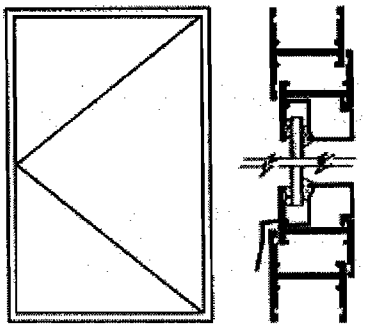
Sketch	Brief Description	STC (IIC)
	1. 4" thick concrete slab, 54 psf.	44 (25)
	1. 6" thick concrete slab, 75 psf.	55 (34)
	1. 6" thick concrete slab. 2. ½" wood-fiber board glued to concrete. 3. 44 oz. carpet on 40 oz. hair pad.	NA (81)
	1. 6" thick hollow-core concrete panel, 45 psf. 2. a. Carpet and pad. b. No floor covering.	48 (a. 69) (b. 23)
	1. 8" thick hollow-core concrete panel, 57 psf. 2. a. 66 oz. carpet on 50 oz. hair pad. b. No floor covering.	50 (a. 74) (b. 28)

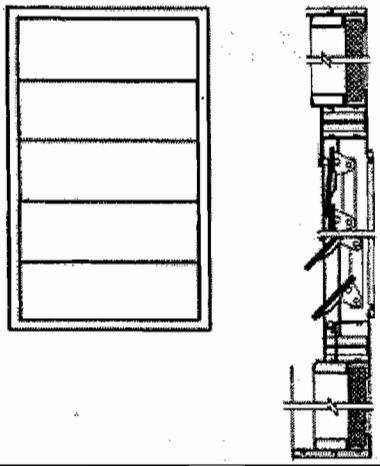
Sketch	Brief Description	STC (IIC)
	1. 8" thick hollow-core concrete panels, 57 psf. 2. 1/4" inorganic felt-supported underlayment board, .6 psf. 3. 3/32" vinyl-asbestos tile.	50 (51)
	1. 3" thick reinforced concrete slab, 35 psf, ceiling bare. 2. a. Vinyl asbestos, 0.08" thick. b. Wood parquet 1/2" thick. c. Soft vinyl tile with foam plastic backing. d. Carpet over soft padding, at least ¼" thick.	45 (a. 42) (b.45) (c. 49) (d. 70)
	1. 3" thick reinforced concrete slab, 35 psf. 2. a. Wood parquet ½" thick. b. Soft vinyl tile with foam plastic backing. c. Carpet over soft padding, at least ¼" thick. 3. Resilient furring channels on ½" fiberglass blanket. 4. ½" gypsum board.	56 (a.51) (b. 55) (c. 70)

Sketch	Brief Description	STC (IIC)
	1. 5" thick reinforced concrete slab, 55 psf. ceiling bare. 2. a. Wood parquet ½" thick. b. Soft vinyl tile with foam plastic backing. c. Carpet over soft padding, at least ¼" thick.	51 (a. 46) (b. 50) (c. 70)
	1. 5" thick reinforced concrete slab, 55 psf. 2. a. Wood parquet ½" thick. b. Soft vinyl tile with foam plastic backing c. Carpet over soft padding, at least ¼" thick. 3. Resilient furring channels on ½" fiberglass blankets. 4. ½" gypsum board.	56 (a. 51) (b. 55) (c. 75)

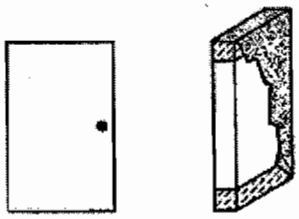
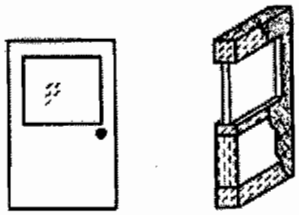
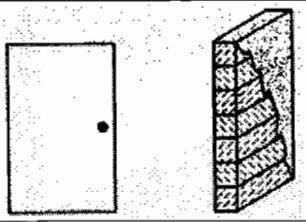
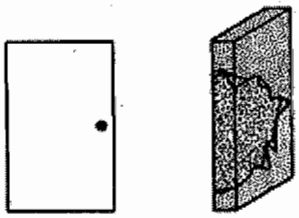
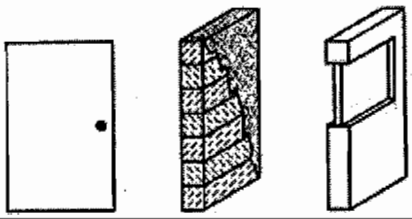
WINDOWS

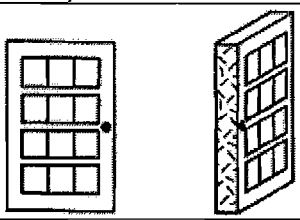
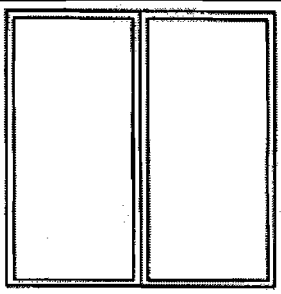
Sketch Front / Cross Section	Brief Description	STC
	30x48" aluminum clad casement, two 1/8" panels of glass, 13/16" apart in a wood frame.	29
	30x48" aluminum clad casement, one 3/32" panel and one 1/8" panel, 13/16" apart in a wood frame.	31
	32x24x24" aluminum double-hung windows (32" wide with 24" high upper sash and a 24" high lower sash), each sash has one 3/32" panel and one 1/8" panel, 13/16" apart in a wood frame.	29
	6x5' picture window glazed double strength, single panel.	29
	6x5' picture window plus storm sash, glazed double strength single panel, 3 ¾" separation between panels.	38

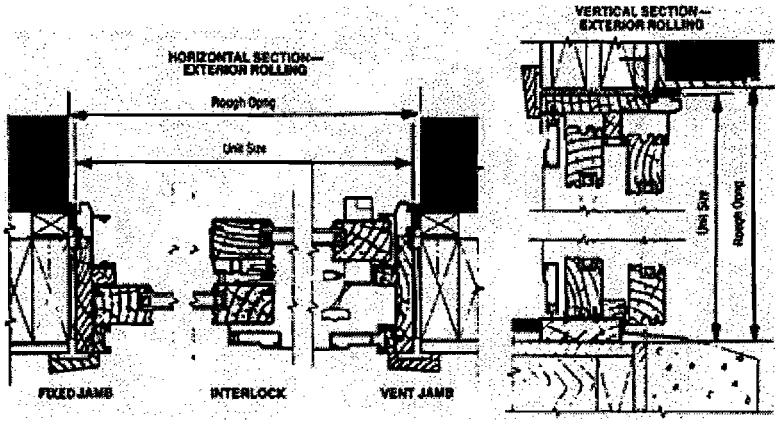
Sketch Front / Cross Section	Brief Description	STC
	3x5' double hung window, 7/16" glazed insulating glass, single panel.	26
	3x5' double hung window, 7/16" glazed insulating glass, single panel plus storm sash, glazed single strength, single sealed separation between panels: upper 1 ½", lower 2 13/16".	35
	3x4' awning window, glazed double strength, cranked shut.	24

Sketch Front / Cross Section	Brief Description	STC
	3x4' jalousie window, glazed ¼" glass, 4 ½" wide louvers with ½" in overlap, cranked tight shut.	20

DOORS: Exterior

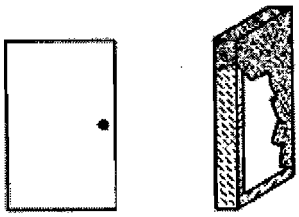
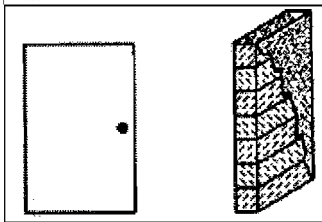
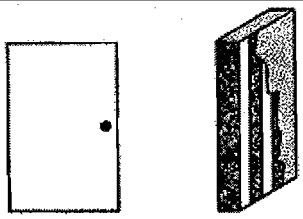
Sketch Front / Cross Section	Brief Description	STC
	3x7' hollow-core wood door, 1 ¾" thick.	20
	3x7' hollow-core door, 1 3/4" thick, 30% of area glazed with 1/8" glass.	19
	3x7' solid-core wood door, 1 ¾" thick.	27
	3x7' steel-faced door, 1 ¾" thick, rigid polyurethane core.	26
	3x7' solid-core wood door, 1 ¾" thick plus an aluminum storm door, glazed single strength.	34

Sketch Front / Cross Section	Brief Description	STC
	3x7' wood French door, 12 lights glazed single strength, mounted in frame, brass weather strip.	26
	6x6' sliding glass doors, ¾" insulating glass (2 pieces 1/8" tempered glass), one door opens, other is permanent in place.	28



*All exterior doors are sealed with a weathering strip around the frame. Interior doors do not have a weather strip and are not flush to the floor to permit the installation of a carpet.

DOORS: Interior

Sketch Front / Cross Section	Brief Description	STC
	3x7' solid-core wood door, 1 ¾" thick, weight 1.5 lb/ft².	17
	3x7' solid-core wood door, 1 ¾" thick, weight 4.0 lb/ft².	20
	3x7' hollow-core steel door, 1 ¾" thick, weight 5.0 lb/ft².	17

Appendix B References

Appendix B
General References

Books:

Acoustical and Thermal Performance of Exterior Residential Walls. Doors and Windows; NBS Building Science Series 77, U.S. Department of Commerce/National Bureau of Standards, 1975.

Acoustics Noise and Buildings; Parkin, Humphreys and Cowell; Faber and Faber; London; 1979.

Airborne Sound Transmission Loss, Characteristics of Wood Frame Construction; Fred F. Rudder, Jr.; USDA, Forest Service; General Technical Report FPL-43.

Handbook of Architectural Acoustics and Noise Control; Michael Retting; Tab Book; Blue Ridge Summit, Pa.; 1979.

Quieting: A Practical Guide to Noise Controls; U.S. Department of Commerce/National Bureau of Standards; NBS Handbook 119; 1976.

Institutions and Organizations:

Amerada Architectural Glass.
DeSco Windows.
Georgia-Pacific.
Industrial Acoustics Company.
National Concrete Masonry Association.
Office of Noise Control; California Department of Health Services.
Overly Manufacturing Company.
Paella Products.
Portland Cement Association.
U.S. Gypsum Company.

Testing Laboratories:

Cedar Knolls Acoustical Laboratories.
Geiger and Hamme.
Kaiser Gypsum.
Kodaras Acoustical.
National Institute of Standards and Technology.
National Research Council of Canada.
Riberbank Acoustical Laboratories.

ERRATA SHEET

The Noise Guidebook
Railway Noise Guidance and Calculation Corrections

February 2009

The following should replace the paragraph entitled "Horns and Whistles" on page 63 (also marked 15) in the Noise Assessment Guidelines, Chapter 5, of *The Noise Guidebook* (September 1991).

> If the Noise Assessment Location (NAL) is perpendicular to any point on along a railroad track between the whistle posts for a road crossing, a factor to account for the noise of warning horns or whistles must be included in the calculation. There are 2 factors to be used based on the type of locomotive. If the locomotive is diesel-powered, enter the number 10 in column 11 of Worksheet D. If the locomotive is electric-powered, enter the number 100 in column 18 of Worksheet D. If the NAL is not between the whistle posts for a road crossing, enter the number 1 in each column.
>
> *Note: Whichever horn factor is appropriate, it must only be applied once. If a factor is applied for diesel locomotives in the first section of the worksheet, it must not be applied to the railcar noise calculation in the second part. In that instance, enter the number 10 in column 11 and the number 1 in column 18.*

A revised Worksheet D also accompanies this correction. It is easily distinguished from the original. The new Worksheet D has an additional column in the second section of page 2 for a total of 27 columns. The original version, with 26 columns, is hereby void.

Railway Noise Data Sheet

Noise Assessment Guidelines

List All Railways within 3000 feet of the site:

1. _____

2. _____

3. _____

Necessary Information	**Railway No. 1**	**Railway No. 2**	**Railway No. 3**	**Notes**
1. Effective distance:				Measured in feet from NAL to center of track
2. Number of Trains in 24 hours:				
a. diesel				
b. electrified				
3. Fraction of operations occuring at night:				10 p.m. - 7a.m.
4. Number of diesel locomotives per train:				
5. Number of rail cars per train:				
a. diesel trains				
b. electrified trains				Include locomotive for electrified trains
6. Average train speed:				
7. Is track welded or bolted?				
8. Is the site opposite a section of tracks between whistle stops?				

Adjustments for Diesel Locomotives

	9 No. of Locomotives 2	10 Average Speed (Table 9)	11 Horns (Enter 10)	12 Night-time (Table 5)	13 No. of Trains (Line 2a)	14 Adj No of Opns.	15 DNL (Workchart 3)	16 Barrier Attn.	17 Partial DNL
Railway No. 1	____ x	____ x	____ x	____ x	____ =	____	____ -	____ =	____
Railway No. 2	____ x	____ x	____ x	____ x	____ =	____	____ -	____ =	____
Railway No. 3	____ x	____ x	____ x	____ x	____ =	____	____ -	____ =	____

Adjustments for Railway Cars or Rapid Transit Trains and Electric Locomotives

	18 Horns on Electric Trains only (Enter 100)	19 Number of cars 50	20 Average Speed (Table 10)	21 Bolted Rails (Enter 4) Welded (Enter 1)	22 Night-time (Table 5)	23 No. of Trains (Lines 2a and 2b)	24 Adj. No. of Opns.	25 DNL (Workchart 4)	26 Barrier Attn.	27 Partial DNL
Railway No. 1	____ x	____ x	____ x	____ x	____ x	____ =	____	____ -	____ =	____
Railway No. 2	____ x	____ x	____ x	____ x	____ x	____ =	____	____ -	____ =	____
Railway No. 3	____ x	____ x	____ x	____ x	____ x	____ =	____	____ -	____ =	____

Combined Locomotive and Railway Car DNL (See combining noise levels table for procedures)

Partial DNL Railway No. 1 ____ Partial DNL Railway No. 2 ____ Partial DNL Railway No. 3 ____ Partial DNL Total DNL for all Railways ____

Signed ____ Date ____

Noise and Its Effects

By Dr. Alice H. Suter, Conference Consultant, Administrative Conference of the United States, November 1991

This report was prepared for the consideration of the Administrative Conference of the United States. The views expressed are those of the author and do not necessarily reflect those of the members of the Conference or its committees except where formal recommendations of the Conference are cited.

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I. Introduction

This report presents an overview of noise and its effects on people. Special emphasis is placed on developments over the past decade, both in terms of noise conditions and noise effects research. By doing so, this report should illustrate some of the reasons for concern about noise problems, which persist after the closing of EPA's Office of Noise Abatement and Control (ONAC).

Noise has a significant impact on the quality of life, and in that sense, it is a health problem in accordance with the World Health Organization's (WHO) definition of health. WHO's definition of health includes total physical and mental well-being, as well as the absence of disease. Along these lines, a 1971 WHO working group stated: "Noise must be recognized as a major threat to human well-being." (Suess, 1973)

The effects of noise are seldom catastrophic, and are often only transitory, but adverse effects can be cumulative with prolonged or repeated exposure. Although it often causes discomfort and sometimes pain, noise does not cause ears to bleed and noise-induced hearing loss usually takes years to

develop. Noise-induced hearing loss can indeed impair the quality of life, through a reduction in the ability to hear important sounds and to communicate with family and friends. Some of the other effects of noise, such as sleep disruption, the masking of speech and television, and the inability to enjoy one's property or leisure time also impair the quality of life. In addition, noise can interfere with the teaching and learning process, disrupt the performance of certain tasks, and increase the incidence of antisocial behavior. There is also some evidence that it can adversely affect general health and well-being in the same manner as chronic stress. These effects will be discussed in more detail in the paragraphs below.

II. ONAC'S Activities in Noise Effects Research and Criteria

In response to the mandates of Section 5 of the Noise Control Act of 1972, ONAC published Public Health and welfare Criteria for Noise (EPA, 1973a) and Information on Levels of Environmental Noise Requisite to Protect Public Health and welfare with an Adequate Margin of Safety (EPA, 1974a), popularly known as the "Levels Document" for obvious reasons). Also in 1973,ONAC sponsored an international conference in Yugoslavia on the effects of noise, from which voluminous proceedings there published (EPA, 1973b). All of these documents there widely distributed and, although somewhat dated, are still read and referenced today. Because a considerable amount of research in this area has been conducted over the past 2 decades, these documents would benefit from revision.

In these documents ONAC established dose-response relationships for noise and its effects, and identified safe levels of noise to prevent hearing loss and activity interference. The agency also established the day-night average noise level as a universal descriptor to be used in assessing the impact of community noise.

Section 14 of the Act directs ONAC to conduct or finance research on noise effects, including investigations of the psychological and physiological effects of noise on humans and the effects of noise on animals. Approximately 35 technical reports resulted from these efforts, as well as contractor reports and numerous articles in scientific journals.

Some of the more noteworthy examples of EPA's research program there:

- Projects involving the cardiovascular effects of noise at the University of Miami, Johns Hopkins University and the Massachusetts Institute of Technology (Peterson, et al., 1978, 1981, 1983; Hattis and Richardson,1980; Turkkan et al, 1983).
- A longitudinal study of noise exposure and hearing threshold levels in children conducted by the Fels Institute (Roche et al., 1977).
- An interagency agreement with the U.S. Air Force to study the effects of noise on hearing (e.g., Guignard, 1973; Johnson, 1973; Schori and McGatha, 1978; Suter, 1978).
- A study identifying the sound levels of speech communication in various environments (Pearsons, et al., 1977).
- Two studies at Northeastern University comparing methods for predicting the loudness and acceptability of noise (Scharf et al., 1977; Scharf and Hellman, 1979).

Although much useful information was derived from these programs, some of them there irreparably damaged by the abrupt termination of funding from ONAC that occurred in 1981 and 1982. For one example, the Johns Hopkins study of cardiovascular effects of noise on primates was terminated after testing on only one subject had been completed. For another, the longitudinal data from the Fels Institute is now of little value after a hiatus of more than a decade.

III. Physical Properties and Measurement of Sound

A. Physical Properties

Noise is often defined as unwanted sound. To gain a satisfactory understanding of the effects of noise, it would be useful to look briefly at the physical properties of sound.

Sound is the result of pressure changes in a medium (usually air), caused by vibration or turbulence. The amplitude of these pressure changes is stated in terms of sound level, and the rapidity with which these changes occur is the sound's frequency. Sound level is measured in decibels (abbreviated dB), and sound frequency is stated in terms of cycles per second, or nowadays, Hertz (abbreviated Hz). Sound level in decibels is a logarithmic rather than a linear measure of the change in pressure with respect to a reference pressure level. A small increase in decibels can represent a large increase in sound energy. Technically, an increase of 3 dB represents a doubling of sound energy, and an increase of 10 dB represents a tenfold increase. The ear, however, perceives a 10-dB increase as doubling of loudness.

Another important aspect is the duration of the sound, and the way it is distributed in time. Continuous sounds have little or no variation in time, varying sounds have differing maximum levels over a period of time, intermittent sounds are interspersed with quiet periods, and impulsive sounds are characterized by relatively high sound levels and very short durations.

The effects of noise are determined mainly by the duration and level of the noise, but they are also influenced by the frequency. Long-lasting, high-level sounds are the most damaging to hearing and generally the most annoying. High-frequency sounds tend to be more hazardous to hearing and more annoying than low-frequency sounds. The way sounds are distributed in time is also important, in that intermittent sounds appear to be somewhat less damaging to hearing than continuous sounds because of the ear's ability to regenerate during the intervening quiet periods. However, intermittent and impulsive sounds tend to be more annoying because of their unpredictability.

B. Instrumentation

The instrument for measuring noise is the basic sound level meter or a number of its derivatives, including noise dose meters (usually called dosimeters), integrating sound level meters, graphic level recorders, and community noise analyzers. Improvements in all of these instruments have taken place during the last decade. This is especially true of the computerized dosimeters and integrating meters, which can measure, compute, store, and display comprehensive data on the noise field (Earshen, 1986). These instruments are now able to measure over very wide dynamic ranges and to measure impulsive sounds with a high degree of accuracy.

C. Measurement and Descriptors

Most sound level meters and dosimeters use built-in frequency filters or "weighting networks " in the measurement process. By far the most frequently used filter is the A weighting network, which discriminates against low-frequency and very high-frequency sounds. A weighting approximates the equal-loudness response of the ear at moderate sound levels, and correlates well with both hearing damage and annoyance from noise. A weighting will be assumed throughout this report unless otherwise specified.

Composite measures of noise, such as the equivalent continuous sound level (Leq) and the day-night average sound level (DNL) incorporate A weighting, (The mathematical notation for DNL is Ldn.) these levels constitute sound energy averages over given periods of time, the DNL incorporates a 10-dB nighttime penalty from 10:00 pm to 7:00 am, meaning that events occurring during

that time are counted as 10 dB higher than they really are. A variant of the DNL that is used in California (and Europe) is the community noise equivalent level (CNEL), which incorporates a 5-dB penalty for evening noise events, as well as the 10-dB nighttime penalty (California Code of Regulations, 1990).

For more than a decade, both the DNL and the simple Leq have been used extensively for assessing the impact of aircraft/airport noise. Recently, however, communities have expressed dissatisfaction with these metrics when used to regulate noise (Wesler, 1990). Metrics that employ averaging fail to describe the disturbance arising from single events, especially low-flying aircraft, unexpected or newly occurring flights, or flights occurring in areas where solitude is at a premium. The sound exposure level (SEL), an event's sound level normalized to one second, is gaining popularity as a supplement to the DNL and the Leq for characterizing single events.

IV. Noise in America

A. Population Trends

The U.S. population has increased an average of 25 million with each census since 1950. According to the World Almanac (1991), the population in 1980 was 226 million and approximately 250 million in 1990. This reflects an increase of nearly 11 percent over the decade, or slightly more than 1 percent per year. Presently, 77 percent of the U.S. population lives in the nation's 283 designated metropolitan areas, and the rate of growth in these areas is twice that of nonmetropolitan areas (Bryant, 1991).

Not surprisingly, EPA research indicates that noise levels in communities is directly related to the population density (EPA, 1974b).[1] Because the noise in urban areas generally exceeds that of suburban and rural areas, it is not unreasonable to assume that noise in the U.S. is increasing at least in proportion to the increase in urbanization and more rapidly than the growth of the general population. In addition, noise sources appear to be multiplying at a faster pace than the population.

B. Noise Sources

Figure 1, from EPA's simplified version of the Levels Document, Protective Noise Levels, shows the range of sound levels for some common noise sources (EPA, 1978). Most leading noise sources will fall into the following categories: road traffic, aircraft, railroads, construction, industry, noise in buildings, and consumer products.

1. Road traffic noise

In its Levels Document (1974), EPA estimated that road traffic noise was the leading source of community noise. EPA's contractors found that to be true in 1981 (EPA, 1981), and there is little reason to believe otherwise today.

Truck transportation, as a convenient and economical means of moving raw materials and consumer goods from place to place, is growing at a faster pace than the general population. For example, a total[2] of 33.6 million trucks there registered in the U.S. in 1980. That number grew to 45.5 million in 1989, an increase of about 35 percent (American Trucking Assoc., 1991).

---

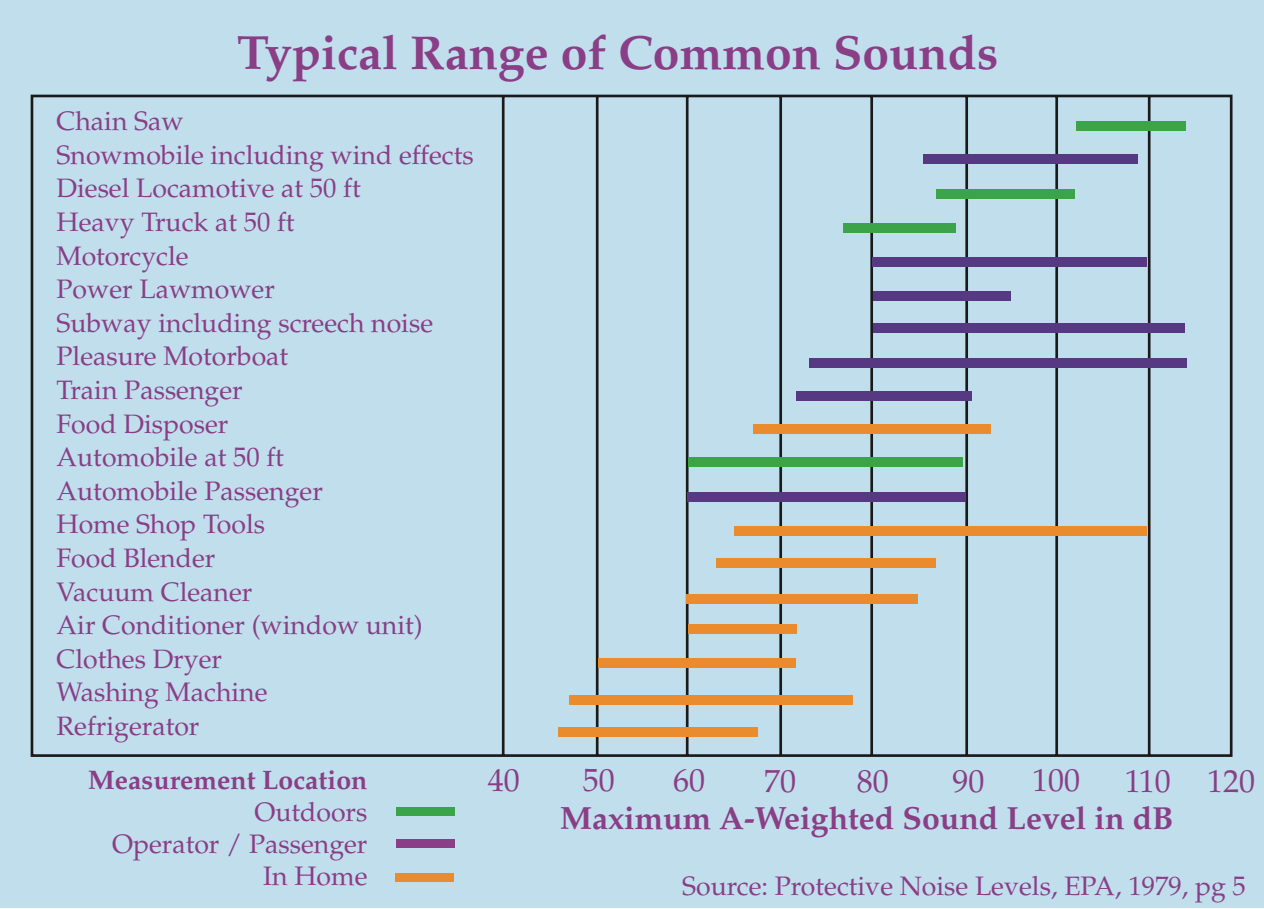
[1] The day-night average sound level appears to be proportional to the log of population density in people per square mile (EPA.1974b).

[2] The total number of trucks registered includes personal-use as well as commercial trucks of all weight classes.

Noise from the motors and exhaust systems of large trucks provides the major portion of highway noise impact, and provides a potential noise hazard to the driver as well.[3] In addition, noise from the interaction of tires with the roadway is generated by trucks, buses, and private autos.

In the city, the main sources of traffic noise are the motors and exhaust systems of autos, smaller trucks, buses, and motorcycles. This type of noise can be augmented by narrow streets and tall buildings, which produce a "canyon" in which traffic noise reverberates.

Typical Range of Common Sounds



2. Aircraft noise

Air traffic also appears to be increasing more rapidly than the U.S. population. In 1980, U.S. scheduled airlines flew approximately 255.2 billion passenger miles and 5.7 billion cargo (ton) miles. By 1990, these figures there 457.9 billion and 10.6 billion, respectively (Air Transport Assoc., 1991a). This represents an increase of 79 percent in passenger mileage, and 86 percent in air height mileage. Air cargo traffic has grown particularly rapidly in the last five years, and will probably continue that trend over the next decade.

By 1989, the quieter "Stage III" airplanes comprised nearly 40 percent of the domestic fleet (Air Transport Assoc, 1991b). By the year 2004, all of the noisier Stage II aircraft must be phased out

---

[3] According to Reinhart (1991) the most common complaint about truck noise is related to problems caused by tampering with the mufflers of trucks using compression brakes. About 5 percent of the heavy trucks surveyed by Reinhart and his colleagues had no functioning muffler, despite the existence of antitampering laws.

(Airport Noise and Capacity Act, 1990). This requirement should promote a quieter environment around airports, but the growth of air transportation and the pressing need for airport expansion threatens to offset the benefits of the quieter aircraft.

Nowadays, the problem of low-flying military aircraft has added a new dimension to community annoyance, as the nation seeks to improve its "nap-of-the-earth" warfare capabilities. In addition, the issue of aircraft operations over national parks, wilderness areas, and other areas previously unaffected by aircraft noise has claimed national attention over recent years (Fidell, 1990; Cantoni, 1991; Weiner, 1990; Mouat, 1990).

3. Noise from railroads

The noise from locomotive engines, horns and whistles, and switching and shunting operations in rail yards can impact neighboring communities and railroad workers. For example, rail car retarders can produce a high-frequency, high-level screech that can reach peak levels of 120 dB at a distance of 100 feet (EPA, 1974), which translates to levels as high as 138 or 140 dB at the railroad worker's ear.

Unlike truck and air transportation, however, rail transportation does not appear to be increasing. According to the Association of American Railroads, the railroad industry loaded 22.1 million freight cars in 1988, down slightly from 22.6 million in 1980 (AAR, 1991).

4. Construction noise

The noise from construction of highways, city streets, and buildings is a major contributor to the urban scene. Construction noise sources include pneumatic hammers, air compressors, bull dozers, loaders, dump trucks (and their back-up signals), and pavement breakers. The construction industry has done very well over recent years with a value-added GNP of $97.9 billion in 1977, increasing to $247.7 billion in 1989 (Dept. of Commerce, 1991), an increase of about 153 percent. The number of workers employed in construction grew from 4.3 million in 1980 to about 5.2 million in 1990, an increase of nearly 21 percent (BLS, 1991a).

5. Noise in industry

Although industrial noise is one of the less prevalent community noise problems, neighbors of noisy manufacturing plants can be disturbed by sources such as fans, motors, and compressors mounted on the outside of buildings. Interior noise can also be transmitted to the community through open windows and doors, and even through building walls. These interior noise sources have significant impacts on industrial workers, among whom noise-induced hearing loss is unfortunately common.

The size of the U.S. manufacturing industry has not grown significantly over the last decade. Although the industrial. GNP increased from $673.9 billion in 1980 to $969.6 billion in 1990 (in terms of constant dollars) (BLS, 1991b), the workforce has declined from slightly more than 20 million to about 19 million during that period (BLS, 1991c). Consequently, industrially-generated community noise is probably no greater than it was in 1980.

From the worker's perspective the industrial noise problem is still very serious. The Occupational Safety and Health Administration has cut back on the enforcement of occupational noise standards and has allowed the substitution of hearing protection devices in lieu of engineering controls in many cases (OSHA, 1986). However, it is difficult to know whether noise levels in industry are increasing or decreasing because no comprehensive survey has been performed since the 1976 survey performed by Bolt Beranek and Newman Inc. (BBN, 1976).

6. Noise in buildings

Apartment dwellers are often annoyed by noise in their homes, especially when the building is not well designed and constructed. In this case, internal building noise from plumbing, boilers, generators, air conditioners, and fans, can be audible and annoying. Improperly insulated walls and ceilings can reveal the sound of amplified music, voices, footfalls, and noisy activities from neighboring units. External noise from emergency vehicles, traffic, refuse collection, and other city noises can be a problem for urban residents, especially when windows are open or insufficiently glazed.

Wetherill (1987) reports that although the lack of soundproofing is the most frequent environmental complaint of apartment dwellers, the knowledge to solve these problems is not being applied. In fact, the quality of construction is steadily declining, and the noise problems are getting worse (Wetherill, 1991).

7. Noise from consumer products

Certain household equipment, such as vacuum cleaners and some kitchen appliances, have been and continue to be noisemakers, although their contribution to the daily noise dose is usually not very large. Added to this list would be yard maintenance equipment, such as lawn mowers and snow blowers, which can, at least, cause disharmony with one's neighbors, and pother shop tools, which can be hazardous to hearing if used for sufficient periods of time.

One example of a fairly new product is the gasoline-pothered leaf blower, with average A-weighted sound levels at the operator's position of 103.6 dB, and maximum levels of 110-l12 dB (Clark, 1991). In an extensive review of nonoccupational noise exposures, Davis et al. (1985) report that the manufacturers of household devices have been reluctant to release sound level information. Consequently, it could be difficult to assess the magnitude of the problem and the extent to which noise levels are increasing or decreasing.

Residents of suburban and rural areas are sometimes disturbed by recreational noise sources, such as off-road vehicles, high-pothered motor boats, and snowmobiles. Some of these sources, such as snowmobiles, are not as noisy as they there more than a decade ago, due to attention to the problem by the manufacturers and their trade associations. Others are no less noisy, and possibly more so because noise seems to be generic to the sport. Example would be motorcycle and car racing, and events like "tractor pulls."

In fact, the allure of noisy recreational activities seems to be considerably greater now than it was a decade or so ago. The technology of sound reproduction has advancer to the point where loudspeakers can faithfully reproduce music and other sounds at levels well above 120 dB. Sporting events use giant digital "applause meters" to measure and display enthusiasm for the more popular team. The extreme in car stereo technology is now the "boom car", with sound levels exceeding 140 dB.[4] Activities like aerobic exercising and ice skating, as well as disco dancing, are accompanied by amplified music played at high sound levels. After summarizing the results of 16 studies of discotheques and rock concerts Clark (1991) reported the geometric mean of the measured sound levels as 103.4 dB. The trend in noise levels for these kinds of activities is definitely upward.

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[4] The International Auto Sound Challenge Association sponsors contests and gives the most points to contestants whom speakers produce the highest sound pressure levels, up to 140 dB. However, levels above that merit no more than 140 points.

One of the most serious sources of recreational noise is sport shooting, where peak sound pressure levels at the ear can range from about 144 dB up to more than 170 dB[5] (Odess, 1972). In his analysis of this literature, Clark (1991) cites estimates of the number of people responding positively to questions about hunting or target shooting. These estimates range from 14 percent of the general population in Scandinavia and the U.K. (Axelsson et al., 1981; Davis et al., 1985) to nearly 50 percent in the Canadian workforce (Chung et al., 1981), which Clark found to be consistent with estimates from U.S. industry. In a population of rural schoolchildren, 45 out of 47 boys and 2 out of 21 girls reported having used guns (Kramer and Wood, 1982).

A subcategory of consumer product noise that deserves mention is noisy toys. A few toys, such as firecrackers, snappers, and cap pistols have been part of the adventurous child's experience for generations. The general assumption is that these toys do not pose a hazard when used occasionally and located at a sufficient distance from the ear[6]. Nowadays, there is a large variety of noisy toys, thanks to the availability of improved technology. Many of them mimic adult noisemakers, such as amplified toy guitars, child-shed vacuum cleaners, and miniature pother saws. Some of these toys generate quite high levels of sound. For example, a baby's squeeze toy (Fay, 1991) and the battery operated siren of a toy police car have both been measured at 110 dB[7].

In a recent report on noisy toys, Leroux and Laroche (1991) cite studies showing A-weighted noise levels for a toy motor at 107 dB and a child's rattle at 99-100 dB (LNE, 1973). Current Canadian legislation limits the sound output of toys to "one hundred decibels measured at the distance that the product ordinarily would be from the ear of the child using it..." (Act, 1969), but Leroux and Laroche propose that this limit be lowered to an A-weighted level of 75 dB.

C. Numbers of People Exposed to Noise

The fact that people are variously exposed to noise is not surprising. Considering that decibels are measured on a logarithmic scale, however, the magnitude of these variations can be enormous. For example, the average noise level outside an urban apartment can be 1,000 times more intense than in a rural residential neighborhood. Fortunately, this difference will be perceived more like an eightfold rather than a thousand-fold increase. Figure 2, from EPA's document Protective Noise Levels, shows examples of outdoor day-night average sound levels measured at various locations (EPA, 1978).

In 1974, EPA estimated that nearly 100 million Americans lived in areas where the daily average noise levels exceeded its identified safe DNL of 55 dB (EPA, 1974a). Figure 3, from EPA's Levels

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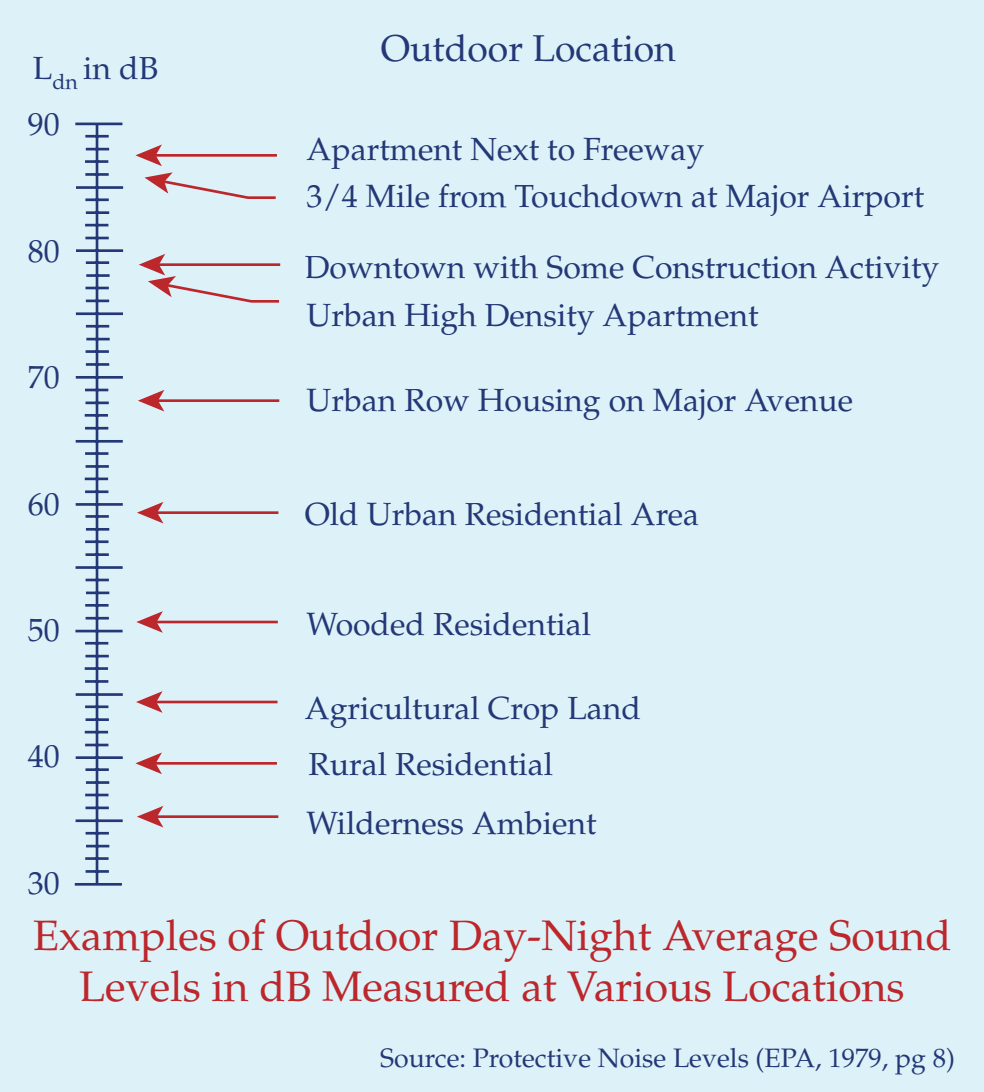
[5] A-weighted level. of these weapons would measure somewhat lower, with levels for .22 caliber rifles at about 132-139 dB and shotguns at 150-165 dB. (See Clark, 1991)

[6] Certain European studies, however, have reported as many as 1 percent to 3.7 percent of teenage children suffer hearing losses caused by impulsive noise from toys (Gjaevenes, 1967; Moe, 1966). Noise from cap guns, for example, can exceed peak sound pressure levels of 140 dB (Gjaevenes, 1966; Hodge and McCommons, 1966; Marshall and Brandt, 1973; all as cited by Leroux and Laroche,
1991).

[7] New York audiologist Thomas Fay has measured the noise levels of a variety of children's toys. In doing so he places the sound level meter's microphone quite close to the noise source (from 2 inches to 1/2 inch away), based on his observations of the children at play. (Personal communication, April 1991).

Document, shows the residential noise environment of the U.S. population as a function of the exterior DNL, with separate curves for the freeway and aircraft increments.

Examples of Outdoor Day-Night Average Sound Levels in dB Measured at Various Locations



A few years later EPA contracted with the consulting firm Bolt Beranek and Newman (BBN) to develop more detailed estimates. The resulting report, Noise in America, includes a breakdown according to noise exposure source (EPA, 1981). Table I gives the estimated number of Americans exposed to traffic; aircraft, construction, rail, and industrial noise for various DNLs from 55 dB to 80 dB. The authors note that there will be some overlap among populations exposed to different sources, so the numbers across categories are not additive. The far right column represents the total estimated number of people exposed to the combined sources. Although the authors do not give an estimate for the number of people exposed above Ldn 55 dB, another authority puts it at 138 million at that time (Eldred, 1990).

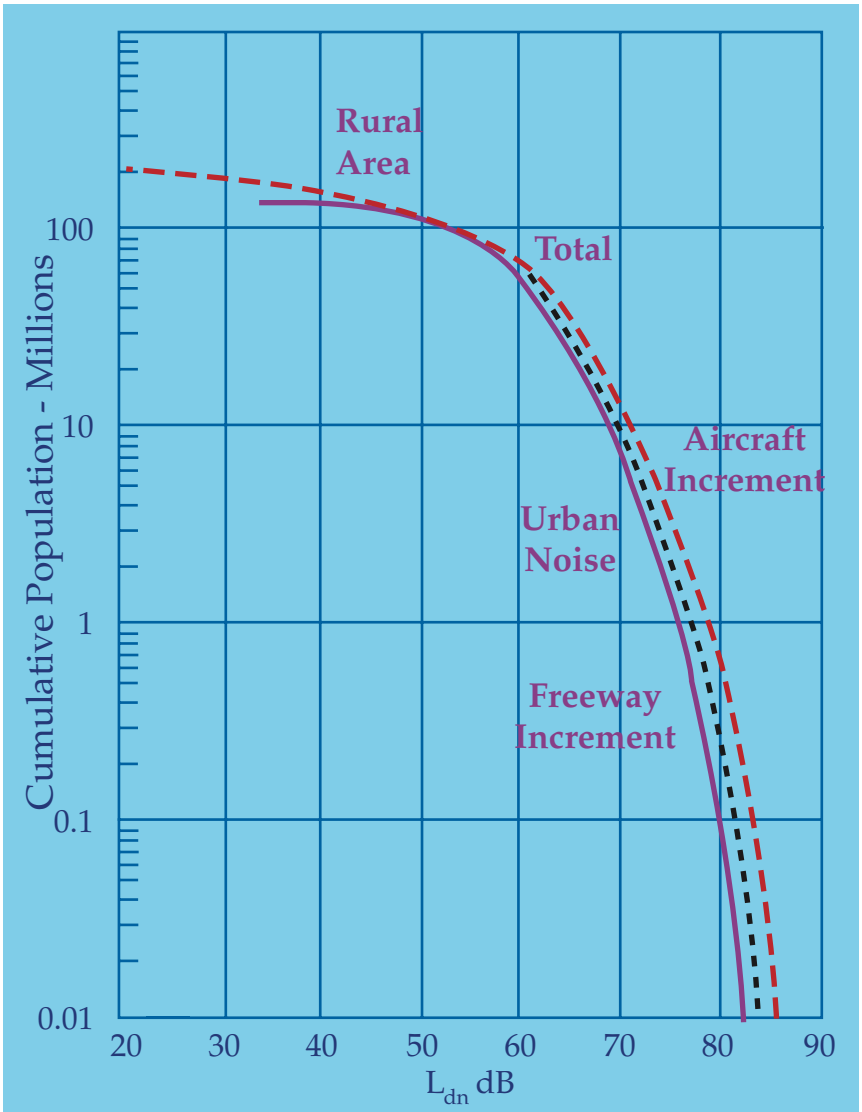
These estimates do not represent the results of a national survey. Instead, the authors used data and models available to EPA and BBN at the time. Because of this, some categories of noise exposure are likely to be more accurate than others. They did, however, represent the best available esti-

mates at the time, and because no efforts have been made to update them, they are the best estimates available today.

D. Summary: Noise in America

It is safe to assume that noise in communities is increasing. Noise levels are directly related to population density, and the urban population is increasing at twice the pace of the nonurban population. In addition, the last decade has seen rapid growth in air transportation, trucking, and the construction industries, indicating that noise levels from these sources has most likely increased. The fact that some of these sources have been and continue to be quieted (especially new generations of trucks and aircraft) should mitigate this increase, but the extent of this mitigation will remain unknown until some sort of national survey is performed. Noise from construction continues to be a problem, and it appears that noise inside buildings as well as noise from recreational activities and consumer products is on the rise. Estimates of the number of people exposed to noise at various levels are now somewhat outdated.

Residential Noise Environment of the National Population As a Function of Exterior Day-Night Average Sound Level



Residential Noise Environment of National Population as Function of Exterior Day-Night Average Sound Level

Source: Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (EPA, 1974a, pg 16)

Table 1: Summary of U.S. Population Exposed to Various Day-Night Average Sound Levels (or higher) From Noise Sources in the Community. (1) From Noise in America (EPA, 1981, pp. 10 and 15)

Estimated Number (in Millions) of People in Each Noise Category

DNL (dB)	Traffic	Aircraft	Construction	Rail	Industrial	Total
>80	0.1	0.1	—	—	—	0.2
>75	1.1	0.3	0.1	—	—	1.5
>70	5.7	1.3	0.6	0.8	—	8.1
>65	19.3	4.7	2.1	2.5	0.3	27.8
>60	46.6	11.5	7.7	3.5	1.9	63.6
>55	96.8	24.5	27.5	6.0	6.9	92.4*

(1) DNL values are yearly averages, outdoors
(2) Note that there is some overlap among populations exposed to different noise sources. For example, some of the 96.8 million people exposed to Ldn 55 dB and above from traffic noise are also exposed to aircraft noise.
(3) Construction estimates include both residential and nonresidential exposure.

*Distribution of total exposed to all sources starts at Ldn 58 dB since the analysis involves combining distributions exposed to 55 dB and above.

V. Effects of Noise

A. Noise-Induced Hearing Loss

Hearing loss is one of the most obvious and easily quantified effects of excessive exposure to noise. Its progression, however, is insidious, in that it usually develops slowly over a long period of time, and the impairment can reach the handicapping stage before an individual is aware of what has happened. While the losses are temporary at first, they become permanent after continued exposure, and there is no medical treatment to counteract the effect. When combined with presbycusis, hearing loss naturally occurring with the aging process, the result is a premature impairment that grows inexorably with age.

According to the U.S. Public Health Service (PHS, 1991), some 10 million of the estimated 21 million Americans with hearing impairments owe their losses to noise exposure (as cited in Carney, 1991). The study goes on to say that it is unclear whether the incidence of hearing impairment has risen in recent years because the necessary studies have not been conducted.

1. Extent of noise-induced hearing loss from environmental sources

Although the major cause of noise-induced hearing loss is occupational, substantial damage can be caused by nonoccupational sources. In addition to the frequently-blamed sources of loud music and shooting, noise-induced hearing loss has been noted in the children of farm families, presumably from the frequent use of tractors (e.g., Broste et al., 1979); general aviation pilots because of the high noise levels emitted by piston aircraft (Anon., 1982); and users of earlier generations of cordless telephones because of the placement of the ring mechanism in the earpiece (Orchik et al., 1985 and 1987).

The prevailing notion among parents is that the hearing threshold levels of children are worse than they used to be because of exposure to loud music. Actually, a recent national survey of 38,000 school children found better hearing threshold levels than 30 years ago, but blames the discrepancies on the sampling methods used in the earlier study and the conversion from an older to a nether zero reference level (Lundeen, 1991). There is, however, evidence that the hearing of some young people is being affected by noisy leisure time activities (Axelsson et al., 1987).

Loud music in particular appears to be the cause of hearing impairment and tinnitus in rock musicians. Such luminaries as Pete Townshend and Ted Nugent[8] have acquired substantial hearing losses and are now campaigning for hearing conservation (Murphy, 1989). Some studies point to a hearing hazard for attendees as well (see in Clark, 1991; Clark and Bohne, 1986; Danenberg et al.,1987).

As mentioned above, probably the greatest nonoccupational hazard to hearing comes from sport shooting. Clark (1991) cites studies of industrial workers by Chung et al. (1981), Johnson and Riffle (1982), and Prosser et al. (1988), showing significantly greater hearing losses among sport-shooters than among their nonshooting counterparts. These losses are almost always characterized by worse hearing in the left ear than the right.

The contribution from nonoccupational sources is called "sociocusis" (a contraction of "socio-acusis"). Evidence from primitive societies suggests that the absence of sociocusis explains the large differences in hearing threshold level between these populations and those of the "civilized" nations (Rosen, 1962). Sociocusis, occupational hearing loss, and presbycusis contribute in various

2. The handicap of noise-induced hearing loss

Vowel sounds tend to be low in frequency and high in sound energy, while the consonants are much higher in frequency and have considerably less amplitude. It also happens that consonants provide the primary intelligibility to speech. Because noise damages the ear's ability to perceive high-frequency sounds much earlier and more severely than the low-frequency sounds, individuals with noise-induced hearing loss are at a particular disadvantage in understanding speech.

Individuals with early noise-induced hearing loss often think that other people no longer speak dearly. They soon begin to notice that they have difficulty understanding speech when there is noise in the background, and in groups of people, and that it is hard to identify which person is talking. As the hearing loss progresses, these individuals avoid social occasions and situations where they must listen at a distance, like church and theater. The eventual result can be loneliness and isolation.

3. The study of noise-induced hearing loss

Noise damages the delicate sensory cells of the inner ear, the cochlea. This process can be studied in the laboratory by inducing temporary shifts in hearing threshold level in humans. Over recent years the preferred method of investigation is to produce temporary and permanent threshold shifts in animals, and to study the resulting physiological and anatomical changes in the cochlea, as well as shifts in hearing threshold level. The laboratory allows for strict control of noise level and

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[8] According to Nugent, who has worn an earplug in his right ear since 1967: "My left ear is there just to balance my face, because it doesn't work at all." (Murphy 1989) proportion to an individual's total hearing impairment. While the contribution of each source may be less than significant, the combination of all three can be enough to produce a handicapping condition. As longevity in the U.S. population increases, the toll of noise-induced hearing loss will become increasingly evident (Carney, 1991).

duration, but the durations are usually relatively short because of the time and expense involved. Also there is some controversy over the extent to which the results can be generalized to humans.

Much of the recent laboratory effort in noise research has focused on the structural and functional basis of noise-induced hearing loss, which has been greatly aided by the electron microscope. Investigators have identified the sensory cell's stereocilia and the rootlets which anchor them as the auditory system's most vulnerable components with respect to noise exposure (Libermnan, 1990).

Field studies of noise-exposed workers avoid the problems of species generalization, and the exposure durations can be over many decades. They are usually cross-sectional studies, however, meaning that the current hearing threshold levels are related to noise exposures that have been experienced over many years. Although the current noise measurements may be valid, their validity over prior years usually has to be assumed without benefit of precise data.

4. Risk of hearing impairment from continuous noise

The methods and results of the major field studies of continuous noise exposure conducted in the late 1960s and early 1970s remain unchallenged. Examples are the studies of Burns and Robinson (1970), Baughn (1973), Passchier-Vermeer (1968), and the U.S. National Institute for Occupational Safety and Health (NIOSH, 1973). Data from these studies have been used by various organizations to estimate the risk of hearing impairment over a working lifetime of exposure to noise. These types of studies have also been used by the EPA to estimate the hazard of nonoccupational noise (Guignard, 1973; Johnson, 1973; EPA, 1973a). The data cited above of Burns and Robinson, Baughn, and Passchier-Vermeer went into EPA's identification of a yearly average exposure level of 70 dB as the safe level, which could be experienced over a lifetime (EPA, 1974a)[9].

A new international standard (ISO, 1989), which is based mainly on the data of Passchier-Vermeer and Burns and Robinson, contains formulas for assessing the risk of noise-induced hearing impairment and handicap: using either a highly screened (for non-occupational hearing loss) or an unscreened population as a control group. The data and analyses found in these major studies have not been seriously challenged, and remain in use today.

5. Varying and intermittent noise

There has been some debate over the best rule for combining noise level and duration to assess the damaging effects of noise, especially varying and intermittent noise. This relationship is often called the doubling rate, or nowadays, the exchange rate. The EPA, as well as most other federal agencies (and most European countries, the United Kingdom, some Canadian provinces) use the equal-energy rule, which incorporates a 3-dB exchange rate. OSHA uses the 5-dB exchange rate, and the U.S. Air Force, uses 4 dB. None of these rules makes any provisions for the temporal order of sounds, although the 5-dB exchange rate supposedly represents a simplification of criteria that take a certain number of intermittencies into account.[10]

Investigations of the relationship between noise level and duration have been conducted over recent years using laboratory animals. The results have confirmed the validity of the equal energy (3-dB) rule for single exposures to continuous noise (Bohne and Pearse, 1982; Ward and Turner, 1982),

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[9] The 70-dB 24-hour average sound level can be interpreted as a 75-dB 8-hour average sound level plus an average sound level during the other 16 hours of less than 60 dB (see EPA's Levels Document, p.29, footnote d).

[10] The 5-dB rule does not necessarily provide for intermittencies because it allows uninterrupted exposures to continuous noise at high levels. See Suter 1983.

or when the exposures are broken up into 8-hour, or even 1-hour "workdays", 5 days per week, so long as the sound energy is equivalent (Ward, 1983). There is, however, some benefit to intermittent quiet periods (Ward and Turner, 1982), during which the ear can recover from small, temporary hearing losses. For this reason EPA has adjusted its identified safe level upward by 5 dB[11] since most environmental noise exposures are intermittent in nature. EPA's use of the equal-energy rule and the 5-dB adjustment have not been seriously challenged.

6. Impulse noise

The effects of impulse noise have been studied extensively over recent years, but there is less agreement on this topic than there is for continuous and intermittent noise. Although there was consensus favoring the 3-dB rule at a 1981 international meeting in England (von Gierke et al., 1981), actual dose-response relationships are still elusive. The effects of impulse noise do not always follow the 3-dB rule, in that temporal pattern, waveform, and rise time can affect the growth of hearing loss, despite constancy of sound energy (Henderson and Hamernik, 1986).

Frequency also has some bearing on the damage caused by impulse noise, in that low-frequency impulses produce significantly less damage than sounds in the mid-to-high-frequency range (Price, 1983). The ear appears to be most susceptible to impulses with peaks around 4,000 Hz (Price, 1989). Also, there may be a critical level, above which the ear is considerably more at risk because of a change in the response mechanism. On the basis of his research, Price (1981) has suggested a critical level of 145 dB, with a standard deviation of 8 dB.

7. Susceptibility

Evidence from field studies indicates that men incur more hearing loss than women from comparable noise exposures (Burns and Robinson, 1970; Berger et al., 1978; Royster et al., 1980), and that Caucasians appear to be more susceptible than Blacks to noise-induced hearing loss (Royster et al., 1980). Other factors, such as age, preexposure hearing threshold level, general health, and use of alcohol, have not yet proved to be reliable predictors of susceptibility (Ward, 1986), although

8. Interactions with other agents

Noise can interact with drugs and industrial agents to produce additive or even synergistic effects on hearing. As expected, the higher the levels of noise and the greater the dose of the other agent, the greater will be the resulting hearing loss. The ototoxic properties of certain drugs, most notably the aminoglycoside antibiotics (the "mycin" drugs), are heightened by exposure to noise. Numerous studies of kanamycin plus noise exposure have revealed additive and some synergistic results (Humes, 1984). High doses of salicylates (aspirin) accompanied by noise exposure can produce temporary hearing losses (McFadden and Plattsmier, 1983), but permanent losses do not seem to occur. Cisplatin, used in cancer chemotherapy, is known to be toxic to the auditory system, and has been shown to interact significantly with none exposure (Boettcher et al., 1989).

A variety of industrial agents, which can be potent neurotoxins, have been shown to be capable of producing hearing loss (Fechter, 1989). These agents include heavy melds, such as lead and mercury, organic solvents, such as toluene, xylene, and carbon disulfide, and an asphyxiant, carbon monoxide.

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[11] The identified safe level of 70 dB reflects the incorporation of the 5-dB adjustment there is some indication that the use of tobacco may increase susceptibility to noise-induced hearing loss (Barone, et al., 1987; Stark, et al., 1988)

9. Hearing protectors

As its first (and only) labeling regulation, EPA promulgated a regulation for labeling the attenuation of hearing protection devices (EPA, 1979). The standard required manufacturers to subject their hearing protectors to specific laboratory tests, and to publish a "Noise Reduction Rating" (NRA) on the product's package. The NRA was subsequently adopted by OSHA in its hearing conservation amendment, which required employers to use it in assessing the adequacy of hearing protectors for given noise environments (OSHA, 1981 and 1983). Recent research shows that the NRA greatly overestimates the noise reduction to be achieved by these devices in actual field use.[12] These kinds of findings have led to the formation of a new ANSI working group to investigate alternatives to the current NRA (Berger et al. 1990), and the recommendation that EPA revise its existing labeling regulation (Berger, 1991; Stewart, 1991).

10. Summary: Noise-induced hearing loss

Noise-induced hearing loss is probably the most well-defined of the effects of noise. Predictions of hearing loss from various levels of continuous and varying noise have been extensively researched and are no longer controversial. Some discussion still remains on the extent to which intermittencies ameliorate the adverse effects on hearing and the exact nature of dose-response relationships from impulse noise. It appears that some members of the population are somewhat more susceptible to noise-induced hearing loss than others, and there is a growing body of evidence that certain drugs and chemicals can enhance the auditory hazard from noise.

Although the incidence of noise-induced hearing loss from industrial populations is more extensively documented, there is growing evidence of hearing loss from leisure time activities, especially from sport shooting, but also from loud music, noisy toys, and other manifestations of our "civilized" society. Because of the increase in exposure to recreational noise, the hazard from these sources needs to be more thoroughly evaluated. Finally, the recent evidence that hearing protective devices do not perform in actual use the way laboratory tests would imply, lends support to the need for reevaluating current methods of assessing hearing protector attenuation.

B. Interference With Communication

Noise can mask important sounds and disrupt communication between individuals in a variety of settings. This process can cause anything from a slight irritation to a serious safety hazard involving an accident or even a fatality because of the failure to hear the warning sounds of imminent danger. Such warning sounds can include the approach of a rapidly moving motor vehicle, or the sound of malfunctioning machinery. For example, Aviation Safety (Anon., 1982), states that hundreds of accident reports have many "say again" exchanges between pilots and controllers, although neither side reports anything wrong with the radios.

Noise can disrupt face-to-face and telephone conversation, and the enjoyment of radio and television in the home. It can also disrupt effective communication between teachers and pupils in schools, and can cause fatigue and vocal strain in those who need to communicate in spite of the noise. Interference with communication has proved to be one of the most important components of noise-related annoyance (EPA, 1974a).

In its Levels Document, EPA determined that a yearly average day-night sound level of 45 dB would permit adequate speech communication in the home, and a DNL of 55 dB would permit

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[12] In a summary of 10 studies, Berger (1983) shows that most hearing protectors in the field provide only one-third to one-half the attenuation that they do in the laboratory.

normal communication outdoors at a distance of about 3 meters.[13] These levels also apply to hospitals and educational facilities. Higher average noise levels would be satisfactory for certain nonresidential spaces, such as commercial and industrial facilities, and inside transportation, depending on the degree to which speech communication is critical. Research over the last 20 years has expanded and refined EPA's criteria development in this area, but has not generated any major changes.

1. Prediction of speech interference

Methods of predicting the amount of speech that can be communicated in various noise backgrounds have been available for decades. Probably the most popular and respected method is the articulation index (AI) (French and Steinberg, 1947), which requires the measurement or estimation of the spectrum level of both speech and noise in 20 contiguous bands. Over the past 2 decades investigators have suggested adjustments to the AI for l13-octave bands, reverberation time, various vocal efforts, etc., and more recently for various degrees of hearing impairment (Humes, et al., 1986 and 1987).

The speech interference level (SIL) (Beranek, 1954) provides a quick method for estimating the distance at which communication can occur for different levels of vocal effort. The current method involves measuring octave-band sound pressure levels at 500, 1,000, 2,000, and 4,000 Hz and referring to a chart to determine the die potential communication distance. The basic chart has been expanded to include such parameters as a broader range of voice levels and provisions for room reverberation (Webster, 1983). Additions to both the AI and the SIL have been proposed by Lazarus (1990), who offers modifications and extensions to account for strain on the part of both talker and listener, and the wearing of hearing protectors.

Another popular method to predict speech communication in a variety of conditions, the speech transmission index (STI), has been developed by a Netherlands research group (Houtgast, 1980; Houtgast and Steeneken, 1983). The STI takes into account room volume and reverberation time, in addition to speech and none levels, and distance between talker and listener. A more recent outgrowth, the rapid speech transmission index (RASTI), represents a simplified version of the STI intended for field use, and is available in an instrument conforming to an international standard (IEC, 1987).

Finally the sound level meter's A-weighting network can be successfully used to predict speech interference levels. It is easy to use, available on virtually all sound level meters, and effective when the noise spectra are not complex.

2. Criteria for speech and warning signals

In addition to the classic work of Beranek and his colleagues (Beranek et al., 1971), Beranek has recently refined the traditional curves to account for the annoyance due to low-frequency "rumble" (Beranek, 1989). New criteria for determining acceptable background levels of noise in rooms are also offered by Lazarus (1986a, 1986b, 1987, and 1990). Lazarus includes in his criteria a variety of parameters such as: type of room, type of communication, communication distance, vocal effort, quality of speech intelligibility, AI, communication strain, listener's hearing sensitivity, and the use of hearing protectors.

Guidelines for audible warning signals have been developed by Patterson (1982). These guidelines, which there originally created for civil aircraft, there later adapted to helicopters and even station-

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[13] These levels represent EPA's identification of safe levels of environmental noise to protect the public health and welfare against all adverse effects of noise with the exception of hearing loss.

ary workplaces like hospitals (Patterson, 1985; Rood et al., 1985). Another set of guidelines for acoustic warning signals has been developed by Lazarus and Hoge (1986), and are based on the compatibility of signal type with various desired or undesired situations.

Although criteria have not yet been developed for speech recognition involving nonnative listeners, experiments by Florentine (1985) and Nabelek (1983) indicate that these individuals need more favorable listening conditions (less background noise and reverberation) than their native- language counterparts. These findings have implications for air traffic control systems.

3. The effect of hearing protectors on speech and warning signal perception

Hearing protectors attenuate both noise and the desired signal by equal amounts in a given frequency band, reducing both to levels where the ear is less likely to distort. This process often improves speech recognition when the level of background noise exceeds 80 to 90 dB. However, because hearing protectors usually provide considerably more attenuation in the high frequencies than in the low frequencies, listeners who have high-frequency hearing losses are at a disadvantage. Many speech sounds and some warning signals will be attenuated beyond the range of audibility. This is especially true of individuals whose losses exceed an average of 30 dB at the audiometric frequencies 2000, 3000, and 4000 Hz (Lindeman, 1976). A potential solution for this problem lies in some newly developed hearing protectors with flat attenuation across the frequency spectrum (Allen and Berger, 1990; Killion et. al., 1988). One type of these protectors has already become popular with orchestral musicians (Killion et al., 1988) and even some rock musicians (Cohen, 1990).

Individuals tend to speak more softly when they wear hearing protectors, and consequently, speech communication is degraded when both talker and listener wear these devices (Hoermann et al,, 1984), Hearing protectors also interfere with the localization of sounds in space, and this is especially true of the ability to localize sounds in the vertical plane while wearing ear muffs (Noble, 1981). Both ear plugs and ear muffs cause these types of problems, but it appears that they are more pronounced with ear muffs (Howell and Martin, 1975; Abel et al., 1982). These findings can have serious implications for safety in some circumstances.

4. Scholastic performance

Noise can disrupt communication in the classroom to the extent that the instructional method used in schools close to airports is sometimes nicknamed " jet pause" teaching. Cohen and Weinstein (1981) have reviewed several studies, which, after controlling for socioeconomic factors, indicate that the academic performance of children in quiet schools is better than that of children in noisy schools.

For example, elementary school children on the side of a school facing train tracks. performed more poorly on a reading achievement test than children in classrooms on the quiet side of the school (Bronzaft and McCarthy,:1975).[14] Cohen and Weinstein also discuss research showing that skills, such as auditory discrimination and reading achievement can be adversely affected when children live in noisy circumstances, even though their schools may be no noisier than average. These latter studies indicate that interference with communication in the classroom is not the only

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[14] Bronzaft reported that in 1978 the city of New York reduced the noise of the elevated train and installed acoustical insulation in the affected classrooms, providing a total reduction in the A-weighted noise level of 6 to 8 dB (Bronzaft, 1981). By 1981, there was essentially no difference. in reading achievement between students on the two sides of the school for the classroom studied.

process at work here. Possible additional explanations include adverse effects on children's information processing strategies and their feelings of personal control[15] (Cohen and Weinstein, 1981).

5. Summary: Interference with communication

Interference with speech communication and other sounds is one of the most salient components of noise-induced annoyance. The resulting disruption can constitute anything from an annoyance to a serious safety hazard, depending on the circumstance.

Research over the past 2 decades has expanded and refined methods for predicting communication interference, but has not produced any major changes. Numerous adjustments have been suggested for the AI, the SIL has been modified and refined, and a new predictive method, the STI has been added. Criteria for determining acceptable background levels in rooms have also been expanded and refined, and progress has been made on the development of effective acoustic warning signals.

It is now clear that hearing protection devices can interfere with the perception of speech and warning signals, especially when the listener is hearing impaired, both talker and listener wear the devices, and when wearers attempt to locate a signal's source.

Noise can interfere with the educational process, and the result has been dubbed "jet-pause teaching" around some of the nation's noisier airports, but railroad and traffic noise can also produce scholastic decrements.

C. Effects of Noise on Sleep

Noise is one of the most common forms of sleep disturbance, and sleep disturbance is a critical component of noise-related annoyance. A study used by EPA in preparing the Levels Document showed that sleep interference was the most frequently cited activity disrupted by surface vehicle noise (BBN, 1971). Aircraft none can also cause sleep disruption, especially in recent years with the escalation of nighttime operations by the air cargo industry. When sleep disruption becomes chronic, its adverse effects on health and well-being are well-known.

1. Assessing sleep disturbance

Noise can cause the sleeper to awaken repeatedly and to report poor sleep quality the next day, but noise can also produce reactions of which the individual is unaware. These reactions include changes from heavier to lighter stages of sleep, reductions in "rapid eye movement" (REM) sleep, increases in body movements during the night, changes in cardiovascular responses, and mood changes and performance decrements the next day. The accuracy and efficiency with which these effects are measured has been greatly assisted by the use of contemporary computers. The most popular measurement tool nowadays is electro-encephalography, but other methods, such as electrocardiography, electromyography, and electrooculography are also used, as well as clinical observation, self-assessment surveys, and accelerometry to measure the motion of the bed frame.

As a result of many years of research on the effects of noise on sleep, it is clear that intermittent and impulsive noise is more disturbing than continuous noise of equivalent energy, and that meaningful sounds are more likely to produce sleep disruption than sounds with neutral content. Also, older people are more likely to have their sleep disturbed by noise than younger people. In fact, children appear to be about 10 dB less sensitive to noise-induced sleep disruption than adults (Eberhardt, 1990). Sleep disturbance from noise tends to be greater in the early hours of the morn-

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[15] See also the discussion of noise, performance, and behavior in sections D.4, and D.5. below.

ing, when individuals spend more time in lighter sleep stages, and this is particularly true of the elderly.

2. Criteria for sleep interference

In the Levels Document EPA identified an indoor DNL of 45 dB, which translates to a nighttime average sound level of 35 dB, as necessary to protect against sleep interference. However, consensus on the levels of noise that can be tolerated without sleep disruption is incomplete at this time. In an attempt to develop a quantitative model for predicting noise-induced sleep interference, Pearsons et al., (1989) reviewed and analyzed 21 studies. However, the authors there unable to derive dose-response relationships from these studies because of large discrepancies between studies conducted in the laboratory and those conducted in the field.

In a recent review of the noise and sleep research, Griefahn (1990) recommends that the nighttime average sound level be kept below 45 dB in the sleeper's quarters. She cites research by Eberhardt (1987 and 1990; Eberhardt et al., 1987;) and Vallet et al., (1976 and 1990) showing self- reported adverse effects from continual road traffic when the average sound level is 40 dB and physiological responses at an average level of 37 dB. For intermittent road traffic noise, maximum recommended levels for single events (as opposed to average levels) range from 45 to 68 dB, depending on the investigation (Griefahn, 1990). Vallet et al. (1990), recommend maximum outside levels of 65 dB, which, of course, relies on some attenuation by the residence. Griefahn also points out that higher maximum levels can be tolerated if the ambient noise level is not very low, and that the difference between single events and the ambient level should not exceed 8 to 10 dB.

3. After-effects and habituation

Numerous recent investigations have revealed after-effects due to noisy nights. Ohrstrom (1983) found mood changes on the day following nights when the average sound level was as low as 35 dB. Adverse effects on performance, such as increased reaction time, have also been measured (Jurriens et al., 1983), and it appears that older peoples' next day performance is more adversely affected by noise than that of younger people (Griefahn and Gros, 1983).

Although people often believe they get used to nighttime noise, physiological tests point to the contrary. Studies have shown that while the subjective response improves with time, cardiovascular responses remain unchanged (Muzet, 1983). Vallet et al. (1990) conclude that habituation is not complete, even after 5 years of exposure to noise.

4. Summary: Effects of noise on sleep

Noise-induced sleep interference is one of the critical components of community annoyance. It can produce short-term adverse effects, such as mood changes and decrements in task performance the next day, with the possibility of more serious effects on health and well-being if it continues over long periods.

EPA's identified indoor DNL of 45 dB has not been seriously challenged over the past decade, but consensus in this area is lacking. One problem is that different experimenters tend to use a variety of descriptors (DNL, Leq, and maximum single-event levels) and a variety of methods for evaluating the effects (EEG, EKG, self-report, etc.). Perhaps one reason for the lack of clear-cut criteria is that this a complex area to research, requiring considerable time and expense. Another is, of course, a need for more field studies in this area.

D. Effects on Performance and Behavior

EPA did not use the literature on the effects of noise on performance and behavior in the identification of its levels of noise to protect against activity interference. One reason may have been that much of the information at that time related to the occupational setting rather than the general environment. Another may have been the complexity of the topic and the difficulty involved in identifying a single noise level that could apply to a great variety of tasks and conditions. Although these difficulties still pertain, much research has been generated in this area over recent years.[16]

Noise can cause adverse effects on task performance and behavior at work, and in nonoccupational and social settings. These effects are the subject of some controversy, however, since they do not always occur as predicted. Sometimes noise actually improves performance, and sometimes there are no measurable differences between performance in noisy and quiet conditions. The presence and degree of effects depends on a variety of intervening variables.

1. Sensory and motor effects

Experiments on the effects of noise on vision have produced conflicting results, with the suggestion of some effects on visual discrimination (Cohen, 1977). There is evidence, however, that high levels of noise can produce shifts in visual field (Parker, et al., 1976, 1978). High levels of noise can affect vestibular function, especially when the presentation to the two ears is asymmetrical, (or the level of attenuation is greater in one ear) (Harris, 1968). Impulsive or other sudden loud sounds can produce a startle response that does not completely habituate with repeated, predictable exposures (May and Rice, 1971).

2. Noise variables

Sound level is one of the most important parameters when predicting performance effects. The level of noise necessary to produce adverse effects is greatly dependent upon the type of task. Simple tasks remain unaffected at noise levels as high as 115 dB or above, while more complex tasks are disrupted at much lower levels. Until fairly recently, the level of beginning effects was thought to be around 95 dB for most conditions, but a summary of recent research (Jones, 1990) points to effects at much lower levels. Effects on serial reaction tasks have been noted for continuous noise with C-weighted noise levels of 90 dB (Jones, 1983) and for intermittent noise with C-weighted levels of around 80 dB (Lahtela et al., 1986).

Frequency and temporal characteristics also play a part. High-frequency sound is more disruptive titan low-frequency sound, and intermittent noise can affect performance more adversely titan continuous noise of equivalent energy. Aperiodic intermittencies are more likely to produce adverse effects than regular ones, and impulse noise may be even more disruptive. Again the effects are variable, depending upon task complexity and other factors.

Much of the important research in the effects of noise on performance conducted over the last decade has focused on the effects of irrelevant speech.[17] The adverse effects of irrelevant speech appear to be fairly independent of sound level, at least in the 55-95 dB range, and therefore, are not mitigated simply by attenuating them by 10 dB or so (Jones, 1990). It also appears that irrelevant speech affects processes involving memory (e.g., reasoning, mental arithmetic, and problem solving)

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[16] For a comprehensive review of the effects of noise on job performance, see Suter, 1989.

[17] The initial work was performed by Salame and Baddeley (1982, 1983, and 1987), and has been summarized by Jones (1990) at a recent conference in Stockholm.

rather than attention. With respect to reading tasks, however, meaningful speech is more disruptive than meaningless speech (Jones, 1990). These findings have significance for many modern work and school environments, where information processing and exchange is so important, especially those of the "open plan" variety.

3. Task variables

Task complexity has been identified in numerous experiments as a crucial determinant of the effects of noise on performance. Noise exposure usually leaves simple routine tasks unaffected, and can even improve performance of monotonous tasks, presumably by elevating one's level of arousal (Broadbent, 1971). Some tasks, such as tracking and jobs requiring intellectual function, can be momentarily disrupted without decrements in overall performance (Broadbent, 1979). But if the noise level is sufficiently high or if the task becomes more complex, noise will have an adverse effect. When two or more tasks must be performed simultaneously in a noisy environment, performance on the primary task usually remains unaffected, while performance on the subsidiary task deteriorates (Hockey and Hamilton, 1970; Davies and Jones, 1975; Finkleman and Glass, 1970).

4. After-effects

It seems that noise can have even greater effects after than during exposure. The most common after-effect appearing in the experimental literature is a reduced tolerance for frustration, manifested in a series of experiments as a reduction in willingness to persist in trying to solve insoluble puzzles (Glass and Singer, 1972; Percival and Loeb, 1980). This research also indicates that predictability of the noise signal greatly reduces its adverse after-effects (Glass and Singer, 1972). One study found that the type of noise also influenced the after-effect. Aircraft noise modified to produce sudden onsets and offsets resulted in a lower tolerance for frustration after the exposure than white noise that ad been similarly modified (Percival and Loeb, 1980).

5. Effects of noise on social behavior

There is an extensive literature concerning the effect of noise on social behavior, and just a few examples of this research will be discussed here. Singer et al. (1990) point out that noise has been used as a noxious stimulus in a variety of investigations because it produces the same biological and psychological effects as other stressors. In fact, they observe that the effects of noise combined with perceived control have been frequently demonstrated, and these investigations have also been extended to many other situations where the presence of control reliably moderates the effects of stress.[18]

In a frequently-cited laboratory study, Matthews and Cannon (1975) found that fewer subjects there willing to help someone who had "accidentally" dropped materials when background noise levels there 85 dB than when they there 65 dB. In a subsequent field study, the same results there demonstrated in a background of lawn mother noise, and this time the addition of a cast on the "victim's" arm enhanced helping behavior under quiet conditions, but failed to do so during the noise episodes (Matthews and Cannon, 1975). In another such experiment, Sauser et al. (1978) found that subjects recommended lower salaries for fictitious employees when exposed to A-weighted levels of office noise at 70 to 80 dB than in quiet. Broadbent (1979 and 1983) cites additional evidence suggesting that subjects will give each other increased amounts of shock and noise when they themselves are exposed to noise, and also cites evidence that noise increases anxiety levels (Broadbent, 1983).

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[18] Singer et al. (1990) cite the research of Langer and Rodin on the effects of patient control in a nursing home situation.

As mentioned above, the presence of control, or even perceived control, is one of the most important predictors of adverse behavioral effects. Subjects who perceive that they have control over the noise show significantly greater tolerance for frustration than subjects without control, even if the control is never exercised (Glass and Singer, 1972). In a recent experiment, Singer and his colleagues found that subjects who there told that they had control of an A-weighted, 103-dB noise stimulus showed significantly greater persistence on a difficult task than subjects who had no control or subjects that had control for only part of the experiment (Singer et al., 1990). This finding occurred despite the fact that the subjects with only partial control reported feelings of control no different from those with full control. To the extent that these findings can be generalized to populations living in noisy areas, this kind of research may have significant sociological implications.

6. Summary: Effects on performance and behavior

Noise can adversely affect task performance in a variety of circumstances. In the past, research in this area has focused mainly on the occupational setting, where noise levels must be sufficiently high and the task sufficiently complex for performance decrements to occur. Recent research implicates more moderate noise levels, especially when speech is the disruptive noise stimulus. Some research indicates that noise can also produce disruptive after-effects, commonly manifested as a reduced tolerance for frustration, and it appears that the presence and timing of control over the noise are critical to the prediction of after-effects. Even moderate noise levels can increase anxiety, decrease the incidence of helping behavior, and increase the risk of hostile behavior in experimental subjects. These effects may, to some extent, help explain the "dehumanization" of today's urban environment.

E. Extra-Auditory Health Effects

Noise has been implicated in the development or exacerbation of a variety of health problems, ranging from hypertension to psychosis. Some of these findings are based on carefully controlled laboratory or field research, but many others are the products of studies that have been severely criticized by the research community. In either case, obtaining valid data can be very difficult because of the myriad of intervening variables that must be controlled, such as age, selection bias, preexisting health conditions, diet, smoking habits, alcohol consumption, socioeconomic status, exposure to other agents, and environmental and social stressors. Additional difficulties lie in the interpretation of the findings, especially those involving acute effects. For example, if noise raises blood pressure on a temporary basis, will prolonged exposure produce permanent changes? In cases where these effects are permanent but slight, what are the long-term implications? These types of questions and problems have caused this particular area of noise research and criteria development to be very controversial.

1. Theoretical basis

Noise is considered a nonspecific biological stressor, eliciting a response that prepares the body . for action, sometimes referred to as the "fight or flight" response. The physiological mechanism thought to be responsible for this reaction is the stimulation by noise (via the auditory system) of the brain's reticular activating system (Cohen, 1977). Neural impulses spread from the reticular system to the higher cortex and throughout the central nervous system. Noise can, therefore, influence perceptual, motor, and cognitive behavior, and also trigger glandular, cardiovascular, and gastrointestinal changes by means of the autonomic nervous system. Evidence of these effects, however, is not easy to. come by. Despite decades of research and probably hundreds of studies, relatively little can be said with much confidence.

2. Effects on blood pressure

Probably the most attention has been directed toward cardiovascular effects, especially potential elevations in blood pressure. Many studies of the stressful effects of noise have been conducted on rodents and other laboratory animals. the advantage of these studies is that they offer a greater degree of control and it is possible to have longer exposures than with human subjects. The disadvantages are that there is difficulty generalizing to humans, especially with the smaller animals, the expense involved when larger animals are used, and the prevailing public sentiment against animal experimentation.

EPA sponsored one of the most notable animal studies of noise exposure, in which Peterson and his colleagues performed five sets of experiments on the cardiovascular effects of noise on monkeys (Peterson et al., 1978, 1981, and 1983). The stimulus consisted of A-weighted levels of workplace noise at 85 to 90 dB, and the exposures there as long as 9 months. The results showed significant elevations of both systolic and diastolic blood pressure the fact that these changes persisted long after exposure cessation argues for a chronic effect, at least in this case. Unfortunately, an attempt to replicate this experiment with another primate model was discontinued for lack of funding after only two subjects had been exposed (Turkkan, et al., 1983). Relatively few animal experiments have been conducted in this area over recent years.

With respect to laboratory investigations involving human subjects, Rehm (1983) cites six studies showing increases in blood pressure, but questions whether these effects would be permanent. In an attempt to identify more susceptible populations, Michalak et al. (1990) investigated the effects of low-flying aircraft on elderly subjects. Using recorded aircraft sounds, they found significant increases in both systolic and diastolic blood pressure after exposure to the two types of noise, with significantly greater response to the rapid-onset flyover noise. Whether or not these increases would become permanent with protracted exposure is not known.

Field studies of noise and blood pressure among workers or community residents are becoming increasingly popular, but the results are not always consistent. Rehm (1983) has reviewed 14 field studies, mostly of occupational noise exposure, and reports that the majority showed significant increases in either systolic or diastolic blood pressure, or both. Van Dijk et al. (1983), however, reports that six other studies of exposure to occupational noise found no significant differences between exposed and nonexposed groups.

Knipschild and Oudshoom (1977) avoided some of the pitfalls characteristic of epidemiological studies by examining a population near the Amsterdam airport before and after an increase in exposure to aircraft noise, and comparing it to a nonexposed population nearby. The dependent variable was the purchase of certain prescription drugs: tranquilizers, sleeping pills, antacids, and cardiovascular drugs. The investigators found that the use of these drugs in the nonnoise area was essentially stable, whereas the use of most types of these drugs in the area newly impacted by noise increased steadily over the years investigated. This increase was especially noticeable for antihypertensive drugs.

In a more recent review, van Dijk (1990) analyzed 12 cross-sectional studies, with half of them showing a positive relation between noise exposure and blood pressure, and the others no significant effects. Van Dijk criticizes these kinds of investigations for the following kinds of weaknesses: inadequate description of noise and blood pressure measurements; absence or inadequate control of intervening variables; use of hearing loss as a determinant of exposure magnitude; use of hearing. protectors; and questionable interpretation of the results. Part of the problem may be that the investigators often come from only one discipline, when, in fact, a multi-disciplinary team is needed.

Thompson and Fidell (1990) recommend the use of prospective or case-control models, rather than the more convenient cross-sectioned study, and they stress the importance of adequate sample size. They maintain that because any changes in blood pressure resulting from community noise are likely to be small, careful controls, large sample sizes, and at least 5 years of exposure to noise would be nerved to identify significant effects.

3. Effects on blood chemistry

Blood chemistry is also of interest in studies of wire exposure and the cardiovascular system. In the review cited above, Rehm (1983) reports on a series of experiments, both laboratory and field, which show increased levels of the catecholamines epinephrine and norepinephrine. Among them are the series of experiments by Ising and his colleagues (1981a, 1981b, 1981c), showing a connection between noise exposure and magnesium metabolism and humans and animals. According to Rehm, this finding suggests a possible mechanism for cardiovascular effects in that a chronic magnesium imbalance can lead to increased intracellular levels of calcium (in the heart, for instance), which, in turn, can cause vasoconstriction and increases the sensitization for catecholamines.

A large epidemiological study, the Caerphilly and Speedwell Heart Disease Study in England, holds some promise for investigating the effects of road traffic noise (Babisch and Gallacher, 1990). This study of heart disease and a variety of environmental factors uses both the cross-sectional and prospective approaches, and should continue for more than 10 years. The investigators have performed detailed noise exposure measurements. Sample sizes of more than 2000 men have been drawn from both the Caerphilly and Speedwell communities, and controls for age, socio-economic factors, family history, body weight, smoking habits, alcohol, and physical activity have been instituted. Initial results (from the cross-sectional study) indicate significant noise related elevations of serum cholesterol and glucose levels, and plasma viscosity, with an absence of significance for blood pressure or any of the other cardiovascular risk factors. The authors point out that all of the effects there slight, but even small increases, should they prove to be real, would be relevant to the public health.

4. Interactions

Several investigators have suggested that aversion to noise may be more highly correlated with health problems than the noise itself. For example, a study by Rehm (1983) found a significant correlation between noise annoyance and cardiovascular disorders. Her data also suggest that those with existing health problems are more annoyed by environmental factors, such as noise. Similarly, Rovekamp (1983) found that subjects who described themselves as sensitive to noise showed significantly greater noise-induced increases in peripheral vasoconstriction than their “normal” counterparts. Finally, a recent study . of road traffic and aircraft noise failed to show a significant increase in blood pressure resulting from noise, but did show a correlation between the presence of noise and subjective health complaints (Pulles et al.,1990). Differences in effects between noise and non-noise groups there dependent upon the subjects’ perceived control over the noise, but independent of noise level.

5. Other adverse effects

Adverse health effects from noise exposure other than cardiovascular effects are even more difficult to isolate. Several studies have investigated the effects of noise on fetal development, with inconclusive results. Some have shown an indication of reduced birth weight or an increase in premature births, but the effects are usually slight, and (except in one case, McDonald et al., 1988), not statistically significant (Rehm and Jansen, 1978; Knipschild et al.., 1981).

The effects of noise on documented mental health disorders are likewise inconclusive. Rehm (1990) cites a series of studies showing increased numbers of psychoneurotic and psychosomatic complaints due to noise exposure, but whether or not these complaints lead to chronic disfunction or illness is not obvious.

6. Summary: Extra-auditory effects

As a biological stressor, noise can influence the entire physiological system. Most effects appear to be transitory, but with continued exposure some effects have been shown to be chronic in laboratory animals. Probably the strongest evidence lies in the cardiovascular effects. However, many studies show adverse effects, while many others show no significant differences between experimental and control populations.

Undoubtedly because of the lack of consistent evidence in thin area, EPA could not use data on extra-auditory health effects in its identification of safe levels of environmental noise. Instead, this subject was relegated to a brief discussion in an appendix in the Levels Document. Although considerable attention was devoted to this topic at the international conference in Yugoslavia, and some coverage was given in the 1973 Criteria Document, the evidence was far from sufficient and much too complex to enable the formulation of dose-response relationships. Later, EPA did fund some promising research in this area (Hattis and Richardson, 1980; Peterson et al., 1978, 1981, 1983; Turkkan, 1983), some of which has clearly demonstrated adverse cardiovascular effects at noise levels typical of occupational settings.

In the interim, there has been considerable European research activity in this area, but nearly 20 years later, criteria are still lacking. What is available, however, should give public policymakers as well as noise producers some reason for concern, especially in situations where those impacted by the noise have no control over or perceive they have no control over their exposures.

F. Annoyance

Annoyance is the measured outcome of a community's response to survey questions on various environmental and other factors, such as noise exposure. Although annoyance in individuals is sometimes measured in the laboratory, field evaluations of community annoyance are most useful for predicting the consequences of planned actions involving highways, airports, road traffic, railroads, or other noise sources. Factors directly affecting annoyance from noise include interference with communication and sleep disturbance, which have been discussed in earlier sections. Other less direct effects are disruption of one's peace of mind, the enjoyment of one's property, and the enjoyment of solitude. The consequences of noise-induced annoyance are privately felt dissatisfaction, publicly expressed complaints to authorities, and potential adverse health effects, as suggested above.

"Annoyance" has been the term used to describe the community's collective feelings about noise ever since the early noise surveys in the 1950s and 1960s, although some have suggested that this term tends to minimize the impact. While "aversion" or "distress" might be more appropriate descriptors, their use would make comparisons to previous research difficult. It should be clear, however, that annoyance can connote more than a slight irritation; it can mean a significant degradation in the quality of life. This represents a degradation of health in accordance with the WHO's definition of health, meaning total physical and mental well-being, as well as the absence of disease.

1. Predicting annoyance for public policy purposes

To facilitate the development of criteria and public policy, Schultz (1978) summarized and analyzed a large number of studies of community annoyance from aircraft, road traffic, and railroad noise. As

part of this effort, Schultz made several simplifying assumptions, among them that the percentage of the population determined to be "highly annoyed" would be the only parameter plotted as a function of day-night average sound level. The resulting curve portrays annoyance as independent of noise source, and it has been dubbed the Schultz curve.

Recently, Fidell et al. (1991) reanalyzed the original data used by Schultz, adding new data from it community noise surveys. The resulting function shows slightly greater annoyance in the range between DNLS of 51 dB and 72 dB, and slightly less annoyance above about a DNL of 76 dB than the original curve. In general, the two curves are fairly close, indicating that the new studies have not drastically altered the prediction of community annoyance, at least when reactions to various noise sources are plotted together. When annoyance from various noise sources is analyzed separately, however, the new data are quite revealing, as will be discussed below.

Although it has been used internationally in the formation of noise policy, the Schultz curve has been the subject of much debate (Kryter, 1982a, 1982b; Griffiths, 1983). For example, Griffiths (1983) criticizes Schultz for treating attitudinal data categorically (highly annoyed or otherwise) rather than scaling it, for failing to analyze the distribution of annoyance, for assuming a fixed threshold for noise-related annoyance, and for choosing such an extreme criterion as highly annoyed. Perhaps because of these reasons, as well as a number of others, researchers and policymakers are beginning to examine alternatives to the Schultz curve for predicting community annoyance from noise.

2. Metrics

The metrics most commonly used to describe the relationship between noise and community annoyance are the equivalent continuous sound level, and the day-night average sound level (DNL), composite ratings based on the A-weighted sound level. The DNL is used almost exclusively for airport planning in the U.S., but this practice has recently been called into question. For example, the importance of communication and relaxation in the evening hours has been recognized (in California and occasionally in Europe) by the use of the community noise equivalent level (CNEL), a metric that includes a 5-dB penalty for noises occurring between 7:00 and 10:00 pm as well as the 10-dB nighttime penalty (California Code of Regulations, 1990). In a study of the communities surrounding two French airports, residents expressed the greatest annoyance during the hours between 7:00 and 11:00 pm (Francois, 1977).

Some authorities are considering the use of the sound exposure level (SEL) for evaluating the effects of single events, such as aircraft flyovers (EPA/FAA, 1990). The importance of other parameters are also being considered, such as rise time (or onset time) as an indicator of the annoyance from low-flying military aircraft (Harris, 1989). Officials from the U.S. Forest Service report that their agency has begun to use an aircraft detectability criterion to site recreational facilities (Harrison et al., 1990).

3. Criteria

Community annoyance resulting from noise-induced activity interference was one of the most important considerations in EPA's identification of an outdoor DNL of 55 dB as the "safe" level of environmental noise (EPA, 1974a). Some years later, a Federal Inter-Agency Committee on Urban

Noise (FICUN) developed guidelines for considering noise in land-use planning and control (DOT, 1980).[19]

In its noise zone classification table, "minimal" exposures to noise there defined as DNLS below 55 dB, and between DNLS of 55 and 65 dB, the exposures there labeled "moderate." However, all of these exposures there considered "acceptable" according to land-use planning standards specified by the Department of Housing and Urban Development (HUD). No research was cited to support these conclusions. In a footnote, FICUN stated the following:

HUD, DOT and EPA recognize Ldn = 55 dB as a goal for outdoors in residential areas in protecting the public health and welfare with an adequate margin of safety (Reference: EPA "Levels" Document.) However, it is not a regulatory goal. It is a level defined by a negotiated scientific consensus without concern for economic and technological feasibility or the needs and desires of any particular community.

The Department of Transportation's Federal Aviation Administration (FAA) has adopted a DNL of 65 as the point above which residential land-use becomes "normally unacceptable." Below this level, the FAA does not require airport authorities to draw noise contours or discuss the impact of airport noise on the surrounding communities for purposes of compatibility planning or to receive grants under the Part 150 program.[20] Thus, public policy decisions, at least on the federal level, have not considered the annoyance of individuals living in the DNL 55-65 dB range.

Recent research confirms the findings of earlier investigations relied upon by the EPA, that annoyance is often generated at day-night average sound levels well below 65 dB (Fidell et al., 1985; Fidell et al., 1991; Hall et al., 1981). Figures 4 and 5 from Fidell et al. (1991) portray the responses from surveys of two mid-sized airports in California: Burbank Airport and the Orange County Airport. The percentage of respondents highly annoyed is depicted as a function of DNL, and compared to the Schultz curve. Both studies show significantly greater numbers of people highly annoyed than would have been predicted by the Schultz curve. For example, at 60 dB, as many as 70 percent of the Burbank population described themselves as highly annoyed and some 40 percent near the Orange County Airport.

Presumably because of this kind of evidence, another interagency task force has convened to discuss the extent to which day-night average sound levels below 65 dB should be taken into account in assessing the impact of aircraft/airport noise, and to examine the possible need for a single-event metric to supplement the DNL (EPA/FAA, 1990).[21]

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[19] FICUN was an ad-hoc interagency panel composed of representatives from EPA, FAA, HUD, the Department of Defense, and the Veterans Administration. In 1990 another such group, the Federal Interagency Committee on Noise (FICON) has been activated (focussing mainly on aircraft noise), but a report has not been published to date.

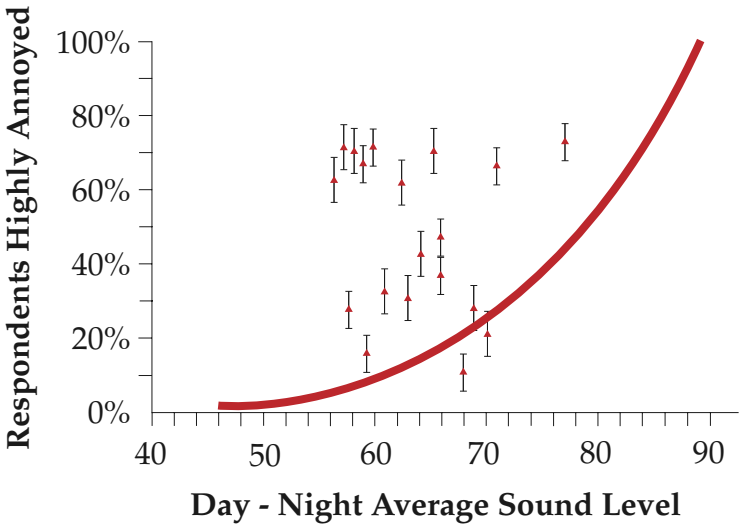
[20] Part 150 studies are conducted at airports where the noise generated by airport construction or expansion is potentially incompatible with the surrounding community. These studies must follow the procedure set out by Federal Aviation Regulations (FAR) Part 150.

[21] The U.S. EPA and FAA put together an intragency agreement to examine the extent to which single event analyses and information beyond the Ldn = 65 contour provide useful additions to current methods of evaluating potential airport noise impacts. Under this agreement, a contractor would identify eight existing airports and perform a quantitative analysis using existing data. No new annoyance data would be developed.

4. Sources

The sources of noise producing community annoyance are primarily aircraft, road traffic, and railroad noise, although noise from industry, construction, and within buildings can also be problematical. The leading offenders are usually aircraft and road traffic noise, although the hierarchy depends upon many factors, such as urbanization, numbers of noise events, and proximity to the sources. Recent research indicates that, despite equivalent noise levels, some sources of community noise are more annoying than others, providing further indication that the Schultz curve cannot be valid for all circumstances.

Treating annoyance from all sources with one predictive curve provokes the hoards of oversimplification. De Jong (1990a) reports that an analysis of Dutch studies carried out over the previous 15 years showed that aircraft and highway noise produced considerably more annoyance than equivalent levels of train, tramway, and urban road noise (Miedema, 1988). The divergence was particularly pronounced at high noise levels. The fact that aircraft generate more annoyance than surface transportation is portrayed dramatically in the analysis described above by Fidell et al. (1991), where annoyance related to mid-sized airports appears substantially greater than that predicted by the Schultz curve, while annoyance from urban sources, such as trains, trams, and street traffic, is considerably less than that predicted by the Schultz curve.[22] Figures 6 and 7, also from Fidell et al. (1991), depict data from British and Swedish railroad studies, showing somewhat less annoyance from these sources in relation to the Schultz curve.



Relationship of data from Burbank Airport Study to 1978 synthesis (Schultz) curve, showing percentage of respondents highly annoyed as a function of day-night average sound level. (After Fidell et al. 1991)

[22] See also Fidell et al. (1985), Hall et al. (1981), and de Jong (1990).

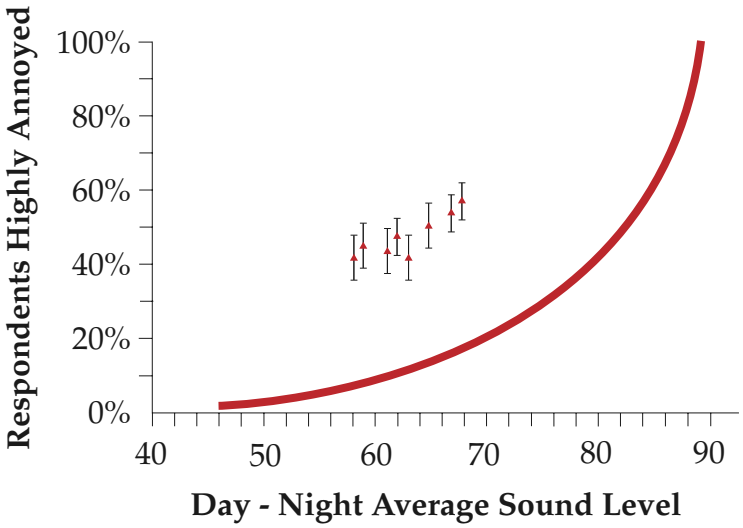


Figure 5
Relationship of data from Orange Country Airport Study to 1978 synthesis (Schultz) curve, showing percentage of respondents highly annoyed as a function of day-night average sound level. (After Fidell et al., 1991).

The explanation for these source-related differences is not necessarily that aircraft noise is inherently more annoying than surface transportation noise. It may be related to differences in people's criteria for responding to various noise sources (de Jong, 1990b; Green and Fidell, 1991). Or it may be caused by differences in sensitivity which are actually biologically based.[23] Green and Fidell (1991) point out that this evidence does not discredit the predictive validity of the DNL, but suggest that communities adopt a more sensitive criterion when evaluating the impact of aircraft noise.[24]

Impulse noise also appears to be more annoying than continuous noise of equivalent energy, and various penalties have been proposed ranging from 0 dB at relatively high ambient noise levels of about 67 dB, to 10 dB at ambient levels as low as 35 dB (Rice, 1983). Vos and Smoorenburg (1983) have recommended a formula for computing the impulse noise penalty, taking into account the type of noise source, the signal level, and the ambient noise level.

As de Jong points out (1990b), most people are exposed to some combination of noise sources, posing a very complex predictive problem. Several models for predicting noise annoyance from complex sources have been proposed, but most fail to solve the difficult theoretical problems involved (de Jong cites Berglund et al., 1981, and Miedema, 1985). Among the groups working on these models are the Institute for Sound and Vibration Research in England, and the Netherlands' Organization for Applied Scientific Research, TNO.

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[23] De Jong (1990b) cites the work of Di Nisi et al. (1987) and Ising, et al.(1981b) to support this theory.

[24] Green and Fidell found a difference of 5.2 dB bettheen the noise levels at which the same percentage of people are highly annoyed by aircraft noise versus noise from surface transportation.

5. Nonacoustics variables

Although it is dear that community annoyance is positively correlated with noise exposure level, other variables also appear to be important, such as ambient noise level, time of day and year, location, and socioeconomic status. None of these other variables, however, is as powerful as the attitude of the residents surveyed. This is a good example of the fact that the human being is not a black box, where the effect is a simple consequence of the input. In a recent analysis of 280 social surveys, Fields (1990) examined 17 hypotheses as they relate to community annoyance from noise. Besides noise exposure level, the only variables Fields identified as strongly correlated with noise annoyance there the attitudinal hypotheses: (1) fear that the noise source might be a danger to the neighborhood, (2) belief that the noise is preventable, (3) awareness that non-noise problems are associated with the noise source, (4) stated sensitivity to noise, and (5) belief that the economic activity represented by the source is not important for the community.

6. Habituation

The evidence is fairly dear that so long as the stimulus remains the same, noise annoyance does not subside over time (e.g., Fields, 1990). Griffiths (1983) cites studies showing no habituation for highway noise 4 months to 2 years after the opening of new routes. De long (1990) found that annoyance in a previously surveyed community increased by 10 percent with no change in noise levels. He suggests that this increase could represent a shift of internal criteria due to increased publicity and other factors, or perhaps an increase in physiological sensitization.

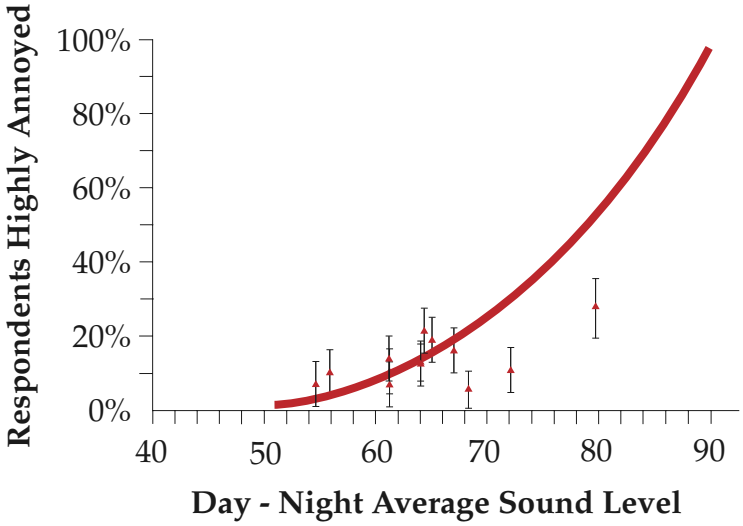

Figure 7 - Relationship of data from Swedish Railroad Study to 1978 synthesis (Schulz) curve, showing percentage of respondents highly annoyed as a function of day-night average sound level. After Fidell et al, 1991).

There has been very little study of the effects of noise-related annoyance on general health, although this would appear to be a fertile field. The study mentioned in section E.4, above by Rehm (1983) suggests a relationship between annoyance and cardiovascular disorders. Likewise, another study indicates a connection between noise and subjective health complaints (Pulles, et al., 1990). De Jong (1990a) refers to the recent use in Germany of the concept of "substantial annoyance" as a

predictor of possible health damage.[25] He recommends the development of an integrated theory of noise effects "to uncover the relationships among medical, physiological, behavioral, and ecological effects of environmental noise. " (de Jong, 1990a, p.520)

8. Summary: Annoyance

Annoyance can be viewed as the expression of negative feelings resulting from interference with activities, as well as disruption of one's peace of mind and the enjoyment of one's environment. Although this reaction can run the gamut of mild irritation to extreme distress, only responses categorized as "highly annoyed" (and greater) have been used to measure the impact of noise on communities. The most respected and widely used criterion to assess community annoyance in the U.S. has been the Schultz curve, although this criterion has been the subject of heated debate. Several recent studies indicate that the Schultz curve underestimates annoyance due to aircraft noise and overestimates annoyance from the noise of urban traffic and trains, leading to the conclusion that annoyance from these categories should be assessed separately. In addition, there has been growing interest in supplementing the traditional DNL with a descriptor for single events.

EPA's Levels Document identified the outdoor level to protect against activity interference as a day-night average sound level of 55 dB. This identification was not to be construed as a standard or regulation,[26] but as information to aid states, localities, and the general public. Later, an interagency task force identified average levels between 55 and 65 dB as "acceptable" for purposes of land-use planning. The DNL 65-dB criterion, which has been applied particularly to airport noise assessments, is now being reconsidered by another interagency task force.

There is evidence that impulse noise is more annoying than continuous noise of equivalent energy, and various correction factors have been proposed to account for the difference. In addition, most people are exposed to a combination of noise sources, and models for predicting the resulting annoyance are in the formative stages.

The most important variables other than noise exposure level relate to people's attitudes about the noise, such as fear of possible danger, stated sensitivity, and the belief that the noise is preventable. Finally, it appears that noise-related annoyance does not subside over time.

VI. Conclusions

Noise has a significant impact on the quality of American life. There is no evidence that the impact has diminished in the years since ONAC was abolished. Rather, it appears that the impact is at least as great, and most probably greater, than it was 10 years ago, due to population growth, especially in urban areas, and the proliferation of certain noise sources.

A considerable amount of noise effects research has been conducted over the last decade, much of it taking place in the European nations where governmental concern about noise is greater than it is in the U.S. at this time. These studies have expanded the knowledge base and filled certain gaps. Many of them suggest important interrelationships between the various noise effects that remain largely unexplored. For example, perceived control over noise appears to decrease its adverse effects on the subsequent performance of certain tasks. The concept of control also has a bearing on annoyance from noise, as do several other nonacoustic factors. Annoyance appears to be related to

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[25] De Jong cites Jansen (1986).

[26] See Foreword, Levels Document (EPA, 1974a).

extra-auditory health effects, and chronic sleep interference, which is a component of annoyance, can have adverse effects on health and well-being.

All of these effects are, to a varying degree, stress related. Nowadays there is increasing evidence in the medical literature on the relationship between stress and illness, one which is often exacerbated by lack of control.

Cumulatively, this evidence suggests the potential for a unifying hypothesis that may well explain some of the health effects that have been observed in connection to noise exposure, but have usually been dismissed because of the absence or insufficiency of direct cause and effect relationships. Such a hypothesis, however, can only be validated by a new interdisciplinary approach, one which takes a broader and somewhat different perspective than is currently employed. This approach could very well provide the key to understanding a great deal more about the general impact of noise on society, and the extra-auditory effects in particular.

GUIDELINES FOR CONSIDERING NOISE IN LAND USE PLANNING AND CONTROL

June 1980

Federal Interagency Committee on Urban Noise

FEDERAL
INTERAGENCY COMMITTEE
ON URBAN NOISE

To all local government officials and others interested in noise/land use concerns:

In his Environmental Message to Congress in August, 1979, President Carter announced a new Urban Noise Initiative to reduce urban noise. The Federal Interagency Committee on Urban Noise was thereby established to coordinate various programs, including an interagency program designed "to encourage noise sensitive development, such as housing, to be located away from major noise sources." As a first step in that program, the Committee is pleased to make available this document which presents a broad consolidation of Federal guidance on the incorporation of noise considerations in local development planning and site review operations. We hope that it will facilitate improved communication among all levels of government on noise compatible land use and that you will find it useful in addressing noise/land use concerns in your community.

Douglas Costle
Administrator
U.S. Environmental Protection Agency

Neil Goldschmidt
Secretary
U.S. Department of Transportation

Moon Landrieu
Secretary
U.S. Department of Housing
and Urban Development

Robert B. Pirie, Jr.
Assistant Secretary of Defense
(Manpower, Reserve Affairs & Logistics)
U.S. Department of Defense

Max Cleland
Administrator
Veterans Administration

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Appendix E. Federal Agency Points of Contact for Additional Information

Section 1 presents consolidated Federal agency land use compatibility guidelines. Section 2 overviews techniques by which the guidelines can be implemented. Section 3 briefly overviews the major Federal agency noise control policies and programs. The Appendices contain brief descriptions of environmental noise descriptors and annotated bibliographies of selected Federal documents.

Section 1. LAND USE COMPATIBILITY GUIDELINES

This section contains two tables. Table 1 classifies noise levels into a set of noise zones according to the most commonly used environmental noise descriptors. Noise zones are identified in order of increasing noise level by the letters "A" through "D". The descriptors are discussed in Appendix A. The Day-Night Average Sound Level (DNL)[1] descriptor can be used for all noise sources. The Equivalent Sound Level (L_{eq}) is included because some highway noise data can be expected to be in terms of an equivalent sound level for the highway "design hour" — see Table 1 for description of when L_{eq} (design hour) is equivalent to DNL for planning purposes. The L_{eq} descriptor itself is not unique to highways and can be applied to any noise source. The Noise Exposure Forecast (NEF) descriptor is used for aircraft noise only and is being superceded by DNL. The Community Noise Equivalent Level (CNEL) descriptor (for the state of California) uses values similar to DNL. Older descriptors unique to airport noise environments, such as the Composite Noise Rating (CNR), may be encountered. For general comparison purposes L_{dn} 65 = NEF 30 = CNR 100, L_{dn} 75 = NEF 40 = CNR 115.

Table 2 contains suggested land use compatibility guidelines. The table arrays land uses[2] on the left with the noise zones of Table 1 across the top. Land use compatibility is expressed as being "compatible", "incompatible" and "compatible with restrictions." The system as presented in the table is comprised of two digit categories identifying land use activity in the most generalized way (e.g. "10 Residential"). Within some of the two-digit categories here are sub-categories identifying activity in greater detail. Compatibility as expressed in this table represents a consolidation of existing Federal agency guidelines. This table serves as a point of departure in making several kinds of determinations, including whether various land uses should be allowed at particular sites based upon the noise levels at those sites. Detailed planning should be based on the procedures and specific general planning guidance found in appropriate Federal agency documents (Appendix B) as well as the needs, desires and site characteristics of the particular community. Another input to the

[1]Day-Night Average Sound Level is abbreviated as DNL and symbolized mathematically as L_{dn} (e.g., L_{dn} 65, L_{dn} 75, etc.).

[2]Land uses are here categorized according to the standard land use activity categories found in the *Standard Land Use Coding Manual*, Housing and Home Finance Agency (now Department of Housing and Urban Development) and Bureau of Public Roads (now Department of Transportation/Federal Highway Administration), 1965.

planning process is the statement of public health and welfare goals in EPA's "Levels" Document. The levels can be used by individual communities to incorporate public health and welfare goals into the planning process. These levels do not *in themselves,* however, form the sole basis for appropriate land use actions because they do not consider cost, feasibility, the noise levels from any particular source, or the development needs of the community and do include an adequate margin of safety. They should be considered by all communities in their planning, including those who now enjoy quiet and wish to preserve it, as well as those which are relatively noisy and wish to mitigate the problem.

TABLE 1. NOISE ZONE CLASSIFICATION

Noise Zone	Noise Exposure Class	Noise Descriptor			HUD Noise Standards
		DNL[1] Day-Night Average Sound Level	L_{eq}(hour)[3] Equivalent Sound Level	NEF[4] Noise Exposure Forecast	
A	Minimal Exposure	Not Exceeding 55	Not Exceeding 55	Not Exceeding 20	"Acceptable"
B	Moderate Exposure	Above 55[2] But Not Exceeding 65	Above 55 But Not Exceeding 65	Above 25 But Not Exceeding 30	
C-1	Significant Exposure	Above 65 Not Exceeding 70	Above 65 Not Exceeding 70	Above 30 But Not Exceeding 35	"Normally Unacceptable"[5]
C-2		Above 70 But Not Exceeding 75	Above 70 But Not Exceeding 75	Above 35 But Not Exceeding 40	
D-1	Severe Exposure	Above 75 But Not Exceeding 80	Above 40 But Not Exceeding 80	Not Exceeding 45	"Unacceptable"
D-2		Above 80 But Not Exceeding 85	Above 80 But Not Exceeding 85	Above 45 But Not Exceeding 50	
D-3		Above 85	Above 85	Above 50	

[1]CNEL — Community Noise Equivalent Level (California only) uses the same values.

[2]HUD, DOT and EPA recognize L_{dn} = 55 dB as a goal for outdoors in residential areas in protecting the public health and welfare with an adequate margin of safety (Reference: EPA "Levels" Document.) However, it is not a *regulatory* goal. It is a level defined by a negotiated scientific consensus without concern for economic and technological feasibility or the needs and desires of any particular community.

[3]The Federal Highway Administration (FHWA) noise policy uses this descriptor as an alternative to L_{10} (noise level exceeded ten percent of the time) in connection with its policy for highway noise mitigation. The L_{eq} (design hour) is equivalent to DNL for planning purposes under the following conditions: 1) heavy trucks equal ten percent of total traffic flow in vehicles per 24 hours; 2) traffic between 10 p.m. and 7 a.m. does not exceed fifteen percent of the average daily traffic flow in vehicles per 24 hours. Under these conditions DNL equals L_{10} - 3 decibels.

[4]For use in airport environs only; is now being superceded by DNL.

[5]The HUD Noise Regulation allows a certain amount of flexibility for non-acoustic benefits in zone C-1. Attenuation requirements can be waived for projects meeting special requirements.

TABLE 2. SUGGESTED LAND USE COMPATIBILITY GUIDELINES

Land Use		Noise Zones/DNL Levels in L_{dn}						
SLUCM No.	Name	A 0-55	B 55-65	C-1 65-70	C-2 70-75	D-1 75-80	D-2 80-85	D-3 85+
10	**Residential**							
11	Household units.							
11.11	Single units — detached	Y	Y*	25[1]	30[1]	N	N	N
11.12	Single units — semidetached	Y	Y*	25[1]	30[1]	N	N	N
11.13	Single units — attached row	Y	Y*	25[1]	30[1]	N	N	N
11.21	Two units — side-by-side	Y	Y*	25[1]	30[1]	N	N	N
11.22	Two Units — one above the other	Y	Y*	25[1]	30[1]	N	N	N
11.31	Apartments — walk up	Y	Y*	25[1]	30[1]	N	N	N
11.32	Apartments — elevator	Y	Y*	25[1]	30[1]	N	N	N
12	Group quarters	Y	Y*	25[1]	30[1]	N	N	N
13	Residential hotels	Y	Y*	25[1]	30[1]	N	N	N
14	Mobile home parks or courts	Y	Y*	N	N	N	N	N
15	Transient lodgings	Y	Y*	25[1]	30[1]	35[1]	N	N
16	Other residential	Y	Y*	25[1]	30[1]	N	N	N
20	**Manufacturing**							
21	Food and kindred products — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
22	Textile mill products — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
23	Apparel and other finished products made from — fabrics, leather, and similar materials — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
24	Lumber and wood products (except furniture) — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
25	Furniture and fixtures — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
26	Paper and allied products — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
27	Printing, publishing, and allied industries	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
28	Chemicals and allied products — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
29	Petroleum refining and related industries	Y	Y	Y	Y[2]	Y[3]	Y[4]	N

*The designation of these uses as "compatible" in this zone reflects individual Federal agencies' consideration of general cost and feasibility factors as well as past community experiences and program objectives. Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider. For an indication of possible community reaction in residential environments at various levels of cumulative noise, Table D-1 in Appendix D should be consulted.

NOTES FOR TABLE 2

1. a) Although local conditions may require residential use, it is discouraged in C-1 and strongly discouraged in C-2. The absence of viable alternative development options should be determined and an evaluation indicating that a demonstrated community need for residential use would not be met if development were prohibited in these zones should be conducted prior to approvals.

   b) Where the community determines that residential uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB (Zone C-1) and 30 dB (Zone C-2) should be incorporated into building codes and be considered in individual approvals. Normal construction can be expected to provide a NLR of 20 dB, thus the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. Additional consideration should be given to modifying NLR levels based on peak noise levels.

   c) NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, design and use of berms and barriers can help mitigate outdoor noise exposure particularly from ground level sources. *Measures that reduce noise at a site should be used wherever practical in preference to measures which only protect interior spaces.*

2. Measures to achieve NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

3. Measures to achieve NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

4. Measures to achieve NLR of 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

KEY TO TABLE 2

SLUCM	Standard Land Use Coding Manual
Y (Yes)	Land Use and related structures compatible without restrictions.
N (No)	Land Use and related structures are not compatible and should be prohibited.
NLR (Noise Level Reduction)	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
Y^X (Yes with restrictions)	Land Use and related structures generally compatible; see notes 2 through 4.
25, 30, or 35	Land Use and related structures generally compatible; measures to achieve NLR of 25, 30 or 35 must be incorporated into design and construction of structure.
25*, 30* or 35*	Land Use generally compatible with NLR; however, measures to achieve an overall do not necessarily solve noise difficulties and additional evaluation is warranted.

TABLE 2. SUGGESTED LAND USE COMPATIBILITY GUIDELINES (continued)

Land Use		Noise Zones/DNL Levels in L_{dn}						
SLUCM No.	Name	A 0-55	B 55-65	C-1 65-70	C-2 70-75	D-1 75-80	D-2 80-85	D-3 85+
30	**Manufacturing (cont'd)**							
31	Rubber and misc. plastic products — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
32	Stone, clay and glass products — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
33	Primary metal industries	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
34	Fabricated metal products — manufacturing.	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
35	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks — manufacturing	Y	Y	Y	25	30	N	N
39	Miscellaneous manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	
40	**Transportation, communication and utilities**							
41	Railroad, rapid rail transit and street railway transportation	Y	Y	Y	Y[2]	Y[3]	Y[4]	Y
42	Motor vehicle transportation	Y	Y	Y	Y[2]	Y[3]	Y[4]	Y
43	Aircraft transportation	Y	Y	Y	Y[2]	Y[3]	Y[4]	Y
44	Marine craft transportation	Y	Y	Y	Y[2]	Y[3]	Y[4]	Y
45	Highway and street right-of-way	Y	Y	Y	Y[2]	Y[3]	Y[4]	Y
46	Automobile parking	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
47	Communication	Y	Y	Y	25[5]	30[5]	N	N
48	Utilities	Y	Y	Y	Y[2]	Y[3]	Y[4]	Y
49	Other transportation, communication and utilities	Y	Y	Y	25[5]	30[5]	N	N
50	**Trade**							
51	Wholesale trade	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
52	Retail trade — building materials, hardware and farm equipment	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
53	Retail trade — general merchandise	Y	Y	Y	25	30	N	N
54	Retail trade — food	Y	Y	Y	25	30	N	N
55	Retail trade — automotive, marine craft, aircraft and accessories	Y	Y	Y	25	30	N	N
56	Retail trade — apparel and accessories	Y	Y	Y	25	30	N	N
57	Retail trade — furniture, home furnishings and equipment	Y	Y	Y	25	30	N	N
58	Retail trade — eating and drinking establishments	Y	Y	Y	25	30	N	N
59	Other retail trade	Y	Y	Y	25	30	N	N

NOTES FOR TABLE 2

2. Measures to achieve NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

3. Measures to achieve NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

4. Measures to achieve NLR of 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

5. If noise sensitive use indicated NLR; if not use is compatible.

KEY TO TABLE 2

SLUCM	Standard Land Use Coding Manual
Y (Yes)	Land Use and related structures compatible without restrictions.
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NLR (Noise Level Reduction)	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
Y^X (Yes with restrictions)	Land Use and related structures generally compatible; see notes 2 through 4.
25, 30, or 35	Land Use and related structures generally compatible; measures to achieve NLR of 25, 30 or 35 must be incorporated into design and construction of structure.
25*, 30* or 35*	Land Use generally compatible with NLR; however, measures to achieve an overall noise reduction do not necessarily solve noise difficulties and additional evaluation is warranted.

TABLE 2. SUGGESTED LAND USE COMPATIBILITY GUIDELINES (continued)

Land Use		Noise Zones/DNL Levels in L_{dn}						
SLUCM No.	Name	A 0-55	B 55-65	C-1 65-70	C-2 70-75	D-1 75-80	D-2 80-85	D-3 85+
60	**Services**							
61	Finance, insurance and real estate services	Y	Y	Y	25	30	N	N
62	Personal services	Y	Y	Y	25	30	N	N
62.4	Cemeteries	Y	Y	Y	Y[2]	Y[3]	Y[4,11]	Y[6,11]
63	Business services	Y	Y	Y	25	30	N	N
64	Repair services	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
65	Professional services	Y	Y	Y	25	30	N	N
65.1	Hospitals, nursing homes	Y	Y*	25*	30*	N	N	N
65.1	Other medical facilities	Y	Y	Y	25	30	N	N
66	Contract construction services	Y	Y	Y	25	30	N	N
67	Governmental services	Y	Y*	Y*	25*	30*	N	N
68	Educational services	Y	Y*	25*	30*	N	N	N
69	Miscellaneous services	Y	Y	Y	25	30	N	N
70	**Cultural, entertainment and recreational**							
71	Cultural activities (including churches)	Y	Y*	25*	30*	N	N	N
71.2	Nature exhibits	Y	Y*	Y*	N	N	N	N
72	Public assembly	Y	Y	Y	N	N	N	N
72.1	Auditoriums, concert halls	Y	Y	25	30	N	N	N
72.11	Outdoor music shells, amphitheaters	Y	Y*	N	N	N	N	N
72.2	Outdoor sports arenas, spectator sports	Y	Y	Y[7]	Y[7]	N	N	N
73	Amusements	Y	Y	Y	Y	N	N	N
74	Recreational activities (incl. golf courses, riding stables, water recreation)	Y	Y*	Y*	25*	30*	N	N
75	Resorts and group camps	Y	Y*	Y*	Y*	N	N	N
76	Parks	Y	Y*	Y*	Y*	N	N	N
79	Other cultural, entertainment and recreation	Y	Y*	Y*	Y*	N	N	N
80	**Resource production and extraction**							
81	Agriculture (except livestock)	Y	Y	Y[8]	Y[9]	Y[10]	Y[10,11]	Y[10,11]
81.5 to 81.7	Livestock farming and animal breeding	Y	Y	Y[8]	Y[9]	N	N	N
82	Agricultural related activities	Y	Y	Y[8]	Y[9]	Y[10]	Y[10,11]	Y[10,11]
83	Forestry activities and related services	Y	Y	Y[8]	Y[9]	Y[10]	Y[10,11]	Y[10,11]
84	Fishing activities and related services	Y	Y	Y	Y	Y	Y	Y
85	Mining activities and related services	Y	Y	Y	Y	Y	Y	Y
89	Other resource production and extraction	Y	Y	Y	Y	Y	Y	Y

*The designation of these uses as "compatible" in this zone reflects individual Federal agencies' consideration of cost and feasibility factors as well as program objectives. Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider. For an indication of possible community reaction in residential environments at various levels of cumulative noise, Table D-1 in Appendix D should be consulted.

NOTES FOR TABLE 2

2. Measures to achieve NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office ares. noise sensitive areas or where the normal noise level is low.

3. Measures to achieve NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

4. Measures to achieve NLR of 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

6. No buildings.

7. Land use compatible provided special sound reinforcement systems are installed.

8. Residential buildings require a NLR of 25.

9. Residential buildings require a NLR of 30.

10. Residential buildings not permitted.

1 Land use not recommended, but if community decides use is necessary, hearing protection devices should be worn by personnel.

KEY TO TABLE 2

SLUCM	Standard Land Use Coding Manual
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NLR (Noise Level Reduction)	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
Y^X (Yes with restrictions)	Land Use and related structures generally compatible; see notes 2 through 4.
25, 30, or 35	Land Use and related structures generally compatible; measures to achieve NLR of 25, 30 or 35 must be incorporated into design and construction of structure.
25*, 30* or 35*	Land Use generally compatible with NLR; however, measures to achieve an overall noise reduction do not necessarily solve noise difficulties and additional evaluation is warranted.

Section 2. TECHNIQUES FOR DEALING WITH NOISE IN LAND USE PLANNING

There are many techniques that local governments can use to reduce the effect of noise on surrounding land uses. These techniques range from simply increasing public awareness of existing noise levels to the very drastic, but admittedly very effective step of public purchase of severely exposed land uses. The following table outlines some of these techniques. The table is not intended to be exhaustive. Rather it is presented simply to illustrate the range of techniques available to reduce the effect of noise on land uses.

The techniques are arrayed in order of increasing stringency and general effectiveness. The effectiveness of any given technique is, however, very much a function of the specific noise situation and the way in which the technique is applied. It should also be understood that often the most effective approach will be a *combination* of techniques such as enacting both zoning and building code requirements.

The table includes, for each technique, a brief general summary of current experience with the techniques. The column entitled "situation where most applicable" includes indications of inherent limitations to given techniques. The "comments" column is intended to provide general insights on how the techniques work.

TABLE 3. TECHNIQUES FOR DEALING WITH NOISE IN LAND USE PLANNING

TECHNIQUE	SITUATION WHERE MOST APPLICABLE	COMMENTS
	Anywhere	Can be an important factor in determining the marketability of homes and other land uses. Can have a direct effect on developers and builders. Use in combination with other actions.
b. Prior Notice of Noise Levels to Renters and Purchasers	Anywhere	Can be required by local ordinance. Enables renters and purchasers to choose environment with full information. May reduce or eliminate subsequent complaints or damage claims.
II. Coordination		
a. OMB Circular A-95 Process	Anywhere Federal and Federally assisted projects are proposed	Allows identification of noise problems in the review and comment of Federal and Federally assisted plans, programs and projects. Indirect control.
b. Environmental Assessment Process	Anywhere Environmental Impact Analyses are required.	Indirect Control. Increase awareness of noise. May discourage inappropriate projects. Mechanism to propose mitigation measures.
III. Providing Advisory Services		
a. Architectural or Planning Review	Where there is appropriate staff or funding.	Site-specific analysis for each case.
b. Design Assistance	Where there is appropriate staff or funding.	Allows inclusion of noise mitigation measures such as building attenuation, siting modification, berms, and barriers, etc.
c. Information Libraries	Anywhere	Passive advisory service.

Continued on following page

TABLE 3. TECHNIQUES FOR DEALING WITH NOISE IN LAND USE PLANNING (continued)

TECHNIQUE	SITUATION WHERE MOST APPLICABLE	COMMENTS
	Where comprehensive planning process is established particularly where controls (zoning) must implement plan.	Works best when noise is considered a basic suitability factor along with others such as slope, soils conditions, etc. Should be addressed in all types of plans. May require enabling legislation.
V. Incorporating Noise Issues Into Environmental Management Programs	Where programs such as Areawide Waste Management, Air Quality, Coastal Zone Management, Prime and Unique Agricultural Lands and Floodplains and Wetlands are established.	These programs influence land use policy.
VI. Development Codes and Policies		
a. Subdivision Regulations and/or site plan approvals. Require Noise Reduction Considerations in site design (site orientation, buffers, barriers, etc.)	Where portions of development projects fall within noise exposure areas.	May not be applicable for airborne aircraft. May require enabling legislation.
b. Building codes. Require sound insulation, isolation, absorption in building construction	Where interior noise exposure can be reduced to acceptable levels and buildings should otherwise be prohibited.	Noise Level Reduction (NLR) up to 35 dB (15 dB above normal construction). Outdoor environment not protected. May require enabling legislation to use noise zones for building code restrictions. Difficult to apply retroactively. Local opposition to increased building costs possible Related to energy conservation. Requirements might also be incorporated into health and/or occupancy codes.

Continued on following page

TABLE 3. TECHNIQUES FOR DEALING WITH NOISE IN LAND USE PLANNING (continued)

TECHNIQUE	SITUATION WHERE MOST APPLICABLE	COMMENTS
VI. Development Codes and Policies — *continued*		
c. Special Permits and/or Special Planning Districts	Anywhere a permit granting system exists or can be started.	Site-specific analysis would be required for each case. May require enabling legislation.
d. Special Use Designations	Anywhere unique or special land characteristics exist (cultural or historic, scenic, wetlands, floodplains, prime agricultural lands, water supply sources).	Such areas may be noise exposed and those designations will normally assure noise compatibility. May require legislation.
e. Official Map	Anywhere streets exist or are planned.	Planned major streets should avoid noise sensitive areas and should encourage development in areas not exposed to noise.
f. Capital Improvements	Anywhere	Governmental constructed utilities, streets, and facilities should be sited to encourage compatible use and be in themselves compatible.
VII. Land Use Controls		
a. Zoning		
1. For compatible land uses	Anywhere	Should be based on a comprehensive plan. May require enabling legislation to use noise as a criterion. Not retroactive and can be removed upon short notice. Most effective for undeveloped areas.
2. To require buffer areas	Where noise source is at ground level.	Easy to implement in low density areas. Not effective for airborne aircraft. May require enabling legislation.
3. To require berms or barriers	Where noise source is at ground level.	Effective but care is needed to insure that it is aesthetically desirable. May require enabling legislation.

Continued on following page

TABLE 3. TECHNIQUES FOR DEALING WITH NOISE IN LAND USE PLANNING (continued)

TECHNIQUE	SITUATION WHERE MOST APPLICABLE	COMMENTS
VII. Land Use Controls — *continued*		
4. To allow cluster or planned unit development	For medium and large developments	Significant potential benefits. Builders can incorporate buffer areas without reducing number of units. May require enabling legislation.
VIII. Purchase Real Property Interests		
a. Fee Purchase		
1. For compatibility	Where noise levels are extreme	Attempts to contain worst noise effects within the right-of-way or site. May require enabling legislation.
2. For public use	Where public use is compatible and needed in that location.	Limited by need for compatible public uses.
b. Fee purchase and resale with development restrictions	Where other measures are impractical	Public authority may be reluctant. Local government may object to controls. Business may object to government becoming developer. Dependent on demand feasibility for compatible use. May require enabling legislation.
c. Easement (development rights) purchase	Where other measures are impractical	May be more practical than Fee Simple purchase. May require enabling legislation.
d. Agricultural Land Preservation District	Where land is suitable.	Requires appropriate legislation. Minimum site size of 50 acres is typical and usually allows a single farm residence. Presents possible bird strike hazards.
IX. Property Tax Incentives (open space, agricultural, etc.)	Where tax pressures exist on owners of undeveloped land.	Requires enabling legislation. Easy in many cases to implement. Cannot prevent incompatible development but can allow economically productive compatible land use.

Section 3. FEDERAL AGENCY PROGRAMS AND POLICIES

The purpose of this section is to briefly overview the noise policies and programs relating to land use of the following agencies:

- Department of Defense (DOD)
- Department of Housing and Urban Development (HUD)
- Environmental Protection Agency (EPA)
- Department of Transportation/Federal Aviation Administration (DOT/FAA)
- Department of Transportation/Federal Highway Administration (DOT/FHWA)
- Veterans Administration (VA)

The Federal noise policies and programs discussed in this section all share the common goal of protecting the public health and welfare with regard to noise. Most policies also state additional goals in recognition that noise is a specific constraint on particular agency missions. DOD, for example, states as a primary goal of its noise policy, the continuance of operational integrity at its airfields.

All of the policies address in varying degrees (and some not exclusively), transportation noise problems, particularly those of highways and airport systems. The policies concentrate on these noise sources not only because their noise problems are among the most pervasive, but because Federal agencies have assisted by providing billions of dollars for their construction and maintenance. Most, however, are actually owned and operated by local and State governments.

The major differences among the policies center upon the noise levels specified and the types of noise measures used or required. There are *four different types of noise levels* used in these policies:

- mitigation levels (e.g., FHWA design levels);
- levels required to protect the public health and welfare (e.g., EPA "levels" document);
- general planning (land use) levels (e.g., DOD);
- levels required for Federal assistance (e.g., HUD, VA) (these are similar to the general planning levels).

As Table 4 shows, a specific purpose is associated with each type of level. *Misuse of a particular type in any situation can produce erroneous results.*

Primarily because of differences in statutory authority, the noise policies differ in the kinds of noise actions and techniques emphasized. The FAA and EPA regulations, for example, stress source and operational controls for aircraft and highway vehicles while the FHWA policy, in the main, stresses noise mitigation (e.g., placement of noise barriers) at noise sensitive locations along highways. HUD and VA, on the other hand, require, in certain cases, that the receiver (e.g., residential development) be provided noise attenuation as a condition for mortgage insurance or assistance.

A brief overview of individual agency noise policies follows.

TABLE 4. FEDERAL AGENCY POLICY AND PROGRAM SUMMARY

AGENCY		1. DEPARTMENT OF DEFENSE (DOD)	2. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)	3. ENVIRONMENTAL PROTECTION AGENCY (EPA)	4. DOT/FEDERAL AVIATION ADMINISTRATION (FAA)	5. DOT/FEDERAL HIGHWAY ADMINISTRATION (FHWA)	6. VETERAN'S ADMINISTRATION (VA)
Type of Program or Policy		Air Installations Compatible Use Zones (AICUZ) Program	HUD Noise Regulations	Health & Welfare Guidance	Aviation Noise Abatement Policy	Highway Noise Policy	VA Noise Policy
Key Documents		DOD Instruction 4165.57 (1977) Installation AICUZ Studies	24 CRF Part 51 Subpart B; Noise Assessment Guidelines (1980)	EPA "Levels" Document (1974)	DOT/FAA Aviation Noise Abatement Policy (1976) Advisory Circular: 150/5050-6 (1977)	FHPM 7-7-3 (1976)	Section VIII Appraisal of residential properties near Airports (1969)
Noise Levels	Title of Levels	Levels used as "reasonable" guidance to communities in planning	Levels which determine whether proposed sites are eligible for HUD insurance or assistance	Levels which are required to protect the public health and welfare with an adequate margin of safety	Levels used as "starting points" in determining noise/land use relationships	Design Noise Levels	Levels determining whether proposed sites are eligible for VA assistance
	Purpose of Levels	Guidance to communities for planning. Reflects cost, feasibility, past community experience, general program objectives and consideration of health and welfare goals.	See above. Levels can be used as general planning levels. Reflects cost, feasibility, general program objectives and consideration of health and welfare goals.	These levels identify in scientific terms the threshold of effect. While the levels have relevance for planning, they do not in themselves form the sole basis for appropriate land use actions because they do *not* consider cost, feasibility or the development needs of the community. The user should make such tradeoffs.	Guidance to communities for planning. Reflects safety, cost, feasibility, general program objectives and consideration of health and welfare goals.	These levels are used in determining where noise mitigation on a particular highway project is warranted. They do reflect cost and feasibility considerations. They are not appropriate land use criteria. Location Specific.	See above. Reflects cost, feasibility general program objectives and consideration of health and welfare goals.
	Source to which applied	Military Airfields	All sources	All sources	Civil Airports	Highways only	Airports only
	Noise Descriptors Used	DNL	DNL	DNL	DNL, L_{eq} (24) (California only)	L_{eq} or L_{10} for design hour	Various (including DNL)

Department of Defense (DOD)

Department of Defense policy for noise compatible land use guidance is called the Air Installation Compatible Use Zone (AICUZ). Each military service has an AICUZ program to investigate, describe, and study noise exposure and land use at all DOD air installations. AICUZ studies for each installation are prepared and given to the public and local, regional, state, and other federal agencies for use in their land use planning/control and intergovernmental programs and processes. Each study contains noise contours, accident potential zones, existing and future land use compatibilities and incompatibilities, land use planning/control recommendations.

Department of Defense Policy:

- Requires that all reasonable, economical, and practical measures will be taken to reduce and/or control the generation of noise from flying.
- Is to work toward achieving compatibility between air installations and neighboring civilian communities by means of a compatible land use planning and control process conducted by the local community.
- Requires working with local governments, local planning commissions, special purpose districts, regional planning agencies, state agencies, and state legislatures as well as other federal agencies.
- Includes technical assistance to local, regional, and state agencies to assist them in developing their land use planning and regulatory processes, to explain an AICUZ study and its implications, and generally to work toward compatible planning and development in the vicinity of military airfields.

Department of Housing and Urban Development (HUD)

The major purpose of the Department of Housing and Urban Development's (HUD) noise regulations (24 CFR Part 51 Subpart B) is to insure that activities assisted or insured by the Department achieve the goal of a suitable living environment. HUD also supports other agencies efforts in noise control.

The regulations generally apply to all HUD actions and provide minimum national standards to protect citizens against excessive noise in their communities and places of residence. The basic policy is that HUD assistance for construction of new noise sensitive uses is prohibited generally for projects with Unacceptable noise exposures and is discouraged for projects with Normally Unacceptable noise exposure. Unacceptable noise exposure is defined as a noise level above 75 dB (Day-night average sound level (DNL) in decibels). A Normally Unacceptable level is one above 65 dB but not exceeding 75 dB. These noise levels are to be based on noise from all sources, highway, railroad and aircraft.

Attenuation measures are normally required before projects in the Normally Unacceptable zone can be approved. Attenuation measures that reduce the external noise at a site are preferred, whenever practicable, over measures which only provide attenuation for interior spaces. HUD's noise regulations also apply to modernization and rehabilitation. For major or substantial rehabilitation projects in the Normally Unacceptable and Unacceptable

noise zones HUD actively will seek to have noise attenuation features incorporated into the project. In the Unacceptable noise zones, HUD will strongly encourage conversion of noise exposed sites to more compatible land uses.

HUD also requires that Comprehensive Planning Assistance grantees give adequate consideration to noise as an integral part of the urban environment with particular emphasis being placed on the importance of compatible land use planning in relation to airports, highways and other sources of high noise. Recipients of community development block grants under Title I of the Housing and Community Development Act of 1974 must also take into consideration the noise criteria and standards in the environmental assessment process.

Environmental Protection Agency (EPA)

The EPA's Noise program is designed to provide leadership to the national noise abatement effort. The key statutory mandates under which EPA operates are the Noise Control Act of 1972 (PL92-574) and the Quiet Communities Act of 1978 (95-609).

Until recently, EPA's Program has concentrated its efforts in setting noise source emission standards for various products, including transportation vehicles, construction equipment and consumer products. EPA also proposes aircraft/airport regulations to the FAA following a special procedure specified in the Noise Control Act of 1972.

Key to these efforts have been EPA reports defining scientifically the relationships between noise level and human response. The EPA "Levels" Document established threshold levels of impact which, if met, would protect the public "with an adequate margin of safety". As noted in Table 4, while these levels have relevance for planning, they, in themselves, are *not* necessarily appropriate land use planning criteria because they do not consider cost, feasibility, or the development needs of the community.

The emphasis of EPA's program today is on assisting cities, States and others to develop and carry out effective noise programs through various approaches, including noise and land use. In addition to a new grants program under the Quiet Communities Act, EPA has initiated such technical assistance programs as The Quiet Communities Program (QCP) and Each Community Helps Others (ECHO). The QCP is a program focusing EPA guidance and fiscal resources on target communities to achieve total community involvement and action. The ECHO program provides technical assistance to local communities on specific noise problems consulting services from officials of communities who have successfully overcome similar problems. Various other programs emphasizing provision of information on noise to various publics are also being developed and carried out.

Department of Transportation/Federal Aviation Administration (DOT/FAA)

The Federal Aviation Administration's noise program is guided by the 1976 Aviation Noise Abatement Policy and the Aviation Safety and Noise Abatement Act of 1979. The policy defines the responsibilities of the FAA, airport proprietors and users, and land use planning and control authorities in achieving and maintaining airport noise compatibility. The FAA uses two major approaches to implement this policy. The first is aimed at reducing

the noise of the individual aircraft. This includes a program to retrofit engines or equipment on noisy aircraft or to replace them with newer, quieter aircraft. It also includes the development of operational procedures which can reduce the aircraft's noise impacts.

The other major approach to noise compatibility is through planning and development activities at airports under the Airport and Airway Development Act of 1970 (as amended). Airport Noise Control and Land Use Compatibility (ANCLUC) planning studies integrate the master planning study activities, the environmental considerations, and the airport-land use compatibility planning activities at an airport. The objective is to achieve maximum noise and environmental compatibility within the constraints of safety, service, and economic viability. The plan may contain operational controls as well as physical improvements for the airport. It will also recommend, based upon a comprehensive study effort, land uses and strategies for land use control for areas around the airport impacted by noise. FAA's advisory circular, Airport-Land Use Compatibility Planning (AC 150/5050-6), serves as the basic guidance for the land use compatibility portion of an ANCLUC study.

The Aviation Safety and Noise Abatement Act of 1979 strengthens the FAA's noise policy by providing assistance to airport operators to prepare and carry out noise compatibility programs and providing incentives for replacing noisy aircraft with new technology aircraft. In compliance with this Act, the FAA will develop and promulgate an amendment to Part 150 of the Federal Aviation Regulations which will standardize airport noise abatement plans and provide for their review, specify standard noise metrics for use in airport noise assessments, and identify compatible land uses.

Department of Transportation/Federal Highway Administration (DOT/FHWA)

As a result of the Federal Aid Highway Act of 1970[1], the Federal Highway Administration (FHWA) is concerned with traffic and construction noise associated with Federal aid highways. Since 1972, FHWA has had a noise policy applicable to new highway construction. The focus of the policy is to elevate the consideration of noise exposure in Federal-Aid highway location and design decisions by requiring substantive study of future noise exposure in conjunction with standards featuring highway design noise levels. (These levels have a very specific purpose which is explained in Table 4. Since 1976, FHWA's policy has also provided for noise mitigation on existing Federal aid highways. The principal noise mitigation measure has been placement of barriers at noise sensitive locations.

FHWA also recognizes and supports other approaches to highway noise control. Although in the source control area FHWA's authority is limited to implementing interstate motor carrier noise standards issued by EPA, it supports legislation to reduce the noise levels of motor vehicles. In the land use area its authority (like that of the other Federal agencies discussed here) is limited to providing information and guidance.[2]

The FHWA noise policy applies to the Federal Highway program which (unique among the policies discussed here) is a state administrated program receiving Federal assistance. The noise policy is actually carried out as part of the overall environmental assessment process required by the National Environmental Policy Act. For each new highway, FHWA

[1]Act amended in 1973 and 1976.

[2]FHWA's key document in this area is *The Audible Landscape* (1974).

requires that state highway agencies furnish localities information on noise and land use. Furthermore, FHWA will normally not approve funds for barrier construction for areas which have become sensitive after May 24, 1976, unless localities have instituted land use controls over the remaining undeveloped lands adjacent to the highways.

Veterans Administration (VA)

The Veterans Administration (VA) policy for consideration of noise and land use planning is contained in separate statements. One statement is for the VA's Loan Guaranty Program and the other is for both the Department of Medicine and Surgery (DM&S) and the Department of Memorial Affairs (DMA).

The VA Loan Guaranty noise policy governs VA decisions as to whether residential sites in airport environs are "acceptable" for loan guaranty programs to eligible veterans and active duty personnel.

The VA Loan Guaranty noise policy features a set of three noise zones. In the case of new construction, all new developments located in the two higher zones generally are not eligible for VA assistance. There is flexibility in that if a local officer recommends acceptance, the VA Central Office will consider the case in light of geographic factors and proposed attenuation features,[1] as well as marketability. In the middle zone, it, therefore, may be possible to develop properties which will be acceptable for VA loans.

In all cases (existing as well as proposed properties) for sites located in the two higher zones, VA requires that a statement from each veteran purchaser be obtained indicating awareness that (a) the property being purchased is located in an area adjacent to an airport, and (b) the aircraft noise factor may affect normal liveability, value and saleability of the property.

The VA's Loan Guaranty Service conducts its business with veteran purchasers, lenders, builders and other sellers who are interested in VA's guaranty of the loan to an individual veteran purchaser. The Loan Guaranty Service rarely has any direct interaction with local authorities.

The policy for land acquisition and maintenance adhered to by DM&S and DMA considers noise in the environmental planning of all acquisition and construction programs. All new VA Medical Centers, domiciliaries, and other medical facilities are compatible or have been designed with noise attenuation features allowing them to be compatible with zones as defined in Table 2. All new VA National Cemetery Construction has generally been limited to Noise Zones A & B as described on Table 2 because of the nature of outdoor services. Guidelines for planning state facilities which are eligible for grant funds from DM&S or DMA programs are slightly relaxed leaving latitude to local conditions in planning requirements.

[1]Such as soundproofing, year round air conditioning and other treatment.

Appendix A

EXPLANATION OF ENVIRONMENTAL NOISE DESCRIPTORS

This appendix discusses various descriptors that Federal agencies have used to assess environmental noise. These descriptors can be categorized as to whether they are applicable to 1) all sources or 2) airport only.

1) *Applicable to all sources*

A. *Day Night Average Sound Level (DNL; scientific notation L_{dn})*

Day-Night average sound level[1], abbreviated as DNL and symbolized as L_{dn}, is the 24 hour average sound level, in decibels, for the period from midnight to midnight, obtained after addition of 10 decibels to sound levels in the night from midnight to 7 a.m. and from 10 p.m. to midnight. DNL is a measureable quantity and can be measured directly at a specific location, using portable monitoring equipment[2]. (When it is measured it is not necessary that the measurement begin at midnight.)

B. *Equivalent sound level (L_{eq})*

L_{eq} is the average sound level[1], in decibels, for any time period under consideration. If averaged over a 24 hour period, the only difference between it and DNL would be the 10 decibel night time weighting used in DNL.

In connection with its highway noise standards featuring design noise levels, FHWA uses an L_{eq} for the highway "design hour" as an alternative to the L_{10} descriptor. (The design hour is normally the 30th highest traffic volume occurring during the year.) Noise levels are predicted for the design year, which is normally 20 years from construction of the highway, and the noisiest hour of the day (usually the design hour). As indicated in Table II-1, under typical conditions the L_{eq} (design hour) approximately equals DNL.

[1]Average sound level — the level, in decibels, of the mean-square A-weighted sound pressure during a stated time period, with reference to the square of the standard reference sound pressure of 20 micropascals.

[2]It is important to note that L_{dn} contours derived from the use of noise prediction models do *not* necessarily reflect precise noise levels at specific locations. Typically, computer based airport noise prediction models forecast yearly average values for L_{dn}.

C. L_{10}

While this descriptor applies to any noise source, FHWA is the only Federal agency using it (as an alternative to L_{eq}). L_{10} is defined as the sound level that is exceeded 10 percent of the time for the period under consideration, which, in the case of FHWA, is the design hour. DNL under typical conditions approximately equals L_{10} - 3 decibels.

D. *Community Noise Equivalent Level (CNEL)*

The CNEL, developed for the State of California, is almost identical to the DNL, except that it introduces an intermediate weighting for the early evening hours between 7:00 p.m. and 10:00 p.m. in addition to the weighting for the nighttime hours (10:00 p.m. to 7:00 a.m.). CNEL, like DNL, is a measurable quantity and can be measured directly. DNL is approximately equal to CNEL in almost all situations.

2) *Measures applying to airport sources only*

A. *Noise Exposure Forecast (NEF)*

The NEF was developed in 1967 as a refinement of the composite noise rating (CNR). It takes into account the factors considered by the CNR plus the additional exposure factors of the duration of aircraft flyovers and of discrete (pure) tones such as turbine "whine". The NEF cannot be directly measured and requires a computer for noise contour development. DNL approximately equals NEF + 35.

REFERENCES FOR APPENDIX A

1. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety; Environmental Protection Agency;* Report No. 550/9-74-004; March 1974 (document for sale by U.S. Government Printing Office, Stock No. 055-000-00120-1, $2.10).

   This document gives the technical basis for the L_{dn} and L_{eq} noise descriptors.

2. *Federal-Aid Highway Program Manual 7-7-3,* Federal Highway Administration, May 14, 1976, Washington, D.C.

   This document describes FHWA's design noise levels which are expressed in L_{eq} and L_{10}.

3. *The Adopted Noise Regulations for California Airports,* Title 4, Register 70, No. 48-11-28-70, Subchapter 6, Noise Standards (distributed by Documents Section, State of California, P.O. Box 20191, Sacramento, California 95820).

   Describes CNEL.

4. *Noise Exposure Forecast: Evolution, Evaluation, Extensions, and Land Use Interpretations;* W.J. Galloway and D.E. Bishop; Bolt, Beranek, and Newman, Inc.; Report No. FAA-No.-70-9; August 1970 (available through the National Technical Information Service, Springfield, Virginia 22151, No. AD 717-131, $5.25).

5. *Procedures for Developing Noise Exposure Forecast Areas for Aircraft Flight Operations;* D.E. Bishop and R.D. Horonjeff; Bolt, Beranek and Newman, Inc.; Report No. DS-67-10; August 1967 (available through the National Technical Information Service, Springfield, Virginia 22151, No. AD 660-706, $5.25).

These documents are basic references for the Noise Exposure Forecast.

6. *Land Use Planning Relating to Aircraft Noise;* W.J. Galloway and A.C. Pietrasanta; Bolt, Beranek, and Newman, Inc.; Technical Report No. 821; October 1964 (available through the National Technical Information Service, Springfield, Virginia 22151, No. AD-615-015, $5.25).

This document describes the CNR methodology (which is no longer in general use).

Appendix B

ANNOTATED BIBLIOGRAPHY OF FEDERAL DOCUMENTS RELATED TO NOISE AND LAND USE ACTIVITIES

The purpose of this bibliography is to provide aid to all persons involved in noise and land use planning and decision making, including planners, elected officials, facility and land managers, the private development community and the general public.

This bibliography discusses only Federal agency publications which are relevant to noise and land use activities. A much more extensive list would result were Federal publications included which cover other noise subject areas of interest to State and local agencies (e.g., highway noise mitigation, construction noise, aircraft source regulation, etc.).

The bibliography is organized into two parts. The first part covers Federal noise regulations, guidance tools and manuals and special studies. The second part discusses relevant Congressional statutes.

Noise/Land Use Bibliography — Part I

DEPARTMENT OF DEFENSE (DOD)

1. "Air Installations Compatible Use Zones," Department of Defense Instruction 4165.57, 8 November 1977.

   This regulation sets forth the broad requirements for the Air Installations Compatible Use Zones (AICUZ) program while leaving implementation to individual military services.

2. "Intergovernmental Coordination of Defense Land and Facility Plans and Projects. Department of Defense Directive 4165.61, 16 December 1976.

   This directive gives DOD's intergovernmental coordination policy.

3. "Planning in the Noise Environment," Air Force Manual 19-10, TM-5-803-2 (Army), and NAVFAC P-970 (Navy), 15 June 1978.

   This is a noise description, reduction and planning handbook; includes noise and land use guidelines.

4. *"USAF Air Installation Compatible Use Zone (AICUZ) Policy,"* June 1979.

   This document contains the U.S. Air Force AICUZ policy.

5. USAF Air Installation Compatible Use Zone (AICUZ) Handbook (Environmental Planning Bulletin 10) 2 Volumes, June 1979.

   This contains the procedures and guidelines for preparing AICUZ studies.

6. "Interagency/Intergovernmental Coordination of Land, Facility and Environmental Plans, and Programs." Air Force Regulation 19-9, 1980.

   This is the USAF's AICUZ and interagency/intergovernmental coordination policy.

7. "Air Force Handbook for Installation Coordination with Civilian Agencies: (Interim Environmental Planning Bulletin 14), two volumes, January 1978.

   This contains USAF's procedures for intergovernmental coordination at the local, regional and State levels.

8. "Air Force Handbook for Federal Agency Coordination" (Interim Environmental Planning Bulletin 15), January 1978.

   This contains procedures for Federal agency coordination; includes Federal agency directory.

9. "Intergovernmental Coordination of Department of the Navy Land Facility Plans, Projects, and Program," OPNAVINST 11010.35, 1979, U.S. Navy.

   This contains Navy intergovernmental coordination policy and procedures.

10. "Air Installation Compatible Use Zone Program (AICUZ)," OPNAVINST 11010.36, 1979, U.S. Navy.

    This contains Navy policy, procedures and guidelines for carrying out the AICUZ program at Navy and Marine Corps installations.

11 "Air Force Directory of State Environmental Planning Agencies," October 1977.

   Lists approximately 1300 State agencies.

12. "Air Installation Compatible Use Zone Studies," U.S. Air Force and U.S. Navy.

    These studies are published for each air installation.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

1. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,* Environmental Protection Agency, Washington, D.C. (EPA 550/9-74-004), March 1974.

   This document is a scientific statement of threshold protective levels of noise without consideration of cost or feasibility or the needs of the community in any specific condition.

2. *Public Health and Welfare Criteria for Noise,* Report No. 550/9-73-002, Environmental Protection Agency, Washington, D.C., July 1973.

   This document contains published descriptive data on the effects of noise which might be expected from various levels and exposure situations.

3. *Model Community Noise Control Ordinance.* Environmental Protection Agency, September 1975.

   This model is intended as a basic tool for use by communities of various sizes in the development of noise control ordinances, (which can include land use provisions) tailored to their specific local conditions and goals.

4. *State and Municipal Noise Control Activities, 1973-74.* Environmental Protection Agency, Washington, D.C., January 1976.

   This report presents an assessment of the status of State and local noise control efforts and is intended as a reference guide for public administrators.

5. *Federal Noise Program Report Series: Volume I, Department of Defense: Air Installations Compatible Use Zones (AICUZ) Program,* Environmental Protection Agency, Washington, D.C., April 1977. (EPA 550/9-77-353).

   This report describes the features and problems of DOD's AICUZ program.

6. *Federal Noise Program Report Series: Volume II, Department of Housing and Urban Development: Noise Abatement and Control Policy,* Environmental Protection Agency, Washington, D.C., April 1977.

   This report discusses the features and problems associated with HUD's Noise Policy.

7. *Federal Noise Program Report Series: Volume III, Department of Transportation, Federal Highway Administration: Noise Policy and Related Environmental Procedures,* Environmental Protection Agency, Washington, D.C., July 1977. (EPA 550/9-77-357).

   This report describes the features and problems associated with FHWA's noise policy and related environmental procedures.

8. *Calculation of Day-Night Levels L_{dn} Resulting from Civil Aircraft Operations.* Environmental Protection Agency, Washington, D.C., January 1977.

   This report gives manual techniques for predicting aircraft noise levels in the environs of specific airports.

GENERAL SERVICES ADMINISTRATION (GSA)

1. *Compatible Land Uses at Federal Airfields.* Federal Management Circular 75-2: General Services Administration, 1975.

   This circular prescribes the Executive Branch's general policy with respect to achieving compatible land uses on either public or privately owned property at or in the vicinity of Federal airfields.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

1. *"Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B,"* U.S. Department of Housing and Urban Development, July 12, 1979.

   This is the basic noise policy with quantitative noise standards and implementation procedures.

2. *Noise Assessment Guidelines.* W.J. Galloway and T.J. Schultz, Bolt, Beranek and Newman, Inc., prepared for the U.S. Department of Housing and Urban Development, 1980.

   These are guidelines for use in implementing the HUD noise regulation. They provide a tool for persons without acoustical training to perform preliminary estimates of the noise exposure at a site in relation to the HUD standards.

3. *HUD Noise Assessment Guidelines Technical Background.* W.J. Galloway and T.J. Schultz, Bolt, Beranek and Newman, Inc., prepared for the U.S. Department of Housing and Urban Development, 1980.

   This report discusses the need for noise abatement, the various techniques for measuring and describing noise and human responses to it. It gives technical background information for the development of site noise assessment techniques.

4. *Aircraft Noise Impact, Planning Guidelines for Local Agencies.* R. Dale Beland, Wilsey and Ham, Inc., prepared for the U.S. Department of Housing and Urban Development, 1972.

   This manual, based upon information developed in joint HUD-DOT studies and other case studies of aircraft noise abatement, provides a tool for local planners, local governments and others in developing a comprehensive aircraft abatement program through land use planning. GPO order number 2308-00214, NTIS order number PB213-020. Some of the technical data is a bit dated, but in general, still very useful.

5. Metropolitan Aircraft Noise Abatement Policy Studies, U.S. Department of Housing and Urban Development, 1971.
   a. MANAPS — O'Hare International Airport, Chicago, Ill., 1971.
   b. MANAPS — Cape Kennedy Regional Airport, East Central Florida Planning Council, 1971.
   c. MANAPS — J.F. Kennedy International Airport, N.Y., Tri-state Transportation Commission, 1971.
   d. MANAPS — Bradley International Airport, Windsor Locks, Conn., Capitol Regional Planning Agency, 1971.

6. *Noise in Urban and Suburban Areas: Results of Field Studies.* Bolt, Beranek and Newman, prepared for the U.S. Department of Housing and Urban Development, 1967. National Technical Information Service order number PB210-849.

   This study identifies significant noise sources, other than aircraft, known to create disturbances within the home. It analyzes the results of a social survey made to determine community responses to traffic noise.

DEPARTMENT OF TRANSPORTATION/Federal Aviation Administration (DOT/FAA)

"Aviation Noise Abatement Policy," DOT/FAA, November 1976.

This discusses actions the Administrator of FAA and Secretary of DOT believe should be taken to reduce aviation noise impact on the people who live in areas surrounding airports. It defines the roles and responsibilities of airport operators, aircraft operators, affected communities and the FAA for noise compatibility.

2. *Airport-Land Use Compatibility Planning,* FAA Advisory Circular 150/5050-6, 1977.

   This is FAA's guidance for compatible land use planning in the vicinity of both new and existing airports. It provides ideas and techniques for planning as well as guidance which may be used in developing noise control plans as encouraged by the DOT/FAA Noise Abatement Policy of 1976.

3. *Airport Noise Control and Land Use Compatibility (ANCLUC) Planning under the Planning Grant Program,* FAA Order 5900.4, 1977.

   This document provides programming and planning guidance for ANCLUC planning.

4. *Noise Control Plans,* FAA Order 1050.11, 1977.

   This document provides FAA policy and procedures for airport noise control plans.

5. *Citizen Participation in Airport Planning,* FAA Advisory Circular 150/5050-4, 1975.

   This circular provides guidances for citizen involvement in airport planning.

6. *Policies and Procedures for Considering Environmental Impacts,* FAA Order 1050.1C, 1979.

   This order covers FAA procedures for environmental assessments for all FAA project actions.

7. *Airport Environmental Handbook,* FAA Order 5050.4, 1980.

   This order covers procedures for airport actions.

8. *Impact of Noise on People,* Federal Aviation Administration, Washington, D.C., 1977.

   This document summarizes known information concerning public health and welfare effects and reactions.

9. *Five Year Environmental Plan 1978-1982,* Federal Aviation Administration.

10. *Airport Development Aid Program Handbook,* FAA Order 5100.36, 1979.

11. *Certified Airplane Noise Levels,* FAA Advisory Circular 36-1B, December 1977.

    This circular provides noise level data for airplanes certified under FAR Part 36 since its publication on November 18, 1969.

12. *Estimated Airplane Noise Levels in A-Weighted Decibels,* AC 36-3A, June 11, 1980.

    This circular provides listings of both certificated and uncertificated aircraft noise levels in A-weighted decibels, both ranked in descending order and listed by aircraft manufacturer. These values are intended to provide a consistent basis for comparison of noise levels of major aircraft models rather than of individual aircraft. Ranking of aircraft noise levels that occur under uniform Federal Aviation Regulation Part 36 certification conditions provides the best information currently available on the relative noisiness of civil aircraft over a wide variety of conditions.

13. *Integrated Noise Model, Version 1, January 1978.* Federal Aviation Administration.

    This report discusses the model and its uses.

14. *FAA INM Basic User's Guide, Version 2, 1979.* Federal Aviation Administration.

    This report contains the procedures for use of the Integrated Noise Model. (INM)

15. *INM Installation Manual, 1978.* Federal Aviation Administration.

    This report contains instructions for installing the INM program.

16. *Report to Congress, Study, Feasibility, Practicability and Cost of Soundproofing of Hospitals, and Public Health Facilities Near Airports.* Federal Aviation Administration, July 1977.

    This study, required by Section 26(3), Appendix B of the Airport and Airway Development Act Amendments of 1976 (P.C. 94-353), concludes that soundproofing of schools, hospitals, and public health facilities located near airports is a feasible and practicable means for alleviating aircraft noise impact.

17. *Planning for the Airport and its Environs: The Sea-Tac Success Story.* Federal Aviation Administration, Washington, D.C., April 1978.

    This is a case study of airport planning in the environs of Sea-Tac Airport, Washington. It constitutes guidance for other communities upset with airport noise incompatibility problems.

18. *Community Involvement Manual,* FAA-EE-79-06, 1979.

    This report gives additional guidance for conducting citizen participation activities.

19. *Developing Noise Exposure Contours for Federal Aviation Airports.* DOT-FA-75WA-3710, NTIS No. ADA 023429. December 1975.

    This report presents a "desk top" method for developing noise contours for airports other than air carrier airports.

DEPARTMENT OF TRANSPORTATION/Federal Highway Administration (DOT/FHWA)

"A Statement of National Highway Transportation Policy," page 21, paragraph 2, Federal Highway Administration, December 1976, Washington, D.C.

This document sets forth FHWA's policy on highway traffic noise. Noise control mitigation, land use and source control are discussed.

"Federal-Aid Highway Program Manual 7-7-3," Federal Highway Administration, Washington, D.C., May 14, 1976.

This document contains FHWA's noise standards for highways and requirements for Federal participation in highway noise mitigation.

3. *"The Audible Landscape: A Manual for Highway Noise and Land Use,"* Federal Highway Administration, Washington, D.C., November 1974, (Reprinted — August 1976).

   This document discusses various land use control techniques which communities can use in highway environs.

4. *Determination of Reference Energy Mean Emission Levels,* FHWA-OEP/HEV-78-1. Reagan, Jerry A., prepared for the Federal Highway Administration, Washington, D.C., July 1978.

   This report provides guidance for measurement of noise emission levels of motor vehicles and for using this measured data to compute reference energy mean emission levels.

5. *Highway Noise Barrier Selection, Design and Construction Experiences, Implementation Package 76-8,* Federal Highway Administration, Region 10. Snow, C.H., prepared for U.S. Department of Transportation, FHWA, Offices of Research and Development, Office of Engineering, Office of Environmental Policy, Washington, D.C., October 1976.

6. *Insulation of Buildings Against Highway Noise.* Davy, Bruce A. and Skale, Steven R., Wyle Research. Prepared for U.S. Department of Transportation, Federal Highway Administration, Office of Development, FHWA-TS-77-202. Washington, D.C., 1977.

   This manual provides highway engineers tools to assess the noise insulation requirements of buildings, to determine the effectiveness of existing buildings in insulation of interior space against highway traffic noise, and to evaluate the effectiveness of proposed modifications.

7. *A Guide to Visual Quality in Noise Barrier Design, Implementation Package 77-12.* Blum, Randolph F., The Organization for Environmental Growth, Inc., Prepared for the U.S. Department of Transportation, Office of Research and Development. Washington, D.C., July 1978.

   This report deals with the esthetic considerations of noise barrier design.

8. *Background Report on Outdoor-Indoor Noise Reduction Calculation Procedures Employing the Exterior Wall Noise Rating (EWNR) Method.* Mange, Gary E.; Skale, Steven R.; and Sutherland, Louis C., Wyle Research. Prepared for the U.S. Department of Transportation, Federal Highway Administration, Office of Development, Report No. FHWA-TS-77-220, Washington, D.C., March 1978.

   This is a background report on the procedures for evaluating outdoor-indoor noise reduction of structure in terms of the single number metric Exterior Wall Noise Rating (EWNR).

9. *Fundamentals and Abatement of Highway Traffic Noise.* Anderson, G.S.; Miller, L.N.; and Shadley, Fr. R., Bolt, Beranek and Newman, Inc. Prepared for U.S. Department of Transportation, FHWA, PB-222-703/1. Washington, D.C., June 1973.

10. *FHWA Highway Traffic Noise Prediction Model.* Barry, T. and J. Reagan, FHWA-RD-77-108, Federal Highway Administration, Washington, D.C., December 1978.

    This draft report describes FHWA traffic noise model. A predicted sound level can be calculated through a series of manual adjustments to the reference energy mean emission level.

VETERANS ADMINISTRATION (VA)

1. Veterans Administration, *"Section VIII Appraisal of Residential Properties Near Airports, 1969.*

   This contains the VA noise policy.

Noise/Land Use Bibliography — Part II

KEY CONGRESSIONAL STATUTES RELEVANT TO NOISE AND LAND USE

- Aviation Safety and Noise Abatement Act of 1979.

  This Act directs the Secretary of Transportation to take specific actions with respect to airport noise reduction.

- Quiet Communities Act of 1978.

  This Act directs the Environmental Protection Agency to assist States and Communities in carrying out their own noise control programs through the administration of a nationwide Quiet Communities Program.

- Federal Aid Highway Act of 1970, and 1973 and 1976 amendments.

  This series of legislation contains provisions directing the Federal Highway Administration to take specific actions with respect to highway noise, including the development and carrying out of noise standards for new highway construction and providing funding for noise mitigation on existing highways.

- Airport and Airways Development Act of 1970 and 1976 amendments.

  This legislation provides the Federal Aviation Administration's Grants Programs for airport planning and development including noise compatibility planning and sharing in the costs of certain airport noise abatement measures and activities.

- Noise Control Act of 1972.

  This Act requires all Federal agencies to carry out their programs in a manner so as to promote an environment free from noise that jeopardizes the health and welfare of the American public, and directs the Environmental Protection Agency to undertake certain noise abatement activities, including setting noise standards and furnishing technical assistance to State and local governments.

- National Environmental Policy Act of 1969.

  This Act requires that for all proposed Federal actions significantly affecting the quality of the environment, Federal agencies should prepare an environmental impact statement concerning the proposed action.

- Federal Aviation Act of 1968 and 1972 amendments.

  This law constitutes the basic authority for Federal regulation of Aircraft noise.

- The Department of Housing and Urban Development Act of 1965.

  This law provides that the Department of Housing and Urban Development may make such rules as may be necessary to carry out its duties and sets forth, as a matter of national purpose, the sound development of the Nation's communities.

Appendix C

ANNOTATED BIBLIOGRAPHY OF FEDERAL MANUALS AND OTHER DOCUMENTS RELATED TO NOISE ATTENUATION IN BUILDINGS

DEPARTMENT OF COMMERCE/National Bureau of Standards (DOC/NBS)

1. *Quieting: A Practical Guide to Noise Control.* Berendt, Raymond D., Corliss, Edith L.R. and Ojalvo, Morris, S., U.S. Department of Commerce, July 1976.

   This guide offers to the general lay reader practical solutions to various noise problems including recommendations for techniques for quiet in existing homes as well as for choosing a quiet home or apartment.

2. *Design Guide for Reducing Transportation Noise in and Around Buildings.* Pallett, David S., Wehrli, R., Kilmer, Roger D., and Quindry, Thomas L., U.S. Department of Commerce/National Bureau of Standards, April, 1978.

   This design guide presents a unified procedure for the selection of noise criteria in and around buildings, for the prediction of exterior and interior noise levels arising as a consequence of transportation systems operations, and for the evaluation of the adequacy of building designs with regard to environmental noise. Noise criteria levels are suggested in terms of equivalent sound levels (L_{eq}). Simplified predictive methods enable the estimation of noise levels from highways, railways, and aircraft. The sound isolation provided by the building shell is estimated by means of a new single-figure rating system. Finally, the manual suggests design manipulations which may make possible the improvement of the acoustic conditions in and around buildings.

3. *Acoustical and Thermal Performance of Exterior Residential Walls, Doors and Windows.* Sabine, H.J., Lacher, M.B., Flynn, D.R., and Quindry, T.L., U.S. Department of Commerce, November 1975.

   This manual is intended to assist in achieving improved design when both noise and energy conservation are to be considered. It describes the results of laboratory tests (109 acoustical, 48 thermal) conducted on typical residential exterior wall constructions and compares them with literature data on similar constructions.

4. *Noise Criteria of Buildings: A Critical Review.* Yaniv, Simone I. and Flynn, D.R., U.S. Department of Commerce, January, 1978.

   This report reviews existing criteria that could be applied to rating the noise environment in dwellings, and to rating noise isolation from outside to inside a dwelling. It concludes that the central problem is to select appropriate criteria for rating the interior noise environment. Once this is done, criteria for noise isolation can be derived directly and these in turn can be used to derive performance requirements for building elements, such as partitions and exterior walls.

DEPARTMENT OF DEFENSE (DOD)

1. *"Air Installation Compatible Use Zone Studies,"* U.S. Air Force and U.S. Navy.

   A standard appendix in each study gives recommendations for design and construction techniques for primarily residential construction to achieve various levels of noise reduction corresponding to the land use guidance contained in the main document.

2. *"Planning in the Noise Environment,"* Air Force Manual 19-10, TM-5-803-2 (Army), and NAVFAC P-970 Navy), 15 June 1978.

   This manual is a tool for installation planners to assist them in developing acceptable noise environments on military installations; contains some information on building acoustics.

3. TM-5-805-15, *U.S. Army Technical Manual on Architectural Acoustics.*

   This manual contains design information to provide occupant with satisfactory acoustical conditions within and protection from noise that may be injurious to health or welfare. Provides recommended techniques for reducing unwanted sounds.

4. *Facility Acoustic Parameters Catalog.* Naval Environmental Support Service (AESO 330-76-02), January 1977.

   This provides a fundamental knowledge of architectural acoustics. Provides techniques for determination of Sound Transmission Class (STC) and composite transmission loss and for relating noise reduction to STC. Provides absorption and transmission loss data.

5. *Noise Reduction Technology Catalog.* Naval Environmental Support Service, AESO Report 330-70-01, January 1977.

   This report provides a fundamental acquaintance with the properties of noise and various techniques applicable to noise control. Provides absorption and transmission loss data for common building materials.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

1. *A Guide to Airborne, Impact, and Structure Borne Noise-control in Multi-family Dwellings.* Berendt, Raymond D., Winzer, George E., and Burroughs, prepared for U.S. Department of Housing and Urban Development, September 1961. NTIS order number PB210-849.

   This Guide incorporates a broad range of criteria appropriate for isolating airborne, impact, and structure-borne noise associated with residential construction. Sound classifications represented in the most common types of building construction are identified.

DEPARTMENT OF TRANSPORTATION/Federal Aviation Administration (DOT/FAA)

"The Feasibility, Practicability and Cost of the Soundproofing of Schools, Hospitals, and Public Health Facilities Near Airports," Federal Aviation Administration, 1977.

This study, required by Section 26(3), Appendix B of the Airport and Airway Development Act Amendments of 1976 (P.C. 94-353), concludes that soundproofing of schools, hospitals, and public health facilities near airports is a feasible and practicable means for alleviating aircraft noise impact.

DEPARTMENT OF TRANSPORTATION/Federal Highway Administration (DOT/FHWA)

1. *Insulation of Buildings Against Highway Noise.* Davy, Bruce A. and Skale, Steven R., Wyle Research, prepared for U.S. Department of Transportation, Federal Highway Administration, Office of Development, FHWA-TS-77-202. Washington, D.C., 1977.

   This manual provides highway engineers with the necessary tools to assess the noise insulation requirements of buildings, to determine the effectiveness of existing buildings in insulating interior space against highway traffic noise, and to evaluate the effectiveness of proposed modifications.

2. *Background Report on Outdoor-Indoor Noise Reduction Calculation Procedures Employing the Exterior Wall Noise Rating (EWNR) Method.* Mange, Gary E.; Skale, Steven R.; and Sutherland, Louis C., Wyle Research. Prepared for U.S. Department of Transportation, Federal Highway Administration, Office of Development, Report No. FHWA-TS-77-220, Washington, D.C., March 1978.

   This is a background report on the procedure for evaluating outdoor-indoor noise reduction of structure in terms of the single number metric Exterior Wall Noise Rating (EWNR), first reviews the basis of previous single number ratings emphasizing the Sound Transmission Class (STC). It is shown that the latter was initially designed to try to account for the relative loudness of interior noises in typical residences as heard by adjoining neighbors on the other side of a common party wall.

In a similar, but quite independent manner, the EWNR metric was developed so that the A-weighted indoor noise level, due to highway noise sources outdoors, could be roughly estimated directly from the value of EWNR and the A-weighted outdoor noise level. The basis for this is defined, first in terms of the basic theory for noise reduction from outdoors to indoors at one frequency. The result is then summed over all frequencies to give the overall effective noise reduction. The EWNR single number rating replaces this complex summation and, as shown by recently conducted field tests, provides a valid method with an accuracy of about ±3 dB for predicting levels inside buildings due to outdoor transportation noise sources.

This background report also briefly reviews the basis for the tables of EWNR values and tables of various EWNR adjustment factors used to evaluate the composite noise reduction of A-weighted noise levels for a wide range of practical residential structural assemblies which may include walls, windows, doors, roofs, and ceilings.

3. *Guide to the Soundproofing of Existing Homes Against Exterior Noise.* Wyle Research, prepared for city of Los Angeles Department of Airports (1970). Reprinted with permission by Federal Highway Administration, Office of Development, 1977.

   This manual is for the designer in selecting and conceptualizing various methods of soundproofing existing homes. This guide presents the various successful methods used in a 1970 pilot project to increase the noise reduction capabilities of existing houses for the Los Angeles Department of Airports. Three categories of modification from minor to extensive are covered. The guide also provides a basic understanding of the elements of noise control and the systematic method of soundproofing houses. This guide expands the repertory of methods and techniques of reducing the impact of highway traffic noise on its neighbors.

DEPARTMENT OF AGRICULTURE (DOA)

1. Jones, R.E., "Effects; of Flankling and Test Environment on Lab Field Correlation of Airborne Sound Insulation," *Journal of the Acoustical Society of America,* 57(5), 1975, 1138-1149.

2. Jones, R.E., "Field Sound Insulation Evaluation for Two Auxiliary Walls," USDA Forest Service Research Paper No. FPL-244, Forest Products Laboratory, Madison, WI, 1975.

3. Jones, R.E., "How to Accurately Predict the Sound Insulation of Partitions," *Sound and Vibration* 10(6), pp. 14-25, 1976: Errata *Sound and Vibration* 10(11), 1976, p. 15.

4. Jones, R.E., "Insulation Evaluation of Load Bearing Sandwich Panels for Housing," Forest Products Laboratory, Madison, WI., 1975 NTIS No. PB 244-152/AS.

5. Jones, R.E., "Laboratory-Field Correlation for Airborne Sound Transmission Through Party Walls," USDA Forest Service Research paper No. FPL-240, Forest Products Laboratory, Madison, WI., 1975.

6. Jones, R.E., "Sound Insulation Evaluation of Several Single-Row-of-Wood Stud Party Walls Under Laboratory and Field Conditions, USDA Forest Service Research paper No. FPL-241, Forest Products Laboratory, Madison, WI., 1975.

7. Jones, R.E., "Sound Insulation of High Performance Wood Frame Party Partitions Under Laboratory and Field Conditions," USDA Forest Service Research paper No. FPL-309, Forest Products Laboratory, Madison, WI., April 1978.

Appendix D

EFFECTS OF NOISE ON PEOPLE

Environmental noise affects health and welfare in many ways. Table D-1 describes some aspects of the effect of noise on people in residential areas to varying levels of cumulative exposure. As stated in the main portion of this document, it can be used as an important input to the local land use decision making process. For a further discussion of the effects of noise consult the bibliography on the following page.

TABLE D-1. EFFECTS OF NOISE ON PEOPLE
(Residential Land Uses Only)

Effects[1] / Day-Night Average Sound Level in Decibels	Hearing Loss	Speech Interference		Annoyance[2]	Average Community Reaction[4]	General Community Attitude Towards Area
		Indoor	Outdoor			
	Qualitative Description	% Sentence Intelligibility	Distance in Meters for 95% Sentence Intelligibility	% of Population Highly Annoyed[3]		
75 and above	May Begin to Occur	98%	0.5	37%	Very Severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	Will Not Likely Occur	99%	0.9	25%	Severe	Noise is one of the most important adverse aspects of the community environment.
65	Will Not Occur	100%	1.5	15%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will Not Occur	100%	2.0	9%	Moderate to Slight	Noise may be considered an adverse aspect of the community environment.
55 and below	Will Not Occur	100%	3.5	4%		Noise considered no more important than various other environmental factors.

1. "Speech Interference" data are drawn from the following tables in EPA's "Levels Document": Table 3, Fig. D-1, Fig. D-2, Fig. D-3. All other data from National Academy of Science 1977 report "Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise."
2. Depends on attitudes and other factors.
3. The percentages of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in integrating annoyance over a very long time.
4. Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

NOTE: Research implicates noise as a factor producing stress-related health effects such as heart disease, high-blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been quantified.

HEALTH EFFECTS BIBLIOGRAPHY

1. *Noise Abatement: Policy Alternatives for Transportation, Report to the EPA.* National Academy of Sciences, Washington, D.C., 1977, p. 63.

2. Bugliarello, George, *Noise Pollution: A Review of Its Techno-Sociological and Health Aspects,* (Biotechnology Program: Carnegie-Mellon University, Feb., 1968), p. 52.

3. Cohen, A., Anticaglia, J. and Jones, H.H., "Sociocusis — Hearing Loss From Non-Occupational Noise Exposure", *Sound and Vibration,* Vol. 4, No. 11, (Nov. 1970), pp. 12-20.

4. Mills, John H., "Noise and Children: A Review of Literature", *Journal of The Acoustical Society of America,* 58, No. 4 (Oct. 1975), pp. 767-89.

5. Lipscomb, David M., "The Increase of Prevalence of High Frequency Hearing Impairment Among College Students", *Audiology,* 11, 231-237, 1972.

6. Lipscomb, David M., "Environmental Noise is Growing — Is It Damaging Our Hearing?", *Clinical Pediatrics,* 11, (7), 374-5, 1972.

7. Welch, B.L. and Welch, A.S., *Physiological Effects of Noise,* New York: Plenum Press, 1970, p. 57.

8. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,* (EPA 550/9-74-004), Mar. 1974.

9. *Some Considerations in Choosing an Occupational Noise Exposure Regulation,* prepared for the U.S. Environmental Protection Agency by MIT Center for Policy Alternatives, (EPA 550/9-76-007), pp. 2-40, 2-41, and 118.

10. *Report to the President and Congress on Noise,* Report of the Administrator of EPA in compliance with Title IV of the Public Law 91-6004: The Clean Air Act Amendments of 1970 (Washington, D.C.; U.S. EPA, Feb., 1972), pp. 1-42.

11 Cohen, Alexander, "Effects of Noise on Psychological State", *Proceedings of the Conference on Noise As a Public Health Hazard,* ASHA, No. 4, Feb. 1969, p. 84.

12. Tanaka, Y., and T. Arayama, in *Practica: Oto-Phino-Laryngo-Logica,* 31, (1969), p. 269.

13. Scibetta, J.J., and M.G. Rosen, in *American Journal Obstet. & Gynec.,* 33 (1969), p. 830.

14. Statement by A. Stanley Weltman in Public Hearing on Physiological and Psychological Effects on Noise, Boston (Oct. 23-9, 1971), p. 123.

15. Ando, Y., and H. Hattori, "Effects of Noise on Human Placental Lacotgen (NPL), Levels in Maternal Plasma", *British Journal of Obstetrics and Gynec.*, 84 (Feb. 1977), p. 115.

16. Jones, F. Nowell and Judy Tauscher, "Residence Under an Airport Landing Pattern as Factor in Teratism", *Archives of Environmental Health,* Jan.-Feb., 1978, p. 10-12.

17. Cohen, S., D.C. Glass and J.E. Singer, "Apartment Noise, Auditory Discrimination, and Reading Ability in Children", *Journal of Exp. and Social Psychology,* 9, No. 5, (1973), pp. 407-422.

18. The Superintendent of Schools of Inglewood, CA, before Congressional Subcommittee, in *The Social Impact of Noise,* EPA report, (Dec. 1971), p. 20.

19. *Public Health and Welfare Criteria for Noise,* (EPA 550/9-73-002), 1973, pp. 8-20, 6-7

20. Miller, "Effects of Noise on People," *Journal of the Acoustical Society of America,* 56, No. 3, (Sept. 1974), pp. 757. 743.

21. Federal Railroad Administration, Advanced Notice of Proposed Rulemaking, "Protection of Railroad Maintenance-of-Ways-and-Structure Employees", *Federal Register,* Vol. 40, No. 76, April 18, 1975, pp. 17265-6.

22. "Noise", *Solidarity,* (Official Publication of the United Auto Workers), 21, No. 2, (Feb. 20, 1978), p. 21.

23. Fidell, S., *The Urban Noise Survey,* (EPA 550/9-70-100), Aug. 1977.

24. Bragdon, C., *Noise Pollution: The Unquiet Crisis,* Philadelphia: University, of Pennsylvania Press, 1970, p. 76.

25. Weinstein, Neil D., *Personal and Family Adjustment to Urban Noise,* Dept. of Human Ecology and Social Sciences, Cook College, Rutgers University, Brunswick, N.J., May 1976.

26. Farr, L.E., "Medical Consequences of Environmental Home Noises", *Journal of the American Medical Association,* 202, (1967).

27. Freeman, H.E., Levine, S., and Reeder, L.G., (Eds.), *Handbook of Medical Sociology,* Englewood Cliffs, N.J.: Prentice-Hall, 1977.

Appendix E

FEDERAL AGENCY POINTS OF CONTACTS FOR ADDITIONAL INFORMATION

DEPARTMENT OF DEFENSE (DoD)

1. Office of the Secretary of Defense

   A. Deputy Assistant Secretary of Defense
   (Energy, Environment and Safety)
   Pentagon, Room 3E784
   Washington, D.C. 20301 (202) 695-0221

   B. Deputy Assistant Secretary of Defense
   (Installations and Housing)
   Pentagon, Room 3E760
   Washington, D.C. 20301 (202) 695-7804

2. United States Army

   A. U.S. Army Environmental Hygiene Agency
   Bioacoustics Division
   Aberdeen Proving Ground, Maryland 21010

   B. Headquarters, Department of the Army
   DAEN-Z-CE
   Washington, D.C. 21010

   C. Headquarters, Department of the Army
   DAEN-MPE-I
   Washington, D.C. 20314

   D. Commander/Director
   CERL
   P.O. Box 4005
   Champaign, Illinois 61820

DEPARTMENT OF DEFENSE (DoD) (continued)

3. United States Navy

   A. General:

   Office of Chief of Naval Operations (OP-04E)
   Department of the Navy
   Washington, D.C. 20350 (202) 325-0090

   B. Specific for Individual Installations
   Commanding Officer of Installation involved

4. United States Air Force

   A. General:

   Environmental Division (AF/LEEV)
   Directorate of Engineering and Services
   Headquarters U.S. Air Force
   Washington, D.C. 20330

   B. General — Standard Federal Regions I-IV:

   Environmental Planning Division (AFRCE/ROV)
   USAF Regional Civil Engineer/Eastern Region
   526 Title Building
   Atlanta, GA 30303

   C. General — Standard Federal Regions V-VIII:

   Environmental Planning Division (AFRCE/ROV)
   USAF Regional Civil Engineer/Central Region
   Main Tower Building
   1200 Main Street
   Dallas, TX 75202

   D. General — Standard Federal Regions IX-X:

   Environmental Planning Division
   USAF Regional Civil Engineer/Western Region
   630 Sansome Street
   San Francisco, CA 94111

   E. Specific for Individual Installations:

   Environmental Planning Section (DEEV)
   Base Civil Engineer

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

A General:

Director
Environmental Planning Division
Office of Environmental Quality
451 7th Street, S.W.
Washington, D.C. 20410 (202) 755-8909

B Specific for Individual Projects:

Environmental Clearance Officers in HUD Regional and Area Offices

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Region X
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DEPARTMENT OF TRANSPORTATION/Federal Aviation Administration (DOT/FAA)

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