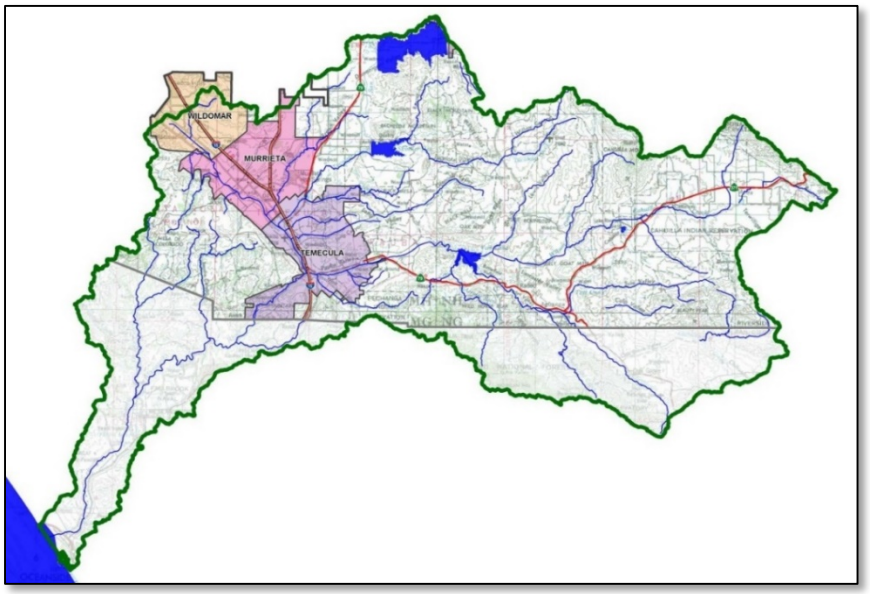
2018 WATER QUALITY MANAGEMENT PLAN

for the City of Wildomar



Functionally equivalent to Model BMP Design Manual
Prepared for Regional Water Quality Control Board Review
Model Manual Draft: June 7, 2018
Effective Date of Jurisdictional Manuals: July 5, 2018

Water Quality Management Plan

Functionally equivalent to the Model BMP Design Manual for the Santa Margarita Region of Riverside County

Jurisdictional BMP Design Manuals are effective July 5, 2018.

In compliance with Order No. R9-2013-0001 as amended by Order No. R9-2015-0001 and Order No. R9-2015-0100 (Regional MS4 Permit), this WQMP (model document) has been developed for review by the San Diego Regional Water Quality Control Board (Water Board). This WQMP, along with Exhibit A, C, F, and G comprise the "Model BMP Design Manual" pursuant to Provision F.2.b of the San Diego Regional MS4 Permit.

Copermittees:

County of Riverside
All Project applications:
www.countyofriverside.us/

For WQMP questions in unincorporated County areas:
www.rctlma.org
(951) 955-3185

Riverside County Flood Control and Water Conservation District
http://www.rcflood.org/

Murrieta
http://www.murrieta.org/

Temecula
http://www.cityoftemecula.org/

Wildomar
http://www.cityofwildomar.org/

Note: This Model BMP Design Manual has been collectively prepared by the Copermittees in the Santa Margarita Region of Riverside County. Each Copermittee will prepare a jurisdiction-specific BMP Design Manual. References to the "Copermittee" or "Local Jurisdiction" contained in this document refer to the City of Wildomar.

Note: This Model WQMP incorporates the hydromodification control criteria relevant for land development projects that were developed in the 2014 Hydromodification Management Plan (HMP). The 2014 HMP is a historical document and is no longer needed to support Project-Specific WQMP preparation for land development projects.

Table of Contents

1.0 POLICIES AND PROCEDURES 11

1.1. Projects Requiring a Project-Specific WQMP 11
1.2. WQMP Requirements for Projects in Progress 17
1.3. Project-Specific WQMP Requirements for Phased Projects 18
1.4. Types of Project-Specific WQMPs 19
1.5. Requirements for All Development Projects 20

2.0 CONCEPTS AND CRITERIA 22

2.1. Regulatory Requirements 22
2.2. Potential Impacts of Development 25
2.3. Low Impact Development (LID) 32
2.4. Hydromodification 52
2.5. Full Trash Capture 59
2.6. Hydrology for NPDES Compliance 62
2.7. Alternative Compliance 69
2.8. References and Resources 73

3.0 PREPARING PROJECT-SPECIFIC WQMPS 75

3.1. Assemble Project and Site Information 76
3.2. Optimize Site utilization (LID Principles) 76
3.3. Delineate Drainage Management Areas 82
3.4. Implement LID BMPs 88
3.5. Document any Alternative Compliance Measures 95
3.6. Address Hydromodification 97
3.7. Implement Trash Capture BMPs 104
3.8. Specify Source Control BMPs 105
3.9. Coordinate your Project-Specific WQMP Design with Other Site Plans 107
3.10. Develop an Operation and Maintenance Plan 107
3.11. Incorporating USEPA Green Streets Guidance 107

4.0 COORDINATION WITH OTHER SITE PLANS 113

4.1. Prepare a Project-Specific WQMP Site Plan 113
4.2. Coordination with Architectural Plans 114
4.3. Coordination with Improvement Plans 114
4.4. Coordination with Construction Activities 118

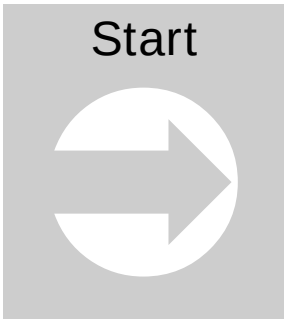
5.0 PROJECT-SPECIFIC WQMP OPERATION & MAINTENANCE 122

5.1. Stage 1: Ownership and Maintenance Responsibility 123
5.2. Stage 2: Identify Maintenance Requirements 125
5.3. Stage 3: Develop Project-Specific WQMP Operations &Maintenance Plan 125
5.4. Stage 4: Interim Operation & Maintenance 131
5.5. Stage 5: Operation & Maintenance Verification 132
5.6. References and Resources 132

BIBLIOGRAPHY 133

Exhibits

EXHIBIT A:	Isohyetal Map for the 85th Percentile 24-hour Storm Event
EXHIBIT B:	Model Jurisdictional Project Specific WQMP Template
EXHIBIT C:	LID BMP Design Handbook
EXHIBIT D:	Model Jurisdictional WQMP Applicability Checklist
EXHIBIT E:	Model Jurisdictional Project Specific WQMP Review Checklist
EXHIBIT F:	Santa Margarita River Hydrology Model (SMRHM) User Guide
EXHIBIT G:	Santa Margarita Region Hydromodification Maps 1. ***Potential Critical Coarse Sediment Yield Map*** 2. ***Hydromodification Requirements Applicability and Exemption Map***
EXHIBIT H:	Not used – placeholder only
EXHIBIT I:	Glossary
EXHIBIT **J**:	**"Other Development Project" Checklist**



INTRODUCTION

This Water Quality Management Plan (WQMP) is a guidance document to assist in the design of projects in compliance with San Diego Regional Water Quality Control Board (San Diego Regional Board) requirements for Priority Development Projects (PDPs). These requirements are specified in the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit issued to the Riverside County Flood Control and Water Conservation District (District), County of Riverside (County), and Cities of Murrieta, Temecula, and Wildomar (Copermittees) in November 2015 (Regional MS4 Permit). The area covered by the Regional MS4 Permit is referred to as the Santa Margarita Region (SMR). This WQMP, inclusive of Exhibits A through I, is functionally equivalent to the BMP Design Manual required pursuant to Provision F.2.b of the Regional MS4 Permit.

This WQMP is effective July 5, 2018. This WQMP is only applicable to projects in the City of Wildomar.

This WQMP is only applicable for development projects located within the Santa Margarita Watershed area of Riverside County. Projects in the SMR Watershed area of San Diego County must use different guidance documents applicable for projects in the County of San Diego. See the current San Diego County Standard Urban Stormwater Mitigation requirements at:
https://www.sandiegocounty.gov/dpw/watersheds/susmp/susmp.html.

Always consult the local jurisdiction with authority over the project.

Because every project is unique, development of a Project-Specific WQMP should begin by scheduling a pre-application meeting with the applicable staff of the City of Wildomar to understand the specific submittal requirements. A pre-application meeting is also recommended to review opportunities for the use of Alternative Compliance (AC) as a component of the project, as further outlined in this WQMP.

Be sure to use the most recent version of this WQMP for each and every project, including updates and errata. The most recent version is available at http://www.cityofwildomar.org/. This WQMP may be updated periodically based on the

City of Wildomar's experience with implementation of this document. Updates to this WQMP will be posted to the Regional Clearinghouse [web address] and reported to the Water Board as part of the Water Quality Improvement Plan Annual Report. If reading the WQMP on a computer, hyperlinks within this document can be used to navigate from section to section. Internet references can be accessed directly via the internet. The hyperlinks are throughout the text, in footnotes, and in "References and Resources" sections (marked by the 🕮 icon).

This WQMP is separate from, but references the Water Quality Improvement Plan (WQIP) and the Watershed Management Area Analysis (WMAA) for the Santa Margarita River WMA, which are available on the Regional Clearinghouse [http://rcflood.org/npdes/SMRWMA.aspx]. Note that the criteria in this WQMP supersede the criteria in the 2014 Hydromodification Management Plan (HMP).

To use the *WQMP* to guide development of a Project-Specific WQMP, start by reviewing Chapter 1 to find out whether and how the requirements apply to your PDP. Chapter 1 also provides an overview of the entire process of planning, design, construction, operation, and maintenance leading to compliance, as well as options for Alternative Compliance.

Terms and concepts used in the *WQMP* are defined in the Glossary or in Chapter 2. Chapter 2 provides background on key stormwater concepts and water quality regulations, including technical criteria for the design and selection of Best Management Practices (BMPs).

Then proceed to Chapter 3 and follow the step-by-step guidance to prepare a Project-Specific WQMP for your site. Note that the steps in Chapter 3 reference additional detail in Chapters 4 and 5. A preliminary Project-Specific WQMP is commonly required to be submitted with applications for entitlements and development approvals and must be approved by the City of Wildomar before any approvals or entitlements will be granted. A final Project-Specific WQMP will be required to be submitted and approved prior to issuance of grading and building permits. Prior to occupancy and/or intended use of any portion of the Priority Development Project, each structural BMP is then inspected to verify that it has been constructed and is operating per plan. The steps in Chapter 3 are intended to serve as a guide. Alternate approaches may be accepted, at the discretion of the City of Wildomar, provided that the Project-Specific WQMP demonstrates conformance with the criteria included in Chapter 2.

Construction Phase Controls

Your Project-Specific WQMP is a separate document from the Stormwater Pollution Prevention Plan (SWPPP). A SWPPP provides for temporary measures to control discharges of sediment and other Pollutants during construction at sites that disturb one acre or more, whereas a WQMP is required to address discharges from the post-construction use of the site. The WQMP requires [Insert Jurisdiction] review and approval.

Chapter 4 describes key ways to coordinate development of the Project-Specific WQMP with other site plans such as landscaping, grading and erosion control plans, and overseeing construction of BMPs.

Chapter 5 provides a description of the process for ensuring operation and maintenance of BMPs over the life of the PDP. The chapter includes step-by-step instructions for preparing a Project-Specific WQMP Operation and Maintenance Plan.

Throughout each chapter, you will find references and resources to help you understand the regulations, complete the Project-Specific WQMP, and design the PDP to be protective of stormwater quality to the Maximum Extent Practicable (MEP). Note that most non-stormwater discharges, including excess irrigation runoff, are prohibited at all times.

Note: The 2014 HMP serves only as a historical reference. It may be consulted for additional background on hydromodification and hydromodification control. However the criteria in this WQMP supersede the criteria in the 2014 HMP.

PLAN AHEAD TO AVOID THE THREE MOST COMMON MISTAKES

The most common (and costly) errors made by Users for development approvals with respect to stormwater compliance are:

1. Not planning for compliance early enough. The strategy for compliance with WQMP requirements should be developed before completing a conceptual site design or sketching a layout of subdivision lots. It is highly recommended that the project team (civil engineers, planners, architects, landscape architects, biologists, geologists, etc.) meet and confer at project inception, and then regularly throughout the design, to discuss design strategies that meet the WQMP requirements, which may include the use of Alternative Compliance. Section 4.0 discusses some of the elements of the Project-Specific WQMP that will need to be coordinated among the site plans that these professionals may develop.

2. Assuming proprietary Stormwater BMPs or Conventional Treatment BMPs will be adequate for compliance. Low Impact Development (LID) BMPs that maximize infiltration, evapotranspiration and/or biofiltration, commonly integrated into the landscape plans for a site, are now required for nearly all projects. Additional hydrologic control BMPs and Sediment Control BMPs may be required for projects that are subject to hydromodification management requirements (Regional MS4 Permit Provision E.3.c(2)). See Chapter 2 for criteria affecting what Stormwater BMPs can be used on a project.

3. Not planning for long-term maintenance of the PDP BMPs, and inspections/verifications by the City of Wildomar. Consider who will own and who will maintain the BMPs in perpetuity and how these parties will obtain access to the site, and identify which arrangements are acceptable to the the City of Wildomar (Chapter 5).

COMPLIANCE PROCESS AT A GLANCE

Users should follow these general steps to comply with the requirements of the Regional MS4 Permit:

1. Discuss WQMP requirements during a pre-application meeting with City of Wildomar staff, if possible. Note that the City of Wildomar will require the User to certify the information provided to so that the City of Wildomar can determine whether the project does or does not qualify as a PDP. The City of Wildomar will

have the ultimate discretion as to whether a Project-Specific WQMP will be required for any particular project.

2. If the project is required to prepare a Project-Specific WQMP, review the instructions in this WQMP BEFORE the tentative map, preliminary site plan, drainage plan, and improvement plans are prepared. The requirements in this WQMP and methods used to achieve compliance will affect each of these items. Neglecting to appropriately consider and address the requirements of this WQMP at all stages of project planning and design, will likely result in costly re-design being required.

3. When required by the City of Wildomar, prepare a preliminary Project-Specific WQMP and submit it with applications for Discretionary Approvals (entitlements).

4. Following receipt of any Discretionary Approvals, the final Project-Specific WQMP can be developed as part of the plan to complete the detailed project design, incorporating the BMPs committed to in the preliminary Project-Specific WQMP.

5. Prepare a draft Project-Specific WQMP Operation and Maintenance Plan and submit both, together with the grading and improvement plans as part of the application for grading and/or building permits. Execute legal documents assigning responsibility for operation and maintenance of BMPs. Execute legal documents (e.g. easements, fee payments, etc.) for Alternative Compliance. Protect proposed Post-Construction BMPs (and underlying infiltration soils) during construction, and maintain them following construction.

6. Following construction, submit 'as-built' plans and a final Project-Specific WQMP Operation and Maintenance Plan for on-site and, as applicable, Alternative Compliance BMPs, and formally transfer responsibility for maintenance to the owner, permanent occupant, or responsible party. Typically, the City of Wildomar will require the final Project-Specific WQMP Operation and Maintenance Plan prior to WQMP acceptance and issuance of Certificate of Occupancy. Provision E.3.e (d) requires that prior to occupancy and/or intended use of any portion of the Priority Development Project, each structural BMP is inspected to verify that it has been constructed and is operating in compliance with all of its specifications, plans, permits, and ordinances. See Section 1.3 for guidance related to phased projects.

7. Following occupancy, the occupant or owner (as defined in the Project-Specific WQMP Operation and Maintenance Plan) must maintain records that all necessary maintenance of Post-Construction BMP facilities has been performed

and allow periodic inspections of Structural BMPs by the City of Wildomar. Where the City of Wildomar allows or requires self-certifications of Structural BMPs, the occupant or owner must certify that the Structural BMPs are properly maintained and submit reports, prepared and certified by a Professional Engineer, to the City of Wildomar staff upon their request. Any responsibilities associated with Alternative Compliance likewise must be carried out and reported.

8. Preparation of a complete and detailed Project-Specific WQMP is the key to cost-effective compliance and expeditious review of your project. Instructions for preparing a Project-Specific WQMP are in Chapter 3.

Consistent with Section E of the Regional MS4 Permit, the City of Wildomar implements a JRMP that identifies an implementation process to verify compliance with the SMR WQMP requirements. In the JRMP, the implementation process identifies roles and responsibilities of the City of Wildomar departments in the method to track post-construction BMPs, to ensure that appropriate easements and ownerships are properly recorded in public records and that the information is conveyed to all applicable parties when there is a change in project or site ownership. Figure 1-1 identifies the typical implementation process for Project-Specific WQMP approval adopted by the City of Wildomar. The User may refer to the JRMP of the City of Wildomar to determine specific roles and responsibilities.

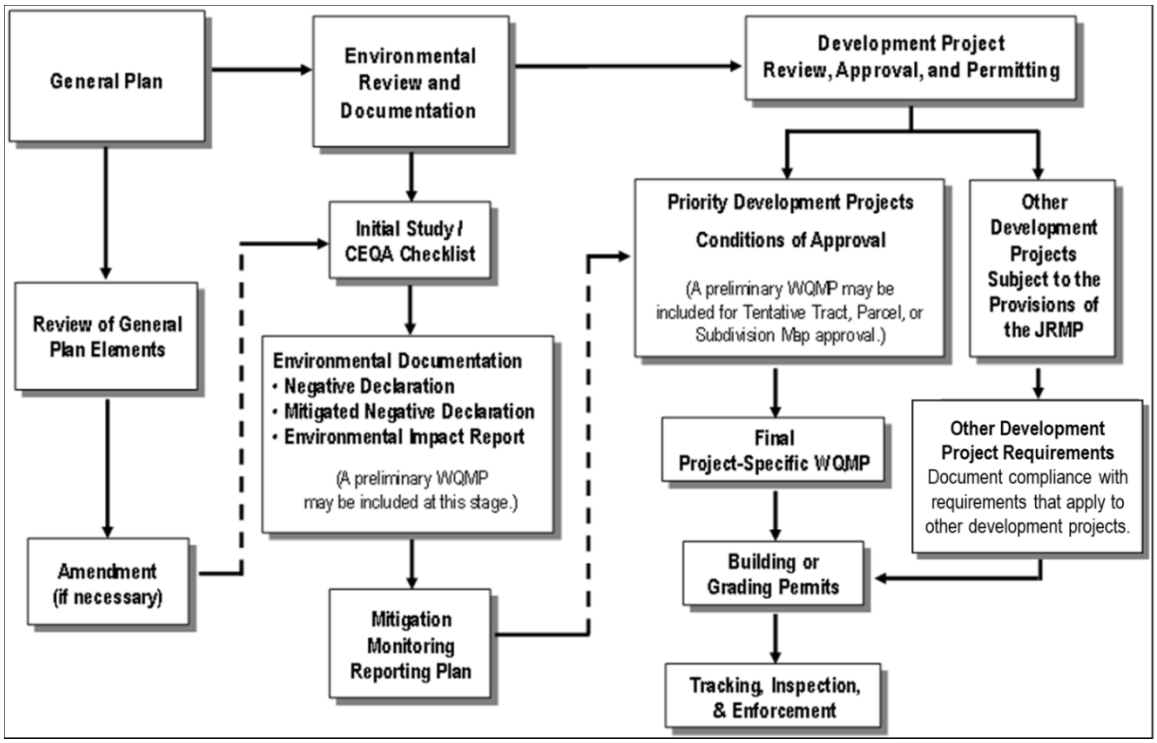


FIGURE 1-1: Development Process Flow Chart

Chapter
1

1.0 POLICIES AND PROCEDURES

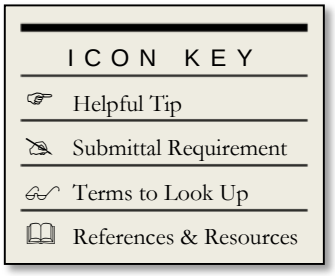
Determine if your project requires a Project-Specific WQMP, and review the steps to compliance.

1.1. PROJECTS REQUIRING A PROJECT-SPECIFIC WQMP

This Document is specific to projects in the [Local Jurisdiction].

> ☞*Before continuing use of this document, it is highly encouraged that the 'Locate your Watershed'* tool available at www.rcflood.org/npdes, or SWCT2 (Stormwater & Water Conservation Tracking Tool -http://rcstormwatertool.org/) is used to verify that your project is within the Santa Margarita Region of Riverside County.*

To ensure compliance with the Regional MS4 Permit the City of Wildomar requires that a Project-Specific WQMP be prepared for all development projects within the SMR that meet the 'Priority Development Project' categories and thresholds listed in Table 1–1 (Section 1.1.1 below). This includes both new development and significant redevelopment meeting these categories and thresholds.



Additionally, the Project-Specific WQMP Applicability Checklist provided in Exhibit D, which is incorporated into the City of Wildomar project application requirements, can be used to document a conclusion that a project does or does not meet the criteria as a PDP. Note some thresholds are defined by square footage of impervious area; others by land area of development; others by total area disturbed. Exhibit E includes a Project-Specific WQMP Review Checklist that can be used to ensure that your Project-Specific WQMP submittal includes all required elements.

* Note that the 'Locate your Watershed' tool may not function properly in web browsers except Internet Explorer.

If the project is not a PDP, a Project-Specific WQMP is generally not required. Such projects, referred to as 'Other Development Projects' are still required to conform with general requirements that apply to all projects and incorporate applicable and feasible Site Design and Source Control BMPs. These requirements are documented in Section 1.5. If your project is an Other Development Project, consult the City of Wildomar to determine acceptable approaches for documenting the incorporation of feasible and applicable site design and source control BMPs and adherence to other general requirements that apply to all development projects. See also Appendix J.

However, City of Wildomar staff may choose to require a Project-Specific WQMP for Other Development Projects, based on their assessment of the potential for the proposed project to impact stormwater quality.

When determining whether WQMP requirements apply, a "project" should be defined consistent with California Environmental Quality Act (CEQA) definitions of "project":

> *"The term **project** refers to the whole of an action that has the potential, directly or ultimately, to result in a physical change to the environment (**CEQA** Guidelines Section 15378). This includes all phases of a **project** that are reasonably foreseeable, and all related **projects** that are directly linked to the **project**."*

In the context of WQMP requirements, the "project" is the whole of an action which has the potential for adding or replacing or resulting in the addition or replacement of roofs, pavement, or other impervious surfaces. "Whole of an action" means the project may not be segmented or piecemealed into small parts if the effect is to reduce the quantity of impervious area for any part to below the applicable threshold.

1.1.1. Priority Development Projects

New Development and Redevelopment Projects are defined by the Regional MS4 Permit as a PDP if the project, or a component of the project, meets the categories and thresholds described in Table 1–1 below.

Table 1–1. Priority Development Project Categories

Category	Threshold	Development Project Description
New Development Projects	10,000 SF new Impervious surface	New Development Projects that create 10,000 square feet or more of impervious surfaces (collectively over the entire project site) including commercial, industrial, residential, mixed-use, and public development projects. This category includes New Development Projects on public and private land which fall under the planning and building authority of the City of Wildomar.

Category	Threshold	Development Project Description
Redevelopment Projects	5,000 SF new or replaced impervious surface on sites with more than 10,000 SF existing impervious surface	Redevelopment projects that create and/or replace 5,000 square feet or more of impervious surfaces (collectively over the entire project site on sites with at least 10,000 square feet of existing impervious surface). This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.
Automotive Repair Shops	5,000 SF new or replaced impervious surface	New Development or Redevelopment Projects that create and/or replace 5,000 square feet or more of impervious surfaces that support automotive repair shops that are categorized in any one of the following Standard Industrial Classification (SIC) codes: 5013, 5014, 5541, 7532-7534, or 7536-7539.†
Restaurants	5,000 SF new or replaced impervious surface	New Development or Redevelopment Projects that create and/or replace 5,000 square feet or more of impervious surfaces (collectively over the entire project site) at sites and support the selling of prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812).
Hillside Developments	5,000 SF new or replaced impervious surface	New Development or Redevelopment Projects that create and/or replace 5,000 square feet or more of impervious surfaces (collectively over the entire project site) and support development on any natural slope that is 25% or greater.
Environmentally Sensitive Areas	2,500 SF new or replaced Impervious surface	New Development or Redevelopment Projects discharging directly to an Environmentally Sensitive Area (ESA) that create and/or replace 2,500 square feet or more of impervious surfaces (collectively over the entire project site). "Discharging directly to" includes flow that is conveyed 200 feet or less from the project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the project to the ESA. See Section 1.1.1.c below for guidance on determining ESAs.
Parking Lots	5,000 SF new or replaced Impervious surface	New Development or Redevelopment Projects that create and/or replace 5,000 square feet or more of impervious surfaces (collectively over the entire project site) and supports land area or a facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce.
Streets, Roads, Highways and Freeways	5,000 SF new or replaced Impervious surface	New Development or Redevelopment Projects that create and/or replace 5,000 square feet or more of impervious surfaces (collectively over the entire project site) and support paved impervious surface used for the transportation of automobiles, trucks, motorcycles and other vehicles.
Retail Gasoline Outlets	5,000 SF or Average Daily Traffic >= 100	New Development or Redevelopment Projects that create and/or replace 5,000 square feet or more of impervious surfaces that support Retail Gasoline Outlets that are either 5,000 square feet or more or have a project average daily traffic of 100 or more vehicles.

† SIC Information and an SIC search function are available at **https://www.osha.gov/pls/imis/sicsearch.html.**

Category	Threshold	Development Project Description
Pollutant Generating projects disturbing 1 or more acres	1 or more acres disturbed area	New Development or Redevelopment Projects that disturb one or more acres of land and are expected to generate pollutants post construction.

1.1.1.a) Entire Project

Where a Project feature, such as a parking lot exceeds applicable area thresholds relevant to that feature to be defined as a PDP as described in Table 1–1 above, and the feature is part of a larger project, the entire project footprint is subject to WQMP requirements. However, the feature, such as a parking lot or road, would need to exceed the individual threshold for that category to trigger PDP designation.

Example 1: A new development project includes a 3,000 sq-ft building and a 4,000 sq-ft parking lot. This would not trigger a PDP because the total impervious cover is less than 10,000 sq-ft and the impervious cover of the parking lot is less than 5,000 sq-ft.

Example 2: A new development project includes a 2,500 sq-ft building and a 5,500 sq-ft driveway. This would trigger a PDP for the whole project because the driveway exceeds the 5,000 sq-ft threshold, even though the total impervious cover is less than 10,000 sq-ft.

Both examples assume that the project does not discharge directly to an ESA.

1.1.1.b) The "50% Rule" for Redevelopment Projects

Redevelopment PDPs may not only be required to develop a Project-Specific WQMP for the new or replaced 'project' footprint, but may also be required to retrofit the existing portions of the site for compliance with this WQMP as well (including BMP capacity for runoff from existing areas not otherwise being modified as part of the current project).

- Where redevelopment results in the creation or replacement of impervious surface in an amount of less than fifty percent of the surface area of the previously existing development, then the requirements associated with a Project-Specific WQMP applies only to the creation or replacement of impervious surfaces, and not to the entire development.
- Where redevelopment results in the creation or replacement of impervious surface in an amount of more than fifty percent of the surface area of the

previously existing development, the Project-Specific WQMP applies to the entire development, including portions of the site not otherwise being modified or improved as part of the current project.

City of Wildomar staff will require submittal of sufficient information about the existing developed site and proposed additions/modifications to assess whether the proposed Redevelopment Project exceeds the 50% threshold. Compliance with the Hydrologic Performance Standard (See Chapter 2.2.3), if it applies, will be determined based on the pre-development condition, i.e. the native condition of the project site prior to any existing development. For sites that have existing grading and improvements, the pre-development condition should be defined based on existing topography and soil properties, but with the removal of any impervious cover and substitution of typical natural vegetation.

1.1.1.c) Environmentally Sensitive Areas

For the purposes of these procedures, the following terms are defined:

- *Adjacent* -located within 200 feet of the listed water body and discharging to the water body. For projects adjacent to an ESA, but not discharging to an ESA, the 2,500 sq-ft threshold does not apply as long as the project does not physically disturb the ESA and the ESA is upstream of the project.
- *Discharging directly to* -discharge from a drainage system that is composed entirely of flows from the subject facility or activity, i.e., discharge from an urban area that comingles with downstream flows prior to discharging to an ESA is not subject to this requirement.

An ESA exists if any of the following designations have been applied to the water body of concern:

- Clean Water Act 303(d) listed impaired water body based on **most recent approved 303(d) list.**
- Water bodies designated with the RARE beneficial use by the SWRCB in the Water Quality Control Plan for the San Diego Region (**Region 9 Basin Plan**)
- Water bodies located within areas designated under the California Department of Fish and Game's Natural Community Conservation Planning (NCCP) Program as preserves or equivalent in subregional plans (**https://www.wildlife.ca.gov/Conservation/Planning/NCCP**)

- Areas identified in the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP). http://rctlma.org/Portals/0/mshcp/volume1/index.html

- Any other equivalent ESAs that contain water bodies that have been identified by the local jurisdiction to be of local concern.

1.1.2. Priority Development Project Exemptions

Several types of projects that would qualify as PDPs under criteria in Section 1.1.1 may be exempted from classification as PDPs, subject to approval by the City of Wildomar, if they follow certain stormwater design guidance. These project types are presented in Table 1–2.

Table 1–2. Priority Development Projects Exemptions

Project Type	Requirements to Quality for Potential PDP Exemption
New or retrofit paved sidewalks, bicycle lanes, or trails	• Designed and constructed to direct stormwater runoff to adjacent vegetated areas, or other non-erodible permeable areas, **OR**, • Designed and constructed to be hydraulically disconnected from paved streets or roads, **OR**, • Designed and constructed with permeable pavements or surfaces in accordance with USEPA Green Streets Guidance.
Retrofit or redevelopment of existing paved alleys, streets or roads	• Designed and constructed in accordance with USEPA Green Streets Guidance.

Guidance for incorporating site design features to qualify for potential sidewalk and path and the Green Streets exemptions (identified in Table 1-2) can be found in Section 3.2 and 3.11, respectively.

When the project types identified in Table 1-2 are associated with a larger project (including project elements that do not qualify for this exemption), the whole of the action must be considered in determining if PDP thresholds are met. If the combined project is a PDP, then the development of a Project-Specific WQMP is required. However, the applicable performance standards identified in Table 1-2 can apply to the respective portions of the project that would have qualified for a PDP exemption. For example, redevelopment of an existing street that is associated with a larger PDP

would be considered a part of the larger PDP for the purpose of Project-Specific WQMP preparation but would meet the standard to be constructed in accordance with USEPA Green Streets Guidance (according to guidance found in Section 3.11 of this WQMP).

1.1.3. Routine Maintenance Exemption

Redevelopment does not include routine maintenance activities, such as trenching and resurfacing associated with utility work; pavement grinding; resurfacing existing roadways, sidewalks, pedestrian ramps, improvement for compliance with the Americans with Disabilities Act (ADA), bike lanes on existing roads; and routine replacement of damaged pavement, such as pothole repair. Routine maintenance is defined in Attachment C of the Regional MS4 Permit.

1.2. WQMP REQUIREMENTS FOR PROJECTS IN PROGRESS

The effective date of Jurisdictional-specific WQMPs is July 5, 2018.

Provisions of the Regional MS4 Permit may apply to projects that have already begun the process for securing approvals from the City of Wildomar.

The Project-Specific WQMP requirements described in this WQMP are based on the provisions of the Regional MS4 Permit and apply to all PDPs or phases of PDPs except where criteria identified in E.3.e.(1)(a) are met. The full text of this Permit provision is included below with clarificatory annotation in square brackets:

> *E.3.e.(1)(a) Each Copermittee must require and confirm that all Priority Development Projects implement the requirements of Provision E.3, except that the Copermittee may allow previous land development requirements to apply to a Priority Development Project if the conditions of Provision E.3.e.(1)(a)(i) or Provision E.3.e.(1)(a)(ii) are met.*
>
> *(i) The Copermittee has, prior to the effective date* [July 5, 2018] *of the BMP Design Manual required to be developed pursuant to Provision E.3.d* [refers to this 2018 WQMP]:
>
> *[a] Approved‡ a design that incorporates the storm water drainage system for the Priority Development Project in its entirety, including all applicable structural pollutant treatment control and hydromodification management BMPs consistent with the previous*

‡ For public projects, a design stamped by the City or County Engineer, or engineer of record for the Project is considered an approved design.

applicable MS4 permit requirements [this refers to the 2010 MS4 Permit and 2014 WQMP]*, AND*

[b] Issued a private project permit or approval, or functional equivalent for public projects, that authorizes the Priority Development Project applicant to commence construction activities based on a design that incorporates the storm water drainage system approved in conformance with Provision E.3.e.(1)(a)(i)[a]; [this refers to bullet [a] above] *AND*

[c] Confirmed that there have been construction activities on the Priority Development Project site within the 365 days prior to the effective date of the BMP Design Manual, OR the Copermittee confirms that construction activities have commenced on the Priority Development Project site within the 180 days after the effective date of the BMP Design Manual, where construction activities are undertaken in reliance on the permit or approval, or functional equivalent for public projects, issued by the Copermittee in conformance with Provision E.3.e.(1)(a)(i)[b] [this refers to bullet [b] above] *; AND*

[d] Issued all subsequent private project permits or approvals, or functional equivalent for public projects, that are needed to implement the design initially approved in conformance with Provision E.3.e.(1)(a)(i)[a] [bullet [a] above] *within 5 years of the effective date of the BMP Design Manual. The storm water drainage system for the Priority Development Project in its entirety, including all applicable structural pollutant treatment control and hydromodification management BMPs must remain in substantial conformity with the design initially approved in conformance with Provision E.3.e.(1)(a)(i)[a]* [bullet [a] above]*.*

(ii) The Copermittee demonstrates it lacks the land use authority or legal authority to require a Priority Development Project to implement the requirements of Provision E.3.

If it appears that the project may meet these criteria, verify with the City of Wildomar. Should ambiguity exist in the requirements above, Provision E.3.e (1) of the MS4 Permit shall prevail.

1.3. PROJECT-SPECIFIC WQMP REQUIREMENTS FOR PHASED PROJECTS

Before occupancy will be granted for any phase of a multi-phase PDP, all requirements of the Project-Specific WQMP must be met for the current phase.

If any Structural BMPs necessary for the current phase of the PDP would be located in a future phase, of the certificate of occupancy or use for the current phase will not be

granted until such 'offsite' BMPs have been constructed and are fully operational. In addition, the Operation and Maintenance requirements described in Section 5.0 must be fully met for all such 'offsite' BMPs. Due to risk of clogging, BMPs that rely on infiltration or filtration should not receive runoff from unstabilized areas of the site that are still undergoing construction.

The City of Wildomar must require and confirm that prior to occupancy and/or intended use of any portion of the Priority Development Project, each structural BMP is inspected to verify that it has been constructed and is operating in compliance with all its specifications, plans, permits, ordinances, and the requirements of the MS4 Permit.

Where a local jurisdiction requires that a certificate of use or occupancy is required to allow for an interim use of a site to occur, such as showing of model homes, then all post-construction BMPs serving the subject portion of the project must be inspected to verify that it has been constructed and is operating in compliance with all its specifications, plans, permits, ordinances, and the requirements of the MS4 Permit before this certificate of occupancy or use can be issued.

1.4. TYPES OF PROJECT-SPECIFIC WQMPS

1.4.1. Preliminary Project-Specific WQMPs

If a Discretionary Approval would entitle construction of new or replaced improvements which, individually or in aggregate, would qualify as a PDP, then the User must prepare a preliminary Project-Specific WQMP. The level of detail in a preliminary Project-Specific WQMP will depend upon the level of detail known about the overall project design at the time project approval is sought.

For example, if approval of a tentative tract map application would entitle site improvements on individual lots that individually or in aggregate would exceed the thresholds for PDPs in Table 1–1, the User should prepare a preliminary Project-Specific WQMP. If particular plans for individual lots have not been identified, the preliminary Project-Specific WQMP may nevertheless be required to identify the type, size, location, and final ownership of Structural BMPs adequate to serve new roadways and any common areas, and to also manage runoff from an expected reasonable estimate of the square footage of future roofs, driveways, and other impervious surfaces on each individual lot. The City of Wildomar will then condition approval of the map on implementation of a final Project-Specific WQMP that is in substantial conformance with the approved preliminary Project-Specific WQMP prior to issuance of grading / building permits.

If the City of Wildomar deems it necessary, the future improvements on one or more lots may be required to be limited by a deed restriction or dedication of an appropriate easement, to suitably restrict the future building of structures at each Structural BMP location.

In general, it is recommended Structural BMPs not be located on individual single-family residential lots in order to ensure long-term maintenance, particularly when those BMPs manage runoff from streets or from common areas. Most often, it is better to locate Structural BMPs on one or more separate, jointly owned parcels such as a parcel owned by a homeowner's association).

1.4.2. Final Project-Specific WQMPs

All PDPs are required to prepare a final Project-Specific WQMP, which the City of Wildomar requires to be submitted together with associated grading and improvement plans, and approved prior to the issuance of any building or grading permits. The final Project-Specific WQMP must be in substantial conformance with any preliminary Project-Specific WQMP submitted to and approved by the City of Wildomar during the land use entitlement process. If Alternative Compliance approaches have been incorporated between the preliminary and final phases, the final Project-Specific WQMP should identify changes made as a result of using Alternative Compliance. Substantial conformance means that the final Project-Specific WQMP should be consistent with the project description, stormwater management approach, adopted mitigation measures, and project conditions of approval associated with the Preliminary Project-specific WQMP and associated discretionary actions. Substantial conformance allows for refinement of the project, such as updates of specific values (e.g., design volumes, tributary area of individual DMAs) and details (e.g., BMP placement, design parameters), commensurate with the greater level of detail and available information available at the stage of grading and improvement plans. The final Project-Specific WQMP must be accompanied by an O&M Plan. The final Project-Specific WQMP must also include a WQMP site plan in the same scale and detail as the final grading and building plans to allow verification of integration of BMP designs in coordination with other development reviews and approvals.

1.5. REQUIREMENTS FOR ALL DEVELOPMENT PROJECTS

This WQMP is primarily intended to provide criteria and guidance for PDPs with preparation of Project-Specific WQMPs. However, certain aspects of the Regional MS4

Permit also apply to Other Development Projects that have a nexus to stormwater quality, are within the land use and planning authority of the Copermittee, and require permits.

Not all permitted site improvement activities are "development projects." Permitted activities that do not add appreciable impervious surface and do not have a nexus to stormwater quality are not considered development projects for the purpose of stormwater quality requirements. Examples include: indoor activities, roof replacement with like materials, signs and retaining walls, activities considered to be routine maintenance per Section 1.1.3, and other activities defined by the Copermittee.

1.5.1. General Requirements for All Development Projects

The following general requirements apply to all development projects, including PDPs and other development projects (MS4 Permit Provision E.3.a):

- Incorporation of applicable and feasible Site Design BMPs described in Section 3.2
- Incorporation of applicable and feasible Source Control BMPs described in Section 3.8.
- Onsite BMPs must be located to remove pollutants from runoff prior to its discharge to any receiving waters, and as close to the source as possible;
- Structural BMPs must not be constructed within waters of the U.S.
- Onsite BMPs must be designed and implemented with measures to avoid the creation of nuisance or pollution associated with vectors (e.g., mosquitos, rodents).

1.5.2. City of Wildomar Determination of Project Status

The City of Wildomar will categorize the site activity as a PDP, Other Development Project, or non-development project as part of its project intake form.

Chapter 2

2.0 CONCEPTS AND CRITERIA

Technical background and explanations of policies and general design requirements.

2.1. REGULATORY REQUIREMENTS

2.1.1. Regional MS4 Permit

The San Diego Regional Board first issued a MS4 Permit to the Copermittees in the Santa Margarita Region in 1990. That permit has been reissued five times since then, with the most recent permit being issued in 2013 and amended in 2015. These permits have required the Copermittees to develop and implement a comprehensive program to prevent stormwater pollution to the MEP and to limit hydromodification resulting from development.

The Regional MS4 Permit mandates the LID approach described in this WQMP for management of the discharge of storm water pollutants from PDPs to the MEP. The Regional MS4 Permit also requires PDPs to manage runoff discharge rates and durations and avoid critical coarse sediment yield areas or implement measures that allow critical coarse sediment to be discharged to receiving waters, such that there is no net impact to the receiving water.

The Regional MS4 Permit provides applicants with the option to use Alternative Compliance measures to achieve compliance (see Section 2.7). Applicants do not need to demonstrate that full compliance on site is technically infeasible in order to make use of these provisions. However, if a PDP is allowed to utilize alternative compliance, "flow-thru" treatment control BMPs[1] must be implemented to treat the

[1] [1] The Regional MS4 Permit, Provision E.3.c(1) uses the terminology "flow-thru design;" and "flow-thru treatment control BMPs." This WQMP uses the term "flow-through," which is intended to be equivalent to "flow-thru" as used in the Regional MS4 Permit.

portion of the DCV that is not reliably retained onsite (see Section 2.7.4) and must demonstrate that the overall alternative compliance approach provides equal or greater benefit to full compliance with the on-site structural pollutant treatment BMP requirements.

This chapter explains the technical background of the City of Wildomar's approach to implementing both pollutant control and hydromodification requirements; and Chapter 3 describes how to prepare a Project-Specific WQMP that is in compliance with these requirements.

2.1.2. Maximum Extent Practicable

The Clean Water Act (CWA) Section 402(p)(3)(iii) sets the standard for control of Stormwater Pollutants as MEP, but the CWA does not quantitatively define this term. As implemented, MEP varies with conditions. In general, to achieve the MEP standard, Copermittees must require deployment of whatever BMPs are technically feasible (that is, are likely to be effective) and are not cost prohibitive.[1]

The Regional MS4 Permit includes a definition of MEP in Attachment C.

Many stormwater controls, including LID, have proven to be practicable in most Development Projects. To achieve fair and effective implementation, criteria and guidance for those controls must be detailed and specific—while also offering the right amount of flexibility or exceptions for special cases. The criteria contained in this WQMP are intended to support the control of stormwater pollutants to the MEP. The intent of these criteria is to support selection of BMPs that are effective, achieve regulatory compliance, have public acceptance, are not cost prohibitive, and are technically feasible.

2.1.3. Best Management Practices

CWA Section 402(p) and United States Environmental Protection Agency (USEPA) regulations (40 CFR 122.26) require the Copermittees to implement a program of "management practices" to control Stormwater Pollutants to the MEP. BMPs are schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. This

[1] "Definition of Maximum Extent Practicable", memo by Elizabeth Jennings, Senior Staff Counsel, State Water Resources Control Board, February 11, 1993.

document defines several categories of BMPs. The glossary includes definitions for each category of BMP.

2.1.4. TMDL

A TMDL, or 'Total Maximum Daily Load', is the maximum amount of a Pollutant that can be discharged into a waterbody from all sources (point and non-point) and still maintain Water Quality Standards. Under CWA Section 303(d), TMDLs must be developed for all waterbodies that do not meet Water Quality Standards after application of technology-based controls.

The current 303(d) list of impaired water is included in Section 2.2.4 of this WQMP.

The only adopted TMDL within the SMR Region of Riverside County is the Rainbow Creek TMDL for Nitrogen and Phosphorus. Rainbow Creek is a tributary to the Santa Margarita River that is primarily within San Diego County. The area within Riverside County that drains to Rainbow Creek is not urbanized. Should a project be proposed within the Rainbow Creek Watershed, nitrogen and phosphorus would be considered high priority pollutants of concern.

Segments of the Santa Margarita River and the SMR Estuary are on the 303(d) list as impaired due to excess nutrient loading and/or eutrophic conditions. A TMDL alternative program is being developed to address these impaired waters.

This WQMP will be updated as necessary to address the pollutants of concern for the SMR River and Estuary and for any other TMDLs that are developed and adopted in the SMR.

2.1.5. Water Quality Improvement Plan

The Water Quality Improvement Plan (WQIP) for the Santa Margarita River Watershed Management Area prioritizes water quality conditions of concern and describes goals, strategies, and schedules for addressing water quality conditions of concern. As part of this document, the Watershed Management Area Analysis (WMAA) identifies Candidate Projects which may be considered for offsite Alternative Compliance, Potential Critical Coarse Sediment Yield areas (CCSYAs), and receiving water segments exempt from hydromodification requirements. For reference, these areas are also presented in maps in Exhibit G of this WQMP.

The requirements under Provision E.3 of the Regional MS4 Permit must be implemented regardless of the findings of the WQIP and WMAA. However, the prioritization of water quality conditions in the WQIP and the assessment of hydromodification susceptibility in the WMAA have an influence on determining

appropriate BMPs and control strategies for stormwater runoff (e.g., determination of hydromodification exemptions, determination of priority pollutants of concern for BMP selection).

*[Interim Note: The hydromodification exemptions proposed in the draft WMAA are not yet effective or available and **cannot be used** unless and until the WMAA is accepted.*

*Exhibit G identifies potential CCSYAs and potential Sediment Source Areas and **may be used** upon the effect date of this WQMP.]*

The highest priority water quality conditions (HPWQCs) identified in the WQIP are:

- **Eutrophication** (elevated algal biomass). This applies to dry weather discharges for tributaries to the SMR Estuary, which may include: Upper Murrieta Creek and Tributaries, Warm Springs, Santa Gertrudis, Murrieta Creek and Long Canyon, Temecula Creek and Redhawk Channel, Upper Santa Margarita River, Lower Santa Margarita River, Rainbow Creek and De Luz Creek.
- **Nutrient loading (N and P)** to above referenced receiving waters during dry weather.
- **Nutrient loading (N and P)** to Rainbow Creek during wet weather.

This WQMP requires projects to eliminate non-exempt non-stormwater discharges. This addresses dry weather HPWQCs.

Because of the nutrient-related impairments and TMDL alternative development process in the SMR River and Estuary, nutrient impairments need to be considered part of determining priority pollutants of concern for projects in any part of the SMR watershed.

2.2. POTENTIAL IMPACTS OF DEVELOPMENT

This section describes the potential impacts that Development Projects can have on streams, rivers and other water bodies.

2.2.1. Imperviousness

Schueler (1995) proposed imperviousness as a "unifying theme" for the efforts of planners, engineers, landscape architects, scientists, and local officials concerned with urban watershed protection. Schueler argued (1) that imperviousness is a useful indicator linking urban land development to the degradation of aquatic ecosystems, and (2) imperviousness can be quantified, managed, and controlled during land development.

Imperviousness has long been understood as the key variable in urban hydrology. Peak runoff flow and total runoff volume from small urban catchments are usually calculated as a function of the ratio of impervious area to total area. The ratio correlates to the composite runoff factor, usually designated "C". Increased flows resulting from urban development tend to increase the frequency of small-scale flooding downstream.

Imperviousness has three major components: rooftops, transportation (including streets, highways, and parking areas) and other hardscape. The transportation component is most likely to be directly connected to the MS4.

The effects of imperviousness can be managed by disconnecting impervious areas from the MS4 and by making drainage conveyances *less* efficient—that is, by encouraging retention and detention of runoff near the point where it is generated, more closely mimicking pre-development runoff flows and durations and time of concentration.

2.2.2. Potential Water Quality Impacts Associated with Developments

Runoff from a developed site has the potential to contribute Pollutants to the MS4 and Receiving Waters. These Pollutants may originate as airborne dust, be washed from the atmosphere during rains or may be generated locally by automobiles and activities present at the site. Pollutants can be grouped in eight general categories as follows:

- Sediments are soils or other surficial materials that are eroded and then transported or deposited by the action of wind, water, ice, or gravity. Excessive discharge of sediments to waterbodies and streams can potentially increase turbidity, clog fish gills, reduce spawning habitat, lower young aquatic organism survival rates, smother bottom dwelling organisms, and/or suppress aquatic vegetation growth.

- Nutrients are inorganic substances, such as nitrogen and phosphorus that are required for plant growth. They commonly exist in the form of mineral salts that are either dissolved or suspended in water, or as particulates. Primary potential sources of nutrients in runoff are fertilizers, vehicles, eroded soils, which can contain high nutrient levels.

  Excessive discharge of nutrients to waterbodies and streams may cause excessive aquatic algae and plant growth. Such excessive production, referred to as cultural eutrophication, may lead to excessive decay of organic matter in

the waterbody, loss of oxygen in the water, release of toxins in bed sediment, and/or the eventual death of aquatic organisms and fish kills.

The WQIP (Section 2.7.1) identifies irrigated agriculture, orchards, vineyards and nurseries, open scrublands and grasslands, and residential land uses as the largest contributors of total nitrogen load to the Santa Margarita River. The WQIP identifies total phosphorus loading as being contributed by roads, orchards, vineyards and nurseries, open scrublands and grasslands, and residential land uses. The WQIP also notes that commercial and industrial sources have the potential to contribute to the HPWQC, including, restaurants, automotive services and carwashes, as well as pet services, food stores, and gardening and landscaping businesses. Sources that contribute to eutrophication are primarily dry weather sources; however stormwater loading during wet weather can also contribute to dry weather eutrophication.

- Metals are raw material components in both metal and non-metal products. Primary potential sources of metal pollution in stormwater are typically commercially-available metals and non-metal products such as fuels, adhesives, paints, and other coatings. The primary current metal of concern in stormwater runoff in the SMR watershed is copper. Zinc is also commonly found in stormwater runoff at levels of concern. Cadmium, chromium, and mercury have limited stormwater sources outside of regulated industrial facilities. Lead has been predominantly addressed via source controls. Iron, aluminum, and manganese are natural soil elements, but are typically bound strongly to particulates and are removed by most structural BMPs. Certain metals can be toxic to aquatic life. Humans can be impacted from contaminated groundwater resources, and bioaccumulation of metals in fish and shellfish. Environmental concerns, regarding the potential for release of metals to the environment, have already led to restricted metal usage in certain applications.

- Toxic Organic Compounds are natural or synthetic carbon-based molecules that may be found in pesticides, solvents, and hydrocarbons. Organic compounds can, at certain concentrations, indirectly or directly constitute a hazard to life or health. When rinsing off objects, toxic levels of solvents and cleaning compounds can inadvertently be discharged to MS4 facilities. Dirt, grease, and grime retained in the cleaning fluid or rinse water may also adsorb levels of organic compounds that are harmful or hazardous to aquatic life.

- Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings,

and food waste) may impact the recreational value or other Beneficial Uses of a waterbody and/or aquatic habitat. Excess organic matter that may have been introduced as trash can create a high biochemical oxygen demand in a stream and thereby lower its water quality.

- Oil and grease are common pollutants in developed areas. Primary sources include motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids. Introduction of these Pollutants to the waterbodies can occur due to the wide uses and applications of some of these products in municipal, residential, commercial, industrial, and construction areas. Elevated oil and grease content can decrease the aesthetic value of the waterbody, as well as the water quality.

- Bacteria and Viruses are environmentally-ubiquitous microorganisms that thrive under certain ecological conditions. Their proliferation is often from natural or uncontrollable sources but can also be caused by the transport of animal or human fecal wastes from a watershed. Water containing excessive bacteria and viruses, can alter the aquatic habitat and create a harmful environment for humans and aquatic life.

- Pesticides are chemical compounds commonly used to control nuisance plant growth or pests such as insects. Excessive or inappropriate application of a pesticide may result in runoff that may be toxic to aquatic life.

The Regional MS4 Permit requires the Copermittees to require proposed PDPs to incorporate site design, source control, and structural treatment control BMPs (including LID BMPs and flow-through treatment control BMPs, subject to a specific BMP selection hierarchy) that address potential water quality impacts from such pollutants.

2.2.3. Hydromodification Impacts

Hydromodification refers to changes in the magnitude and frequency of stream flows and associated sediment loading and transport because of urbanization or other land use changes. Hydromodification can impact receiving streams by causing increased erosion, increased sedimentation, and degradation of in-stream habitat.

Once altered by hydromodification, natural streams and their ecosystems may have diminished beneficial uses. However, the stream may reach a new geomorphic equilibrium if proper management measures are implemented, and beneficial uses may be partially or fully recovered. Managing runoff from a single development site may seem inconsequential, but by changing the way most sites are developed (and

redeveloped), it may be possible to protect existing stream ecosystems downstream of urban and urbanizing areas.

The Regional MS4 Permit requires Copermittees to require proposed PDPs to incorporate LID principles, LID BMPs, and Hydrologic Control BMPs to limit the potential for increased hydromodification from development. PDPs must also avoid critical coarse sediment yield areas or implement measures that allow critical coarse sediment to be discharged to receiving waters, such that there is no net impact to the receiving water.

The 2014 HMP established criteria for hydromodification control in the Santa Margarita Region of Riverside County. Certain hydromodification criteria were updated in the Regional MS4 Permit. This WQMP describes the current applicable hydromodification control criteria. The project applicant may consult the HMP for historical information, however the criteria and guidance in this WQMP is prevailing and the user does not need to consult the 2014 HMP.

2.2.4. Priority Pollutants of Concern

"Priority Pollutants of Concern" are those Pollutants that the proposed PDP has the potential to generate, and are also known to be impairing the downstream Receiving Waters. Identifying Priority Pollutants of Concern involves the following steps:

1. Identify Receiving Waters – Use the most recent version of the Water Quality Control Plan for the San Diego Region Basin to determine the PDPs Receiving Waters. Receiving Waters for a given PDP consist of the direct receiving water and each subsequent downstream receiving water until reaching the ocean. In the SMR region of Riverside County, The Santa Margarita Estuary, the Lower Santa Margarita River, and the Upper Santa Margarita River are receiving waters for every PDP. This information can be accessed from the following site:

   (http://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/).

2. Identify Receiving Water Impairments – Use the most recent approved 303(d) listings and TMDLs to identify impairments for Receiving Waters including all downstream receiving waters. Rainbow Creek has a TMDL for Nitrogen and Phosphorus. There is not currently urban development within the Rainbow Creek Watershed in Riverside County, however if projects are proposed in this area, the Nutrient TDML must be identified as a priority pollutant of concern.

Watersheds identified as impaired in the Approved 2010 303(d) list are presented in Table 2–1. The most recent 303(d) lists are available from the State Water Resources Control Board website[1]

Table 2–1. Summary of Approved 2010 303(d) listed waterbodies and associated pollutants of concern for the Riverside County SMR Region and downstream waterbodies.

Water Body	Nutrients[1]	Metals[2]	Toxicity	Bacteria and Pathogens	Pesticides and Herbicides	Sulfate	Total Dissolved Solids
De Luz Creek	X	X				X	
Long Canyon Creek		X		X	X		
Murrieta Creek	X	X	X		X		
Redhawk Channel	X	X		X	X		X
Santa Gertrudis Creek	X	X		X	X		
Santa Margarita Estuary	X						
Santa Margarita River (Lower)	X			X			
Santa Margarita River (Upper)	X		X				
Temecula Creek	X	X	X		X		X
Warm Springs Creek	X	X		X	X		

[1] Nutrients include nitrogen, phosphorus and eutrophic conditions caused by excess nutrients.

[2] Metals includes copper, iron, and manganese.

3. **Identify Highest Priority Water Quality Conditions** – Use the WQIP to identify the highest priority water quality conditions for the project location. Access the SMR WQIP from the Riverside County Watershed protection website[2].

   Highest priority water quality conditions (HPWQCs) identified in the WQIP are:

   - **Eutrophication** (elevated algal biomass). This applies to dry weather discharges for tributaries to the SMR Estuary, which may include: Upper Murrieta Creek and Tributaries, Warm Springs, Santa Gertrudis, Murrieta Creek and Long Canyon, Temecula Creek and Redhawk Channel, Upper

[1] https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml

[2] http://rcflood.org/npdes/WQIP.aspx

Santa Margarita River, Lower Santa Margarita River, Rainbow Creek and De Luz Creek.

- **Nutrient loading (N and P)** to above referenced receiving waters during dry weather.
- **Nutrient loading (N and P)** to Rainbow Creek during wet weather.

This WQMP requires projects to eliminate non-exempt non-stormwater discharges. This addresses dry weather HPWQCs. Nutrient-related impairment of the SMR River and Estuary effectively require nutrients to be considered as a stormwater impairment in the entire SMR watershed.

Table 2-2 reflects the sources of nitrogen and phosphorus identified in the WQIP.

4. Identify Pollutants associated with your site/project - This includes Pollutants that are listed for the category of development on Table 2–2 below.
5. Determine Primary Pollutants of Concern for your site/project – Primary Pollutants of Concern (PPCs) for a given site/project include both:
    - Pollutants for which Receiving Waters are impaired or associated with a WQIP priority (Step 2 and 3) which are also associated with the site/project (Step 4)

Table 2–2: Potential Pollutants by Land Use Type

Priority Development Project Categories and/or Project Features	General Pollutant Categories									
	Bacterial Indicators	Metals	Nutrients	Pesticides	Toxic Organic Compounds	Sediments	Trash & Debris	Oil & Grease	Total Dissolved Solids	Sulfate
Detached Residential Development	P	N	P	P	N	P	P	P	N	N
Attached Residential Development	P	N	P	P	N	P	P	P[(2)]	N	N
Commercial/ Industrial Development	P[(3)]	P[(7)]	P	P[(1)]	P	P[(1)]	P	P	N	N
Automotive Repair Shops	N	P[(7)]	P	N	P[(4, 5)]	N	P	P	N	N
Restaurants (>5,000 ft^2)	P	N	P	P[(1)]	N	N	P	P	N	N
Hillside Development (>5,000 ft^2)	P	N	P	P	N	P	P	P	N	N
Parking Lots (>5,000 ft^2)	P[(6)]	P[(7)]	P	P[(1)]	P[(4)]	P	P	P	N	N
Streets, Highways, and Freeways	P[(6)]	P[(7)]	P	P[(1)]	P[(4)]	P	P	P	N	N
Retail Gasoline Outlets	N	P[(7)]	P	N	P[(4)]	N	P	P	N	N

P = Potential
N = Not Potential
[(1)] A potential Pollutant if non-native landscaping exists or is proposed onsite; otherwise not expected.
[(2)] A potential Pollutant if the project includes uncovered parking areas; otherwise not expected
[(3)] A potential Pollutant if land use involves animal waste products, otherwise not expected
[(4)] Including petroleum hydrocarbons
[(5)] Including solvents
[(6)] Bacterial Indicators are routinely detected in pavement runoff
[(7)] A potential source of metals, primarily copper and zinc. Iron, magnesium, and aluminum are commonly found in the environment and are commonly associated with soils, but are not primarily of anthropogenic stormwater origin in the municipal environment.

2.3. LOW IMPACT DEVELOPMENT (LID)

LID is a stormwater management and land development strategy that emphasizes conservation and use of onsite natural features integrated with engineered, small-scale hydrologic controls to more closely reflect pre-development hydrologic features.

The Low Impact Development Manual for Southern California (SMC, 2010) further describes that there are two types of LID:

- LID Principles (also referred to as "Site Design") are site design concepts that prevent or minimize the causes (or drivers) of post-construction impacts, and help mimic the pre-development hydrologic regime. LID Principles should be implemented as applicable and feasible for all projects, including PDPs and Other Development Projects.

- LID BMPs (also referred to as "Structural Pollutant Control BMPs") are Structural BMPs that help manage otherwise unavoidable post-construction impacts; i.e., where implementation of LID Principles cannot fully address the Design Capture Volume for a particular portion of a PDP site, LID BMPs must be implemented. The User may also investigate the feasibility of using LID BMPs as Hydrologic Control BMPs to manage the increases in runoff discharge rates and durations that may cause Hydromodification impacts. LID BMPs include retention and biofiltration BMPs. In the Regional MS4 Permit, these are referred to as the first two tiers of Stormwater Pollutant Control BMPs. Quantitative requirements for LID BMPs apply only to PDPs; however these BMPs could also be applied to Other Development Projects.

2.3.1. Benefits of LID

There are many potential benefits associated with the use of LID. Foremost, LID BMPs tend to retain runoff, thus reducing the amount of potentially Polluted runoff that can be transported to Receiving Waters. Additionally, LID BMPs have the advantage of supplementing the physical processes of interstitial settling and adsorption—common to all media filters—with additional complexation and adsorption to the biofilms that are developed, and for those that include vegetation, additional Pollutant removal through uptake through the plant roots. In addition, LID BMPs that integrate engineered/amended soils and/or vegetation benefit from the biological activity of bacteria, insects, and worms, which helps renew and maintain the media, increasing reliability and eliminating the need for frequent maintenance or re-setting of the filtration layers. LID BMPs also act as "sponges", absorbing the amount of Runoff from small storm events and some of the Runoff from larger events and retaining it so as to maximize infiltration and evapotranspiration. This, in turn helps the post-development site's hydrologic regime mimic the pre-development hydrology and can be useful in achieving compliance with the HMP Performance Standards.

In addition to Stormwater management, LID implementation can result in environmental, economic, and community benefits:

Potential Environmental Benefits:

- Improved water quality
- Maintenance of predevelopment Runoff volume and discharge
- Groundwater recharge
- Terrestrial and aquatic habitat preservation
- Reduced potable water demand
- Recycling and beneficial reuse
- Reduction in urban heat island effect

Potential Economic Benefits:

- Reduced construction and maintenance costs
- Improved marketability
- Energy cost reduction and water conservation

Potential Community Benefits:

- Improved aesthetic value
- Provides "green job" opportunities
- Educational opportunities

LID BMPs have been shown in studies throughout the country to be effective and reliable at treating a wide range of Pollutants that can be found in Runoff, including those listed in Section 2.2.2 above. As such, the LID BMPs required in this WQMP are expected to treat discharges of urban-sourced Pollutants from PDPs with a high level of effectiveness, such that the runoff discharges from the PDP should not cause or contribute to an exceedance of Receiving Water Quality Objectives.

2.3.2. LID BMP Types and Prioritization for Pollutant Control

LID BMPs are a type of Structural BMP that provide many of the benefits described above. For the purposes of complying with stormwater pollutant control requirements, LID BMPs are categorized and prioritized into three categories. Where

Hydrologic Performance Standards apply, a proposed PDP may use, but are not required to use, LID BMPs to comply with both pollutant control and hydromodification requirements.

For the purposes of this WQMP, LID BMPs are prioritized as follows:

- Priority 1: Full Retention LID BMPs

  Under the Regional MS4 permit, PDPs are required to consider full retention using LID BMPs (including BMPs that have design discharges only to infiltration, evaporation, and evapotranspiration) to comply with pollutant control requirements before considering other BMPs. Full Retention LID BMPs are considered to achieve pollutant control compliance if they retain 100% of the runoff from the 24-hour 85th percentile storm event at the project location, hereafter referred to as the Design Capture Volume (DCV). The following Infiltration BMPs are considered Priority 1 Full Retention LID BMPs that may be used to retain 100% of the DCV:

  - Infiltration Basin BMPs are engineered depressions that are designed to infiltrate captured runoff into the underlying native soils. As such, these Infiltration BMPs can be used to infiltrate the entire DCV only where soils are highly permeable.

  - Infiltration Trench BMPs are engineered trenches filled with gravel that are designed to infiltrate captured runoff into the underlying native soils. As such, these Infiltration BMPs can be used to infiltrate the entire DCV only where soils are highly permeable. They can be a preferred option when space constraints exist.

  - Pervious Pavement BMPs are designed to infiltrate captured runoff into underlying soils. Pervious pavements can be designed as Infiltration BMPs or as LID Principles[1]. They can be used on soils with any reasonable infiltration rate, however when they are designed as Infiltration BMPs they can only be used on more permeable soils.

[1] When pervious pavement is designed primarily as a site design feature (i.e., it receives runoff from up to 2 parts tributary impervious area to 1 part pervious pavement), the pervious pavement is considered a self-retaining area as described in Section 3.3.3. If additional area is drained onto the pervious pavement beyond the 2:1 ratio, the pervious pavement will be required to be constructed in accordance with a Copermittee approved Stormwater BMP design that allows for greater ratios, (such as the LID BMP Design Handbook). In this case, pervious pavement is considered a LID Retention BMP.

- Bioretention BMPs are engineered vegetated areas that are designed to receive and fully infiltrate runoff. Because they are designed to infiltrate the full Design Capture Volume (DCV), Bioretention BMPs are feasible only where soils are moderately to highly permeable. Water retained by Bioretention BMPs is either evapotranspired by plants in the BMP, or slowly allowed to infiltrate into the underlying soils.

- Priority 2: Biofiltration BMPs

Under the Regional MS4 Permit, if full retention of the DCV is not technically feasible per the criteria in Section 2.3.3, a PDP may use Biofiltration BMPs to achieve compliance with pollutant control requirements. Biofiltration BMPs must be **designed to maximize retention and pollutant removal** and must be sized according to one of the following methods:

1. Treat 1.5 times the DCV not reliably retained on site; or

2. Treat the DCV not reliably retained on site with a design that has a total static storage volume, including pore spaces and pre-filter detention volume, sized to hold at least 0.75 times the DCV not reliably retained on site.

Water can be considered "reliably retained" if it is estimated to infiltrate or evapotranspire within a reasonable time and is applied in conformance with infiltration feasibility criteria described in Section 2.3.3.

"Static storage volume" refers to the volume in ponded area and soil/media pore space, tabulated without accounting for any storm routing.

The following BMPs are considered Priority 2 Biofiltration BMPs:

- Biofiltration with Partial Infiltration BMPs are engineered vegetated areas that are designed to receive and filter runoff and infiltrate a portion of that runoff into underlying soils. Biofiltration with Partial Infiltration BMPs also retain runoff via evapotranspiration. They are typically used in areas with moderate soil infiltration rates where full infiltration of the DCV is not technically feasible (per criteria in Section 2.3.3) but where BMPs can still be designed to achieve partial infiltration in less permeable soils.

- Biofiltration with No Infiltration BMPs are engineered vegetated areas that are designed to receive and filter runoff but are not designed to promote infiltration of runoff into underlying soils. Because the

Regional MS4 Permit requires that Biofiltration BMPs be designed to maximize retention, Biofiltration with No Infiltration BMPs are typically used only in areas with low soil infiltration rates where infiltration potential is minimal and maximized volume reduction is primarily via evapotranspiration. They may also be used in areas where infiltration of runoff has been adequately documented to pose risks to property, people, or the environment, such as sites where documentation demonstrates that infiltration would pose geotechnical risks or mobilize soil contamination.

- Proprietary Biofiltration BMPs are engineered vegetated biofiltration systems that have been designed by product vendors to receive and treat runoff. These BMPs typically achieve minor volume reduction via evapotranspiration unless supplemented with infiltration to increase retention, where feasible. Guidance for acceptance of proprietary BMPs is provided in Section 2.3.6. Use of proprietary biofiltration BMPs is at the discretion of the [Local Jurisdiction].

- Priority 3: Flow-Through[1] Treatment BMPs

  Note: use of these BMPs may require pre-approval from the City of Wildomar.

  Under the Regional MS4 Permit, if Biofiltration is not technically feasible per the criteria in Section 2.3.3, a PDP may use Flow-Through Treatment Control BMPs to manage pollutants in runoff from the site. Flow-Through Treatment Control BMPs must be sized to remove pollutants to the MEP and filter or treat either:

  1. The maximum flow rate of runoff produced from a rainfall intensity of 0.2 inches of rainfall per hour, for each hour of a storm event; or,
  2. The maximum flow rate of runoff produced by the 85th percentile hourly rainfall intensity as determined form the local historical record.

  Flow-Through Treatment BMPs must be ranked with medium or high pollutant removal efficiency for the Priority Pollutants of Concern for a PDP (Section 2.2.4).

PDPs that utilize Flow-Through Treatment Control BMPs to manage pollutants in site runoff must also mitigate, through participation in Alternative Compliance (if available), for the pollutant load in the portion of the DCV not reliably retained on site. Alternative compliance options and their availability are described in Section 2.7.

Similarly, PDPs that opt to participate in alternative compliance (if available) are required to provide flow-through treatment for water prior to discharge to a water of the state. It is possible that the same off-site BMP could serve as alternative compliance and also provide pollutant treatment prior to discharge to a receiving water if it is located downstream of the PDP and upstream of the receiving water (see Section 2.7.4).

The following BMPs are considered Priority 3 Flow-Through Treatment Control BMPs:

- Sand Filter BMPs are stormwater BMPs that are designed primarily to remove pollutants from runoff via filtration. Sand filters are not typically designed to achieve any retention of runoff.
- Extended Detention Basin BMPs are stormwater BMPs that are designed primarily to remove pollutants from runoff via sedimentation. They can also be designed to help achieve Hydrologic Performance Standards, when applicable.
- Proprietary Flow-Through Treatment BMPs are stormwater BMPs that have been engineered by product vendors to remove pollutants from stormwater runoff. See Section 2.3.6 for acceptance criteria for proprietary flow-through treatment BMPs to be approved for use.

Table 2–3 summarizes those BMPs that are included under each BMP category. Descriptions, illustrations, designs, and design criteria for the BMPs described in this WQMP can be found in the LID BMP Design Handbook (Exhibit C).

2.3.2.a) LID Prioritization

Consistent with Provision E.3.c.(1).(a) of the Regional MS4 Permit, each PDP must implement LID Infiltration BMPs that capture and retain onsite the pollutants contained in the DCV for each of the project's Drainage Management Areas (DMAs). If it has been shown to be technically infeasible, per the criteria in Section 2.3.3, to implement such LID Retention BMPs for some or all of the DMAs on the site, Biofiltration LID BMPs may be used to treat pollutants in runoff from those DMAs. Biofiltration BMPs must be selected and designed with a preference for

designs that maximize volume reduction. If it is also shown to be technically infeasible to implement Biofiltration (per the criteria in Section 2.3.3), flow through treatment control BMPs may be used to treat the DCV in combination with Alternative Compliance requirements for the pollutant load in the portion of the DCV not reliably retained on site (Section 2.7).

A PDP may optionally achieve pollutant control compliance via Alternative Compliance in combination with the use of flow-through treatment control BMPs[1]. This approach does not require an evaluation of infiltration feasibility within the project site. Pathways for participating in Alternative Compliance are presented in Figure 2-1. The Regional MS4 Permit Provision E.3.c(3)(a)-(e) specifies requirements for Alternative Compliance options, including the use of approved Water Quality Equivalency calculations, WMAA Candidate Projects, and Project Applicant-Proposed Alternative Compliance Projects. The Regional MS4 Permit also specifies requirements for development and implementation of an In-Lieu Fee Structure and a Water Quality Credit System for transfer, accounting, and verification of fees and credits for Alternative Compliance Projects. These options are described further in Section 2.7.

[1] It is possible that the same off-site BMP could serve as alternative compliance and also meet flow-through pollutant treatment requirements prior to discharge to a receiving water if it is located downstream of the PDP and upstream of the receiving water (see Section 2.7.4)

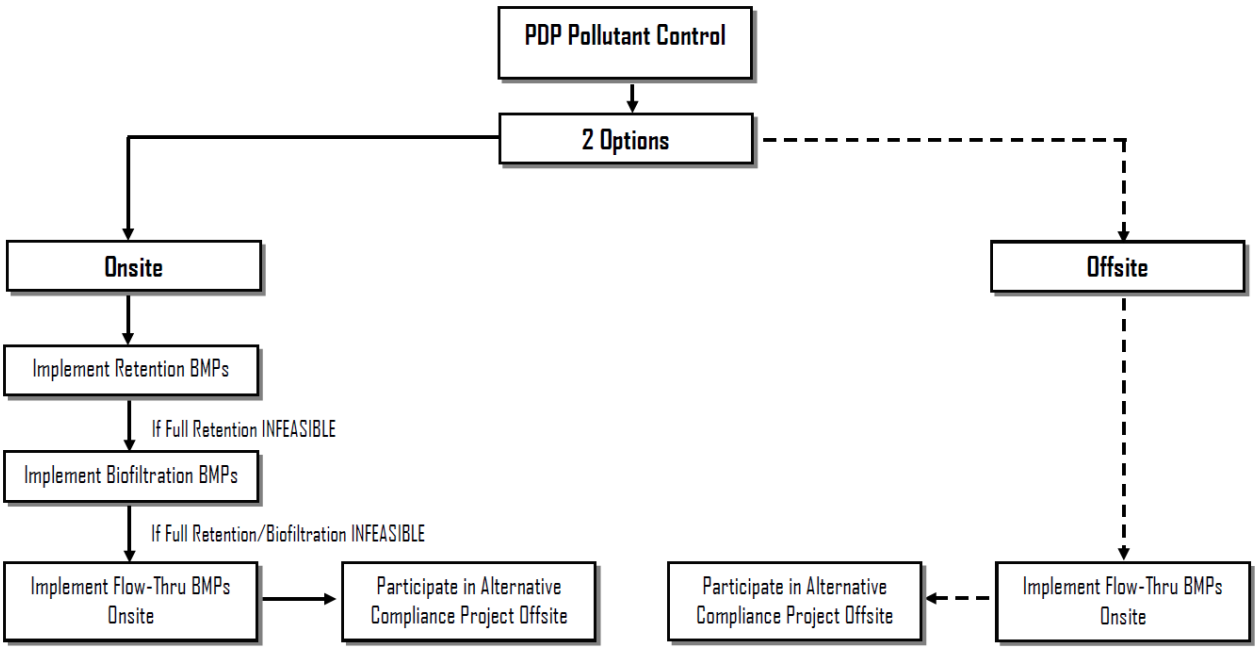


Figure 2-1. Pathways to participating in Alternative Compliance

LID BMP types and prioritization are summarized in Table 2–3. Feasibility criteria are included in Section 2.3.3.

Further detail about design of LID BMPs is presented in BMP fact sheets for each of the listed BMPs (LID Design Handbook).

Table 2–3. BMP category summary.

BMP Category	BMP Types with Fact Sheets	BMP Sizing Standard for Pollutant Control[1]	Alternative Compliance also Required?
Priority 1: Full Retention BMPs	• Infiltration Basin • Infiltration Trench • Permeable Pavement • Bioretention	Retain 100% of DCV	No
Priority 2: Biofiltration	• Biofiltration with Partial Infiltration • Biofiltration with No Infiltration • Proprietary Biofiltration meeting Acceptance Criteria	Have a static storage volume equal to 0.75 x DCV not retained on site (may not account for routing) **OR** Treat 1.5 x DCV not retained on site with a volume-based or flow-based design (may account for routing) **AND** Design BMP to maximize incidental volume reduction and select applicable and feasible LID Principles to maximize runoff volume reduction	No
Priority 3: Flow-Through Treatment Control	• Extended Detention Basin • Sand Filter Basin • Proprietary Flow-Through Treatment Control BMPs meeting Acceptance Criteria	Filter or treat the maximum flow rate of runoff from a 0.2"/hour storm **OR** Filter or treat twice the maximum flow rate from the 85th percentile storm	Yes, for portion of pollutant load in the DCV not removed/ retained on site.

2.3.3. Infiltration Feasibility Criteria

In some areas of Riverside County, soils are sandy and will support Infiltration BMPs. However, there are several factors that affect their feasibility that must be considered before utilizing such BMPs. Some of these factors may also apply to Biofiltration with Partial Infiltration BMPs that infiltrate a portion of the DCV. Additionally, some of the factors will require a licensed Geotechnical Engineer to verify, as identified in the sub-sections below.

2.3.3.a) Downstream Impacts

If it is demonstrated that infiltrating the DCV would negatively impact downstream water rights or other Beneficial Uses, Infiltration BMPs shall not be used. Likewise, Biofiltration BMPs may need to be designed to prevent infiltration (i.e. Biofiltration with No Infiltration) under such circumstances. Such a condition must be

substantiated by sufficient modeling to demonstrate an impact and would be subject to the City of Wildomar's discretion. There is not a standardized method for assessing this criterion. Water rights evaluations should be site-specific.

2.3.3.b) Groundwater Protection

The following restrictions on the use of centralized Infiltration BMPs are identified to ensure that BMPs do not cause or contribute to an exceedance of groundwater quality objectives. These restrictions primarily apply to centralized BMPs with limited soil treatment process (e.g., infiltration basins, infiltration trenches). They do not apply to small infiltration or biofiltration systems dispersed throughout a PDP.

- Infiltration BMPs must not be used in industrial areas, and other high threat to water quality land uses and activities unless runoff is first treated or filtered to remove Pollutants prior to infiltration. Bioretention soil media (BSM) will typically be sufficient to remove most pollutants from industrial land uses so Bioretention BMPs and Biofiltration with Partial Infiltration BMPs can be used in industrial areas. Stormwater shall not be infiltrated from active industrial process areas.

- The seasonal high groundwater mark must be at least 10 feet below the infiltration surface of the Infiltration BMP. This may be assessed via regional maps, groundwater monitoring, and/or soil redoximorphic classification subject to the discretion of the City of Wildomar. Assessments shall be conducted by a qualified professional.

- Infiltration BMPs must be located a minimum of 100 feet horizontally from any water supply wells.

- No part of an Infiltration BMP should be within a 2:1 (horizontal: vertical) influence line extending from any septic leach line.

- Infiltration BMPs must not be located in soils that, according to a licensed Geotechnical Engineer, Hydrogeologist, or Environmental Engineer, do not have adequate physical and chemical characteristics (such as appropriate cation exchange capacity, organic content, clay content, and infiltration rate) for the protection of groundwater. Treatment provided in amended media layers in the BMP should be considered in evaluating this factor.

2.3.3.c) Public Safety and Offsite Impacts

Neither Infiltration BMPs nor Biofiltration with Partial Infiltration BMPs should be used in locations or in soils that may create a public safety or structural concern, such as but not limited to slope or structural instability, landslides, mudslides, liquefaction, seeps, adjacent to building foundations, or other geotechnical concerns. Such a determination must be in accordance with the recommendations of a licensed Geotechnical Engineer.

2.3.3.d) Infiltration Characteristics for LID BMPs

Infiltration BMPs require a high level of confidence in long-term infiltration characteristics of underlying soils. Adequate long-term infiltration capacity is the determining factor as to whether an Infiltration BMP will be effective for the protection of Receiving Water quality, because lower than expected or diminished underlying soil infiltration rates can cause significantly greater bypass of untreated runoff and/or nuisance conditions caused by extended standing water.

"In-Situ" tested infiltration rates (i.e., the Saturated Hydraulic Conductivity) can vary widely both spatially and temporally within a project site. It is not uncommon to find that tested infiltration rates vary be an order of magnitude between tests conducted feet apart– even within the same BMP footprint. Additionally, infiltration rates can be reduced after construction of the project (compared to exploratory/feasibility testing performed before construction) due to grading, cut and fill conditions, unintentional or planned compaction, and other construction phase activities. Infiltration rates usually further degrade over time due to clogging of the native soils or amended media.

If the actual long-term infiltration rates within the BMP are too low, excessive ponding may occur, which may result in negative effects:

1) Mosquitoes and other vectors may begin breeding;
2) Public safety could be jeopardized; and
3) Runoff from subsequent rainfall events may bypass the BMP, resulting in untreated runoff being discharged from the site and potential impacts to receiving waterbodies.

To avoid creation of these conditions, a maximum Drawdown Time of 72 hours has been established. To ensure that over the life of the BMP the actual Drawdown Time does not exceed 72 hours, and based on the maximum typical infiltration basin design depth of five (5) feet, the minimum long-term post-development

infiltration rate must be at least 0.83 inch per hour (5ft * 12/72 hours = 0.83 inch/hour).

Accordingly, infiltration rate estimation is an important component of initial BMP feasibility screening and BMP design. Appendix A of the LID BMP Design Handbook (Exhibit C) details infiltration testing methods.

Factors of safety are applied to measured infiltration rates to generate "Factored Infiltration Rates" during both the feasibility screening phase and design phase. The Factored Infiltration Rate for any potential BMP location is equal to the average measured rate divided by the appropriate factor of safety.

For feasibility screening, the City of Wildomar will check that the factor of safety is reasonable and will evaluate whether an excessive factor of safety is being used to account for other factors, such as deficient investigation or lack of pre-treatment. An excessive factor of safety could result in a feasible infiltration or partial infiltration opportunity being inappropriately excluded from consideration. The City of Wildomar may allow a factor of safety as low as 1.0 for infiltration feasibility screening on a case-by case basis. The factor of safety used for infiltration feasibility screening may be lower than the factor of safety used for design. The LID Design Handbook specifies appropriate factors of safety for design (typically 3.0).

Because Infiltration BMPs that are designed to infiltrate the entire DCV are highly sensitive to underlying soil infiltration rates, they are generally applicable only in soils with factored infiltration rates greater than 0.8 inches per hour.

When infiltration characteristics are not suitable for full infiltration, Biofiltration BMPs can still be designed to promote volume reduction without relying solely on infiltration to manage pollutants in runoff. Under the Regional MS4 Permit, Biofiltration BMPs must be designed to maximize stormwater pollutant retention. In soils with factored infiltration rates between 0.1 and 0.8 inches per hour Biofiltration BMPs should be designed to maximize infiltration into underlying soils. In soils with infiltration rates below 0.1 inches per hour volume reduction via infiltration is minimal, so Biofiltration BMPs need not be designed to maximize infiltration.

A summary of applicable LID BMPs for different soil infiltration rate ranges is presented in Table 2–4.

Table 2–4. Soil Infiltration Rates for Screening Level BMP Applicability

Factored Infiltration Rate (inches per hour)	Potential LID BMPs	BMP Design Requirements
> 0.8 in/hr	Bioretention Infiltration Basin Infiltration Trench Pervious Pavement	Fully retain the DCV without surface discharge
0.1 – 0.8 in/hr	Biofiltration with Partial Infiltration Proprietary Biofiltration with Supplemental Volume Reduction	Meet biofiltration sizing requirements and be designed to maximize infiltration.
< 0.1 in/hr	Biofiltration with No Infiltration Proprietary Biofiltration	Meet biofiltration sizing requirements and maximize volume reduction via ET and applicable and feasible LID principles.

If a project meets the criteria in Table 2–5, **and** the project is underlain with Hydrologic Soils Group (HSG) “C” or "D" soils according to available regional soils maps, and no available data for the site is conflicting with such a designation, 'in-situ' testing of infiltration rates may not be required, at the discretion of the Copermittee. In this case, LID Infiltration BMPs cannot be used, but incidental infiltration may still be possible in biofiltration BMPs, unless it is documented that infiltration would cause other problems. If infiltration BMPs are selected, then the design of infiltration BMPs should be supported by site-specific testing regardless of project size.

Table 2–5: Project Criteria to Rely on Regional Soils Maps for Infiltration Rate Evaluation

Residential	Commercial, Institutional	Industrial
Less than 10 acres and less than 30 DU	Less than 5 acres and less than 50,000 SF Impervious	Less than 2 acres and less than 20,000 SF Impervious

2.3.3.e) Cut / Fill Conditions

The soil beneath Infiltration BMPs must be thoroughly evaluated in a geotechnical report since such BMPs are reliant solely on the infiltration rates of the underlying soils for their long-term performance. Because of this, the project proponent must be able to perform tests on the actual soils that will exist at the infiltration surface. It is impossible to test the infiltration rate of an engineered fill that does not yet

exist. As such, Infiltration BMPs would be prohibited if the planned fill was so deep that the bottom of the BMP could not extend down through the fill and into the native soils. A similar situation exists for those areas that will be significantly excavated as part of the site grading process, and the testing cannot be performed at the future cut elevation. If there is no practicable way to verify infiltration rates at the final BMP infiltration surface, Infiltration BMPs may not be used. In such situations Biofiltration with Partial Infiltration should be used to maximize infiltration into future fill materials unless geotechnical or other factors preclude any level of infiltration. If infiltration testing is completed after fill placement and indicates that factored infiltration rates are less than 0.1 inches per hour (as detailed in Table 2–4) a PDP may still use Biofiltration with No Infiltration to comply with water quality requirements.

The presence of fill on a project site does not automatically preclude infiltration everywhere on the site. Infiltration BMPs may still be applicable for DMAs in other parts of a project site where cut/fill is less and where infiltration testing is feasible. Each DMA on a project site should be assessed for infiltration feasibility independently.

2.3.3.f) Other Site-Specific Factors

If the geotechnical investigation performed by a licensed engineer discovers other site-specific factors that would preclude effective and/or safe infiltration, such as, but not limited to, clay lenses, restrictive layers, or soils prone to liquefaction, Infiltration BMPs are not required in those areas. Biofiltration BMPs may still be applicable in such areas. If such factors preclude infiltration of any amount of runoff, a PDP may use Biofiltration with No Infiltration to comply with water quality requirements.

2.3.3.g) Adaptable Design Features and Construction/Post Construction Design Adjustments

Estimates of infiltration rates prior to construction tend to be uncertain in describing long-term full-scale infiltration. This can be especially significant for design decisions if there will be substantial excavation and/or the factored infiltration rates are only slightly above 0.8 inches per hour (i.e. up to approximately 2 inches per hour measured). After construction, there are limited opportunities to improve the rate of infiltration. For a BMP that relies solely on infiltration, this uncertainty can span the difference between success and failure.

In these cases, adaptable or resilient design features should be considered. Adaptable design features are design elements that can be constructed as part of

the original project that would allow simple adaptation of the BMP (**with applicable jurisdiction approval**) in the event of inadequate infiltration rates. Examples include installation of underdrains within bioretention BMPs that are originally capped but can be activated (**with applicable approval process**) if infiltration is less than expected, such that the system would be converted to biofiltration with partial infiltration.

For this option to be acceptable, the following conditions must be met:

1) The BMP must be categorized as an infiltration BMP for the Project-Specific WQMP preparation. The Project-Specific WQMP must demonstrate that the BMP will meet applicable standards without any discharge through the underdrain.

2) The Project-Specific WQMP must also demonstrate that the BMP would meet the biofiltration sizing standards (and hydromodification flow control standard, if applicable) with the underdrain uncapped. These sizing calculations must also be documented in the Project-Specific WQMP.

3) The underdrain must remain capped. This aspect of O&M inspection must be clearly defined in the O&M Plan. Inspections conducted as part of the O&M Plan must corroborate that the underdrain remains capped.

4) If conditions are identified that require the underdrain to be uncapped to allow the BMP to be enlarged or otherwise modified to remedy the documented unacceptable performance, then the process for implementing this change must include:

    a. Documentation of the conditions that prompt and justify the require design revision. This could include construction-phase infiltration testing, observations of extended standing water following construction, etc. This must be accepted by the City of Wildomar.

    b. Revision of the Project-Specific WQMP to reflect the changed design. Sizing calculations provided within the original Project-Specific WQMP will have already verified adequate sizing for the uncapped condition.

    c. Jurisdictional review, approval, and recordation of the revised Project Specific WQMP with commensurate updates to the O&M Plan.

See Section 5.3.6 for guidance on Project-Specific WQMP updates. Note that this is the same process that would be required to wholly redesign and reconstruct an underperforming BMP. However, if adaptable design features are included, the

actual physical change could be limited to uncapping the underdrain if the size is already adequate to meet biofiltration sizing requirements.

2.3.4. Feasibility of Other LID BMPs

Experience has shown implementation of LID BMPs, such as Bioretention and/or Biofiltration is feasible on nearly all PDP sites with sufficient advance planning. Projects where LID Bioretention and/or Biofiltration BMPs may not always be feasible generally fall into one of the following two categories:

- Portions of sites which are not being developed or redeveloped, but which must be retrofitted in accordance with the "50% rule" for redevelopment projects (1.1.1.b). For example, if site-specific conditions preclude draining existing impervious surfaces on the newly developed portion of the site – and if the existing impervious surfaces cannot be otherwise retrofitted with other LID BMPs.

- Sites smaller than one acre approved for lot-line to lot-line development or redevelopment as part of pedestrian-oriented "smart-growth" type of urban design. For many scenarios, LID Biofiltration BMP options such as planters or proprietary Biofiltration BMPs will be feasible.

If you believe specific conditions on your site preclude the use of LID BMPs, you must submit, in the Project-Specific WQMP, a detailed site-specific examination and demonstration that implementation of LID BMPs is technically infeasible. Note that using flow-through treatment BMPs will also trigger the need to participate in Alternative Compliance.

2.3.5. Expectations for Documenting Infiltration Feasibility and Site Design Considerations

Most LID BMPs can be fit within planned landscaped areas of a project with proper planning and site and grading/drainage optimization. Additionally, early consideration of soil conditions and site design should be conducted as part of evaluating infiltration feasibility to help maximize opportunities for feasible infiltration and partial infiltration BMPs. As part of meeting the requirements of this WQMP, the Project-Specific WQMP should provide transparent and robust documentation of how these factors were considered.

This section clarifies expectations for documenting infiltration feasibility and site design considerations. This is based on the clarification letter titled “San Diego Water Board’s Expectations of Documentation to Support a Determination of Priority Development Project Infiltration Infeasibility” (April 28, 2017, Via email from San

Diego Regional Water Quality Control Board to San Diego County Municipal Storm Water Copermittees[1]). Key elements of this letter include:

- Initiate infiltration feasibility investigations as early in the project entitlement process as possible. This is consistent with the approaches described in this WQMP.
- A systematic approach should be used to evaluate infiltration feasibility. This WQMP describes a systematic approach.
- The systematic approach should create a robust transparent record supporting the determinations associated with infiltration feasibility. The Project-Specific WQMP should document:
    - When in the entitlement process did a geotechnical engineer analyze the site for infiltration feasibility,
    - Other investigations conducted (e.g., groundwater quality, water rights) to evaluate infiltration feasibility.
    - Scope and results of testing, if conducted, or rationale for why testing was not needed to reach findings,
    - Public health and safety requirements that affect infiltration locations,
    - And conclusions and recommendations of the geotechnical engineer and/or other professional responsible for other investigations.
- The record should also include a detailed narrative of site design considerations and discussions between the applicant and the jurisdiction reviewer related to potential infiltration locations. The Project-Specific WQMP should include:
    - The development status of the project site prior to the project application (i.e., new development with raw ungraded land, development on existing graded conditions, redevelopment of existing development);
    - History of design discussions for the proposed project, resulting in the final design determination;
    - Consideration of the site design alternatives to achieve infiltration or partial infiltration on site;

[1] http://www.projectcleanwater.org/download/pdp-infiltration-infeasibility/

  - Physical impairments (i.e., fire road egress, public safety considerations, utilities) and public safety concerns; and
  - The extent of LID Principles (site design BMPs) included in the project site design.

- This record of investigations, communication, and consideration is an important part of supporting BMP selection when a project will infiltrate less than the full DCV. This record should be included in the Project-Specific WQMP.

2.3.6. Approval Requirements for Proprietary BMPs

Proprietary BMPS may be used to comply with pollutant control requirements under certain circumstances if they meet the requirements in this section of the WQMP. Proprietary BMPs may be implemented as Biofiltration and Flow-Through Treatment Control BMPs, depending on the characteristics of the proprietary device.

Approval for a given Proprietary BMP is as follows:

1. The Project WQMP must adequately demonstrate that it is appropriate to use a proprietary BMP in the intended role. This shall be done per the BMP selection and design process described in Sections 2.3 and 3.4 of this WQMP. For example, if a DMA can fully or partially infiltrate stormwater, then it would be unacceptable to circumvent this infiltration feasibility through the use of a proprietary BMP that does not achieve the feasible level of infiltration.

2. The selected proprietary BMP must have adequate certifications or field-scale third party performance demonstration to serve the intended role. The performance standards for determining adequacy are based on the Washington State Technology Acceptance Protocol-Ecology (WA TAPE). Only BMPs with General Use Level Designation (GULD), or equivalent performance, for a treatment category that is appropriate for the identified BMP role will be considered valid. Specifically, a Proprietary BMP must have Washington TAPE GULD, or equivalent third party demonstrated performance, for any Primary Pollutants of Concern for a given PDP (see Section 2.2.4). Because the Washington TAPE program uses different pollutant treatment categories than this WQMP, Table 2–6 should be used to identify Washington TAPE Treatment Categories needed to provide treatment for any Primary Pollutants of Concern.

Table 2–6. Washington TAPE GULD Treatment Categories for Primary Pollutants of Concern.

Primary Pollutants of Concern	Acceptable Washington TAPE GULD Treatment Category
Trash	Pretreatment, Basic Treatment, Phosphorus Treatment, or Enhanced Treatment
Sediments	Basic Treatment, Phosphorus Treatment, or Enhanced Treatment
Oil and Grease	Basic Treatment, Oil Treatment, Phosphorus Treatment, or Enhanced Treatment
Nutrients	Phosphorus Treatment[1]
Metals	Enhanced Treatment
Pesticides and Herbicides	Basic Treatment[2], Phosphorus Treatment[2], or Enhanced Treatment[2]
Other Organics	Basic Treatment, Phosphorus Treatment, or Enhanced Treatment
Bacteria and Viruses	Basic Treatment[3], Phosphorus Treatment[3], or Enhanced Treatment[3]

[1] There is no TAPE equivalent for nitrogen compounds; however, systems that are designed to retain phosphorus (as well as meet basic treatment designation), generally also provide treatment of nitrogen compounds. Where nitrogen is a pollutant of concern, relative performance of available certified systems for nitrogen removal should be considered in BMP selection.

[2] Pesticides, organics, and oxygen demanding substances are typically addressed by particle filtration; if a system does not provide filtration, it is not acceptable for pesticides, organics or oxygen demanding substances.

[3] There is no TAPE equivalent for pathogens (viruses and bacteria), and testing data are limited because of typical sample hold times. Systems with any GULD must also include one or more significant bacteria removal process such as media filtration, physical sorption, predation, reduced redox conditions, and/or solar inactivation.

3. The BMP must be used in a manner consistent with manufacturer guidelines and conditions of its third-party certification. Practically, this means that the BMP is used in the same way in which it was tested and certified. For example, it is not acceptable for a BMP of a given size to be certified/verified with a 100 gallon per minute treatment rate and be applied at a 150 gallon per minute treatment rate in a design. Certifications or verifications issued by the Washington TAPE program are typically accompanied by a set of guidelines regarding appropriate design and maintenance conditions that would be consistent with the certification/verification. It is common for these approvals to specify the specific model of BMP, design capacity for given unit sizes, type of media that is the basis for approval, and/or other parameters. The applicant must demonstrate conclusively that the proposed application of the BMP is consistent with these criteria.

4. The acceptability of any proprietary BMP is ultimately at the discretion of the City of Wildomar. In addition to demonstrated performance, the City of Wildomar may consider other factors such as the ability to inspect the BMP

and determine the need for maintenance, the ability to maintain the system with available equipment and staff, the ability to procure a replacement BMP in a similar footprint should a vendor no longer be in business at the time of required replacement, relevant local experience with operation and maintenance of the BMP, and other potential factors. If a proprietary BMP is rejected, the basis for rejection will be provided to the applicant.

2.3.6.a) Proprietary Biofiltration BMPs

Proprietary Biofiltration BMPs may be used as LID BMPs to comply with pollutant control requirements under the following conditions:

- To be considered Biofiltration, a Proprietary BMP must include biological features including vegetation supported by engineered or other growing media, or other viable biological and filtration processes acceptable to the City of Wildomar.
- Proprietary Biofiltration BMPs must be sized according to one of the two methods for sizing LID Biofiltration BMPs presented in Section 2.3.2.
- To qualify as LID Biofiltration BMPs, Proprietary BMPs must be designed to maximize infiltration according to the same set of requirements that apply to typical LID Biofiltration BMPs. Specifically, if Proprietary BMPs are used in soils with factored infiltration between 0.1 and 0.8 inches per hour they may be required to incorporate supplemental infiltration to achieve comparable retention to Biofiltration with Partial Infiltration BMPs.

2.3.6.b) Proprietary Flow-Through Treatment Control BMPs

Proprietary Flow-Through Treatment Control BMPs may be used in situations that would allow implementation of typical Flow-Through Treatment Control BMPs (see Sections 2.3.2 and 5.3.1). These BMPs are not required to meet the definition for Biofiltration. They must be sized according to applicable standards for pollutant control.

2.4. HYDROMODIFICATION

As land converts from natural land covers to developed land covers, runoff discharge rates, velocities, and durations, and the delivery of Bed Sediment Supply (also referred to as “Critical Coarse Sediment”) from PDPs to the Receiving Waters may be altered. The alteration of both hydrology and sediment transport regimes may cause erosion or aggradation to channels. Where this occurs, this phenomenon is referred to as Hydromodification.

The Regional MS4 Permit specifies Hydromodification Performance Standards, including:

- **Hydrologic Performance Standards** include requirements to controls flow and duration of discharge from PDPs within ranges that that can increase erosion in receiving waters, and

- **Sediment Supply Standards require PDPs to** avoid critical coarse sediment yield areas or implement measures that allow critical coarse sediment to be discharged to receiving waters, such that there is no net impact to the receiving water.

These requirements apply to all PDPs except those exempted from Hydromodification Performance Standards per Section 2.4.1.

2.4.1. Hydromodification Applicability and Exemptions

PDPs located in specific areas may be exempted from all Hydromodification Performance Standards. These areas include PDPs that discharge stormwater runoff to:

- Existing storm drains that discharge directly to water storage reservoirs, lakes, or enclosed embayments. (this exemption is not dependent on WMAA approval)

- Conveyance channels whose bed and bank are concrete lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean. (this exemption is not dependent on WMAA approval)

- Additional areas identified in an approved WMAA. **PLACEHOLDER** *(At the time of preparation of this WQMP, the draft WMAA was still under review by the San Diego Regional Board. Once accepted, this WQMP will be revised to incorporate the relevant information regarding Candidate Projects, the CCSY map(s), and any applicable Hydromodification Exemptions. Interim note: Until the WMA is accepted, the proposed hydromodification exemptions identified in the WMAA are not applicable.)*

A list of proposed hydromodification exempt areas can be found in the SMR WMAA which can be accessed via the SMR Regional Clearinghouse Site[1].

[1] http://rcflood.org/NPDES/SantaMargaritaWS.aspx

2.4.2. Hydrologic Performance Standard and Design Approaches

2.4.2.a) Hydrologic Performance Standard

The Hydrologic Performance Standard specified in the MS4 Permit is:

> *Each Copermittee must require each Priority Development Project to implement onsite BMPs to manage hydromodification that may be caused by storm water runoff discharged from a project as follows: Post-project runoff conditions (flow rates and durations) must not exceed pre-development (naturally occurring) runoff conditions by more than 10 percent (for the range of flows that result in increased potential for erosion, or degraded instream habitat downstream of PDPs).*

The applicable "range of flows" in the SMR Region[1] is:

> *10% of the 2-year return interval runoff event (Q2) to the 10-year return interval runoff event (Q10)*

Conformance with this flow standard must be documented by continuous simulation modeling of the naturally occurring condition and the post-project conditions.

Site specific analysis may be used to support Jurisdiction acceptance of different low flow threshold for a specific receiving water based on the specific methods identified in Section 2.6.2 of this WQMP.

2.4.2.b) Hydrologic Performance Standard Design Approach

Hydrologic Performance Standards are separate from, but overlap with, pollutant control requirements of the Regional MS4 Permit. The LID Design process will help to avoid potential hydromodification impacts from a PDP but may not result in full compliance with the Hydrologic Performance Standards. There are four general approaches for complying with both LID and Hydrologic Performance Standards. These approaches are summarized in Table 2–7 and presented in the following subsections.

[1] A hydrologic evaluation conducted as part of the 2014 HMP determined the applicable "range of flows expected to result in increased potential for erosion or degraded instream habitat downstream of PDPs" for the SMR Region.

Table 2–7. Design and Sizing Approaches for Hydromodification Hydrologic Performance Standards

Sizing and Design Approach		Favorable Conditions for Such an Approach
1	Demonstrate that LID BMPs also comply with Hydromodification Hydrologic Performance Standards	This approach is typically only feasible in areas with highly permeable soils and low impervious cover. Most of the time compliance with Hydrologic Performance Standards will require that BMPs are sized larger than required for LID compliance.
2	Provide supplemental infiltration or flow duration control within combined LID / Hydromodification Control facilities	Where the allowable release rates for flow duration control do not conflict with drawdown times of LID (i.e., water ponded for too long) or require orifice sizes that are too small to maintain. Where space allows for enlargement of combined LID/hydromodification control facilities.
3	Provide separate LID and Hydromodification Control BMPs	Where it is not practicable or not preferable to design facilities with combined purposes. Where hydromodification storage needs to be below ground due to space constraints.
4	Alternative Compliance	Where it is desirable to utilize Alternative Compliance approaches, if such approaches exist for hydromodification hydrologic control standards. Note: alternative compliance is not acceptable for coarse sediment standards (See Section 2.4.4).

- **Approach 1: Demonstrate that LID BMPs comply with Hydromodification Performance Standards.** This option involves no changes to the design of LID BMPs. However, it involves conducting separate hydrologic analyses of these systems using the SMRHM to demonstrate that the systems meet Hydrologic Performance Standards. This option could also involve minor changes to the outlet control of these systems, if LID sizing and design criteria are still demonstrated to be met after these modifications.

- **Approach 2: Provide Supplemental Infiltration or Flow Duration Control within Combined Facilities.** This option could involve increasing the footprint of LID facilities, adding storage compartments above or below LID storage compartments, and/or incorporating multiple-stage outlet structures so that systems conform to both LID and Hydrologic Performance Standards. It is critical that this integration does not compromise LID treatment performance or design requirements which are presented in the LID Design Handbook (Exhibit C).

  Meeting flow duration and LID criteria using the same BMPs is inherently an iterative process. A suggested design approach is to:

- Use the SMRHM (or alternative continuous simulation model accepted by the local jurisdiction) to determine the overall sizing and flow control parameters needed to conform with flow duration control criteria. How large of a volume is needed? How fast can low flows be released? What is the drawdown time from various points in the facility?

- Determine if there is space to simply increase the LID footprint, maintaining a standard LID depth profile, to provide the required volume for flow duration control. Check that drawdown times do not violate LID design standards.

- If not, determine if there is an opportunity to provide the overall required volume using an adapted profile such as adding detention below the LID BMP such that extended detention could be provided without extended surface ponding.

- Conduct flow duration and LID sizing checks on the combined system to demonstrate that both standards are met.

- **Approach 3: Provide Separate LID and Flow Control BMPs.** This option involves designing separate BMPs for complying with LID and Hydromodification Performance Standards. These systems may be designed at the same scale (e.g., both for the same DMA, but not integrated), or at different scales (e.g., LID at the DMA scale and flow duration control at the point of compliance). Using this approach, LID BMPs would be sized to comply with LID standards but Hydromodification Hydrologic Control BMPs would be sized to comply with Hydromodification Performance Standards which would be demonstrated using the SMRHM or other accepted continuous simulation model.

- **Approach 4: Alternative Compliance.** This option consists of using the Alternative Compliance pathway detailed in Section 2.7. As detailed in Section 2.7, this option may not always be available.

2.4.3. Hydromodification Hydrologic Control BMPs

Hydromodification Hydrologic Control BMPs are those BMPs that can be used to manage hydromodification effects to comply with Hydrologic Performance Standards. These include LID BMPs and other BMPs that do not serve a water quality function but are instead intended solely to manage hydromodification impacts.

2.4.3.a) On-Site / Distributed Controls

This type of BMP refers to LID BMPs that have been specifically sized and designed to meet applicable hydromodification control criteria. The design criteria applicable to the LID of interest, as described in BMP fact sheets in the LID BMP Design Handbook (Exhibit C) still apply even if the LID BMP is also used for hydromodification control. Deviations within the ranges allowed for LID design are acceptable.

2.4.3.b) Combination Basins

Combination basins refers to extended detention basins that have other LID BMPs incorporated into the floor of the basin. Under typical conditions, the LID BMP (of whatever type) in the floor of the basin operates as if it were located in any other location. Under storm events that are more critical for meeting Hydrologic Performance Standards, the ponding depth in the basin would exceed the LID storage volume and fill or partly fill the detention storage volume. Where this occurs infrequently and appropriate design approaches are followed, these two functions can coexist within a single facility. The use of combination basins is at the discretion of the City of Wildomar.

2.4.3.c) Flow Control Vaults, Basins, and Cisterns

Flow control vaults, basins, and cisterns are BMPs that do not typically serve a water quality purpose. A full suite of such BMPs is included in the SMRHM User's Manual (Exhibit F). These BMPs may be above or below ground and should be designed to:

- Meet hydraulic flow control objectives applicable to the PDP,
- Avoid nuisance conditions such as excessive standing water,
- Avoid public safety issues, and
- Facilitate inspection and maintenance.

2.4.4. Hydromodification Sediment Supply Standards and Compliance Pathways

Hydromodification Sediment Supply Standards require that PDPs must either avoid Critical Coarse Sediment Yield Areas or implement Sediment Supply BMPs that allow critical coarse sediment to be discharged such that there is no net impact to receiving waters as a result of changes in critical coarse sediment supply. Potential Critical Coarse Sediment Yield Areas known to the Copermittees and Potential Sediment Source Areas are shown in Exhibit G of this WQMP. PDPs located in Potential Critical

Coarse Sediment Yield Areas or Potential Sediment Source Areas identified in Exhibit G must conduct a site-specific analysis to determine and avoid impacts to actual verified Critical Coarse Sediment Yield Areas within a given site (Section 3.6.4). In addition, PDPs which propose to discharge to the Santa Margarita Ecological Reserve identified in Exhibit G must conduct a site-specific analysis to ensure that the project will have no net impact to that reach of the Santa Margarita River.

There are three general approaches for complying with the requirements for critical coarse sediment supply which are presented in Table 2–8 and in the following subsections.

Table 2–8. Compliance Approaches for Hydromodification Sediment Supply Standards

Compliance Approach		Favorable Conditions for Such an Approach
1	Avoid development of Potential Critical Coarse Sediment Yield Areas	This approach is applicable for PDPs that do not include Potential Critical Coarse Sediment Yield Areas or for PDPs that can avoid disturbing these areas.
2	Avoid development of Critical Coarse Sediment Yield Areas identified in site-specific analysis	This approach involves completing a site-specific analysis to determine actual verified Critical Coarse Sediment Yield Areas and avoiding development of these areas.
3	Implement sediment supply BMPs such that there is no net impact of development to Critical Coarse Sediment supply to receiving waters	This approach is applicable for PDPs that cannot reasonably avoid impacts to Critical Coarse Sediment Yield Areas but can implement measures that allow critical coarse sediment to be discharged to receiving waters, to ensure that there is no net impact to the receiving water. Alternative compliance for impacts to Critical Coarse Sediment Yield Areas is not acceptable.

2.4.4.a) Approach 1: Avoid Development of Potential CCSY Areas

This approach requires that PDPs avoid areas that are identified as Potential Critical Coarse Sediment Yield Areas known to the Copermittees, or Potential Sediment Source Areas as identified in Exhibit G. If a portion of a site is within an area identified as a Potential Critical Coarse Sediment Yield Area or a Potential Sediment Source Area, a PDP may still achieve compliance with Sediment Supply Standards by avoiding development of those portions of the site identified as Potential Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas, and maintaining pathways for coarse sediment to continue to be discharged to receiving waters.

2.4.4.b) Approach 2: Avoid Development of Critical Coarse Sediment Yield Areas Identified by Site-Specific Analysis

If PDPs cannot avoid development of Potential Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas, a site-specific analysis is required to identify and avoid development of those areas that are actual verified Critical Coarse Sediment Yield Areas, and maintain pathways for coarse sediment to continue to be discharged to receiving waters. These areas must be determined by site-specific analysis as detailed in Section 3.6.4.

2.4.4.c) Approach 3: Implement Sediment Supply BMPs to Prevent Net Impacts for Coarse Sediment to Receiving Waters

If PDPs cannot reasonably avoid development of actual verified Critical Coarse Sediment Yield Areas, sediment supply BMPs must be used to allow critical coarse sediment to be discharged to receiving waters, such that there is no net impact to the receiving water. This approach must be supported with a site-specific analysis conducted by appropriate and qualified professionals. Acceptance of this approach is at the discretion of the City of Wildomar. Alternative compliance for impacts to actual verified Critical Coarse Sediment Yield Areas is not acceptable.

2.5. FULL TRASH CAPTURE

The City of Wildomar may require PDPs to comply with the trash capture requirements in this section. PDP project proponents should contact the City of Wildomar to determine if provisions in this section are applicable.

Compliance with the California Statewide Trash Amendments and San Diego Regional Water Board Order No. R9-2017-0077, SMR MS4 Copermittees are required to comply with narrative objectives for trash and a prohibition on the discharge of trash to surface waters of the State. Compliance with Order No. R9-2017-0077 will require that Copermittees implement full trash capture devices or equivalent control measures for priority land uses. These provisions are expected to be included in the Regional MS4 Permit when it is reissued. More information about statewide and regional implementation of the Statewide Trash Amendments can be found on the State Water

Resources Control Board Trash Implementation Website[1] and on the San Diego Regional Board Trash Amendments Website[2].

2.5.1. Trash Capture Priority Land Uses

Full trash capture requirements will apply to "priority land uses." The following are listed as Priority land uses under Trash Capture Amendments:

- High-density residential: all land uses with at least ten (10) developed dwelling units/acre.
- Industrial: land uses where the primary activities on the developed parcels involve product manufacture, storage, or distribution (e.g., manufacturing businesses, warehouses, equipment storage lots, junkyards, wholesale businesses, distribution centers, or building material sales yards).
- Commercial: land uses where the primary activities on the developed parcels involve the sale or transfer of goods or services to consumers (e.g., business or professional buildings, shops, restaurants, theaters, vehicle repair shops, etc.).
- Mixed urban: land uses where high-density residential, industrial, and/or commercial land uses predominate collectively (i.e., are intermixed).
- Public transportation stations: facilities or sites where public transit agencies' vehicles load or unload passengers or goods (e.g., bus stations and stops).

The City of Wildomar may maintain an alternative list of priority land uses.

2.5.2. Full Trash Capture BMPs

Full Trash Capture BMPs may include catch basin insert devices, in line high flow devices, and LID BMPs. Full Trash Capture Devices must be certified by the State Water Resources Control Board and for devices within the City of Wildomar right-of-way or requiring City of Wildomar maintenance, the specific State certified BMP must be approved by the City of Wildomar. These BMPs are intended to remove all particles larger than 5 mm from runoff during most storm events. For any given BMP to meet Full Trash Capture requirements, upon installation the BMP:

[1] http://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html

[2] http://www.waterboards.ca.gov/sandiego/water_issues/programs/stormwater/trash_amendments.html

- Must be sized to treat the volume of runoff produced by the region specific 1-year, 1-hour storm event (trash capture design storm – see additional detail as part of Section 2.6.3),
- Must not bypass the trash capture design storm under fully loaded conditions, and
- Must not have a diversion structure present upstream such that a portion of the design storm is not treated to trap all particles 5 mm or greater.

Fact sheets for all Certified Full Trash Capture BMPs are available from the State Water Resources Control Board Trash Implementation Website[1] and include:

- **Catch basin insert devices.** These devices consist of proprietary screen and fence devices that prevent trash from entering storm drains.
- **High Flow Capacity Trash Devices.** These trash capture devices are typically installed within, or at the discharge point, of storm drains and include hydrodynamic separators, screens, and baffle boxes.
- **Multi-Benefit Treatment Systems including LID.** Non-proprietary LID and Hydrologic Control BMPs may achieve full trash capture if they include certain design elements. Guidance to implement these design elements is available in fact sheets from the State Water Resources Control Board Trash Implementation Website. The following LID and Hydrologic Control BMPs may be designed to serve as Full Trash Capture BMPs:
  - Bioretention and Biofiltration BMPs,
  - Harvest and Use BMPs,
  - Detention Basin BMPs,
  - Infiltration Basin and Infiltration Trench BMPs, and
  - Media Filter (i.e. Sand Filter) BMPs.

  Note: These BMPs do not qualify as full trash capture if they do not meet the sizing and design criteria or are not on the list of Certified Full Trash Capture Devices found on the State Water Resources Control Board Trash Implementation Website. At the time of preparation of this Model WQMP, the

[1] http://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html

State Water Resources Control Board was still evaluating acceptable sizing and design criteria for these BMPs—project proponents are advised to verify the current accepted sizing and design specifications.

Sizing criteria for Full Trash Capture BMPs is provided in Section 2.6.3.

2.6. HYDROLOGY FOR NPDES COMPLIANCE

2.6.1. Water Quality Hydrology

Most runoff, and therefore, most of the potential for conveyance of Pollutants, is produced by frequent storms of small or moderate intensity and duration. Accordingly, Structural pollutant control BMPs (including LID) are designed to treat smaller storms and the first flush of larger storms.

2.6.1.a) Design Storm

Methods that have historically been used to determine an MEP-based and cost-effective volume of treatment involve continuous simulation of long term rainfall and corresponding runoff from a hypothetical one-acre area entering a basin designed to draw down in a specified amount of time. The simulation is iterated with varying unit basin sizes, and the results are graphed to find the point of diminishing returns (i.e., the 'knee' of the curve) where incrementally larger BMPs result in incrementally smaller benefits to treatment of runoff.

It has been found that the knee of the curve typically occurs with a basin designed for the 85th percentile 24-hour storm event. It has also been found that a basin of this size results in treating about 80% of the total long-term volume of runoff that occurs during the simulation period.

To simplify design calculations (that is, to avoid the need to perform continuous simulation for design of all BMPs), the Regional MS4 Permit has established the 85th percentile, 24-hour storm event as the "Design Capture Storm", which is the standard used in this WQMP.

An Isohyetal map showing the 85th percentile 24-hour storm depth at different locations throughout western Riverside County, based on long-term rainfall data, is provided in Exhibit A.

2.6.1.b) Composite Runoff Factor

The sizing of pollutant control BMPs (i.e. Infiltration, Biofiltration, and Flow-Through Treatment Control) begins with determination of a composite runoff factor, which represents the average fraction of precipitation that becomes runoff.

This fraction varies depending on the land use covers tributary to the BMP. This composite runoff factor, C, is determined using the following equation

$$C = 0.858 \cdot I_f{}^3 - 0.78 \cdot I_f{}^2 + 0.774 * I_f + 0.04$$

where the Impervious Fraction, I_f is obtained from Table 2–9 below.

Table 2–9: Impervious Fraction Based on Various Land Use Covers

Surface Type	Effective Impervious Fraction, I_f
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15
Natural (C Soil)	0.30
Natural (D Soil)	0.40

Where multiple surface types are present, a Composite Impervious Fraction, and therefore a Composite Runoff Factor can be calculated using the following equation:

$$I_{f_{composite}} = \frac{\left[(I_f)_1 \cdot A_1\right] + \left[(I_f)_2 \cdot A_2\right] + [\ldots]}{A_T}$$

2.6.1.c) Design Capture Volume (DCV or V_{BMP}))

The design capture volume (DCV) (also referred to as V_{BMP}) forms the basis for sizing Retention and Biofiltration BMPs. For reference, the following equations are used by the LID BMP Design Handbook:

$$\mathrm{DCV} = \mathrm{D_{85}} \cdot \mathrm{C} \cdot \mathrm{A_{TRIB}} * 3630$$

Where:

DCV = Design Capture Volume (ft^3)

> **NOTE**
> The LID BMP Design Handbook (Exhibit C) includes calculation sheets that can be used to calculate and document the '**Design Capture Volume**,' and the **Design Flow Rate**. These should be documented as described in Section 3 herein.

D_{85} = Design Storm depth (inches, from Exhibit A)

C = Composite Runoff Factor (unitless, per 2.6.1.b)

A_{TRIB} = Area tributary to the BMP (acres, see Section 3.3) (Note: this should include any tributary area from outside of the project limits that produces runoff which flows to the BMP and comingles with project site runoff.)

3630 = Conversion factor = (1 foot / 12 inches x 43,560 ft^2/acre)

To achieve pollutant control compliance, Infiltration BMPs must be sized to retain the entire DCV with a maximum drawdown period of 72 hours.

2.6.1.d) Design Flow Rate (Q_{BMP})

Flow-based Treatment Control BMPs can be sized according to the Design Flow Rate. The Design Flow Rate is calculated using the rational method and uses the following equation:

$$Q_{BMP} = C \cdot i \cdot A_{TRIB}$$

Where:

Q_{BMP} = Design Flow Rate (cfs)

i = rainfall intensity (0.2 inches/hour)

C = Composite Runoff Factor (unitless, per Section 2.6.1.b)

A_{TRIB} = area tributary to the BMP (acres, see Section 3.3) (Note: this should include any tributary area from outside of the project limits that produces runoff which flows to the BMP and comingles with project site runoff.)

Where local rainfall records are available, Q_{BMP} can also be calculated based on the maximum runoff flow rate produced by the 85^{th} percentile hourly rainfall intensity from the local historical record multiplied by 2.

2.6.1.e) Application of Design Hydrology to Biofiltration BMP Sizing

Volume-based Biofiltration BMPs must be sized to either:

- Treat 1.5 times that portion of the DCV not reliably retained on site (this can be a volume-based or flow-based design), OR

- Have a total static storage volume, including pore spaces and pre-filter detention volume, at least 0.75 times the portion of the DCV not reliably retained on site.

Stormwater volume can be considered "reliably retained" if it is estimated to infiltrate or evapotranspire within a reasonable time and is applied in conformance with infiltration feasibility criteria described in Section 2.3.3. The standard drawdown time for stored water is 72 hours.

Static storage volume refers to the volume available in ponded area and soil pores, tabulated without accounting for any storm routing.

Biofiltration BMPs must also be sized and designed to maximize retention of volume and pollutants. Specific sizing methods for Biofiltration to meet these standards are described in the applicable Fact Sheets in the LID Design Handbook (Exhibit C).

For **Flow-based Biofiltration BMPs**, the Q_{BMP} calculated per Section 2.6.1.d shall be multiplied by 1.5x to conform with the intent of the biofiltration sizing criteria above. Flow-based proprietary biofiltration BMPs may not be permitted in all cases. See Section 2.3.6 for approval requirements.

2.6.2. Hydromodification Hydrology

In addition to incorporating applicable LID BMPs to achieve pollutant control requirements, PDPs may be required to use LID Principles, additional or oversized LID BMPs, or other Structural Hydrologic Control BMPs to manage Hydromodification.

2.6.2.a) Santa Margarita Region Hydrology Model

All PDPs must use continuous simulation to ensure compliance with Hydrologic Performance Standards which require that post-project runoff flow rates and durations for the PDP do not exceed pre-development, naturally occurring, runoff flow rates and durations by more than 10% over more than 10% of the range of flows that result in increased potential for erosion. The range of flows that results in increased potential for erosion is typically considered to be 10% of the 2-year runoff event up to the 10-year runoff event.

To comply with this provision, users may use the Santa Margarita Region Hydrology Model (SMRHM) or an alternate continuous simulation model to demonstrate compliance with the Hydrologic Performance Standard. The SMRHM is an integrated flow control sizing tool that performs continuous hydrologic simulations over the entire available rainfall record. The tool allows the User to size LID BMPs

and match or reduce the flow duration curve of post-development to that of pre-existing, naturally occurring, conditions. Geomorphically significant flows that are embedded in SMRHM range from 10% of the 2-year runoff event up to the 10-year runoff event. The SMRHM is made available to Users at no cost. The SMHRM Guidance Manual is included as Exhibit F.

Alternatively, the User may opt to develop its own model using publicly-available software, which performs continuous hydrologic simulation over the available period of rainfall record. The use of a different model than SMRHM must receive prior approval from the City of Wildomar. Examples of other potential hydrologic simulation models include:

- Hydrologic Simulation Program – FORTRAN (HSPF), distributed by the United States Environmental Protection Agency
- Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS), distributed by the US Army Corps of Engineers Hydrologic Engineering Center
- Stormwater Management Model (SWMM) distributed by the United States Environmental Protection Agency
- Other models

2.6.2.b) Site-Specific Hydromodification Low Flow Threshold Analysis

The lower boundary of this flow range must correspond to the critical channel flow that produces the critical shear stress that initiates channel bed movement or that erodes the toe of channel banks.

The default low flow threshold is 10% of the pre-development 2-year flow. This value can be used without any site-specific study. The City of Wildomar has the discretion to approve an alternative lower boundary for the Hydrologic Performance Standards based on site-specific analysis per one of the two options below:

1) The Copermittee may use monitoring results collected by the Copermittees pursuant to Permit Provision D.1.a.(2) to re-define the range of flows resulting in increased potential for erosion, or degraded instream habitat conditions, as warranted by the data. OR

2) A site-specific analysis may be conducted by the Copermittee or Project Proponent in accordance with the procedure described in the 2011 San Diego

County HMP[1]. These low flow thresholds were evaluated and verified in the Effectiveness Assessment of the San Diego County HMP (ESA et al., 2016). To follow this process, the user will need to refer to guidance and methods in the 2011 San Diego County HMP. Lower flow thresholds may be determined using the San Diego HMP Channel Vulnerability Calculator and the Southern California Coastal Water Research Project (SCCWRP) Hydromodification Screening Tools (Report 606[2], Bledsoe et al., 2010) detailed in Chapter 5 of the San Diego HMP. These methods identify low flow thresholds for a range of channel conditions. The San Diego HMP Channel Vulnerability Calculator recommends a lower flow value of 0.1Q2, 0.3Q2, or 0.5Q2 dependent on the receiving channel material and dimensions. This value must be compared to the channel susceptibility rating (High, Medium, or Low) as determined from the SCCWRP Hydromodification Screening Tools (SCCWRP Technical Report 606) located in Appendix B of the San Diego HMP to determine the final lower flow threshold. Both tools rate the overall susceptibility to channel erosion, and assign a low-flow threshold as a function of the pre-development 2-year flow event (Q2):

- 0.1 Q2 for streams with HIGH susceptibility to channel erosion
- 0.3 Q2 for streams with MEDIUM susceptibility to channel erosion
- 0.5 Q2 for streams with LOW susceptibility to channel erosion

The final susceptibility rating and low-flow threshold assigned to a receiving channel is determined from the more conservative of the two methods. Both analyses must be performed based on site-specific data in accordance with the methods described in 2011 San Diego HMP.

A site-specific analysis may or may not be ultimately approved by the City of Wildomar. It is the responsibility of the PDP applicant to assess the potential for an analysis to successfully demonstrate that the project is consistent with the guidelines of this WQMP and with the provisions of the Regional MS4 Permit.

[1] http://www.projectcleanwater.org/images/stories/Docs/LDS/HMP/0311_SD_HMP_wAppendices.pdf

[2] https://www.waterboards.ca.gov/water_issues/programs/academy/courses/riverrat/606_hydromodscrntool_fldmanl.pdf

2.6.3. Trash Capture Hydrology

The City of Wildomar may require PDPs to comply with the trash capture requirements in this section. PDP project proponents should contact the City of Wildomar to determine if provisions in this section are applicable.

Trash Capture BMPs must be sized to treat the runoff generated by the 1-year 1-hour rainfall event (Trash Capture Design Storm). This flowrate is separate from LID/hydromodification sizing and is not intended to be applied above or beyond what is required for LID and/or hydromodification control. BMPs sized for LID and/or hydromodification control may already meet or partially meet this requirement.

The 1-year 1-hour rainfall intensity for a given site location can be determined by using the web-based NOAA Atlas 14 Point Precipitation Frequency Estimation Tool[1]. The tool is used by zooming to the project area, clicking on the project location, and recording the 1-year 1-hour rainfall intensity estimate from the output table. Approximate 1-year 1-hour rainfall intensities for calculation of the Trash Capture Design Storm are presented in Table 2–10 for the cities of Murrieta, Temecula, and Wildomar.

Table 2–10. Approximate precipitation depth/intensity values for calculation of the Trash Capture Design Storm.

City	1-year 1-hour Precipitation Depth/Intensity (inches/hr)
Murrieta	0.47
Temecula	0.50
Wildomar	0.37

Sizing requirements for Trash Capture BMPs are based upon the runoff flow rate generated during the Trash Capture Design Storm. The Trash Capture Design Flow Rate is calculated using the rational method according to the following equation:

$$Q_{TRASH} = C \cdot i \cdot A_{TRIB}$$

Where:

Q_{TRASH} = Design Flow Rate (cfs)

[1] http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

i = rainfall intensity from NOAA Atlas 14 Point Estimate

C = Composite Runoff Factor (unitless, per 2.6.1.b))

A_{TRIB} = area tributary to the BMP (acres, see Section 3.3)

2.7. ALTERNATIVE COMPLIANCE

2.7.1. Introduction

Alternative Compliance refers to compliance activities conducted by choice and/or by necessity when the full pollutant control and Hydromodification Performance Standards are not met through BMPs implemented within the PDP site. Alternative Compliance fundamentally consists of implementing off-site projects in lieu of, or as a compliment to, some or all on-site LID BMPs such that the combination of on- and off-site treatment achieves an equal or greater benefit to water quality.

2.7.2. Prerequisite Elements for Alternative Compliance

The Regional MS4 Permit establishes several prerequisite efforts that must be completed prior to allowing Priority Development Projects to participate in Alternative Compliance pathways. The following sections identify these prerequisite efforts and describe the current status of program development for specific Alternative Compliance pathways. This section of the WQMP may be updated from time to time.

2.7.2.a) Water Quality Equivalence Guidance

On December 17, 2015, the San Diego Regional Water Board's Executive Officer accepted the Water Quality Equivalency Guidance Document for Region 9, including the portions of San Diego, Orange, and Riverside Counties within this region. This guidance document establishes a mechanism to correlate quantifiable Alternative Compliance Project (ACP) water quality benefits with PDP water quality impacts and ultimately demonstrate that the ACP benefits outweigh the PDP impacts. Pursuant to the requirements set forth in Provision E.3.c.(3)(a) of the Permit, the methods presented within this guidance must be incorporated as part of any Offsite Alternative Compliance Program developed by a Copermittee or Project Applicant Proposed Alternative Compliance Projects allowed by the Copermittee.

The Water Quality Equivalency Guidance Document is available at this link: http://projectcleanwater.org/index.php?option=com_content&view=article&id=252&Itemid=210

2.7.2.b) Watershed Management Area Analysis

The WMAA conducted as part of the WQIP identifies candidate projects to which a project applicant could agree to fund, contribute funds to, or implement. The WMAA is subject to revision prior to acceptance.

See http://rcflood.org/NPDES/SMRWMA.aspx for the latest version of the WMAA (the WMAA is Appendix 4b of the WQIP).

2.7.2.c) In-Lieu Fee Structure

If a Copermittee chooses to allow a PDP applicant to fund or partially fund a candidate project or other alternative compliance project, the Copermittee must develop and implement an in-lieu fee structure authorizing this course of action. This authorization may be developed by an individual co-permittee, or through a joint agreement with other Copermittees or entities.

At a minimum, this authorization must include an agreement executed between the participating PDP applicant, the permittee responsible for approval of the PDP, the entity responsible for construction, operation and maintenance of the alternative compliance project (if different), and any other entities party to the agreement. This agreement must legally assign the required units of compliance from the alternative compliance project to the participating PDP. Payment of required fees and recording of legal agreements must be complete prior to the construction of the PDP that relies on the alternative compliance project.

In all cases, consultation with each permittee involved in the alternative compliance project or PDP approval is essential to identify potential options for funding or partially funding candidate projects or project applicant proposed ACPs.

2.7.2.d) Alternative Compliance Water Quality Credit System Option

The Copermittee may develop and implement an alternative compliance water quality credit system option, individually or with other Copermittees and/or entities, subject to review and acceptance by the Executive Officer as part of the WQIP or updates to this Plan. Consult with the City of Wildomar to determine whether a water quality credit system option may be available for any particular PDP.

2.7.3. Project Applicant Proposed Alternative Compliance Projects

The City of Wildomar may allow a PDP applicant to propose and implement an Alternative Compliance project. This option is allowed provided the City of Wildomar determines that implementation of the Alternative Compliance project, in conjunction with any on-site BMPs to be used, will have an equal or greater overall water quality benefit than fully complying with LID and hydromodification requirements on-site. This pathway is subject to all of the following criteria:

- If the PDP applicant chooses to implement an Alternative Compliance project, the applicant must record agreements and other legal encumbrances in a form acceptable to the City of Wildomar memorializing to this means of compliance, and accepting all related conditions.
- These agreements must identify and bind parties to provide reliable sources of funding for the ongoing operation and maintenance of the Alternative Compliance project.
- The PDP applicant must provide adequate documentation, using the WQE and in a form acceptable to the City of Wildomar, demonstrating that that pollutant control and/or hydromodification management by the Alternative Compliance project are sufficient to achieve the same level of treatment and control that would be achieved by implementing structural BMPs fully on-site.
- As with any submittal under this WQMP, design of the Alternative compliance project must be conducted under an appropriately qualified engineer, geologist, architect, landscape architect, or other professional, licensed where applicable, and competent and proficient in the fields pertinent to the candidate project design.
- The Alternative Compliance project must be completed and operating prior to or concurrent with certificate of occupancy and/or intended use the first phase of the associated PDP. The WQMP approval issued by the City of Wildomar will determine the specific local approval that may not be issued without certification of completion of the Alternative Compliance project, which is typically a certificate of occupancy or intended use for the first phase of the PDP that involves land disturbance.

2.7.4. Additional Requirement to Provide Treatment Prior to Discharge to Waters of the US

For PDPs utilizing Alternative Compliance, flow-thru (i.e. treatment control) BMPs must be implemented on-site to treat any portion of the DCV that is not (1) reliably treated on-site by LID retention or biofiltration BMPs, or (2) reliably treated by the Alternative Compliance project prior to discharge to Waters of the US.

- If the Alternative Compliance project is located in the same drainage area and will reliably treat stormwater runoff from the PDP prior to its discharge to Waters of the US, separate treatment control BMPs do not need to be provided on the site of the PDP. The requirement to treat stormwater is satisfied through treatment provided by the Alternative Compliance project. However, at the discretion of the City of Wildomar the project applicant may still be required to provide pre-treatment BMPs prior to discharge of water from PDP site; coordination with the City of Wildomar is recommended.

- If the Alternative Compliance project is located in a different drainage area, or otherwise will not reliably treat stormwater runoff from the PDP prior to its discharge to Waters of the US, then treatment control BMPs are required on the PDP site. The amount of pollutants treated by flow-thru BMPs can be credited to reduce the amount of pollutant load required to be achieved by the Alternative Compliance project.

Where flow-through treatment control BMPs are required to be used, they must be sized and designed to:

- Remove pollutants to the MEP
- Filter or treat either:
    - the maximum flow rate of runoff produced from a rainfall intensity of 0.2 inch of rainfall per hour, for each hour of a storm event, or
    - the maximum flow rate of runoff produced by the 85th percentile hourly rainfall intensity (for each hour of a storm event), as determined from the local historical rainfall record, multiplied by a factor of two, or
    - the required flowrate to result in capture of 80 percent of average annual runoff volume after accounting for the portion of the DCV retained on site.

- Be ranked with high or medium pollutant removal efficiency for the PDP's most significant pollutants of concern. Proprietary treatment control devices must be approved for use on the project per the requirements in Section 2.3.6.

Guidance for sizing and design of Flow-Through Treatment Control BMPs is provided in Section 2.3.2.

2.7.5. Potential Future Alternative Compliance Pathways

In the future, additional options may become available for Alternative Compliance as the City of Wildomar and other Copermittees and agencies further develop these programs. These options may include:

- Implementing candidate projects identified in the WMAA
- Funding or partially funding candidate projects identified in the WMAA via an in-lieu fee program
- Funding or partially funding project applicant-proposed Alternative Compliance projects
- Participating in a water quality credit system option

2.8. REFERENCES AND RESOURCES

- *The Importance of Imperviousness* (Tom Scheuler, 1995)
  Site Planning for Urban Stream Protection, available from the Center for Watershed Protection)
- California Stormwater BMP Handbooks
  - Southern California LID Manual
  - *Urban Runoff Quality Management,* Water Environment Federation and American Society of Civil Engineers, 1998. ISBN 1-57278-039-8 ISBN 0-7844-0174-8.
  - *Stormwater Infiltration,* Bruce K. Ferguson, 1994. ISBN 0-87371-987-5
  - Clean Water Act Section 402(p)
  - 40 CFR 122.26(d)(2)(iv)(A)(2) – Stormwater Regulations for New Development
- *Restoring Streams in Cities* (Riley, 1998)
- *Stream Restoration: Principles, Processes, and Practices*
  (Federal Interagency Stream Restoration Working Group, 1998, revised 2001)
- *Municipal Handbook, Rainwater Harvesting Policies* (USEPA, 2008)
- *Green Roofs for Stormwater Runoff Control* (USEPA, 2009a)
- *Porous Pavements* (Ferguson, 2005)
- *Orange County WQMP and TGD, with errata, 2011, 2013, 2017*
- *CASQA LID Guidance Manual for Southern California*

- *RWQCB Water Quality Control Plan for the San Diego Basin (Basin Plan)*
- *Design Handbook for Low Impact Development Best Management Practices,* Riverside County Flood Control and Water Conservation District, 2011.

Chapter 3

3.0 PREPARING PROJECT-SPECIFIC WQMPS

Step-by-step assistance to document compliance.

A Project-Specific WQMP is a document to demonstrate that a PDP complies with applicable requirements of the Regional MS4 Permit — to implement LID Principles and BMPs, manage Hydromodification, incorporate required Source Control BMPs, and provide for operation and maintenance of Structural BMPs.

ICON KEY
Helpful Tip
Submittal Requirement
1. Terms to Look Up
References & Resources

The City of Wildomar requires a 'Project-Specific' WQMP for every PDP as described in Section 1.1. The Project-Specific WQMP must be submitted with the application for Discretionary Approvals (entitlements) and must have sufficient detail to ensure the stormwater design, site plan, and landscaping plan are congruent and will comply with the applicable LID and Hydromodification Standards in the Regional MS4 Permit. Submitting a complete and thorough Project-Specific WQMP will facilitate quicker review and fewer cycles of review.

The procedure in this section is intended to facilitate, not substitute for, creative interplay among site design, landscape design, and drainage design. Several iterations may be needed to optimize your drainage design as well as aesthetics, circulation, and use of available area for the PDP site.

Structural BMPs should be planned and designed integrally with the site planning and landscaping for the PDP. It is best to start with general project requirements and preliminary site design concepts; then prepare the detailed site design, landscape design, and Project-Specific WQMP simultaneously. This will facilitate the development of a congruent site plan, landscape plan, grading plan and Project-Specific WQMP.

3.1. ASSEMBLE PROJECT AND SITE INFORMATION

To perform the LID design, the designer needs to identify pertinent site and PDP characteristics, including information such as (but not limited to):

- Existing natural hydrologic features and natural resources, including any contiguous natural areas, wetlands, watercourses, seeps, or springs.
- Existing site topography, including contours of any slopes of 4% or steeper, general direction of surface drainage, local high or low points or depressions, and any outcrops or other significant geologic features.
- Zoning, including requirements for setbacks and open space.

- Soil types (including Hydrologic Soil Groups) and depth to groundwater, which may determine whether infiltration is a feasible option for managing site Runoff. Depending on site location and characteristics, and on the selection of Structural BMPs, site-specific information (e.g., from boring logs or geotechnical studies) may be required.
- Existing site drainage. For undeveloped sites, this should be obtained by inspecting the site and examining topographic maps and survey data. For previously developed sites, site drainage and connection to the MS4 can be located from site inspection, MS4 maps, and plans for previous development.
- Onsite Significant Sources of Bed Sediment and first order, or higher, channels, as defined in Section 2.3.i of the SMR HMP and the WMAA.
- Existing vegetative cover and impervious areas, if any.
- Project Design Features, including impervious surfaces, landscaped surfaces, parking lots, land uses, etc.

3.2. OPTIMIZE SITE UTILIZATION (LID PRINCIPLES)

Review the information collected in Section 3.1. Identify the principal constraints on site design as well as opportunities to reduce imperviousness and incorporate LID Principles into the PDP site and landscape design. For example, constraints might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, utility locations, or safety concerns. Opportunities might include existing natural areas, significant demands for harvested stormwater, low areas, oddly configured

or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which may be able to double as locations for LID Bioretention BMPs), areas with lower amounts of cut or fill, and areas with lower elevation (which may provide hydraulic head).

Apply the following LID Principles to the layout of the PDP to the extent they are applicable and feasible. Putting thought upfront about how best to organize the various elements of PDP site can help to significantly reduce the PDP's potential impact on the environment and reduce the number of Structural LID and/or Conventional Treatment BMPs that must be implemented. Analyze the preliminary PDP site layout concepts, and look for opportunities to accommodate the following LID Principles within the PDP site layout. Performing this analysis and optimizing the layout for LID will likely be useful during the remaining steps.

These principles also apply to Other Development Projects (smaller than PDPs). This section may be used to guide LID site design BMP application for these project types as well as PDPs.

3.2.1. Preserve Existing Drainage Patterns

Integrating existing drainage patterns into the site plan may facilitate maintaining the PDPs predevelopment hydrologic function. Preserving existing drainage paths and depressions will not only help maintain the time of concentration and infiltration rates of Runoff, decreasing peak flows, but may also help preserve the contribution of Bed Sediment Supply from the PDP to the Receiving Water. The best way to define existing drainage patterns may be to visit the site of the PDP during a rain event and to directly observe runoff flowing over the site. If this is not possible, drainage patterns may be inferred from topographic data, though it should be noted that depression micro-storage features are often not accurately mapped in topographic surveys. Analysis of the existing site drainage patterns during the site assessment phase of the PDP can help to identify the best locations for buildings, roadways, and Structural BMPs.

Minimize unnecessary site grading that eliminates small depressions, which may provide storage of small volumes of runoff. Where appropriate, add additional depression "micro" storage throughout the site's landscaping. This is referred to in Section 3.3 as 'self-retaining areas'. Mild gradients may be used to extend the time of concentration, which reduces peak flows and increases the potential for additional infiltration. While risk of serious flooding must be limited, the persistence of temporary "puddles" during storms may be beneficial to infiltration.

- Where possible, conform the PDP site layout along natural landforms, avoid excessive grading and disturbance of vegetation and soils, and preserve or replicate the site's natural drainage features and patterns.
- Set back PDP improvements from creeks, wetlands, riparian habitats, and any other natural water bodies.
- Use both existing and proposed site drainage patterns as a natural design element, rather than using expensive impervious conveyance systems. Use depressed landscape areas, vegetated buffers, and bioretention areas as amenities and focal points within the site and landscape design.

3.2.2. Protect Existing Vegetation and Sensitive Areas

Identify any areas of the PDP containing dense native vegetation or well-established trees, and try to avoid disturbing these areas. Soils with thick, undisturbed vegetation have a much higher capacity to store and infiltrate Runoff than do disturbed soils. Reestablishment of a mature vegetative community may take decades. Sensitive areas, such as streams and floodplains should also be avoided.

- Define the development envelope and protected areas, identifying areas that are most suitable for development and areas that should be left undisturbed.
- Establish setbacks and buffer zones surrounding sensitive areas.
- Preserve significant trees and other natural vegetation where possible.

3.2.3. Preserve Natural Infiltration Capacity

A key component of LID is taking advantage of a site's natural infiltration and storage capacity. A site survey and geotechnical investigation can help define areas with high potential for infiltration and surface storage. Identify opportunities to locate LID Principles and Structural BMPs in highly pervious areas. Doing so will maximize infiltration and limit the amount of runoff generated. Concentrate development on portions of the site with less permeable soils, and preserve areas that can promote infiltration.

3.2.4. Minimize Impervious Area

As discussed in Chapter 2, creation of impervious cover can be tied to potential environmental impacts due to runoff. Look for opportunities to limit impervious cover through identification of the smallest possible land area that can be practically impacted or disturbed during site development.

- Limit overall coverage of paving and roofs. This can be accomplished by designing compact, taller structures, narrower and shorter streets and sidewalks, clustering buildings and sharing driveways, smaller parking lots (fewer stalls, smaller stalls, and more efficient lanes), and indoor or underground parking.

- Examine site layout and circulation patterns and identify areas where landscaping can be substituted for pavement, such as for overflow parking.

- Inventory planned impervious areas on your preliminary site plan. Identify where permeable pavements, or other permeable materials, such as crushed aggregate, turf block, permeable modular blocks, pervious concrete or pervious asphalt could be substituted for impervious concrete or asphalt paving. This will help reduce the amount of Runoff that may need to be addressed through Structural BMPs.

- Consider green roofs. Green roofs are roofing systems that provide a layer of soil/vegetative cover over a waterproofing membrane. A green roof mimics pre-development conditions by filtering, absorbing, and evapotranspiring precipitation to help manage the effects of an otherwise impervious rooftop. Green roofs with growing media four inches or deeper are considered 'self-retaining areas' as defined in Step 3, and do not produce increased Runoff or Runoff Pollutants (i.e., any Runoff from a green roof requires no further LID or Hydrologic Control BMPs).

3.2.5. Disperse Runoff to Adjacent Pervious Areas or Small Collection Areas

Look for opportunities to direct Runoff from impervious areas to adjacent landscaping, other pervious areas, or small collection areas where such runoff may be retained. This is sometimes referred to as reducing Directly Connected Impervious Areas.

- Direct roof runoff into landscaped areas such as medians, parking islands, planter boxes, etc., and/or areas of pervious paving. Instead of having landscaped areas raised above the surrounding impervious areas, design them as depressed areas that can receive Runoff from adjacent impervious pavement. For example, a lawn or garden depressed 3"-4" below surrounding walkways or driveways provides a simple but quite functional landscape design element. This is referred to as 'areas draining to self-retaining areas' in Section 3.3.

- Detain and retain Runoff throughout the site. On flatter sites, smaller Structural BMPs may be interspersed in landscaped areas among the buildings and paving.
- On hillside sites, drainage from upper areas may be collected in conventional catch basins and piped to landscaped areas and LID BMPs and/or Hydrologic Control BMPs in lower areas. Low retaining walls may also be used to create terraces that can accommodate LID BMPs. Wherever possible, direct drainage from landscaped slopes to small self-retaining areas and not to impervious surfaces like parking lots.
- Use curb cuts to allow water to disperse into landscaped areas, where practical.
- Design landscaped areas or other pervious areas to receive and infiltrate runoff from nearby impervious areas.
- Use Tree Wells to intercept, infiltrate, and evapotranspire precipitation and runoff before it reaches structural BMPs. Tree wells can be used to limit the size of Drainage Management Areas that must be treated by structural BMPs. Guidelines for Tree Wells are included in the Tree Well Fact Sheet in the LID BMP Design Handbook.

3.2.6. Utilize Native or Drought Tolerant Species in Site Landscaping

Wherever possible, use native or drought tolerant species within site landscaping instead of alternatives. These plants are uniquely suited to local soils and climate and can reduce the overall demands for potable water use associated with irrigation.

3.2.7. Implement Harvest and Use of Runoff

Under the Regional MS4 Permit, Harvest and Use BMPs must be employed to reduce runoff on any site where they are applicable and feasible. However, Harvest and Use BMPs are effective for retention of stormwater runoff only when there is adequate demand for non-potable water during the wet season. If demand for non-potable water is not sufficiently large, the actual retention of stormwater runoff will be diminished during larger storms or during back-to-back storms.

For the purposes of planning level Harvest and Use BMP feasibility screening, Harvest and Use is only considered to be a feasible if the total average wet season demand for non-potable water is sufficiently large to use the entire DCV within 72 hours. If the average wet season demand for non-potable water is not sufficiently large to use the

entire DCV within 72 hours, then Harvest and Use is not considered to be feasible and need not be considered further.

Harvest and Use should be evaluated at the project scale, not limited to a single DMA. For the purpose of planning level feasibility screening, it is assumed that harvested water from one DMA could be used in another. Types of non-potable water use that may apply in a given project include:

- Toilet and urinal flushing;
- Irrigation;
- Vehicle washing;
- Evaporative cooling;
- Dilution water for recycled water systems;
- Industrial processes; and
- Other non-potable uses.

The general feasibility and applicability of Harvest and Use BMPs should consider:

- Any downstream impacts related to water rights that could arise from capturing stormwater (not common).
- Conflicts with recycled water used – where the project is conditioned to use recycled water for irrigation, this should be given priority over stormwater capture as it is a year-round supply of water.
- Code Compliance - If a particular use of captured stormwater, and/or available methods for storage of captured stormwater would be contrary to building codes in effect at the time of approval of the preliminary Project-Specific WQMP, then an evaluation of harvesting and use for that use would not be required.
- Wet season demand – the applicant shall demonstrate, to the acceptance of the City of Wildomar, that there is adequate demand for harvested water during the wet season to drain the system in a reasonable amount of time.

3.2.8. Keep Pervious Area Runoff Hydrologically Separate from Developed Areas Requiring Treatment

Pervious area that qualify as self-treating areas (See Section 3.3.1) or off-site open space should be kept separate from drainage to structural BMPs whenever possible. This helps limit the required size of structural BMPs, helps avoid impacts to sediment supply, and helps reduce clogging risk to BMPs. Open space area or exposed soil area should generally not make up more than 10 percent of the tributary area to an Infiltration or Biofiltration BMP. This value could be exceeded if adequate pre-treatment is provided.

3.3. DELINEATE DRAINAGE MANAGEMENT AREAS

The delineation of DMAs is key to successfully implementing your LID design. The procedure begins with:

1. Careful delineation of pervious areas and impervious areas (including roofs) throughout the site, and then;

2. Dividing the entire PDP site into individual, discrete DMAs.

Typically, lines delineating DMAs follow grade breaks and roof ridge lines. The exhibits, tables, text, and calculations in the Project-Specific WQMP will illustrate, describe, and account for runoff from each of the areas of the PDP.

DMA boundaries should not be based on project limits or lot lines. If water from outside of the project limits comingles with water from inside of the limits, then the BMP should be sized to treat the full tributary area.

Where possible, establish separate DMAs for each surface type (e.g., landscaping, pervious paving, or roofs). Assign each DMA a unique code and determine its size in *square feet*. The total area of your site should total the sum of all of your DMAs.

Next, determine how drainage from each DMA will be handled. Each DMA will be classified as one of the following four types:

A. Self-treating areas.

B. Self-retaining areas (also called "zero-discharge" areas).

C. Areas that drain to self-retaining areas.

D. Areas that drain to BMPs.

The first three types of DMAs: Self-Treating, Self-Retaining, and draining to Self-Retaining, are ways to account for successful implementation of the LID Principles discussed in Step 1. Areas addressed by LID Principles are self-managing and do not require any further management measures. Further, these areas will not require specialized Operation and Maintenance procedures, and can typically be maintained with normal landscape and site maintenance.

The fourth type of DMA is a way to document the specific areas within the site layout that require additional mitigation measures through LID BMPs.

> As more LID Principles are implemented, more of the site will mimic natural processes and become self-managing, resulting in less area that must be managed through structural LID BMPs.

3.3.1. Type 'A': Self-Treating areas

Self-Treating Areas are those that meet the following criteria:

- Are either undisturbed from their natural condition, or restored with Native and/or California Friendly vegetative covers, AND
- Are irrigated, if at all, with appropriate low water use irrigation systems to prevent irrigation runoff.

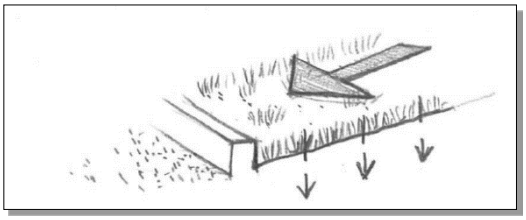


Figure 3-1: Self-Treating Areas

- Runoff from the area will not comingle with runoff from the developed portion of the site, or across other landscaped areas that do not meet the above criteria.

Examples include up-sloped undeveloped areas which are ditched and drained around a development, and landscaped areas (as described above) that drain offsite. Areas that do not meet the above criteria do not qualify as a Self-Treating Area. In general, Self-Treating Areas include no impervious areas, unless the impervious area is very small (e.g., 5% or less of the Self-Treating Area) and Runoff from impervious areas will be absorbed into the vegetation and soil.

Table 3–1: Table for Documenting Self-Treating Areas (Type 'A' DMA)

DMA Name or ID	Area (Sq. Ft.)	Stabilization Type	Irrigation Type (if any)
A/1	*4,460*	*Undisturbed Natural*	*None*
A/2	*1,026*	*Native Low Water Use*	*Drip Irrigation*

Note: Example Data shown

3.3.2. Type 'B': Self-retaining Areas

Self-Retaining Areas are shallowly depressed 'micro infiltration' areas designed to retain the Design Storm rainfall that reaches the area, without producing any Runoff. The technique works best on flat, landscaped sites. It may be used on mild slopes if there is a reasonable expectation that design of the area will result in the Design Storm rainfall event producing no Runoff.

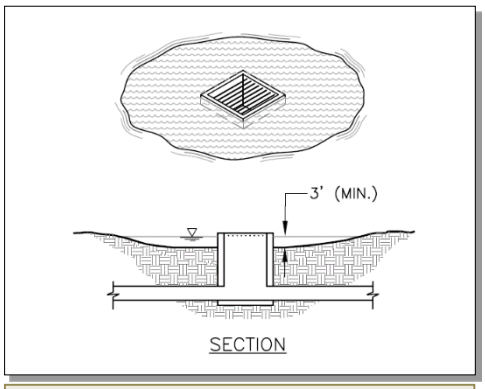


Figure 3-2 Self-Retaining Areas

To create Self-Retaining Areas in flat areas or on terraced slopes, either berm the area or depress the grade into a concave cross section so that there is a reasonable expectation that these areas will retain the Design Storm rainfall. Grade slopes, if any, toward the center of the pervious area.

Soils: Self-Retaining Areas are not recommended for soils that are not expected to be freely draining, so as not to create vector or nuisance conditions. Self-retaining areas within C or D soils must be constructed with appropriately amended soils to increase the shallow storage capacity of the soils such that surficial ponded water will not occur due to the design storm rainfall. All Self-Retaining Areas (regardless of soil type) should be protected during construction such that compaction is minimized or avoided entirely where possible. If compaction within a Self-Retaining area nevertheless occurs, the compacted surface must be re-tilled to a depth of at least six inches and amended as necessary to restore the infiltrative and storage capacity of the soil.

Inlet elevations of area/overflow drains, if any, should be clearly specified to be three inches or more above the low point to promote ponding. In setting elevations, account for mulch or other landscaping cover that could reduce available ponding depth. Construction documents must clearly specify the required elevation(s) of any overflow drain inlets.

Pervious pavements (e.g., crushed stone, porous asphalt, pervious concrete, or permeable pavers) can be self-retaining when constructed with a gravel base course four or more inches deep. This will ensure an adequate proportion of rainfall is infiltrated into native soils (including clay soils) rather than producing Runoff. Consult with a qualified (geotechnical) engineer regarding infiltration rates, pavement stability, and suitability for the intended traffic.

Tree Wells and areas draining to Tree Wells, can be self-retaining when constructed according to guidelines contained in the Tree Well Fact Sheet in the LID BMP Design Handbook. Drainage from green roofs is considered to be self-retained, however, an emergency overflow should be provided for extreme events. Drainage from green roofs should be routed to landscaping rather than being tied directly into MS4 facilities.

Note, site design BMPs used in Type B DMAs may be considered structural LID BMPs at the discretion of the City of Wildomar.

Table 3–2: Table for Documenting Self-Retaining Areas (Type 'B' DMAs)

Self-Retaining Area				Type 'C' DMAs that are draining to the Self-Retaining Area		
DMA Name/ ID	Post-project surface type	Area (square feet) [A]	Storm Depth (inches) [B]	DMA Name / ID	[C] from table 3-3 = [C]	Required Retention Depth (inches) [D]
B/1	*Planter*	*604*	*0.8*	*C/1, C/2*	*1100+80 =1180*	*2.4*
B/2	*Pervious patio*	*2,149*	*0.8*	*C/3*	*1946*	*1.5*
B/3	*Planter*	*1677*	*0.8*	*N/A*	*N/A*	*0.8*

Note: Example Data shown

$$[D] = [B] + \frac{[B] \cdot [C]}{[A]}$$

3.3.3. Type 'C': Areas Draining to Self-Retaining Areas

Runoff from impervious or partially pervious areas can be managed by routing it to Self-Retaining Areas consistent with the LID Principle discussed in Section 3.2.5 for 'Dispersing Runoff to Adjacent Pervious Areas'. For example, roof downspouts can be directed to lawns, and parking areas can be drained to landscaped areas.

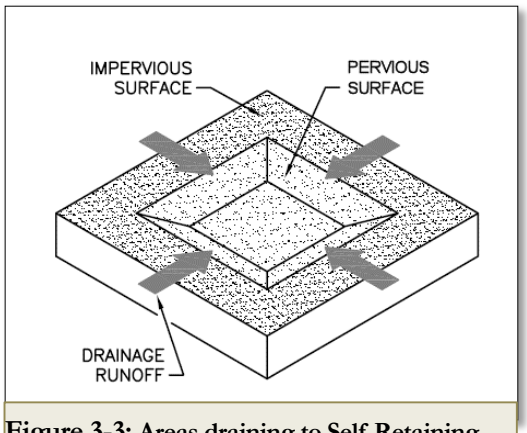


Figure 3-3: Areas draining to Self-Retaining Areas

For *impervious* areas such as pavements that drain to a nearby Self-Retaining Area, the maximum ratio, based upon past modeling efforts in California, is 2 parts impervious area for every 1 part pervious area.

For *partially* pervious areas draining to a Self-Retaining area the maximum ratio is:

$$\left(\frac{\mathbf{2}}{\boldsymbol{Impervious\ Fraction}}\right) : \mathbf{1}$$

(Tributary Area: Self-Retaining Area)

Special Case

If your self-retaining area is a **Permeable Pavement**, higher ratios than 2:1 can be used **IF** the pervious pavement is designed in accordance with the LID BMP Design Handbook or other standard approved by the Copermittee with jurisdiction over the project site. In this case, the area draining to the pavement will be considered a **Type D DMA** (area draining to a BMP).

Where the Impervious Fraction is obtained from Section 2.6.1.b).

The drainage from the tributary area must be directed to and dispersed within the Self-Retaining Area, and the area must be designed to retain the entire Design Storm runoff without flowing offsite. For example, if the ratio of 2 parts impervious area into 1 part pervious area is used, and the Design Storm is one inch, then the pervious area must absorb three inches of water over its surface before overflowing to an offsite drain (one inch of rainfall for the Self-Retaining Area itself, plus one inch for each of the 2 parts of tributary impervious area).

Prolonged ponding is a potential problem at higher impervious/pervious ratios. In your design, ensure that the pervious area soils can handle the additional run-on and are sufficiently well-drained, and/or amended as described in Section 3.3.2.

Table 3–3: Table for Documenting Areas Draining to Self-Retaining Areas (Type 'C' DMAs)

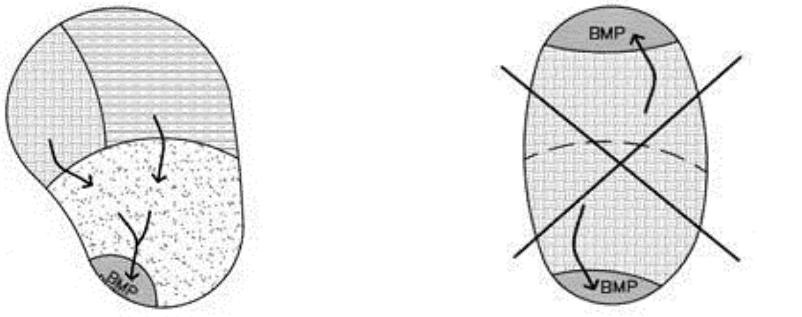
DMA					Receiving Self-Retaining DMA		
DMA Name/ ID	Area (square feet) [A]	Post-project surface type	Runoff factor [B]	Product [C] = [A] x [B]	DMA name /ID	Area (square feet) [D]	Ratio [C]/[D]
C/1	*1100*	*Roof*	*1*	*1100*			
C/2	*800*	*Pervious Walkway*	*0.1*	*80*			
				1180	*B/1*	*604*	*1.95 < 2*
C/3	*1946*	*Driveway*	*1*	*1946*	*B/2*	*2,149*	*0.91 < 2*

Note: Example Data shown

3.3.4. Type 'D': Areas Draining to BMPs

Areas draining to BMPs are those that could not be fully managed through LID Principles (DMA Types A through C) and will instead drain to a LID BMP and/or a Conventional Treatment BMP designed to manage water quality impacts from that area, and Hydromodification where necessary. More than one DMA can drain to a single LID BMP, however, one DMA may not drain to more than one LID BMP. See Figures 3-4.

Where possible, design site drainage so only impervious roofs and pavement drain to LID BMPs. This yields a simpler, more efficient design, with minimized LID BMP requirements, and also helps protect LID BMPs from becoming clogged by sediment. Sediment producing areas, such as landscaping and open space should be limited to no more than 10 percent of the tributary area to an infiltration or biofiltration BMP. Greater area may be allowed with adequate pre-treatment.



More than one DMA can drain to a single BMP.

One DMA cannot drain to multiple BMPs

Figure 3-4: Drainage from Multiple DMAs

Table 3-5, Example Format for Determining the Required DCV for BMPs, is discussed in Section 3.4.3.

3.4. IMPLEMENT LID BMPS

Type 'D' DMAs draining to BMPs, as defined in Section 2.3.4, must be addressed using LID BMPs according to the prioritization discussed in Section 2.3.2.

Special Note

The User should distinguish the four types of DMAs ('A', 'B', 'C', and 'D'), which identifies the type and magnitude of LID principles incorporated into the site drainage, from the Hydrologic Soil Group (A,B,C, and D), which designate the minimum rate of infiltration obtained for bare soil after prolonged wetting.

3.4.1. LID BMP Selection

3.4.1.a) Infiltration BMP Assessment

An assessment of the feasibility of utilizing Infiltration BMPs is required for PDPs, except where it can be shown that site design LID principals fully retain the DCV (i.e., all DMAs are Type A, B, or C.

A site-specific evaluation of the feasibility of Infiltration BMPs must at minimum incorporate consideration of the criteria identified in Section 2.3.3. If one or more of the infiltration criteria indicate that Infiltration BMPs are not feasible for the PDP site, the other remaining infiltration criteria do not need to be assessed.

3.4.1.b) LID BMP Selection Matrix for Type D DMAs (not fully treating or retaining)

Per the site investigation described in Section 3.1 and the DMA locations identified in Section 3.3, and the infiltration feasibility criteria described in Section 2.3.3, use Table 3–4 to determine the appropriate type of structural LID BMP for each DMA. Note that selecting BMPs depends on the BMP locations, so this step may be iterative with the process of laying out BMPs, as described in Section 3.4.2, below.

Table 3–4: LID BMP Selection Matrix

Infiltration Feasibility and Infiltration Rate Conditions of the DMA See Infiltration Feasibility Criteria (Section 2.3.3).	**BMP Selection**
Factored infiltration rate > 0.8 in/hr **and** Other feasibility considerations allow for full infiltration.	Full Infiltration BMPs: • Infiltration Basins • Infiltration Trenches • Permeable Pavements • Bioretention
Factored infiltration between 0.1 and 0.8 in/hr **and** Other feasibility considerations allow for partial infiltration.	Biofiltration BMPs designed to maximize incidental infiltration: • Biofiltration with Partial Infiltration • Proprietary Biofiltration with Supplemental Retention
Factored infiltration less than 0.1 in/hr **or** Other feasibility considerations preclude full or partial infiltration	Biofiltration BMPs not designed to maximize incidental infiltration: • Biofiltration with No Infiltration • Proprietary Biofiltration

3.4.2. Laying out LID BMPs on the PDP site

Finding the right location for LID BMPs on the PDP site involves a careful and creative integration of several factors:

- To make the most efficient use of the site and to maximize aesthetic value, integrate LID BMPs with site landscaping. Many local zoning codes may require landscape setbacks or buffers, or may specify that a minimum portion of the site be landscaped. It may be possible to locate some or all LID BMPs within this same area, or within utility easements or other non-buildable areas.

- Use permeable pavements wherever possible. These pavement systems are not only aesthetically pleasing but they also minimize the amount of runoff that needs to be treated.

- LID Infiltration and Biofiltration BMPs must be level or nearly level all the way around. When configured in a linear fashion (similar to swales) LID Bioretention and Biofiltration BMPs may be gently sloped end to end, but opposite sides must be at the same elevation. BMPs on steeper slopes must be terraced or provided with check dams.

- For effective, low-maintenance operation, locate LID BMPs so drainage into and out of the device is by gravity flow. Many LID BMPs require three feet or more of hydraulic head.

- LID BMPs require excavations three or more feet deep, which can conflict with underground utilities.

- If the property is being subdivided now or in the future, the BMP should be in a common, accessible area. In particular, avoid locating LID BMPs on private residential lots. Even if the LID BMP will serve only one site owner or operator, make sure the BMP is located for ready access for inspection by the City of Wildomar and the local mosquito and vector control agency. The goal is to ensure that LID BMPs are maintained and functional, to assure a properly functioning maintenance mechanism since the ability of individual homeowners to provide maintenance is variable, and to avoid residential property rights issues for inspections and verifications. Maintenance via a public maintenance mechanism will require BMPs to be located in common areas and not in individual lots.

- The LID BMP must be accessible to equipment needed for its maintenance. Access requirements for maintenance will vary with the type of BMP

selected. LID Bioretention BMPs will typically need access for the same types of equipment used for landscape maintenance.

Document site layout and site design decisions in the Project-Specific WQMP. This will provide background and context for how the design meets the quantitative LID BMP design criteria. Once the LID BMPs have been laid out, calculate the square footage set aside on the site plan for each BMP.

3.4.3. Calculate Minimum LID BMP Sizes

Infiltration BMPs must at minimum be sized to capture the DCV to achieve pollutant control requirements.

Biofiltration BMPs must at a minimum be sized to:

- Treat 1.5 times the DCV not reliably retained on site using a volume-base or flow-based sizing method, or
- Include static storage volume, including pore spaces and pre-filter detention volume, at least 0.75 times the portion of the DCV not reliably retained on site.

LID BMPs can be additionally sized and configured to meet Hydromodification Performance Standards described in Section 3.6, if applicable.

3.4.3.a) Design Capture Volume

Appendix F of the LID BMP Design Handbook contains worksheets that can be used for calculating the required DCV for LID BMPs. The User may also compute the DCV and Q_{BMP} using the LID BMP interface of SMRHM. Refer to the SMRHM Guidance Manual located in Exhibit F

If neither the worksheet nor the LID BMP interface of SMRHM are used, your calculations should be in tables using the following format.

Table 3–5: Example Format for Determining the Required DCV for BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here*		
	[A]		[B]	[C]	[A] x [C]			
						Design Storm Depth (in)	*Design Capture Volume, (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	$A_T = \Sigma[A]$				$\Sigma = [D]$	[E]	$[F] = \frac{[D]x[E]}{12}$	[G]

[B], [C] are obtained as described in Section 2.6.1.b)

[E] is obtained from Exhibit A

[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook. Maintain a completed design procedure sheet for each LID BMP.

3.4.3.b) Hydromodification

The User should consider the full suite of Hydrologic Control BMPs to manage runoff from the post-development condition and meet the Hydrologic Performance Standard identified in Section 3.6. The User may consider the following in identifying the Hydrologic Control BMPs for incorporation in the design of the PDP:

- LID principles as defined in Section 3.2;
- Structural LID BMPs that may be modified or enlarged, if necessary, beyond pollutant control sizing requirements;
- Structural Hydrologic Control BMPs are distinct from the LID BMPs. The LID BMP Design Handbook provides information not only on Hydrologic Control BMP design, but also on BMP design to meet the combined LID and Hydromodification requirements. The Handbook specifies the type of BMPs that can be used to meet the Hydrologic Performance Standard.

LID principles, structural LID BMPs, and structural Hydrologic Control BMPs can each be modeled in the SMRHM or an alternative continuous simulation model acceptable to the City of Wildomar.

Refer to Section 3.6 to determine if the PDP is subject to the Hydromodification Performance Standards, and Section 2.6.2 for acceptable methodologies to demonstrate compliance with the Hydrologic Performance Standard.

3.4.4. Specify Design Details

Preliminary design details sufficient to demonstrate that the area, volume, and other criteria of each can be met within the constraints of the PDP site are required in the preliminary Project-Specific WQMP.

The final Project-Specific WQMP and the construction and grading plans will need to include final design details consistent with your approved preliminary Project-Specific WQMP. These final details must demonstrate that the required pollutant control requirements, potential Hydromodification Performance Standards, and any other requirements specified by the City of Wildomar, have been met. Ensure these details are consistent with preliminary site plans, landscaping plans, and architectural plans submitted with your application for planning and zoning approvals.

The User may elect to use SMRHM to select and design LID BMPs and Hydrologic Control BMPs, where required. Selection and design of Hydrologic Control BMPs is an iterative process that can be facilitated using the SMRHM. The SMRHM has a comprehensive menu of site design LID BMPs and Hydrologic Control BMPs that can be selected for PDPs. The design standards for these Hydrologic Control BMPs have been pre-incorporated into SMRHM and can be modified to an extent based on site constraints. The User must verify that the design details of LID BMPs and Hydrologic Control BMPs defined in SMRHM are consistent with the BMP standards set forth in the LID BMP Design Handbook.

Alternatively, the User may opt to develop its own model using publicly-available software, which performs continuous hydrologic simulation over the available period of rainfall record, consistent with the conditions set forth in Section 2.6.2.a).The use of a different model than SMRHM must receive prior approval from the City of Wildomar. The City of Wildomar is not obligated to accept analysis performed in a model other than the SMRHM.

The LID BMP Design Handbook includes standard configurations, details and sizing calculator worksheets that are available for the LID BMPs referenced in this WQMP. Check with the City of Wildomar to determine if this or alternative standards should be used for your PDP. The information in the LID BMP Design Handbook is designed to address sizing for pollutant control requirements and includes alternative designs and sizes for managing Hydromodification.

The planning, building, and public works officials of the City of Wildomar have final review and approval authority over the project design.

3.4.5. Determine if BMP Area and Volume are Adequate

Sizing and configuring BMPs is typically an iterative process. After specifying the preliminary design details as described in Section 3.4.4, review the site plan to determine if the reserved BMP locations are sufficient for each of the LID BMPs.

If so, the planned BMPs will meet the WQMP sizing requirements for water quality.

If not, revise the plan accordingly. Revisions may include:

- Reducing the overall imperviousness of the PDP site. For example, consider incorporating additional permeable pavements to reduce the imperviousness of the site.
- Changing the grading and drainage to redirect some Runoff toward other BMPs which may have excess capacity.
- Making tributary landscaped DMAs self-treating or self-retaining (may require changes to grading).
- Expanding BMP surface area.
- Revision to the square footage of a BMP typically requires a corresponding revision to the square footage of the surrounding or adjacent DMA.
- The Hydromodification Performance Standards described in Section 3.6 are separate and additional standards that must be met by applicable PDPs. Even if the PDP has demonstrated compliance with the pollutant control requirements, such Development Projects may need to implement additional and/or larger BMPs to meet the Hydromodification Performance Standards, for structural LID BMPs.

Section 3.5 describes alternative compliance measures that can be implemented if it has been demonstrated that it is technically infeasible to address all required Type 'D' DMAs with LID BMPs.

3.4.6. Unpaved Roads

If the PDP includes unpaved roads, ensure that appropriate erosion and sediment control BMPs are incorporated to manage runoff and erosion during the post-

construction life of the unpaved roads. At a minimum, the BMPs must include the following or alternative BMPs that are equally effective:

- Practices to minimize road related erosion and sediment transport;
- Grading of unpaved roads to slope outward where consistent with road engineering safety standards;
- Installation of water bars as appropriate; and
- Unpaved roads and culvert designs that do not impact creek functions and where applicable, that maintain migratory fish passage.

3.5. Document any Alternative Compliance Measures

Alternative Compliance may be used to achieve compliance with pollutant control and/or hydromodification requirements for a given PDP. Alternative Compliance may be used under two scenarios:

- If it is not feasible to implement Infiltration or Biofiltration BMPs at a PDP site, Flow-Through Treatment Control BMPs may be used to treat pollutants contained in the portion of DCV not reliably retained on site and Alternative Compliance measures must also be implemented to mitigate for those pollutants in the DCV that are not retained or removed on site prior to discharging to a receiving water.
- Alternative Compliance is selected to comply with either pollutant control or hydromodification requirements even if complying with these requirements is potentially feasible on-site. If such voluntary Alternative Compliance is implemented, Flow-Through Treatment Control BMPs must still be used to treat those pollutants in the portion of the DCV not reliably retained on site prior to discharging to a receiving water.

Additional details on the Alternative Compliance approach are included in Section 2.7.

3.5.1. Flow-Through Treatment Control BMPs

Flow-Through Treatment Control BMPs are typically proprietary devices that provide treatment mechanisms for Pollutants in runoff, but do not reduce the volume of runoff. PDPs that use Alternative Compliance to achieve pollutant control or hydromodification requirements are still required to implement on site Flow-Through

Treatment Control BMPs to treat that portion of the DCV not reliably retained on site prior to that untreated flow discharging to a receiving water.

3.5.1.a) Selection and Sizing of Flow-Through Treatment Control BMPs

Flow-Through Treatment Control BMPs must be implemented and sized to meet the following criteria:

- Remove pollutants from stormwater to the MEP, and
- Filter or treat either:
  - The maximum flow rate of runoff produced from a rainfall intensity of 0.2 inches per hour, for each hour of a storm event, or,
  - The maximum flow rate of runoff produced by the 85th percentile hourly rainfall intensity as determined from the local historical rainfall record, multiplied by a factor of 2.

Table 3–6: Example Format for Conventional Treatment Control BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here*	
	[A]		[B]	[C]	[A] x [C]		
						Design Storm (in)	*Design Flow Rate (cfs)*
	$A_T = \Sigma[A]$				$\Sigma = [D]$	[E]	$[F] = \frac{[D]x[E]}{[G]}$

[B], [C] are obtained as described in Section 2.6.1.b)

[E] is either 0.2 inches or 2 times the 85th percentile hourly rainfall intensity

[G] = 43,560.

Proprietary flow-through treatment BMPs must meet the acceptance criteria described in Section 2.3.6.

3.6. ADDRESS HYDROMODIFICATION

Section 3.6 identifies the critical questions and steps that the User must fulfill to meet the Hydromodification Performance Standards. The major steps to be fulfilled include:

- Identify if the project is subject to the Hydromodification Performance Standards;
- Understand the Hydromodification Performance Standards; and
- Incorporate Hydrologic Control BMPs and Sediment Supply BMPs, if required.

3.6.1. Projects Subject to Hydromodification Performance Standards

PDPs are subject to hydromodification performance standards unless exempted by the City of Wildomar. Exemptions may be granted under each of the following conditions:

- If the project is not classified as PDP per Section 1.1; OR
- If the PDP discharges to an existing underground storm drain discharging directly to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean; OR
- If the PDP discharges to a conveyance channel whose bed and bank are concrete lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean; OR
- If the PDP discharges runoff directly to an exempt river reach or an exempt reservoir as identified in an approved WMAA (the WMAA is not currently approved so no such exemptions are currently available).

It should be noted that all PDPs are subject to the LID and water quality treatment requirements even if they are not subject to Hydromodification Performance Standards.

In addition, the User should note that properly designed energy dissipation systems are required for all project outfalls to unlined channels.

3.6.2. Hydromodification Performance Standards

PDPs that are subject to Hydromodification requirements must demonstrate compliance with the Hydromodification Performance Standards, consisting of the Hydrologic Performance Standard and the Sediment Supply Performance Standard.

The Hydrologic Performance Standard requires that post-project runoff flow rates do not exceed pre-development, naturally occurring runoff flow rates by more than 10% for the range of flows that result in increased potential for erosion (considered to be 10% of the 2-year runoff event up to the 10-year runoff event unless site-specific analysis is completed). The Sediment Supply Performance Standard consists of maintaining the pre-project Bed Sediment supply (Critical Coarse Sediment) to the channel receiving runoff from the project site (Receiving Channel).

PDPs may also comply with the Hydrologic Performance Standard via Alternative Compliance. Alternative Compliance options are presented in Section 2.7. There are no alternative compliance options for Sediment Supply requirements.

3.6.3. Hydrologic Performance Standard Compliance

The applicant must design and implement onsite LID BMPs, modified LID BMPs, or Hydrologic Control BMPs or participate in Alternative Compliance to meet the Hydrologic Performance Standard.

Hydrologic Control BMPs must be sized to mitigate flow rates and durations from the post-development condition to the Permit standards. Some PDPs may be able to comply with Hydrologic Performance Standard by implementing LID BMPs required for compliance with water quality requirements. As identified in Section 2.5.2, the User is required to use the SMRHM tool (or another acceptable continuous simulation model at the discretion of the City of Wildomar), which is an HSPF model overlaid with an interactive interface, to demonstrate compliance with the Hydrologic Performance Standard. A manual to this tool, the SMRHM Guidance Document (Appendix F), describes the specifics and functionality of the SMRHM and is available to all applicants at no cost.

The applicant should consider the full suite of LID BMPs and Hydrologic Control BMPs to manage runoff from the post-development condition and meet the Hydrologic Performance Standard identified in this section. The intent of this WQMP is not to specify the types of Hydrologic Control BMPs that can be used but rather identify the criteria that must be met, allowing flexibility for PDPs to use the full suite of BMPs to meet the Hydrologic Performance Standard. The applicant may consider the following in identifying the Hydrologic Control BMPs for incorporation in the design of the PDP:

- LID principles as defined in Section 3.2;
- Structural LID BMPs that may be modified or enlarged, if necessary, beyond the DCV;

- Structural Hydrologic Control BMPs are distinct from the LID BMPs. The LID BMP Design Handbook provides information not only on Hydrologic Control BMP design, but also on BMP design to meet the combined LID requirement and Hydrologic Performance Standard. The Handbook specifies the type of BMPs that can be used to meet the Hydrologic Performance Standard.

LID principles, structural LID BMPs, and structural Hydrologic Control BMPs can be modeled in the SMRHM or an alternative continuous simulation model acceptable to the City of Wildomar. SMRHM can be employed by the applicant not only to meet the Hydrologic Performance Standard, but also to meet the LID requirements. SMRHM incorporates additional BMPs that may be investigated by the applicant. For example, buffer zones for those PDPs adjacent to channels can be modeled and sized the meet the Hydrologic Performance Standard.

3.6.4. Meet the Sediment Supply Performance Standard

Bed Sediment Supply to a Receiving Channel may be reduced as compared to the pre-development condition. The purpose of the Sediment Supply Performance Standard is to maintain the pre-development supply of Bed Sediment to the Receiving Channel following urban development.

Complying with the Sediment Supply Performance Standard can be done in three ways:

1. Ensuring that any development as part of a PDP will not impact a Potential Critical Coarse Sediment Yield Area known to the Copermittees or a Potential Sediment Source Area as identified in Exhibit G of this WQMP,

2. Document compliance by completing a site-specific Critical Coarse Sediment Analysis, avoiding any areas determined to be actual verified Critical Coarse Sediment Yield Areas, and allow Critical Coarse Sediment to continue to be discharged to receiving waters, OR

3. Implement Sediment Supply BMPs that allow critical coarse sediment to be discharged such that there is no net impact to receiving waters.

3.6.4.a) Avoiding Critical Coarse Sediment Yield Areas

The simplest approach for complying with Sediment Supply Performance Standard is to avoid development of Potential Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas (Exhibit G). If a portion of a PDP is identified as a Potential Critical Coarse Sediment Yield Area or a Potential Sediment Source Area, that PDP may still achieve compliance with the Sediment Supply Performance Standards so long as development does not occur in those portions of the site

identified as Potential Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas and the sediment transport pathways (e.g., channels) are not interrupted.

PDP applicants should use Appendix G to this WQMP to identify any potential Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas on the PDP site and avoid developing or interrupting the flow of critical coarse sediment from those areas. If avoiding these areas is not feasible, PDP applicants should complete a site-specific Critical Coarse Sediment Analysis outlined below.

3.6.4.b) Site-Specific Critical Coarse Sediment Analysis

If a PDP intends to develop portions of a site classified as a Potential Critical Coarse Sediment Yield Area or a Potential Sediment Source Area, a Site-specific Critical Coarse Sediment Analysis must be performed according to the steps outlined below.

PDP proponents must perform a stepwise assessment to ensure the maintenance of the pre-project Bed Sediment Supply (Critical Coarse Sediment) according to the steps below.

Step 1: Determine whether Project Site is a Significant Source of Critical Coarse Sediment (i.e., Significant Source of Bed Sediment Supply) to the Channel Receiving Runoff

A triad approach will be completed to determine whether the project site is a Significant Source of Bed Sediment Supply to the channel receiving runoff and includes the following components:

- Site soil assessment, including an analysis and comparison of the Bed Sediment in the receiving channel and the onsite channel;
- Determination of the capability of the channels on the project site to deliver the site Bed Sediment (if present) to the receiving channel; and
- Present and potential future condition of the receiving channel.

Step 1A: Site soil assessment, including an analysis and comparison of the Bed Sediment in the channel receiving runoff and the onsite channels

A geotechnical and sieve analysis is the first piece of information to be used in a triad approach to determine if the project site is a Significant Source of Bed Sediment Supply to the assessment channel. An investigation must be completed of the assessment channel to complete a sieve analysis of the Bed Sediment. Two

samples will be taken of the assessment channel using the "reach" approach in the National Engineering Handbook, Part 654, Technical Supplement 13A (USDA, 2007a). Samples in each of the two locations should be taken using the surface and subsurface bulk sample technique for a total of four samples. Pebble counts may be required for some channels.

A similar sampling assessment should be conducted on the project site, also following Technical Supplement 13A. First-order and greater channels that may be impacted by the PDP (drainage area changed, stabilized, lined or replaced with underground conduits) will be analyzed in each subwatershed. First-order channels are identified as the unbranched channels that drain from headwater areas and develop in the uppermost topographic depressions, where two or more contour crenulations (notches or indentations) align and point upslope (National Engineering Handbook, Section 654, Chapter 3, USDA, 2007b). First-order channels may, in fact, be field ditches, gullies, or ephemeral gullies. One channel per subwatershed that may be impacted on the project site must be assessed. A subwatershed is defined as tributary to a single discharge point at the project site boundary.

The sieve analysis should report the coarsest 90% (by weight) of the sediment for comparison between the site and the assessment channel. The User should render an opinion if the Bed Sediment found on the site is of similar gradation to the Bed Sediment found in the receiving channel. The opinion will be based on the following information:

- Sieve analysis results
- Soil erodibility (K) factor
- Topographic relief of the project area
- Lithology of the soils on the project site

The User should rate the similarity of onsite Bed Sediment and Bed Sediment collected in the receiving channel as high, medium, or low.

Step 1B: Determination of the capability of the onsite channels to deliver Bed Sediment Supply (if present) to the channel receiving runoff from the project site.

The second piece of information is to qualitatively assess the sediment delivery potential of the channels on the project site to deliver the Bed Sediment Supply to the channel receiving runoff from the project site, or the Bed Sediment delivery potential or ratio. There are few documented procedures to estimate the Bed

Sediment delivery ratio (see: Williams, J. R., 1977: Sediment delivery ratios determined with sediment and runoff models. IAHS Publication (122): 168-179, as an example); it is affected by a number of factors, including the sediment source, proximity to the receiving channel, onsite channel density, project sub-watershed area, slope, length, land use and land cover, and rainfall intensity. The User will qualitatively assess the Bed Sediment delivery potential and rate the potential as high, medium, or low.

Step 1C: Present and potential future condition of the channel receiving runoff from the project site.

The final piece of information is the present and potential future condition of the channel receiving runoff from the project site. The User should assess the receiving channel for the following:

- Bank stability - Receiving channels with unstable banks may be more sensitive to changes in Bed Sediment Load.
- Degree of incision - Receiving channels with moderate to high incision may be more sensitive to changes in Bed Sediment Load.
- Bed Sediment gradation - Receiving channels with more coarse Bed Sediment (such as gravel) are better able to buffer change in Bed Sediment Load as compared to beds with finer gradation of Bed Sediment (sand).
- Transport vs. supply limited channels. Receiving channels that are transport limited may be better able to buffer changes in Bed Sediment Load as compared to channels that are supply limited.

The User will qualitatively assess the channel receiving runoff from the project site using the gathered observations and rate the potential for adverse response based on a change in Bed Sediment Load as high, medium, or low.

The User should use the triad assessment approach, weighting each of the components based on professional judgment to determine if the project site provides a Significant Source of Bed Sediment Supply to the receiving channel, and the impact the PDP would have on the receiving channel. The final assessment and recommendation must be documented in the Hydromodification portion of the WQMP.

The recommendation may be any of the following:

- Site is a Significant Source of Bed Sediment Supply (i.e., contains actual verified Critical Coarse Sediment Yield Areas) – all channels on the project site must be preserved or by-passed within the site plan.
- Site is a source of Bed Sediment Supply – some of the channels on the project site are actual verified Critical Coarse Sediment Yield Areas and must be preserved (with identified channels noted).
- Site is not a Significant Source of Bed Sediment Supply (i.e., not a source of Critical Coarse Sediment).

The final recommendation will be guided by the triad assessment. Projects with predominantly "high" values for each of the three assessment areas would indicate preservation of channels on the project site. Sites with predominantly "medium" values may warrant preservation of some of the channels on the project site, and sites with generally "low" values would not require site design considerations for Bed Sediment Load.

The User should also assess if the receiving channel has been altered either for alignment, cross section, or longitudinal grade, or has degraded to the extent that an in-channel restoration or rehabilitation project would be required to restore the functions and values of the channel bed. In such cases, the User should discuss options for participating in an in-channel project in lieu of onsite design features to preserve supply of Critical Coarse Sediment.

Step 2: Avoid Areas Identified as Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas in the Site Design and Maintain Sediment Supply Pathways.

If the analysis in Step 1 indicates that some or all of the channels on the project site must be preserved as a source of Critical Coarse Sediment to the receiving channel, the site plan should be developed to avoid impacting the identified channels. The User will designate channels on the project site that should be avoided to preserve the discharge of Critical Coarse Sediment from the site. The User may consider the factors discussed above when determining whether a specific channel on the project site is an Actual Critical Coarse Sediment Yield Area and should be preserved.

If the analysis in Step 1 shows that some reaches of the site channels upstream of the developed portion of the site are actual verified Critical Coarse Sediment Yield Areas, then the sediment transport pathways for this sediment must be maintained by preserving the channels that transport this sediment and/or bypassing the

sediment from these areas (e.g., sediment-carrying channels or pipes). Note: in many cases if there is an actual verified Critical Coarse Sediment Yield Area upstream, then the channel that transports this sediment would also be considered an actual verified Critical Coarse Sediment Yield Area.

3.6.4.c) Implement Sediment Supply BMPs

If impacts to actual verified Critical Coarse Sediment Yield Areas cannot be avoided, sediment supply BMPs must be implemented such there is no net impact to receiving waters. Sediment supply BMPs may consist of approaches that permit flux of bed sediment supply from actual verified Critical Coarse Sediment Yield Areas within the project boundary. This approach is subject to acceptance by the City of Wildomar. It may require extensive documentation and analysis by qualified professionals to support this demonstration.

Appendix H of the San Diego Model BMP Design Manual* provides additional information on site-specific investigation of Critical Coarse Sediment Supply areas and Sediment Supply BMPs.

3.7. IMPLEMENT TRASH CAPTURE BMPS

The City of Wildomar may require PDPs to comply with the trash capture requirements in this section. PDP project proponents should contact the City of Wildomar to determine if provisions in this section are applicable.

Runoff from Type 'D' DMAs, as defined in Section 2.3.4, must be addressed using Trash Capture BMPs. Trash Capture BMPs must be designed to treat Q_{TRASH}, the runoff flow rate generated during the 1-year 1-hour precipitation depth.

Table 3–7. Example Format for Sizing Trash Capture BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here*	
	[A]		[B]	[C]	[A] x [C]		
						Trash Capture Design Storm Intensity (in)	*Trash Capture Design Flow Rate (cubic feet or cfs)*

* http://www.projectcleanwater.org/download/2018-model-bmp-design-manual/

	$A_T = \Sigma[A]$			$\Sigma = [D]$	[E]	$[F] = \frac{[D]x[E]}{[G]}$	

[B], [C] are obtained as described in Section 2.6.1.b)

[E] is equal to the 1-year 1-hour precipitation depth as determined in Section 2.6.3.

[G] = 43,560.

Sizing criteria for LID BMPs may be subject to revisions. Prior to sizing any LID BMPs for full trash capture, users should review the most recent materials available from the State Water Resources Control Board Trash Implementation Website*.

3.8. SPECIFY SOURCE CONTROL BMPS

Some everyday activities–such as trash recycling/disposal and washing vehicles and equipment–may generate Pollutants that may discharge into the MS4. These Pollutants can be minimized by applying Source Control BMPs.

Source Control BMPs include Permanent, structural features (Source Control BMPs) that may be required in your Development Project plans—such as roofs over and berms around trash and recycling areas—and Operational BMPs, such as regular sweeping and "housekeeping", that must be implemented by the site's occupant or user. The MEP standard typically requires both types of BMPs. In general, Operational Source Control BMPs cannot be substituted for a feasible and effective Source Control BMP.

Use the following procedure to specify Source Control BMPs for the PDP site:

1. Identify Pollutant Sources. Review the PDP site plan to identify potential Pollutant sources such as, but not limited to:
    - Storm Drain Inlets
    - Floor Drains
    - Sump Pumps

* http://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html

- Pets Control/Herbicide Application
- Pools, Spas, Fountains and other water features
- Food Service Areas
- Trash Storage Areas
- Industrial Processes
- Outdoor storage areas
- Material storage areas
- Vehicle and Equipment Cleaning and Maintenance/Repair Areas
- Fueling areas
- Loading Docks
- Fire Sprinkler Test/Maintenance water
- Plazas, Sidewalks and Parking Lots

2. Identify in the Project-Specific WQMP the permanent Source Control BMPs, as applicable, for each identified source. At a minimum, the following Source Control BMPs must be implemented:

    1) Prevention of illicit discharges into the storm sewer

    2) Stenciling or signage on storm drain inlets indicating that discharges are not permissible

    3) Protection of outdoor material storage areas, outdoor work areas, and trash storage areas from rainfall, run-on, runoff, and wind dispersal

3. Using Table 3-8 as a model, identify in the Project-Specific WQMP the Operational Source Control BMPs, for each source, which should be implemented as long as the anticipated activities continue at the site. City of Wildomar Stormwater Ordinances require that applicable Source Control BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable Discretionary Approval for use of the site.

Table 3–8: Format for Table of Structural and Operational Source Control BMPs

Potential source of Runoff Pollutants	*Structural Source Control BMPs*	*Operational Source Control BMPs*

3.9. COORDINATE YOUR PROJECT-SPECIFIC WQMP DESIGN WITH OTHER SITE PLANS

Follow the guidance in Section 4.0 to verify that the Project-Specific WQMP, including all LID Principles, LID BMPs, Alternative Compliance measures, Hydrologic Control BMPs, and Source Control BMPs are properly identified on and coordinated with all other site plans, such as Architectural Plans, Improvement Plans, Construction Plans, and Landscaping Plans.

3.10. DEVELOP AN OPERATION AND MAINTENANCE PLAN

All Structural Control BMPs must be maintained and functional throughout the life of the project to ensure their ongoing effectiveness for protecting runoff quality and quantity. As required by the Regional MS4 Permit, the City of Wildomar will periodically verify that Structural Control BMPs on your site are maintained and continue to operate as designed.

To make this possible, the City of Wildomar will also require preparation and submittal of a Project-Specific WQMP Operation and Maintenance Plan.

Details of these requirements and instructions for preparing a Project-Specific WQMP Operation and Maintenance Plan are provided in Section 5.0.

3.11. INCORPORATING USEPA GREEN STREETS GUIDANCE

The Regional MS4 Permit specifies that projects that consist of retrofitting or redevelopment of existing paved alleys, streets, or roads may be exempted from classification as PDPs if they are designed and constructed in accordance with USEPA Green Streets Guidance. USEPA Green Streets guidance is documented in "Managing Wet Weather with Green Infrastructure: Green Streets*." As compared to requirements for PDPs, designing according to US EPA Green Streets Guidance is generally more opportunistic, requiring implementation of LID features when feasible within the

* USEPA Green Streets Guidance can be accessed at https://www.epa.gov/green-infrastructure/green-street-handbook

constraints of existing roadways. To qualify for this exemption, development projects shall be designed in and constructed in accordance with the US EPA Green Street Guidance to the MEP. This exemption removes the requirement that a Development Project complete a Project-Specific WQMP, however, such projects are still required to complete an analogous planning document that will be kept on file with the City of Wildomar. The following sections provide guidance for documenting that US EPA Green Streets Guidance is implemented to the MEP to qualify for the Green Streets PDP Exemption.

3.11.1. Site and Watershed Considerations for Applicable Green Streets Projects

Site and watershed assessment for applicable Green Streets projects includes many of the same considerations described in Sections 3.1 and 3.3. In addition, specific elements which should be given special consideration in the site assessment process for applicable Green Streets include:

- **Ownership of land adjacent to rights of way.** The opportunity to provide stormwater treatment may depend on the ownership of land adjacent to the right-of-way. Acquisition of additional right-of-way and/or access easements may be more feasible if land bordering the project is owned by relatively few land owners.

- **Location of existing utilities.** The location of existing storm drainage utilities can influence the opportunities for Green Streets infrastructure. For example, small stormwater bioretention and biofiltration BMPs can be designed to overflow along the curb-line to an existing storm drain inlet, thereby avoiding the infrastructure costs associated with an additional inlet. The location of other utilities will influence the ability to plumb BMPs to storm drains, and therefore, may limit the allowable placement of BMPs to only those areas where a clear pathway to the storm drain exists.

- **Grade differential between road surface and storm drain exists.** Some BMPs require more head from inlet to outlet than others; therefore, allowable head drop may be an important consideration in BMP selection for Green Streets. Storm drain elevations may be constrained by a variety of factors in a roadway project (utility crossings, outfall elevations, etc.) that cannot be overcome and may override stormwater management considerations.

- **Longitudinal slope.** The suite of LID BMPs which may be installed on steeper road sections is more limited. Specifically, permeable pavement and swales are more suitable for gentle grades. Other BMPs may be more readily terraced to be used on steeper slopes.

- **Potential access opportunities.** A significant concern with installation of BMPs in major right of ways is the ability to safely access the BMPs for maintenance considering traffic hazards. The site assessment should identify vehicle travel lanes and areas of specific safety hazards for maintenance crews. Whenever possible, designers should avoid placing BMPs in these areas.

3.11.2. Site Design and Drainage Plan for Applicable Green Streets Projects

Applicable Green Streets projects should apply the following LID site design measures to the MEP in the drainage plan as specified in the local permitting agency's codes:

- Minimize street width to the appropriate minimum width for maintaining traffic flow and public safety.
- Add tree canopy by planting or preserving trees/shrubs and providing adequate root volumes. See the Tree Well Fact Sheet in the LID Design Handbook (Exhibit C).
- Use porous pavement or pavers for low traffic roadways, on-street parking, shoulders or sidewalks.
- Integrate traffic calming measures in the form of bioretention and/or biofiltration curb extensions.

3.11.3. Selecting LID BMPs for Green Streets Projects

Infiltration feasibility should be conducted for green streets projects as described in Section 2.3.3. Specific attention should be given to the potential impact of infiltration on the structural integrity of the adjacent road bed.

Applicable Green Streets projects should select BMPs consistent with the Green Streets guidance. The fundamental tenants of the approach described by the USEPA Green Streets guidance include:

- Selecting LID BMPs to the opportunities of the site and to attempt to address pollutants of concern;
- Developing innovative stormwater management configurations integrating “green” with “grey” infrastructure; and
- Sizing BMPs opportunistically to provide stormwater pollution reduction to the MEP, accounting for the many competing considerations in right of ways.

Table 3–9 provides an inventory of LID BMPs which may be appropriate for applicable Green Streets projects. The performance criteria for applicable green streets projects

do not require Infiltration BMPs to be considered to the MEP before considering Biofiltration BMPs, Flow-Through Treatment Control BMPs, or other stormwater BMPs. A formal process of BMP prioritization and selection is not required for applicable Green Streets projects; however, infiltration infeasibility criteria still apply as documented in Table 2–4. In other words, only feasible BMPs may be selected and used.

BMPs should be prioritized based on a comparison of drainage area characteristics to the opportunity criteria listed in Table 3–9. The USEPA Green Streets guidance describes how some of these BMPs may be used in combination to achieve optimal benefits in runoff reduction and water quality improvement. Specific examples and applications for residential streets, commercial streets, arterials streets, and alleys are provided in the US EPA guidance.

The drainage patterns of the project should be developed so that drainage can be routed to areas with BMP opportunities before entering storm drains. For example, if a median strip is present, a reverse crown should be considered, where allowed, so that stormwater can drain to a median swale. Likewise, standard peak-flow curb inlets should be located downstream of areas with potential for stormwater bioretention or biofiltration planters so that water can first flow into the planter, and then overflow to the downstream inlet if capacity of the planter is exceeded. Design the project to treat runoff with green infrastructure before it enters the storm drain system.

Conceptual drainage plans for redevelopment projects should identify tributary areas outside of the project site that generate runoff that comingles with on-site runoff. The project is not required to treat off-site runoff; however, treatment of comingled off-site runoff may be used to off-set the inability to treat areas within the project for which significant constraints prevent the ability to provide treatment.

Table 3–9. Potential BMPs for Applicable Green Streets Projects

BMP Type	Opportunity Criteria for Applicable Green Streets Projects
Street Trees	• Access roads, residential streets, local roads and minor arterials • Drainage infrastructure, sea walls/break waters • Effective for projects with any slope • Trees may be prohibited along high speed roads for safety reasons or must be setback behind the clear zone or protected with guard rails and barriers
Stormwater Bioretention and Biofiltration BMPs located in Curb Extensions or Planters	• Access roads, residential streets, and local roads with parallel or angle parking and sidewalks • Can be designed to overflow back to curb line and to standard inlet • Shape is not important and can be integrated wherever unused space exists • Can be installed on relatively steep grades with terracing
Bioretention and Biofiltration Areas	• Low density residential streets without sidewalks • Requires more space than curb extensions/ planters, most feasibly implemented in combination with minimized road widths

BMP Type	Opportunity Criteria for Applicable Green Streets Projects
Permeable Pavement	• Parking and sidewalk areas of residential streets, and local roads • Should not receive significant run-on from major roads • Should not be subject to heavy truck/ equipment traffic • Light vehicle access roads
Permeable Friction Course Overlays	• High speed roadways unsuitable for full depth permeable pavement • Suitable for parking lots and all roadway types
Vegetated Swales	• Roadways with low to moderate slope • Residential streets with minimal driveway access • Minor to major arterials with medians or mandatory sidewalk set-backs • Access roads • Swales running parallel to storm drain can have intermittent discharge points to reduce required flow capacity
Filter strips (amended road shoulder)	• Access roads • Major roadways with excess ROW • Not practicable in most ROWs because of excessive width requirements
Proprietary Biofiltration	• Constrained ROWs • Typically have small footprint to tributary area ratio • Simple install and maintenance • Can be installed on roadways of any slope • Can be designed to overflow back to curb line and to standard inlet
Infiltration Trench	• Constrained ROWs • Can require small footprint where soils are suitable • Low to moderate traffic roadways • Infiltration trenches are not suitable for high traffic roadways • Requires robust pretreatment
Proprietary Flow-Through Treatment Control	• Highly constrained ROW with little available surface area • Installed in underground vaults, manholes, or catch basins • Require minimum available head loss • Simple installation and maintenance
WSDOT Media Filter Drains	• See : http://www.ecy.wa.gov/programs/wq/stormwater/newtech/use_designations/MFDwsdotGULD.pdf

3.11.4. BMP Sizing Targets for Applicable Green Streets Projects

Applicable green street projects are not required to meet the same sizing requirements for BMPs as other projects, but should attempt to meet a sizing target to the MEP. The following steps are used to size BMPs for applicable Green Streets projects:

1. Delineate drainage areas tributary to BMP locations and compute imperviousness.
2. Determine sizing goal by referring to sizing criteria presented in Section 2.3.2 (V_{BMP}).
3. Attempt to provide the target BMP sizing according to Step 2.

4. If the target criteria cannot be achieved, document the constraints that override the application of BMPs, and provide the largest portion of the sizing criteria that can be reasonably provided given constraints.

Even if BMPs cannot be sized to meet the target sizing criteria, it is still important to design the BMP inlet, energy dissipation, and overflow capacity for the full tributary area to ensure that flooding and scour is avoided. It is strongly recommended that BMPs which are designed to less than their target design volume be designed to bypass peak flows.

3.11.5. Trash Capture for Green Streets Projects

Application of full trash capture to a green street project is at the discretion of the City of Wildomar. It is advisable to incorporate trash capture BMPs into green streets projects when the project is within or adjacent to a priority land use, as defined in Section 2.5.

3.11.6. Alternative Compliance Options for Applicable Green Streets Projects

Applicable green streets projects are not Priority Development Projects and are not required to meet alternative compliance options if stormwater management controls described in this section, or equivalent, are installed in a manner consistent with the MEP standard.

Chapter
4

4.0 COORDINATION WITH OTHER SITE PLANS

Guidance for coordinating the Project-Specific WQMP with other site plans, including Architectural Plans, Grading Plans, Construction SWPPPs, and Landscaping Plans.

The Project-Specific WQMP must contain enough detail to demonstrate the planned LID Principles, LID BMPs, Trash Capture BMPs, Alternative Compliance measures, Hydrologic Control BMPs, and Source Control BMPs are feasible and are coordinated with the project construction plan, architectural renderings, grading plan, landscape design, and other information submitted with your application for development approvals.

4.1. PREPARE A PROJECT-SPECIFIC WQMP SITE PLAN

To help ensure that the PDP design has fully met the WQMP requirements and is coordinated with your other project plans, Users are required to prepare and submit a Project-Specific WQMP Site Plan with the Project-Specific WQMP. At a minimum, the Project-Specific WQMP Site Plan should include the following:

- Vicinity and location maps
- Drainage Management Areas
- Proposed Structural BMPs
- Drainage paths
- Drainage infrastructure, inlets, overflows
- Source Control BMPs
- Buildings, roof lines, downspouts
- Impervious surfaces
- Standard labeling

Use discretion on whether or not you may need to show additional information and/or to create multiple sheets to appropriately accommodate these features. Keep in mind that the City of Wildomar plan reviewer must be able to easily analyze your Project-Specific WQMP and Site plan, and compare those to your other plans and maps as described below to verify that applicable requirements will be met.

4.2. COORDINATION WITH ARCHITECTURAL PLANS

If the User is required by the City of Wildomar to submit information and presentations to design review committees, planning commissions, and other decision-making bodies, the User may be required to incorporate relevant aspects of the BMP design. In particular:

- The visual impact of Structural BMPs adjacent to building foundations and any terracing or retaining walls required for the BMP design should be shown in renderings and other architectural drawings.
- Renderings and representation of street views should incorporate Structural Control BMPs located in street-side buffers and setbacks.
- Potential conflicts with local development standards should be identified and resolved.
- Verify that the selected BMPs do not create conflicts with pedestrian access between parking and building entrances.
- Verify that potential conflicts with local development standards have been identified and resolved.

4.3. COORDINATION WITH IMPROVEMENT PLANS

Details of how the project BMPs are constructed can be critical to proper operation. A misplaced inlet, an overflow at the wrong elevation, or the wrong soil mix used in an LID BMP may delay project approvals and incur additional expenses.

Additional details identified in this section must be shown on plans submitted with applications for building and grading permits. During construction and at completion, City of Wildomar inspectors will verify the installation of BMPs against the approved plans.

LID principles and LID BMPs have been routinely incorporated into PDPs for only a few years. Land development professionals and City of Wildomar staff continue to compile and analyze "lessons learned" from their experiences. The following guidance is based on those lessons.

4.3.1. What to Show on Improvement Plans

With few exceptions, the plan set should include separate sheets specifically incorporating the BMPs described in the Project-Specific WQMP. The information on these sheets should be carefully coordinated and made consistent with grading plans, utility plans, landscaping plans, and (in many cases) architectural plans. Consider including the grading plan (screened) as background for the BMP sheets. It may also be appropriate to show portions of the roofing plan wherever roof ridges define DMAs. Additionally, utilizing different colors with associated legends will help the City of Wildomar reviewers differentiate the details shown on the construction plans with respect to grading and runoff management.

In particular, verify that relevant aspects of the BMP design are properly incorporated into your construction documents, including:

4.3.1.a) BMP Reference Table

The City of Wildomar plan checker will compare the Building and Grading plans with the Project-Specific WQMP. To facilitate the plan checker's comparison and speed review of your project, a WQMP Checklist should be prepared for your PDP.

Table 4–1: Format for BMP Reference Table

Project-Specific WQMP Page #	*BMP Identifier and Description*	*See Plan Sheet #s*

Here's how:

1) Create a table similar to Table 4–1. Number and list each measure or BMP specified in the Project-Specific WQMP in Columns 1 and 2 of the table. Leave Column 3 blank. Incorporate the table into the Project-Specific WQMP.

2) When you submit construction plans, duplicate the table (by photocopy or electronically). Now fill in Column 3, identifying the plan sheets where the BMPs are shown. List all plan sheets on which the BMP appears. Submit the updated table with your construction plans so that

the plan checker can quickly locate the Structural Control BMPs that were committed to in the Project-Specific WQMP.

Note that the updated table—or Construction Plan WQMP Checklist—is only a reference tool to facilitate comparison of the construction plans to the Project-Specific WQMP. The City of Wildomar plan checker can advise regarding the process required to propose changes, if any, to the approved Project-Specific WQMP.

4.3.1.b) Grading is Key

City of Wildomar plan checkers typically require grading plans to show each BMP in addition to the delineation of DMAs. Elevations, including the following, should be called out:

- Curbs, inlets, grade breaks and other features of the drainage design consistent with the delineation of the DMAs.
- Top of paving at curb cut inlets, top of curb and top of the bioretention soil layer.
- Grate elevation at overflow grates and the adjacent top of soil elevation.
- Piped inlets.

Show how DMAs follow grade breaks, consistent with the grading plan and the Project-Specific WQMP.

4.3.1.c) Show How Runoff Moves

As needed for clarity, show the direction of Runoff flow across roofs and pavement and into BMPs. For runoff conveyed via pipes or channels, show locations, slopes, and elevations at the beginning and end of each run.

For roof drainage, show the routing of roof downspouts, use drawings or notes to make clear how drainage from leaders is routed under walkways, across pavement, through drainage pipes, or by other means to reach the BMP.

Show pipes or channels connecting the BMP underdrain and overflow to the site drainage system, MS4, or other approved discharge point. Call out slopes and key elevations.

4.3.1.d) Landscaping and Utility Plans

- The Regional MS4 Permit requires the Copermittees to prohibit irrigation runoff. Any instance of irrigation water reaching the MS4 or Receiving Water is a violation of the City of Wildomar ordinances. Ensure that irrigation systems are designed to avoid the potential for irrigation runoff. For example, drip irrigation may be an appropriate technology to meet this objective.

- Vaults and utility boxes should be accommodated outside BMPs and not placed within Structural BMPs in a manner that may interfere with their performance and/or operation and maintenance.

- Landscaping plans, including planting plans, should identify locations of Structural BMPs and the plant requirements must be consistent with the engineered soils and conditions in the BMPs. For more information on plant species appropriate for LID Bioretention BMPs, see Appendix A of the LID Manual for Southern California:

https://www.casqa.org/resources/lid/socal-lid-manual

4.3.1.e) Show LID Principles and Structural BMPs in Cross-Section

Use one or more cross section drawings to illustrate details and key BMP elevations, including bottom of excavation, top of gravel layer, top of soil layer, edge treatments, inlet elevations, overflow grate elevations, rim elevations, locations of rock for energy dissipation, moisture barriers, and other information. If structural BMPs include gravel and soil mix, call out specifications or refer to specifications elsewhere for gravel and soil mix.

- Any area drains within Type B Self-Retaining areas should be identified with elevations of the inlet into the drain, such that the required retention depth will be provided.

- The top edge (overflow) of each BMP provides for the required ponding depth.

4.3.1.f) Develop Appropriate Specifications for Key BMP Materials and Construction Methods

Some materials used in BMPs should be provided to a different specification than similar materials not used in BMPs. For example, bioretention soil must meet more stringent specification than landscaping soil. Rock and sand used in underdrains and permeable pavement layers should typically be washed and provided to a more stringent specification than similar rock materials used in traditional pavement base layers. Similarly, the construction and placement of materials in

BMPs may differ than construction and placement of similar materials in other applications. Contractors may not appreciate these differences unless the specifications are clearly related to the BMPs they support. For these reasons, it is recommended to develop special specifications that describe how properties and placement of common construction materials should differ when they are used in a BMP.

4.4. COORDINATION WITH CONSTRUCTION ACTIVITIES

Successful construction of BMPs requires attention to detail during every stage of the construction process, from initial layout to rough grading, installation of utilities, construction of buildings, paving, landscaping, and final clean-up and inspection.

Construction project managers need to understand the purpose and function of BMPs and know how to avoid common missteps that can occur during construction. For LID BMPs, the following operating principles should be noted at a pre-construction meeting.

- Runoff flow from the intended tributary DMA must flow into the BMP.
- The surface reservoir must fill to its intended volume during high inflows.
- Runoff must filter rapidly through the filtration/soil layer.
- Filtered Runoff must infiltrate into the native soil to the extent feasible (or allowable).
- Remaining Runoff must be captured and drained to a storm drain or other approved location.

4.4.1. Coordination with Erosion and Sediment Control Plan/SWPPP

BMPs may not perform as designed if the BMP and the BMP location are not protected during site construction. It is important to specify that appropriate measures be taken by construction staff to protect these areas and BMPs. Be sure that all construction site staff is aware of these requirements, because historical construction habits may take time to change.

- Avoid intentional or unintentional compaction of planned landscaped areas, particularly areas that have been designated for infiltration such as Self-Retaining Areas, Infiltration and LID Bioretention BMPs. If these areas are compacted, or even just used as an access path for heavy equipment during site grading, then the soil structure and infiltration characteristics will be destroyed, and the BMP will not perform as designed. If this occurs, require

re-tilling and/or soil amendments as necessary to restore the infiltrative capacity of the underlying soils.

- Once any BMP is constructed, surround the BMP with Sediment Control BMPs, and maintain them until site occupancy is granted. Even small amounts of construction sediment can significantly affect the performance of the Sediment Control BMPs.
- Construct pervious pavements as the last order of work, if possible, to minimize the risk of clogging the constructed pervious pavement by sediment and debris generated from additional construction activities.

4.4.2. Items to Be Inspected During Construction

Verify that the project contract documents are sufficiently detailed to provide for the proper construction of the elements of the BMPs specified in the Project-Specific WQMP. See the example construction checklist on the following pages for ideas of items that may need to be verified in the contract documents and during construction.

EXAMPLE BMP CONSTRUCTION CHECKLIST

Staking

- ❒ Square footage of BMPs meets or exceeds minimum shown in Project-Specific WQMP
- ❒ Site grading and grade breaks are staked consistent with and sufficient to define the boundaries of the tributary Drainage Management Area(s) (DMAs) shown in the Project-Specific WQMP
- ❒ Inlet elevation of the BMP is low enough to receive drainage from the entire tributary DMA
- ❒ Locations and elevations of overland flow or piping, including roof leaders, from impervious areas to the BMP have been laid out and any conflicts resolved
- ❒ Rim elevation of the BMP is staked consistent with plans
- ❒ Locations for vaults, utility boxes, and light standards have been identified so that they will not conflict with BMPs

EXCAVATION (to be confirmed prior to backfilling or pipe installation)

- ❒ Excavation conducted with materials and techniques to minimize compaction of soils within the BMP area
- ❒ Excavation is to accurate area and depth
- ❒ Slopes or side walls protected from sloughing of native soils into the BMP
- ❒ Moisture barrier, if specified, has been added to protect adjacent pavement or structures
- ❒ Native soils at bottom of excavation are ripped or loosened to promote infiltration

OVERFLOW OR SURFACE CONNECTION TO MS4
(to be confirmed prior to backfilling with any materials)

- ❒ Overflow is at specified elevation (typically no lower than two inches below BMP rim)
- ❒ No knockouts or side inlets are in overflow riser
- ❒ Overflow location selected to minimize surface flow velocity (near, but offset from, inlet recommended)
- ❒ Grating excludes mulch and litter (beehive or atrium-style grates with ¼" openings recommended)
- ❒ Overflow structures are located away from inlets to the BMP
- ❒ Overflow is connected to storm drain or other specified outlet via appropriately sized piping

UNDERGROUND CONNECTION TO MS4 /OUTLET ORIFICE
(to be confirmed prior to backfilling BMP with any materials)

- ❒ Perforated pipe underdrain is installed with holes facing down
- ❒ Perforated pipe is connected to the specified discharge point
- ❒ Underdrain pipe is at elevation shown on plans. In facilities allowing infiltration, preferred elevation is above native soil but low enough to still be covered by the underdrain rock; in bioretention facilities that are sealed or with liners, preferred elevation is as near bottom as possible
- ❒ Cleanouts are in accessible locations and connected via sweeps
- ❒ Structures (arches or large diameter pipes) for additional surface storage are installed as shown in plans and specifications and have the specified volume

(continued)

Figure 4-1: Example BMP Construction Checklist

EXAMPLE BMP CONSTRUCTION CHECKLIST (CONTINUED)

DRAIN ROCK/SUBDRAIN (to be confirmed prior to installation of soil mix)

- ❒ Rock is installed as specified.
- ❒ Rock is smoothed to a consistent top elevation. Depth and top elevation are as shown in plans
- ❒ Slopes or side walls protected from sloughing of native soils into the BMP
- ❒ No filter fabric is placed between the subdrain and soil mix layers

SOIL MIX (FOR BIORETENTION)

- ❒ Soil mix is as specified. Quality of mix is confirmed by delivery ticket or onsite testing as appropriate to the size and complexity of the BMP
- ❒ Mix is not compacted during installation but may be thoroughly wetted to encourage consolidation
- ❒ Mix is smoothed to a consistent top elevation. Depth of mix and top elevation are as shown in plans, accounting for depth of mulch to follow and required reservoir depth

IRRIGATION

- ❒ Irrigation system is installed so it can be controlled separately from other landscaped areas. Smart irrigation controllers and drip emitters are recommended
- ❒ Spray heads, if any, are positioned to avoid direct spray into outlet structures

PLANTING

- ❒ Plants are installed consistent with approved planting plan
- ❒ Any trees and large shrubs are staked securely
- ❒ No clayey material, including inappropriate native soils are used in the BMP
- ❒ 1"-2" mulch may be applied following planting; mulch selected to avoid floating
- ❒ Final elevation of soil mix, including mulch, is maintained following planting
- ❒ Curb openings are free of obstructions

FINAL ENGINEERING INSPECTION

- ❒ Drainage Management Area(s) are free of construction sediment and landscaped areas are stabilized
- ❒ Inlets are installed to provide smooth entry of Runoff from adjoining pavement, have sufficient reveal (drop from the adjoining pavement to the top of the mulch or soil mix, and are not blocked
- ❒ Inflows from roof leaders and pipes are connected and operable
- ❒ Temporary flow diversions are removed
- ❒ Rock or other energy dissipation at piped or surface inlets is adequate
- ❒ Overflow outlets are configured to allow the BMP to flood and fill to near rim before overflow
- ❒ Plantings are healthy and becoming established
- ❒ Irrigation is operable
- ❒ If rains have occurred: BMP drains rapidly; no surface ponding is evident
- ❒ Any accumulated construction debris, trash, or sediment is removed from BMP
- ❒ Certification Statement from design professional that all BMPs have been constructed and/or installed in accordance with the approved plans and specs.

Chapter 5

5.0 PROJECT-SPECIFIC WQMP OPERATION & MAINTENANCE

How to prepare a customized Project-Specific WQMP Operation & Maintenance Plan for the BMPs on your PDP site.

Provision E.3.e of the Regional MS4 Permit requires that each Copermittee must verify that Structural BMPs are adequately maintained. Copermittees must report the results of these verifications to the San Diego Regional Board annually.

Structural BMPs installed as part of the PDP will be incorporated into the City of Wildomar's verification program. This is a five-stage process:

1) Determine who will own the Structural BMPs and be responsible for its maintenance in perpetuity and document this in the Project-Specific WQMP. The Project-Specific WQMP must also identify the means by which ongoing maintenance will be assured (for example, a maintenance agreement that runs with the land).

2) Identify project-specific maintenance requirements, allow for these requirements in your project planning and preliminary design, and document the typical maintenance requirements in the Project-Specific WQMP.

3) Prepare a Project-Specific WQMP Operation and Maintenance Plan (WQMP O&M Plan) for the site incorporating detailed requirements for each LID, Conventional Treatment and Hydrologic Control BMP. Other types of LID Principles, such as self-retaining areas may also require operation and maintenance to ensure that they continue to function as designed. Typically, a draft Project-Specific WQMP Operation and Maintenance Plan must be submitted with the Final Project-Specific WQMP, and a final Project-Specific WQMP Operation and Maintenance Plan must be submitted to and approved by the City

of Wildomar prior to issuance of a certificate of occupancy. Local requirements vary as to schedule. Check with City of Wildomar staff.

4) Maintain the Structural BMPs from the time they are constructed until ownership and maintenance responsibility is formally transferred to the site owner/operator.

5) **Maintain** the BMPs in perpetuity and comply with the City of Wildomar's self-inspection, reporting, and verification requirements.

Table 5–1: Schedule for Planning the Project-Specific WQMP Operation and Maintenance Plan

Stage	*Description*	*Where documented*	*Schedule*
1	Determine BMP ownership and maintenance responsibility	Preliminary Project-Specific WQMP	Discuss with project owner at initial project planning phase
2	Identify Project-Specific maintenance requirements	Preliminary Project-Specific WQMP	Submit with planning & zoning application
3	Develop detailed operation and maintenance plan	Final Project-Specific WQMP	Submit draft with Building Permit application; final due before building permit final and applying for a Certificate of Occupancy
4	Interim operation and maintenance of BMPs	As required by the City of Wildomar O&M verification program	During and following construction including warranty period
5	Ongoing maintenance and compliance with inspection & reporting requirements	As required by the City of Wildomar O&M verification program	In perpetuity

5.1. STAGE 1: OWNERSHIP AND MAINTENANCE RESPONSIBILITY

Ownership & maintenance responsibility for Structural BMPs should be discussed as early as due diligence and definitely at the beginning of project planning. Experience has shown that provisions to implement and finance maintenance of Structural BMPs can be a major stumbling block to project approval, particularly for small residential subdivisions.

Your Project-Specific WQMP must specify:

1) Who will be responsible for maintaining the site in conformance with the WQMP Operation & Maintenance Plan.

2) The means for financing the maintenance of Structural BMPs in perpetuity once the BMP is implemented and the Development Project is complete. This should include the mechanisms for the eventual replacement of the BMP or elements of the BMP.

3) How the maintenance obligations will carry over to subsequent owners, as further described in Sections 5.1.1 through 5.1.3 below.

5.1.1. Private Ownership and Maintenance

The City of Wildomar may require—as a condition of project approval—that a maintenance agreement be executed and recorded against the title of the property. Consult with the City of Wildomar for a copy of any required maintenance agreement.

The agreement will thereby "run with the land", so the maintenance agreement executed by a developer is binding on the owners of the subdivided lots and subsequent owners. The agreement must be recorded prior to conveyance of the subdivided property.

5.1.2. Transfer to Public Ownership

Some Copermittees may have developed a process by which a Structural BMP can be deeded to the public in fee or as an easement, for public maintenance. The Copermittee may recoup the costs of maintenance through a special tax, assessment district, or similar mechanism.

☞ Check with the City of Wildomar to determine if any such 'public maintenance' mechanisms are in place, and for any associated requirements.

Transferring a LID BMP to Public Ownership may create additional design constraints; however, it removes the burden from the site owner/operator from having to maintain the BMP in perpetuity. Because PDP sites typically drain to the street, it may be possible to locate a BMP parallel to the street and within road right of way, or on a common, publicly-accessible lot.

Even if the Structural BMP is to be deeded or transferred to the City of Wildomar after construction is complete, it is still the responsibility of the User, to maintain the BMP in accordance with the Project-Specific WQMP O&M Plan until that responsibility is formally transferred to the subsequent owner.

5.1.3. City of Wildomar Projects

Public projects (such as Public Works/Capital Improvement Projects) implemented by the City of Wildomar will be maintained by the City of Wildomar in accordance with a Facility Pollution Prevention Plan as described in the City of Wildomar's JRMP.

5.2. STAGE 2: IDENTIFY MAINTENANCE REQUIREMENTS

Include in the Project-Specific WQMP a description of the maintenance requirements for each Structural BMP, including for any self-retaining and/or landscaped self-treating areas. This will help ensure that:

- Ongoing costs of Structural BMP maintenance have been considered in BMP selection and design.
- Site and landscaping plans provide for access for inspections and by maintenance equipment.
- Landscaping plans incorporate irrigation requirements for Structural BMP plantings as appropriate.
- Initial maintenance and replacement of Structural BMP plantings is incorporated into landscaping contracts and guarantees.

Fact sheets in the LID BMP Design Handbook describe typical maintenance requirements for many of the Structural BMPs described in this WQMP. Use this information, or other requirements specified by the City of Wildomar to specify the maintenance requirements for each of the Structural BMPs, including LID BMPs, Conventional Treatment Control BMPs, Hydrologic Control BMPs, and Source Control BMPs identified in the Project-Specific WQMP. In addition, identify any necessary maintenance requirements for any other LID Principles that were incorporated into the project, such as buffer areas, etc.

5.3. STAGE 3: DEVELOP PROJECT-SPECIFIC WQMP OPERATIONS &MAINTENANCE PLAN

Submit a draft Project-Specific WQMP O&M Plan with your final Project-Specific WQMP included with the application for permits to begin grading or construction on the site. A final Project-Specific WQMP O&M Plan (updated as necessary) will be required to be submitted with the 'as-built' plans and approved before occupancy is granted.

The final Project-Specific WQMP O&M Plan should incorporate solutions to any problems noted or changes that occurred during construction.

The Final Project-Specific WQMP O&M Plan and 'as-built' plans must be submitted to and approved by the City of Wildomar before a building permit can be made final and a certificate of permanent occupancy issued.

The Project-Specific WQMP and WQMP O&M Plan must be kept onsite for use by maintenance personnel and during site inspections.

The following step-by-step guidance will help you prepare each required section of your WQMP O&M Plan. Preparation of the Plan will require familiarity with the Structural BMPs as they have been designed/constructed and a fair amount of "thinking through" plans for their operation and maintenance. The text and forms provided here will assist you, but are no substitute for thoughtful planning.

5.3.1. Step 1: Designate Responsible Individuals

To begin creating the Project-Specific WQMP O&M Plan, the User must designate and identify:

- The individual who will have direct responsibility for the maintenance of the BMPs identified in the Project-Specific WQMP O&M Plan. This individual should be the designated contact with City of Wildomar inspectors and should sign self-inspection reports and any correspondence with the City of Wildomar regarding verification inspections. The City of Wildomar may accept self-certification or third-party certification by a California licensed Professional Engineer.
- Employees or contractors who will report to the designated contact and are responsible for conducting all required operation and maintenance.
- The corporate officer authorized to negotiate and execute contracts that might be necessary for future changes to operation and maintenance of the BMPs identified in the Project-Specific WQMP O&M Plan or to implement remedial measures if problems occur.
- The designated respondent to problems with the BMPs, such as clogged drains or broken irrigation mains, that would require immediate response should they occur during off-hours.

Include an organization chart to show the relationships of authority and responsibility between the individuals responsible for Project-Specific WQMP operation and maintenance. This need not be elaborate, particularly for smaller organizations.

Describe how funding for operation and maintenance will be assured, including sources of funds, budget category for expenditures, process for establishing the annual maintenance budget, and process for obtaining authority should unexpected expenditures for major corrective maintenance be required.

Describe how training of staff or contractors regarding the purpose, mode of operation, and maintenance requirements for the BMPs Identified in the Project-

Specific WQMP O&M Plan will be provided. Also, describe how ongoing training will be provided as needed and in response to staff changes.

5.3.2. Step 2: Summarize Drainage and BMPs

Incorporate the following information from the Project-Specific WQMP into the Project-Specific WQMP O&M Plan:

- Figures delineating and designating DMAs
- Figures showing locations of BMPs on the site
- Tables of the DMAs served by each Structural BMP

Verify that these figures incorporate changes that may have occurred during planning and zoning review, building permit review, or construction.

5.3.3. Step 3: Document BMPs 'As-Built'

Once each Structural BMP is constructed, plans for the BMP must be 'as-built' by a licensed civil/geotechnical engineer registered in the State of California and submitted to the City of Wildomar, and also included as part of the Project-Specific WQMP O&M Plan. The information contained on the 'as-built' plans must be consistent with standard engineering practice. Following is a list of types of information that should be documented on 'as-built' plans as applicable and appropriate:

- Plans, elevations, and details of all Structural BMPs. Annotate if necessary with designations used in the Project-Specific WQMP.
- Design information or calculations submitted in the detailed design phase (i.e., not included in the Project-Specific WQMP).
- Specifications of construction of the Structural BMPs, including sand or soil, compaction, pipe materials, and bedding.

In the final Project-Specific WQMP O&M Plan, incorporate field changes to design drawings, including changes to any of the following:

- Location and layouts of inflow piping, flow splitter boxes, and piping to offsite discharge.
- Depths and layering of soil, sand, or gravel.
- Placement of filter fabric or geotextiles.
- Changes or substitutions in soil or other materials.

- Natural soils encountered (e.g., sand or clay lenses).
- Vegetation type within or around the BMP.
- Changes in tree types.
- Fencing around the BMP.
- Etc.

5.3.4. Step 4: Prepare Customized Maintenance Plans including Long Term O&M Criteria

Prepare a maintenance plan, schedule, and inspection checklists (e.g. routine, annual, and after major storms) for each Structural BMP including for any self-retaining and/or landscaped self-treating areas. Plans and schedules for two or more similar BMPs on the same site may be combined. The O&M Plan must include long term maintenance criteria for BMP. These criteria are found in the LID Design Handbook.

Use the following resources to prepare the customized maintenance plan, schedule, and checklists.

- Specific information noted in Steps 2 and 3, above.
- Other input from the Structural BMP designer, City of Wildomar staff, or other sources.
- BMP Fact Sheets in the LID BMP Design Handbook, as applicable.

Note any particular characteristics or circumstances that may require attention in the future, and include any troubleshooting advice.

Also include in an appendix any manufacturer's data, operating manuals, and maintenance requirements for any:

- Pumps or other mechanical equipment.
- Proprietary devices used as or in conjunction with BMPs.

Manufacturers' publications should be referenced in the text (including models and serial numbers where available). Copies of the manufacturers' publications should be included as an attachment in the back of the Project-Specific WQMP O&M Plan or as a separate document.

5.3.5. Step 5: Compile O&M Plan

The Project-Specific WQMP O&M Plan should follow the general outline below.

I. Inspection and Maintenance Log

II. Updates, Revisions and Errata

III. Introduction

Narrative overview describing the site; drainage areas, routing, and discharge points; and Structural BMPs

> **Note** that for [Insert Jurisdiction] Projects, the WQMP O&M Plan requirements will be incorporated into a new or existing, Facility Pollution Prevention Plans (FPPP).

IV. Responsibility for Maintenance

A. General

1) Name and contact information for responsible individual(s).

2) Organization chart or charts of the maintenance function and location within the overall organization.

3) Reference to Operation and Maintenance Agreement (if any). A copy of the agreement should be attached.

4) Maintenance Funding

a. Sources of funds for maintenance

b. Budget category or line item

c. Description of procedure and process for ensuring adequate funding for maintenance

B. Staff Training Program

C. Records

D. Safety

V. Summary of DMAs and BMPs

A. DMAs

1) Drawings showing pervious and impervious areas (copied or adapted from Project-Specific WQMP)

2) Designation and description of each DMA and how flow is routed to the corresponding BMP

B. Structural BMPs

1) Drawings showing location and type of each Structural Post-Construction BMP

2) General description of each BMP (consider a table if more than two BMPs)

(b) DMA and routing of discharge

(c) BMP type and size

VI. BMP Design Documentation

A. 'As-built' drawings of each Structural BMP (design drawings in the draft Plan).

B. Manufacturer's data (as applicable) including manuals, and maintenance requirements for pumps, mechanical or electrical equipment, and proprietary facilities (include a "placeholder" in the draft Project-Specific WQMP Operations and Maintenance Plan for information not yet available at the draft phase).

C. Specific operation and maintenance concerns and troubleshooting.

VII. Maintenance Schedule or Matrix

A. Maintenance Schedule for each Structural BMP with specific requirements for:

(1) Routine inspection and maintenance

(2) Annual inspection and maintenance

(3) Inspection and maintenance after major storms

B. Service Agreement Information

Assemble and make copies of the Project-Specific WQMP O&M Plan. One or more copies must be submitted to the City of Wildomar, including one electronic copy. At least one copy must be kept onsite. Following are some suggestions for formatting the Project-Specific WQMP O&M Plan:

- Format plans to 8½" x 11" to facilitate duplication, filing, and handling

- Include the revision date in the footer on each page
- Scan graphics and incorporate with text into a single electronic file. Keep the electronic file backed up so that copies of the Project-Specific WQMP O&M Plan can be made if the hard copy is lost or damaged.

5.3.6. Step 6: Updates

The Stormwater Control Operation and Maintenance Plan (or Facility Pollution Prevention Plan for City of Wildomar projects) will be a living document and, thus, will require periodic updates by the Facility/Activity Manager at least annually. There are two types of updates, each with their own implications as noted below. Note that these are examples of minimum thresholds that should be verified with the City of Wildomar for specific direction and advisement.

- Minor Updates – Turnover of named maintenance personnel, mechanical equipment, addition of maintenance procedures, etc.
- Major Updates – Relocation of BMPs, modification of maintenance schedule(s) of BMPs, change in legal ownership and/or party responsible for maintaining the BMPs in perpetuity, major site re-grading or re-paving that can affect DMAs, changing one BMP for an alternative BMP, etc.

Updates may be transmitted to the City of Wildomar at any time. However, at a minimum, updates to the O&M Plan must be maintained, implemented, and available to City of Wildomar inspectors. These updates should reference the sections of the O&M Plan being changed. In addition, major updates may necessitate a revision to the Project-Specific WQMP and as such may cause the need for the document to be re-recorded. Consult with the City of Wildomar before performing any major updates to the approved and implemented Project-Specific WQMP. Conversely, updates may not require re-recordation if they are consistent with the original, executed agreement.

Failure to maintain an up-to-date copy of the O&M Plan may be a violation of City of Wildomar requirements subject to fines and/or other penalties.

5.4. STAGE 4: INTERIM OPERATION & MAINTENANCE

The User is responsible for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent property owner. Users may be required to warranty Stormwater BMPs against lack of performance due to flaws in design or construction for a minimum of two rainy seasons following completion

of construction. The warranty may need to be secured by a bond or other financial instrument if required by the City of Wildomar.

5.5. STAGE 5: OPERATION & MAINTENANCE VERIFICATION

The City of Wildomar implements a program to ensure that the Structural BMPs are operating and are maintained properly and all BMPs are working effectively to remove Pollutants in Runoff from the site. This may include periodic site inspections, or requirements for self-certifications by a licensed professional engineer. This program will be described by the City of Wildomar in their respective JRMP.

5.6. REFERENCES AND RESOURCES

- *Start at the Source* (BASMAA, 1999) pp. 139-145.
- *Urban Runoff Quality Management* (WEF/ASCE, 1998). pp 186-189.
- *Stormwater Management Manual* (Portland, 2004). Chapter 3.
- *California Stormwater Best Management Practice Handbooks* (CASQA, 2003).
- *Best Management Practices Guide* (Public Telecommunications Center for Hampton Roads, 2002).
- Operation, Maintenance, and Management of Stormwater Management Systems (Watershed Management Institute, 1997)

Bibliography

ASCE. 1996. American Society of Civil Engineers. *Hydrology Handbook, Second Edition*. ASCE Manuals and Reports on Engineering Practice No. 28. ISBN 0-7844-0138-1. 784 pp.

Association of Bay Area Governments. 1986. Manual of Standards for Erosion and Sediment Control Measures.

BASMAA. 1999. Bay Area Stormwater Management Agencies Association. *Start at the Source: Design Guidance Manual for Stormwater Quality*. Tom Richman and Associates. 154 pp. plus appendix. (on CCCWP website)

BASMAA. 2003. *Using Site Design Techniques to Meet Development Standards for Stormwater Quality*. www.basmaa.org

Bledsoe, B.P., Hawley, R.J., Stein, E.D., Booth, D.B., 2010. Hydromodification screening tools: field manual for assessing channel susceptibility. Technical report 606. Southern California Coastal Water Research Project, Costa Mesa, CA.

Brown and Caldwell, 2011. San Diego County Hydromodification Management Plan (March 2011). http://www.projectcleanwater.org/images/stories/Docs/LDS/HMP/0311_SD_HMP_wAppendices.pdf

California Governor's Office of Planning and Research (OPR). 2009. CEQA and Low Impact Development Stormwater Design: Preserving Stormwater Quality and Stream Integrity through California Environmental Quality Act (CEQA) Review. www.opr.ca.gov/ceqa/pdfs/Technical_Advisory_LID.pdf

CASQA. 2003. California Stormwater Quality Association. *California Stormwater BMP Handbooks*. Four Handbooks: *New Development and Redevelopment, Construction, Municipal, and Industrial/Commercial*. www.cabmphandbooks.org

SMC. 2010. Stormwater Monitoring Coalition. *Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies*. Prepared for the Southern California Stormwater Monitoring Coalition in cooperation with the State Water Resources Control Board by the Low Impact Development Center. www.casqa.org/LID/SoCalLID/tabid/218/Default.aspx

Environmental Science Associates (ESA), Weston Solutions, and Alta Environmental, 2016. Effectiveness Assessment of The San Diego Hydromodification Management Plan, Final Report. November 2016.

Ferguson, Bruce K. 2005. *Porous Pavements*. CRC Press.

Federal Interagency Stream Restoration Working Group. 1998. *Stream Restoration: Principles, Processes, and Practices*. http://www.nrcs.usda.gov/technical/stream_restoration/

Hampton Roads, VA. 2002. *Best Management Practices Guide*. Public Telecommunications Center. http://www.hrstorm.org/BMP.shtml

Low Impact Development Center. 2006. *LID for Big-Box Retailers*. 75 pp. http://lowimpactdevelopment.org/bigbox/

Maryland. 2000. State of Maryland. *Maryland Stormwater Design Manual*. www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp

Orange County Stormwater Program (2017). Model WQMP and Technical Guidance Document for South Orange County.

Portland. City of Portland, OR. *2004 Stormwater Management Manual*. http://www.portlandonline.com/bes/index.cfm?c=35117

Prince George's County, Maryland. 1999. *Low-Impact Development Design Strategies: An Integrated Design Approach.* Department of Environmental Resources, Programs and Planning Division. June 1999. 150 pp. http://www.epa.gov/owow/nps/lid/

Prince George's County, Maryland. 2007. *Bioretention Manual.* Department of Environmental Resources, Programs and Planning Division. http://www.princegeorgescountymd.gov/Government/AgencyIndex/DER/ESG/Bioretention/bioretention.asp

Puget Sound Action Team. 2005. Low Impact Development Technical Guidance Manual for Puget Sound. http://www.psat.wa.gov/Publications/LID_tech_manual05/lid_index.htm

Riley, Ann. 1998. *Restoring Streams in Cities.* Island Press, Washington, DC. 425 pp. http://www.islandpress.org/bookstore/details.php?isbn=9781559630429

Riverside County Flood Control and Water Conservation District, 2011. Design Handbook for Low Impact Development Best Management Practices.

RWQCB, 2010. California Regional Water Quality Control Board for the Santa Ana Region. NPDES Permit and Waste Discharge Requirements from the Municipal Separate Storm Sewer Systems (MS4s) Draining the County of Riverside, the Incorporated Cities of Riverside County, and the Riverside County Flood Control and Water Conservation District within the San Diego Region. Order R9-2010-0016.

San Diego County Land Development Work Group (2016). Model BMP Design Manual for San Diego County.

Salvia, Samantha. 2000. "Application of Water-Quality Engineering Fundamentals to the Assessment of Stormwater Treatment Devices." Santa Clara Valley Urban Runoff Pollution Prevention Program. Tech. Memo, 15 pp. www.scvurppp-w2k.com/pdfs/9798/SC18.02finalTM.pdf

Schueler, Tom. 1995. *Site Planning for Urban Stream Protection.* Environmental Land Planning Series. Metropolitan Washington Council of Governments. 232 pp.

USDA, 2007a. Technical Supplement 13A: Guidelines for Sampling Bed Material, Part 654, National Engineering Handbook. https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17835.wba

USDA, 2007b. Chapter 3, Site Assessment and Investigation, Part 654 Stream Restoration Design, National Engineering Handbook. https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17779.wba

USEPA. 2008. *Managing Wet Weather with Green Infrastructure Municipal Handbook: Rainwater Harvesting Policies.* http://cfpub.epa.gov/npdes/greeninfrastructure/technology.cfm

USEPA. 2009a. *Green Roofs for Stormwater Runoff Control.* http://cfpub.epa.gov/npdes/greeninfrastructure/technology.cfm

USEPA. 2009b. *Stormwater Management Handbook: Implementing Green Infrastructure in Northern Kentucky Communities.* http://www.epa.gov/smartgrowth/publications.htm

Washington Department of Ecology. 2001. Stormwater Management Manual for Western Washington. www.ecy.wa.gov/biblio/9911.html

Watershed Management Institute. 1997. *Operation, Maintenance, and Management of Stormwater Management Systems.*

WEF/ASCE. 1998. Water Environment Foundation/American Society of Civil Engineers. Urban Runoff Quality Management. WEF Manual of Practice No. 23, ASCE Manual and Report on Engineering Practice No. 87. ISBN 1-57278-039-8 ISBN 0-7844-0174-8. 259 pp. Access: Order from WEF or ASCE, www.wef.org or www.asce.org.

EXHIBIT A:

Isohyetal Map for the 85th Percentile 24-hour Storm Event

R 07 W | R 06 W | R 05 W | R 04 W | R 03 W | R 02 W | R 01 W | R 01 E | R 02 E | R 03 E | R 04 E | R 05 E

T 01 S
T 02 S
T 03 S
T 04 S
T 05 S
T 06 S
T 07 S
T 08 S

06	05	04	03	02	01
07	08	09	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

0.85 MiraLoma
0.61 RiversideNorth
0.54 RiversideSouth
0.68 PigeonPass
0.66 MorenoEast
0.85 Beaumont
0.88 PradoDam
0.51 Woodcrest
0.50 LakeMathews
0.68 PerrisReservoir
0.87 VistaGrandeGS
0.70 SanJacintoNWS
1.18 Idyllwild
0.58 SunCity
0.68 Winchester
0.90 HurkeyCreek
0.70 ElsinoreNWS
1.11 ElCarisoStation
0.77 WildomarLaCresta
0.52 SkinnerLake
0.65 Anza
0.77 SantaRosaPlateau
1.00 TemeculaNWS
0.64 AguangaValley

Santa Ana River Watershed
Santa Margarita Watershed

JURUPA VALLEY | EASTVALE | NORCO | CORONA | RIVERSIDE | MORENO VALLEY | CALIMESA | BEAUMONT | SAN JACINTO | PERRIS | HEMET | CANYON LAKE | LAKE ELSINORE | WILDOMAR | MENIFEE | MURRIETA | TEMECULA

N

Rain Gage Locations

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

Isohyetal Map for the 85th Percentile 24 hour Storm Event

July 2011

EXHIBIT B:

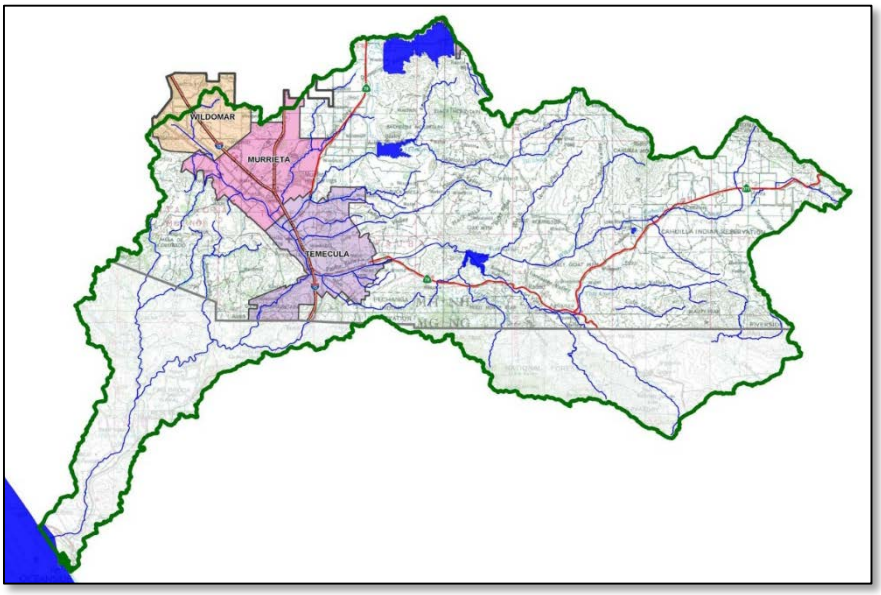
Model Project-Specific WQMP Template

Project Specific Water Quality Management Plan (WQMP)

A Template for preparing Project Specific Water Quality Management Plans (WQMPs) for Priority Development Projects located in the City of Wildomar.

Attention: This submittal package only applies to "Priority Development Projects" and does not apply to "Other Development Projects". Proceed only if the Applicabilty Checklist completed for your project categorizes project activities as a "Priority Development Project."

Project Title:	Insert text here	**Prepared for:**	Insert Developer Name, Address, and Phone Number
Development No:	Insert text here	**Prepared by:**	Insert Name and Title of Preparer, address, and Phone Number
City Project No:	Insert text here	**WQMP Type:**	☐ **Preliminary (entitlement submittal)** ☐ **Final**



Original Date Prepared: Insert text here

Revision Summary (post WQMP acceptance):

MARK	**BY**	**DATE**	**REVISIONS**	**APPRV.**	**DATE**
ENGINEER				**CITY**	

Prepared for Compliance with Regional Board Order No. **R9-2013-0001** *as amended by Order No.* **R9-2015-0001** *and Order No.* **R9-2015-0100**

A Brief Introduction

The Regional Municipal Separate Stormwater Sewer System (MS4) Permit[1] requires that a Project-Specific WQMP be prepared for all development projects within the Santa Margarita Region (SMR) that meet the 'Priority Development Project' categories and thresholds listed in the SMR Water Quality Management Plan (WQPM). This Project-Specific WQMP Template for Development Projects in the **Santa Margarita Region** has been prepared to help document compliance and prepare a WQMP submittal. Below is a flowchart for the layout of this Template that will provide the steps required to document compliance.

[1] Order No. R9-2013-0001 as amended by Order Nos. R9-2015-0001 and R9-2015-0100, NPDES No. CAS0109266, National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the MS4s Draining the Watersheds within the San Diego Region, California Regional Water Quality Control Board, May 8, 2013.

OWNER'S CERTIFICATION

This Project-Specific WQMP has been prepared for <Owner's Name> by <Preparer's Name> for the <Project Name> project.

This WQMP is intended to comply with the requirements of the City of Wildomar for Wildomar Municipal Code Ch. 13.12 which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of storm water Best Management Practices until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under the City of Wildomar Water Quality Ordinance (Wildomar Municipal Code Ch. 13.12).

"I, the undersigned, certify under penalty of law that the provisions of this WQMP have been reviewed and accepted and that the WQMP will be transferred to future successors in interest."

Owner's Signature	Date
Owner's Printed Name	Owner's Title/Position

PREPARER'S CERTIFICATION

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control Best Management Practices (BMPs) in this plan meet the requirements of Regional Water Quality Control Board Order No. **R9-2013-0001** as amended by Order Nos. **R9-2015-0001 and R9-2015-0100**."

Preparer's Signature	Date
Preparer's Printed Name	Preparer's Title/Position

Preparer's Licensure:

Table of Contents

Section A: Project and Site Information 0
A.1 Maps and Site Plans 1
A.2 Identify Receiving Waters 1
A.3 Drainage System Susceptibility to Hydromodification 2
A.4 Additional Permits/Approvals required for the Project: 2
Section B: Optimize Site Utilization (LID Principles) 4
Section C: Delineate Drainage Management Areas (DMAs) 9
Section D: Implement LID BMPs 20
D.1 Full Infiltration Applicability 20
D.2 Biofiltration Applicability 22
D.3 Feasibility Assessment Summaries 24
D.4 LID BMP Sizing 26
Section E: Implement Hydrologic Control BMPs and Sediment Supply BMPs 28
E.1 Hydrologic Control BMP Selection 28
E.2 Hydrologic Control BMP Sizing 29
E.3 Implement Sediment Supply BMPs 29
Section F: Alternative Compliance 34
F.1 Identify Pollutants of Concern 34
F.2 Treatment Control BMP Selection 37
F.3 Sizing Criteria 37
F.4 Hydrologic Performance Standard – Alternative Compliance Approach 38
Section G: Implement Trash Capture BMPs 39
Section H: Source Control BMPs 41
Section I: Coordinate Submittal with Other Site Plans 42
Section J: Operation, Maintenance and Funding 43
Section K: Acronyms, Abbreviations and Definitions 44

List of Tables

Table A-1 Identification of Receiving Waters 1
Table A-2 Identification of Susceptibility to Hydromodification 2
Table A-3 Other Applicable Permits 2
Table C-1 DMA Identification 9
Table C-2 Type 'A', Self-Treating Areas 17
Table C-3 Type 'B', Self-Retaining Areas 18
Table C-4 Type 'C', Areas that Drain to Self-Retaining Areas 18
Table C-5 Type 'D', Areas Draining to BMPs 19
Table D-1 Infiltration Feasibility 21
Table D-2 Geotechnical Concerns for Onsite Infiltration 22
Table D-3 Evaluation of Biofiltration BMP Feasibility 23
Table D-4 Proprietary BMP Approval Requirement Summary 23
Table D-5 LID Prioritization Summary Matrix 24
Table D-6 DCV Calculations for LID BMPs 26
Table D-7 LID BMP Sizing 27
Table E-1 Hydrologic Control BMP Sizing 29
Table E-2 Triad Assessment Summary 32
Table F-1 Summary of Approved 2010 303(d) listed waterbodies and associated pollutants of concern for the Riverside County SMR Region and downstream waterbodies. 35
Table F-2 Potential Pollutants by Land Use Type 36
Table F-3 Treatment Control BMP Selection 37
Table F-4 Treatment Control BMP Sizing 37
Table F-5 Offsite Hydrologic Control BMP Sizing 38
Table G-1 Sizing Trash Capture BMPs 39
Table G-2 Approximate precipitation depth/intensity values for calculation of the Trash Capture Design Storm 39
Table G-3 Trash Capture BMPs 40
Table I-1 Construction Plan Cross-reference 42
Table I-2 Other Applicable Permits 42

List of Appendices

Appendix 1: Maps and Site Plans 51
Appendix 2: Construction Plans 52
Appendix 3: Soils Information 53
Appendix 4: Historical Site Conditions 54
Appendix 5: LID Infeasibility 55

Appendix 6: BMP Design Details 56
Appendix 7: Hydromodification 57
Appendix 8: Source Control 58
Appendix 9: O&M 59
Appendix 10: Educational Materials 60

Section A: Project and Site Information

Use the table below to compile and summarize basic site information that will be important for completing subsequent steps. Subsections A.1 through A.4 provide additional detail on documentation of additional project and site information.

PROJECT INFORMATION		
Type of PDP:	Insert text here (e.g. New Development or Redevelopment)	
Type of Project:	Insert text here (e.g., commercial, residential, etc.)	
Planning Area:	Insert Planning Area if known	
Community Name:	Insert Community Name if known	
Development Name:	Insert Development Name if known	
PROJECT LOCATION		
Latitude & Longitude (DMS):	Insert coordinates here	
Project Watershed and Sub-Watershed:	Santa Margarita River or Santa Ana River (select one), Insert HSA here (see Section A.2)	
24-Hour 85th Percentile Storm Depth (inches):	Insert text here, refer to SMR WQMP Exhibit A	
Is project subject to Hydromodification requirements?	☐ Y ☐ N (Select based on Section A.3)	
APN(s):	Insert text here	
Map Book and Page No.:	Insert text here	
PROJECT CHARACTERISTICS		
Proposed or Potential Land Use(s)		Insert text here
Proposed or Potential SIC Code(s)		Insert text here
Existing Impervious Area of Project Footprint (SF)		Insert text here
Total area of proposed Impervious Surfaces within the Project Limits (SF)/or Replacement		Insert text here
Total Project Area (ac)		Insert text here
Does the project consist of offsite road improvements?		☐ Y ☐ N
Does the project propose to construct unpaved roads?		☐ Y ☐ N
Is the project part of a larger common plan of development (phased project)?		☐ Y ☐ N
Is the project exempt from Hydromodification Performance Standards?		☐ Y ☐ N
Does the project propose the use of Alternative Compliance to satisfy BMP requirements? (note, alternative compliance is not allowed for coarse sediment performance standards)		☐ Y ☐ N
Has preparation of Project-Specific WQMP included coordination with other site plans?		☐ Y ☐ N
EXISTING SITE CHARACTERISTICS		
Is the project located within any Multi-Species Habitat Conservation Plan area (MSHCP Criteria Cell?)		☐ Y ☐ N If "Y" insert Cell Number
Are there any natural hydrologic features on the project site?		☐ Y ☐ N
Is a Geotechnical Report attached?		☐ Y ☐ N
If no Geotech. Report, list the Natural Resources Conservation Service (NRCS) soils type(s) present on the site (A, B, C and/or D)		Insert text here.

A.1 Maps and Site Plans

When completing your Project-Specific WQMP, include a map of the Project vicinity and existing site. In addition, include all grading, drainage, landscape/plant palette and other pertinent construction plans in Appendix 2. At a **minimum**, your WQMP Site Plan should include the following:

- Vicinity and location maps
- Parcel Boundary and Project Footprint
- Existing and Proposed Topography
- Drainage Management Areas (DMAs)
- Proposed Structural Best Management Practices (BMPs)
- Drainage Paths
- Drainage infrastructure, inlets, overflows
- Source Control BMPs
- Site Design BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces
- Pervious Surfaces (i.e. Landscaping)
- Standard Labeling

Use your discretion on whether or not you may need to create multiple sheets or can appropriately accommodate these features on one or two sheets. Keep in mind that the Copermittee plan reviewer must be able to easily analyze your Project utilizing this template and its associated site plans and maps. Complete the checklists in Appendix 1 to verify that all exhibits and components are included.

A.2 Identify Receiving Waters

Using Table A-1 below, list in order of upstream to downstream, the Receiving Waters that the Project site is tributary to. Continue to fill each row with the Receiving Water's 303(d) listed impairments (if any), designated Beneficial Uses, and proximity, if any, to a RARE Beneficial Use. Include a map of the Receiving Waters in Appendix 1. This map should identify the path of the storm water discharged from the site all the way to the outlet of the Santa Margarita River to the Pacific Ocean. Use the most recent 303(d) list available from the State Water Resources Control Board Website.
(http://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/)

Table A-1 Identification of Receiving Waters

Receiving Waters	USEPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Insert name of 1st receiving water	List any 303(d) impairments of 1st receiving water, including Approved TMDL pollutant limitations	Insert designated beneficial use of 1st receiving water	Insert distance of project to RARE-designated waters (indicate whether feet, yards, or miles)
insert name of 2nd receiving water	List any 303(d) impairments of 2nd receiving water, including Approved TMDL pollutant limitations	Insert designated beneficial use of 2nd receiving water	Insert distance of project to RARE-designated waters (indicate whether feet, yards, or miles)
Insert name of 3rd receiving water	List any 303(d) impairments of 3rd receiving water, including Approved TMDL pollutant limitations	Insert designated beneficial use of 3rd receiving water	Insert distance of project to RARE-designated waters (indicate whether feet, yards, or miles)

A.3 Drainage System Susceptibility to Hydromodification

Using Table A-2 below, list in order of the point of discharge at the project site down to the Santa Margarita River[2], each drainage system or receiving water that the project site is tributary to. Continue to fill each row with the material of the drainage system, and any exemption (if applicable). Based on the results, summarize the applicable hydromodification performance standards that will be documented in Section E. Exempted categories of receiving waters include:

- Existing storm drains that discharge directly to water storage reservoirs, lakes, or enclosed embayments, or
- Conveyance channels whose bed and bank are concrete lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean.
- Other water bodies identified in an approved Watershed Management Area Analysis (WMAA) (See Exhibit G to the WQMP)

Include a map exhibiting each drainage system and the associated susceptibility in Appendix 1.

Table A-2 Identification of Susceptibility to Hydromodification

Drainage System	Drainage System Material	Hydromodification Exemption	Hydromodification Exempt
Insert name and length (in miles) of 1st drainage system	Identify either (1) the type of material of bed and bank for open channels; or (2) the material of storm drain pipes and conduits	Insert exemption justification for the 1st receiving water may qualify for. If none, insert NONE.	☐ Y ☐ N
Insert name and length (in miles) of 2nd drainage system	Identify either (1) the type of material of bed and bank for open channels; or (2) the material of storm drain pipes and conduits	Insert exemption justification for the 2nd receiving water may qualify for. If none, insert NONE.	☐ Y ☐ N
Insert name and length (in miles) of 3rd drainage system	Identify either (1) the type of material of bed and bank for open channels; or (2) the material of storm drain pipes and conduits	Insert exemption justification for the 3rd receiving water may qualify for. If none, insert NONE.	☐ Y ☐ N
Summary of Performance Standards			
☐ **Hydromodification Exempt** – Select if "Y" is selected in the Hydromodification Exempt column above, project is exempt from hydromodification requirements. ☐ **Not Exempt**-Select if "N" is selected in any row of the Hydromodification Exempt column above. Project is subject to hydrologic control requirements and may be subject to sediment supply requirements.			

A.4 Additional Permits/Approvals required for the Project:

Table A-3 Other Applicable Permits

Agency	Permit Required	
State Department of Fish and Game, 1602 Streambed Alteration Agreement	☐ Y	☐ N
State Water Resources Control Board, Clean Water Act Section 401 Water Quality Certification	☐ Y	☐ N
US Army Corps of Engineers, Clean Water Act Section 404 Permit	☐ Y	☐ N

[2] Refer to Exhibit G of the WQMP for a map of exempt and potentially exempt areas. These maps are from the Draft SMR WMAA as of January 5, 2018 and will be replaced upon acceptance of the SMR WMAA.

US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	☐ Y	☐ N
Statewide Construction General Permit Coverage	☐ Y	☐ N
Statewide Industrial General Permit Coverage	☐ Y	☐ N
Western Riverside Multiple Species Habitat Conservation Plan (MSHCP) Consistency Approval (e.g., Joint Project Review (JPR), Determination of Biological Equivalent or Superior Preservation (DBESP))	☐ Y	☐ N
Other *(please list in the space below as required)*	☐ Y	☐ N

If yes is answered to any of the questions above, the Copermittee may require proof of approval/coverage from those agencies as applicable including documentation of any associated requirements that may affect this Project-Specific WQMP.

Section B: Optimize Site Utilization (LID Principles)

Review of the information collected in Section 'A' will aid in identifying the principal constraints on site design and selection of LID BMPs as well as opportunities to reduce imperviousness and incorporate LID Principles into the site and landscape design. For example, constraints might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, utility locations or safety concerns. Opportunities might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which can double as locations for LID Bioretention BMPs), and differences in elevation (which can provide hydraulic head). Prepare a brief narrative for each of the site optimization strategies described below. This narrative will help you as you proceed with your Low Impact Development (LID) design and explain your design decisions to others.

Apply the following LID Principles to the layout of the Priority Development Project (PDP) to the extent they are applicable and feasible. Putting thought upfront about how best to organize the various elements of a site can help to significantly reduce the PDP's potential impact on the environment and reduce the number and size of Structural LID BMPs that must be implemented. Integrate opportunities to accommodate the following LID Principles within the preliminary PDP site layout to maximize implementation of LID Principles.

Site Optimization

Complete checklist below to determine applicable Site Design BMPs for your site.

Project- Specific WQMP Site Design BMP Checklist

The following questions below are based upon Section 3.2 of the SMR WQMP will help you determine how to best optimize your site and subsequently identify opportunities and/or constraints, and document compliance.

SITE DESIGN REQUIREMENTS

Answer the following questions below by indicating "Yes," "No," or "N/A" (Not Applicable). Justify all "No" and "N/A" answers by inserting a narrative at the end of the section. The narrative should include identification and justification of any constraints that would prevent the use of those categories of LID BMPs. Upon identifying Site Design BMP opportunities, include these on your WQMP Site plan in Appendix 1.

☐ Yes ☐ No ☐ N/A

Did you identify and preserve existing drainage patterns?

Integrating existing drainage patterns into the site plan helps to maintain the time of concentration and infiltration rates of runoff, decreasing peak flows, and may also help preserve the contribution of Critical Coarse Sediment (i.e., Bed Sediment Supply) from the PDP to the Receiving Water. Preserve existing drainage patterns by:

- Minimizing unnecessary site grading that would eliminate small depressions, where appropriate add additional "micro" storage throughout the site landscaping.
- Where possible conform the PDP site layout along natural landforms, avoid excessive grading and disturbance of vegetation and soils, preserve or replicate the sites natural drainage features and patterns.
- Set back PDP improvements from creeks, wetlands, riparian habitats and any other natural water bodies.
- Use existing and proposed site drainage patterns as a natural design element, rather than using expensive impervious conveyance systems. Use depressed landscaped areas, vegetated buffers, and bioretention areas as amenities and focal points within the site and landscape design.

Discuss how this was included or provide a discussion/justification for "No" or "N/A" answer.
Insert discussion/justification here

☐ Yes ☐ No ☐ N/A

Did you identify and protect existing vegetation?

Identify any areas containing dense native vegetation or well-established trees, and try to avoid disturbing these areas. Soils with thick, undisturbed vegetation have a much higher capacity to store and infiltrate runoff than do disturbed soils. Reestablishment of a mature vegetative community may take decades. Sensitive areas, such as streams and floodplains should also be avoided.

- Define the development envelope and protected areas, identifying areas that are most suitable for development and areas that should be left undisturbed.
- Establish setbacks and buffer zones surrounding sensitive areas.
- Preserve significant trees and other natural vegetation where possible.

Discuss how this was included or provide a discussion/justification for "No" or "N/A" answer. *Insert discussion/justification here*

Project- Specific WQMP Site Design BMP Checklist	
☐ Yes ☐ No ☐ N/A	**Did you identify and preserve natural infiltration capacity?** A key component of LID is taking advantage of a site's natural infiltration and storage capacity. A site survey and geotechnical investigation can help define areas with high potential for infiltration and surface storage. • Identify opportunities to locate LID Principles and Structural BMPs in highly pervious areas. Doing so will maximize infiltration and limit the amount of runoff generated. • Concentrate development on portions of the site with less permeable soils, and preserve areas that can promote infiltration.
Discuss how this was included or provide a discussion/justification for "No" or "N/A" answer. *Insert discussion/justification here*	
☐ Yes ☐ No ☐ N/A	**Did you minimize impervious area?** Look for opportunities to limit impervious cover through identification of the smallest possible land area that can be practically impacted or disturbed during site development. • Limit overall coverage of paving and roofs. This can be accomplished by designing compact, taller structures, narrower and shorter streets and sidewalks, clustering buildings and sharing driveways, smaller parking lots (fewer stalls, smaller stalls, and more efficient lanes), and indoor or underground parking. • Inventory planned impervious areas on your preliminary site plan. Identify where permeable pavements, or other permeable materials, such as crushed aggregate, turf block, permeable modular blocks, pervious concrete or pervious asphalt could be substituted for impervious concrete or asphalt paving. This will help reduce the amount of Runoff that may need to be addressed through Structural BMPs. • Examine site layout and circulation patterns and identify areas where landscaping can be substituted for pavement, such as for overflow parking. • Consider green roofs. Green roofs are roofing systems that provide a layer of soil/vegetative cover over a waterproofing membrane. A green roof mimics pre-development conditions by filtering, absorbing, and evapotranspiring precipitation to help manage the effects of an otherwise impervious rooftop.
Discuss how this was included or provide a discussion/justification for "No" or "N/A" answer. *Insert discussion/justification here*	

Project- Specific WQMP Site Design BMP Checklist	
☐ Yes ☐ No ☐ N/A	**Did you identify and disperse runoff to adjacent pervious areas or small collection areas?** Look for opportunities to direct runoff from impervious areas to adjacent landscaping, other pervious areas, or small collection areas where such runoff may be retained. This is sometimes referred to as reducing Directly Connected Impervious Areas. • Direct roof runoff into landscaped areas such as medians, parking islands, planter boxes, etc., and/or areas of pervious paving. Instead of having landscaped areas raised above the surrounding impervious areas, design them as depressed areas that can receive Runoff from adjacent impervious pavement. For example, a lawn or garden depressed 3"-4" below surrounding walkways or driveways provides a simple but quite functional landscape design element. • Detain and retain runoff throughout the site. On flatter sites, smaller Structural BMPs may be interspersed in landscaped areas among the buildings and paving. • On hillside sites, drainage from upper areas may be collected in conventional catch basins and piped to landscaped areas and LID BMPs and/or Hydrologic Control BMPs in lower areas. Low retaining walls may also be used to create terraces that can accommodate LID BMPs. Wherever possible, direct drainage from landscaped slopes offsite and not to impervious surfaces like parking lots. • Reduce curb maintenance and provide for allowances for curb cuts. • Design landscaped areas or other pervious areas to receive and infiltrate runoff from nearby impervious areas. • Use Tree Wells to intercept, infiltrate, and evapotranspire precipitation and runoff before it reaches structural BMPs. Tree wells can be used to limit the size of Drainage Management Areas that must be treated by structural BMPs. Guidelines for Tree Wells are included in the Tree Well Fact Sheet in the LID BMP Design Handbook.
Discuss how this was included or provide a discussion/justification for "No" or "N/A" answer. *Insert discussion/justification here*	
☐ Yes ☐ No ☐ N/A	**Did you utilize native or drought tolerant species in site landscaping?** Wherever possible, use native or drought tolerant species within site landscaping instead of alternatives. These plants are uniquely suited to local soils and climate and can reduce the overall demands for potable water use associated with irrigation.
Discuss how this was included or provide a discussion/justification for "No" or "N/A" answer. *Insert discussion/justification here*	

Project- Specific WQMP Site Design BMP Checklist

☐ Yes ☐ No ☐ N/A

Did implement harvest and use of runoff?

Under the Regional MS4 Permit, Harvest and Use BMPs must be employed to reduce runoff on any site where they are applicable and feasible. However, Harvest and Use BMPs are effective for retention of stormwater runoff only when there is adequate demand for non-potable water during the wet season. If demand for non-potable water is not sufficiently large, the actual retention of stormwater runoff will be diminished during larger storms or during back-to-back storms.

For the purposes of planning level Harvest and Use BMP feasibility screening, Harvest and Use is only considered to be a feasible if the total average wet season demand for non-potable water is sufficiently large to use the entire DCV within 72 hours. If the average wet season demand for non-potable water is not sufficiently large to use the entire DCV within 72 hours, then Harvest and Use is not considered to be feasible and need not be considered further.

The general feasibility and applicability of Harvest and Use BMPs should consider:

- Any downstream impacts related to water rights that could arise from capturing storm water (not common).
- Conflicts with recycled water used – where the project is conditioned to use recycled water for irrigation, this should be given priority over storm water capture as it is a year-round supply of water.
- Code Compliance - If a particular use of captured storm water, and/or available methods for storage of captured storm water would be contrary to building codes in effect at the time of approval of the preliminary Project-Specific WQMP, then an evaluation of harvesting and use for that use would not be required.
- Wet season demand – the applicant shall demonstrate, to the acceptance of the [Insert Jurisdiction], that there is adequate demand for harvested water during the wet season to drain the system in a reasonable amount of time.

Discuss how this was included or provide a discussion/justification for "No" or "N/A" answer. *Insert discussion/justification here*

☐ Yes ☐ No ☐ N/A

Did you keep the runoff from sediment producing pervious area hydrologically separate from developed areas that require treatment?

Pervious area that qualify as self-treating areas or off-site open space should be kept separate from drainage to structural BMPs whenever possible. This helps limit the required size of structural BMPs, helps avoid impacts to sediment supply, and helps reduce clogging risk to BMPs.

Discuss how this was included or provide a discussion/justification for "No" or "N/A" answer. *Insert discussion/justification here*

Section C: Delineate Drainage Management Areas (DMAs)

This section provides streamlined guidance and documentation of the DMA delineation and categorization process, for additional information refer to the procedure in Section 3.3 of the SMR WQMP which discusses the methods of delineating and mapping your project site into individual DMAs. Complete Steps 1 to 4 to successfully delineate and categorize DMAs.

Step 1: Identify Surface Types and Drainage Pathways

Carefully delineate pervious areas and impervious areas (including roofs) throughout site and identify overland flow paths and above ground and below ground conveyances. Also identify common points (such as BMPs) that these areas drain to.

Step 2: DMA Delineation

Use the information in Step 1 to divide the entire PDP site into individual, discrete DMAs. Typically, lines delineating DMAs follow grade breaks and roof ridge lines. Where possible, establish separate DMAs for each surface type (e.g., landscaping, pervious paving, or roofs). Assign each DMA a unique code and determine its size in square feet. The total area of your site should total the sum of all of your DMAs (unless water from outside the project limits comingles with water from inside the project limits, i.e. run-on). Complete Table C-1

Table C-1 DMA Identification

DMA Name or Identification	Surface Type(s)[1]	Area (Sq. Ft.)	DMA Type
Enter Unique Code	Enter Pervious, Impervious, or Mixed	Enter Area in Square Feet	To be Determined in Step 3
Enter Unique Code	Enter Pervious, Impervious, or Mixed	Enter Area in Square Feet	
Enter Unique Code	Enter Pervious, Impervious, or Mixed	Enter Area in Square Feet	
Enter Unique Code	Enter Pervious, Impervious, or Mixed	Enter Area in Square Feet	
Enter Unique Code	Enter Pervious, Impervious, or Mixed	Enter Area in Square Feet	
Enter Unique Code	Enter Pervious, Impervious, or Mixed	Enter Area in Square Feet	

Add Columns as Needed

Step 3: DMA Classification

Determine how drainage from each DMA will be handled by using information from Steps 1 and 2 and by completing Steps 3.A to 3.C. Each DMA will be classified as one of the following four types:

- Type 'A': Self-Treating Areas:
- Type 'B': Self-Retaining Areas
- Type 'C': Areas Draining to Self-Retaining Areas
- Type 'D': Areas Draining to BMPs

Step 3.A – Identify Type 'A' Self-Treating Area

Indicate if the DMAs meet the following criteria by answering "Yes" or "No".

☐ Yes ☐ No — Area is undisturbed from their natural condition OR restored with Native and/or California Friendly vegetative covers.

☐ Yes ☐ No — Area is irrigated, if at all, with appropriate low water use irrigation systems to prevent irrigation runoff.

☐ Yes ☐ No Runoff from the area will not comingle with runoff from the developed portion of the site, or across other landscaped areas that do not meet the above criteria.

If all answers indicate "Yes," complete Table C-2 to document the DMAs that are classified as Self-Treating Areas.

Table C-2 Type 'A', Self-Treating Areas

DMA Name or Identification	Area (Sq. Ft.)	Stabilization Type	Irrigation Type (if any)

Step 3.B – Identify Type 'B' Self-Retaining Area and Type 'C' Areas Draining to Self-Retaining Areas

Type 'B' Self-Retaining Area: A Self-Retaining Area is shallowly depressed 'micro infiltration' areas designed to retain the Design Storm rainfall that reaches the area, without producing any Runoff.

Indicate if the DMAs meet the following criteria by answering "Yes," "No," or "N/A".

☐ Yes ☐ No ☐ N/A Slopes will be graded toward the center of the pervious area.

☐ Yes ☐ No ☐ N/A Soils will be freely draining to not create vector or nuisance conditions.

☐ Yes ☐ No ☐ N/A Inlet elevations of area/overflow drains, if any, should be clearly specified to be three inches or more above the low point to promote ponding.

☐ Yes ☐ No ☐ N/A Pervious pavements (e.g., crushed stone, porous asphalt, pervious concrete, or permeable pavers) can be self-retaining when constructed with a gravel base course four or more inches deep below any underdrain discharge elevation.

If all answers indicate "Yes," DMAs may be categorized as Type 'B', proceed to identify Type 'C' Areas Draining to Self-Retaining Areas.

Type 'C' Areas Draining to Self-Retaining Areas: Runoff from impervious or partially pervious areas can be managed by routing it to Self-Retaining Areas consistent with the LID Principle discussed in SMR WQMP Section 3.2.5 for 'Dispersing Runoff to Adjacent Pervious Areas'.
Indicate if the DMAs meet the following criteria by answering "Yes" or "No".

☐ Yes ☐ No The drainage from the tributary area must be directed to and dispersed within the Self-Retaining Area.

☐ Yes ☐ No Area must be designed to retain the entire Design Storm runoff without flowing offsite.

If all answers indicate "Yes," DMAs may be categorized as Type 'C'.

Complete Table C-3 and Table C-4 to identify Type 'B' Self-Retaining Areas and Type 'C' Areas Draining to Self-Retaining Areas.

Table C-3 Type 'B', Self-Retaining Areas

Self-Retaining Area				Type 'C' DMAs that are draining to the Self-Retaining Area		
DMA Name/ ID	Post-project surface type	Area (square feet) [A]	Storm Depth (inches) [B]	DMA Name / ID	[C] from Table C-4= [C]	Required Retention Depth (inches) [D] = $[B] + \frac{[B]\cdot[C]}{[A]}$

Table C-4 Type 'C', Areas that Drain to Self-Retaining Areas

DMA					Receiving Self-Retaining DMA		
DMA Name/ ID	Area (square feet) [A]	Post-project surface type	Runoff factor [B]	Product [C] = [A] x [B]	DMA name /ID	Area (square feet) [D]	Ratio [C]/[D]

Note: (See Section 3.3 of SMR WQMP) Ensure that partially pervious areas draining to a Self-Retaining area do not exceed the following ratio:

$$\left(\frac{2}{Impervious\ Fraction}\right) : 1$$

(Tributary Area**:** Self-Retaining Area)

Step 3.C – Identify Type 'D' Areas Draining to BMPs

Areas draining to BMPs are those that could not be fully managed through LID Principles (DMA Types A through C) and will instead drain to an LID BMP and/or a Conventional Treatment BMP designed to manage water quality impacts from that area, and Hydromodification where necessary.

Complete Table C-5 to document which DMAs are classified as Areas Draining to BMPs

Table C-5 Type 'D', Areas Draining to BMPs

DMA Name or ID	BMP Name or ID Receiving Runoff from DMA

Note: More than one DMA may drain to a single LID BMP; however, one DMA may not drain to more than one BMP.

Section D: Implement LID BMPs

The Regional MS4 Permit requires the use of LID BMPs to provide retention or treatment of the DCV and includes a BMP hierarchy which requires Full Retention BMPs (Priority 1) to be considered before Biofiltration BMPs (Priority 2) and Flow-Through Treatment BMPs and Alternative Compliance BMPs (Priority 3). LID BMP selection must be based on technical feasibility and should be considered early in the site planning and design process. Use this section to document the selection of LID BMPs for each DMA. Note that feasibility is based on the DMA scale and may vary between DMAs based on site conditions.

D.1 Full Infiltration Applicability

An assessment of the feasibility of utilizing full infiltration BMPs is required for all projects, *except where it can be shown that site design LID principals fully retain the DCV (i.e., all DMAs are Type A, B, or C), or where Harvest and Use BMPs fully retain the DCV. Check the following box if applicable:*

☐ Site design LID principals fully retain the DCV (i.e., all DMAs are Type A, B, or C), (Proceed to Section E).

If the above box remains unchecked, perform a site-specific evaluation of the feasibility of Infiltration BMPs using each of the applicable criteria identified in Chapter 2.3.3 of the SMR WQMP and complete the remainder of Section D.1.

Geotechnical Report

A Geotechnical Report or Phase I Environmental Site Assessment may be required by the Copermittee to confirm present and past site characteristics that may affect the use of Infiltration BMPs. In addition, the Copermittee, at their discretion, may not require a geotechnical report for small projects as described in Chapter 2 of the SMR WQMP. If a geotechnical report has been prepared, include it in Appendix 3. In addition, if a Phase I Environmental Site Assessment has been prepared, include it in Appendix 4.

Infiltration Feasibility

Table D-1 below is meant to provide a simple means of assessing which DMAs on your site support Infiltration BMPs and is discussed in the SMR WQMP in Chapter 2.3.3. Check the appropriate box for each question and then list affected DMAs as applicable. If additional space is needed, add a row below the corresponding answer.

Table D-1 Infiltration Feasibility

Downstream Impacts (SMR WQMP Section 2.3.3.a)		
Does the project site…	**YES**	**NO**
…have any DMAs where infiltration would negatively impact downstream water rights or other Beneficial Uses[3]?		
If Yes, list affected DMAs:		
Groundwater Protection (SMR WQMP Section 2.3.3.b)		
Does the project site…	**YES**	**NO**
…have any DMAs with industrial, and other land uses that pose a high threat to water quality, which cannot be treated by Bioretention BMPs? Or have DMAs with active industrial process areas?		
If Yes, list affected DMAs:		
…have any DMAs with a seasonal high groundwater mark shallower than 10 feet?		
If Yes, list affected DMAs:		
…have any DMAs located within 100 feet horizontally of a water supply well?		
If Yes, list affected DMAs:		
…have any DMAs that would restrict BMP locations to within a 2:1 (horizontal: vertical) influence line extending from any septic leach line?		
If Yes, list affected DMAs:		
…have any DMAs been evaluated by a licensed Geotechnical Engineer, Hydrogeologist, or Environmental Engineer, who has concluded that the soils do not have adequate physical and chemical characteristics for the protection of groundwater, and has treatment provided by amended media layers in Bioretention BMPs been considered in evaluating this factor?		
If Yes, list affected DMAs:		
Public Safety and Offsite Improvements (SMR WQMP Section 2.3.3.c)		
Does the project site…	**YES**	**NO**
…have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact?		
If Yes, list affected DMAs:		
Infiltration Characteristics For LID BMPs (SMR WQMP Section 2.3.3.d)		
Does the project site…	**YES**	**NO**
…have factored infiltration rates of less than 0.8 inches / hour? (Note: on a case-by-case basis, the City may allow a factor of safety as low as 1.0 to support selection of full infiltration BMPs. Therefore, measured infiltration rates could be as low as 0.8 in/hr to support full infiltration. A higher factor of safety would be required for design in accordance with the LID BMP Deign Handbook).		
If Yes, list affected DMAs:		
Cut/Fill Conditions (SMR WQMP Section 2.3.3.e)		
Does the project site…	**YES**	**NO**
…have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface?		
If Yes, list affected DMAs:		
Other Site-Specific Factors (SMR WQMP Section 2.3.3.f)		
Does the project site…	**YES**	**NO**
…have DMAs where the geotechnical investigation discovered other site-specific factors that would preclude effective and/or safe infiltration?		
Describe here:		

If you answered "Yes" to any of the questions above for any DMA, Infiltration BMPs that rely solely on infiltration should not be used for those DMAs and you should proceed to the assessment for Biofiltration BMPs below. Biofiltration BMPs that provide partial infiltration may still be feasible and should be

[3] Such a condition must be substantiated by sufficient modeling to demonstrate an impact and would be subject to [Insert Jurisdiction] discretion. There is not a standardized method for assessing this criterion. Water rights evaluations should be site-specific.

assessed in Section D.2. Summarize concerns identified in the Geotechnical Report, if any, that resulted in a "YES" response above in the table below.

Table D-2 Geotechnical Concerns for Onsite Infiltration

Type of Geotechnical Concern	DMAs Feasible (By Name or ID)	DMAs Infeasible (By Name or ID)
Collapsible Soil		
Expansive Soil		
Slopes		
Liquefaction		
Other		

D.2 Biofiltration Applicability

This section should document the applicability of biofiltration BMPs for Type D DMAs that are not feasible for full infiltration BMPs. The key decisions to be documented in this section include:

1. Are biofiltration BMPs with partial infiltration feasible?
    a. Biofiltration BMPs must be designed to maximize incidental infiltration via a partial infiltration design unless it is demonstrated that this design is not feasible.
    b. These designs can be used at sites with low infiltration rates where other feasibility factors do not preclude incidental infiltration.

    Document summary in Table D-3.
2. If not, what are the factors that require the use of biofiltration with no infiltration? This may include:
    a. Geotechnical hazards
    b. Water rights issues
    c. Water balance issues
    d. Soil contamination or groundwater quality issues
    e. Very low infiltration rates (factored rates < 0.1 in/hr)
    f. Other factors, demonstrated to the acceptance of the City

    If this applies to any DMAs, then rationale must be documented in Table D-3.
3. Are biofiltration BMPs infeasible?
    a. If yes, then provide a site-specific analysis demonstrating the technical infeasibility of all LID BMPs has been performed and is included in Appendix 5. If you plan to submit an analysis demonstrating the technical infeasibility of LID BMPs, request a pre-submittal meeting with the Copermittee with jurisdiction over the Project site to discuss this option. Proceed to Section F to document your alternative compliance measures.

Table D-3 Evaluation of Biofiltration BMP Feasibility

DMA ID	Is Partial/ Incidental Infiltration Allowable? (Y/N)	Basis for Infeasibility of Partial Infiltration (provide summary and include supporting basis if partial infiltration not feasible)
Insert text here		
Insert text here		
Insert text here		
Insert text here		

Proprietary Biofiltration BMP Approval Criteria

If the project will use proprietary BMPs as biofiltration BMPs, then this section is completed to document that the proprietary BMPs are selected in accordance with Section 2.3.7 of the SMR WQMP. Proprietary Biofiltration BMPs must meet both of the following approval criteria:

1. Approval Criteria for All Proprietary BMPs, and
2. Acceptance Criteria for Proprietary Biofiltration BMPs.

When the use of proprietary biofiltration BMPs is proposed to meet the Pollutant Control performance standards, use Table D-4 to document that appropriate approval criteria have been met for the proposed BMPs. Add additional rows to document approval criteria are met for each type of BMP proposed.

Table D-4 Proprietary BMP Approval Requirement Summary

Proposed Proprietary Biofiltration BMP	Approval Criteria	Notes/Comments
Insert BMP Name and Manufacturer Here	☐ Proposed BMP has an active TAPE GULD Certification for the project pollutants of concern[4] or equivalent 3rd party demonstrated performance.	Insert text here
	☐ The BMP is used in a manner consistent with manufacturer guidelines and conditions of its third-party certification.	Insert text here
	☐ The BMP includes biological features including vegetation supported by engineered or other growing media.	Describe features here.
	☐ The BMP is designed to maximize infiltration, or supplemental infiltration is provided to achieve retention equivalent to Biofiltration with Partial Infiltration BMPs if factored infiltration rate is between 0.1 and 0.8 inches/hour.	Describe supplemental retention practices if applicable.

[4] Use Table F-1 and F-2 to identify and document the pollutants of concern and include these tables in Appendix 5.

	☐ The BMP is sized using one of two Biofiltration LID sizing options in Section 2.3.2 of the SRM WQMP.	List sizing method used, resulting size (i.e. volume or flow), and provided size (for proposed unit)

D.3 Feasibility Assessment Summaries

From the Infiltration, Biofiltration with Partial Infiltration and Biofiltration with No Infiltration Sections above, complete Table D-5 below to summarize which LID BMPs are technically feasible, and which are not, based upon the established hierarchy.

Table D-5 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy			No LID (Alternative Compliance)
	1. Infiltration	2. Biofiltration with Partial Infiltration	3. Biofiltration with No Infiltration	
Insert text here	☐	☐	☐	☐
Insert text here	☐	☐	☐	☐
Insert text here	☐	☐	☐	☐
Insert text here	☐	☐	☐	☐
Insert text here	☐	☐	☐	☐
Insert text here	☐	☐	☐	☐

For those DMAs where LID BMPs are not feasible, provide a narrative in Table D-6 below summarizing why they are not feasible, include your technical infeasibility criteria in Appendix 5, and proceed to Section F below to document Alternative Compliance measures for those DMAs. Recall that each proposed DMA must pass through the LID BMP hierarchy before alternative compliance measures may be considered.

This is based on the clarification letter titled "San Diego Water Board's Expectations of Documentation to Support a Determination of Priority Development Project Infiltration Infeasibility" (April 28, 2017, Via email from San Diego Regional Water Quality Control Board to San Diego County Municipal Storm Water Copermittees[5]).

Table D-6 Summary of Infeasibility Documentation

Question	Narrative Summary (include reference to applicable appendix/attachment/report, as applicable)
a) When in the entitlement process did a geotechnical engineer analyze the site for infiltration feasibility?	
b) When in the entitlement process were other investigations conducted (e.g., groundwater quality, water rights) to	

[5] http://www.projectcleanwater.org/download/pdp-infiltration-infeasibility/

evaluate infiltration feasibility?	
c) What was the scope and results of testing, if conducted, or rationale for why testing was not needed to reach findings?	
d) What public health and safety requirements affected infiltration locations?	
e) What were the conclusions and recommendations of the geotechnical engineer and/or other professional responsible for other investigations?	
f) What was the history of design discussions between the permittee and applicant for the proposed project, resulting in the final design determination related locations feasible for infiltration?	
g) What site design alternatives were considered to achieve infiltration or partial infiltration on site?	
h) What physical impairments (i.e., fire road egress, public safety considerations, utilities) and public safety concerns influenced site layout and infiltration feasibility?	
i) What LID Principles (site design BMPs) were included in the project site design?	

D.4 LID BMP Sizing

Each LID BMP must be designed to ensure that the DCV will be captured by the selected BMPs with no discharge to the storm drain or surface waters during the DCV size storm. Infiltration BMPs must at minimum be sized to capture the DCV to achieve pollutant control requirements.

Biofiltration BMPs must at a minimum be sized to:

- Treat 1.5 times the DCV not reliably retained on site using a volume-base or flow-based sizing method, or
- Include static storage volume, including pore spaces and pre-filter detention volume, at least 0.75 times the portion of the DCV not reliably retained on site.

First**,** calculate the DCV for each LID BMP using the V_{BMP} worksheet in Appendix F of the LID BMP Design Handbook. Second**,** design the LID BMP to meet the required V_{BMP} using the methods included in Section 3 of the LID BMP Design Handbook. Utilize the worksheets found in the LID BMP Design Handbook or consult with the Copermittee to assist you in correctly sizing your LID BMPs. Use Table D-7 below to document the DCV for each LID BMP. Provide the completed design procedure sheets for each LID BMP in Appendix 6. You may add additional rows to the table below as needed.

Table D-7 DCV Calculations for LID BMPs

DMA Type/ID	**DMA (square feet)**	**Post-Project Surface Type**	**Effective Impervious Fraction, I_f**	**DMA Runoff Factor**	**DMA Areas x Runoff Factor**	***Enter BMP Name / Identifier Here***		
	[A]		[B]	[C]	[A] x [C]			
						Design Storm Depth (in)	*DCV, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	$A_T = \Sigma[A]$				$\Sigma = [D]$	[E]	$[F] = \frac{[D]x[E]}{12}$	[G]

[B], [C] is obtained as described in Section 2.6.1.b of the SMR WQMP

[E] is obtained from Exhibit A in the SMR WQMP

[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6.

Complete Table D-8 below to document the Design Capture Volume and the Proposed Volume for each LID BMP. You can add rows to the table as needed. Alternatively, the Santa Margarita Hydrology Model (SMRHM) can be used to size LID BMPs to address the DCV and, if applicable, to size Hydrologic Control BMPs to meet the Hydrologic Performance Standard described in the SMR WQMP, as identified in Section E.

Table D-8 LID BMP Sizing

BMP Name / ID	DMA No.	BMP Type / Description	Design Capture Volume (ft^3)	Proposed Volume (ft^3)

If bioretention will include a capped underdrain, then include sizing calculations demonstrating that the BMP will meet infiltration sizing requirements with the underdrain capped and also meet biofiltration sizing requirements if the underdrain is uncapped.

Section E: Implement Hydrologic Control BMPs and Sediment Supply BMPs

If a completed Table 1.2 demonstrates that the project is exempt from Hydromodification Performance Standards, specify N/A and proceed to Section G.

☐ N/A Project is Exempt from Hydromodification Performance Standards.

If a PDP is not exempt from hydromodification requirements than the PDP must satisfy the requirements of the performance standards for hydrologic control BMPs and Sediment Supply BMPs. The PDP may choose to satisfy hydrologic control requirements using onsite or offsite BMPs (i.e. Alternative Compliance). Sediment supply requirements cannot be met via alternative compliance. If N/A is not selected above, select one of the two options below and complete the applicable sections.

☐ Project is Not Hydromodification Exempt and chooses to implement Hydrologic Control and Sediment Supply BMPs Onsite (complete Section E).

☐ Project is Not Hydromodification Exempt and chooses to implement Hydrologic Control Requirements using Alternative Compliance (complete Section F). Selection of this option must be approved by the Copermittee.

E.1 Hydrologic Control BMP Selection

Capture of the DCV and achievement of the Hydrologic Performance Standard may be met by combined and/or separate structural BMPs. The user should consider the full suite of Hydrologic Control BMPs to manage runoff from the post-development condition and meet the Hydrologic Performance Standard identified in this section.

The Hydrologic Performance Standard consists of matching or reducing the flow duration curve of post-development conditions to that of pre-existing, naturally occurring conditions, for the range of geomorphically significant flows (10% of the 2-year runoff event up to the 10-year runoff event). Select each of the hydrologic control BMP types that are applied to meet the above performance standard on the site.

☐ LID principles as defined in Section 3.2 of the SMR WQMP.

☐ Structural LID BMPs that may be modified or enlarged, if necessary, beyond the DCV.

☐ Structural Hydrologic Control BMPs that are distinct from the LID BMPs above. The LID BMP Design Handbook provides information not only on Hydrologic Control BMP design, but also on BMP design to meet the combined LID requirement and Hydrologic Performance Standard. The Handbook specifies the type of BMPs that can be used to meet the Hydrologic Performance Standard.

E.2 Hydrologic Control BMP Sizing

Hydrologic Control BMPs must be designed to ensure that the flow duration curve of the post-development DMA will not exceed that of the pre-existing, naturally occurring, DMA for the range of geomorphically significant flows. Using SMRHM, (or another acceptable continuous simulation model if approved by the Copermittee) the applicant shall demonstrate that the performance of the Hydrologic Control BMPs complies with the Hydrologic Performance Standard. Complete Table E-1 below and identify, for each DMA, the type of Hydrologic Control BMP, if the SMRHM model confirmed the management (Identified as "passed" in SMRHM), the total volume capacity of the Hydrologic Control BMP, the Hydrologic Control BMP footprint at top floor elevation, and the drawdown time of the Hydrologic Control BMP. SMRHM summary reports should be documented in Appendix 7. Refer to the SMRHM Guidance Document for additional information on SMRHM. You can add rows to the table as needed.

Table E-1 Hydrologic Control BMP Sizing

BMP Name / ID	DMA No.	BMP Type / Description	SMRHM Passed	BMP Volume (ac-ft)	BMP Footprint (ac)	Drawdown time (hr)
			☐			
			☐			
			☐			
			☐			

If a bioretention BMP with capped underdrain is used and hydromodification requirements apply, then sizing calculations must demonstrate that the BMP meets flow duration control criteria with the underdrain capped and uncapped. Both calculations must be included.

E.3 Implement Sediment Supply BMPs

The sediment supply performance standard applies to PDPs for which hydromodification applied that have the potential to impact Potential Critical Coarse Sediment Yield Areas. Refer to Exhibit G of the WQMP to determine if there are onsite Potential Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas. Select one of the two options below and include the Potential Critical Coarse Sediment Yield Area Exhibit showing your project location in Appendix 7.

☐ There are no mapped Potential Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas on the site. The Sediment Supply Performance Standard is met with no further action.

☐ There are mapped Potential Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas on the site, the Sediment Supply Performance Standard will be met through Option 1 or Option 2 below.

The applicant may refer to Section 3.6.4 of the SMR WQMP for a description of the methodology to meet the Sediment Supply Performance Standard. Select the applicable compliance pathway and complete the appropriate sections to demonstrate compliance with the Sediment Supply Performance Standard if the second box is selected above:

☐ Avoid impacts related to any PDP activities to Potential Critical Coarse Sediment Yield Areas. Proceed to Section E.3.1.

☐ Complete a Site-Specific Critical Coarse Sediment Analysis. Proceed to Section E.3.2.

E.3.1 Option 1: Avoid Potential Critical Coarse Sediment Yield Areas and Potential Sediment Source Areas

The simplest approach for complying with the Sediment Supply Performance Standard is to avoid impacts to areas identified as Potential Critical Coarse Sediment Yield Areas or Potential Sediment Supply Areas. If a portion of PDP is identified as a Potential Critical Coarse Sediment Yield Area or a Potential Sediment Source Area, that PDP may still achieve compliance with the Sediment Supply Performance Standards if Potential Critical Coarse Sediment Yield Areas and Potential Sediment Supply Areas are avoided, i.e. areas are not developed and thereby delivery of Critical Coarse Sediment to the receiving waters is not impeded by site developments.

Provide a narrative describing how the PDP has avoided impacts to Potential Critical Coarse Sediment Yield Areas and/or Potential Sediment Source Areas below.

Insert narrative description here

If it is not feasible to avoid these areas, proceed to Option 2 to complete a Site-Specific Critical Coarse Sediment Analysis.

E.3.2 Option 2: Site-Specific Critical Coarse Sediment Analysis

Perform a stepwise assessment to ensure the maintenance of the pre-project source(s) of Critical Coarse Sediment (i.e., Bed Sediment Supply):

1. Determine whether the site or a portion of the site is a Significant Source of Bed Sediment Supply to the Receiving Channel (i.e., an actual verified Critical Coarse Sediment Yield Area);
2. Avoid areas identified as actual verified Critical Coarse Sediment Yield Areas in the PDP design and maintain pathways for discharge of Bed Sediment Supply from these areas to receiving waters.

Step 1: Identify if the site is an actual verified Critical Coarse Sediment Yield Area supplying Bed Sediment Supply to the receiving channel

☐ **Step 1.A** – Is the Bed Sediment of onsite streams similar to that of receiving streams?

Rate the similarity: ☐ High
☐ Medium
☐ Low

Results from the geotechnical and sieve analysis to be performed both onsite and in the receiving channel should be documented in Appendix 7. Of particular interest, the results of the sieve analysis, the soil erodibility factor, a description of the topographic relief of the project area, and the lithology of onsite soils should be reported in Appendix 7.

☐ **Step 1.B** – Are onsite streams capable of delivering Bed Sediment Supply from the site, if any, to the receiving channel?

Rate the potential:
- ☐ High
- ☐ Medium
- ☐ Low

Results from the analyses of the sediment delivery potential to the receiving channel should be documented in Appendix 7 and identify, at a minimum, the Sediment Source, the distance to the receiving channel, the onsite channel density, the project watershed area, the slope, length, land use, and rainfall intensity.

☐ **Step 1.C** – Will the receiving channel adversely respond to a change in Bed Sediment Load?

Rate the need for bed sediment supply:
- ☐ High
- ☐ Medium
- ☐ Low

Results from the in-stream analysis to be performed both onsite should be documented in Appendix 7. The analysis should, at a minimum, quantify the bank stability and the degree of incision, provide a gradation of the Bed Sediment within the receiving channel, and identify if the channel is sediment supply-limited.

☐ **Step 1.D** – Summary of Step 1

Summarize in Table E.3 the findings of Step 1 and associate a score (in parenthesis) to each step. The sum of the three individual scores determines if a stream is a significant contributor to the receiving stream.

- Sum is equal to or greater than eight - Site is a significant source of sediment bed material – all on-site streams must be preserved or by-passed within the site plan. The applicant shall proceed to Step 2 for all onsite streams.
- Sum is greater than five but lower than eight. Site is a source of sediment bed material – some of the on-site streams must be preserved (with identified streams noted). The applicant shall proceed to Step 2 for the identified streams only.
- Sum is equal to or lower than five. Site is not a significant source of sediment bed material. The applicant may advance to Section F.

Table E-2 Triad Assessment Summary

Step	Rating			Total Score
1.A	☐ High (3)	☐ Medium (2)	☐ Low (1)	
1.B	☐ High (3)	☐ Medium (2)	☐ Low (1)	
1.C	☐ High (3)	☐ Medium (2)	☐ Low (1)	
Significant Source Rating of Bed Sediment to the receiving channel(s)				

Step 2: Avoid Development of Critical Coarse Sediment Yield Areas, Potential Sediment Sources Areas, and Preserve Pathways for Transport of Bed Sediment Supply to Receiving Waters

Onsite streams identified as a actual verified Critical Coarse Sediment Yield Areas should be avoided in the site design and transport pathways for Critical Coarse Sediment should be preserved

Check those that apply:

☐ The site design does avoid all onsite channels identified as actual verified Critical Coarse Sediment Yield Areas

AND

☐ The drainage design bypasses flow and sediment from onsite upstream drainages identified as actual verified Critical Coarse Sediment Yield Areas to maintain Critical Coarse Sediment supply to receiving waters

(If both are yes, the applicant may disregard subsequent steps of Section E.3 and directly advance directly to Section G).

- *Or* -

☐ The site design **does NOT avoid** all onsite channels identified as actual verified Critical Coarse Sediment Yield Areas

OR

☐ The project impacts transport pathways of Critical Coarse Sediment from onsite upstream drainages.

(If either of these are the case, the applicant may proceed with the subsequent steps of Section E.3).

Provide in Appendix 7 a site map that identifies all onsite channels and highlights those onsite channels that were identified as a Significant Source of Bed Sediment. The site map shall demonstrate, if feasible, that the site design avoids those onsite channels identified as a Significant Source of Bed Sediment. In addition, the applicant shall describe the characteristics of each onsite channel identified as a Significant Source of Bed Sediment. If the design plan cannot avoid the onsite channels, please provide a rationale for each channel individually.

The site map shall demonstrate that the drainage design bypasses those onsite channels that supply Critical Coarse Sediment to the receiving channel(s). In addition, the applicant shall describe the characteristics of each onsite channel identified as an actual verified Critical Coarse Sediment Yield Area.

Identified Channel #1 - Insert narrative description here

Identified Channel #2 - Insert narrative description here

Identified Channel #3 - Insert narrative description here

E.3.3 Sediment Supply BMPs to Result in No Net Impact to Downstream Receiving Waters

If impacts to Critical Coarse Sediment Yield Areas cannot be avoided, sediment supply BMPs must be implemented such there is no net impact to receiving waters. Sediment supply BMPs may consist of approaches that permit flux of bed sediment supply from Critical Coarse Sediment Yield Areas within the project boundary. This approach is subject to acceptance by the [Insert Jurisdiction]. It may require extensive documentation and analysis by qualified professionals to support this demonstration.

Appendix H of the San Diego Model BMP Design Manual provides additional information on site-specific investigation of Critical Coarse Sediment Supply areas.

http://www.projectcleanwater.org/download/2018-model-bmp-design-manual/

If applicable, insert narrative description here

Documentation of sediment supply BMPs should be detailed in Appendix 7.

Section F: Alternative Compliance

Alternative Compliance may be used to achieve compliance with pollutant control and/or hydromodification requirements for a given PDP. Alternative Compliance may be used under two scenarios, check the applicable box if the PDP is proposing to use Alternative Compliance to satisfy all or a portion of the Pollutant Control and/or Hydrologic Control requirements (but not sediment supply requirements)

☐ If it is not feasible to fully implement Infiltration or Biofiltration BMPs at a PDP site, Flow-Through Treatment Control BMPs may be used to treat pollutants contained in the portion of DCV not reliably retained on site and Alternative Compliance measures must also be implemented to mitigate for those pollutants in the DCV that are not retained or removed on site prior to discharging to a receiving water.

☐ Alternative Compliance is selected to comply with either pollutant control or hydromodification flow control requirements even if complying with these requirements is potentially feasible on-site. If such voluntary Alternative Compliance is implemented, Flow-Through Treatment Control BMPs must still be used to treat those pollutants in the portion of the DCV not reliably retained on site prior to discharging to a receiving water.

Refer to Section 2.7 of the SMR WQMP and consult the City for currently available Alternative Compliance pathways. Coordinate with the Copermittee if electing to participate in Alternative Compliance and complete the sections below to document implementation of the Flow-Through BMP component of the program.

F.1 Identify Pollutants of Concern

The purpose of this section is to help you appropriately plan for mitigating your Pollutants of Concern in lieu of implementing LID BMPs and to document compliance and.

Utilize Table A-1 from Section A, which noted your project's Receiving Waters, to identify impairments for Receiving Waters (including downstream receiving waters) by completing Table F-1. Table F-1 includes the watersheds identified as impaired in the Approved 2010 303(d) list; check box corresponding with the PDP's receiving water. The most recent 303(d) lists are available from the State Water Resources Control Board website:
https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml).https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml.

Table F-1 Summary of Approved 2010 303(d) listed waterbodies and associated pollutants of concern for the Riverside County SMR Region and downstream waterbodies.

	Water Body	Nutrients[1]	Metals[2]	Toxicity	Bacteria and Pathogens	Pesticides and Herbicides	Sulfate	Total Dissolved Solids
☐	De Luz Creek	X	X				X	
☐	Long Canyon Creek		X		X	X		
☐	Murrieta Creek	X	X	X		X		
☐	Redhawk Channel	X	X		X	X		X
☐	Santa Gertudis Creek	X	X		X	X		
☐	Santa Margarita Estuary	X						
☐	Santa Margarita River (Lower)	X			X			
☐	Santa Margarita River (Upper)	X		X				
☐	Temecula Creek	X	X	X		X		X
☐	Warm Springs Creek	X	X		X	X		

[1] Nutrients include nitrogen, phosphorus and eutrophic conditions caused by excess nutrients.

[2] Metals includes copper, iron, and manganese.

Use Table F-2 to identify the pollutants identified with the project site. Indicate the applicable PDP Categories and/or Project Features by checking the boxes that apply. If the identified General Pollutant Categories are the same as those listed for your Receiving Waters, then these will be your Pollutants of Concern; check the appropriate box or boxes in the last row.

Table F-2 Potential Pollutants by Land Use Type

Priority Development Project Categories and/or Project Features (check those that apply)		General Pollutant Categories									
		Bacterial Indicators	Metals	Nutrients	Pesticides	Toxic Organic Compounds	Sediments	Trash & Debris	Oil & Grease	Total Dissolved Solids	Sulfate
☐	Detached Residential Development	P	N	P	P	N	P	P	P	N	N
☐	Attached Residential Development	P	N	P	P	N	P	P	P[(2)]	N	N
☐	Commercial/Industrial Development	P[(3)]	P[(7)]	P[(1)]	P[(1)]	P	P[(1)]	P	P	N	N
☐	Automotive Repair Shops	N	P	N	N	P[(4, 5)]	N	P	P	N	N
☐	Restaurants (>5,000 ft^2)	P	N	N	P[(1)]	N	N	P	P	N	N
☐	Hillside Development (>5,000 ft^2)	P	N	P	P	N	P	P	P	N	N
☐	Parking Lots (>5,000 ft^2)	P[(6)]	P[(7)]	P[(1)]	P[(1)]	P[(4)]	P	P	P	N	N
☐	Streets, Highways, and Freeways	P[(6)]	P[(7)]	P[(1)]	P[(1)]	P[(4)]	P	P	P	N	N
☐	Retail Gasoline Outlets	N	P[(7)]	N	N	P[(4)]	N	P	P	N	N
Project Priority Pollutant(s) of Concern		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

P = Potential

N = Not Potential

(1) A potential Pollutant if non-native landscaping exists or is proposed onsite; otherwise not expected

(2) A potential Pollutant if the project includes uncovered parking areas; otherwise not expected

(3) A potential Pollutant is land use involving animal waste products; otherwise not expected

(4) Including petroleum hydrocarbons

(5) Including solvents

(6) Bacterial indicators are routinely detected in pavement runoff

(7) A potential source of metals, primarily copper and zinc. Iron, magnesium, and aluminum are commonly found in the environment and are commonly associated with soils, but are not primarily of anthropogenic stormwater origin in the municipal environment.

F.2 Treatment Control BMP Selection

Treatment Control BMPs typically provide proprietary treatment mechanisms to treat potential Pollutants in runoff, but do not sustain significant biological processes. Treatment Control BMPs must be selected to address the Project Priority Pollutants of Concern (identified above) and meet the acceptance criteria described in Section 2.3.7 of the SMR WQMP. Documentation of acceptance criteria must be included in Appendix 6. In addition, ensure that proposed Treatment Control BMPs are properly identified on the WQMP Site Plan in Appendix 1.

Table F-3 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID[1]	Priority Pollutant(s) of Concern to Mitigate[2]	Removal Efficiency Percentage[3]

[1] Treatment Control BMPs must not be constructed within Receiving Waters. In addition, a proposed Treatment Control BMP may be listed more than once if they possess more than one qualifying pollutant removal efficiency.
[2] Cross Reference Table E.1 above to populate this column.
[3] As documented in a Copermittee Approved Study and provided in Appendix 6.

F.3 Sizing Criteria

Utilize Table F-4 below to appropriately size flow-through BMPs to the DCV, or Design Flow Rate, as applicable. Please reference Chapter 3.5.1 of the SMR WQMP for further information.

Table F-4 Treatment Control BMP Sizing

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here*	
	[A]		[B]	[C]	[A] x [C]		
						Design Storm (in)	*Design Flow Rate (cfs)*
	$A_T = \Sigma[A]$				$\Sigma = [D]$	[E]	$[F] = \frac{[D]x[E]}{[G]}$

[B], [C] is obtained as described in Section 2.6.1.b from the SMR WQMP
[E] either 0.2 inches or 2 times the 85th percentile hourly rainfall intensity
[G] = 43,560,.

F.4 Hydrologic Performance Standard – Alternative Compliance Approach

Alternative compliance options are only available if the governing Copermittee has acknowledged the infeasibility of onsite Hydrologic Control BMPs and approved an alternative compliance approach. See Section 3.5 and 3.6 of the SMR WQMP.

Select the pursued alternative and describe the specifics of the alternative:

☐ Offsite Hydrologic Control Management within the same channel system

Insert narrative description here

☐ In-Stream Restoration Project

Insert narrative description here

For Offsite Hydrologic Control BMP Option

Each Hydrologic Control BMP must be designed to ensure that the flow duration curve of the post-development DMA will not exceed that of the pre-existing, naturally occurring, DMA by more than ten percent over a one-year period. Using SMRHM, the applicant shall demonstrate that the performance of each designed Hydrologic Control BMP is equivalent with the Hydrologic Performance Standard for onsite conditions. Complete Table F-5 below and identify, for each Hydrologic Control BMP, the equivalent DMA the Hydrologic Control BMP mitigates, that the SMRHM model passed, the total volume capacity of the BMP, the BMP footprint at top floor elevation, and the drawdown time of the BMP. SMRHM summary reports for the alternative approach should be documented in Appendix 7. Refer to the SMRHM Guidance Document for additional information on SMRHM. You can add rows to the table as needed.

Table F-5 Offsite Hydrologic Control BMP Sizing

BMP Name / Type	Equivalent DMA (ac)	SMRHM Passed	BMP Volume (ac-ft)	BMP Footprint (ac)	Drawdown time (hr)
		☐			
		☐			
		☐			
		☐			

For Instream Restoration Option

Attach to Appendix 7 the technical report detailing the condition of the receiving channel subject to the proposed hydrologic and sediment regimes. Provide the full design plans for the in-stream restoration project that have been approved by the Copermittee. Utilize the San Diego Regional Water Quality Equivalency Guidance Document.

Section G: Implement Trash Capture BMPs

The City may require full trash capture BMPs to be installed as part of the project. Consult with the City to determine applicability.

Trash Capture BMPs may be applicable to Type 'D' DMAs, as defined in Section 2.3.4 of the SMR WQMP. Trash Capture BMPs are designed to treat Q_{TRASH}, the runoff flow rate generated during the 1-year 1-hour precipitation depth. Utilize Table G-1 to size Trash Capture BMP. Refer to Table G-2 to determine the Trash Capture Design Storm Intensity (E).

Table G-1 Sizing Trash Capture BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here*	
	[A]		[B]	[C]	[A] x [C]		
						Trash Capture Design Storm Intensity (in)	*Trash Capture Design Flow Rate (cubic feet or cfs)*
	$A_T = \Sigma[A]$				$\Sigma = [D]$	[E]	$[F] = \frac{[D]x[E]}{[G]}$

[B], [C] is obtained as described in Section 2.6.1.b from the SMR WQMP
[G] = 43,560

Table G-2 Approximate precipitation depth/intensity values for calculation of the Trash Capture Design Storm

City	1-year 1-hour Precipitation Depth/Intensity (inches/hr)
Murrieta	0.47
Temecula	0.50
Wildomar	0.37

Use Table G-3 to summarize and document the selection and sizing of Trash Capture BMPs.

Table G-3 Trash Capture BMPs

BMP Name / ID	DMA No(s)	BMP Type / Description	Required Trash Capture Flowrate (cfs)	Provided Trash Capture Flowrate (cfs)

Section H: Source Control BMPs

Source Control BMPs include permanent, structural features that may be required in your Project plans, such as roofs over and berms around trash and recycling areas, and Operational BMPs, such as regular sweeping and "housekeeping," that must be implemented by the site's occupant or user. The Maximum Extent Practicable (MEP) standard typically requires both types of BMPs. In general, Operational Source Control BMPs cannot be substituted for a feasible and effective Structural Source Control BMP. Complete checklist below to determine applicable Source Control BMPs for your site.

Project-Specific WQMP Source Control BMP Checklist

All development projects must implement Source Control BMPs. Source Control BMPs are used to minimize pollutants that may discharge to the MS4. Refer to Chapter 3 (Section 3.8) of the SMR WQMP for additional information. Complete Steps 1 and 2 below to identify Source Control BMPs for the project site.

Step 1: Identify Pollutant Sources

Review project site plans and identify the applicable pollutant sources. "Yes" indicates that the pollutant source is applicable to project site. "No" indicates that the pollutant source is not applicable to project site.

☐ Yes ☐ No	Storm Drain Inlets	☐ Yes ☐ No	Outdoor storage areas
☐ Yes ☐ No	Floor Drains	☐ Yes ☐ No	Material storage areas
☐ Yes ☐ No	Sump Pumps	☐ Yes ☐ No	Fueling areas
☐ Yes ☐ No	Pets Control/Herbicide Application	☐ Yes ☐ No	Loading Docks
☐ Yes ☐ No	Food Service Areas	☐ Yes ☐ No	Fire Sprinkler Test/Maintenance water
☐ Yes ☐ No	Trash Storage Areas	☐ Yes ☐ No	Plazas, Sidewalks and Parking Lots
☐ Yes ☐ No	Industrial Processes	☐ Yes ☐ No	Pools, Spas, Fountains and other water features
☐ Yes ☐ No	Vehicle and Equipment Cleaning and Maintenance/Repair Areas		

Step 2: Required Source Control BMPs

List each Pollutant source identified above in column 1 and fill in the corresponding Structural Source Control BMPs and Operational Control BMPs by referring to the Stormwater Pollutant Sources/Source Control Checklist included in Appendix 8. The resulting list of structural and operational source control BMPs must be implemented as long as the associated sources are present on the project site. Add additional rows as needed.

Pollutant Source	Structural Source Control BMP	Operational Source Control BMP
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here

Section I: Coordinate Submittal with Other Site Plans

Populate Table I-1 below to assist the plan checker in an expeditious review of your project. During construction and at completion, City inspectors will verify the installation of BMPs against the approved plans. The first two columns will contain information that was prepared in previous steps, while the last column will be populated with the corresponding plan sheets. This table is to be completed with the submittal of your final Project-Specific WQMP.

Table I-1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here

Note that the updated table — or Construction Plan WQMP Checklist — is **only a reference tool** to facilitate an easy comparison of the construction plans to your Project-Specific WQMP. The Copermittee with jurisdiction over the Project site can advise you regarding the process required to propose changes to the approved Project-Specific WQMP.

Use Table I-2 to identify other applicable permits that may impact design of the site. If yes is answered to any of the items below, the Copermittee may require proof of approval/coverage from those agencies as applicable including documentation of any associated requirements that may affect this Project-Specific WQMP.

Table I-2 Other Applicable Permits

Agency	Permit Required	
State Department of Fish and Game, 1602 Streambed Alteration Agreement	☐ Y	☐ N
State Water Resources Control Board, Clean Water Act Section 401 Water Quality Certification	☐ Y	☐ N
US Army Corps of Engineers, Clean Water Act Section 404 Permit	☐ Y	☐ N
US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	☐ Y	☐ N
Statewide Construction General Permit Coverage	☐ Y	☐ N
Statewide Industrial General Permit Coverage	☐ Y	☐ N
Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)	☐ Y	☐ N
Other *(please list in the space below as required)*	☐ Y	☐ N

Section J: Operation, Maintenance and Funding

The Copermittee with jurisdiction over the Project site will periodically verify that BMPs on your Project are maintained and continue to operate as designed. To make this possible, the Copermittee will require that you include in Appendix 9 of this Project-Specific WQMP:

1. A means to finance and implement maintenance of BMPs in perpetuity, including replacement cost.
2. Acceptance of responsibility for maintenance from the time the BMPs are constructed until responsibility for operation and maintenance is legally transferred. A warranty covering a period following construction may also be required.
3. An outline of general maintenance requirements for the Stormwater BMPs you have selected.
4. Figures delineating and designating pervious and impervious areas, location, and type of Stormwater BMP, and tables of pervious and impervious areas served by each facility. Geo-locating the BMPs using a coordinate system of latitude and longitude is recommended to help facilitate a future statewide database system.
5. A separate list and location of self-retaining areas or areas addressed by LID Principles that do not require specialized Operations and Maintenance or inspections but will require typical landscape maintenance as noted in Chapter 5, in the SMR WQMP. Include a brief description of typical landscape maintenance for these areas.

The Copermittee with jurisdiction over the Project site will also require that you prepare and submit a detailed BMP Operation and Maintenance Plan that sets forth a maintenance schedule for each of the BMPs built on your site. An agreement assigning responsibility for maintenance and providing for inspections and certification may also be required.

Details of these requirements and instructions for preparing a BMP Operation and Maintenance Plan are in Chapter 5 of the SMR WQMP.

Maintenance Mechanism: Insert text here.

Will the proposed BMPs be maintained by a Homeowners' Association (HOA) or Property Owners Association (POA)?

☐ Y ☐ N

Include your Operation and Maintenance Plan and Maintenance Mechanism in Appendix 9. Additionally, include all pertinent forms of educational materials for those personnel that will be maintaining the proposed BMPs within this Project-Specific WQMP in Appendix 10.

Section K: Acronyms, Abbreviations and Definitions

Regional MS4 Permit	Order No. R9-2013-0001 as amended by Order No. R9-2015-0001 and Order No. R9-2015-0100 an NPDES Permit issued by the San Diego Regional Water Quality Control Board.
Applicant	Public or private entity seeking the discretionary approval of new or replaced improvements from the Copermittee with jurisdiction over the project site. The Applicant has overall responsibility for the implementation and the approval of a Priority Development Project. The WQMP uses consistently the term "user" to refer to the applicant such as developer or project proponent. The WQMP employs also the designation "user" to identify the Registered Professional Civil Engineer responsible for submitting the Project-Specific WQMP, and designing the required BMPs.
Best Management Practice (BMP)	Defined in 40 CFR 122.2 as schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. In the case of municipal storm water permits, BMPs are typically used in place of numeric effluent limits.
BMP Fact Sheets	BMP Fact Sheets are available in the LID BMP Design Handbook. Individual BMP Fact Sheets include sitting considerations, and design and sizing guidelines for seven types of structural BMPs (infiltration basin, infiltration trench, permeable pavement, harvest-and-use, bioretention, extended detention basin, and sand filter).
California Stormwater Quality Association (CASQA)	Publisher of the California Stormwater Best Management Practices Handbooks, available at www.cabmphandbooks.com.
Conventional Treatment Control BMP	A type of BMP that provides treatment of storm water runoff. Conventional treatment control BMPs, while designed to treat particular Pollutants, typically do not provide the same level of volume reduction as LID BMPs, and commonly require more specialized maintenance than LID BMPs. As such, the Regional MS4 Permit and this WQMP require the use of LID BMPs wherever feasible, before Conventional Treatment BMPs can be considered or implemented.
Copermittees	The Regional MS4 Permit identifies the Cities of Murrieta, Temecula, and Wildomar, the County, and the District, as Copermittees for the SMR.
County	The abbreviation refers to the County of Riverside in this document.

CEQA	California Environmental Quality Act - a statute that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible.
CIMIS	California Irrigation Management Information System - an integrated network of 118 automated active weather stations all over California managed by the California Department of Water Resources.
CWA	Clean Water Act - is the primary federal law governing water pollution. Passed in 1972, the CWA established the goals of eliminating releases of high amounts of toxic substances into water, eliminating additional water pollution by 1985, and ensuring that surface waters would meet standards necessary for human sports and recreation by 1983. CWA Section 402(p) is the federal statute requiring NPDES permits for discharges from MS4s.
CWA Section 303(d) Waterbody	Impaired water in which water quality does not meet applicable water quality standards and/or is not expected to meet water quality standards, even after the application of technology based pollution controls required by the CWA. The discharge of urban runoff to these water bodies by the Copermittees is significant because these discharges can cause or contribute to violations of applicable water quality standards.
Design Storm	The Regional MS4 Permit has established the 85th percentile, 24-hour storm event as the "Design Storm". The applicant may refer to Exhibit A to identify the applicable Design Storm Depth (D85) to the project.
DCV	Design Capture Volume (DCV) is the volume of runoff produced from the Design Storm to be mitigated through LID Retention BMPs, Other LID BMPs and Volume Based Conventional Treatment BMPs, as appropriate.
Design Flow Rate	The design flow rate represents the minimum flow rate capacity that flow-based conventional treatment control BMPs should treat to the MEP, when considered.
DCIA	Directly Connected Impervious Areas - those impervious areas that are hydraulically connected to the MS4 (i.e. street curbs, catch basins, storm drains, etc.) and thence to the structural BMP without flowing over pervious areas.
Discretionary Approval	A decision in which a Copermittee uses its judgment in deciding whether and how to carry out or approve a project.
District	Riverside County Flood Control and Water Conservation District.
DMA	A Drainage Management Area - a delineated portion of a project site that is hydraulically connected to a common structural BMP or conveyance point. The Applicant may refer to Section 3.3 for further guidelines on how to delineate DMAs.

Drawdown Time	Refers to the amount of time the design volume takes to pass through the BMP. The specified or incorporated drawdown times are to ensure that adequate contact or detention time has occurred for treatment, while not creating vector or other nuisance issues. It is important to abide by the drawdown time requirements stated in the fact sheet for each specific BMP.
Effective Area	Area which 1) is suitable for a BMP (for example, if infiltration is potentially feasible for the site based on infeasibility criteria, infiltration must be allowed over this area) and 2) receives runoff from impervious areas.
ESA	An Environmental Sensitive Area (ESA) designates an area "in which plants or animals life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which would be easily disturbed or degraded by human activities and developments". (Reference: California Public Resources Code § 30107.5).
ET	Evapotranspiration (ET) is the loss of water to the atmosphere by the combined processes of evaporation (from soil and plant surfaces) and transpiration (from plant tissues). It is also an indicator of how much water crops, lawn, garden, and trees need for healthy growth and productivity
FAR	The Floor Area Ratio (FAR) is the total square feet of a building divided by the total square feet of the lot the building is located on.
Flow-Based BMP	Flow-based BMPs are conventional treatment control BMPs that are sized to treat the design flow rate.
FPPP	Facility Pollution Prevention Plan
HCOC	Hydrologic Condition of Concern - Exists when the alteration of a site's hydrologic regime caused by development would cause significant impacts on downstream channels and aquatic habitats, alone or in conjunction with impacts of other projects.
HMP	Hydromodification Management Plan – Plan defining Performance Standards for PDPs to manage increases in runoff discharge rates and durations.
Hydrologic Control BMP	BMP to mitigate the increases in runoff discharge rates and durations and meet the Performance Standards set forth in the HMP.
HSG	Hydrologic Soil Groups – soil classification to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSGs are A (very low runoff potential/high infiltration rate), B, C, and D (high runoff potential/very low infiltration rate)

Hydromodification	The Regional MS4 Permit identifies that increased volume, velocity, frequency and discharge duration of storm water runoff from developed areas has the potential to greatly accelerate downstream erosion, impair stream habitat in natural drainages, and negatively impact beneficial uses.
JRMP	A separate Jurisdictional Runoff Management Plan (JRMP) has been developed by each Copermittee and identifies the local programs and activities that the Copermittee is implementing to meet the Regional MS4 Permit requirements.
LID	Low Impact Development (LID) is a site design strategy with a goal of maintaining or replicating the pre-development hydrologic regime through the use of design techniques. LID site design BMPs help preserve and restore the natural hydrologic cycle of the site, allowing for filtration and infiltration which can greatly reduce the volume, peak flow rate, velocity, and pollutant loads of storm water runoff.
LID BMP	A type of storm water BMP that is based upon Low Impact Development concepts. LID BMPs not only provide highly effective treatment of storm water runoff, but also yield potentially significant reductions in runoff volume – helping to mimic the pre-project hydrologic regime, and also require less ongoing maintenance than Treatment Control BMPs. The applicant may refer to Chapter 2.
LID BMP Design Handbook	The LID BMP Design Handbook was developed by the Copermittees to provide guidance for the planning, design and maintenance of LID BMPs which may be used to mitigate the water quality impacts of PDPs within the County.
LID Bioretention BMP	LID Bioretention BMPs are bioretention areas are vegetated (i.e., landscaped) shallow depressions that provide storage, infiltration, and evapotranspiration, and provide for pollutant removal (e.g., filtration, adsorption, nutrient uptake) by filtering storm water through the vegetation and soils. In bioretention areas, pore spaces and organic material in the soils help to retain water in the form of soil moisture and to promote the adsorption of pollutants (e.g., dissolved metals and petroleum hydrocarbons) into the soil matrix. Plants use soil moisture and promote the drying of the soil through transpiration. The Regional MS4 Permit defines "retain" as to keep or hold in a particular place, condition, or position without discharge to surface waters.
LID Biofiltration BMP	BMPs that reduce stormwater pollutant discharges by intercepting rainfall on vegetative canopy, and through incidental infiltration and/or evapotranspiration, and filtration, and other biological and chemical processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded, and sequestered by the soil and plants, and collected through an underdrain.

LID Harvest and Reuse BMP	BMPs used to facilitate capturing storm water runoff for later use without negatively impacting downstream water rights or other Beneficial Uses.
LID Infiltration BMP	BMPs to reduce storm water runoff by capturing and infiltrating the runoff into in-situ soils or amended onsite soils. Typical LID Infiltration BMPs include infiltration basins, infiltration trenches and pervious pavements.
LID Retention BMP	BMPs to ensure full onsite retention without runoff of the DCV such as infiltration basins, bioretention, chambers, trenches, permeable pavement and pavers, harvest and reuse.
LID Principles	Site design concepts that prevent or minimize the causes (or drivers) of post-construction impacts, and help mimic the pre-development hydrologic regime.
MEP	Maximum Extent Practicable - standard established by the 1987 amendments to the Clean Water Act (CWA) for the reduction of Pollutant discharges from MS4s. Refer to Attachment C of the Regional MS4 Permit for a complete definition of MEP.
MF	Multi-family – zoning classification for parcels having 2 or more living residential units.
MS4	Municipal Separate Storm Sewer System (MS4) is a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or designated and approved management agency under section 208 of the CWA that discharges to waters of the United States; (ii) Designated or used for collecting or conveying storm water; (iii) Which is not a combined sewer; (iv) Which is not part of the Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.26.
New Development Project	Defined by the Regional MS4 Permit as 'Priority Development Projects' if the project, or a component of the project meets the categories and thresholds described in Section 1.1.1.
NPDES	National Pollution Discharge Elimination System - Federal program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 318, 402, and 405 of the CWA.
NRCS	Natural Resources Conservation Service

PDP	Priority Development Project - Includes New Development and Redevelopment project categories listed in Provision E.3.b of the Regional MS4 Permit.
Priority Pollutants of Concern	Pollutants expected to be present on the project site and for which a downstream water body is also listed as Impaired under the CWA Section 303(d) list or by a TMDL.
Project-Specific WQMP	A plan specifying and documenting permanent LID Principles and storm water BMPs to control post-construction Pollutants and storm water runoff for the life of the PDP, and the plans for operation and maintenance of those BMPs for the life of the project.
Receiving Waters	Waters of the United States.
Redevelopment Project	The creation, addition, and or replacement of impervious surface on an already developed site. Examples include the expansion of a building footprint, road widening, the addition to or replacement of a structure, and creation or addition of impervious surfaces. Replacement of impervious surfaces includes any activity that is not part of a routine maintenance activity where impervious material(s) are removed, exposing underlying soil during construction. Redevelopment does not include trenching and resurfacing associated with utility work; resurfacing existing roadways; new sidewalk construction, pedestrian ramps, or bike lane on existing roads; and routine replacement of damaged pavement, such as pothole repair. Project that meets the criteria described in Section 1.
Runoff Fund	Runoff Funds have not been established by the Copermittees and are not available to the Applicant. If established, a Runoff Fund will develop regional mitigation projects where PDPs will be able to buy mitigation credits if it is determined that implementing onsite controls is infeasible.
San Diego Regional Board	San Diego Regional Water Quality Control Board - The term "Regional Board", as defined in Water Code section 13050(b), is intended to refer to the California Regional Water Quality Control Board for the San Diego Region as specified in Water Code Section 13200. State agency responsible for managing and regulating water quality in the SMR.
SCCWRP	Southern California Coastal Water Research Project
Site Design BMP	Site design BMPs prevent or minimize the causes (or drivers) of post-construction impacts, and help mimic the pre-development hydrologic regime.
SF	Parcels with a zoning classification for a single residential unit.
SMC	Southern California Stormwater Monitoring Coalition
SMR	The Santa Margarita Region (SMR) represents the portion of the Santa Margarita Watershed that is included within the County of Riverside.

Source Control BMP	Source Control BMPs land use or site planning practices, or structural or nonstructural measures that aim to prevent runoff pollution by reducing the potential for contamination at the source of pollution. Source control BMPs minimize the contact between Pollutants and runoff.
Structural BMP	Structures designed to remove pollutants from stormwater runoff and mitigate hydromodification impacts.
SWPPP	Storm Water Pollution Prevention Plan
Tentative Tract Map	Tentative Tract Maps are required for all subdivision creating five (5) or more parcels, five (5) or more condominiums as defined in Section 783 of the California Civil Code, a community apartment project containing five (5) or more parcels, or for the conversion of a dwelling to a stock cooperative containing five (5) or more dwelling units.
TMDL	Total Maximum Daily Load - the maximum amount of a Pollutant that can be discharged into a waterbody from all sources (point and non-point) and still maintain Water Quality Standards. Under CWA Section 303(d), TMDLs must be developed for all waterbodies that do not meet Water Quality Standards after application of technology-based controls.
USEPA	United States Environmental Protection Agency
Volume-Based BMP	Volume-Based BMPs applies to BMPs where the primary mode of pollutant removal depends upon the volumetric capacity such as detention, retention, and infiltration systems.
WQMP	Water Quality Management Plan
Wet Season	The Regional MS4 Permit defines the wet season from October 1 through April 30.

Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map

Complete the checklist below to verify all exhibits and components are included in the Project-Specific WQMP. Refer Section 4 of the SMR WQMP and Section D of this Template.

Map and Site Plan Checklist
Indicate all Maps and Site Plans are included in your Project-Specific WQMP by checking the boxes below.
☐ Vicinity and Location Map
☐ Existing Site Map (unless exiting conditions are included in WQMP Site Plan)
☐ WQMP Site Plan
☐ Parcel Boundary and Project Footprint
☐ Existing and Proposed Topography
☐ Drainage Management Areas (DMAs)
☐ Proposed Structural Best Management Practices (BMPs)
☐ Drainage Paths
☐ Drainage infrastructure, inlets, overflows
☐ Source Control BMPs
☐ Site Design BMPs
☐ Buildings, Roof Lines, Downspouts
☐ Impervious Surfaces
☐ Pervious Surfaces (i.e. Landscaping)
☐ Standard Labeling

Appendix 2: Construction Plans

Grading and Drainage Plans

Examples of material to provide in Appendix 2 may include but are not limited to the following:

- Site grading plans from the Project's Civil Plan Set,
- Drainage plans showing the exiting condition and proposed drainage system from the project's drainage report,
- Other plan sheets containing elements that impact site grading and drainage.

Refer to Section 4 of the SMR WQMP and Section I of this Template.

Appendix 3: Soils Information

Geotechnical Study, Other Infiltration Testing Data, and/or Other Documentation

Examples of material to provide in Appendix 3 may include but are not limited to the following:

- Geotechnical Study/Report prepared for the project,
- Additional soils testing data (if not included in the Geotechnical Study),
- Exhibits/Maps/Other Documentation of the Hydrologic Soils Groups (HSG)s at the project site.

This information should support the Full Infiltration Applicability, and Biofiltration Applicability sections of this Template. Refer to Section 2.3 of the SMR WQMP and Sections A and D of this Template.

Appendix 4: Historical Site Conditions

Phase I Environmental Site Assessment or Other Information on Past Site Use

Examples of material to provide in Appendix 4 may include but are not limited to the following:

- Environmental Site Assessments conducted for the project,
- Other information on Past Site Use that impacts the feasibility of LID BMP implementation on the site.

This information should support the Full Infiltration Applicability, and Biofiltration Applicability sections of this Template. Refer to Section 2.3 of the SMR WQMP and Sections D of this Template.

Appendix 5: LID Feasibility Supplemental Information

Information that supports or supplements the determination of LID technical feasibility documented in Section D

Examples of material to provide in Appendix 5 may include but are not limited to the following:

- Technical feasibility criteria for DMAs
- Site specific analysis of technical infeasibility of all LID BMPs (if Alternative Compliance is needed)
- Documentation of Approval criteria for Proprietary Biofiltration BMPs

This information should support the Full Infiltration Applicability, and Biofiltration Applicability sections of this Template. Refer to Section 2.3 of the SMR WQMP and Sections D of this Template.

Appendix 6: LID BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation to supplement Section D

Examples of material to provide in Appendix 6 may include but are not limited to the following:

- DCV calculations,
- LID BMP sizing calculations from Exhibit C of the SMR WQMP
- Design details/drawings from manufacturers for proprietary BMPs

This information should support the Full Infiltration Applicability, and Biofiltration Applicability sections of this Template. Refer to Section 3.4 of the SMR WQMP and Sections D.4 of this Template.

Appendix 7: Hydromodification

Supporting Detail Relating to compliance with the Hydromodification Performance Standards

Examples of material to provide in Appendix 7 may include but are not limited to the following:

- Hydromodification Exemption Exhibit,
- Potential Critical Coarse Sediment Yield Area Mapping
- Hydromodification BMP sizing calculations,
- SMRHM report files,
- Site-Specific Critical Coarse Sediment Analysis,
- Design details/drawings from manufacturers for proprietary BMPs

This information should support the hydromodification exemption (if applicable) and hydrologic control BMP and Sediment Supply BMP sections of this Template. Refer to Section 2.4 and 3.6 of the SMR WQMP and Sections E of this Template.

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

Include a copy of the completed Pollutant Sources/Source Control Checklist used to document Source Control BMPs in Section H of this Template.

Appendix 8

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section **H** of the 20**18** SMR WQMP Template):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your WQMP Exhibit.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in your WQMP. Use the format shown in Table H.1 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ A. **On-site storm drain inlets**	❑ **Locations of inlets.**	❑ **Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.**	❑ **Maintain and periodically repaint or replace inlet markings.** ❑ **Provide stormwater pollution prevention information to new site owners, lessees, or operators.** ❑ **See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** ❑ **Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."**
❑ B. **Interior floor drains and elevator shaft sump pumps**		❑ **State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.**	❑ **Inspect and maintain drains to prevent blockages and overflow.**
❑ C. **Interior parking garages**		❑ **State that parking garage floor drains will be plumbed to the sanitary sewer.**	❑ **Inspect and maintain drains to prevent blockages and overflow.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ D1. **Need for future indoor & structural pest control**		❑ **Note building design features that discourage entry of pests.**	❑ **Provide Integrated Pest Management information to owners, lessees, and operators.**
❑ D2. **Landscape/ Outdoor Pesticide Use**	❑ **Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained.** ❑ **Show self-retaining landscape areas, if any.** ❑ **Show stormwater treatment and hydrograph modification management BMPs.**	**State that final landscape plans will accomplish all of the following.** ❑ **Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.** ❑ **Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.** ❑ **Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.** ❑ **Consider using pest-resistant plants, especially adjacent to hardscape. To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.**	❑ **Maintain landscaping using minimum or no pesticides.** ❑ **See applicable operational BMPs in "What you should know for…..Landscape and Gardening"** at: http://www.rcwatershed.org/about/materials-library/#1450469138395-bb76dd39-d810 ❑ **Provide IPM information to new owners, lessees and operators.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ E. **Pools, spas, ponds, decorative fountains, and other water features.**	❑ **Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)**	**If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.**	❑ **See applicable operational BMPs in "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at:** http://www.rcwatershed.org/about/materials-library/#1450469201433-f5f358c9-6008
❑ F. **Food service**	❑ **For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment.** ❑ **On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.**	❑ **Describe the location and features of the designated cleaning area.** ❑ **Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.**	❑ **See the brochure, "The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at** http://www.rcwatershed.org/about/materials-library/#1450389926766-61e8af0b-53a9 **Provide this brochure to new site owners, lessees, and operators.**
❑ G. **Refuse areas**	❑ **Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas.** ❑ **If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area.** ❑ **Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.**	❑ **State how site refuse will be handled and provide supporting detail to what is shown on plans.** ❑ **State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.**	❑ **State how the following will be implemented:** **Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ H. **Industrial processes.**	❑ **Show process area.**	❑ **If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."**	❑ **See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at: **http://www.rcwatershed.org/about/materials-library/#1450389926766-61e8af0b-53a9**
❑ I. **Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)**	❑ **Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area.** ❑ **Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults.** ❑ **Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.**	❑ **Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.** **Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:** ▪ **Hazardous Waste Generation** ▪ **Hazardous Materials Release Response and Inventory** ▪ **California Accidental Release (CalARP)** ▪ **Aboveground Storage Tank** ▪ **Uniform Fire Code Article 80 Section 103(b) & (c) 1991** ▪ **Underground Storage Tank** **www.cchealth.org/groups/hazmat/**	❑ **See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ J. **Vehicle and Equipment Cleaning**	❑ **Show on drawings as appropriate:** **(1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.** **(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).** **(3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.** **(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.**	❑ **If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.**	**Describe operational measures to implement the following (if applicable):** ❑ **Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system. Refer to "Outdoor Cleaning Activities and Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at: http://www.rcwatershed.org/about/materials-library/#1450389926766-61e8af0b-53a9** ❑ **Car dealerships and similar may rinse cars with water only.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ K. **Vehicle/Equipment Repair and Maintenance**	❑ **Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.** ❑ **Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.** ❑ **Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.**	❑ **State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.** ❑ **State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.** ❑ **State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.**	**In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:** ❑ **No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.** ❑ **No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.** ❑ **No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.** **Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations; "Outdoor Cleaning Activities;" and "Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants. Brochures can be found at: http://www.rcwatershed.org/about/materials-library/#1450389926766-61e8af0b-53a9**

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ L. **Fuel Dispensing Areas**	❑ **Fueling areas[6] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.** ❑ **Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.**		❑ **The property owner shall dry sweep the fueling area routinely.** ❑ **See the Fact Sheet SD-30 , "Fueling Areas" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

[6] **The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ M. **Loading Docks**	❑ **Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.** ❑ **Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.** ❑ **Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.**		❑ **Move loaded and unloaded items indoors as soon as possible.** ❑ **See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ N. **Fire Sprinkler Test Water**		❑ **Provide a means to drain fire sprinkler test water to the sanitary sewer.**	❑ **See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**
O. **Miscellaneous Drain or Wash Water or Other Sources** ❑ **Boiler drain lines** ❑ **Condensate drain lines** ❑ **Rooftop equipment** ❑ **Drainage sumps** ❑ **Roofing, gutters, and trim.** ❑ **Other sources**		❑ **Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.** ❑ **Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system.** ❑ **Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment.** ❑ **Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water.** ❑ **Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.** ❑ **Include controls for other sources as specified by local reviewer.**	

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ P. **Plazas, sidewalks, and parking lots.**			❑ **Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.**

Appendix 9: O&M

Operation and Maintenance Plan and Documentation of Finance, Maintenance and Recording Mechanisms

Include the completed Operation and Maintenance Plan in this Appendix along with additional documentation of Finance and Maintenance Recording Mechanisms for the site. Refer to Sections 3.10 and 5 of the SMR WQMP and Section J of this Template.

Appendix 10: Educational Materials

BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information

Examples of material to provide in Appendix 10 may include but are not limited to the following:

- BMP Fact Sheets for proposed BMPs form Exhibit C: LID BMP Design Handbook of the SMR WQMP,
- Source control information and training material for site owners and operators,
- O&M training material,
- Other educational/training material related to site drainage and BMPs.

EXHIBIT C:

LID BMP Design Handbook

Riverside County

Santa Margarita River Watershed Region

Design Handbook

for

Low Impact Development

Best Management Practices

Prepared by:

Revised June 2018

Riverside County Flood Control and Water Conservation District

1995 Market Street

Riverside, CA 92501

TABLE OF CONTENTS

1.0 Introduction 3

What is Low Impact Development? 3
About this Handbook 4
Selecting appropriate LID BMPs 4
Who should be involved in the selection, siting and design of LID BMPs? 4
Many of the BMP fact sheets reference the 'Engineering Authority' (EA). Who is the EA for my project? 5
Do I need to do additional studies? 5
Designing the BMPs 5
Can I make my BMP smaller? 5
Can I place my BMP underground? 6
What are Drawdown Times? 6
What is the tributary drainage area? 6
What are pervious and impervious areas? 6

2.0 Sizing Calculations 7

2.1 Calculating V_{BMP} 7
2.2 Calculating Q_{BMP} 9

3.0 BMP Fact Sheets 11

3.1 Infiltration Basins
3.2 Infiltration Trenches
3.3 Permeable Pavement
3.4 Bioretention Facilities
3.5 Biofiltration with Partial Infiltration
3.6 Biofiltration with No Infiltration
3.7 Regional Bioretention/Biofiltration Facility Guidance
3.8 Bioretention Soil Media
3.9 Tree Wells
3.10 Extended Detention Basins
3.11 Sand Filter Basins
3.12 Harvest and Use

APPENDICES

Appendix A: Infiltration Testing Guidelines

Appendix B: Underdrain Guidelines

Appendix C: Basin Guidelines

Appendix D: Pollutant Removal Effectiveness Table

Appendix E: Calculation Worksheets for V_{BMP} and Q_{BMP}

Riverside County - Santa Margarita River Watershed Region

Design Handbook for Low Impact Development Best Management Practices

1.0 Introduction

What is Low Impact Development?

According to the State Water Resources Control Board, Low Impact Development (LID) is:

> *… a sustainable practice that benefits water supply and contributes to water quality protection. Unlike traditional storm water management, which collects and conveys storm water runoff through storm drains, pipes, or other conveyances to a centralized storm water facility, LID takes a different approach by using site design and storm water management to maintain the site's pre-development runoff rates and volumes. The goal of LID is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to the source of rainfall.*[1]

When implemented correctly on a site, LID provides two primary benefits: 1) The post-construction site hydrology will more closely mimic the pre-development hydrology, thus reducing the downstream erosion that may occur due to increased runoff from impervious surfaces; and 2) Pollutants in runoff from the site will be significantly reduced.

Additionally, the California Stormwater Quality Association (CASQA) LID Manual[2] identifies that a properly and effectively designed site will incorporate two forms of LID: LID Principles and LID BMPs. Whereas LID Principles focus on planning and designing a site in a manner that minimizes the causes, or drivers, of project impacts (sometimes referred to as site design), this Handbook discusses LID BMPs which are implemented to help mitigate any impacts that are otherwise unavoidable.

Notes on terminology: This Handbook uses the term "LID Principles" or "Site Design" to refer to BMPs described in Provision E.3.a(3) of the Regional MS4 Permit (note the Permit calls these BMPs "Low Impact Development"). This Handbook uses the terms "LID BMPs" and "Treatment

[1] State Water Resources Control Board, *Low Impact Development – Sustainable Storm Water Management*, 2010; http://www.waterboards.ca.gov/water_issues/programs/low_impact_development/index.shtml

[2] California Stormwater Quality Association, *Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies*, April 2010

Control BMPs" are used to refer to classes of Structural Stormwater Pollutant Control BMPs described in Provision E.3.c(1) of the Regional MS4 Permit.

About this Handbook

This Handbook supplements the Water Quality Management Plan (WQMP) for the Santa Margarita River Watershed Region (SMR) of Riverside County by providing guidance for the planning, design and maintenance of Low Impact Development (LID) BMPs (i.e. Permit Provision E.3.c(1))which may be used to mitigate the water quality impacts of development within the SMR Watershed.

This Handbook contains detailed information and designs for twelve (12) LID BMPs that are designed to encourage replication of the site's natural hydrologic processes. This includes maximizing direct or incidental infiltration and evapotranspiration, and using vegetation and other biological processes to filter and absorb pollutants. For each BMP, pertinent information is provided such as the maximum tributary drainage area, siting considerations, design procedures, and maintenance requirements. This Handbook also includes detailed guidance for infiltration testing, and basin considerations. It should be noted that project specific engineering analysis may be used to over-ride certain requirements described in this manual, as approved by the reviewing agency to ensure water quality is protected to the maximum extent practicable.

Selecting appropriate LID BMPs

LID BMPs are an effective, naturally-based form of stormwater pollutant treatment BMPs. Before selecting any particular BMPs for a site, refer to the 2018 SMR WQMP to determine LID options and requirements. The WQMP specifies particular types of LID or Treatment Control BMPs that can or must be considered for use on the project. Considerations for BMP selection include whether or not the LID BMP will maximize on-site retention of runoff, or be based on the types of pollutants that the site may generate, types of pollutants that are impairing the downstream receiving waters, and which BMPs are effective at addressing those pollutants.

Generally, infiltration BMPs have advantages over other types of BMPs, including reduction of the volume and rate of runoff, as well as full treatment of all potential pollutants potentially contained in the stormwater runoff. It is recognized however, that infiltration and retention BMPs may not be feasible on sites with high groundwater, low infiltration rates, or located on compacted engineered fill. In those situations, biofiltration based BMPs that provide opportunity for evapotranspiration and incidental infiltration may be a more feasible option. The WQMP specifies criteria that should be used to determine when particular BMPs are considered feasible.

Who should be involved in the selection, siting and design of LID BMPs?

Everyone involved with the project site development, including owners, architects, engineers, biologists, and geologists, should be informed about the proposed/required BMPs as early as possible in the planning of a project. This reduces the chance of costly redesign, the need for additional testing and produces a better and more integrated site overall. For most detention or retention basins and all infiltration BMPs, it is important that the responsible engineer/geologist

be made aware of the location of BMPs, so they can make design recommendations including setbacks and perform the appropriate infiltration testing, as applicable. Landscape architects will need to know the locations and types of proposed BMPs as these might change the types of plants that can be used. Owners must be made aware of the construction costs, long-term maintenance requirements and costs, and total costs of ownership for the BMPs in order to make informed decisions during the BMP selection process.

Many of the BMP fact sheets reference the 'Engineering Authority' (EA). Who is the EA for my project?

The engineering authority for a project is the public agency responsible for reviewing and approving the proposed project. Usually the EA is the City/County wherein the project is located.

Do I need to do additional studies?

Most infiltration BMPs and basins will require a geotechnical report prepared by either a licensed geotechnical engineer, civil engineer or certified engineering geologist. The report must provide characterization of site specific soil conditions, recommendations of any required testing, and site-specific recommendations for setbacks as well as commentary on slope stability and potential offsite impacts. See Infiltration Testing Requirements and Basin Guidelines in Appendices A and C, respectively, for more information. Some sites will require other studies, such as biological resources, geomorphology, or groundwater hydrology.

Designing the BMPs

The BMPs in this Handbook are designed based on required capture volume or treatment flow rate. Volume-based BMPs are designed to capture a particular volume of stormwater runoff (referred to as V_{BMP} or the Design Capture Volume (DCV)), and either infiltrate that volume, re-use the water, or slowly and naturally filter pollutants from that stormwater, and discharge the volume within a specified "drawdown time" (the time required to regenerate the storage capacity of the BMP). Flow-based BMPs are designed to treat a required minimum flow rate of stormwater runoff (referred to as Q_{BMP}).

This Handbook contains worksheets to assist the designer in determining the required V_{BMP} and Q_{BMP} based on the location of the site. While there are likely significant direct or indirect volume reduction benefits associated with each of the included LID BMPs, these sizing worksheets are not intended to meet Hydromodification Performance Standards detailed in the SMR WQMP.

Can I make my BMP smaller?

The worksheets in this Handbook calculate the minimum required size for each LID BMP based on the amount of runoff routed to the BMP. However, early and aggressive implementation of LID Principles (site design) during the planning stages of a project can reduce the size of the effective drainage management area (DMA) for the BMP, which reduces runoff volume from the DMA, which in turn will help minimize the required size of the BMPs. To further reduce the required size, consider looking for additional ways to increase the percentage of permeable areas and porous surfaces on the site, and opportunities to drain impervious areas into pervious areas.

Can I place my BMP underground?

Underground BMPs can be an important part of an LID solution for a site. However, underground BMPs create some special challenges that must be addressed in order to provide a sustainable solution. Challenges include but are not limited to a need for effective pre-treatment, structural stability, vector control, maintenance, and the cost of replacement at the time that clogging cannot be remediated with maintenance. Special consideration needs to be given to how underground BMPs can be sustainably operated, maintained, and replaced when needed. This may include: greater emphasis on pre-treatment, inclusion of adequate inspection and maintenance features, regular inspections and effective maintenance of the BMP, and budgetary planning for major construction efforts when replacement is needed.

What are Drawdown Times?

Volume based BMPs are usually associated with a required drawdown time. The drawdown time refers to the amount of time required to regenerate the storage capacity of the BMP (i.e., drain the BMP from brim full). The specified or incorporated drawdown times are to ensure that adequate contact or detention time has occurred for treatment, while not creating vector or other nuisance issues. It is important to abide by the drawdown time requirements stated in the fact sheet for each specific BMP, or as specified by the local jurisdiction.

What is the tributary drainage area?

The tributary drainage area is the entire area that drains to the proposed onsite BMP. While small sites could be tributary to a single BMP, usually the site is broken up into several drainage management areas (DMAs), each draining to a discrete BMP. Although it is usually desirable to address offsite flows separately, if flows from offsite areas commingle with onsite flows they shall also be included in the sizing calculation. At the beginning of each fact sheet, the maximum (or minimum) tributary drainage area for each BMP is listed. The tributary areas for each BMP will be required to be clearly shown on one or more drainage exhibits. Such exhibits shall be clearly labeled to show which areas drain to which BMP.

What are pervious and impervious areas?

Project sites are made up of both pervious and impervious surfaces. The pervious portion of a site is where stormwater has the opportunity to infiltrate into the ground, such as but not limited to landscaped or natural areas. Impervious areas are where water has no opportunity to infiltrate and immediately becomes surface runoff (e.g. roofs, standard roadway pavements, concrete driveways or walkways, tightly compacted earthen materials, etc.). When a site is developed, the percentage of impervious area typically increases from the natural state. This higher impervious percentage increases the volume and flow rate of stormwater runoff.

2.0 Sizing Calculations

The following section includes sizing calculations for LID BMPs in the Santa Margarita River Watershed. There may be circumstances when flow-based Treatment Control BMPs are utilized and therefore this section also includes guidelines for calculating the design flow rate, Q_{BMP}.

2.1 Calculating V_{BMP}

Volume based BMPs and Biofiltration BMPs, including all of the BMPs in this manual, can be sized based on the design capture volume, (DCV or V_{BMP}).

The design capture volume (DCV or V_{BMP}) is based on capturing the volume of runoff generated from an 85th percentile, 24-hour storm event. Follow the steps below to calculate V_{BMP}. For convenience, these steps have also been integrated into an excel worksheet that has been provided in Appendix E of this Handbook.

1) Determine the tributary drainage area to the BMP, A_T. This includes all areas that will contribute runoff to the proposed BMP, including pervious areas, and runoff from off-site areas that commingle with on-site runoff. Calculate this area in acres.

2) Locate the project site on the full sized Isohyetal Map for the 85th Percentile 24-hour Storm Event contained in Appendix A of the SMR WQMP). These values were determined throughout Riverside County using rain gauges with the greatest periods of record. Use township, range and section information to locate the project site, and interpolate the closest value, D85, for the site. For areas near the edge of the county, extend the isohyetal lines linearly to the County boundary.

3) Determine the effective impervious fraction (I_f) for the area tributary to the BMP, using the following table:

Surface Type	Effective Impervious Fraction, I_f
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15
Natural (C Soil)	0.30
Natural (D Soil)	0.40

If the area tributary to the BMP contains mixed post-project surface types, a composite or area-weighted average effective impervious fraction should be used. The following equation can be used for determining an area-weighted average:

$$\frac{\left[(I_f)_1 \cdot A_1\right] + \left[(I_f)_2 \cdot A_2\right] + [\dots]}{A_T}$$

4) Calculate a runoff factor, 'C', using the following equation:

$$C = 0.858 \cdot {I_f}^3 - 0.78 \cdot {I_f}^2 + 0.774 * I_f + 0.04$$

5) Determine unit storage volume, V_U. This is found by multiplying the Design Storm Depth found in Step 2 by the runoff coefficient found in Step 4.

$$V_U = D_{85} \times C$$

6) Determine V_{BMP} using the equation below or the worksheet provided in Appendix E of this Handbook. This is the volume to be used in the design of selected BMPs presented in this Handbook. Multiply the BMP tributary drainage area, A_T, by the unit storage volume, V_U, to give the BMP design storage volume.

$$V_{BMP}(ft^3) = \frac{V_U(in - ac/ac) \times A_T(ac) \times 43{,}560(ft^2/ac)}{12\ (in/ft)}$$

If Biofiltration BMPs are used, they must be sized according to either of the following approaches:

- Have a total static storage volume including pore spaces and pre-filter detention volume, at least 0.75 times the V_{BMP} (aka DCV) not reliably retained on site. The pre-filter detention volume refers to the volume stored above the soil media and up to the maximum water quality ponding level. Pore volume refers to the volume available in the pores of the soil and/or gravel in the system.
- Treat 1.5 times the V_{BMP} (aka DCV) not reliably retained on site. This may be a volume-based or a flow-based design.

Application of these sizing methods is explained in the respective biofiltration fact sheets (3.5 and 3.6).

2.2 Calculating Q_{BMP}

While the BMPs in this Handbook are designed based on V_{BMP} (aka DCV) as discussed in 2.1 above, in some circumstances flow-based BMPs may be used. Flow-based BMPs are sized to treat the design flow rate.

Q_{BMP} is the runoff flow rate resulting from a design rainfall intensity of 0.2 inches per hour or 2 times the maximum runoff flow rate produced during 85th percentile hourly rainfall intensity. Follow the steps below to calculate Q_{BMP}.

1) Determine the tributary drainage area, A_T, that drains to the proposed BMP. This includes all areas that will contribute runoff to the proposed BMP, including pervious areas, impervious areas, and runoff from offsite areas that commingle with site runoff, whether or not they are directly or indirectly connected to the BMP. Calculate this area in units of acres.

2) Determine the effective impervious fraction (I_f) for the area tributary to the BMP, using the following table:

Surface Type	Effective Impervious Fraction, I_f
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15

Natural (C Soil)	0.30
Natural (D Soil)	0.40

If the area tributary to the BMP contains mixed post-project surface types, a composite or area-weighted average effective impervious fraction should be used. The following equation can be used for determining an area-weighted average:

$$\frac{\left[(I_f)_1 \cdot A_1\right] + \left[(I_f)_2 \cdot A_2\right] + [\dots]}{A_T}$$

3) Calculate a runoff factor, 'C', using the following equation:

$$C = 0.858 \cdot {I_f}^3 - 0.78 \cdot {I_f}^2 + 0.774 * I_f + 0.04$$

4) Determine the Design Rainfall Intensity using one of the following methods:
   - Use a value of 0.2 inches per hour, or,
   - Use local rainfall records, if suitable records exist, to calculate two times the maximum runoff during the 85th percentile hourly rainfall intensity.

5) Determine the BMP Design Flow Rate using the equation:

$$Q_{BMP} = C \times I \times A_T$$

Where,

A_T = Tributary Area to the BMP, in acres

I = Design Rainfall Intensity, from Step 4.

C = Runoff Factor, found in Step 3

For flow-based biofiltration BMPs, the Q_{BMP} calculated above needs to be multiplied by 1.5 to meet the sizing standard for biofiltration BMPs in the SMR watershed. Flow-based biofiltration BMPs are not acceptable in all cases.

3.0 BMP Fact Sheets

This section provides fact sheets for the following thirteen types of BMPs:

3.1 - Infiltration Basins

3.2 - Infiltration Trenches

3.3 - Permeable Pavement

3.4 - Bioretention Facilities

3.5 - Biofiltration with Partial Infiltration

3.6 - Biofiltration with No Infiltration

3.7 – Regional Bioretention/Biofiltration Facility Guidance

3.8 - Bioretention Soil Media

3.9 - Tree Wells

3.10 - Extended Detention Basins

3.11 - Sand Filter Basins

3.12 - Harvest and Use

►For portability, the fact sheets for each BMP, as well as Calculation worksheets for sizing and documenting the design of these BMPs, are provided as separate downloadable files on the LID Handbook page at www.rcflood.org/NPDES/developers.aspx

BEFORE selecting any particular BMP for use on your project, review the requirements of the 2018 SMR WQMP, and the discussions in sections 1 and 2 of this Handbook. These provide important context and instructions that may dictate that particular BMPs be used.

APPENDIX A

Infiltration Testing

APPENDIX A - INFILTRATION TESTING

Infiltration BMPs use the interaction of chemical, physical, and biological processes between soil and water to filter out sediments and constituents from stormwater. Infiltration BMPs require a maximum drawdown time to avoid nuisance issues. Since drawdown time is contingent on the infiltration rate of the underlying soil, tests are used to help establish the vertical infiltration rate of the soil below a proposed infiltration facility. The tests attempt to simulate the physical process that will occur when the facility is in operation.

Section 1 - General Requirements

1.1 - Summary of Requirements

The following is a brief summary of the requirements for all infiltration test reports submitted to the Engineering Authority (EA)[1] for the purpose of water quality BMP design. A checklist form is included at the end of this document.

1. Where infiltration testing is to be performed (as directed by the EA or in the WQMP), the measured infiltration rate of the underlying soil must be determined using either the single ring infiltrometer test (as described in ASTM D 5126, Section 4.1.2.1), the double ring infiltrometer test (ASTM D 3385), the well permeameter method (USBR 7300-89), or a percolation test per County of Riverside Department of Environmental Health (RCDEH) test procedures. A general explanation of these test methods can be found in Section 2 of this appendix. The minimum number of tests required can be found in Table 1 and is dependent upon the type of infiltration test performed.

2. Test pits and borings (ASTM D 1452) may be used to determine the USCS series and textural class (SM, CL, etc.) of the soil horizons, the thickness of soil and rock strata, and to estimate the historical high groundwater mark[2]. Test pits or boring logs must be of sufficient depth to establish that a minimum of 5 feet of permeable soil exists below the infiltration facility and that there is a minimum of 10 feet between the bottom of the infiltration facility and the historical high groundwater mark (Sections 1.7 and 2.5). The required number of test pits or borings are listed in Table 1.

3. A final report, prepared by a registered civil engineer, geotechnical engineer, certified engineering geologist or certified hydrogeologist shall be provided to the EA which demonstrates through infiltration testing and/or soil logs that the proposed facility location is suitable for the proposed infiltration facility and an infiltration rate shall be recommended. In addition, any requirements associated with impacts to a landslide, erosion or steep slope hazard area should also be addressed in the final report. (Section 1.7)

[1]*County Transportation, Coachella Valley Water District and the City Engineer for incorporated cities within the County may choose to alter these guidelines and may have different/additional requirements. These entities, along with the District, will be referred to as the Engineering Authority (EA).*

[2]*The "historical high groundwater mark" is defined as the groundwater elevation expected due to a normal wet season and shall be obtained by boring logs or test pits.*

4. Tests may be performed only by individuals trained and educated to perform, understand and evaluate the field conditions. The individual(s) supervising the field work must be named in the final report as described in Item 3. (Section 1.7)

5. Preliminary site grading plans shall be provided to the EA showing the proposed BMP locations along with section views through each BMP clearly identifying the extents of cut/fill relative to native soil. (See Section 1.1)

6. For sites where infiltration BMPs have been determined to be feasible and will be used, infiltration tests shall be performed within the boundaries of the proposed infiltration BMP and at the bottom elevation (infiltration surface) of the proposed infiltration BMP to confirm the suitability of infiltration. (See Photo 5)

A Note on "Infiltration Rate" vs. "Percolation Rate"

A common misunderstanding exists that the "percolation rate" obtained from a percolation test is equivalent to the "infiltration rate" obtained from a single or double ring infiltrometer test. While the percolation rate is related to the infiltration rate, percolation rates tend to overestimate infiltration rates and can be off by a factor of ten or more. However, as is discussed in Section 2.3, the percolation rate can be converted to a reasonable estimate of the infiltration rate using the Porchet Method.

1.2 Applicability of Infiltration BMPs

The WQMP guidance applicable to a project (based on the watershed location of the project), may include specific criteria for evaluating whether infiltration BMPs are feasible for a particular project. Where the WQMP requires that infiltration testing be performed as part of an infiltration feasibility evaluation, a testing method approved by the EA shall be used. The District requires the use of the methods described in Section 2 herein. The remainder of Section 1 herein describes requirements that must be implemented whenever an infiltration BMP is to be implemented.

1.3 - Grading Plans

Many projects require a significant amount of grading prior to their construction. It is important to determine if the BMP will be placed in cut or fill since this may affect the performance of the BMP or even the soil. As such, preliminary site grading plans showing the proposed BMP locations are required along with section views through each BMP clearly identifying the extents of cut or fill. In addition, since it is imperative that any testing be performed at the proper elevations and locations, it is highly recommended that the preliminary site grading plans be provided to the engineer/geologist prior to any tests being performed.

1.4 - Cut Condition

Where the proposed infiltration BMP is to be located in a cut condition, the infiltration surface level at the bottom of the BMP might be far below the existing grade. For example, if the infiltration surface of a proposed BMP is to be located at an elevation that is currently beneath 15 feet of cut, how can the proposed infiltration surface be tested?

In order to determine an infiltration rate where the proposed infiltration surface is in a cut condition, the following procedures may be used:

1. The USBR 7300-89, "Procedure for Performing Field Permeability Testing by the Well Permeameter Method" (Section 2.4). Note: the result must be converted to an infiltration rate.
2. The Percolation Test per RCDEH (Section 2.3) may be used. Note: the result must be converted to an infiltration rate.

Refer also to the WQMP guidance document applicable to the project, which may identify applicability criteria for infiltration BMPs in cut conditions.

1.5 - Fill Condition

If the bottom of a BMP (infiltration surface) is in a fill location, the infiltration surface may not exist prior to grading. How then can the infiltration rate be determined? For example, if a proposed infiltration BMP is to be located in 12 feet of fill, how could one reasonably establish an infiltration rate prior to the fill being placed?

Unfortunately, no reliable assumptions can be made about the in-situ properties of fill soil. As such, the bottom, or rather the infiltration surface of the BMP, must extend into natural soil. The natural soil shall be tested at the design elevation prior to the fill being placed.

In some cases, the extension of the BMP down to natural soil may prove infeasible. In that case, another BMP must be selected.

1.6 - Factors of Safety

Long term monitoring has shown that the performance of working full-scale infiltration facilities may be far lower than the rate measured by small-scale testing. There are several reasons for this:

- Over time, the surface of infiltration facilities can become plugged as sedimentary particles accumulate at the infiltration surface.
- Post-grading compaction of the site can destroy soil structure and seriously impact the facility's performance.

- Soils and soil strata are rarely homogenous, and variations across a site, and sometimes even within a BMP footprint, can cause tested infiltration rates to vary widely.
- Testing procedures in general are subject to natural variations and errors which can skew the results.

As such, to obtain an appropriate level of confidence in the final design infiltration rate, factors of safety shall be applied to the tested infiltration rate, I_t, in order to determine the design infiltration rate, I_d. These factors are based on such considerations as the type of tests used, the number of tests performed and whether testing is performed at all. Table 1 provides a complete matrix of testing requirements versus factors of safety.

1.7 - Infiltration Testing Requirements

Table 1 is a list of infiltration BMPs with test regime options and their corresponding design factors of safety. The options are summarized below:

Option 1- This test regime includes ring infiltrometer type tests, test pit or boring logs and a final report. The minimum required number of tests is as described in Table 1. The minimum required factor of safety for this option is FS=3.

Option 2- This test regime includes percolation type tests, test pit or boring logs and a final report. The minimum required number of tests is as described in Table 1. The minimum required factor of safety for this option is FS=3.

Option 3- This test regime includes test pit or boring logs only and a final report. The minimum required number of tests is as described in Table 1. An expected infiltration rate shall be included in the final report based on the specifics of the borings or test pits. The minimum required factor of safety for this option is FS=6. This option may be used for projects with a maximum tributary area of 5 acres only.

Option 4- This test regime includes a single test pit or boring log at any representative location on the project site. Plates E-6.1 and E-6.2 of the Riverside County Flood Control and Water Conservation District's (RCFCD) Hydrology Manual shall then be used to establish an approximate infiltration rate based on the appropriate Runoff Index and the Antecedent Moisture Content (AMC) as defined on page C-3 of the Hydrology Manual. The minimum required factor of safety for this option is FS=10.

Table 1 - Infiltration Testing Requirements							
Infiltration BMP	Testing Options	Ring Infiltrometer Tests[1]	Percolation Test[2]	Test Pits or Boring Logs[3]	Final Report[4]	Hydrology Manual[5]	Factor of Safety
Infiltration Trench	Option 1►	2 tests min. with at least 1 per trench	not used	1 boring or test pit per trench	Required	not used	FS = 3
	Option 2►	not used	4 tests min. with at least two per trench	1 boring or test pit per trench	Required	not used	FS = 3
	Option 3[7]►	not used	not used	1 boring or test pit per trench	Required	not used	FS = 6
	Option 4►	not used	not used	1 boring or test pit per site	not used	only	FS = 10
Infiltration Basin	Option 1►	2 tests min. with at least 1 per basin[6]	not used	1 boring or test pit per basin	Required	not used	FS = 3
	Option 2►	not used	4 tests min. with at least 2 per basin[6]	1 boring or test pit per trench	Required	not used	FS = 3
	Option 3[7]►	not used	not used	1 boring or test pit per basin	Required	not used	FS = 6
	Option 4►	not used	not used	1 boring or test pit per site	not used	only	FS = 10
Permeable Pavement	Option 1►	2 tests min. with at least 1 every 10,000 ft^2	not used	1 boring or test pit every 10,000 ft^2	Required	not used	FS = 3
	Option 2►	not used	4 tests min. with at least 2 every 10,000 ft^2	1 boring or test pit every 10,000 ft^2	Required	not used	FS = 3

Table Footnotes:

[1] Ring Infiltrometer tests per Section 2.2

[2] Percolation tests per Section 2.3 and Well Permeameter Test per Section 2.4

[3] Test pits or boring logs per Section 2.5

[4] Final Report per Section 1.7

[5] See Plate E-6.2 of the District's Hydrology Manual

[6] For basins in excess of 10,000 ft^2, provide one (1) ring infiltrometer test or two (2) percolation tests for each additional 10,000 ft^2

[7] This option may be used for projects with a maximum tributary area of 5 acres only.

1.8 - Final Report

Where a final report is required, a civil engineer, geotechnical engineer, certified engineering geologist or certified hydrogeologist shall establish whether the location is suitable for the proposed infiltration facility. At least 5 feet of permeable soil must be present below the infiltration facility and a minimum of 10 feet between the bottom of the infiltration facility and the historical high groundwater mark[1] is required. The signed/stamped report shall include discussion and records of the infiltration testing as well as boring log findings. Based on the results of these tests, the report shall provide an estimate of the infiltration rate found at the location of each proposed infiltration BMP in units of inches per hour. The factor of safety specified in Table 1 will be applied to the interpreted test results to determine the design infiltration rate for each infiltration BMP. Any requirements associated with impacts to an erosion hazard area, steep slope hazard area, or landslide hazard area should also be addressed in the report. In addition, the report shall include complete field records with the following information:

- Location of the test site.
- Dates of test, start and finish.
- Weather conditions, start to finish.
- Names(s) of technician(s).
- Description of test site, including assessment of boring profile and USCS soil classification.
- Depth to the water table and a description of the soils to a depth of at least 10 feet below proposed infiltration surface.
- Type of equipment used to construct the boreholes or test holes (such as backhoe, hollow stem auger, etc.)
- Areas of the rings (if used) or test hole diameter.
- Volume constants for graduated cylinder or Mariotte tube (if used).
- Complete field results in tabular format. Sample test data forms, as well as examples, have been provided following the description of each test in Section 2.
- A plot of the infiltration rate versus total elapsed time. An example is provided following the description of each test in Section 2.
- A labeled keymap showing test and boring locations.
- Confirmation that the soil was pre-saturated in accordance with the testing methods described herein.

Section 2 - Accepted Testing Methods

There is a wide range of different methods for measuring the infiltration rate of a given soil with varying degrees of accuracy and reliability. However, the District will accept only the following test methods:

1. Single Ring Infiltrometer (Per ASTM D 5126), Section 2.1.1
2. Double Ring Infiltrometer (Per ASTM D 3385), Section 2.1.2
3. Well Permeameter Method (USBR 7300-89), Section 2.4
4. Percolation Test (per County of Riverside Department of Environmental Health procedure), Section 2.3

[1]The "historical high groundwater mark" is defined as the groundwater elevation expected due to a normal wet season and shall be obtained by boring logs or test pits.

The following pages of this document provide an overview of these tests. It is recommended that the original Standards be referenced.

2.1 - Constant Head vs. Falling Head Method

There are two operational techniques used with all four of the testing techniques herein: the *constant head method* and the *falling head method*. With the *constant head method*, water is consistently added to both the outer and inner rings (ring infiltrometers) or to the test hole (pecolation test and well permeameter) to maintain a constant level throughout the testing. The volume of water needed to maintain the fixed level of the inner ring is measured. Conversely, in the *falling head method*, the water level is allowed to fall and the time that the water level takes to decrease is measured.

2.2 - Overview of Ring Infiltrometer Test Methods

Ring infiltrometers measure the rate of infiltration at the soil surface. Infiltration is influenced by both saturated hydraulic conductivity as well as capillary effects. The term *capillary effects* refers to the ability of dry soil to pull, or wick away, water from a zone of saturation faster than would occur if the soil were uniformly saturated. The magnitude of the capillary effect is determined by initial moisture content at the time of testing, the pore size, soil properties (texture, structure) and a number of other factors. The effects of capillarity are short lived and can greatly skew test results. As such, it is critical to obtain steady-state infiltration so that capillary effects are minimized. (ASTM 5126)

The ***single ring infiltrometer*** and ***double ring infiltrometer*** methods both employ the use of metal cylinders driven to shallow depths into the test soil. The rings are filled with water and the rate at which the water moves into the soil is measured. This rate becomes constant when the saturated hydraulic conductivity for the particular soil has been reached. This is reflected by the flattening out of the curve generated by sample test data as shown in Figure 2, "Plot of Infiltration Rate vs. Time". While we note that infiltration rate is not exactly the same as saturated hydraulic conductivity, for the purposes of this guidance document they are synonymous.

2.2.1 - Single Ring Infiltrometers

Single ring infiltrometer tests using a ring 40 inches or larger in diameter have been shown to closely match full-scale facility performance (Figures 1 and 2, Photo 1). The cylindrical ring is driven approximately 12 inches into the soil. Water is ponded within the ring above the soil surface. The upper surface of the ring is often covered to prevent evaporation. Using the constant head method, the volumetric rate of water added to the ring, sufficient to maintain a constant head within the ring is measured. The test is complete and the tested infiltration rate, I_t, is determined after the flow rate has stabilized. (ASTM D 5126)

Photo 1 – Simple Single Ring Infiltrometer

To help maintain a constant head, a variety of devices may be used. A hook gauge, steel tape or rule, length of steel, or plastic rod pointed on one end can be used for measuring and controlling the depth of liquid (head) in the infiltrometer ring. If available, a graduated Mariotte tube or automatic flow control system may also be used. Care should be taken when driving the ring into the ground as there can be a poor connection between the ring wall and the soil. This poor connection can cause a leakage of water along the ring wall and an overestimation of the infiltration rate.

The volume of liquid used during each measured time interval may be converted into an incremental infiltration velocity (infiltration rate) using the following equation:

$$I_t = \Delta V/(A*\Delta t)$$

Where:

I_t = tested infiltration rate, in/hr

ΔV = volume of liquid used during time interval to maintain constant head in the ring, in^3

A = internal area of ring, in^2

Δt = time interval, hr.

Final Report - Ultimately, as discussed in Section 1.7, a final report shall be provided and, based on the test results, an infiltration rate shall be recommended.

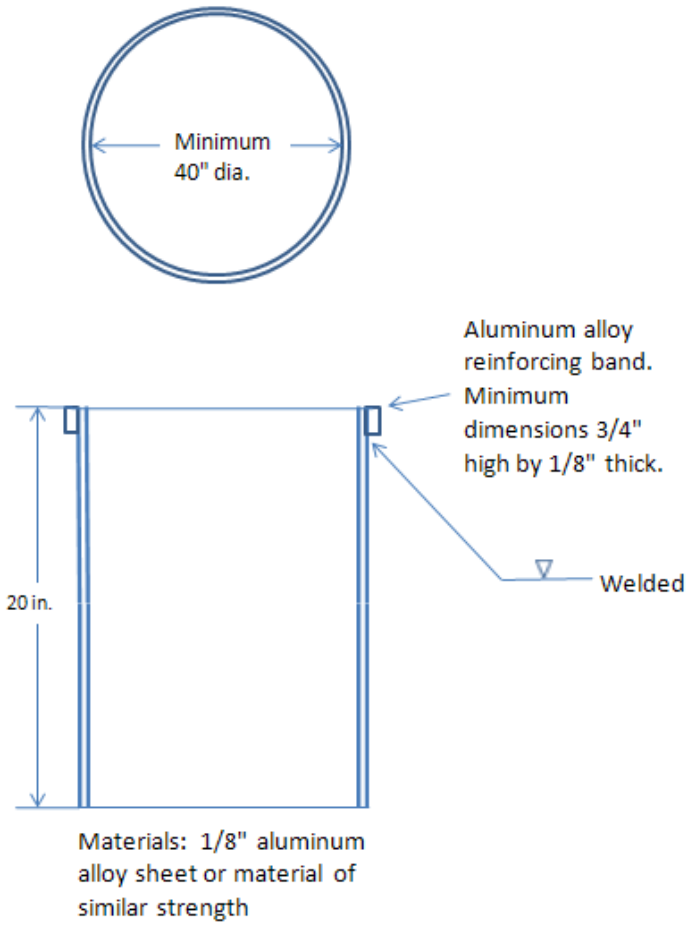


Figure 1- Single Ring Infiltrometer Construction

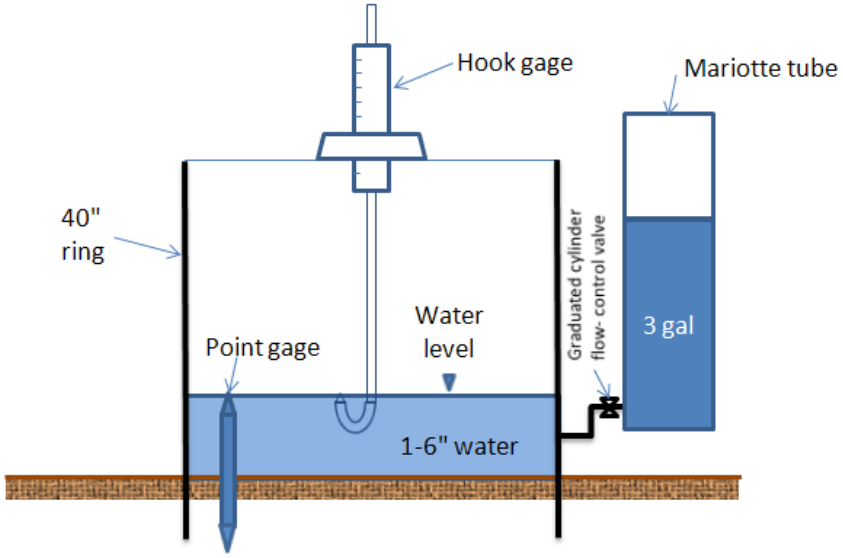


Figure 2- SIngle Ring Setup with Mariotte Tube

SINGLE RING INFILTROMETER TEST DATA								
Project Name and Test Location:			Constants-		Ring Data		Liquid Containers	
					Ring Area, A_r (in^2)	Depth of Liquid (in)	Reservoir Container Volume, V_r (in^3/in)	
Test By:		USCS Class:		Penetration of Ring into Soil (in.):				
Liquid Used:		pH:		Ground Temp (°F):		at Depth:		
Date of Test:		Depth to Water Table:						
Liquid Level Maintained by using:	( ) Flow Valve ( ) Float Valve ( ) Marriotte Tube ( ) Other:							
Additional Comments:								

Time interval	Time (hr:min)	Dt (min) & Total	Flow Readings		Liquid Temp (°F)	Infiltratn Rate , I**(in/hr)	Remarks
			Elev., H (In)	ΔH (in) & Q_f* (in^3)			
1 - Start							
End							
2 - Start							
End							
3 - Start							
End							
4 - Start							
End							
5 - Start							
End							
6 - Start							
End							
7 - Start							
End							
8 - Start							
End							
9 - Start							
End							
10 - Start							
End							
11 - Start							
End							
12 - Start							
End							
13 - Start							
End							
14 - Start							
End							
15 - Start							
End							

*Flow, $Q_f = \Delta H \times V_r$ **Infiltration Rate, $I = (Q_f/A_r)/$

Table 2 – Sample Test Data Form for Single Ring Infiltrometer Test

SINGLE RING INFILTROMETER TEST DATA

Project Name and Test Location:	Constants-	Ring		Liquid Containers
ACME IND. SITE 24166 ELM, RIVERDALE *WESTERN CORNER OF SITE (NEAR WAREHOUSE)		Ring Area, A_r (in^2)	Depth of Liquid (in)	Reservoir Container Volume, V_r (in^3/in)
		1256	4.0	78.54

Test By:	CMD	USCS Class:	SM	Penetration of Ring into Soil (in.):	3.0		
Liquid Used:	TAP WATER	pH:	8.0	Ground Temp (°F):	57	at Depth:	16"
Date of Test:	3-21-09	Depth to Water Table:	40 FEET				
Liquid Level Maintained by using:	( ) Flow Valve ( ) Float Valve (X) Marriotte Tube ( ) Other:						
Additional Comments:	DRY GROUND						

Time interval	Time (hr:min)	Dt (min) & Total	Flow Readings: Elev., H (In)	Flow Readings: ΔH (in) & Q_f* (in^3)	Liquid Temp (°F)	Infiltratn Rate, I**(in/hr)	Remarks
1 - Start	10:00	15	3.0	1.45	59	0.36	CLOUDY, SLIGHT WIND
End	10:15	(15)	4.45	114	59		
2 - Start	10:15	15	4.45	2.7	59	0.68	
End	10:30	(30)	7.15	212	59		
3 - Start	10:30	15	7.15	3.35	59	0.84	
End	10:45	(45)	10.5	263	59		
4 - Start	10:45	15	10.5	3.9	59	0.97	
End	11:00	(60)	14.4	306	60		
5 - Start	11:00	30	14.4	9.65	60	1.2	
End	11:30	(90)	24.05	758	61		
6 - Start	11:30	30	24.05	10.8	61	1.4	
End	12:00	(120)	34.85	848	62		
7 - Start	12:10	60	3.5	24.7	62	1.5	REFILLED TUBES
End	13:10	(180)	28.25	1944	63		
8 - Start	13:20	60	2.4	23.9	64	1.5	)(
End	14:20	(240)	26.3	1877	64		
9 - Start	14:30	60	4.3	21.6	64	1.4	)(
End	15:30	(300)	25.9	1696	64		
10 - Start	15:40	60	2.2	20.2	64	1.3	)(
End	16:40	(360)	22.4	1586	64		CLOUDY, SLIGHT WIND
11 - Start							
End							
12 - Start							
End							
13 - Start							
End							
14 - Start							
End							
15 - Start							
End							

*Flow, $Q_f = \Delta H \times V_r$ **Infiltration Rate, $I = (Q_f/A_r)/\Delta t$

FIGURE 3 – Sample Test Data

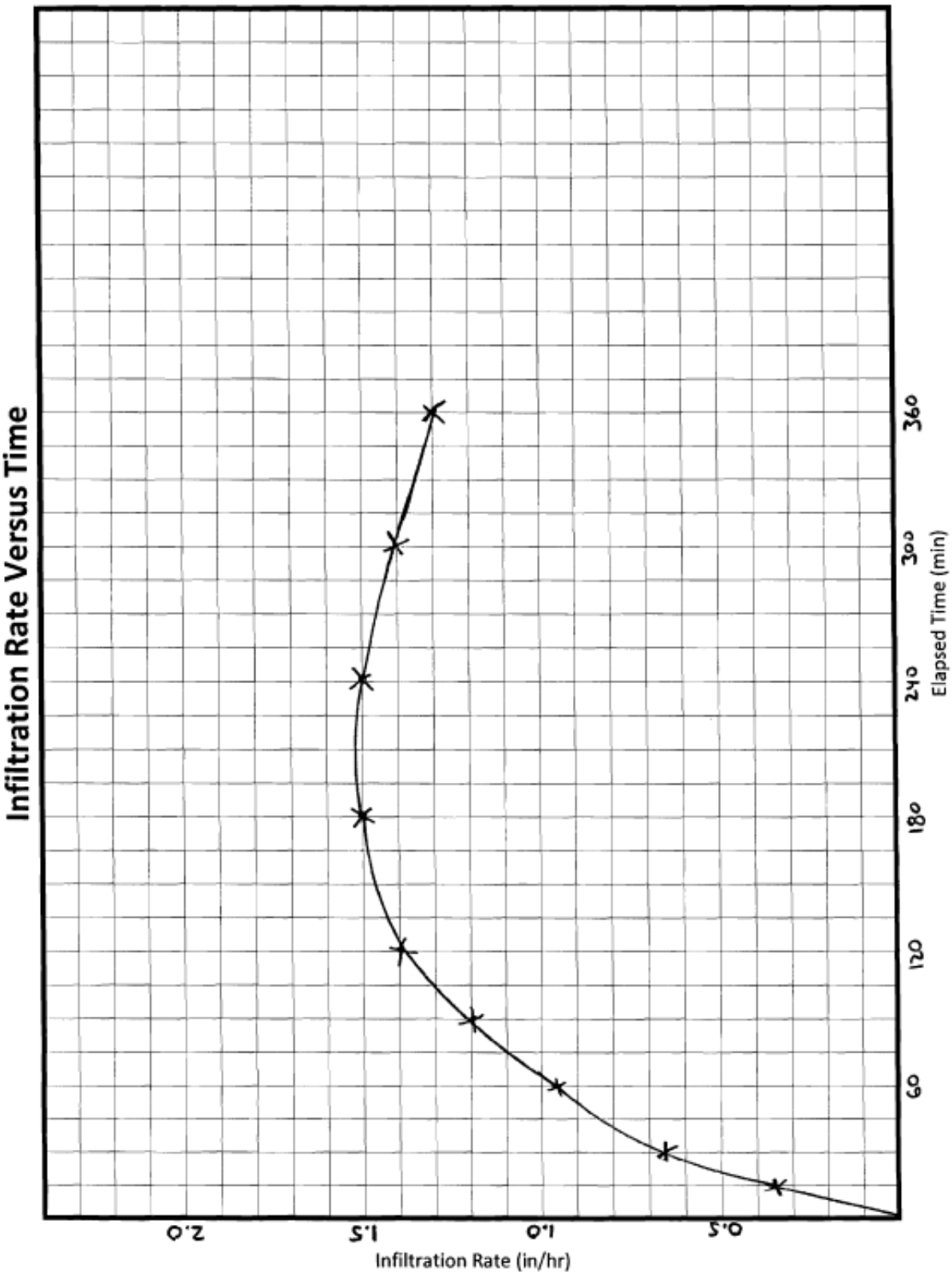


FIGURE 4 – Plot of Sample Test Data for Single Ring Infiltrometer Test

2.2.2 - Double Ring Infiltrometers

The ***double ring infiltrometer*** test (ASTM D 3385) is a well recognized and documented technique for directly measuring the soil infiltration rate of a site (see Figure 5, 6 and 7; Photos 2, 3, 4 and 5). Double ring infiltrometers were developed in response to the fact that smaller (less than 40 inch diameter) single ring infiltrometers tend to overestimate vertical infiltration rates. This has been attributed to the fact that the flow of water beneath the cylinder is not purely vertical and diverges laterally. Double ring infiltrometers minimize the error associated with the single-ring method because the water level in the outer ring forces vertical infiltration of water in the inner ring. Care should be taken when driving the rings into the ground as there can be a poor connection between the ring wall and the soil. This poor connection can cause a leakage of water along the ring wall and an overestimation of the infiltration rate. Another potential source of error is attributed to the size of the cylinders. As such, the use of cylinder sizes less than those prescribed in ASTM D 3385 is not recommended.

A typical double ring infiltrometer would consist of a 12 inch inner ring and a 24 inch outer ring. While there are two operational techniques used with the double-ring infiltrometer, the constant head method and the falling head method, ASTM D3385 mandates the use of the constant head method. With the constant head method, water is consistently added to both the outer and inner rings to maintain a constant level throughout the testing. The volume of water needed to maintain the fixed level of the inner ring is measured. To help maintain a constant head, a variety of devices may be used. A hook gauge, steel tape or rule, or length of steel or plastic rod pointed on one end, can be used for measuring and controlling the depth of liquid (head) in the infiltrometer ring. If available, a graduated Mariotte tube or automatic flow control system may also be used.

The volume of liquid used during each measured time interval may be converted into an incremental infiltration velocity (infiltration rate) using the following equation:

$$I_t = \Delta V/(A*\Delta t)$$

Where:

I_t = tested infiltration rate, in/hr

ΔV = volume of liquid used during time interval to maintain constant head in the inner ring, in^3

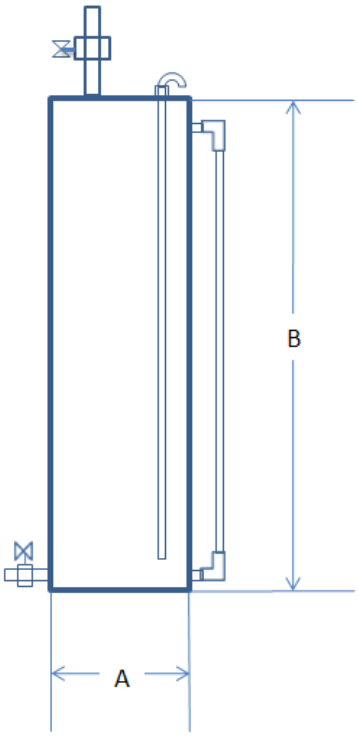
A = area of inner ring, in^2

Δt = time interval, hr.

Final Report - Ultimately, as discussed in Section 1.7, a final report shall be provided and, based on the test results, an infiltration rate shall be recommended.

Photo 2 – Simple Double Ring Infiltrometer

Photo 3 – Pre-fabricated Double Ring Infiltrometer
(Photo courtesy of Turf-Tec International)



Mariotte Tube
Useful Capacity

	1 gal	3 gal
A =	3 in.	6 in.
B =	18 in.	24 in.

Figure 5 - Mariotte Tube

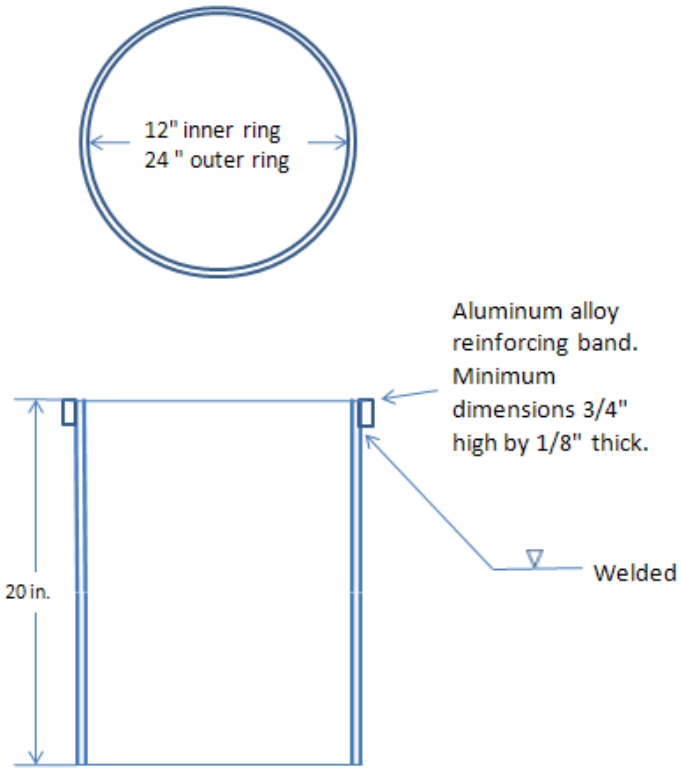


Figure 6- Double Ring Infiltrometer Construction

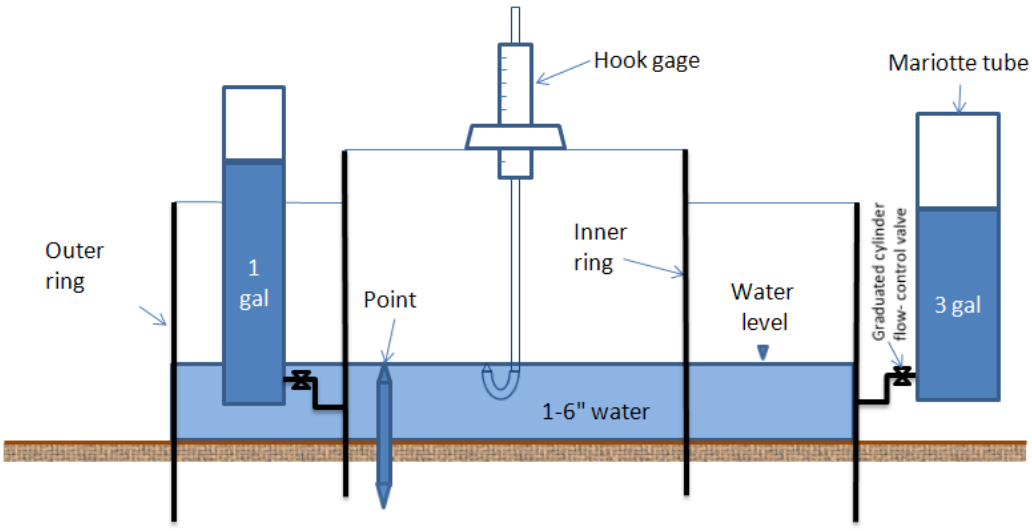


Figure 7- Double Ring Setup with Mariotte Tubes

Photo 4- Double Ring Infiltrometer Set-up with Mariotte Tubes
(Photo courtesy of Turf-Tec International)

Photo 5 – Double Ring Infiltrometer Set-up for Test at Basin Surface Elevation
(Photo courtesy of Turf-Tec International)

DOUBLE RING INFILTROMETER TEST DATA

Project Name and Test Location:				Constants-	Ring Data		Liquid Containers	
					Area, A_r (in^2)	Depth of Liquid (in)	No.	Vol., V_r (in3/in)
				Inner Ring:				
Test By:		USCS Class:		Annular Space:				
Water Table Depth:		Penetration of Rings into Soil (in.):			Inner:		Outer:	
Date of Test:		Liquid Used:		pH:	Ground Temp (°F):		at Depth:	
Liquid Level Maintained by using:	( ) Flow Valve ( ) Float Valve ( ) Marriotte Tube ( ) Other:							
Additional Comments:								

Time interval	Time (hr:min)	Dt (min) & Total	Inner Ring		Annular Ring		Liquid Temp °F	Infiltration Rate, I**		Remarks
			Elev., H (In)	ΔH (in) &	Elev., H (In)	ΔH (in) &		Inner in/hr	Outer in/hr	
1 - Start										
End										
2 - Start										
End										
3 - Start										
End										
4 - Start										
End										
5 - Start										
End										
6 - Start										
End										
7 - Start										
End										
8 - Start										
End										
9 - Start										
End										
10 - Start										
End										
11 - Start										
End										
12 - Start										
End										
13 - Start										
End										
14 - Start										
End										
15 - Start										
End										

***Flow, Qf = ΔH x Vr **Infiltration Rate, I = (Qf/Ar)/Δt**

Table 3 – Sample Test Data Form for Double Ring Infiltrometer Test

DOUBLE RING INFILTROMETER TEST DATA

Project Name and Test Location:				Constants-	Ring Data		Liquid Containers	
ACME Industrial Site 24166 Elm, Riverdale (Western corner of site, near warehouse)					Area, A_r (in^2)	Depth of Liquid (in)	No.	Vol., V_r (in3/in)
				Inner Ring:	113	4	1	78.54
Test By:	CMD	USCS Class:	SM	Annular Space:	339	4.1	2	176.7
Water Table Depth:	40 ft.	Penetration of Rings into Soil (in.):			Inner:	3.0	Outer:	7.0
Date of Test:	3/22/09	Liquid Used:	tap water	pH: 8.0	Ground Temp (°F):	57.2	at Depth:	16 in.
Liquid Level Maintained by using:	( ) Flow Valve ( ) Float Valve (X) Marriotte Tube ( ) Other:							
Additional Comments:	Dry Gound							

Time interval	Time (hr:min)	Dt (min) & Total	Inner Ring Elev., H (In)	Inner Ring ΔH (in) &	Annular Ring Elev., H (In)	Annular Ring ΔH (in) &	Liquid Temp °F	Infiltration Rate, I** Inner in/hr	Infiltration Rate, I** Outer in/hr	Remarks
1 - Start	9:00	15	3	0.2	3	0.4	59	0.6	0.8	Cloudy, slight wind
End	9:15	15	3.2	15.71	3.4	70.68	59			
2 - Start	9:15	15	3.2	0.35	3.4	0.6	59	1.0	1.3	
End	9:30	30	3.55	27.49	4	106	59			
3 - Start	9:30	15	3.55	0.5	4	0.9	59	1.4	1.9	
End	9:45	45	4.05	39.27	4.9	159	59			
4 - Start	9:45	15	4.05	0.65	4.9	1.2	59	1.8	2.5	
End	10:00	60	4.7	51.05	6.1	212	60			
5 - Start	10:00	30	4.7	1.5	6.1	2.65	60	2.1	2.8	
End	10:30	90	6.2	117.8	8.75	468.3	61			
6 - Start	10:30	30	6.2	1.7	8.75	2.75	61	2.4	2.9	
End	11:00	120	7.9	133.5	11.5	485.9	62			
7 - Start	11:10	60	3.25	3.75	2.5	5.9	62	2.6	3.1	
End	12:10	180	7	294.5	8.4	1043	63			Refilled tubes
8 - Start	12:20	60	3.5	3.9	3	5.7	64	2.7	3.0	
End	13:20	240	7.4	306.3	8.7	1007	64			Refilled tubes
9 - Start	13:30	60	3	3.6	3.1	5.5	64	2.5	2.9	
End	14:30	300	6.6	282.7	8.6	971.9	64			Refilled tubes
10 - Start	14:40	60	3.25	3.45	3	5.4	64	2.4	2.8	
End	15:40	360	6.7	271	8.4	954.2	64			Refilled tubes
11 - Start	15:50	60	3.3	3.4	2.9	5	64	2.4	2.6	
End	16:50	420	6.7	267	7.9	883.5	64			Refilled tubes
12 - Start	18:00	60	3	3.5	3.1	4.9	64	2.4	2.6	Refilled tubes
End	19:00	480	6.5	274.9	8	865.8	64			Cloudy, no wind
13 - Start										
End										
14 - Start										
End										
15 - Start										
End										

***Flow, Qf = ΔH x Vr **Infiltration Rate, I = (Qf/Ar)/Δt**

Table 4 – Sample Test Data Form for Double Ring Infiltrometer Test

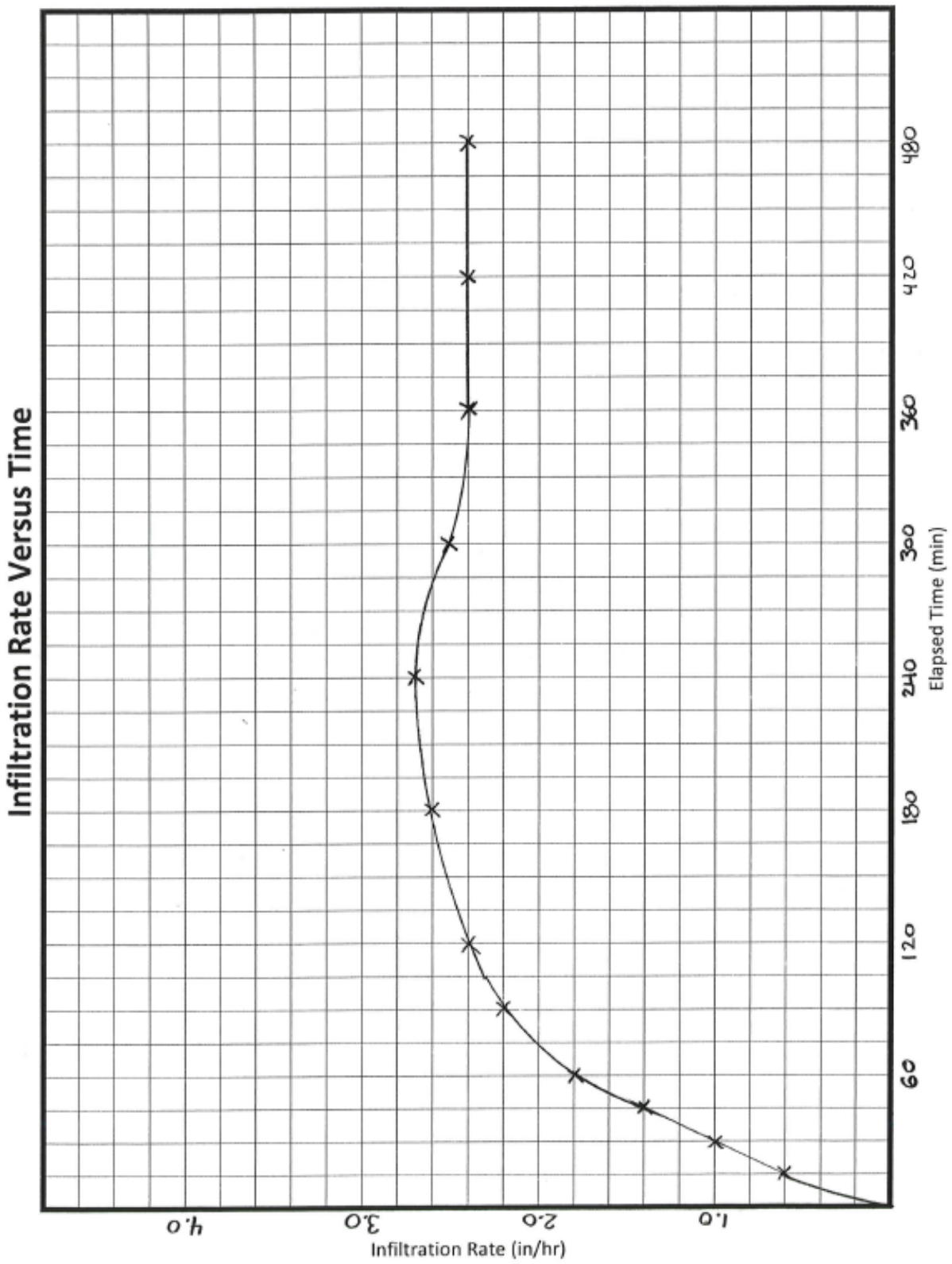


FIGURE 8 – Plot of Sample Test Data for Double Ring Infiltrometer Test

2.3 - Percolation Tests

The ***percolation test*** is widely used for assessing the suitability of a soil for onsite wastewater disposal. Depending on the required depth of testing, there are two versions of the percolation test. For shallow depth testing (less than 10 feet), the procedure would be as shown in Figure 8 (Photo 6). For deep testing (10 feet to 40 feet), the procedure is as shown in Figure 9. For deep testing, special care must be taken to ensure that caving of the sidewalls does not occur.

This test measures the length of time required for a quantity of water to infiltrate into the soil and is often called a "percolation rate". It should be noted that the percolation rate is related to, but not equal to, the infiltration rate. While an infiltration rate is a measure of the speed at which water progresses downward into the soil, the percolation rate measures not only the downward progression but the lateral progression through the soil as well. This reflects the fact that the surface area for infiltration testing would include only the horizontal surface while the percolation test includes both the bottom surface area and the sidewalls of the test hole. However, there is a relationship between the values obtained by a percolation test and infiltration rate. Based on the [1]"Porchet Method", the following equation may be used to convert percolation rates to the tested infiltration rate, I_t:

$$I_t = \frac{\Delta H\ \pi r^2\ 60}{\Delta t(\pi r^2 + 2\pi r H_{avg})} = \frac{\Delta H\ 60\ r}{\Delta t(r + 2H_{avg})}$$

Where:

I_t = tested infiltration rate, inches/hour
ΔH = change in head over the time interval, inches
Δt = time interval, minutes
$^*r$ = effective radius of test hole
H_{avg} = average head over the time interval, inches

An example of this procedure is provided on Page 26 based data form Table 5, *Sample Percolation Test Data*. Figure 11 provides a plot of the converted percolation test data.

*Where a rectangular test hole is used, an equivalent radius should be determined based on the actual area of the rectangular test hole. (i.e., $r = (A/\pi)^{0.5}$)

Note to the designer: The values obtained using this method may vary from those obtained from methods considered to be more accurate. The designer is encouraged to explore the derivation of these equations (Ritzema; Smedema)

Final Report - Ultimately, as discussed in Section 1.7, a final report shall be provided and, based on the test results, an infiltration rate shall be recommended.

[1]H.P. Ritzema, "Drainage Principles and Applications," International Institute for Land Reclamation and Improvement (ILRI), Publication 16, 2nd revised edition, 1994, Wageningen, The Netherlands.

Percolation Test Procedure

Only those individuals trained and educated to perform, understand and evaluate the field conditions and tests may perform these tests. This would include those who hold one of the following State of California credentials and registrations: Professional Civil and Geotechnical Engineers, Certified Engineering Geologist and Certified Hyrdrogeologist. The District will only approve the percolation test method described in this Chapter.

When the percolation testing has been completed, a 3 foot long surveyor's stake (lath) shall be flagged with highly visible banner tape and placed in the location of the test indicating date, test hole number as shown on the field data sheet, and firm performing the test. Field data shall be included in the Final Report as described in Section 1.7.

Shallow Percolation Test (less than 10 feet)

Test Preparation

1.) The test hole opening shall be between 8 and 12 inches in diameter or between 7 and 11 inches on each side if square.

2.) The bottom elevation of the test hole shall correspond to the bottom elevation of the proposed basin (infiltration surface). Keep in mind that this procedure will require the test hole to be filled with water to a depth of at least 5 times the hole's radius.

3.) The bottom of the test hole shall be covered with 2 inches of gravel.

4.) The sides of the hole shall remain undisturbed (not smeared) after drilling and any cobbles encountered left in place.

5.) **Pre-soaking** shall be used with this procedure. Invert a full 5 gallon bottle (more if necessary) of clear water supported over the hole so that the water flow into the hole holds constant at a level at least 5 times the hole's radius above the gravel at the bottom of the hole. Testing may commence after all of the water has percolated through the test hole or after 15 hours has elapsed since initiating the pre-soak. However, to assure saturated conditions, testing must commence no later than 26 hours after all pre-soak water has percolated through the test hole. The use of the "continuous pre-soak procedure" is no longer accepted. When sandy soils (as described below) are present, the test shall be run immediately.

Test Procedure

Test hole shall be carefully filled with water to a depth equal to at least 5 times the hole's radius (H/r>5) above the gravel at the bottom of the test hole prior to each test interval.

- In **sandy soils**, when 2 consecutive measurements show that 6 inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Measurements shall be taken with a precision of 0.25 inches or better. The drop that occurs during the final 10 minutes is used to calculate the percolation rate. Field data must show the two 25 minute readings and the six 10 minute readings.

- In **non-sandy soils**, obtain at least twelve measurements per hole over at least six hours with a precision of 0.25 inches or better. From a fixed reference point, measure the drop in water level over a 30 minute period for at least 6 hours, refilling after every 30 minute reading. The total depth of the hole must be measured at every reading to verify that collapse of the borehole has not occurred. The drop that occurs during the final reading is used to calculate the percolation rate.

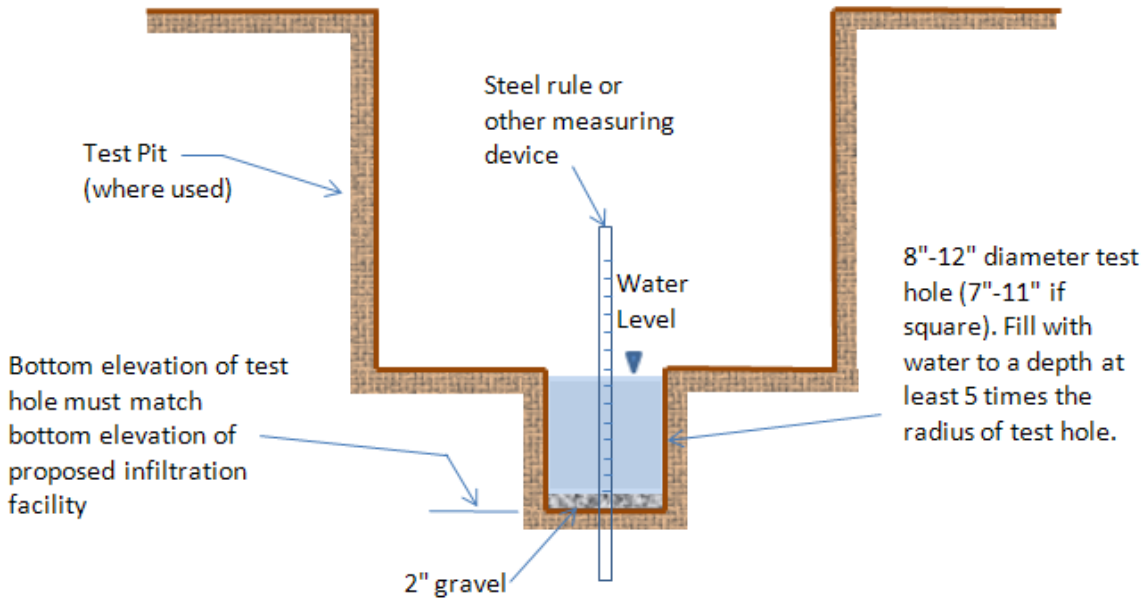


Figure 9- Test Pit for Shallow Percolation Test

Deep Percolation Test (Depths 10-40 feet)

Test Preparation

1.) Borehole diameter shall be either 6 inch or 8 inch only. No other diameter test holes will be accepted.

2.) The bottom elevation of the test hole shall correspond to the bottom elevation of the proposed basin (infiltration surface). Keep in mind that this procedure will require the test hole to be filled with water to a depth of at least 5 times the hole's radius.

3.) The bottom of the test hole shall be covered with 2 inches of gravel.

4.) The sides of the hole shall remain undisturbed (not smeared) after drilling and any cobbles encountered left in place. Special care should be taken to avoid cave-in.

5.) **Pre-soaking** shall be used with this procedure. Invert a full 5 gallon bottle of clear water supported over the hole so that the water flow into the hole holds constant at a maximum depth of 4 feet below the surface of the ground or if grading cuts are anticipated, to the approximate elevation of the **top** of the basin but at least 5 times the hole's radius (H/r>5). Pre-soaking shall be performed for 24 hours unless the site consists of sandy soils containing little or no clay. If sandy soils exist as described below, the tests may then be run after a 2 hour pre-soak. However, to assure saturated conditions, testing must commence no later than

26 hours after all pre-soak water has percolated through the test hole. The use of the "continuous pre-soak procedure" is no longer accepted. When sandy soils (as described below) are present, the test shall be run immediately.

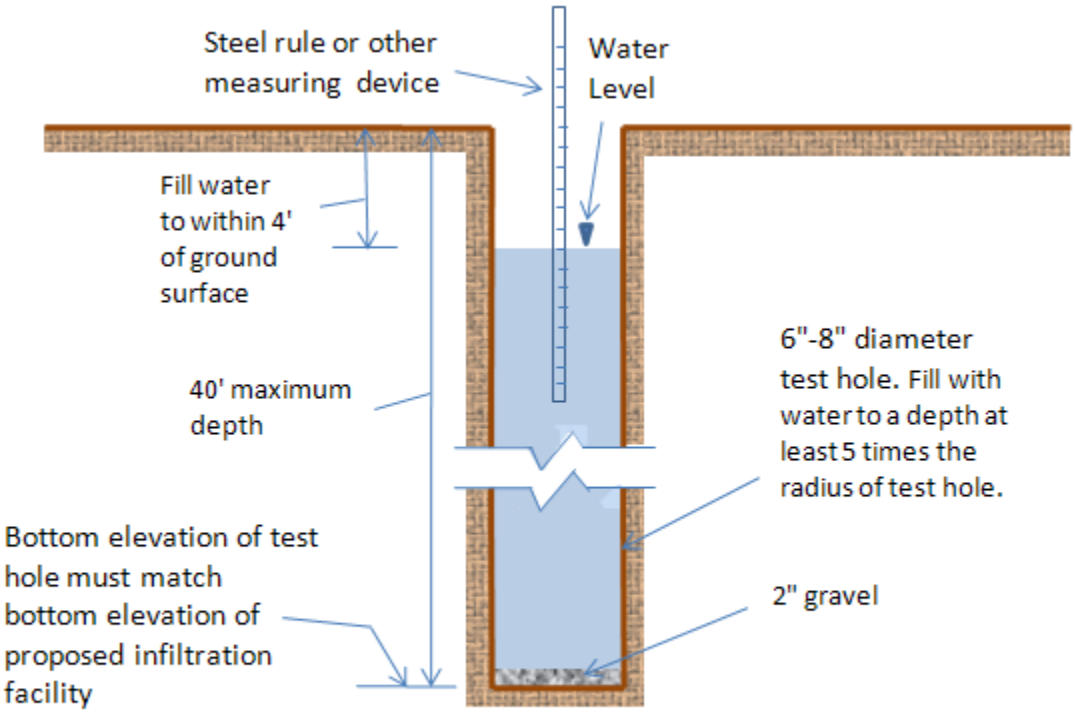


Figure 10- Test Pit for Deep Percolation Test

Test Procedure

Carefully fill the hole with clear water to a maximum depth of 4 feet below the surface of the ground or, if grading cuts are anticipated, to the approximate elevation of the **top** of the basin. However, at a minimum, the bore hole shall be filled with water to a depth equal to 5 times the hole's radius (H/r>5).

- In **sandy soils**, when 2 consecutive measurements show that 6 inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Measurements shall be taken with a precision of 0.25 inches or better. The drop that occurs during the final 10 minutes is used to calculate the percolation rate. Field data must show the two 25 minute readings and the six 10 minute readings.

- In **non-sandy soils**, the percolation rate measurement shall be made on the day following initiation of the pre-soak as described in Item #5 above. From a fixed reference point, measure the drop in water level over a 30 minute period for at least 6 hours, refilling after every 30 minute reading. Measurements shall be taken with a precision of 0.25 inches or better. The total depth of hole must be measured at every reading to verify that collapse of the borehole has not occurred. The drop that occurs during the final reading is used to calculate the percolation rate.

Photo 6 – Percolation Test Pit. Use of perforated PVC pipe is a variation.

Percolation Test Data Sheet							
Project:		Project No:		Date:			
Test Hole No:		Tested By:					
Depth of Test Hole, D_T:		USCS Soil Classification:					
Test Hole Dimensions (inches)				Length	Width		
Diameter (if round)=		Sides (if rectangular)=					
Sandy Soil Criteria Test*							
Trial No.	Start Time	Stop Time	Time Interval, (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1							
2							
*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Other wise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25".							
Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (in.)	D_f Final Depth to Water (in.)	ΔD Change in Water Level (in.)	Percolation Rate (min./in.)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
COMMENTS:							

Table 5 – Sample Test Data Form for Percolation Test

Percolation Rate Conversion

Example:

The bottom of a proposed infiltration basin would be at 5.0 feet below natural grade. Percolation tests are performed within the boundaries of the proposed basin location with the depth of the test hole set at the infiltration surface level (bottom of the basin). The Percolation Test Data Sheet (Table 5) is prepared as the test is being performed. After the minimum required number of testing intervals, the test is complete. [1]**The data collected at the final interval is as follows:**

Time interval, Δt = 10 minutes
Initial Depth to Water, D_0 = 12.25 inches
Final Depth to Water, D_f = 13.75 inches
Total Depth of Test Hole, D_T = 60 inches
[2]Test Hole Radius, r = 4 inches

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg})}$$

"H_o" is the initial height of water at the selected time interval.

$H_o = D_T - D_0 = 60 - 12.25 =$ **47.75 inches**

"H_f" is the final height of water at the selected time interval.

$H_f = D_T - D_0 = 60 - 13.75 =$ **46.25 inches**

"ΔH" is the change in height over the time interval.

$\Delta H = \Delta D = H_o - H_f = 47.75 - 46.25 =$ **1.5 inches**

"H_{avg}" is the average head height over the time interval.

$H_{avg} = (H_o - H_f)/2 = (47.75 - 46.25)/2 =$ **47.0 inches**

"I_t" is the tested infiltration rate.

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg})} = \frac{(1.5\text{ in})(60\text{ min/hr})(4\text{ in})}{(10\text{ min})((4\text{ in}) + 2(47\text{ in}))} = \textbf{0.37 in/hr.}$$

Percolation Test Data Sheet

Project:	ACME SITE	Project No:	1106 B	Date:	2-18-09
Test Hole No:	3	Tested By:	CMD		
Depth of Test Hole, D_T:	60 IN.	USCS Soil Classification:	SM		
Test Hole Dimensions (inches)			Length	Width	
Diameter (if round)=	8	Sides (if rectangular)=			
Sandy Soil Criteria Test*					

Trial No.	Start Time	Stop Time	Time Interval, (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1	8:00	8:25	25	12.0	19.5	7.5	Y
2	8:30	8:55	25	12.0	18.75	6.75	Y

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Other wise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (in.)	D_f Final Depth to Water (in.)	ΔD Change in Water Level (in.)	Percolation Rate (min./in.)
1	9:00	9:10	10	12.0	14.25	2.25	4.4
2	9:10	9:20	10	11.5	13.5	2.0	5.0
3	9:20	9:30	10	12.0	14.0	2.0	5.0
4	9:30	9:40	10	11.75	13.5	1.75	5.7
5	9:40	9:50	10	12.0	13.5	1.5	6.7
6	9:50	10:00	10	12.25	13.75	1.5	6.7
7							
8							
9							
10							
11							
12							
13							
14							
15							

Data used for conversion to Infiltration rate.

COMMENTS: OVERCAST (62°F). GROUND DRY. FIRST (2) MEASUREMENTS MET SANDY SOIL CRITERIA.

Table 6 – Sample Percolation Test Data

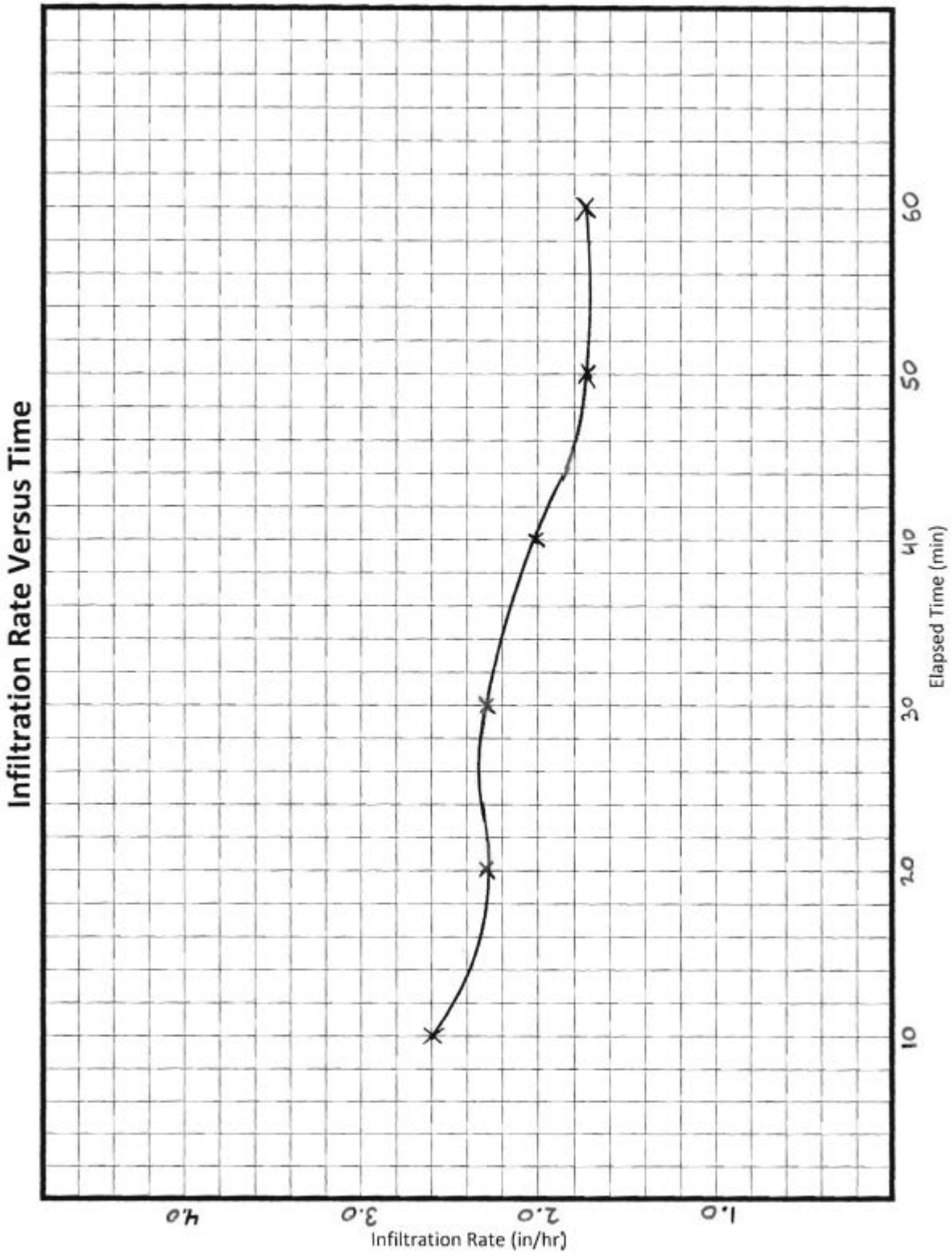


FIGURE 11 – PLOT OF CONVERTED PERCOLATION TEST DATA

2.4 - Field Permeability Test (Well Permeameter Method USBR 7300-89)

Similar to a constant-head version of the percolation test used for seepage pit design is the Well Permeameter Method of the United States Bureau of Reclamation. [1]USBR 7300-89 is an in-hole hydraulic conductivity test performed by drilling test wells with a 6-8 inch diameter auger to the desired depth. This test measures the rate at which water flows into the soil under constant-head flow conditions and is used to determine field-saturated hydraulic conductivity. As with the percolation test, the rate determined with this test is a "percolation rate" and is related, but not equal, to the infiltration rate. Infiltration rate is a measure of the speed at which water progresses downward into the soil. A percolation rate measures not only the downward progression but the lateral progression through the soil. However, this procedure uses the following equation(s) to establish an infiltration rate:

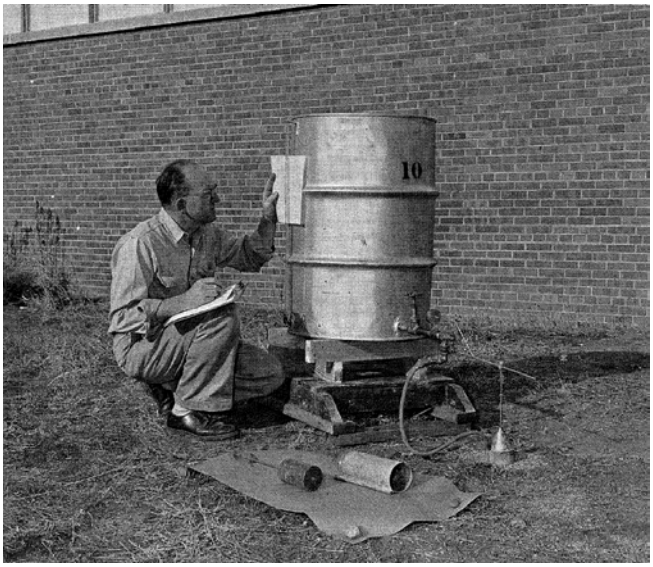


Photo 7 - Typical Well Permeamater Test Installation

Condition I: Typical condition (See Figure 12). The distance between the historical high water mark[2] and the water surface in the well is at least three (3) times the height of water in the well. In addition, there must be at least 10 feet from the bottom of the well to the historical high water table and at least 5 feet to impervious strata.

$$K_s = \frac{Q(\mu_T/\mu_{20})}{2\pi H^2}\left[\ln\left[\frac{H}{r}+\sqrt{\left(\frac{H}{r}\right)^2+1}\right]-\frac{\sqrt{1+\left(\frac{H}{r}\right)^2}}{\frac{H}{r}}+\frac{r}{H}\right]$$

Where:

K_s = saturated hydraulic conductivity (infiltration rate, inches/hour)
H = height of water in well (inches)
Q = percolation flow rate from selected time interval (cubic inches/hour)
r = effective radius of well (inches)
μ_T = viscosity of water at test temperature, T
μ_{20} = viscosity of water at 20°C

[1]A detailed description of this procedure along with a complete example using the associated equations can be found in the United States Bureau of Mines and Reclamation (USBR) document 7300-89.

[2]The "historical high groundwater mark" is defined as the groundwater elevation expected due to a normal wet season and shall be obtained by boring logs or test pits.

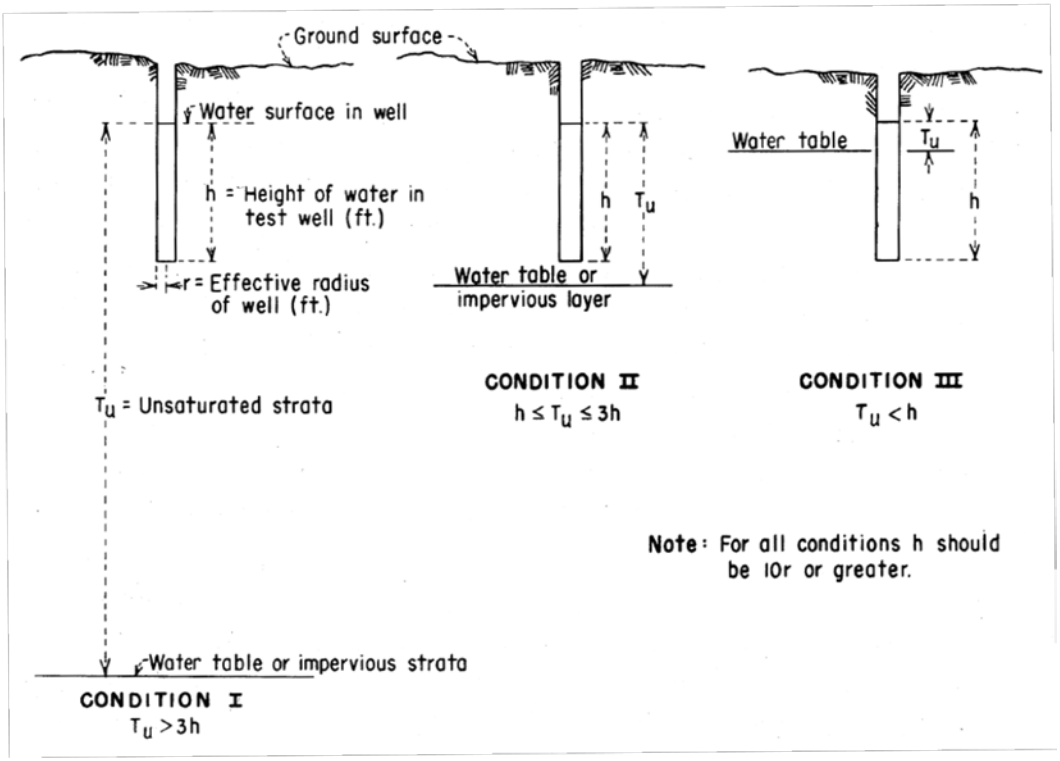


Figure 12 – Site Conditions Govern Procedure to be Used

Condition II: The distance between the historical high groundwater mark[1] and the water surface in the well is less than three (3) times, but at least equal to, the height of water in the well. In addition, there must be at least 10 feet from the bottom of the well to the historical high water mark[1] and at least 5 feet to impervious strata.

$$K_s = \frac{Q(\mu_{20}/\mu_T)}{2\pi H^2}\left[\frac{\ln\left(\frac{H}{r}\right)}{\frac{1}{6}+\frac{1}{3}\left(\frac{H}{T_u}\right)^{-1}}\right]$$

Where:

K_s = saturated hydraulic conductivity (infiltration rate, inches/hour)
H = height of water in well (inches)
Q = percolation flow rate from selected time interval (cubic inches/hour)
r = effective radius of well (inches)
μ_T = viscosity of water at water temperature, T
μ_{20} = viscosity of water at 20° C
T_u = unsaturated distance between the water surface and the water table or impervious strata

Condition III: Unacceptable location. The distance between the historical high groundwater mark and the water surface in the well is less than the height of water in well. As such, the base of the BMP would not be 10 feet above the historical high water mark or 5 feet from impervious strata.

Final Report - Ultimately, as discussed in Section 1.7, a final report shall be provided and, based on the test results, an infiltration rate shall be recommended.

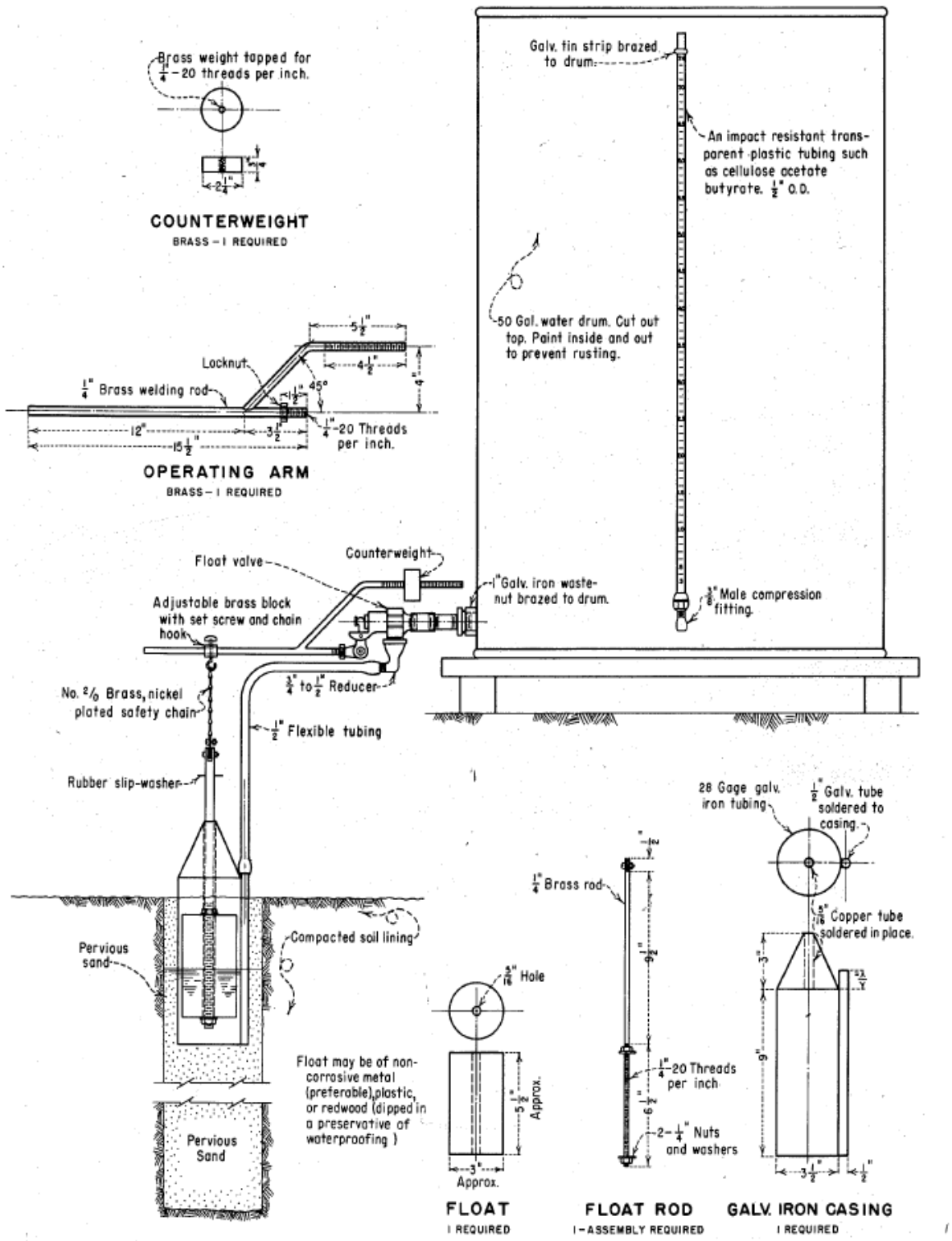


Figure 11 – Well Permeameter Test Equipment

2.5 - Borings and Test Pits

Borings and test pits are used to determine the thickness of soil and rock strata, estimate the depth to groundwater, obtain soil or rock specimens and perform field tests such as standard penetration tests (SPTs) or cone penetration tests (CPTs).

Test pits and trenches may be used to evaluate near-surface conditions up to about 15 feet deep but are often used for performing subsurface exploration at shallower depths. Test pits are often square in plan view and may be dug with shovels in less accessible areas. Trenches are long and narrow excavations usually made by a backhoe or bulldozer.

Borings (ASTM D 1452) are generally used to investigate deeper subsurface conditions. A cylindrical hole is drilled into the ground for the purpose of investigating subsurface conditions, performing field tests, and obtaining soil, rock, or underground specimens for testing. Borings can be excavated by hand (e.g., hand auger), although the usual procedure is to use mechanical equipment to excavate the borings.

Whatever method is used, testing shall be sufficient to establish USCS series and textural class (SM, CL, etc) of the soil beneath the infiltration surface of the BMP and of sufficient depth to establish that a minimum of 5 feet of permeable soil exists below the infiltration facility and that there is a minimum of 10 feet between the bottom of the infiltration facility and the historical high groundwater mark[1].

Photo 8- Auger Boring Rig

Photo 9 – Test Pit Excavation

[1]The "historical high groundwater mark" is defined as the groundwater elevation expected due to a normal wet season and shall be obtained by boring logs or test pits.

Infiltration Test Requirement Checklist

___ Where infiltration testing is to be performed, the measured infiltration rate of the underlying soil must be determined using either the single ring infiltrometer test (as described in ASTM D 5126, Section 4.1.2.1), the double ring infiltrometer test (ASTM D 3385), the well permeameter method (USBR 7300-89), or a percolation test per County of Riverside Department of Environmental Health (RCDEH) test procedures. A general explanation of these test methods can be found in Section 2 of this appendix. The minimum number of tests required can be found in Table 1 and is dependent upon the type of infiltration test performed.

___ Test pits and borings (ASTM D 1452) may be used to determine the USCS series and textural class (SM, CL, etc.) of the soil horizons throughout the depth of boring log or pit, the thickness of soil and rock strata, and estimate the historical groundwater depth. Test pits or boring logs must be of sufficient depth to establish that a minimum of 5 feet of permeable soil exists below the infiltration facility and that there is a minimum of 10 feet between the bottom of the infiltration facility and the historical high groundwater mark[1] (Section 1.7 and 2.5). The required number of test pits or borings is listed in Table 1.

___ A final report, prepared by a registered civil engineer, geotechnical engineer, certified engineering geologist or certified hydrogeologist shall be provided to the District or other EA which demonstrates through infiltration testing and/or soil logs that the proposed facility location is suitable for the proposed infiltration facility and an infiltration rate shall be recommended. In addition, any requirements associated with impacts to a landslide, erosion or steep slope hazard area should also be addressed in the final report. (Section 1.7)

___ Tests may be performed only by individuals trained and educated to perform, understand and evaluate the field conditions. The individual(s) supervising this field work must be named along with their education or training background in the final report as described in Item 3. (Section 1.7)

___ Preliminary site grading plans shall be provided to the District or other EA showing the proposed BMP locations along with section views through each BMP clearly identifying the extents of cut/fill.

___ All infiltration tests shall be performed within the boundaries of the proposed infiltration BMP and at the bottom elevation (infiltration surface) of the proposed infiltration facility. (See Photo 5)

[1]The "historical high groundwater mark" is defined as the groundwater elevation expected due to a normal wet season and shall be obtained by boring logs or test pits.

APPENDIX B

Underdrains

APPENDIX B – UNDERDRAINS

Where underdrains are specified, the following information provides guidance for underdrain requirements.

Underdrain Material Types
Underdrain pipe shall be 6-inch diameter ABS pipe or PVC pipe. ABS pipe shall meet the requirements of ASTM Designation D-2751, SDR 23.5, and PVC pipe shall meet the requirements of ASTM Designation D-2665. Perforations shall be as described in ASTM Designation C-700. It should be noted that placing the pipe such that the perforations are oriented upward may help to maximize infiltration in unlined BMP's with underdrains. If the BMP is constructed with an impermeable liner, the perforations should be angled downward to maximize the volume of water that will be drained from the BMP.

Underdrain Connections
Pipe joints and storm drain structure connections must be adequately sealed to avoid piping conditions (water seeping through pipe or structure joints). Pipe sections shall be coupled using suitable connection rings and flanges. Field connections to storm drain structures and pipes shall be sealed with polymer grout material that is capable of adhering to surfaces. Underdrain pipe shall be capped (at structure) until completion of site construction. Underdrains connected directly to a storm drainage structure shall be non-perforated for an appropriate distance from the structure interface to avoid possible piping problems.

Underdrain Slope
Underdrains must "daylight" or connect to an existing drainage system to achieve positive flow. All underdrains must be placed with a minimum slope of 0.5% (s = 0.005 ft/ft).

Underdrains Layout and Spacing
Typically, there are two main layouts for underdrains. One is a non-perforated central collector pipe with perforated lateral feeder pipes, the other is simply a series of longitudinal perforated pipes. Both layouts connect to a non-perforated outlet pipe before "daylighting" or connecting to an existing drainage system. The minimum spacing is shown below.

BMP Type	Underdrains Center to Center Spacing
Sand Filter Basin	20'
Extended Detention Basins (Bottom stage 500 sq ft. or greater)	20'
Extended Detention Basins (Bottom stage < 500 sq ft.)	10'
Bioretention Facility	5'

Underdrain Gravel

Gravel bed materials should be used to protect an underdrain pipe and to reduce clogging potential. Placement of gravel over the underdrain must be done with care. Avoid dropping the gravel from excessive heights from a backhoe or front-end loader bucket. Spill directly over underdrain and spread manually.

Recommended construction specifications for gravel used to protect underdrains are as follows:

- AASHTO #57 stone preferred
- Geotextile fabrics should be avoided because tearing and/or plugging can dramatically affect performance. If the designer is concerned about the engineered soil media migrating into the underdrain, a 3-inch thick layer of "pea gravel" may be added to create a “choker” course.

Maintenance

Access for cleaning underdrains is required for each system. Clean-outs, with diameters equal to the underdrain, should extend 6 inches above the media and have a lockable screw cap for easy access. Cleanouts should be located for every 50 feet of lateral, at the collector drain line connection, and at any bends.

Underdrain Orifice Plate

When designing a BMP to meet Hydraulic Conditions of Concern (HCOC) criteria in addition to water quality criteria, it is sometimes necessary to install an orifice plate near the downstream end of the underdrain system. The orifice plate restricts the opening of the underdrain to mitigate flows to a specific lower flow threshold. Proper maintenance access should be provided to the orifice plate location to facilitate maintenance activities, specifically the removal of accumulated sediment and debris upstream of the orifice plate.

APPENDIX C

Basin Guidelines

APPENDIX C – BASIN GUIDELINES

This appendix is broken up into two sections. Section 1 presents guidelines and standards for the design and maintenance of water quality and increased runoff basins used within Riverside County. Applicable water quality basins include infiltration, sand filter and extended detention basins but do not include Bioretention BMPs. Section 2 is devoted to guidelines and standards for debris basins. Regional Basins are only loosely governed by this document and are largely considered on a case-by-case basis.

These guidelines are *intended* to be used on both private and public facilities throughout Riverside County and *shall* be adhered to for all facilities to be maintained by the Riverside County Flood Control and Water Conservation District (District). It is anticipated that County Transportation, Coachella Valley Water District and the City Engineer for incorporated cities within the County may choose to alter these guidelines and may have different/additional requirements. These entities, along with the District, will be referred to as the Engineering Authority (EA). Similarly, County or City Planning Departments, Parks Departments and Parks Districts may also have different/additional requirements. These entities will be referred to as the Planning Authority (PA). Both the EA and PA should be consulted regarding their specific requirements.

Section 1- Detention and Water Quality Basins

1.1 General Criteria

Off-line versus In-stream Mitigation – All water quality mitigation basins must be flow-through. In-stream mitigation is extremely difficult to accomplish unless the basin is designed to accommodate all upstream tributary area and to mitigate for all impacts due to upstream development. Therefore most EAs will not allow in-stream water quality mitigation basins. It shall be noted that while flow mitigation BMPs may be allowed to be constructed within "jurisdictional waters", water quality mitigation BMPs will not be permitted.

Dam Safety Compliance – Basin designs that would be considered "jurisdictional" and fall under the Division of Safety of Dams (DSoD) review are not recommended.

Standard Details - Most EAs would prefer standardization of elements of outlet structures that are likely to wear (e.g., trash racks). Outflow control structures shall be designed in accordance with the EA's standards unless site-specific conditions preclude it. The District requires the use of Standard Drawing WQ501 for most basins. However a modified District CB110 overflow outlet is recommended for infiltration and sand filter basins. Minor modifications to provide supplemental hydraulic routing characteristics above the water quality storage volume are acceptable.

General Sizing Criteria – These guidelines relate to the basic features to be included in the various types of basins and the general geometrics of the basins design criteria. This

appendix does not include the volumetric sizing of facilities. Follow the appropriate increased runoff guidelines or BMP fact sheet sizing.

Geotechnical Reports – A geotechnical report prepared by either a licensed geotechnical engineer, civil engineer or certified engineering geologist is required for all basins. The minimum content of the Geotechnical report shall include the following:

- Slope stability - Discussion shall include the affect the basin may have on the stability of adjacent slopes as a result of the basin's proposed location.

- Compaction, cut and fill - Issues due to soil compaction and/or cut and fill conditions with regards to the safety and effectives of the basin shall be discussed.

- Setbacks from buildings, slopes, wells - The report shall include recommendations for the minimum setback required from buildings, onsite walls, and slopes. In addition, the report shall determine the location of any pre-existing wells (onsite or offsite) and clarify that the minimum 100 foot horizontal setback has been maintained.

- Embankment design - For embankments over 5 feet in height, the geotechnical report shall include recommendations as to its construction and clarify that the embankment meets the requirements herein.

- Boring logs - Boring logs shall be provided within the report and a discussion of their findings included. Any subsurface conditions which may be pertinent to the safety and effectiveness of the basin shall be discussed.

- High Groundwater Level - The historic high groundwater level shall be determined. It shall be clarified that a minimum 10 foot vertical separation from the bottom of the basin to the top of the historic high groundwater level will be maintained.

In addition, where infiltration basins are to be utilized on the site the following topics shall be discussed:

- Existing Conditions (i.e., legacy pollutants) - Where existing soil contains unusually high levels of pollutants, the report shall clarify the extent of the pollution, mitigation efforts and the viability of using an infiltration BMP effectively as a result.

- Infiltration Testing - The use of infiltration BMPs may require an infiltration rate be established as described in Appendix A, "Infiltration Testing Guidelines". An infiltration testing report may be required and documented as described therein

Parking Lot Detention - Parking lots <u>shall not</u> be used to provide additional surface (above ground) storage for either water quality BMPs or to address HCOCs.

Seeps and Springs- Intermittent seeps along cut slopes are typically fed by a shallow groundwater source (interflow) flowing along a relatively impermeable soil stratum. These flows are precipitation driven and should discontinue after a few weeks of dry weather. No special provisions are needed when directing these flows through the basin. However, more continuous seeps and springs, which extend through longer dry periods, are likely from a deeper groundwater source. When continuous flows are intercepted and directed through basins, adjustments to the approved facility design may be required to account for the additional base flow (unless already considered in design).

Privately Owned Basins - All of the criteria herein apply to privately maintained basins except that retaining walls may be used for a portion of interior slopes. Privately owned basins are only acceptable for commercial projects, multi-family residential projects and single family residential communities with a viable maintenance mechanism. Retaining walls may not be used to support water impounding embankments. Retaining walls shall not exceed one third of the outside perimeter of the basin. Detailed structural design calculations must be submitted with every retaining wall proposal. A fence shall be provided along the top of the wall. **The use of retaining walls in a basin requires approval prior to tentative project approval.** The EA or PA may reject the proposed use of retaining walls due to aesthetic and maintenance concerns relating to nuisance and graffiti abatement.

1.2 - Basin Grading Parameters

Basins must meet the following requirements for side slopes, fencing, and embankments:

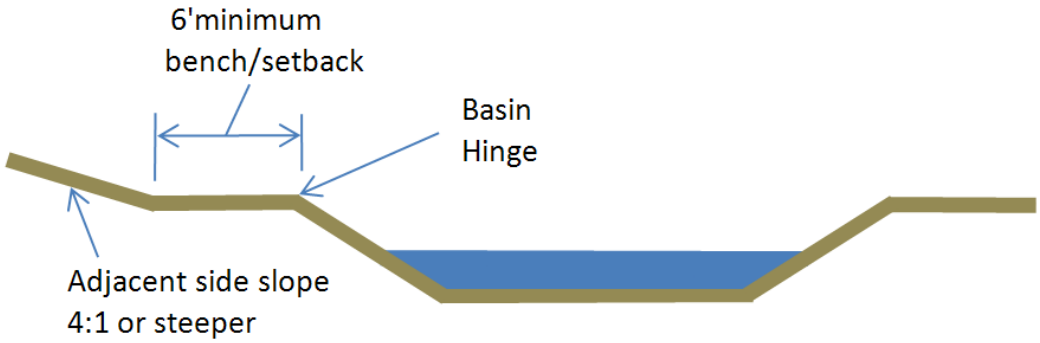
Interior Side Slopes - At least 50 percent of the facility perimeter shall have interior sides no steeper than 4H:1V and in no case steeper than 2H:1V (even if fenced) to minimize safety risks. Side slopes shall be no steeper than 4H:1V whenever adjacent to down-gradient external property lines, roadways, sidewalks and trails.

Embankments - Embankment fill slopes (external and internal) may be no steeper than 4:1 with no exceptions. Basin embankment height will be based on the vertical distance from the design overflow water surface (typically the spillway invert elevation) to the lowest downstream toe of embankment fill. Basin embankments higher than 5 feet shall require design by a geotechnical engineer and shall have a top width not less than 20 feet. For embankments 5 feet or less in height, the minimum top width shall be 6 feet. Embankments for water quality basins may not exceed 3 feet in height.

Setbacks - All basin grading impacts shall be set back a minimum of 6 feet from down-gradient external property lines. This requirement applies to both the top of a cut-slope and the toe of any exterior slope embankment, along with rip-rap energy dissipaters relative to the property line (excluding road right of way). The cut-slope setback requirement is intended to avoid situations where future offsite grading/cut-slopes could turn an incised

basin into an embankment-impounded reservoir. For all cases, depending on the amount of discharge and site characteristics, additional setback may be required unless appropriate easements are secured from the affected property owner(s).

There shall be a minimum 6 foot setback between a basin and an adjacent slope 4:1 or steeper measured horizontally from the basin hinge to the toe of the slope.



Forebay - A forebay shall be placed at each inlet to the basin to allow for the settlement and collection of larger particles. A relatively smooth concrete bottom surface should be provided to facilitate mechanical removal of accumulated sediment, trash and debris. A rock or concrete berm separates the forebay from the remainder of the basin. The forebay's design volume must be from 3 to 5% of the design volume, with the exception of infiltration and sand filter basins whose forebays should be 0.5% of the design volume. A full height notch-type weir shall be made through the berm to convey water to the main body of the basin. This notch shall be offset from the inflow streamline to prevent low-flows from short circuiting.

Basin Floor Slopes - Surface slopes should be kept at a minimum to allow for as much infiltration/groundwater recharge as is possible while still meeting vector concerns. All detention and extended detention basins shall have transverse and longitudinal bottom surface slopes of 1% minimum. For infiltration and sand filter basins, the basin floor should be level.

Gravel filled low-flow trench

Dry Weather Flow Management – All increased runoff or extended detention basins (**excluding** infiltration or sand filter basins) shall be designed to accommodate dry weather flows without impairing wet weather function or creating potential nuisance or maintenance issues. The basin shall have a network of gravel filled low-flow and collector trenches covering the entire basin floor area along with a sand filter drain adjacent to the outlet structure. See Figure 1 on following page.

A 48-inch wide by 24-inch deep low-flow trench conveys flow from the forebay to the filter drain. With a mild longitudinal slope of at least 1% to promote infiltration, the unlined low-flow trench shall be filled with 2" gravel (ASTM No. 2 or similar) to the finished surface and shall not use perforated subdrains.

Collector trenches beneath the top stage shall be arranged in accordance with Figure 1 with a maximum slope of 0.5% to promote infiltration and must extend from the low-flow channel to the toe of the basin side slopes. They shall be 18-inches wide by 24-inches deep and filled with 2" gravel (ASTM No. 2 or similar) to the finished surface. The collector trenches shall not have perforated subdrains and shall be constructed with a maximum spacing of 25 feet on center. See Figure 1 on following page.

A sand filter drain shall be constructed at the low point (or bottom-stage) of the basin adjacent to the outlet structure. To avoid clogging at the lowest orifice of the outlet structure, the top of the filter drain is offset below the lowest orifice of the outlet structure by 0.33 feet (4 inches). The sand filter drain shall include an 18 inch layer of sand (fine aggregate per

ASTM C-33) over a 10-inch gravel subdrain system and shall line the entire bottom stage. The total depth of the sand filter drain, $D_{FD,}$ shall therefore not be less than 2.33 feet. See Appendix B for standard subdrain construction. The filter drain's design volume must be a minimum of 0.5% of V_{BMP} and the minimum bottom stage area is $A_{BS}= V_{BMP}/ D_{BS}$.

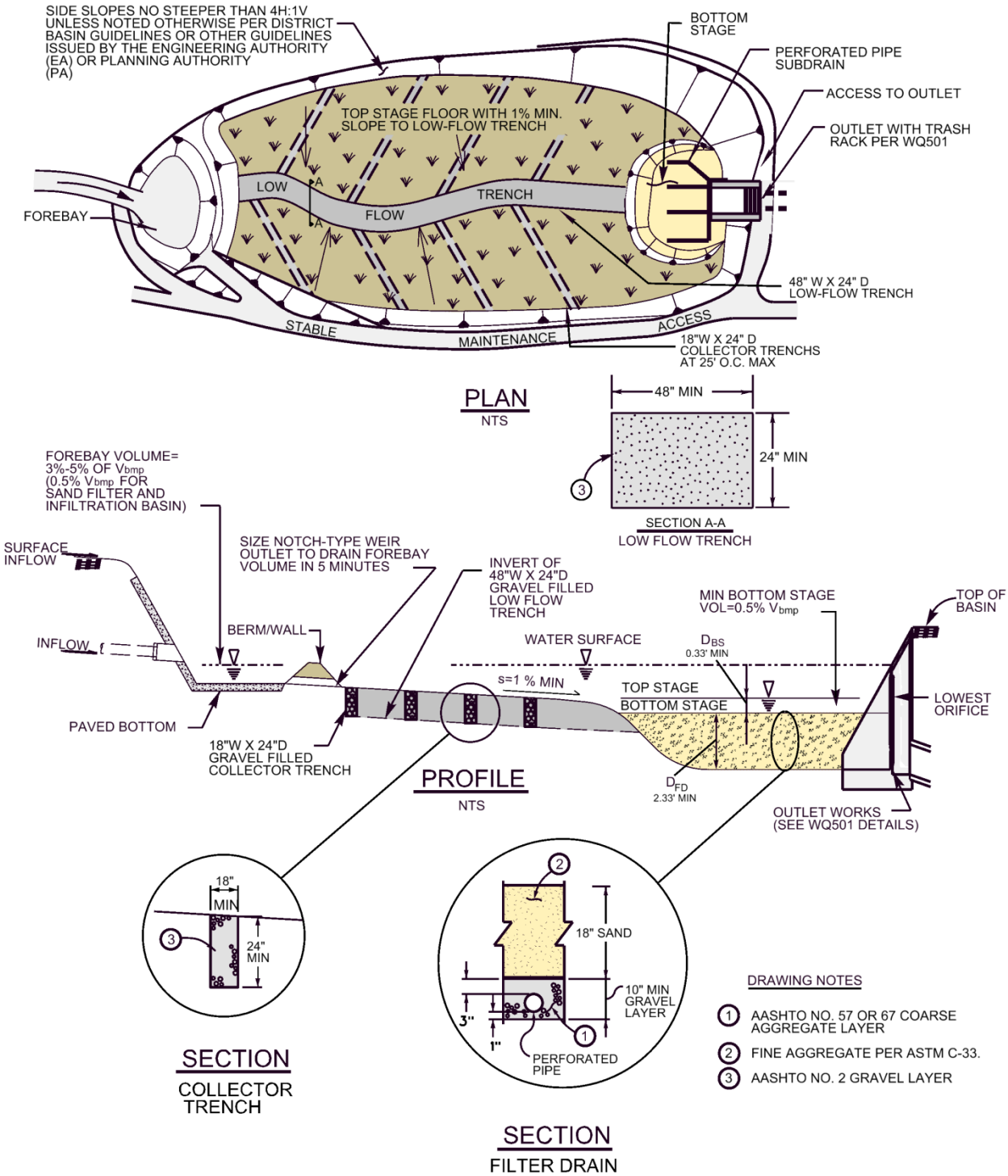
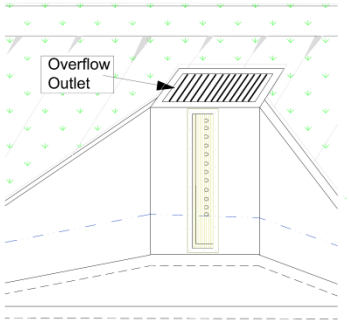


Figure 1 –Dry Weather Management Features

Outlet Structure and Spillway - Outlet structures shall conform to District Standard Drawing WQ501 unless approved in advance by the EA. This standardization is important in order to provide for efficient maintenance.

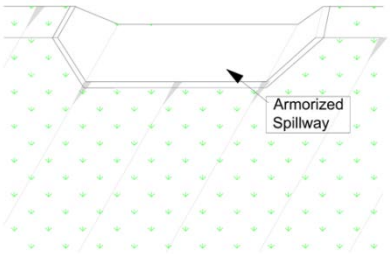
a. Water Quality Outlet Trash Rack/Screen - The outlet's orifice plate shall be protected with a conforming trash rack with at least six square feet of open surface area or 25 times the total orifice area, whichever is greater. The rack shall be adequately secured to prevent it from being removed or opened when maintenance is not occurring.

b. Overflow Outlet - In all basins, a primary overflow (usually integrated into the control structure) must be provided to pass flows greater than the design volume up to the 100-year event. The design must provide controlled discharge directly into the downstream conveyance system or an acceptable discharge point.



c. Emergency Overflow - In addition to the above overflow requirements, basins must have an emergency overflow escape path sized to safely pass the 100-year tributary developed peak flow in the event of total control structure failure (e.g., blockage of the control structure outlet pipe) or extreme inflows. Emergency overflow pathways are intended to control the location of basin overtopping and direct overflows back into the downstream conveyance system or other acceptable discharge point.

d. Emergency Overflow Spillway - Basins with constructed embankment over 3 feet in height and for BMP embankments of any height, or located on grades in excess of 5% must provide an emergency overflow spillway structure. The emergency overflow spillway must be designed to pass the 100-year developed peak flow, with a minimum 12 inches of freeboard, directly to the downstream conveyance system or an acceptable discharge point. The emergency overflow spillway shall be armored full width, beginning at a point midway across the berm embankment and extending downstream to an adequate outlet point. Design of emergency overflow spillways generally requires the analysis of a broad-crested trapezoidal weir.



Access Roads and Ramps - Maintenance access road(s) shall be provided to the top of the control structure and other drainage structures associated with the basin (e.g., inlet/forebay, emergency overflow or bypass structures). All basins shall have unobstructed access from a public street (see Section 1.4, "Right-of-Way") with commercial size curb cut-outs and driveway approaches. Flood control basins designed to attenuate the 100 year flood event shall have an access road around the entire basin. Manhole and catch basin lids should be within or at the edge of the access road and shall be at least three feet from a property line. Rims shall be set at the access road grade.

On large, deep basins (at least 1500 square feet bottom area, measured without the ramp, and over 4 feet deep), an access ramp must extend to the basin bottom at the forebay for removal of sediment with a trackhoe and truck. This is necessary so truck loading can be done in the basin bottom.

However, on small deep basins (less than 1500 square feet, but over 4 feet deep), the truck can remain on the ramp for loading. As such, the ramp may end at an elevation up to 4 feet above the basin bottom provided the basin side slopes are 4:1 or flatter.

On small shallow basins (less than 1500 square feet bottom area, and 4 feet deep or less), a ramp to the bottom is not required if the trackhoe can load a truck parked at the basin edge (trackhoes can negotiate mild interior basin side slopes).

No ramp is required for <u>any</u> basin 4-feet or less in depth if vehicular access is provided to the top of slope at the forebay and the side slopes are 4:1 or flatter. (Depth trigger for ramp is measured from top of slope adjacent to forebay invert.)

Design of access roads and ramps shall meet the following design criteria:

a. Maximum grade (measured along ramp centerline) shall be 15% for asphalt or concrete paving and 10% for soft surface or modular grid paving.
b. Inside turning radius shall be 35 feet, minimum.
c. Fence gates shall be located only on straight sections of road.
d. Access roads shall be constructed with an asphalt, concrete, 3-inch layer of compacted Class 2 aggregate road base material, decomposed granite or modular grid pavement.
e. Access roads and ramps shall be 15 feet in width on curves, 12 feet on straight sections. A paved apron shall be provided where access roads connect to paved public roadways.

1.3 - Landscaping

Landscaping will likely be required by the Planning Authority. Landscaping requirements shall be in accordance with Riverside County Ordinance 859 or equivalent agency ordinance. Care must be taken to ensure that landscaping does not hinder maintenance operations.

a. Facilities shall be designed so that they do not require mowing. Where mowing cannot be avoided, facilities shall be designed to require mowing no more than once or twice annually. A 6-foot minimum width must be provided to allow a mower to pass (see Figure 2).

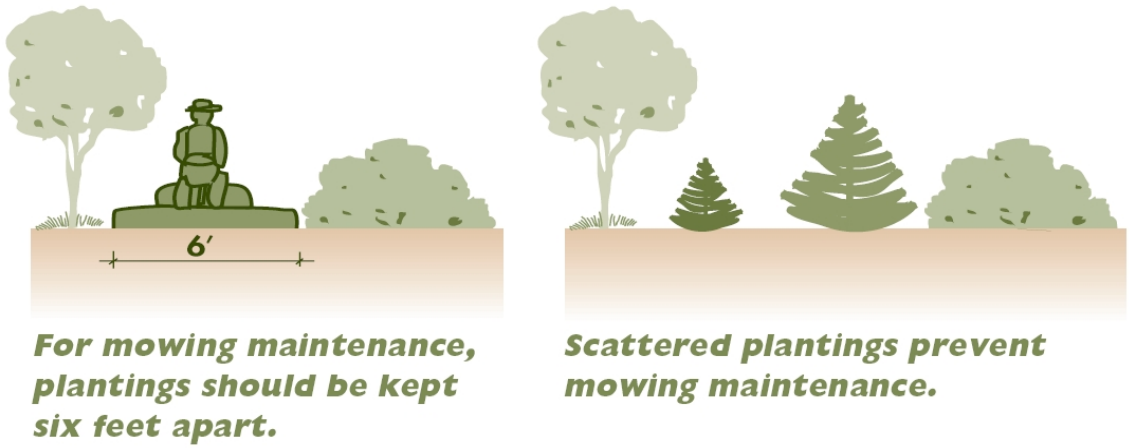


Figure 2- Landscaping setbacks (Source: King County WLR)

b. Turf and lawn areas are not allowed for publicly maintained basins unless an appropriate landscape maintenance entity is identified.

c. Planting is restricted on embankments that impound water either permanently or temporarily during storms (see figure 3). This reduces the likelihood of blown down trees, or the possibility of channeling or piping of water through the root system, which may contribute to dam failure on embankments that retain water.

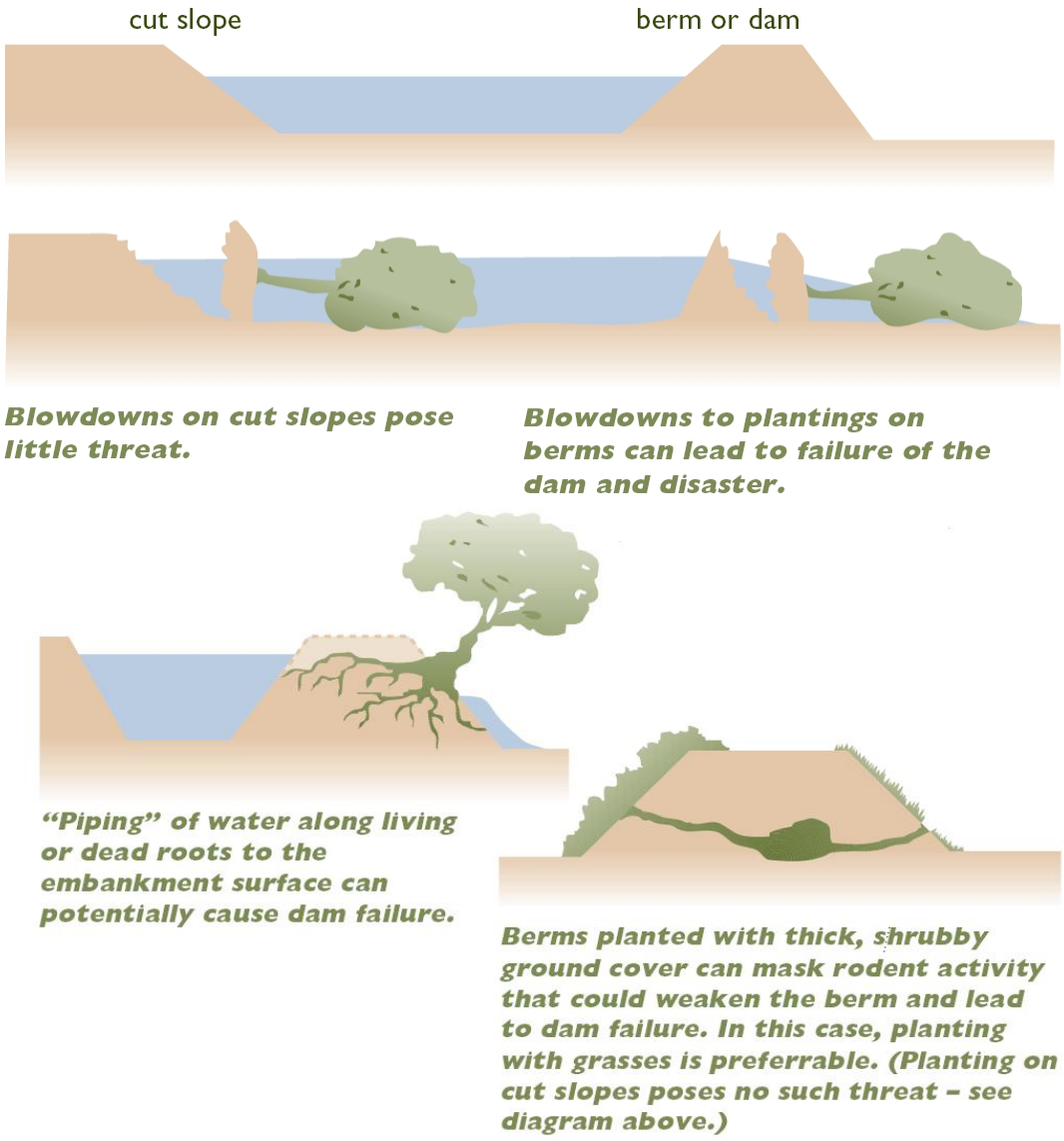


Figure 3 - Hazardous Landscaping Practices (Source: King County WLR)

Note: *This restriction does not apply to cut slopes that form basin banks, only to embankments.*

d. No trees or shrubs may be planted within 10 feet of inlet or outlet pipes or from manmade drainage structures such as spillways or flow spreaders.

e. Trees with roots that seek water, such as willow or poplar, should be avoided within 50 feet of pipes or manmade structures.

f. Evergreen trees and others that produce relatively little leaf-fall (such as locust) are preferred in areas draining to the basin. Trees should be set back so branches do not extend over the outlet structure area of the basin (to help prevent clogging). Drought tolerant species are recommended.

g. Trees or shrubs may not be planted on portions of water-impounding embankments taller than four feet high. Only grasses may be planted on embankments taller than four feet.

1.4 - Additional Requirements

Fencing Criteria - The requirements for slopes and fencing are intended to discourage access to portions of a basin where steep side slopes (steeper than 4:1) increase the potential for slipping into the basin, and to allow easy egress for those who have fallen with slopes that are mild enough (flatter than 4:1 and unfenced) to allow for easy escape. If the basin will hold water deeper than 2 feet, a physical barrier as demarcation of the basin limits is required:

a. Where interior slopes are steeper than 4:1, the barrier shall be a fence 6 feet in height (see District Standard Drawing M-801 for chain link fence details). In joint use ventures where a special district or agency has agreed to maintain landscape facilities, tubular steel fencing such as that meeting Valley Wide Recreation and Parks District landscape standard LC-10 is also acceptable. Functionally equivalent designs may be acceptable on a case by case basis.

b. Where interior slopes are 4:1 or milder, the physical demarcation shall be (3-foot minimum height) vinyl or PVC rail fence, post-and-cable, masonry wall, or densely planted hedges. Functionally equivalent designs may be acceptable on a case by case basis.

c. If the side slopes undulate, and segments of the slope are steeper than 4:1, the barrier standard from "b." above may be used in place of the 6-foot fence for the short lengths of slope as specified here: The barriers described in "b." may be used for sections of 2:1 slope not to exceed 20 lineal feet and sections of 3:1 slope not exceeding 50 lineal feet.

d. If required, fencing shall be placed at or above the overflow water surface. Side slope and attendant fencing requirements are not applicable to slopes above the overflow water surface.

Gates - Vehicular access shall be limited by a double-posted gate if a fence is required, or by bollards. Access road gates shall be 14 feet in width consisting of two swinging sections 7 feet in width (see the District's Standard Drawing M-801 for details). Alternately, two fixed bollards on each side of the access road and two removable bollards equally located between the fixed bollards may be used. Additional vehicular access gates may be required as needed to facilitate maintenance access. Pedestrian access gates (if needed) shall be 4 feet in width.

Signage - All basins to be maintained by the District shall have a sign placed for maximum visibility from adjacent streets, sidewalks, and paths. The sign shall meet the design and installation requirements illustrated in Figure 4.

Right-of-Way - Basins shall not be located in a dedicated public road right-of-way. Publicly maintained basins shall be in a lot dedicated to the public. Any lot not abutting the public right-

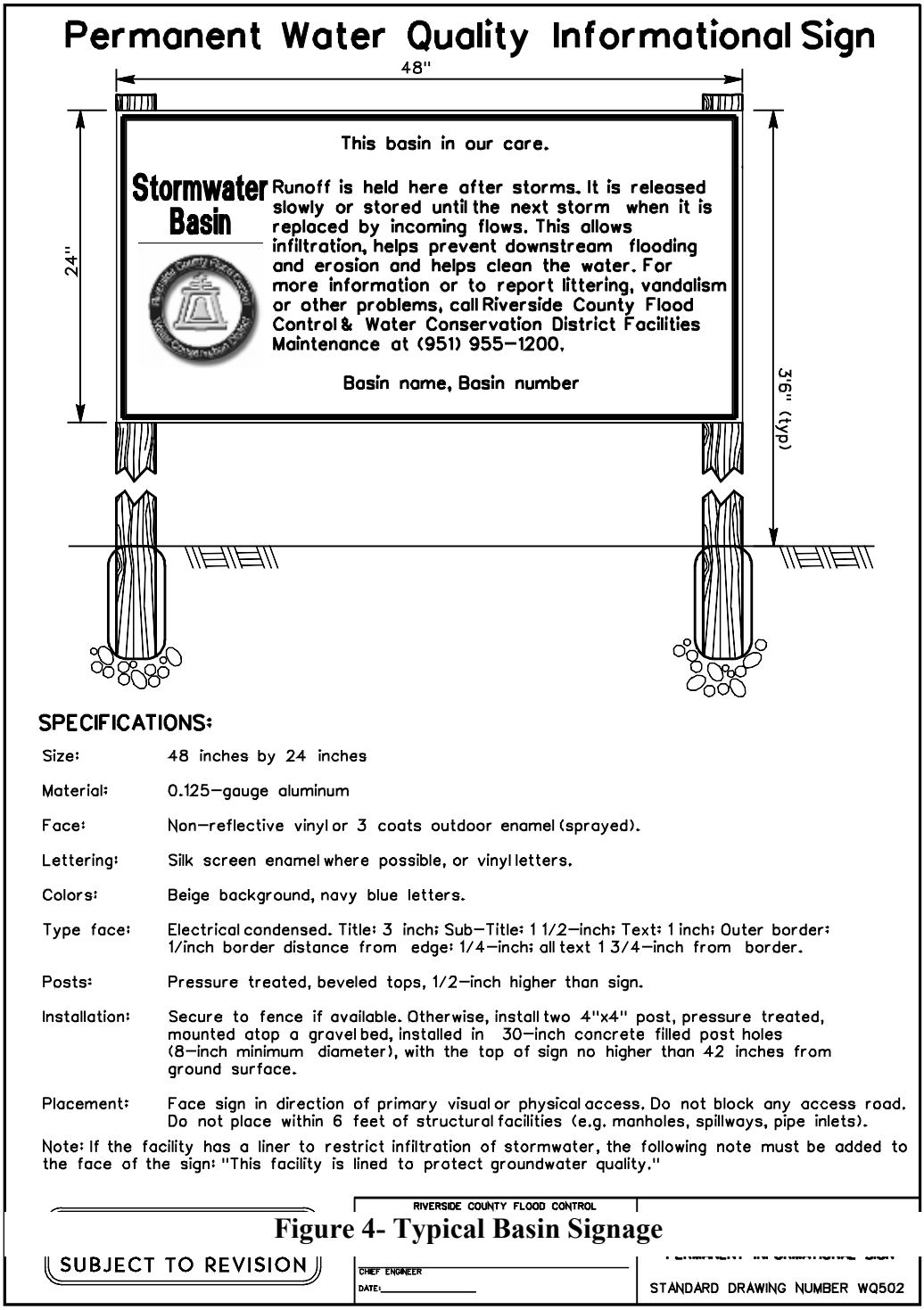
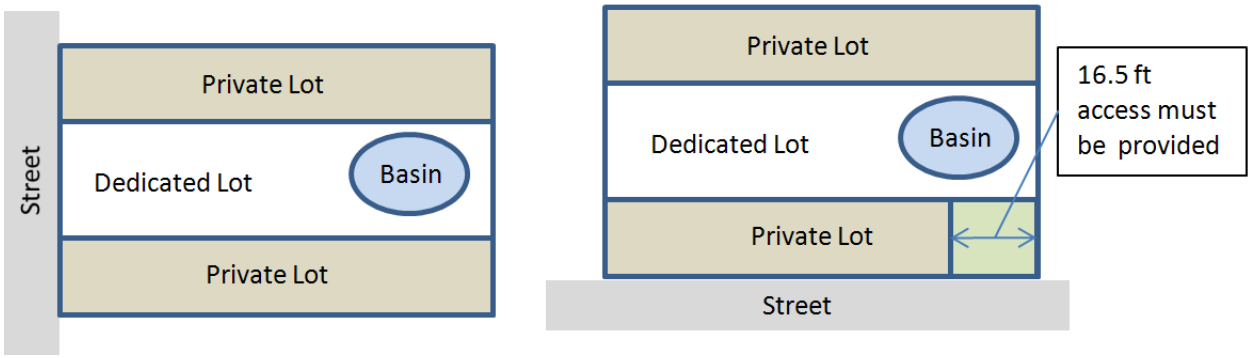


Figure 4- Typical Basin Signage

of-way will require a 16.5-foot wide extension of the lot to an acceptable access location.



Case 1 - Access available to public road right-of-way.

Case 2 - Access must be acquired through adjacent lot to public road right-of-way.

1.5 - Basins in Recreational Spaces

Any basin site with a bottom surface area larger than one acre will likely be required to incorporate active use area and shall be designed only after consultation with the PA to establish site-specific guidance which may increase the total facility footprint.

If multiple uses are being contemplated, consider the following:

- Place the active use areas such as ballparks, playing fields, and picnic areas above the water quality design volume (V_{BMP}) ponding limit.
- Use a multiple-stage detention basin to limit inundation of passive recreational areas to one or two occurrences a year.
- Side slopes shall not exceed 25% (4:1) unless they are existing, natural, and covered with vegetation.
- Locate the basin in a separate lot.
- Incorporate a bypass system or emergency overflow pathway that does not present a safety hazard or discharge into active recreation areas.
- The basin shall be landscaped in a manner to enhance passive recreational opportunities such as trails and aesthetic viewing. Inquire with the PA whether the basin can be compatible with the open space value and functions.

If the criteria above are met, projects may be able to receive some reduction in required onsite recreational space if approved in advance of tentative project approval by the PA.

Section 2 - Debris Basins

Debris basins differ from stormwater detention and water quality basins in that they are not intended to detain flows or to mitigate pollutants (other than debris). They are simply utilized to collect large debris from storm flows for later removal. The guidelines in this section apply to debris basins only.

Site access – Debris basins shall have unobstructed access from a public street (see Section 1.4, "Right-of-Way") with commercial size curb cut-outs and driveway approaches.

Fencing – The entire facility shall be enclosed with 6-foot high chain link fencing and 14-foot high double drive gates. Where the perimeter fencing crosses a streambed, cable or barbed wire fencing across streambed will be provided.

Maintenance access - Maintenance access shall extend around the entire perimeter of the facility. Roads shall be a minimum of 15 feet wide (20 feet wide if on an embankment of 3 feet or higher). The minimum design turning radius shall be 35 feet. Ramps shall be a minimum of 15 feet wide with a maximum longitudinal slope of 10%. Both roads and ramps shall be surfaced (full width) with 3" of compacted Class 2 base material.

Basin Cut/Fill slopes – All basin slopes shall not be steeper than 3:1.

Stockpile/Staging Area – Shall be situated immediately adjacent to the basin. The minimum acreage shall be sufficient to temporarily store 20% of volume of debris accumulated in the 100-yr-frequency design event. Surface acreage shall be calculated assuming a stockpile of 10 feet high with 2:1 fill slopes. A minimum 15-foot wide access road with a 35-foot wide turning radius shall be provided to accommodate equipment access. In addition, a 70-foot long by 15-foot wide strip is required for equipment loading and unloading within an area of sufficient size to maneuver heavy construction equipment.

Minimum Basin Floor Surface Area – Basin floors 1,400 square or greater must be provided with a minimum width of 30 feet.

Outlet Structure – A tower-type outlet is not permitted. Use outlet structure design similar to that used in designs for Tahquitz Creek and Oak Street Debris Basins (slotted/slanted grate). All structures and ramps to structures shall include safety rails/belly bars at all stairways and wherever appropriate. A minimum of two (2) visible depth (paddle) gauges shall be provided.

APPENDIX D

BMP Pollutant Removal Effectiveness

APPENDIX D

BMP POLLUTANT REMOVAL EFFECTIVENESS

BMP Pollutant Removal Effectiveness[1]

Pollutant of Concern	Harvest and Use [9]	Infiltration BMPs[3]	Bioretention	Biofiltration with Partial Infiltration	Biofiltration with No Infiltration	Extended Detention Basins [2]	Sand Filter Basin[8]
Sediment	H	H	H	H	H	M	H
Nutrients	H	H	H	H/M[5]	M/L[6]	M/L[4]	M
Trash	H	H	H	H	H	H	H
Metals	H	H	H	H	H	M	M[7]
Bacteria	H	H	H	H	M	L	M
Oil & Grease	H	H	H	H	H	M	H
Organic Compounds	H	H	H	M	M	L	H
Pesticides and Herbicides	H	H	H	M	M	L	M

Abbreviations:

L: Low removal efficiency M: Medium removal efficiency H: High removal efficiency U: Unknown

Notes:

(1) Periodic performance assessment and updating of this table has occurred based on updated information from studies from the District, CASQA, Caltrans, the International BMP Database, and others. These effectiveness ratings are bases on the specific BMP designs incorporated into this manual. Effectiveness ratings assume operation of a given BMP in isolation. If BMPs are used in series the overall pollutant removal effectiveness may be increased. Where direct data are not available to describe the performance rating of a certain BMP/pollutant combination, professional judgement was applied based on evaluation of unit operations and processes of BMPs and the associated unit operations and processes that are effective for pollutant removal.

(2) Effectiveness based upon total 72-hour drawdown time.

(3) Includes infiltration basins, infiltration trenches, and permeable pavements without underdrains.

(4) Medium for Phosphorous, Low for Nitrogen.

(5) Nutrient removal is High if Bioretention Soil Media is formulated according to requirements in Fact Sheet 3.8 Bioretention Soil Media. Otherwise nutrient removal efficiency is Medium.

(6) Nutrient removal efficiency is Medium if Bioretention Soil Media is formulated according to requirements in Fact Sheet 3.8 Bioretention Soil Media. Otherwise nutrient removal efficiency is Low. Medium if the standard Bioretention Soil Media is used. If a nutrient sensitive Bioretention Soil Media is used, removal efficiency is High.

(7) High if specialized media targeting metals is used.

(8) Considered to be a Treatment Control BMP. See the WQMP to determine if this BMP can be used.

(9) Cisterns, when associated with an adequate and reliable (year-round) demand for non-potable use of captured storm water (see the applicable WQMP for any specific requirements), have a High effectiveness at removing all pollutants from stormwater runoff. If there is inadequate demand to reliably drain the cistern through non-potable use throughout the year, pollutant removal effectiveness will be low.

References:

Technical Guidance Document (TGD) for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMPs) in South Orange County. (2017)

International Stormwater Best Management Practices (BMP) Database 2014 Performance Summaries. http://www.bmpdatabase.org/Docs/2014%20Water%20Quality%20Analysis%20Addendum/BMP%20Database%20Categorical_StatisticalSummaryReport_December2014.pdf

International Stormwater Best Management Practices (BMP) Database 2016 Performance Summaries. http://www.bmpdatabase.org/Docs/03-SW-1COh%20BMP%20Database%202016%20Summary%20Stats.pdf

Strecker, E.W., W.C Huber, J.P. Heaney, D. Bodine, J.J. Sansalone, M.M. Quigley, D. Pankani, M. Leisenring, and P. Thayumanavan, "Critical Assessment of Stormwater Treatment and Control Selection Issues." Water Environment Research Federation, Report No. 02-SW-1. ISBN 1-84339-741-2. 290pp

Oil and grease, Organics, and Trash and Debris based on review of unit operations and processes; comprehensive dataset not generally available. BMP must include design elements
to address pollutants of concern.

APPENDIX E

Worksheets for calculating V_{BMP} and Q_{BMP}

Santa Margarita Watershed

V_{BMP} and Q_{BMP} worksheets

These worksheets are to be used to determine the required

Design Capture Volume (V_{BMP})
or the
Design Flow Rate (Q_{BMP})

for BMPs in the Santa Margarita Watershed

To verify which watershed your project is located within, visit

www.rcflood.org/npdes

and use the 'Locate my Watershed' tool

If your project is not located in the Santa Margarita Watershed,

Do not use these worksheets! Instead visit

www.rcflood.org/npdes/developers.aspx

To access worksheets applicable to your watershed

Use the tabs across the bottom
to access the worksheets for the Santa Margarita Watershed

Santa Margarita Watershed

BMP Design Volume, V_{BMP} (Rev. 03-2012)

Legend: Required Entries / Calculated Cells

(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)

Company Name		Date	
Designed by		County/City Case No	
Company Project Number/Name			
Drainage Area Number/Name			

Enter the Area Tributary to this Feature A_T = _____ acres

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

Site Location

Township _____

Range _____

Section _____

Enter the 85th Percentile, 24-hour Rainfall Depth D_{85} = _____

Determine the Effective Impervious Fraction

Type of post-development surface cover (use pull down menu): Roofs

Effective Impervious Fraction I_f = _____

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$

C = _____

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 85% Unit Storage Volume $V_U = D_{85} \times C$

V_u = _____ (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

V_{BMP} = _____ ft^3

Notes:

Santa Margarita Watershed

BMP Design Flow Rate, Q_{BMP} (Rev. 03-2012)

Legend: Required Entries; Calculated Cells

Company Name | Date

Designed by | County/City Case No

Company Project Number/Name

Drainage Area Number/Name

Enter the Area Tributary to this Feature A_T = acres

Determine the Effective Impervious Fraction

Type of post-development surface cover (use pull down menu): Roofs

Effective Impervious Fraction I_f =

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$

C =

BMP Design Flow Rate

$Q_{BMP} = C \times I \times A_T$

Q_{BMP} = ft^3/s

Notes:

Effective Impervious Fraction

Developed Cover Types	Effective Impervious Fraction
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15
Natural (C Soil)	0.30
Natural (D Soil)	0.40
Mixed Surface Types	

Use this table to determine the effective impervious fraction for the V_{BMP} and Q_{BMP} calculation sheets

EXHIBIT D:

WQMP Applicability Checklist

2018 City of Wildomar WQMP – Exhibit D

Checklist for Identifying Development Project Type and Submittal Requirements within the City of Wildomar

SECTION A: PROJECT INFORMATION		
Project File No.:		
Project Name:		
Project Location:		
Project Description:		
SECTION B: PROJECT TYPE IDENTIFICATION		
Proposed Project Consists of or Includes:	Yes	No
New Development. The creation of 10,000 square feet or more of impervious surfaces (collectively over the entire project site) including commercial, industrial, residential, mixed-use, and public projects. New Development Projects include projects that are on public or private land which fall under the planning and building authority of the [Insert Jurisdiction].	☐	☐
Redevelopment. The creation, addition or replacement of 5,000 square feet or more of impervious surfaces (collectively over the entire project site) on sites with at least 10,000 square feet of existing impervious surfaces, including commercial, industrial, residential, mixed-use, and public development projects on public or private land.	☐	☐
Automotive repair shops. The creation, addition, or replacement of 5,000 square feet or more of impervious surfaces that support automotive repair shops that are categorized in any one of the following Standard Industrial Classification (SIC) Codes 5013–Motor vehicle supplies or parts, 5014–Tires & Tubes, 5541–Gasoline Service Stations, 7532–Top, Body & Upholstery Repair Shops and Paint Shops, 7533–Automotive Exhaust System Repair Shops, 7534–Tire Retreading and Repair Shops, 7536–Automotive Glass Replacement Shops, 7537–Automotive Transmission Repair Shops, 7538–General Automotive Repair Shops, 7539–Automotive Repair Shops, not elsewhere classified).	☐	☐
Restaurants. The creation, addition, or replacement of 5,000 square feet or more of impervious surfaces (collectively over the entire project site) at sites and support the selling of prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812).	☐	☐
All Hillside developments. The creation, addition, or replacement of 5,000 square feet or more of impervious surfaces (collectively over the entire project site) and support development on any natural slope that is 25% or greater.	☐	☐
Environmentally Sensitive Areas (ESAs). Developments or Redevelopments discharging directly to an ESA that add or replace 2,500 square feet or more of impervious surfaces collectively over the entire project site. "Discharging directly to" includes flow that is conveyed 200 feet or less from the project to the ESA, or conveyed in a pipe of channel any distance as an isolated flow from the project to the ESA.	☐	☐
Parking lots. The creation, addition, or replacement of 5,000 square feet or more of impervious surfaces (collectively over the entire project site) and supports land area or a facility for the temporary parking or storage of motor vehicles used personally for business or commerce.	☐	☐
Streets, roads, highways, and freeways. The creation, addition, or replacement of 5,000 square feet or more of impervious surfaces (collectively over the entire project site) and supports paved impervious surface used for the transportation of automobiles, trucks, motorcycles, and other vehicles.	☐	☐
Retail Gasoline Outlets (RGOs). The creation, addition, or replacement of 5,000 square feet or more of impervious surfaces that in support Retail Gasoline Outlets that are either 5,000 square feet or more or have a project average daily traffic of 100 or more vehicles.	☐	☐
Pollutant Generating projects disturbing over 1 acre. Developments or Redevelopments that disturb over one acre of land and are expected to generate pollutants post construction.	☐	☐
If one or more boxes are checked "Yes" in Section B, project is a Priority Development Project (PDP). Check box below and proceed to Section C. ☐ PDP subject to Site Design, Source Control, Pollutant Control, and Hydromodification Management Requirements. If all boxes are checked "No" in Section B, project is not a PDP. Check box below. ☐ Non-PDP subject to SD and SC requirements. Project requires "Other Development Project" Water Quality Checklist Submittal or local equivalent documentation method.		
SECTION C: POTENTIAL GREEN STREET EXEMPTION		
☐ PDP does not qualify for (or elect to pursue) the 'Green Streets Exemption' and must submit a Project-Specific WQMP ☐ PDP qualifies for, and elects to pursue, the 'Green Streets Exemption', consult with Copermittee for submittal requirements. This exemption requires that the project be designed a manner consistent with the USEPA Green Streets Manual to the maximum extent practicable. Acceptance of this pathway is contingent on Copermittee approval. See Section 1.1.2 of the WQMP.		

* Descriptions of SIC codes can be found at http://www.osha.gov/pls/imis/sicsearch.html.

Where a Project feature, such as a parking lot, falls into a PDP Category above and exceeds the applicable area threshold for that PDP category, the entire project footprint is subject to WQMP requirements. However, the feature, such as a parking lot or road, would need to exceed the individual area threshold for that category to trigger PDP designation.

Example 1: A new development project that includes a 3,000 sq-ft building and a 4,000 sq-ft parking lot. This would not trigger a PDP because the total impervious cover is less than 10,000 sq-ft and the impervious cover of the parking lot is less than 5,000 sq-ft.

Example 2: A new development project that includes a 2,000 sq-ft building and a 5,500 sq-ft driveway. This would trigger a PDP because the driveway area is greater than 5,000 sq-ft. The PDP applies to the entire project even though the total impervious total impervious cover is still less than 10,000 sq-ft.

EXHIBIT E:

WQMP Review Checklist

Water Quality Management Plan Review Checklist

The purpose of this checklist is to provide a format for uniform, comprehensive, and well-documented reviews of the Water Quality Management Plans (WQMPs) submitted by project applicants. The completed checklist should be transmitted to the project applicant with the project WQMP. A copy of the completed checklist should be retained with the project planning/permitting file.

Planning Project/Design Review Number: _____

Project Name: _____

Project Address: _____

_____

First Review

WQMP Received on: _____

Review Completed on: _____

Second Review

WQMP Received on: _____

Review Completed on: _____

Third Review

WQMP Received on: _____

Review Completed on: _____

Signature of Reviewer: _____ Date: _____

WQMP REQUIREMENT	Requirement Satisfied?		
	Yes	No	N/A
Title Page			
The Title Page includes the following:			
Project Title			
Development No. (Tract, Parcel, or Use number)			
Design Review/Case number			
Prepared for: (Owner/Developer name and contact information)			
Prepared by: (Consulting/Engineering firm that prepared WQMP with contact person, title and information)			
Date WQMP was prepared and appropriate revision date(s)			
Preliminary or Final box checked			
Owner's Certification			
Includes a fully completed and signed certification statement, in which the project owner acknowledges and accepts the provisions of the WQMP, follows the title page. *Note: Original signature and notarization certification for the project owner will be required for each approval document(s).*			
Includes a fully completed and signed certification statement following the title page in which the preparer acknowledges that the "WQMP meets the requirements of Regional Water Quality Control Board Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100"			
Table of Contents			
Includes a fully completed Table of Contents, list of figures, and appendices, as applicable.			
SECTION A: PROJECT AND SITE INSPECTION			
Includes an accurate description of project information, project location, project characteristics, and existing site characteristics.			
Section A.1: Maps and Site Plans			
Includes a WQMP site plan • Refer to Appendix 1 for specific WQMP site plan information to be provided.			
Section A.2: Identify Receiving Waters			
Includes fully completed Table A.1: Identification of Receiving Waters - All receiving waters that the project site is tributary to, are listed in order of upstream to downstream.			
Section A.3: Drainage System Susceptibility to Hydromodification			
Includes fully completed Table A.3: Identification of Susceptibility to Hydromodification			
Section A.4: Additional Permits/Approvals required for the Project:			
Includes fully completed Table A.2: Other Applicable Permits - Identifies additional permits/approvals required for the project: • State Department of Fish and Wildlife, 1602 Streambed Alteration Agreement. • State Water Resources Control Board, Clean Water Act (CWA) section 401 Water Quality Certification. • US Army Corps of Engineers, CWA section 404 permit. • US Fish and Wildlife, Endangered Species Act section 7 biological opinion. • Statewide Construction General Permit Coverage. • Statewide Industrial General Permit Coverage. • Western Riverside MSHCP Consistency Approval (e.g. JPR, DBESP). • Other.			

WQMP REQUIREMENT	Requirement Satisfied?		
	Yes	No	N/A
SECTION B: OPTIMIZE SITE UTILIZATION (LID PRINCIPLES)			
Includes fully completed Project-Specific WQMP Site Design BMP Checklist.			
SECTION C: DELINEATE DRAINAGE MANAGEMENT AREAS (DMA'S)			
Includes fully completed Table C.1: DMA Identification			
Indicates if the DMAs meet the Type 'A' Self-Treating Area criteria and Includes fully completed Table C.2: Type 'A', Self-Treating Areas.			
Indicates if the DMAs meet the Type 'B' Self-Retaining Area criteria and includes fully completed Table C.3: Type 'B', Self-Retaining Areas.			
Indicates if the DMAs meet the Type 'C' Areas that Drain to Self-Retaining Areas criteria and includes fully completed Table C.4: Type 'C', Areas that Drain to Self-Retaining Areas			
Includes fully completed Table C.5: Type 'D', Areas Draining to BMPs. • Where possible, site drainage should be designed so that only impervious roofs and pavement drain to LID BMPs. This yields a simpler, more efficient design and minimizes the potential for clogging by sediment.			
SECTION D: IMPLEMENT LID BMPS			
Section D.1: Full Infiltration Applicability			
Indicates if site design LID principles fully retain the DCV. • If Yes, Infiltration BMPs shall not be used for the site • If No, a project site-specific evaluation of the feasibility of Infiltration BMPs shall be performed and is included with the WQMP'.			
Includes fully completed Table D.1: Infiltration Feasibility, listing any affected DMAs.			
Includes fully completed Table D.2: Geotechnical Concerns for Onsite Infiltration			
Section D.2: Biofiltration Applicability			
Includes fully completed Table D.3: Evaluation of Biofiltration BMP Feasibility. • If Partial/Incidental Infiltration is not allowable, a basis for infeasibility is provided in the table and supported by material in Appendix 5.			
If proprietary Biofiltration BMPs are proposed, includes fully completed Table D.4: Proprietary BMP Approval Requirement Summary. • All proposed Proprietary Biofiltration BMPs satisfy each of the approval criteria listed in the table.			
Section D.3: Feasibility Assessment Summaries			
Includes fully completed Table D.5: LID Prioritization Summary Matrix. • If 'No LID (Alternative Compliance)' box is checked for any DMA, applicant is proposing use of Alternative Compliance and must complete Section F of the Template and should consult with the Copermittee.			
Section D.4: LID BMP Sizing			
Includes fully completed Table D.6: DCV Calculations for LID BMPs.			
Includes fully completed Table D.7: LID BMP Sizing. • Proposed BMP sizes (volumes) equal or exceed the Design Capture Volume for each DMA.			
SECTION E: IMPLEMENT HYDROLOGIC CONTROL BMPs AND SEDIMENT SUPPLY BMPs			
Indicates if project is exempt from Hydromodification Performance Standards.			
If project is not exempt, indicates that Hydrologic and Sediment Supply BMPs will be implemented Onsite. Offsite-alternative compliance is available for hydrologic control performance standard but no alternative compliance allowed for the sediment supply performance standard.			
Section E.1: Hydrologic Control BMP Selection			

WQMP REQUIREMENT	Requirement Satisfied?		
	Yes	No	N/A
Identifies each hydrologic control BMP types that are applied to meet performance standard on the site. • LID principles. • Structural LID BMPs that may be modified or enlarged, if necessary, beyond the DCV. • Structural Hydrologic Control BMPs that are distinct from the LID BMPs.			
Section: E.2 Hydrologic Control BMP Sizing			
Includes fully completed Table E.1: Hydrologic Control BMP Sizing.			
Section E.3: Implement Sediment Supply BMPs			
Indicates if there are mapped Potential Critical Coarse Sediment Yield Areas or Potential Sediment Source Areas on, or draining through the site. Includes Exhibit G indicating project location in Appendix 7. • If there are no mapped areas, the Sediment Supply Performance Standard is met. • If there are mapped areas, applicant must complete section E.3.1 or E.3.2.			
For mapped Potential Critical Coarse Sediment Yield Areas and Potential Sediment Source Areas, applicable compliance pathway is selected, and appropriate sections are completed.			
Section E.3.1: Option 1: Avoid Critical Coarse Sediment Yield Areas			
If applicable, narrative included describing how the PDP has avoided impacts to onsite and offsite Potential Critical Coarse Sediment Yield Areas and Potential Sediment Source Areas.			
Section E.3.2: Option 2: Site-Specific Critical Coarse Sediment Analysis			
Completed Step 1: Identify if site is a Significant Source of Bed Sediment Supply			
• Step 1.A: Identifies bed sediment similarity as…High, Medium or Low. • Results from geotechnical report attached in Appendix 7			
• Step 1.B: Identifies onsite streams capable of delivering bed sediment to receiving channel as…High, Medium or Low. • Results from analysis attached in Appendix 7			
• Step 1.C: Identifies if receiving channel will adversely respond to change in Bed Sediment Load as…High, Medium or Low. • Results from in-stream analysis provided in Appendix 7			
• Step 1.D: Provides summary of Step 1 in Table E.2: Triad Assessment Summary			
Completed Step 2: Preservation of identified onsite channels			
- Indicates whether site design will or will not avoid onsite channels that are identified as Significant Source of Bed Sediment…Yes or No.			
- Provides map identifying all onsite channels that are Significant Source of Bed Sediment in Appendix 7			
Completed Step 3: By-Pass of Upstream Drainage(s)			
- Indicates if site design avoids or doesn't avoid all onsite channels			
- Provides a site map identifying all upstream channels that are Significant Source of Bed Sediment in Appendix 7			
Completed Step 4 (if applicable). Copermittee has given approval to investigate other Bed Sediment Supply BMP options and the approval document is provided in the WQMP. The WQMP documents that project will have no net impact to receiving waters associated with coarse sediment supply.			

WQMP REQUIREMENT	Requirement Satisfied?		
	Yes	No	N/A
SECTION F: ALTERNATIVE COMPLIANCE			
Indicates if Alternative Compliance has been used to achieve compliance with pollutant control and/or hydrologic control requirements for a given PDP. Indicates that either full implementation of LID BMPs is infeasible and must be supplemented with Alternative Compliance BMPs, or applicant has elected to use Alternative Compliance BMPs even if use of onsite LID BMPs is feasible. If neither box is checked, Section F is not required to be completed. Preparer to skip to Section G. Note, there is no alternative compliance for sediment supply BMPs			
Section F.1: Identify Pollutants of Concern			
Includes fully completed Table F.1: Summary of Approved 2010 303(d) listed waterbodies and associated pollutants of concern for the Riverside County SMR Region and downstream waterbodies.			
Includes fully completed Table F.2: Potential Pollutants by Land Use Type. • Indicates all applicable project categories. • Identifies the project's Pollutants of Concern by comparing general pollutant categories to those listed as impairments in the project's receiving waters.			
Section F.2: Treatment Control BMP Selection			
Includes fully completed Table F.3: Treatment Control BMP Selection. • Lists proposed treatment control BMP. • List project's priority pollutants of concern. • List removal efficiency percentage, as documented in TAPE GULD Certification or equivalent 3rd party certification, certification is provided in Appendix 6.			
Section F.3: Sizing Criteria			
Includes appropriate V_{BMP} or Q_{BMP} calculations and are analyzed using method described in Section 2.3.1 of the 2018 SMR WQMP.			
Section F.4:Hydrologic Performance Standard – Alternative Compliance Approach			
Provides an Technical Feasibility Study in Appendix 7 • Written approval from Copermittee has been given prior to development of study			
Indicates if offsite hydrologic control management within the same channel system will be pursued.			
Provides a completed Table F.5: Offsite Hydrologic Control BMP Sizing			
Indicates if in-stream restoration project is being pursued			
Provides a technical report detailing in-stream restoration option in Appendix 7			
Sediment Supply Performance Standard – NO ALTERNATIVE COMPLIANCE IS AVAILABLE			
SECTION G: IMPLEMENT TRASH CAPTURE BMPS			
Documents whether Trash Capture is required for the project.			
Includes fully completed Table G.1: Sizing Trash Capture BMPs.			
Includes fully completed Table G.2: Approximate precipitation depth/intensity values for calculation of the Trash Capture Design Storm.			
Includes fully completed Table G.3: Trash Capture BMPs.			
SECTION H: SOURCE CONTROL BMPS			
Includes completed Table H-1: Project Specific WQMP Source Control BMP Checklist – Table is consistent with Stormwater Pollutant Sources/Source Control Checklist located in Appendix 8 for the following: • Potential sources of runoff pollutants. • Structural source control BMPs. • Operational source control BMPs.			

WQMP REQUIREMENT	Requirement Satisfied?		
	Yes	No	N/A
SECTION I: COORDINATE SUBMITTAL WITH OTHER SITE PLANS			
Includes fully completed Table I.1: Construction Plan Cross-Reference. • For Final WQMP only. • Reference tool to be used for easy reference of related construction plans.			
Includes fully completed Table I.2: Other Applicable Permits.			
SECTION I. OPERATION, MAINTENANCE AND FUNDING			
Describes Maintenance Mechanism that is included in Appendix 9.			
Indicates Maintenance Mechanism and if the proposed BMPs will be maintained by a Homeowners' Association (HOA) or Property Owners Association (POA).			
APPENDICES			
Appendix 1: Maps and Site Plans			
Includes fully completed Map and Site Plan Checklist.			
Includes an accurate project location Map.			
Includes a fully complete and labeled map of all project identified receiving waters.			
Includes WQMP Site Plan that includes all of the following elements: • Parcel Boundary and Project Footprint • Existing and Proposed Topography • Drainage Management Areas (DMAs) • Proposed Structural Best Management Practices (BMPs) Drainage Paths • Drainage infrastructure, inlets, overflows • Source Control BMPs • Site Design BMPs • Buildings, Roof Lines, Downspouts • Impervious Surfaces • Pervious Surfaces (i.e. Landscaping) Standard Labeling			
Appendix 2: Construction Plans			
Includes grading, drainage, landscape/plant palette and other pertinent construction plans.			
Appendix 3: Soil Information			
Includes Geotechnical Study.			
Includes infiltration testing data.			
Includes HSG map.			
Includes other soils information.			
Appendix 4: Historical Site Conditions			
Includes Phase 1 Environmental Site Assessment and/or other information on past site use.			
Includes other historical site condition information.			
Appendix 5: LID infeasibility			
Includes LID Technical Feasibility/Infeasibility Analysis. • Analysis should be approved by Copermittee.			

WQMP REQUIREMENT	Requirement Satisfied?		
	Yes	No	N/A
Appendix 6: BMP Design Details			
Includes Design procedure sheets for LID BMPs. • Includes separate calculations for each DMAs draining to an LID BMP. • Includes calculations of V_{BMP} for each DMA using worksheets from Appendix F of the *LID BMP Design Handbook.* • Sizing of the LID BMP is performed using worksheets found in the *LID BMP Design Handbook* or other approved method by the Copermittee, and all worksheets are included. • Calculation values are consistent with those provided in Table D.6 and D.7.			
Appendix 7: Hydromodification			
Includes supporting documentation for exemption of hydromodification performance standards.			
Includes exhibit showing project site location in relation to mapped Potential Critical Coarse Sediment Yield Areas and Potential Sediment Source Areas			
Includes SMRHM summary reports			
Includes sieve analysis from Geotechnical Report, including soil erodibility factor.			
Includes analysis of sediment delivery potential to receiving channel			
Includes in-stream analysis			
Includes a site map identifying all onsite/upstream channels that are a significant source of bed sediment supply			
Includes site specific Technical Infeasibility Study of Hydrologic Control and Sediment Supply BMPs, including, but not limited to: • Modeling analysis • Long-term monitoring program • Potential corrective actions • SMRHM summary reports for alternative hydrologic approach BMPs			
Includes supporting documentation for alternative compliance option for offsite/in-stream restoration for hydrologic performance standard			
Includes analysis of sediment delivery potential to receiving channel.			
Includes full design plans for in-stream restoration project that has been approved by Copermittee.			
Appendix 8: Source Control			
Includes Pollutant Sources/Source Control Checklist. • Checklist is consistent with Project-Specific WQMP Source Control BMP Checklist • Checklist is consistent with the WQMP Site Plan.			
Appendix 9: O&M			
Includes a means to finance and implement facility maintenance in perpetuity, including replacement cost.			
Includes acceptance of responsibility for maintenance from the time the BMPs are constructed until the responsibility for operation and maintenance is legally transferred.			
Includes an outline of general maintenance requirements for the Stormwater BMPs selected.			
Includes figures delineating and designating pervious and impervious areas, location, and type of Stormwater BMP, and tables of pervious and impervious areas served by each facility. Geo-locating the BMPs using a coordinate system of latitude and longitude is recommended to help facilitate a future statewide database system.			
Includes a separate list and location of self-retaining areas, or areas addressed by LID Principles, that do not require specialized O&M or inspections, but will require typical landscape maintenance as noted in Chapter 5, in the WQMP Guidance. Includes a brief description of typical landscape maintenance for these areas.			
Includes Maintenance and Recording Mechanisms			

WQMP REQUIREMENT	Requirement Satisfied?		
	Yes	No	N/A
Appendix 10: Educational Materials			
Includes BMP Fact Sheets			
Includes Maintenance Guidelines			
Includes Other End-User BMP Information			

WQMP REVIEW COMMENTS

The following is a summary of major comments and/or questions relative to this project-specific WQMP:

EXHIBIT F:

Santa Margarita Region Hydrology Model Guidance Manual

Santa Margarita Region Hydrology Model

Guidance Document

Prepared By:

Santa Margarita Region Copermittees: Riverside County Flood Control and Water Conservation District, County of Riverside, and the cities of Murrieta, Temecula, and Wildomar

With assistance from:

Clear Creek Solutions, Inc. www.clearcreeksolutions.com

April 2014

This page has been intentionally left blank.

To download the Santa Margarita Region Hydrology Model and the electronic version of this document,
please go to http://www.floodcontrol.co.riverside.ca.us/NPDES/SantaMargaritaWS.aspx#SMdocs

If you have questions about SMRHM or its use, please contact: Clear Creek Solutions, Inc.
360-943-0304 (8 AM – 5 PM Pacific time)

End User License Agreement

End User Software License Agreement (Agreement). By clicking on the "Accept" Button when installing the Santa Margarita Region Hydrology Model (SMRHM) Software or by using the Santa Margarita Region Hydrology Model Software following installation, you, your employer, client and associates (collectively, "End User") are consenting to be bound by the following terms and conditions. If you or User do not desire to be bound by the following conditions, click the "Decline" Button, and do not continue the installation process or use of the SMRHM Software.

The SMRHM Software is being provided to End User pursuant to a sublicense of a governmental licensee of Clear Creek Solutions, Inc. Pursuant to the terms and conditions of this Agreement, End User is permitted to use the SMRHM Software solely for purposes authorized by participating municipal, county or special district member agencies of signatory programs which are organized on a county-wide basis for implementation of stormwater discharge permits issued by the California Regional Water Quality Control Board, under the National Pollutant Discharge Elimination System. The End User is not permitted to use the SMRHM Software for any other purpose than as described above.

End User shall not copy, distribute, alter, or modify the SMRHM Software.

The SMRHM incorporates data on soils, climate and geographical features to support its intended uses of identifying site-appropriate modeling parameters, incorporating user-defined inputs into long-term hydrologic simulation models of areas within the Santa Margarita Region , and assisting design of facilities for flow duration control as described in the accompanying documentation. These data may not be adequate for other purposes such as those requiring precise location, measurement or description of geographical features, or engineering analyses other than those described in the documentation.

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc., or authorized representatives be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc., has been advised of the possibility of such damages. Software Copyright © by Clear Creek Solutions, Inc. 2005-2013; All Rights Reserved.

FOREWORD

The Santa Margarita Region Hydrology Model (SMRHM) is a tool for analyzing the hydromodification effects of land development projects and sizing solutions to mitigate the increased stormwater runoff from these projects. This section of the guidance documentation provides background information on the definition and effects of hydromodification and relevant findings from technical analyses conducted in response to regulatory requirements. It also summarizes the current Hydromodification Management Standard and general design approach for hydromodification control BMPs, which led to the development of the SMRHM.

Regulatory Context

The California Regional Water Quality Control Board (Regional Board) requires stormwater programs to address the increases in stormwater runoff rate and volume from New Development and Redevelopment projects where those increases could cause increased erosion of receiving channels. Phase 1 municipal separate stormwater system (MS4) permits in Riverside County contain requirements to develop and implement hydromodification management plans (HMPs) and to implement associated management measures.

TABLE OF CONTENTS

End User License Agreement iii

FOREWORD iv
Regulatory Context iv
Acknowledgements iv

INTRODUCTION TO SMRHM 1

QUICK START 3

MAIN SCREENS 35
MAP INFORMATION SCREEN 36
GENERAL PROJECT INFORMATION SCREEN 37
SCHEMATIC EDITOR 39
LAND USE BASIN ELEMENT 40
LATERAL BASIN ELEMENT (Pervious) 43
LATERAL I BASIN ELEMENT (Impervious) 44
TRAPEZOIDAL POND ELEMENT 45
VAULT ELEMENT 49
TANK ELEMENT 51
IRREGULAR POND ELEMENT 53
PONDPAD INTERFACE 54
GRAVEL TRENCH BED ELEMENT 56
SAND FILTER ELEMENT 58
OUTLET STRUCTURE CONFIGURATIONS 60
INFILTRATION 66
AUTO POND 67
CHANNEL ELEMENT 69
FLOW SPLITTER ELEMENT 71
TIME SERIES ELEMENT 73
STAGE-STORAGE-DISCHARGE TABLE 74
SSD TABLE ELEMENT 75
BIORETENTION ELEMENT 78
POINT OF COMPLIANCE 85
CONNECTING ELEMENTS 87
ANALYSIS SCREEN 90
FLOW DURATION 92
FLOW FREQUENCY 94
DRAWDOWN 95
HYDROGRAPHS 96
LID BMP SIZING 97
REPORTS SCREEN 104

TOOLS SCREEN 106
LID ANALYSIS SCREEN 110
OPTIONS 114
DURATION CRITERIA 115
SCALING FACTORS 116

TIPS AND TRICKS FOR LID PRACTICES AND FACILITIES 118
INFILTRATION BASIN/POND 119
INFILTRATION TRENCH 122
PERMEABLE PAVEMENT 125
BIORETENTION (STANDARD DESIGN) 128
BIORETENTION (VERTICAL SIDESLOPES) 130
BIORETENTION (PLANTER BOX) 132
SAND FILTER BASIN 134
EXTENDED DETENTION BASIN 136

APPENDIX A: DEFAULT SMRHM HSPF PERVIOUS PARAMETER VALUES ... 140

APPENDIX B:DEFAULT SMRHM HSPF IMPERVIOUS PARAMETER VALUES 157

APPENDIX C: ADDITIONAL GUIDANCE FOR USING SMRHM 161
Infiltration Reduction Factor 161
Flow Duration Outlet Structures – Practical Design Considerations 162
Drawdown time and treatment/vector considerations 163

APPENDIX D: SMRHM REVIEWER CHECKLIST 167

APPENDIX E: SMRHM BACKGROUND 169
Effects of Hydromodification 169
Development of the Santa Margarita Region Hydrology Model 169

SMRHM OVERVIEW 170
BIORETENTION MODELING METHODOLOGY 172

ACRONYMS and ABBREVIATIONS

AGWETP	Active Groundwater Evapotranspiration Fraction
AGWRC	Active Groundwater Recession Constant (per day)
AGWS	Initial Active Groundwater Storage (inches)
ASCE	American Society of Civil Engineers
ASTM	American Society of Testing and Materials
A_T	Tributary Area
BASETP	Base Flow (from groundwater) Evapotranspiration Fraction
BMP	Best Management Practice
C	Runoff Coefficient
CCS	Clear Creek Solutions
CEPSC	Interception storage (inches)
CF	Correction Factor
CFS	Cubic Feet per Second
d	Surface ponding depth (feet)
DEEPFR	Fraction of groundwater to deep aquifer or inactive storage
Dev.	Development
DMA	Drainage Management Area
D_{85}	85^{th} percentile, 24-hour rainfall depth
Ft	Foot
GWVS	Initial Groundwater Vertical Slope (feet/feet)
h	Hydraulic head (feet)
Headr	The water height over the notch/orifice bottom
HMP	Hydromodification Management Plan
HSPF	Hydrologic Simulation Program in Fortran
H/V	Ratio of horizontal to vertical distance
I	Gradient of the water table surface (slope)
IFWS	Initial interflow (inches)
in.	inch
INFEXP	Infiltration Exponent
INFILD	Infiltration ratio (maximum to mean)
INFILT	Infiltration (inches per hour)
INTFW	Interflow index
IRC	Interflow Recession Constant (per day)
K	Hydraulic conductivity (inches per hour)
KVARY	Variable groundwater recession
LID	Low Impact Development
LSUR	Length of surface flow path (feet)
LZETP	Lower Zone Evapotranspiration fraction
LZS	Initial Lower Zone Storage (inches)

LZSN	Lower Zone Storage Nominal (inches)
m	rank (largest event, m = 1)
Mitigated	The developed land use with mitigation measures (as selected by the user).
MS4	Municipal Separate Storm Sewer System
N	Number of years
NRCS	Natural Resources Conservation Service
NSUR	Surface roughness (Manning's n) for impervious area
NTS	Not to Scale
Phi	Soil porosity
POC	Point of Compliance
Predev	Predevelopment: the native land cover conditions prior to any land use development.
Q	Flow rate (cfs)
q	Darcy flux (cm/hr)
Q_{BMP}	LID BMP flow rate (cfs)
Q_{cp}	Critical Flow (cfs)
RETS	Initial surface retention storage (inches) for impervious area
RETSC	Surface retention storage (inches) for impervious area
SLSUR	Slope of surface flow path (feet/feet) for impervious area
SMMWW	Stormwater Management Manual for Western Washington
SMR	Santa Margarita Region
SMRHM	Santa Margarita Region Hydrology Model
SSD	Stage Storage Discharge
Stormwater runoff	Stormwater that does not soak into the ground and either flows directly into surface waterways or is channeled into storm drains
SURS	Initial surface runoff (inches) for impervious area
SWMM	Stormwater Management Model
Theta	Notch Angle
Tr	Return period (years)
TSS	Total suspended solids
USDA	United States Department of Agriculture
UZS	Initial Upper Zone Storage (inches)
UZSN	Upper Zone Storage Nominal (inches)
V_{BMP}	LID BMP design volume
V_U	85% unit storage volume
WDM	Watershed Data Management
WEF	Water Environment Federation
Wh	Notch Width
WS	Water Surface
WWHM	Western Washington Hydrology Model

This page has been intentionally left blank.

INTRODUCTION TO SMRHM

SMRHM is the Santa Margarita Region Hydrology Model. SMRHM is based on the WWHM (Western Washington Hydrology Model) stormwater modeling software platform. WWHM was originally developed for the Washington State Department of Ecology. More information about WWHM can be found at www.clearcreeksolutions.com. More information can be found about the Washington State Department of Ecology's stormwater management program and manual at http://www.ecy.wa.gov/programs/wq/stormwater/manual.html.

Clear Creek Solutions is responsible for SMRHM and the SMRHM guidance documentation.

This guidance documentation is organized so as to provide the user an example of a standard application using SMRHM (described in *Quick Start*) followed by descriptions of the different components and options available in SMRHM. The *Tips and Tricks* section presents some ideas of how to incorporate LID (Low Impact Development) facilities and practices into the SMRHM analysis. Riverside County's *Design Handbook for Low Impact Development Best Management Practices* (September 2011) has the most up-to-date information regarding BMP standards and should be consulted prior to the start of any SMRHM LID BMP modeling.

Appendices A and B provide a full list of the HSPF parameter values used in SMRHM. Appendix C contains additional guidance and recommendations by the stormwater programs that have sponsored the SMRHM development. Appendix D is a checklist for use by SMRHM project reviewers. Appendix E provides additional background information on SMRHM.

Throughout the guidance documentation notes using this font (sans-serif italic) alert the user to actions or design decisions for which guidance must be consulted that is external to the SMRHM software, either provided in Appendix C of this guidance documentation or by the Copermittee with jurisdiction over the project site.

Purpose

The purpose of SMRHM is to size hydromodification management or flow control BMPs to mitigate the effects of increased stormwater runoff (peak discharge, duration, and volume) from proposed land use changes that impact natural streams, wetlands, and other water courses.

SMRHM provides:

- A uniform methodology for the SMR
- A more accurate methodology than single-event design storms
- An easy-to-use software package

SMRHM is based on:

- Continuous simulation hydrology (HSPF)
- Actual long-term recorded precipitation data
- Measured pan evaporation data
- Existing vegetation (for predevelopment conditions)
- Regional HSPF parameters

Computer Requirements

- Windows 2000/XP/Vista/7/8 with 300 MB uncompressed hard drive space
- Internet access (only required for downloading SMRHM, not required for executing SMRHM)
- Pentium 3 or faster processor (desirable)
- Color monitor (desirable)

It is important to know the following information prior to using SMRHM for a project:

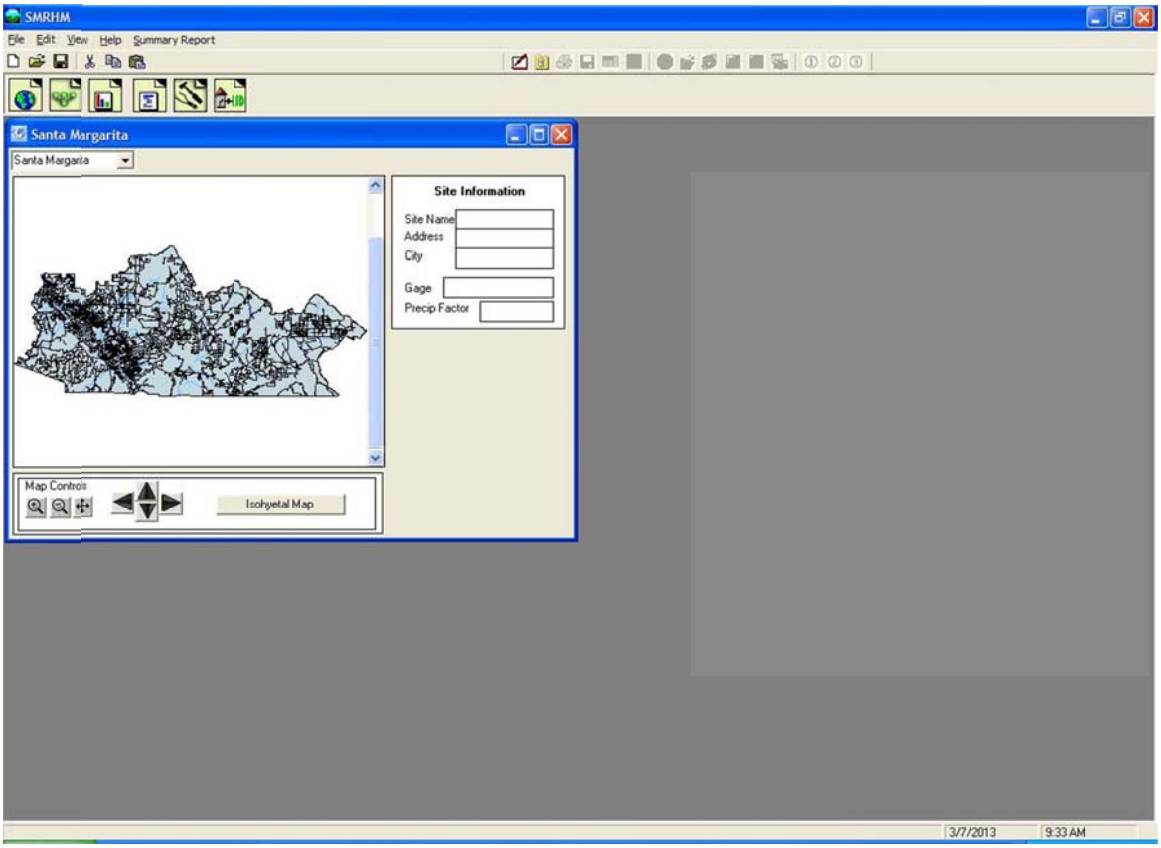
- Knowledge of the site location and/or street address
- Knowledge of the actual distribution of existing site soil by category (A, B, C, or D)
- Knowledge of the actual distribution of existing and proposed site land cover by category (forest, shrub, grass, or urban)
- Knowledge of the actual distribution of existing and proposed site topography by category (flat, moderate, steep, or very steep)
- Knowledge of the planned distribution of the proposed development (buildings, streets, sidewalks, parking, lawn areas) overlying the soil categories

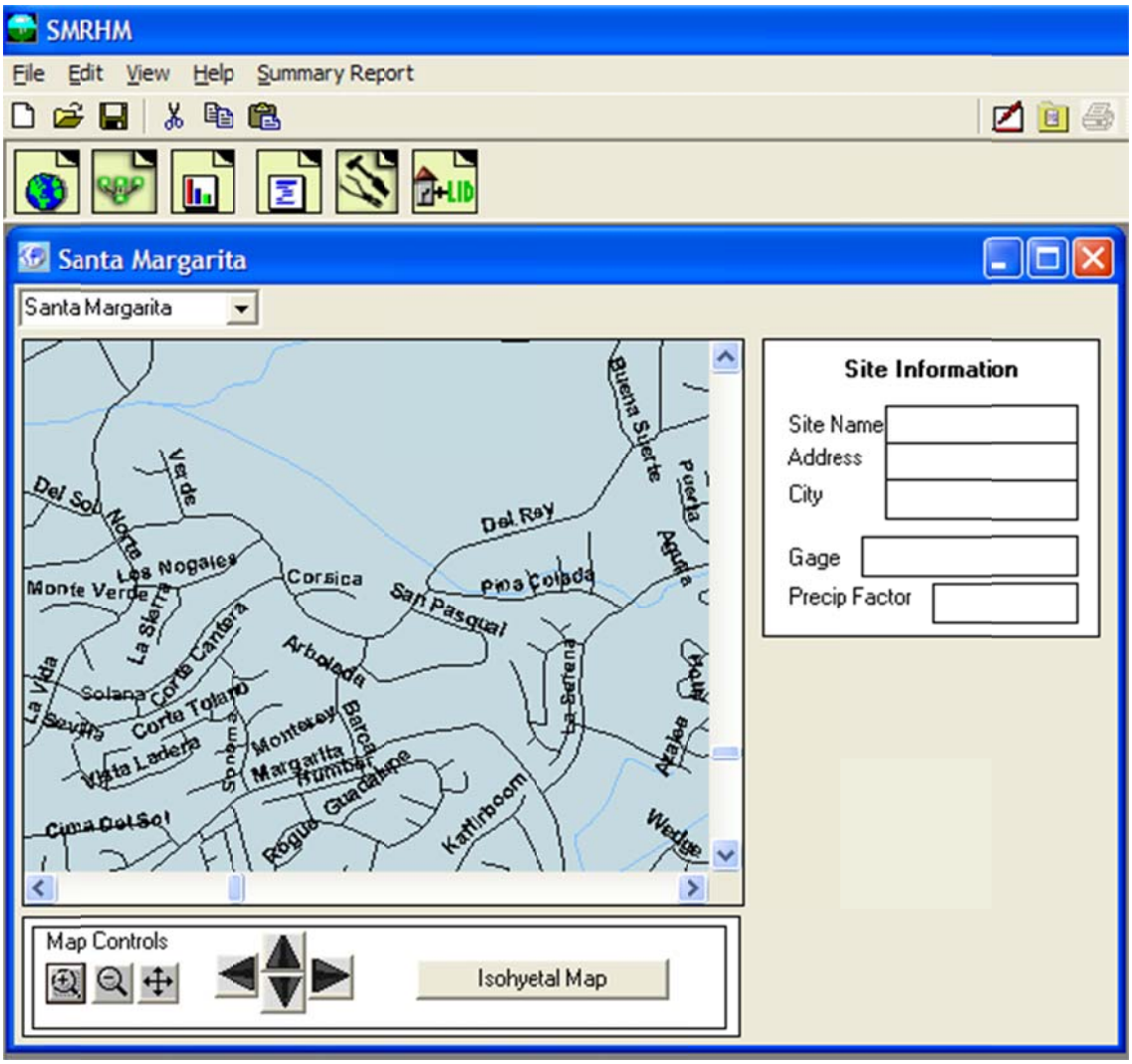
QUICK START

Quick Start very briefly describes the steps to quickly size a stormwater runoff detention pond using SMRHM. New users should read the descriptions of the SMRHM screens, elements, and analysis tools before going through the steps described below.

1. Open SMRHM.

SMRHM will open with a map of the SMR.



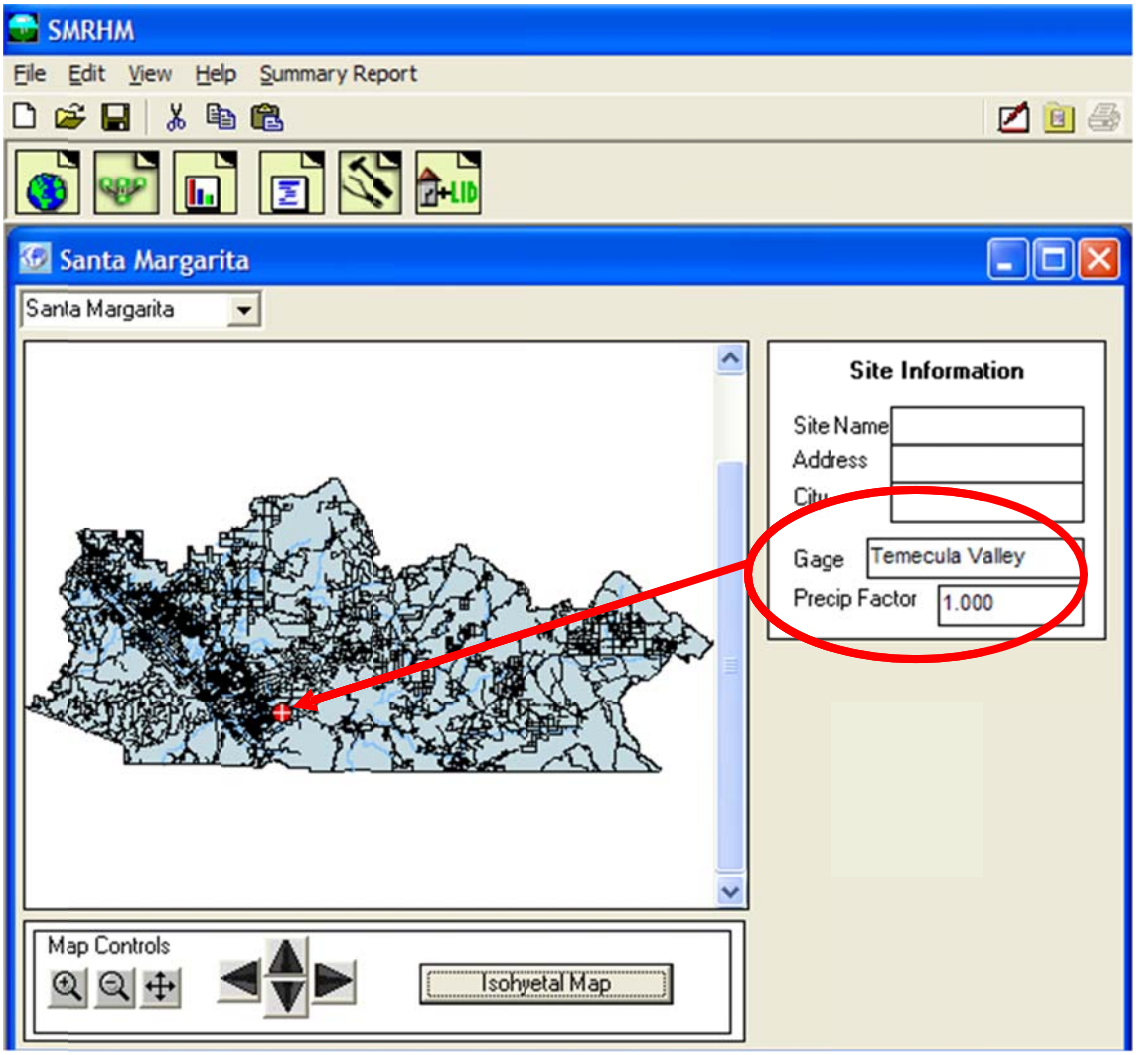


The map controls can be used to enlarge a specific area on the street map layer. This option helps to locate the specific project site.

When the street map layer is enlarged a sufficient amount the individual street names are shown on the map.

2. Select the project site location.

Locate the project site on the map. Use the map controls to magnify a portion of the map, if needed. Select the project site by left clicking on the map location. A red circle will be placed on the map identifying the project site.



The model will then automatically select the appropriate rain gauge record for the project site. The SMR has four long-term 15-minute precipitation records: Eastern Slopes, Temecula Valley, Western Plateau, and Wildomar/North Murrieta.

For this example we will use the Temecula Valley rain gauge.

The site name, address, and city information is optional. It is not used by SMRHM, but will be included in the project report summary.

3. Use the tool bar (immediately above the map) to move to the Scenario Editor. Click on the *General Project Information* button.

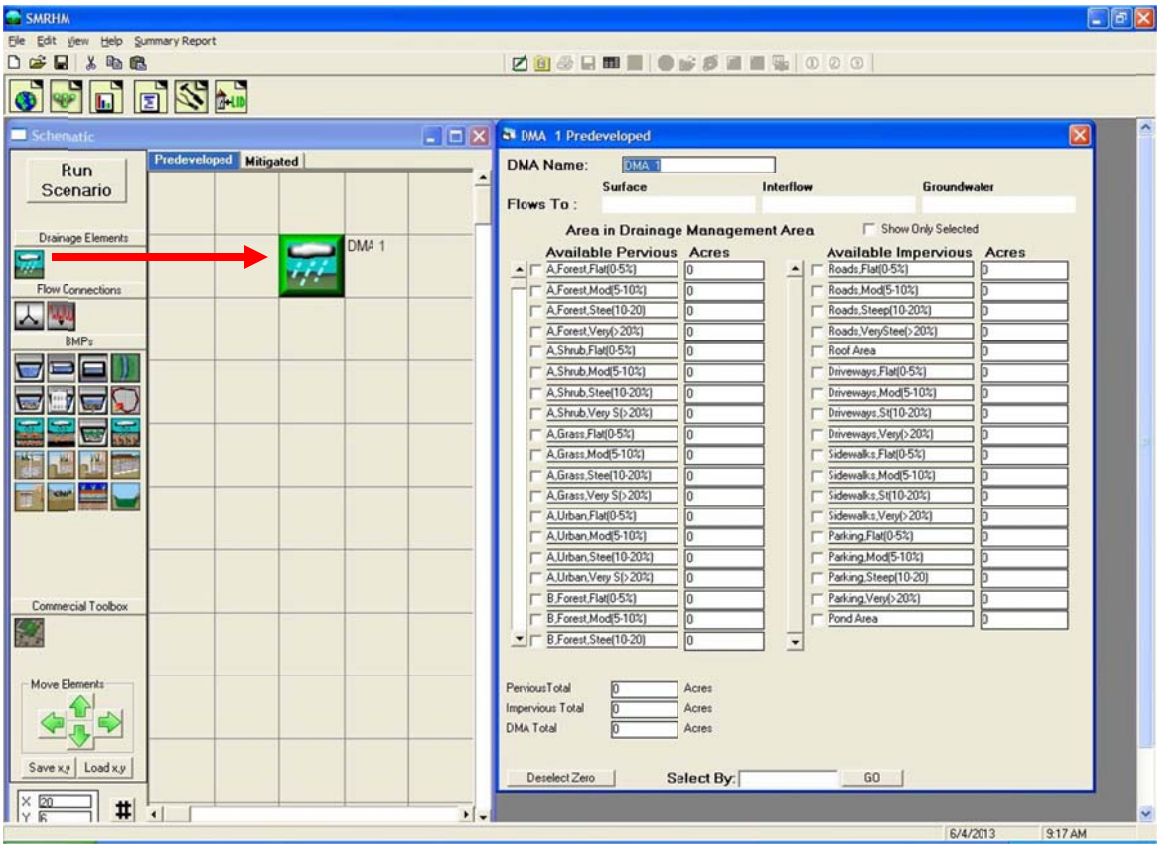
The ***General Project Information*** button will bring up the Schematic Editor.

The schematic editor screen contains two scenarios: Predevelopment and Mitigated.

First set up the Predevelopment scenario and then the Mitigated scenario.

Left click on the Land use Basin element under the Drainage Elements heading. The Land use Basin element represents a drainage management area (DMA).

Select any grid cell (preferably near the top of the grid) and left click on that grid. The DMA will appear in that grid cell.



To the right of the grid is the land use information associated with the DMA. Select the appropriate soil, land cover, and land slope for the Predevelopment scenario. Soils are based on NRCS general categories A, B, C, and D.

Land cover is based on the native vegetation for the Predevelopment project area and the planned vegetation for the planned development (Mitigated scenario). Non-urban land cover can be forest, shrub, and/or grass. In contrast, the developed landscape will consist of urban vegetation (lawns, flowers, planted shrubs and trees) and is regularly irrigated.

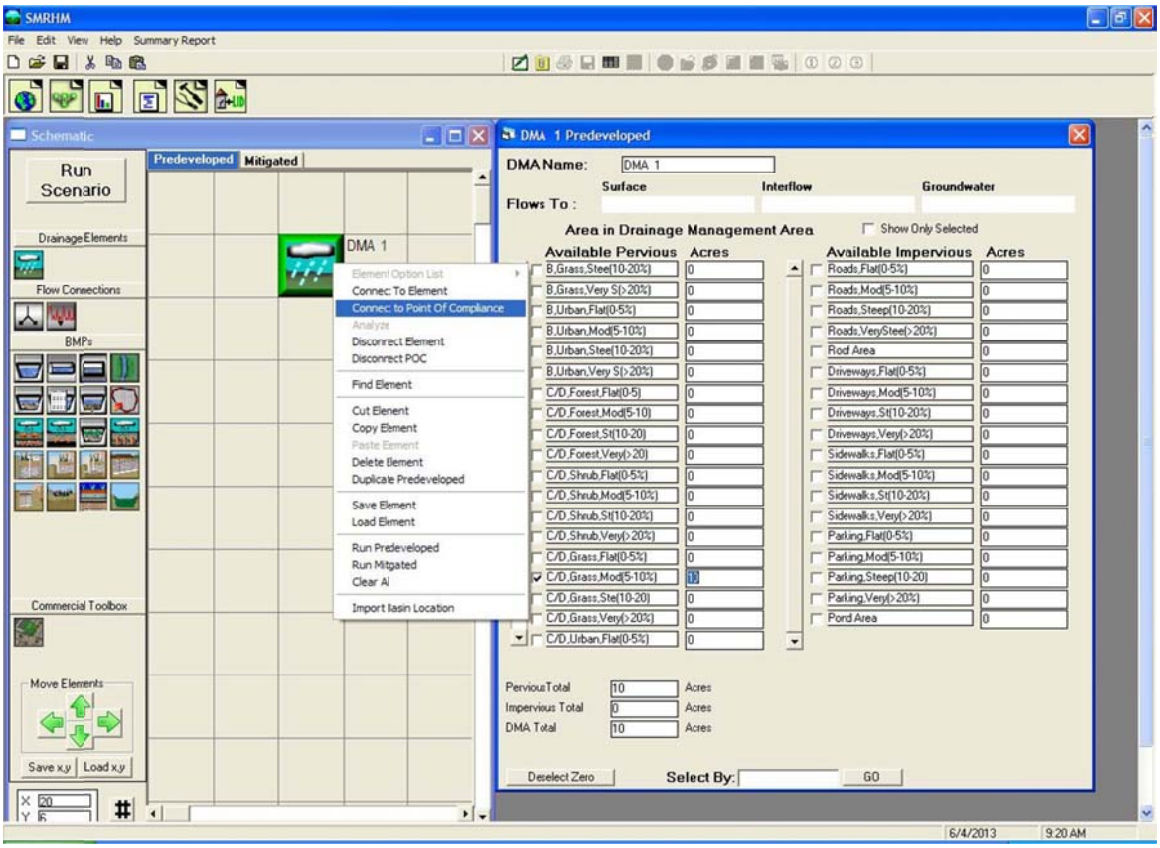
Land slope is divided into flat (0-5%), moderate (5-10%), steep (10-20%), and very steep (>20%) land slopes.

HSPF parameter values in SMRHM have been adjusted for the different soil, land cover, and land slope categories.

For this example we will assume that the Predevelopment land use is:

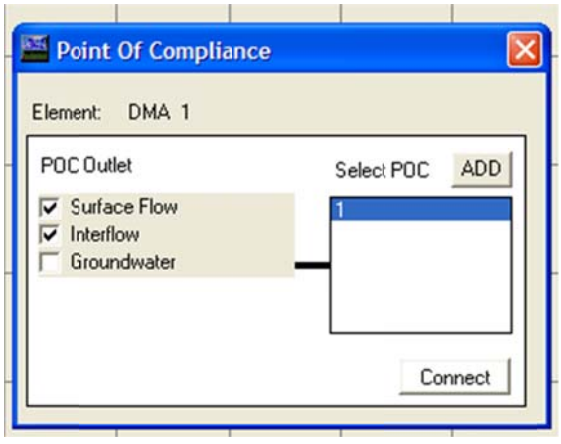
- D soil
- grass vegetation
- moderate slope (5-10%)
- DMA equals 10 acres

Note that the Predevelopment land use never includes man-made impervious areas. Existing impervious areas must be modeled as they were prior to any land use development on the project site.

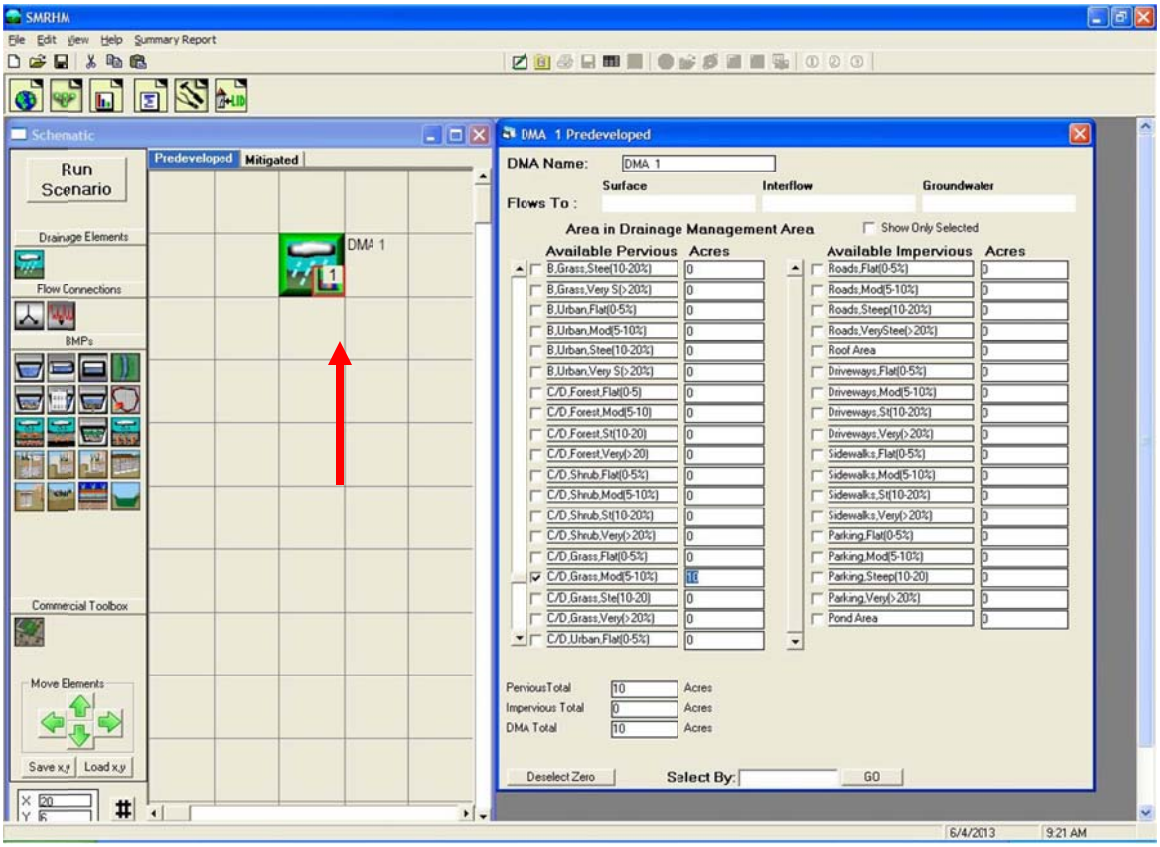


The downstream discharge from this DMA will be selected as our point of compliance for the Predevelopment scenario. Right click on the DMA and highlight ***Connect to Point of Compliance*** (the point of compliance is defined as the location at which the stormwater runoff from both the Predevelopment scenario and the Mitigated scenario are compared).

The Point of Compliance screen will be shown for Predevelopment DMA 1. The POC (Point of Compliance) Outlet has been checked for both surface runoff and interflow (shallow subsurface flow). These are the two flow components of stormwater runoff. Do not check the groundwater box unless there is observed and documented base flow on the project site.

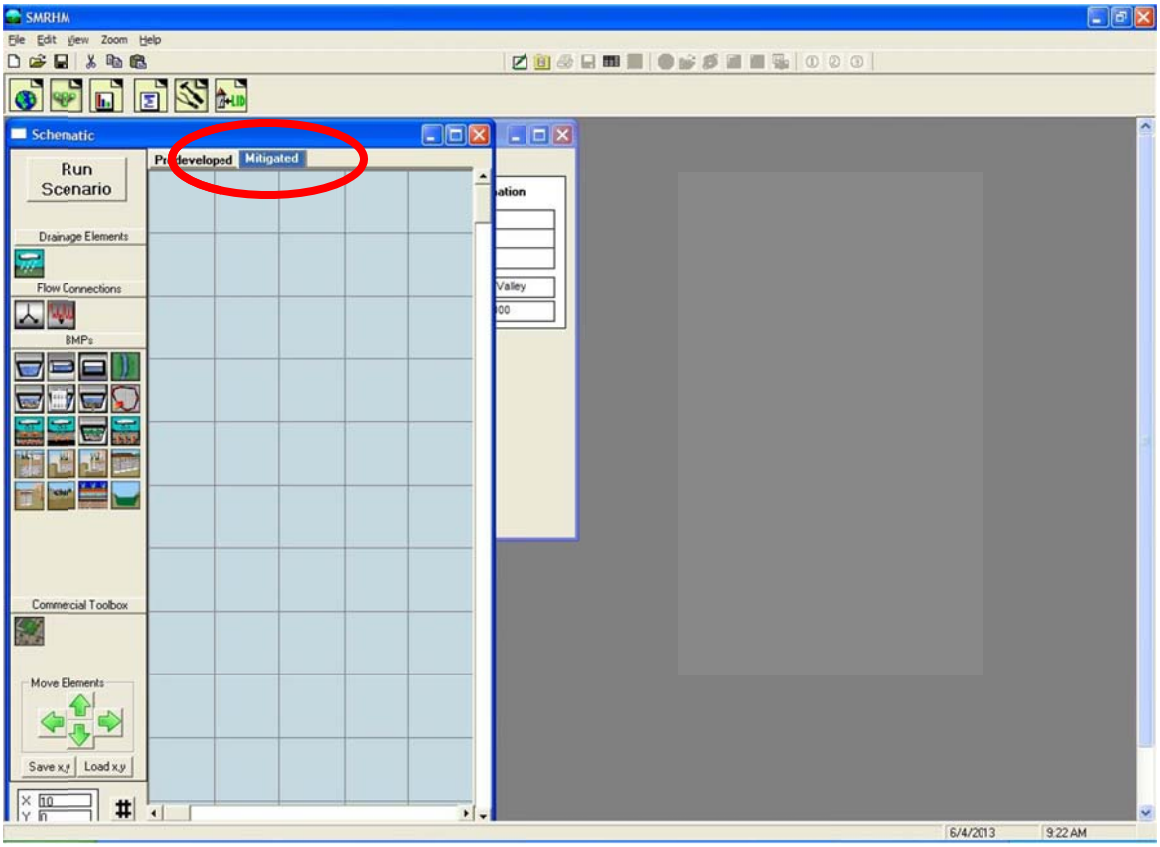


Click the ***Connect*** button in the low right corner to connect this point of compliance to the Predevelopment basin.

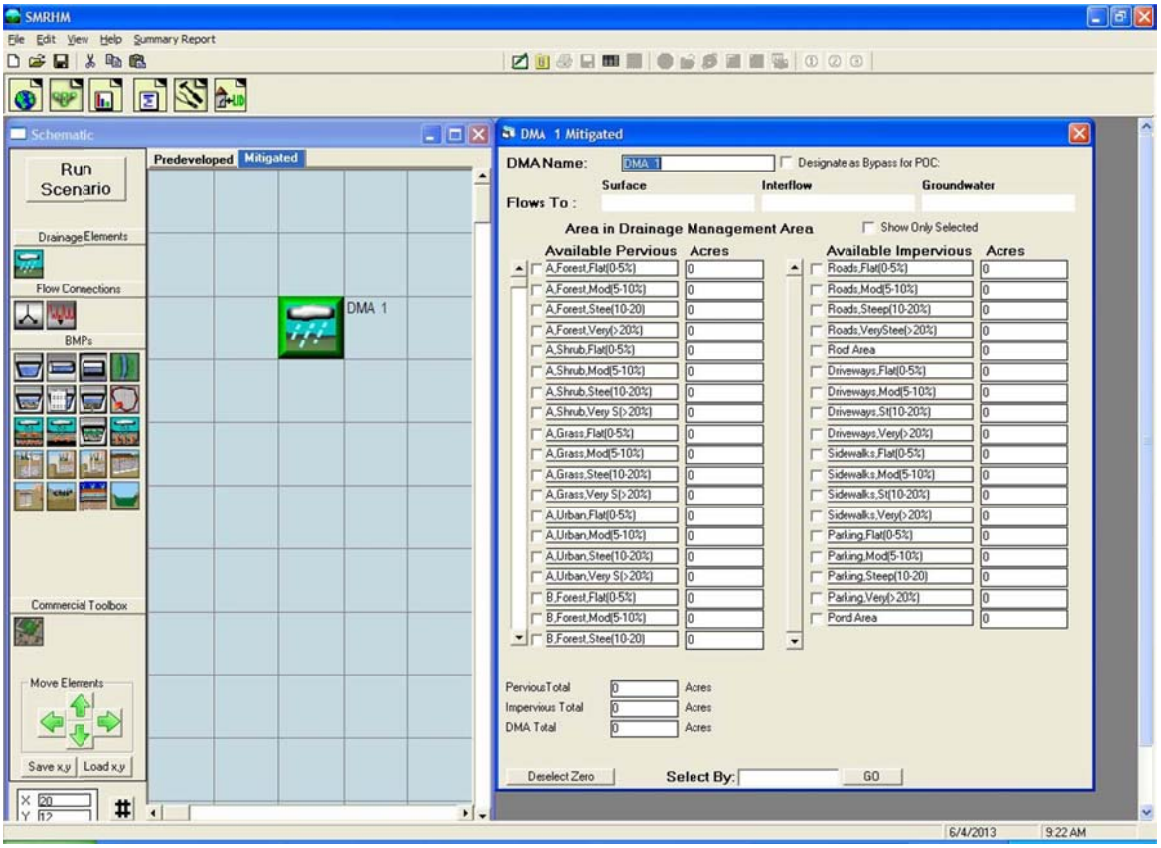


After the point of compliance has been added to the DMA, the land use basin element will change. A small box with a bar chart graphic and a number will be shown in the lower right corner of the element. This small POC box identifies this DMA as a point of compliance. The number is the POC number (e.g., POC 1).

4. Set up the Mitigated scenario.



First, select the Mitigated scenario tab at the top of the grid. Place a land use basin element on the grid to represent the same DMA, as selected in the Predevelopment scenario.



For the Mitigated scenario DMA we will input the following information:

Pervious area:

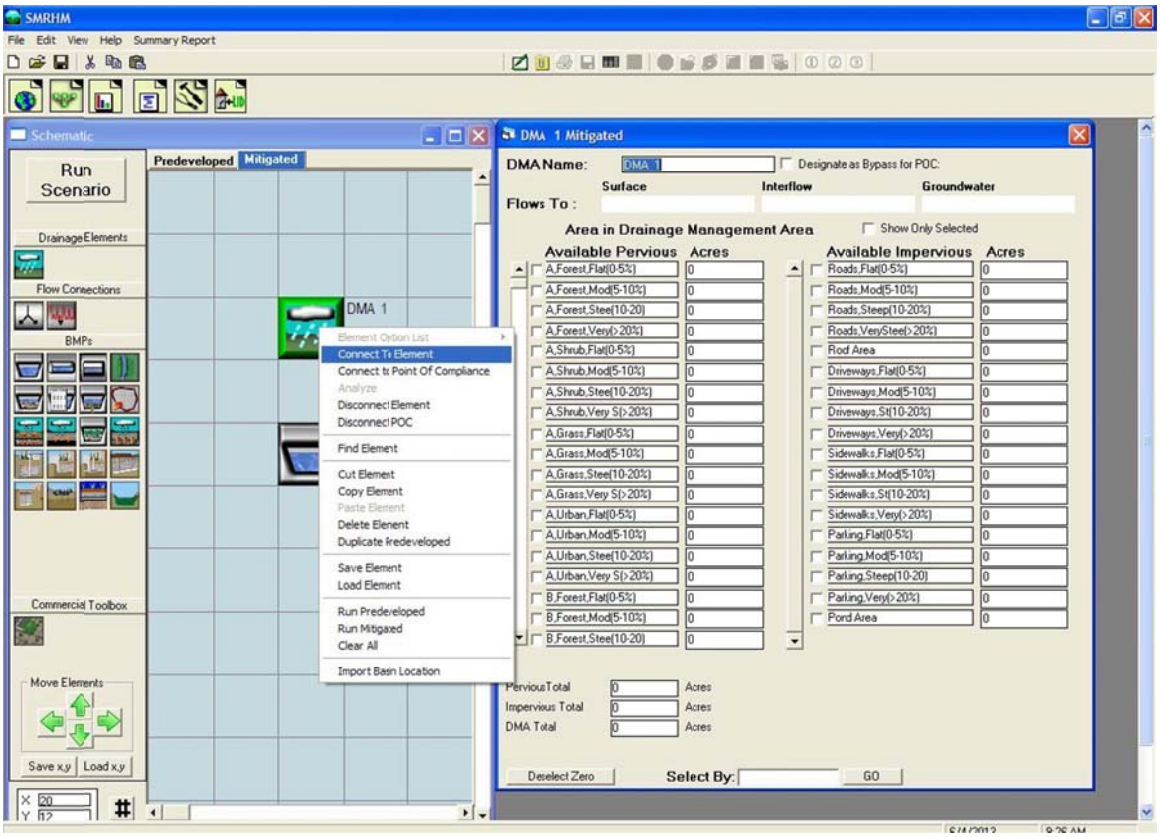
- D soil
- urban vegetation
- moderate slope (5-10%)
- 4.5 acres

Impervious area:

- Roads, moderate slope: 2.5 acres
- Roof Area: 1.5 acres
- Parking, flat slope: 1.5 acres

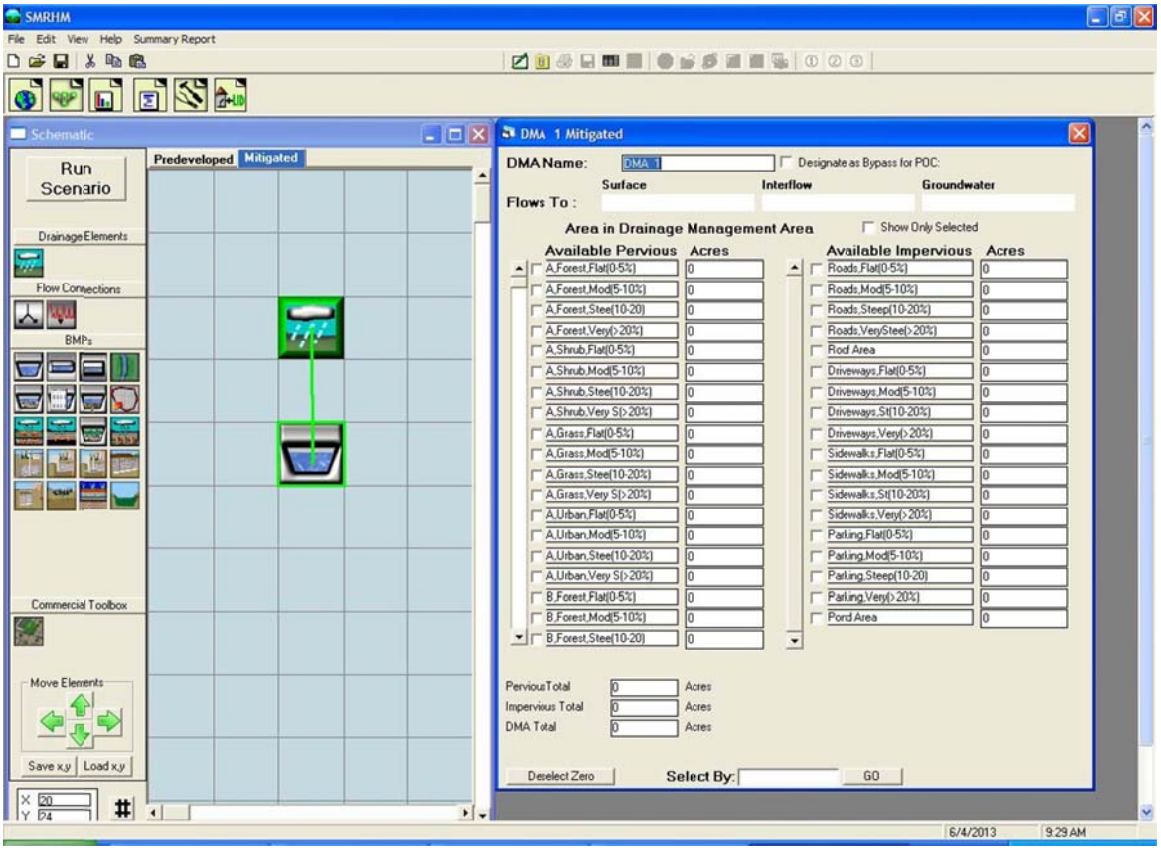
The impervious land category includes roads, roofs, sidewalks, parking, driveways, and any other impervious surfaces. All are modeled the same; the surface runoff produced from an impervious land surface only varies by land slope (steeper slopes produce more surface runoff than flatter slopes).

The next step is to add a mitigation facility downstream of the DMA. For this example we will use a trapezoidal stormwater pond (also known as a detention basin) to provide the required hydromodification mitigation.



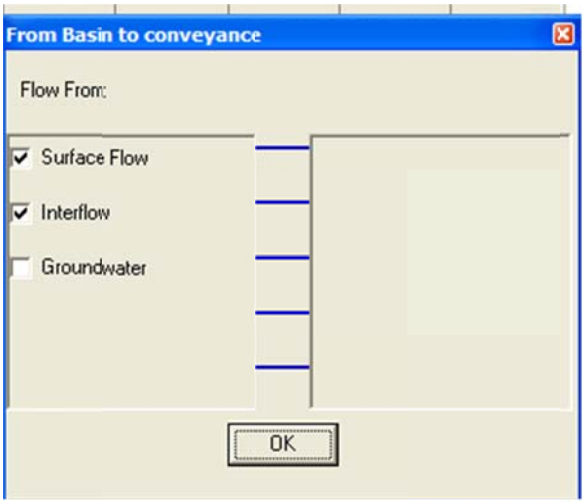
Place the trapezoidal pond element below the DMA in any cell on the grid. It doesn't have to be directly below the DMA, but it must be somewhere on a lower row in the grid.

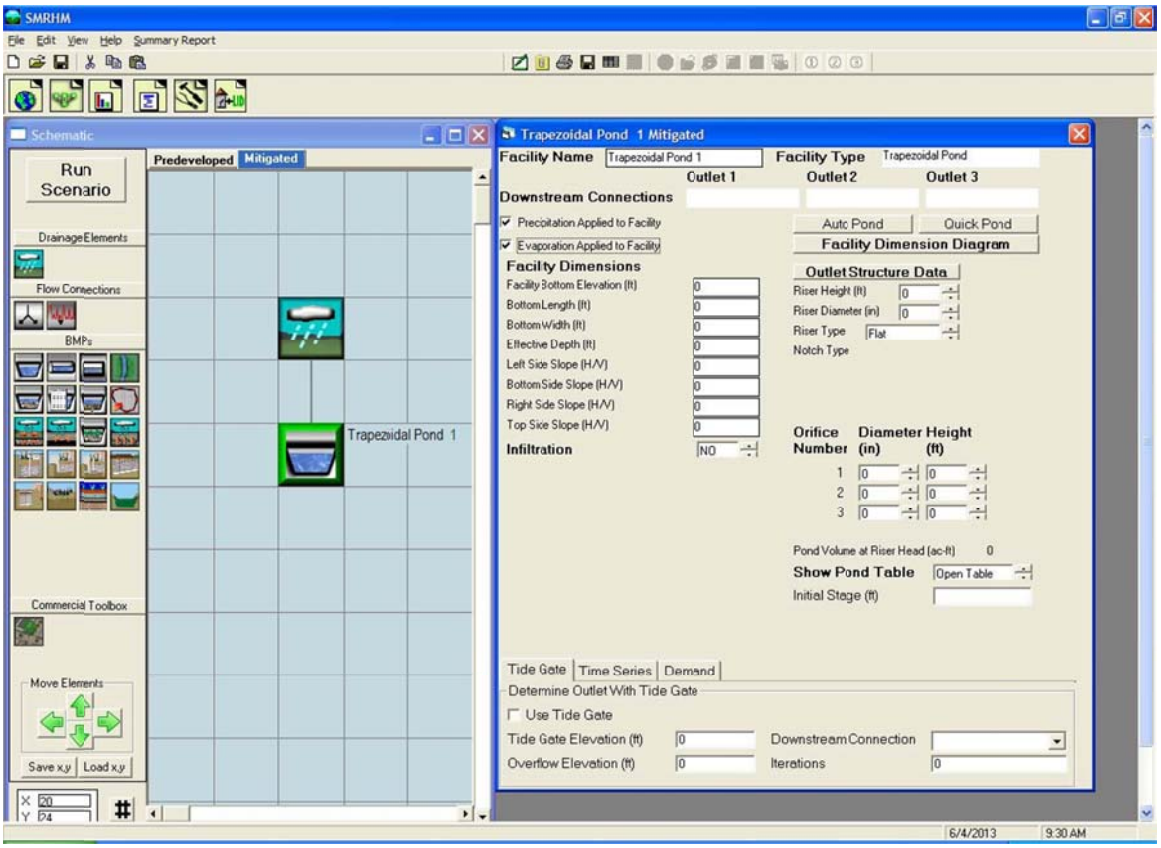
Right click on the DMA and select ***Connect To Element***. A green line will appear with one end connected to the DMA.



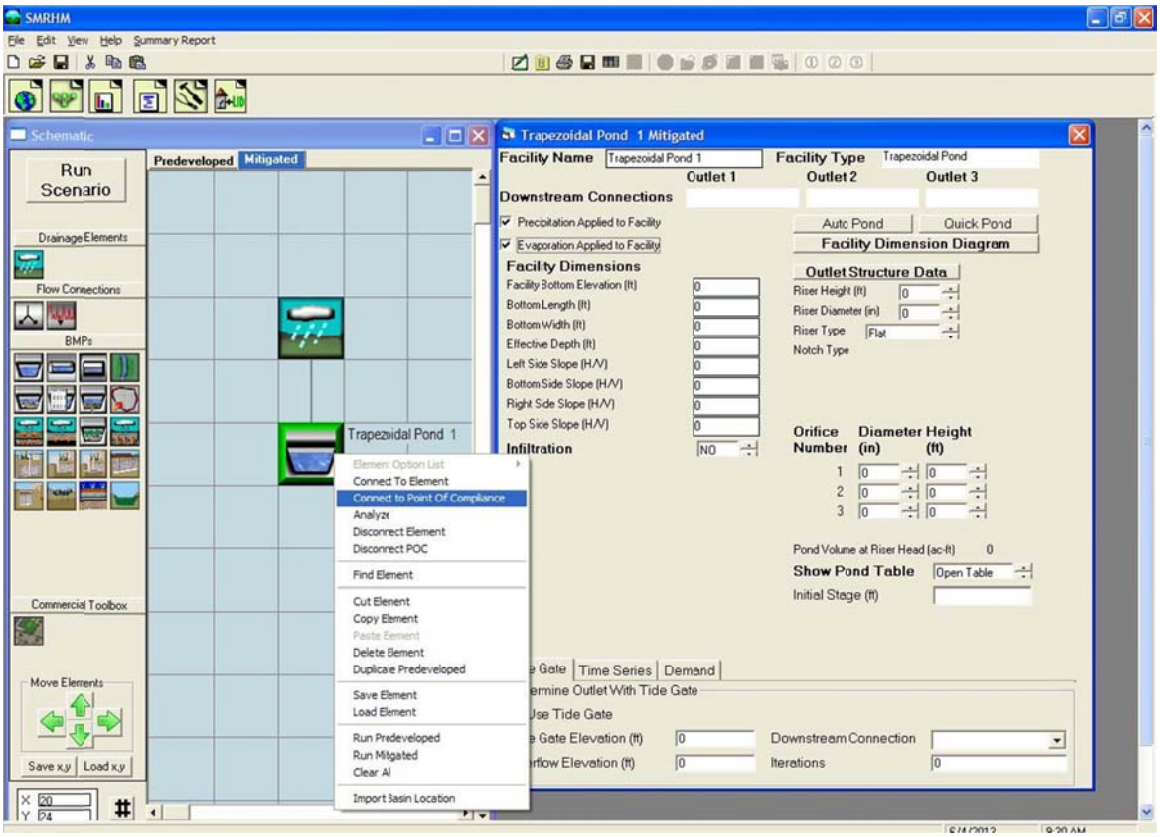
Pull the other end of the line down to the trapezoidal pond with the mouse pointer and click on the pond. This action will bring up the From Basin to Conveyance screen.

As with the Predevelopment scenario we want to only connect the surface flow and the interflow (shallow subsurface seepage) from the basin to the pond. Click ***OK***.

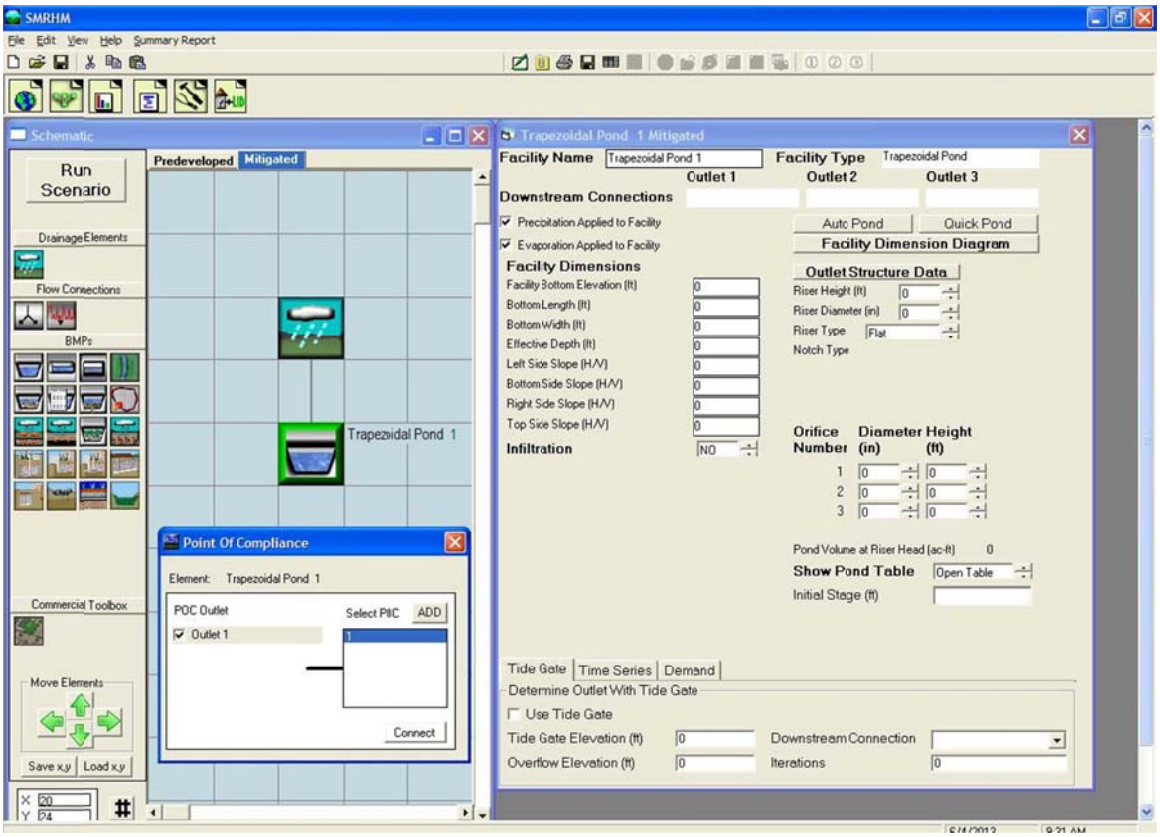




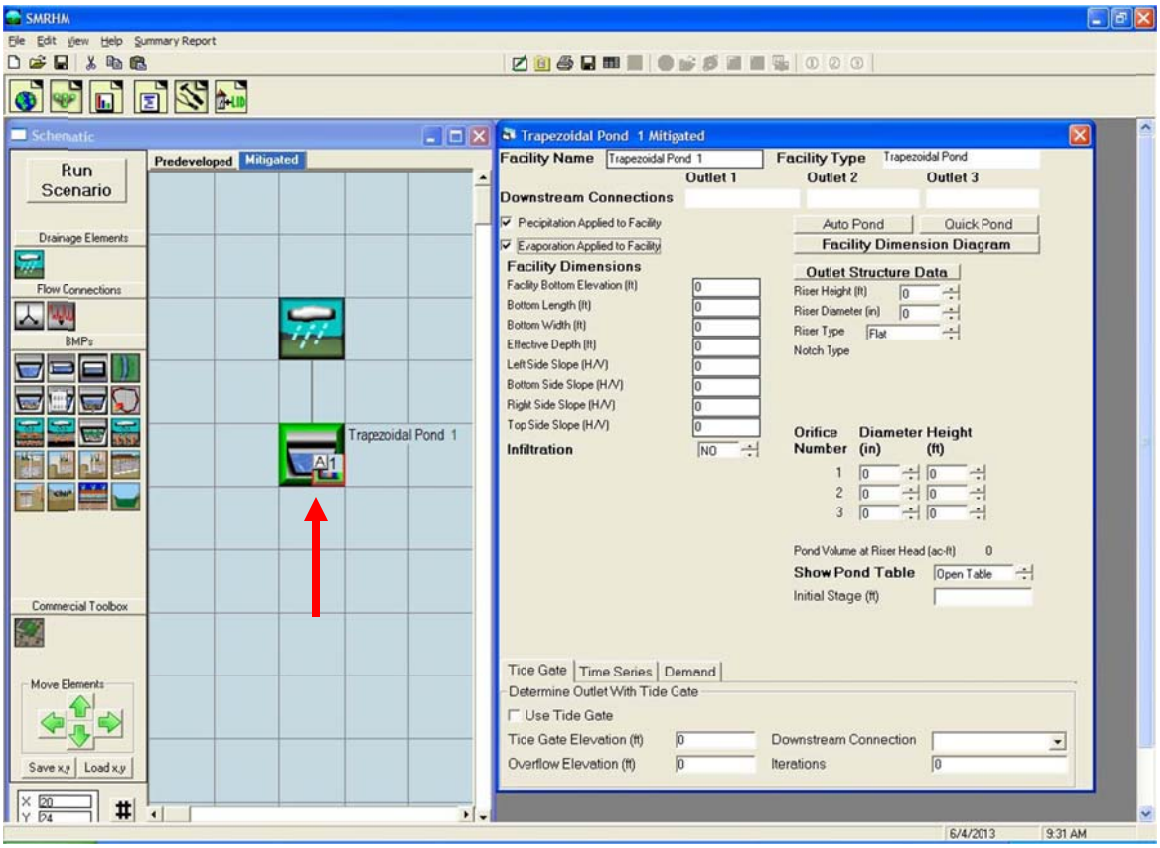
A line will then be shown connecting the DMA to the trapezoidal pond.



Right click on the trapezoidal pond element to connect the pond's outlet to the point of compliance. Highlight and click on ***Connect to Point Of Compliance***.



The Point of Compliance screen will be shown for the pond. The pond has one outlet (by default). The outflow from the pond will be compared with the Predevelopment runoff. The point of compliance is designated as POC 1 (SMRHM allows for multiple points of compliance). Click on the ***Connect*** button.

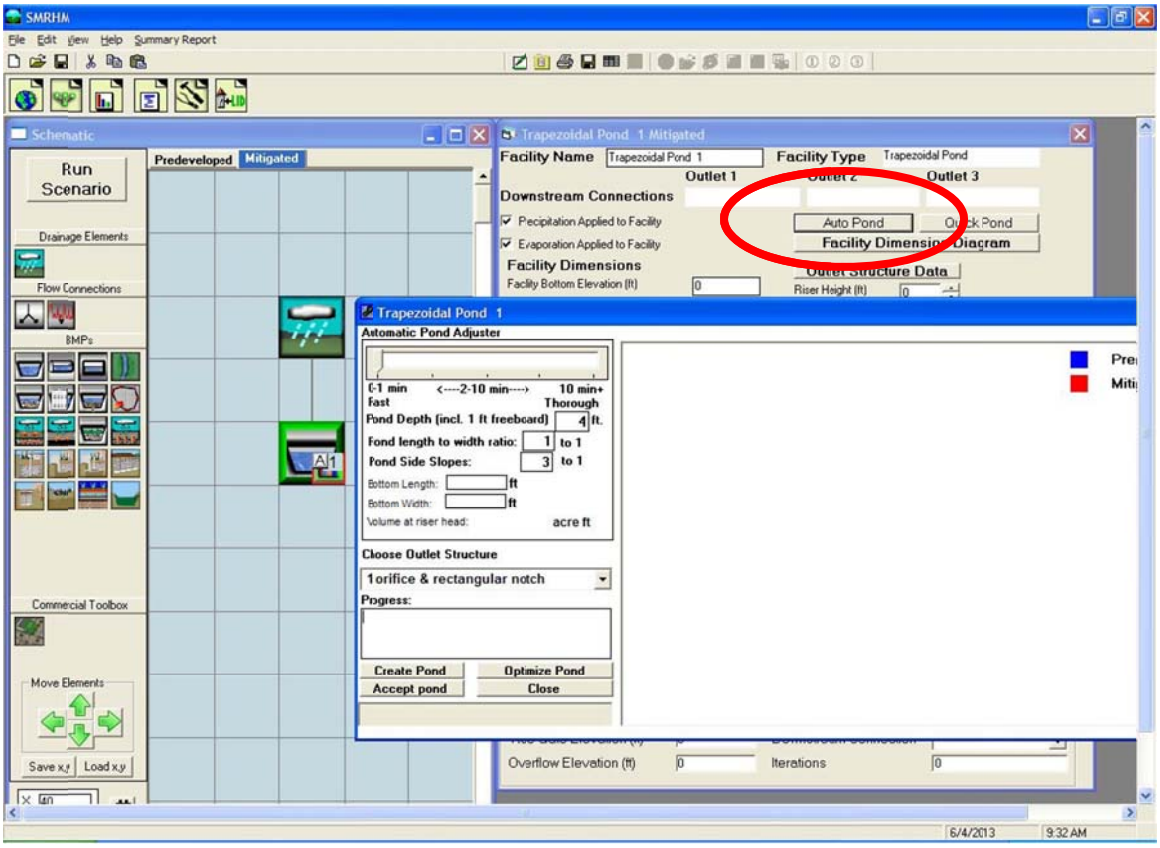


The point of compliance is shown on the pond element as a small box with the letter "A" and number 1 in the bar chart symbol in the lower right corner.

NOTE: The letter "A" stands for Analysis and designates that this is an analysis location where flow and stage will be computed and the output flow and stage time series will be made available to the user. The number 1 denotes that this is POC 1.

You can have an analysis location without having a point of compliance at the same location, but you cannot have a point of compliance that is also not an analysis location.

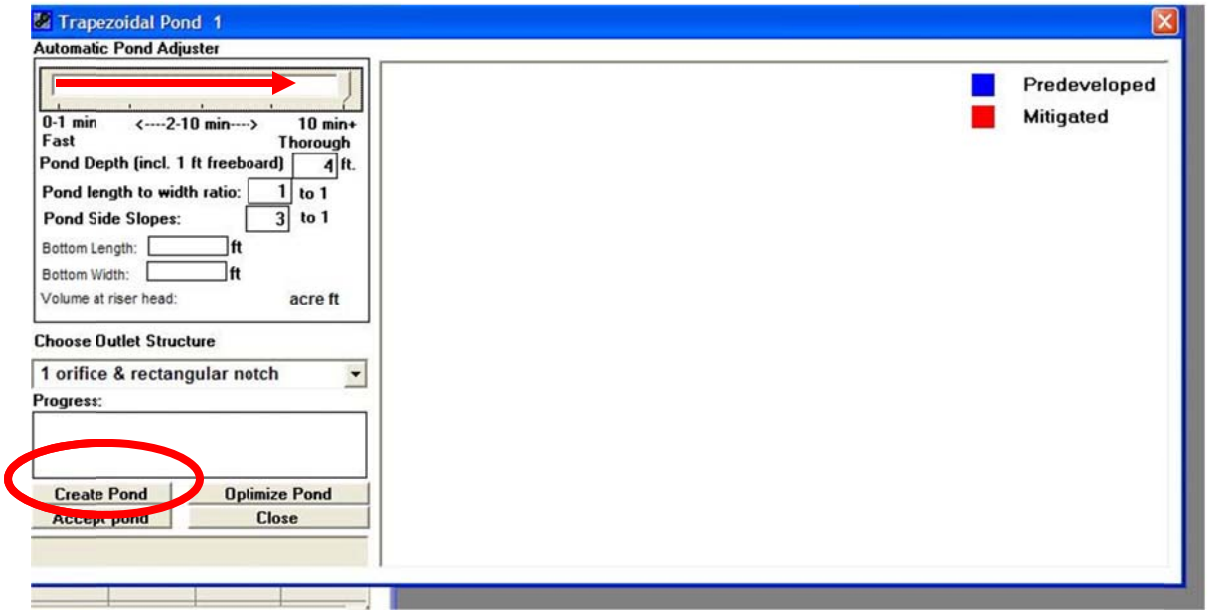
5. Sizing the trapezoidal pond.



A trapezoidal stormwater pond can be sized either manually or automatically (using the Auto Pond feature). For this example Auto Pond will be used. (Go to page 48 to find more information about how to manually size a stormwater pond, detention basin, or other HMP BMP.)

Click on the ***Auto Pond*** button and the Auto Pond screen will appear. The user can set the pond depth (default: 4 feet), pond length to width ratio (default: 1 to 1), pond sideslopes (default: 3 to 1), and the outlet structure configuration (default: 1 orifice and riser with rectangular notch weir).

To optimize the pond design and create the smallest pond possible, move the Automatic Pond Adjuster pointer from the left to the right.



The pond does not yet have any dimensions. Click the ***Create Pond*** button to create initial pond dimensions, which will be the starting point for Auto Pond's automated optimization process to calculate the pond size and outlet structure dimensions.

NOTE: Depending on the complexity of the project, the length of the precipitation record and the computational speed of the computer, Auto Pond may take 1 to 15 minutes to run.

Running Auto Pond automates the following SMRHM processes:

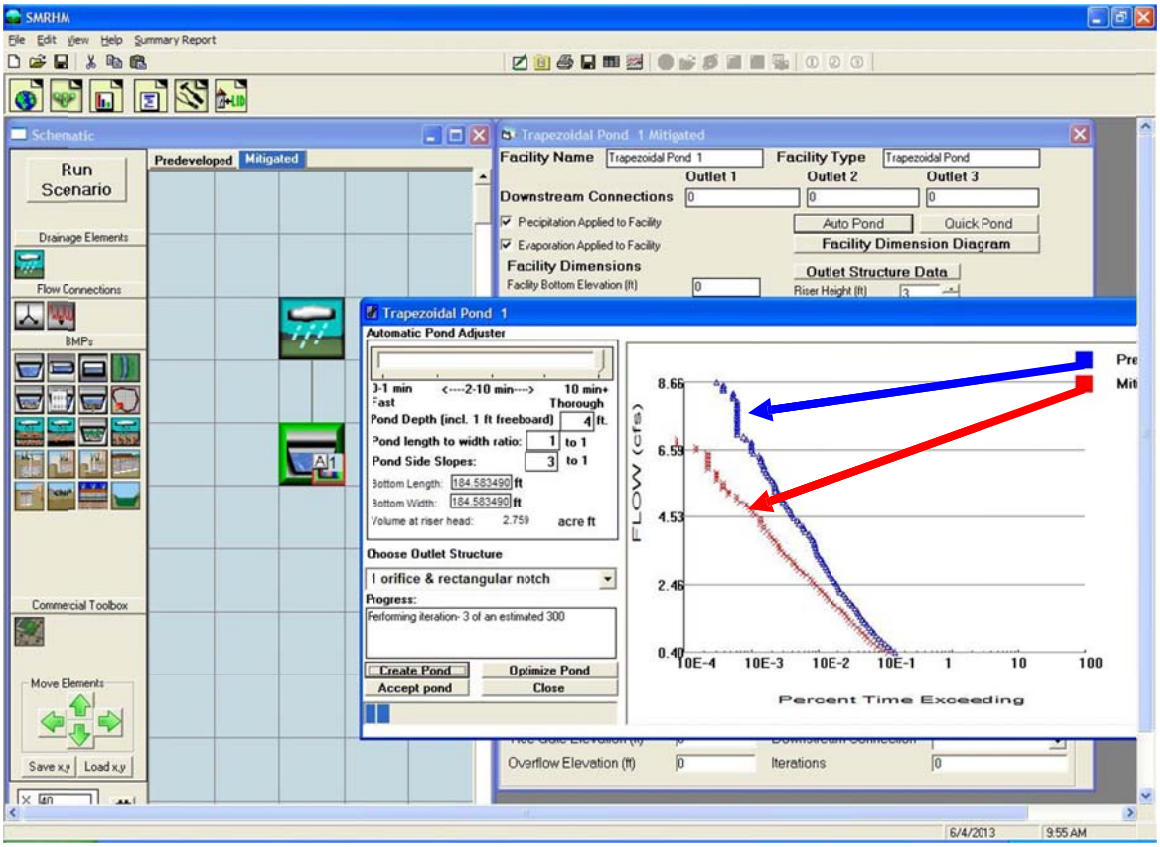
1. the 15-minute Predevelopment scenario runoff is computed for the 30-50 years of record (it varies depending on the rain gauge used),
2. the Predevelopment runoff flood frequency is calculated based on the partial duration peak flows,
3. the range of flows is selected for the flow duration (10% of the 2-year peak to the 10-year peak),
4. this flow range is divided into 100 increments, and
5. the number of 15-minute Predevelopment flow values that exceed each flow increment level (Predevelopment flow duration) are counted to create the flow duration curves and accompanying tabular results.

Next, SMRHM computes the post-development runoff (in the Mitigated scenario) and routes the runoff through the pond. But before the runoff can be routed through the pond the pond must be given dimensions and an outlet configuration. Auto Pond uses a set of rules based on the Predevelopment and Mitigated scenario land uses to give the pond an initial set of dimensions and an initial outlet orifice diameter and riser (the riser is given a default rectangular notch). This information allows SMRHM to compute a stage-storage-discharge table for the pond.

With this initial pond stage-storage-discharge table SMRHM:

1. routes the 15-minute post-project runoff through the pond for the 30-50 years of record to create the Mitigated flow time series,
2. counts the number of 15-minute Mitigated flow values that exceed each flow increment level (this is the Mitigated flow duration), and
3. computes the ratio of Mitigated flow values to Predevelopment flow values for each flow increment level (comparing the Predevelopment and Mitigated flow duration results).

If any of the 100 individual ratio values is greater than allowed by the flow duration criteria then the pond fails to provide an appropriate amount of mitigation and needs to be resized.



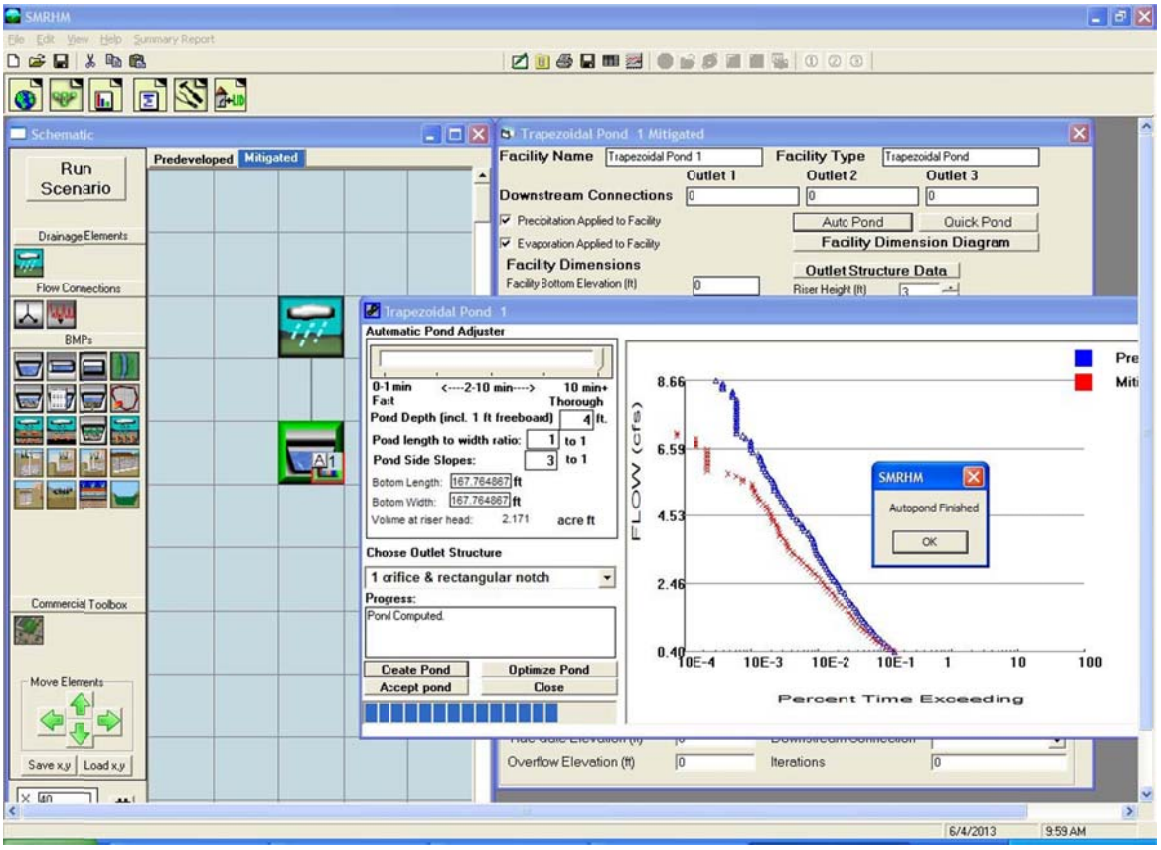
Flow duration results are shown in the plots above. The vertical axis shows the range of flows from 10% of the 2-year flow (0.40 cfs) to the 10-year flow (8.66 cfs). The horizontal axis is the percent of time that flows exceed a flow value. Plotting positions on the horizontal axis typically range from 0.001% to 1%, as explained below.

For the entire 30- to 50-year simulation period (depending on the period of record of the precipitation station used) all of the 15-minute time steps are checked to see if the flow for that time step is greater than the minimum flow duration criteria value (0.40 cfs, in this example). For a 50-year simulation period there are approximately 1,600,000 15- minute values to check. Many of them are zero flows. The 10% of the Predevelopment 2-year flow value is typically exceeded less than 1% of the total simulation period.

This flow duration check is done for both the Predevelopment flows (shown in blue on the screen) and the Mitigated flows (shown in red).

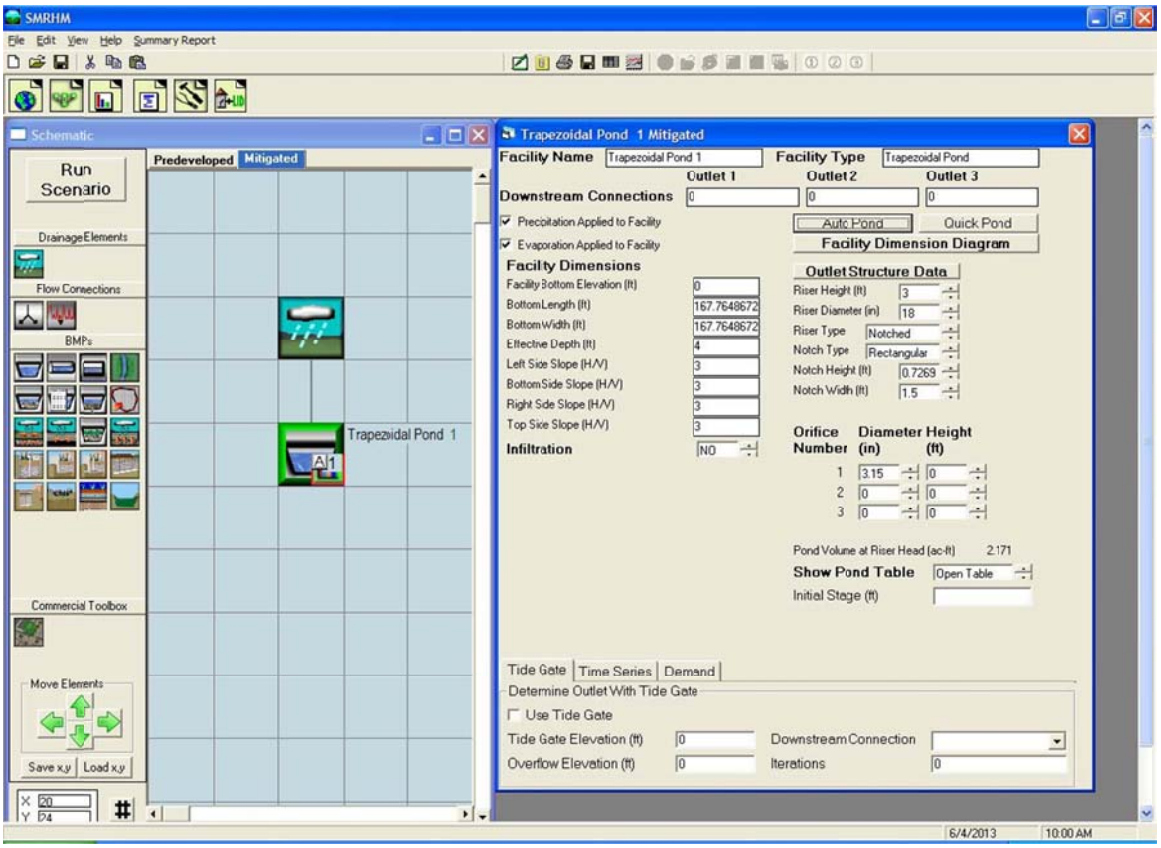
If all of the Mitigated flow duration values (in red) are to the left of the Predevelopment flow duration values (in blue), then the number of occurrences decreases and the pond successfully mitigates the additional erosive flows produced by the development.

If the Mitigated flow duration values (in red) are far to the left of the Predevelopment flow duration values (in blue), then the pond can be made smaller and still meet the flow duration criteria.



Auto Pond goes through an iteration process by which it changes the pond dimensions and outlet configuration, then instructs SMRHM to again compute the resulting Mitigated runoff, compare flow durations, and decide if it has made the results better or worse. This iteration process continues until Auto Pond finally concludes that an optimum solution has been found and the Mitigated flow duration values (in red) are as close as possible to the Predevelopment flow duration values (in blue). When this occurs the ***Auto Pond Finished*** message appears on the screen.

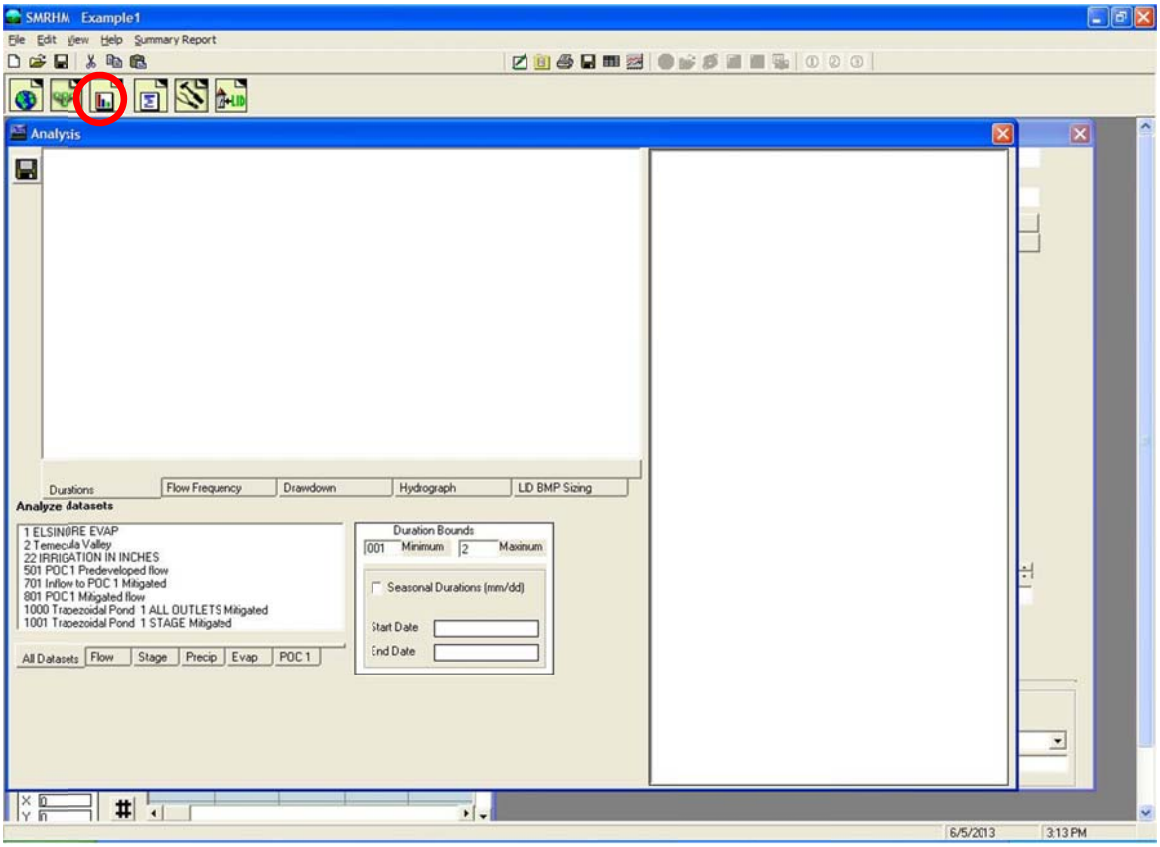
The user has the option to continue to manually optimize the pond by manually changing pond dimensions and/or the outlet structure configuration. (Manual optimization is explained in more detail on page 48.) After making these changes the user should click on the ***Optimize Pond*** button to check the results and see if Auto Pond can make further improvements.



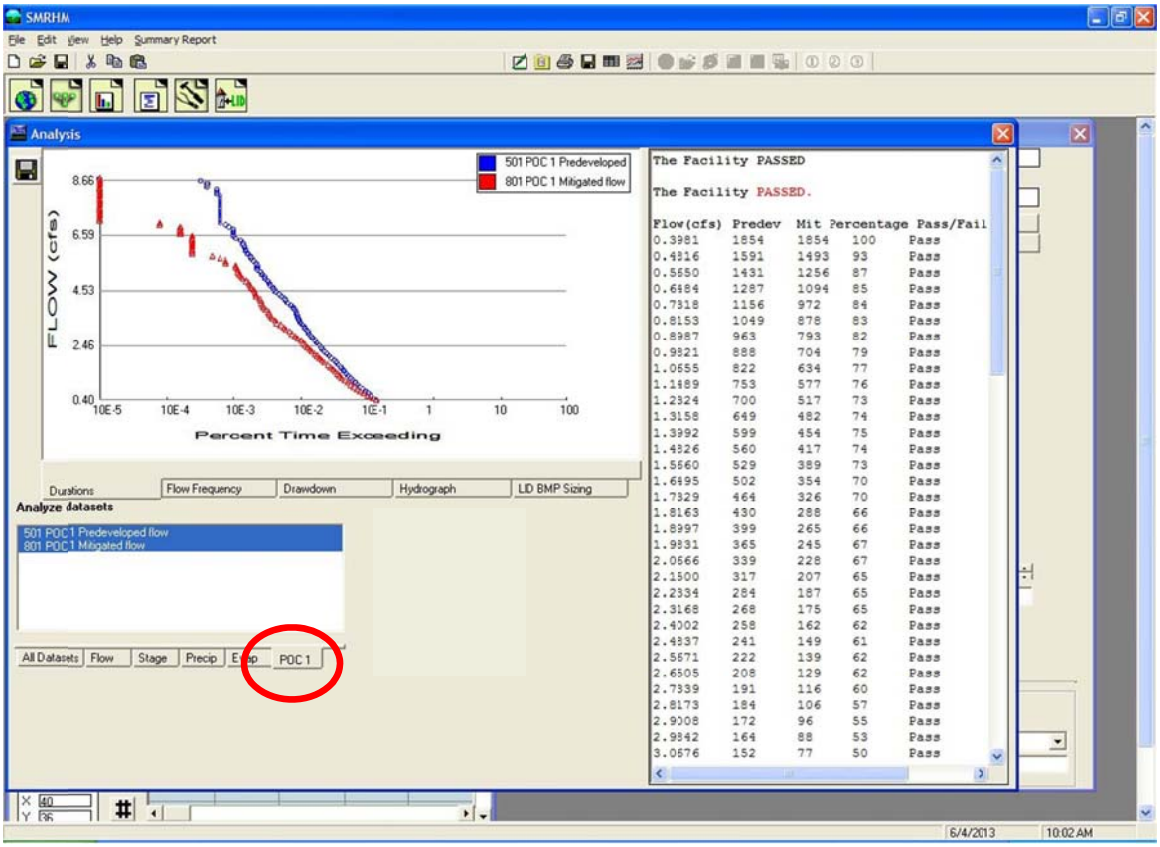
The final pond dimensions (bottom length, bottom width, effective pond depth, and sideslopes) and outlet structure information (riser height, riser diameter, riser weir type, weir notch height and width, and orifice diameter and height) are shown on the trapezoidal pond screen to the right of the Schematic grid.

NOTE: If Auto Pond selects a bottom orifice diameter smaller than the smallest diameter allowed by the local municipal permitting agency then the user has the option of specifying a minimum allowable bottom orifice diameter even if this size diameter is too large to meet flow duration criteria for this element. Additional mitigating BMPs may be required to meet local hydromodification control requirements. Please see Appendix C or consult with the Copermittee with jurisdiction over the project site for more details. For manual sizing information see page 48.

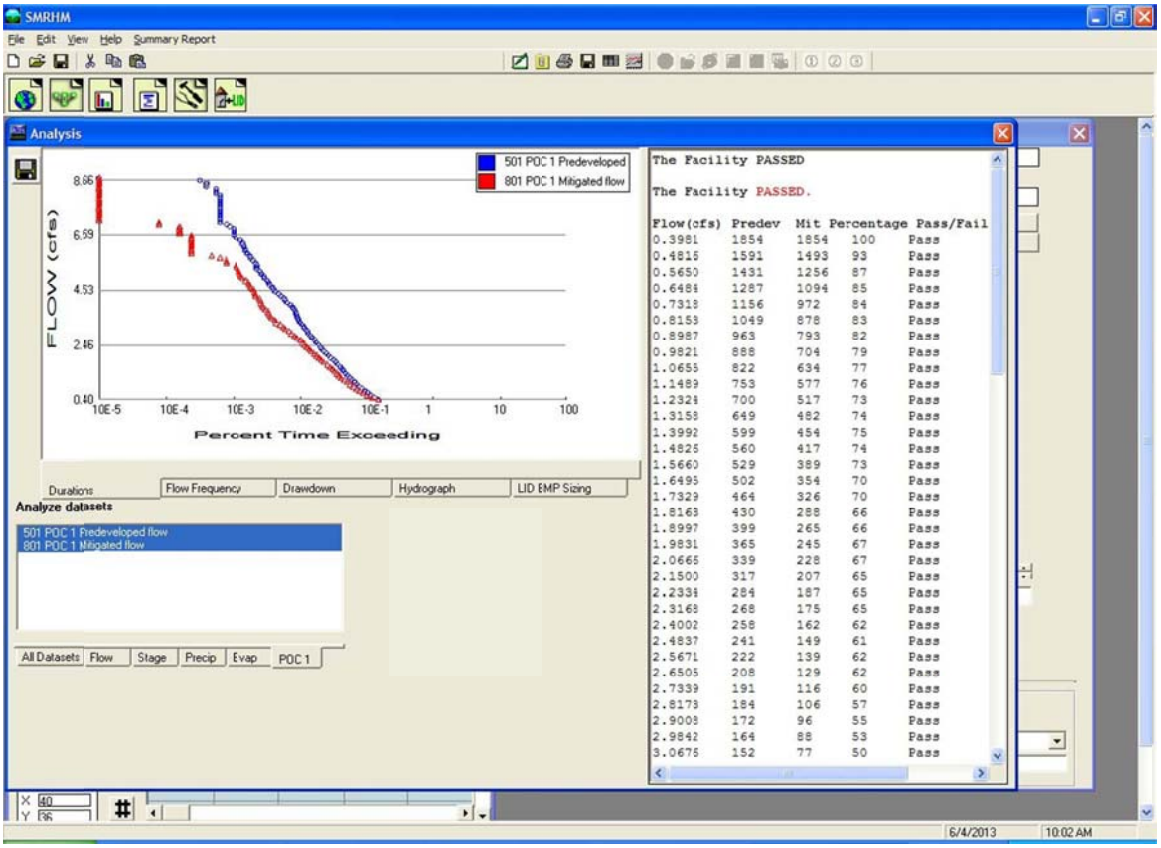
6. Review analysis.



The ***Analysis*** tool bar button (third from the left) brings up the Analysis screen where the user can look at the results. Each time series dataset is listed in the Analyze Datasets box in the lower left corner.

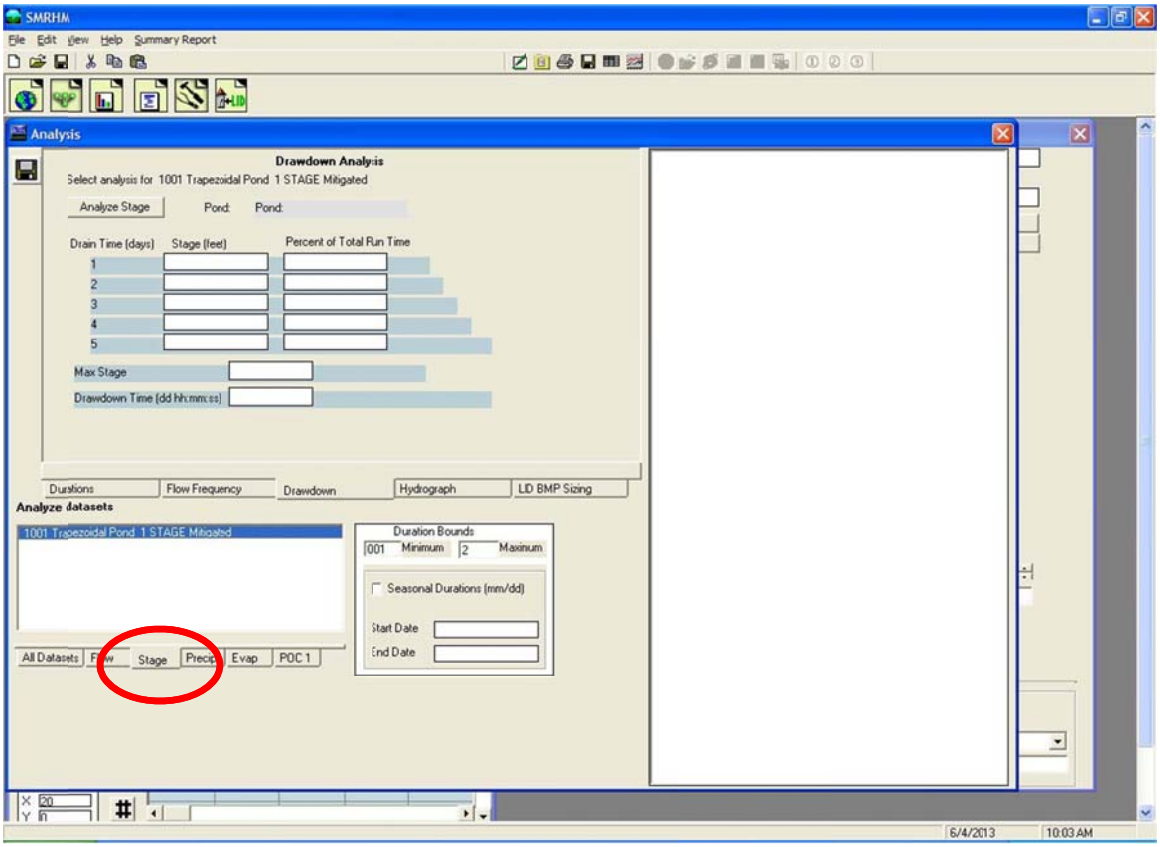


To review the flow duration analysis at the point of compliance select the ***POC 1*** tab at the bottom and make sure that both the 501 POC 1 Predevelopment flow and 801 POC 1 Developed flow are highlighted.



The flow duration plot for both Predevelopment and Mitigated flows will be shown along with the specific flow values and number of times Predevelopment and Mitigated flows exceeded those flow values. The Pass/Fail on the right indicates whether or not at that flow level the flow control standard criteria were met and the pond passes at that flow level (in this example from 10% of the 2-year flow to the 10-year). If not, a Fail is shown.

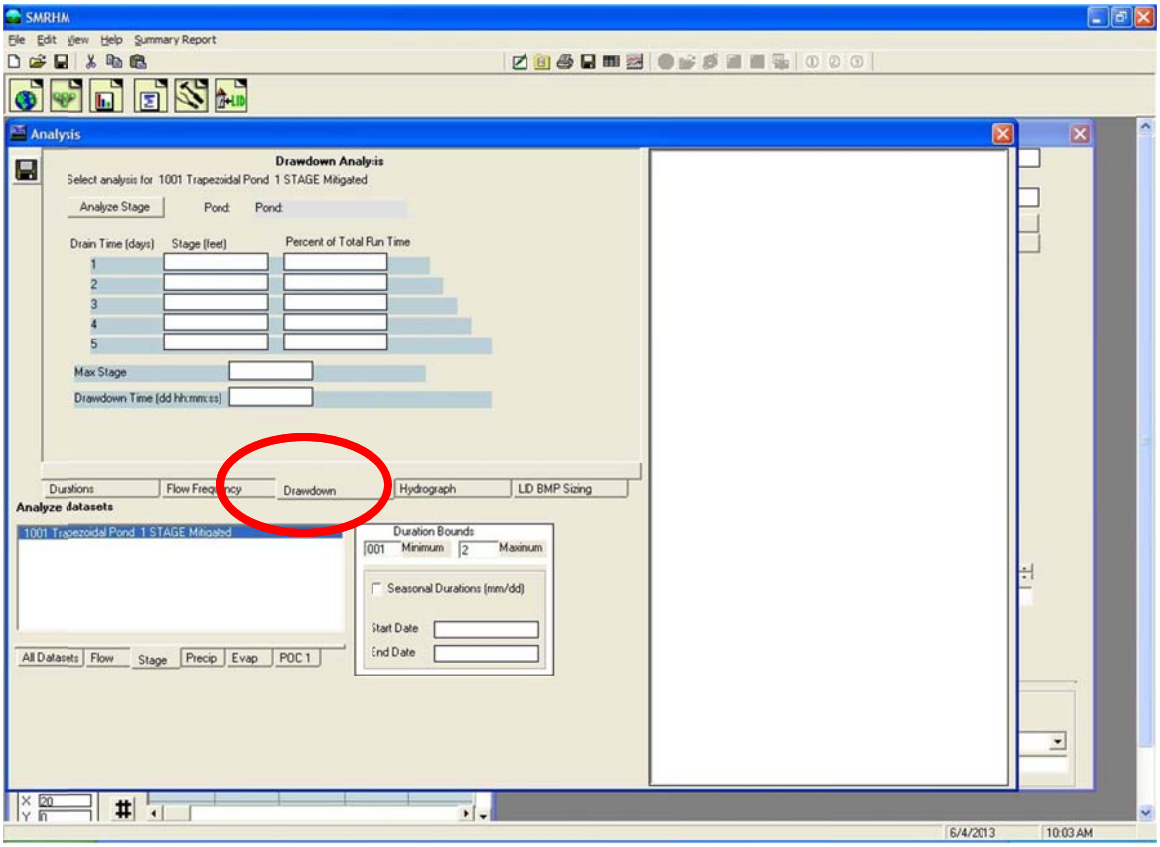
NOTE: A single **Fail** fails the hydromodification pond design criteria.



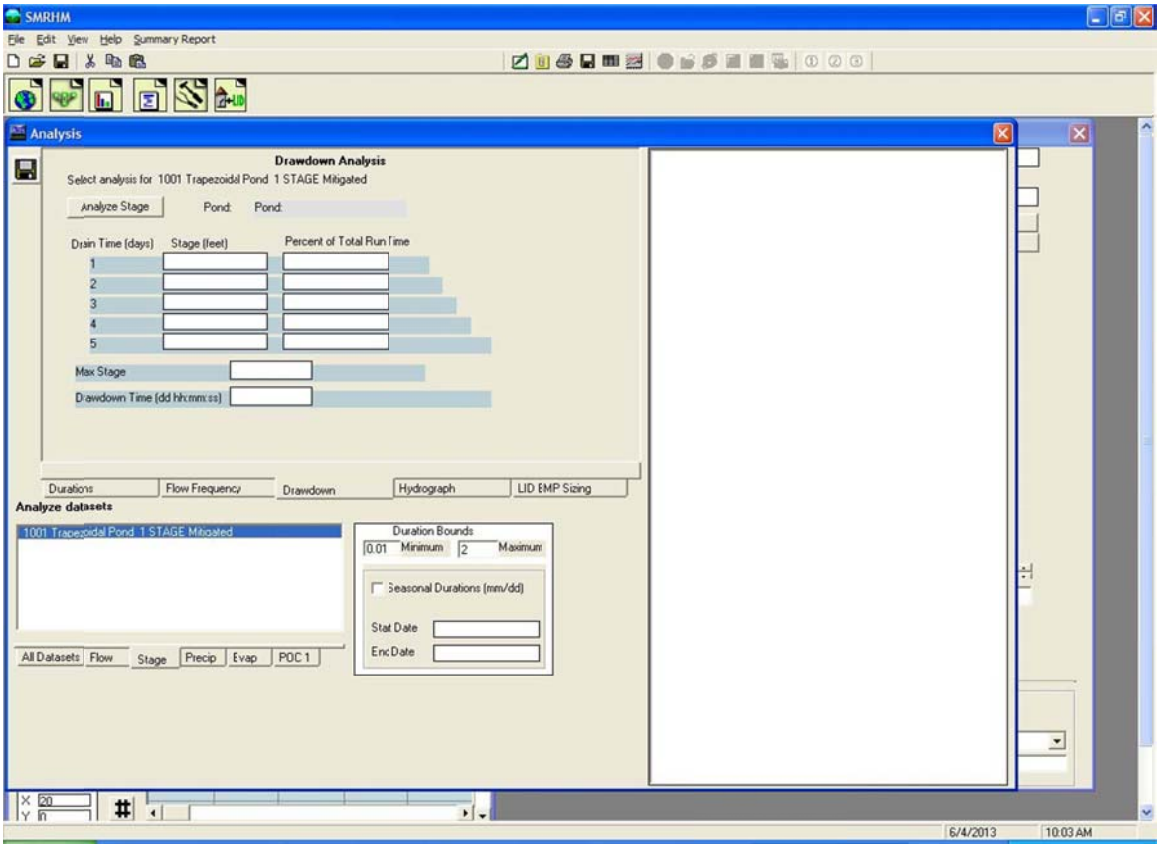
Pond drawdown/retention time is computed on the Analysis screen.

NOTE: This information is not required for basic sizing of the flow duration facility, but can assist the user in determining the overall suitability of the mitigated design in meeting additional, related requirements for treating stormwater runoff and minimizing risk of vector (mosquito) breeding problems. See page 98 for more descriptions of this SMRHM feature, and Appendix C for discussion and references for these requirements.

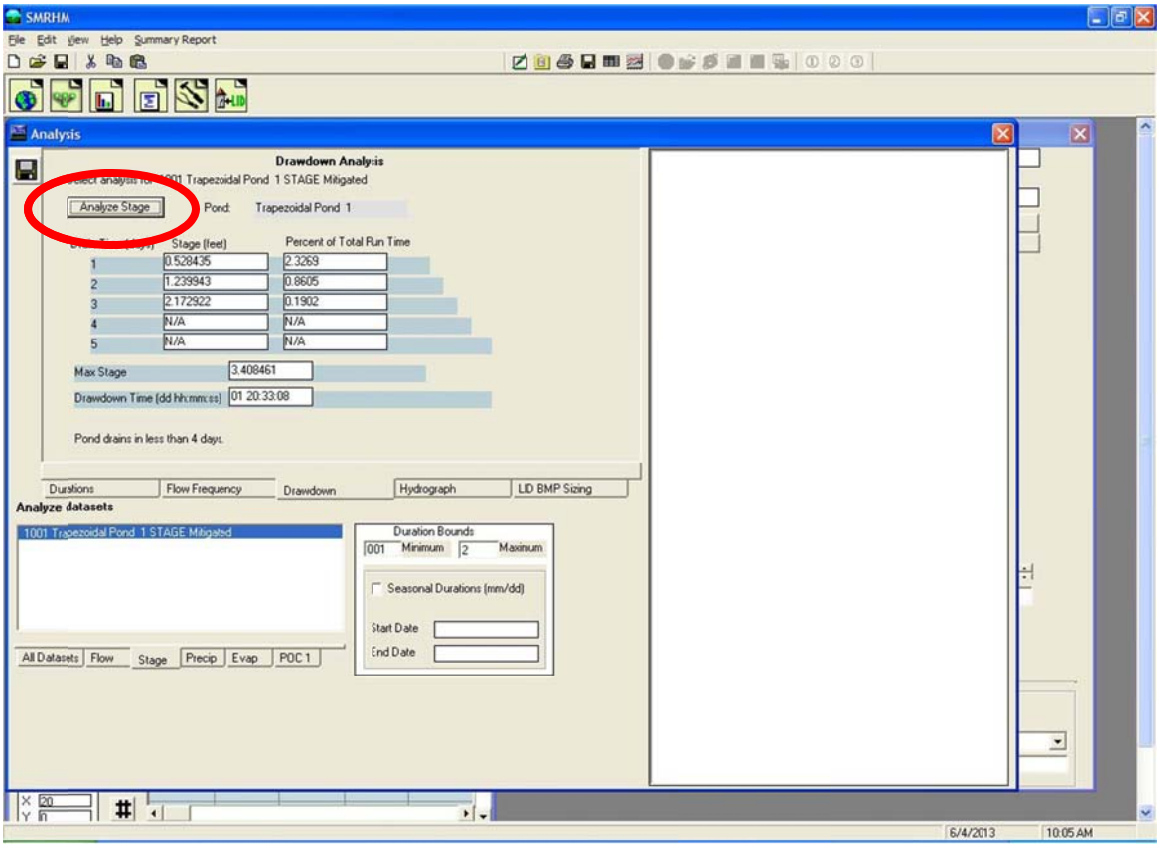
Click on the ***Stage*** tab at the bottom to get the Mitigated pond stage time series.



Click on the tab labeled ***Drawdown***. This is where the pond drawdown/retention time results will be shown.



Select the pond you want to analyze for drawdown/retention time (in this example there is only one pond: Trapezoidal Pond 1) by clicking on the dataset and highlighting it.



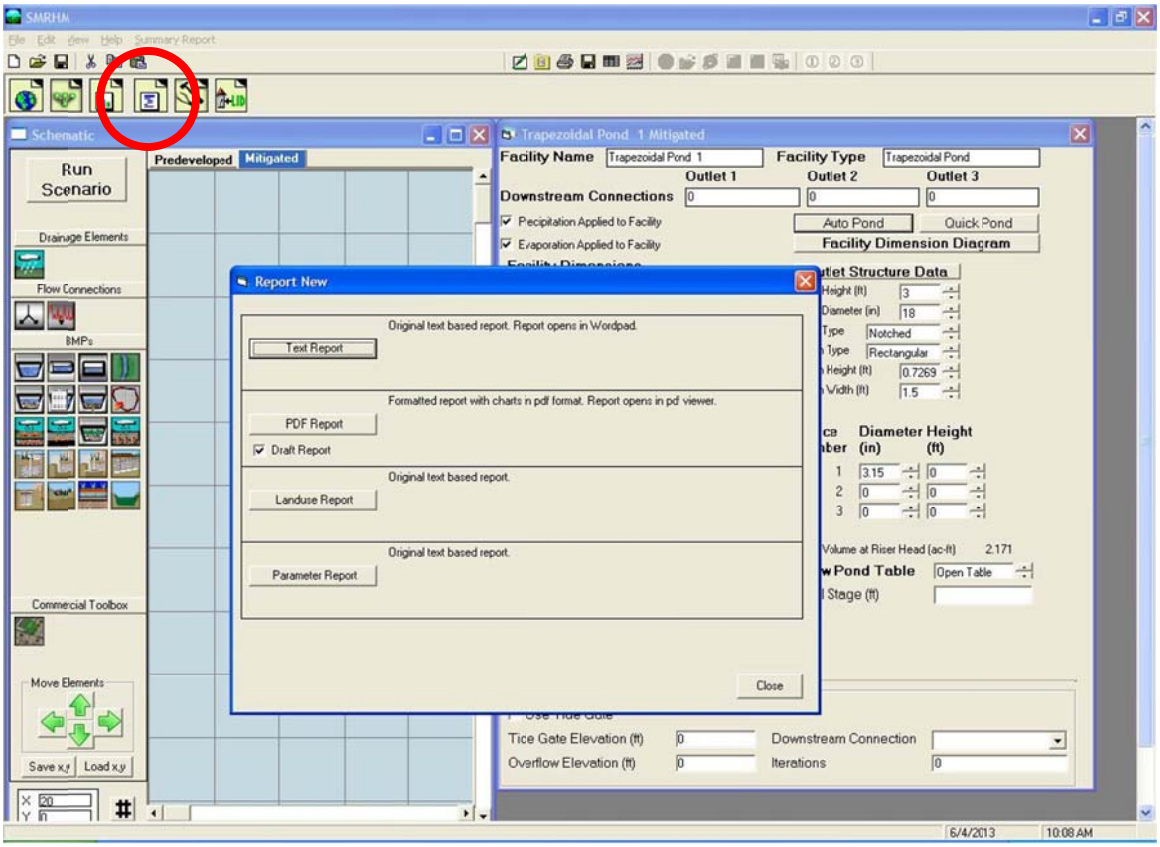
Click on the ***Analyze Stage*** button and the computed pond stages (pond water depths) are summarized and reported in terms of drain/retention time (in days).

For this example, the maximum stage computed during the entire 30-50 year simulation period is 3.40 feet. This maximum stage has a drawdown time of 1 day, 20 hours, 33 minutes, and 8 seconds.

Ponds may have drain times in excess of the allowed maximum of hours. This can occur when a pond has a small bottom orifice. If this is not acceptable then the user needs to change the pond outlet configuration, manually run the Mitigated scenario, and repeat the analyze stage computations. A situation may occur where it is not possible to have both an acceptable pond drawdown/retention time and meet the flow duration criteria.

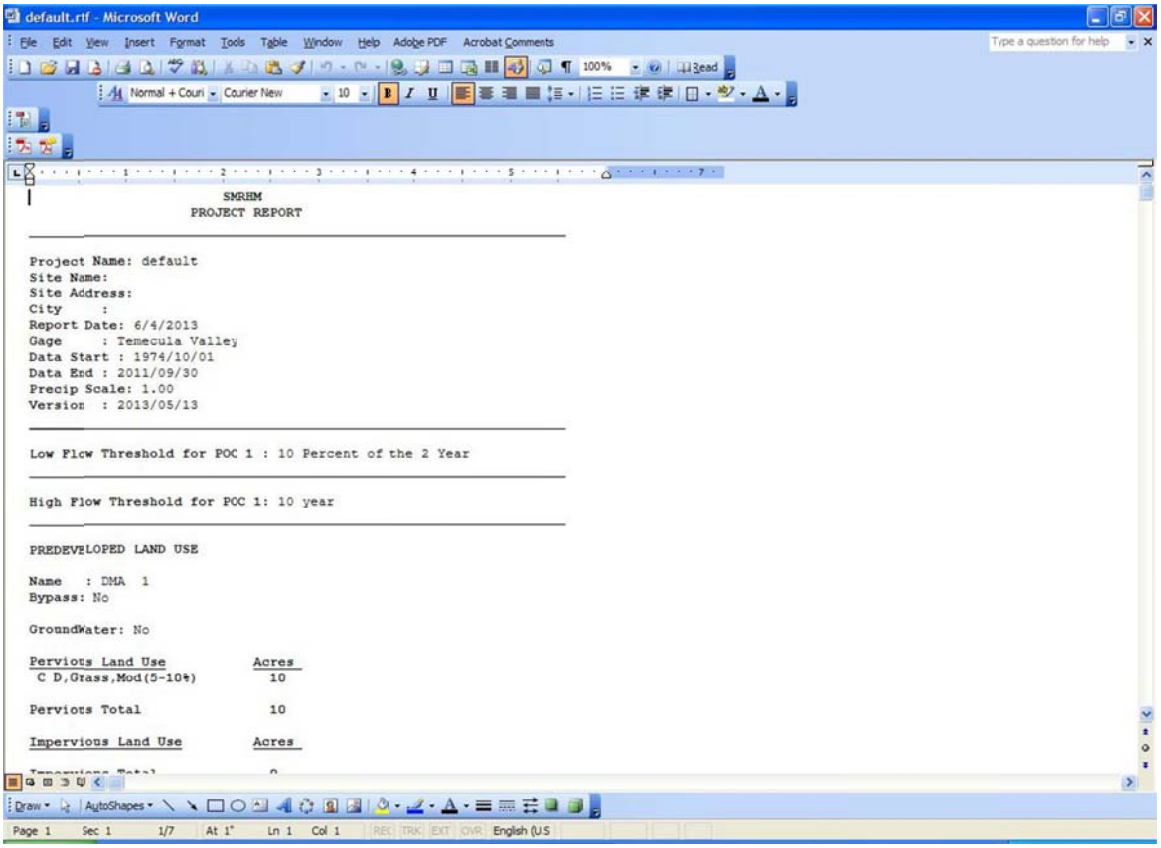
NOTE: See Appendix C or the local municipal permitting agency for an overview of other requirements that may apply regarding drawdown time, and suggestions for addressing situations where it is not possible to meet all drawdown/retention time guidelines and also meet the flow duration criteria. The guidance documentation assumes that the flow duration criteria take precedence unless the user is instructed otherwise by the local municipal permitting agency.

7. Produce report.



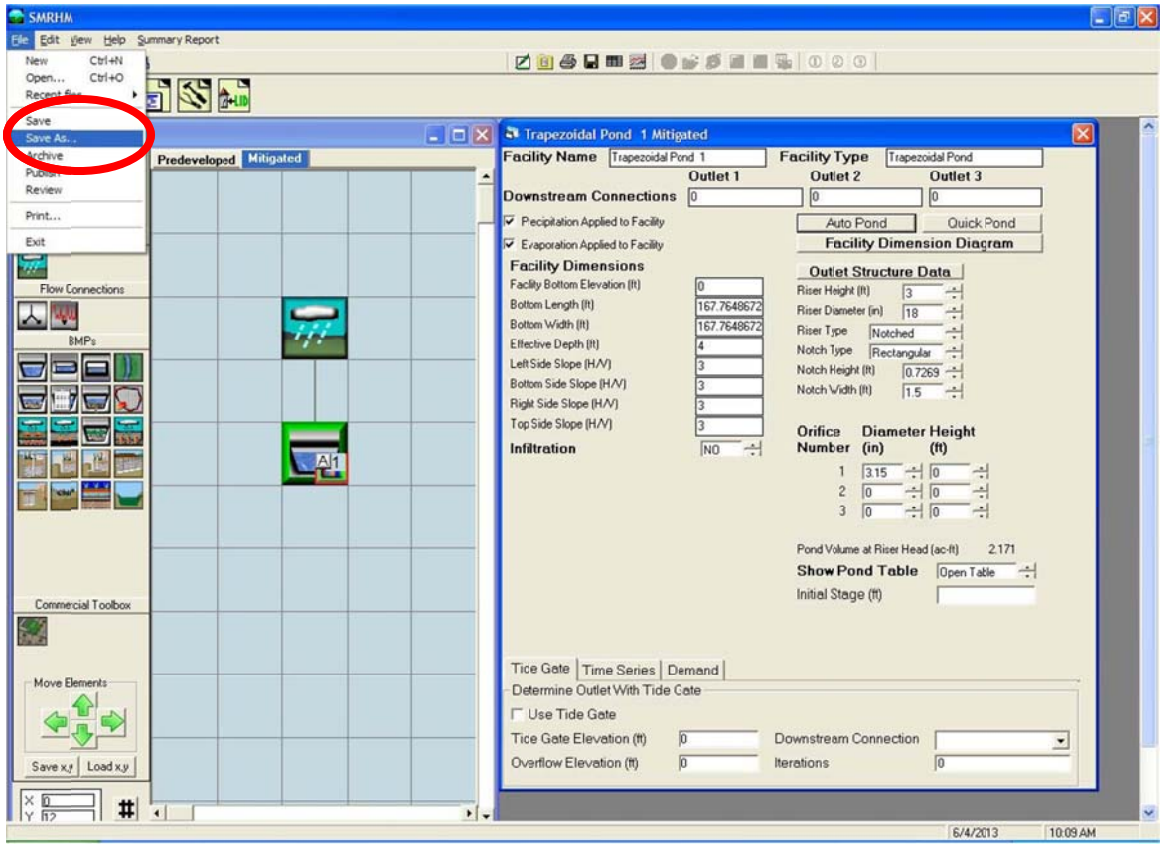
Click on the ***Reports*** tool bar button (fourth from the left) to generate a project report with all of the project information and results.

The project report can be generated as either a Microsoft Word file or a PDF file.

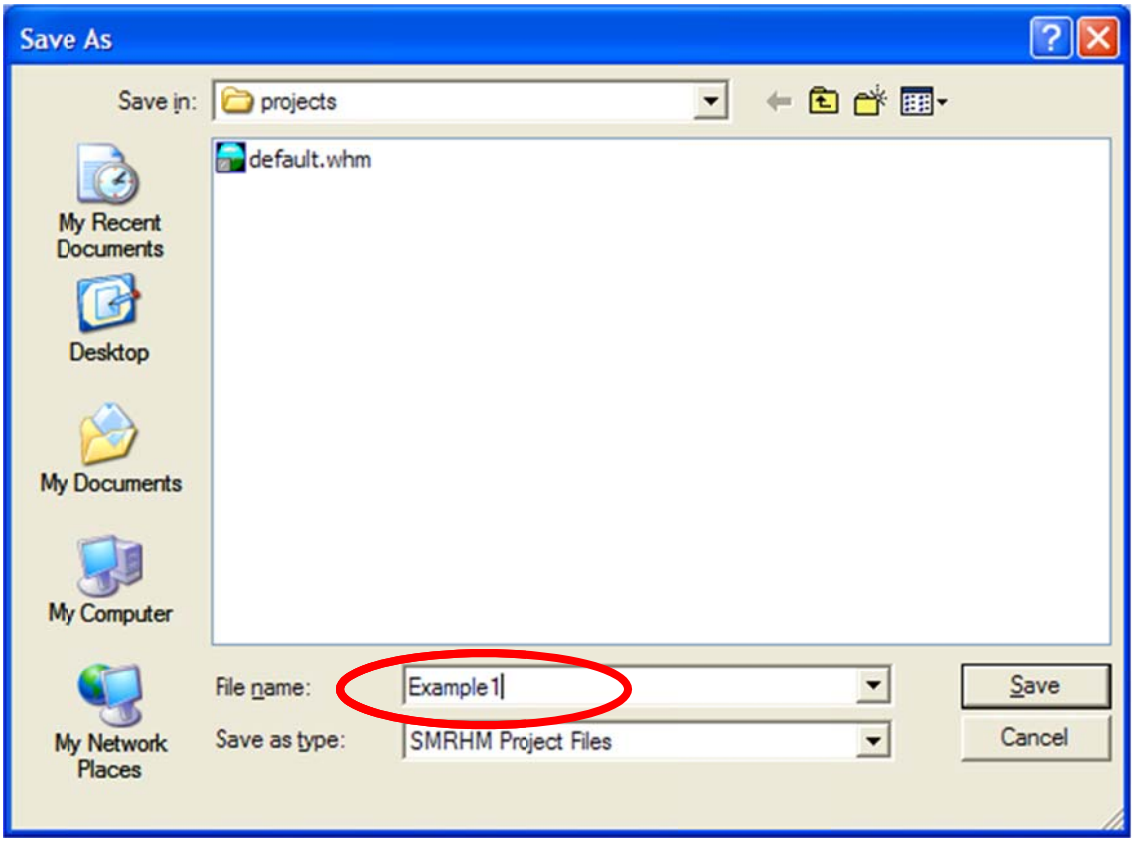


Scroll down the Report screen to see all of the results.

8. Save project.

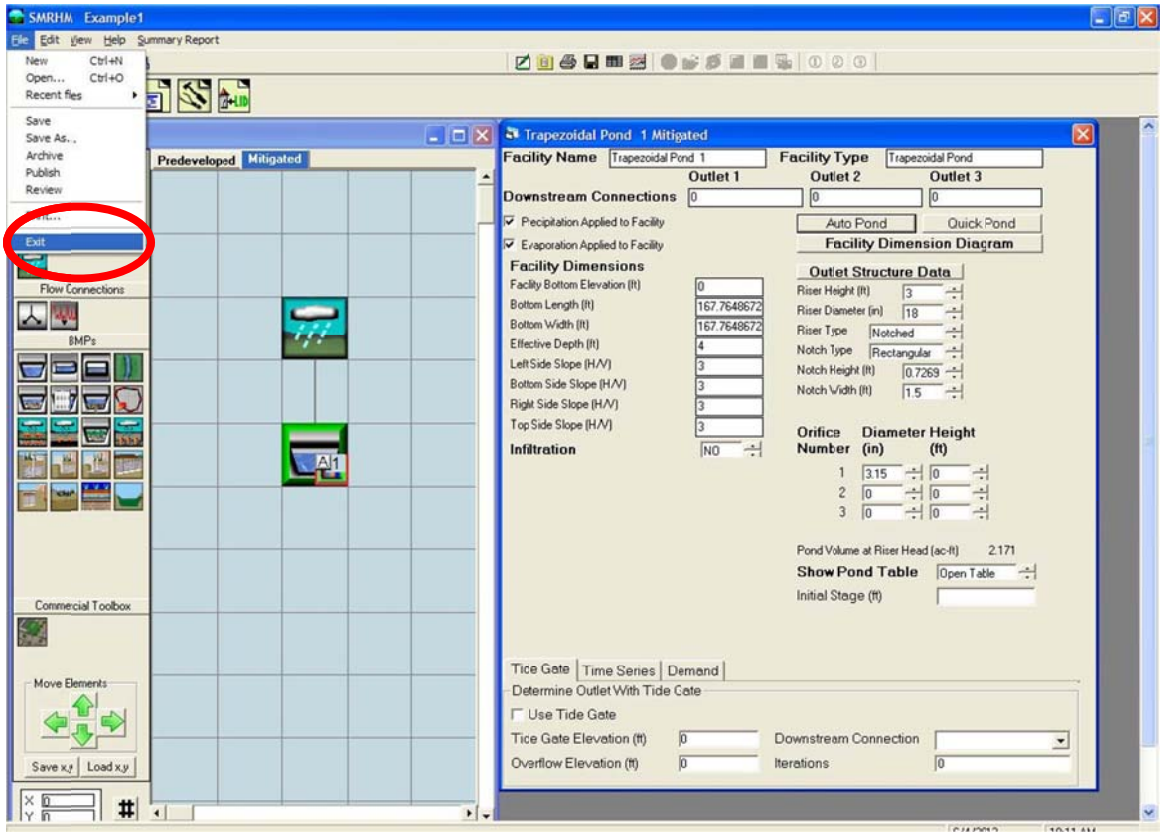


To save the project click on ***File*** in the upper left corner and select ***Save As***.



Select a file name and save the SMRHM project file. The user can exit SMRHM and later reload the project file with all of its information by going to ***File, Open***.

9. Exit SMRHM.



To exit SMRHM click on ***File*** in the upper left corner and select ***Exit***. Or click on the ***X*** in the red box in the upper right hand corner of the screen.

MAIN SCREENS

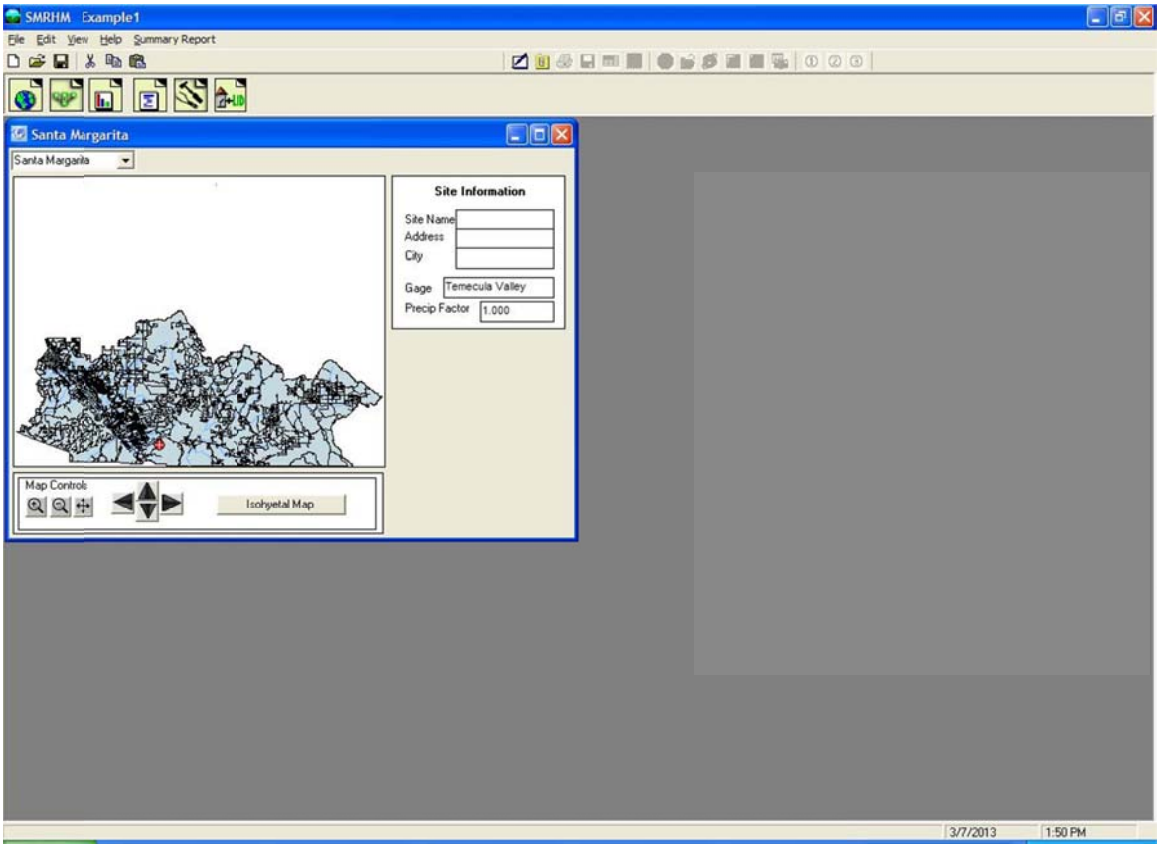
SMRHM has six main screens. These main screens can be accessed through the buttons shown on the tool bar above or via the View menu.

The six main screens are:

- Map Information
- General Project Information
- Analysis
- Reports
- Tools
- LID (Low Impact Development) Analysis

Each is discussed in more detail in the following sections.

MAP INFORMATION SCREEN

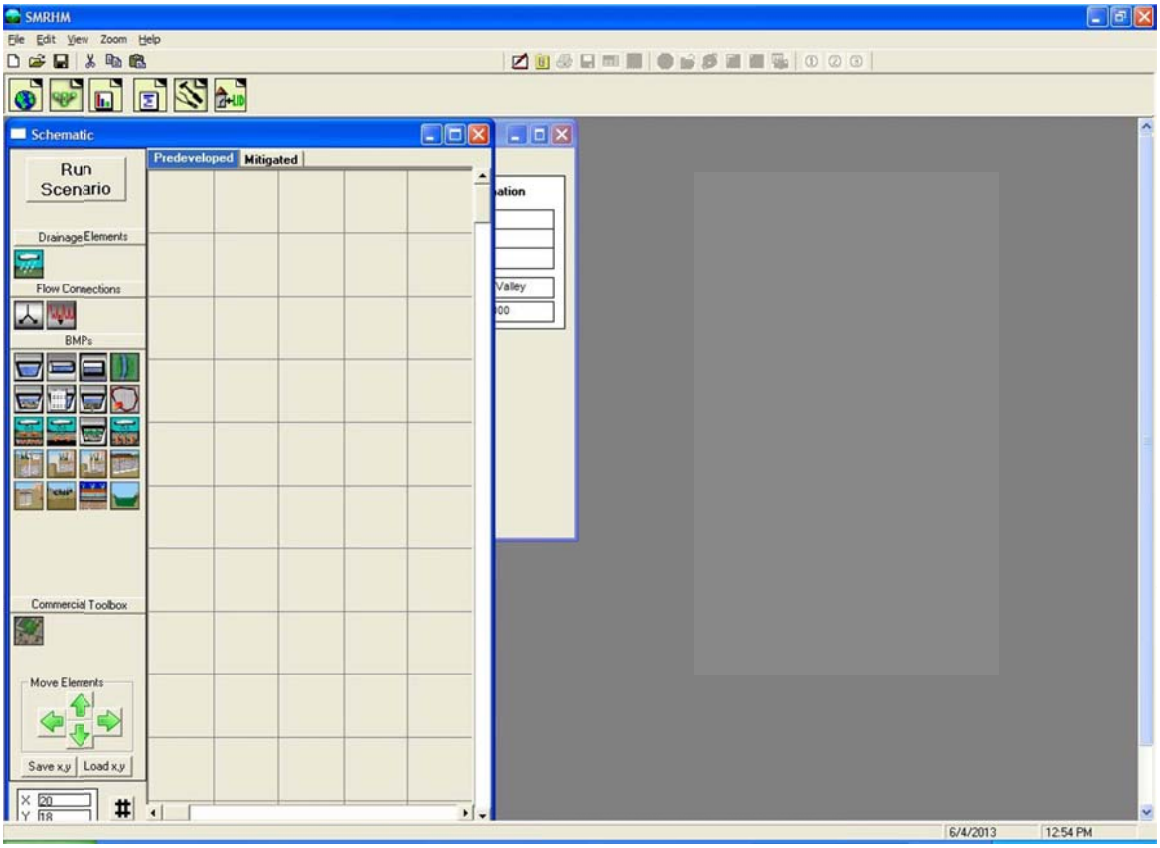


The Map screen contains county information. The precipitation gauge and precipitation factor are shown to the right of the map. They are based on the project site location.

The user can provide site information (optional). The site name and address will help to identify the project on the Report screen and in the printed report provided to the local municipal permitting agency.

The user locates the project site on the map screen by using the mouse and left clicking at the project site location. Right clicking on the map re-centers the view. The + and – buttons zoom in and out, respectively. The cross hair button zooms out to the full county view. The arrow keys scroll the map view.

GENERAL PROJECT INFORMATION SCREEN



The Project screen contains all of the information about the project site for the two land use scenarios: Predevelopment land use conditions and Mitigated (developed) land use conditions. To change from one scenario to another click on the tab containing the appropriate scenario name at the top of the grid.

Predevelopment is defined as the native land cover conditions prior to any land use development. Runoff from the Predevelopment scenario is used as the target for the Mitigated scenario compliance. The model will accept any land use for this scenario.

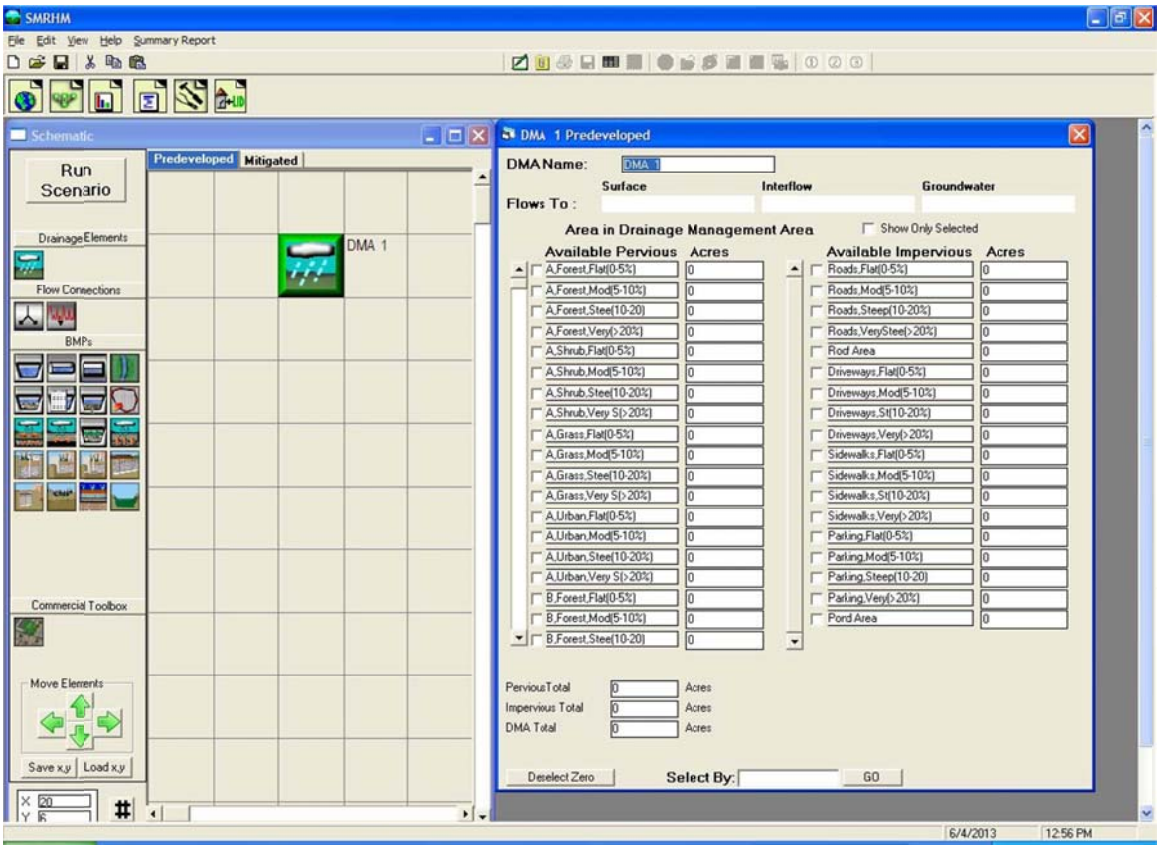
Mitigated is defined as the developed land use with mitigation measures (as selected by the user). Mitigated is used for sizing hydrologic control and water quality facilities. The runoff from the Mitigated scenario is compared with the Predevelopment scenario runoff to determine compliance with flow duration criteria.

The ***Run Scenario*** button executes the runoff calculations for the scenario shown on the screen.

Note: Any changes made by the user to the element dimensions and other input are not analyzed by SMRHM until the *Run Scenario* button is clicked.

Below the ***Run Scenario*** button are the Elements. Each element represents a specific stormwater-related feature (drainage elements, flow connections, BMPs, etc.) and is described in more detail in the following section.

SCHEMATIC EDITOR



The Project screen also contains the Schematic Editor. The Schematic Editor is the grid to the right of the elements. This grid is where each element is placed and linked together. The grid, using the scroll bars on the left and bottom, expands as large as needed to contain all of the elements for the project. A maximum of 500 elements is allowed.

NOTE: All movement of water on the grid must be from the top of the grid down.

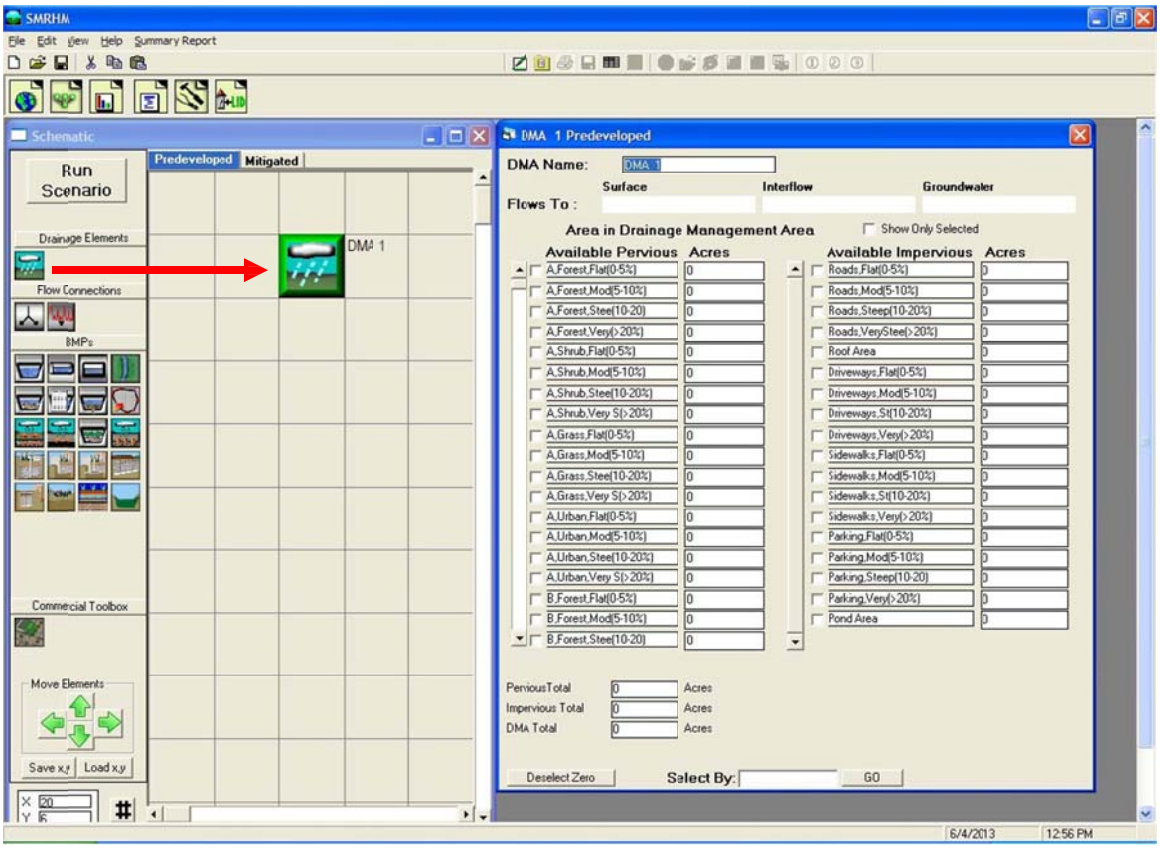
The space to the right of the grid will contain the appropriate element information.

To select and place an element on the grid, first left click on the specific element in the Elements menu and then drag the element to the selected grid square. The selected element will appear in the grid square.

The entire grid can be moved up, down, left, or right using the Move Elements arrow buttons.

The grid coordinates from one project can be saved **(**Save x, y) and used for new projects (Load x, y).

LAND USE BASIN ELEMENT



The Land use Basin element represents a DMA that can have any combination of soils, land cover, and land slopes. A DMA produces three types of runoff: (1) surface runoff, (2) interflow, and (3) groundwater.

Surface runoff is defined as the overland flow that quickly reaches a MS4 facility or receiving water. Surface runoff mainly comes from impervious surfaces.

Interflow is shallow, subsurface flow produced by pervious land categories and varies based on soil characteristics and how these characteristics are altered by land development practices.

Groundwater is the subsurface flow that typically does not enter a MS4 facility, but provides base flow directly to a channel.

The user can specify where each of these three sources of flow should be directed. The default setting is for the surface runoff and interflow to go to the MS4 facility; groundwater should not be connected unless there is observed base flow occurring in MS4 facilities in the DMA.

Table 1 shows the different pervious land types represented in the Land use Basin element.

Table 1. SMRHM Pervious Land Types

PERLND No.	Soil Type	Land Cover	Land Slope
1	A	Forest	Flat (0-5%)
2	A	Forest	Moderate (5-10%)
3	A	Forest	Steep (10-20%)
4	A	Forest	Very Steep (>20%)
5	A	Shrub	Flat (0-5%)
6	A	Shrub	Moderate (5-10%)
7	A	Shrub	Steep (10-20%)
8	A	Shrub	Very Steep (>20%)
9	A	Grass	Flat (0-5%)
10	A	Grass	Moderate (5-10%)
11	A	Grass	Steep (10-20%)
12	A	Grass	Very Steep (>20%)
13	A	Urban	Flat (0-5%)
14	A	Urban	Moderate (5-10%)
15	A	Urban	Steep (10-20%)
16	A	Urban	Very Steep (>20%)
17	B	Forest	Flat (0-5%)
18	B	Forest	Moderate (5-10%)
19	B	Forest	Steep (10-20%)
20	B	Forest	Very Steep (>20%)
21	B	Shrub	Flat (0-5%)
22	B	Shrub	Moderate (5-10%)
23	B	Shrub	Steep (10-20%)
24	B	Shrub	Very Steep (>20%)
25	B	Grass	Flat (0-5%)
26	B	Grass	Moderate (5-10%)
27	B	Grass	Steep (10-20%)
28	B	Grass	Very Steep (>20%)
29	B	Urban	Flat (0-5%)
30	B	Urban	Moderate (5-10%)
31	B	Urban	Steep (10-20%)
32	B	Urban	Very Steep (>20%)
33	C/D	Forest	Flat (0-5%)
34	C/D	Forest	Moderate (5-10%)
35	C/D	Forest	Steep (10-20%)
36	C/D	Forest	Very Steep (>20%)
37	C/D	Shrub	Flat (0-5%)
38	C/D	Shrub	Moderate (5-10%)
39	C/D	Shrub	Steep (10-20%)
40	C/D	Shrub	Very Steep (>20%)
41	C/D	Grass	Flat (0-5%)
42	C/D	Grass	Moderate (5-10%)
43	C/D	Grass	Steep (10-20%)

44	C/D	Grass	Very Steep (>20%)
45	C/D	Urban	Flat (0-5%)
46	C/D	Urban	Moderate (5-10%)
47	C/D	Urban	Steep (10-20%)
48	C/D	Urban	Very Steep (>20%)

The user does not need to know or keep track of the HSPF PERLND number. That number is used only for internal tracking purposes.

The user inputs the number of acres of appropriate basin land use information. Pervious land use information is in the form of soil, land cover, and land slope. For example, "A, Grass, Flat" means NRCS soil type A, natural grass vegetative cover, and flat (0-5%) land slope.

There are four basic soil types: A (well infiltrating soils), B (moderate infiltrating soils), C (poor infiltrating soils), and D (really poor infiltrating soils).

There are four basic land cover categories: forest, shrub, grass and urban landscaped vegetation.

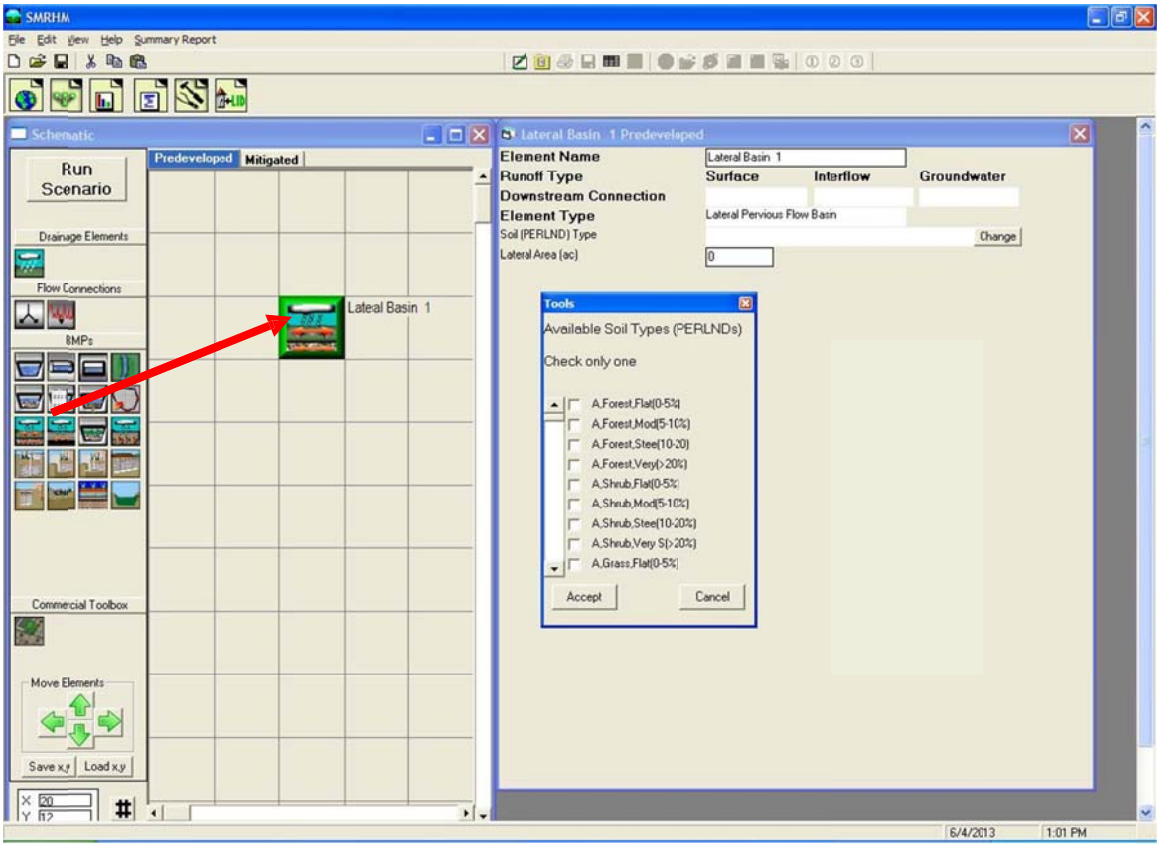
Native land cover is assumed to be grass and refers to the natural (non-planted) vegetation. In contrast, the developed landscape will consist of urban vegetation (lawns, flowers, planted shrubs and trees). Urban vegetation is irrigated in SMRHM.

Land slope is divided into flat (0-5%), moderate (5-10%), steep (10-20%), and very steep (>20%) land slopes.

HSPF parameter values in SMRHM have been adjusted for the different soil, land cover, and land slope categories. SMRHM HSPF soil parameter values take into account the hydrologic effects of land development activities that result from soil compaction when "Urban" is specified.

The impervious land use category includes roads, roofs, sidewalks, parking, driveways, and any other impervious surfaces. All are modeled in the same manner: the surface runoff produced from an impervious land surface only varies by land slope (steeper slopes produce more surface runoff than flatter slopes).

LATERAL BASIN ELEMENT (Pervious)



Surface runoff dispersion from impervious surfaces onto adjacent pervious land can be modeled using pervious and impervious lateral basins. For example, surface runoff from an impervious parking lot can sheet flow onto an adjacent lawn prior to draining into a MS4 facility. This action slows the surface runoff and allows for some limited infiltration into the pervious lawn soil prior to discharging into a MS4 facility.

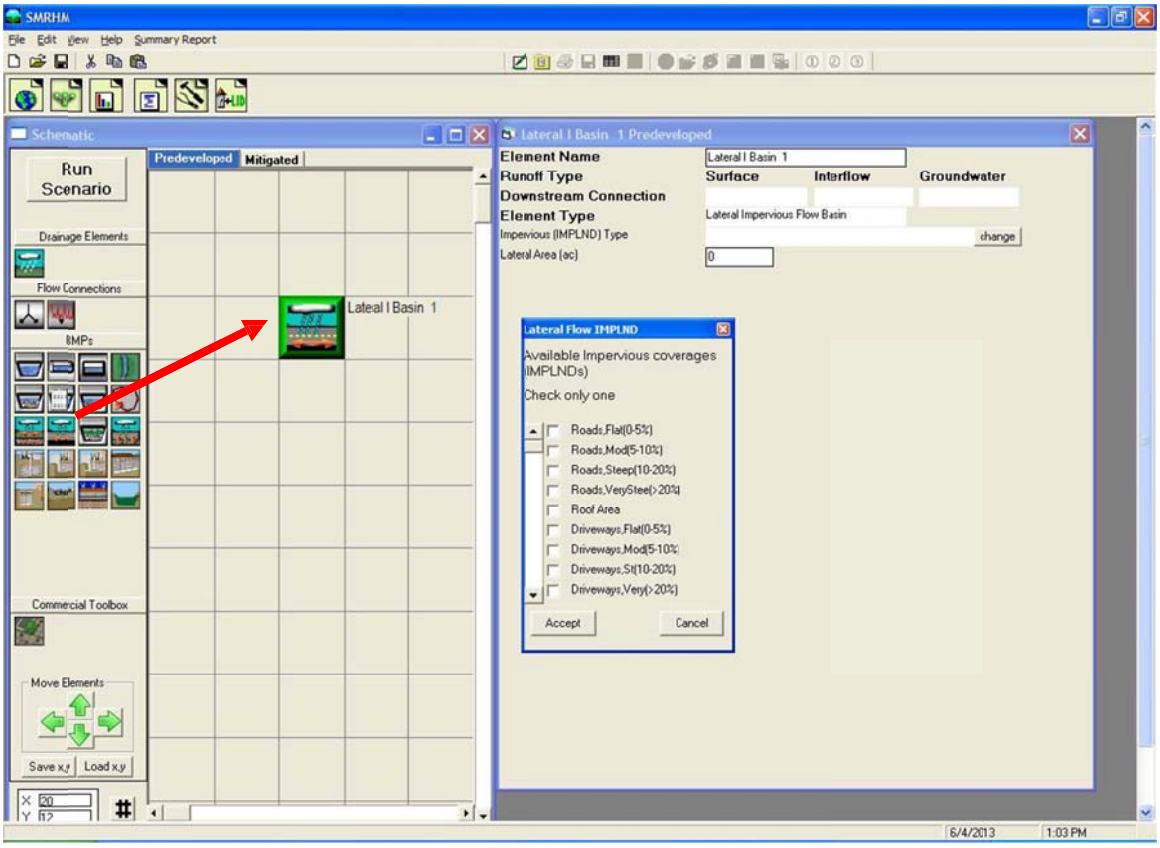
The pervious lateral basin is similar to the standard land use basin except that the surface runoff from the lateral basin goes to another adjacent lateral basin (impervious or pervious) rather than directly to a MS4 facility or receiving water. By definition, the pervious lateral basin contains only a single pervious land type. Impervious area is handled separately with the impervious lateral basin (Lateral I Basin).

The user selects the pervious lateral basin land type by checking the appropriate box on the ***Available Soil Types (PERLNDs)*** screen. This information is automatically placed in the ***Soil Types (PERLNDs)*** box above. Once entered, the land type can be changed by clicking on the ***Change*** button on the right.

The user enters the number of acres represented by the lateral basin land type.

If the lateral basin contains two or more pervious land use types then the user should create a separate lateral basin for each.

LATERAL I BASIN ELEMENT (Impervious)

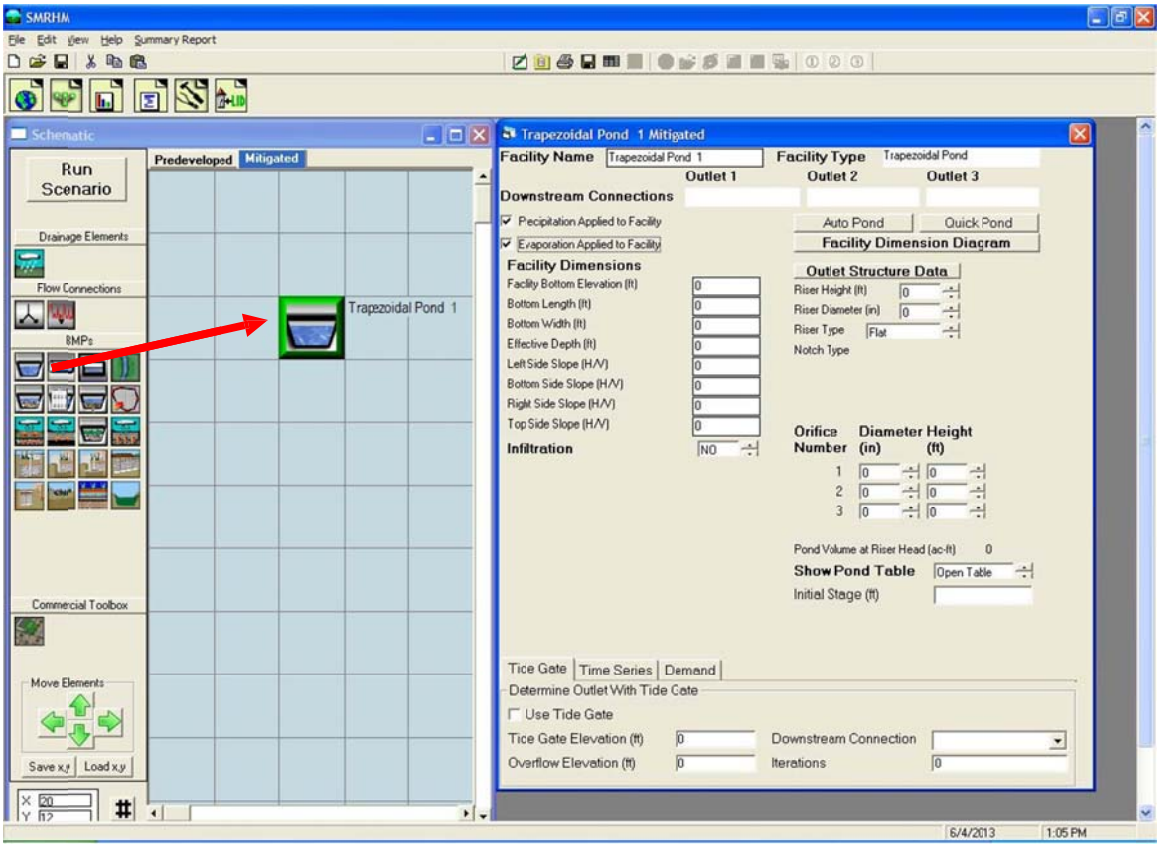


The impervious lateral basin is similar to the standard land use basin except that the surface runoff from the lateral impervious basin goes to another adjacent lateral basin (impervious or pervious) rather than directly to a MS4 facility or receiving water. By definition, the impervious lateral basin contains only impervious land types. Pervious area is handled separately with the pervious lateral basin (Lateral Basin).

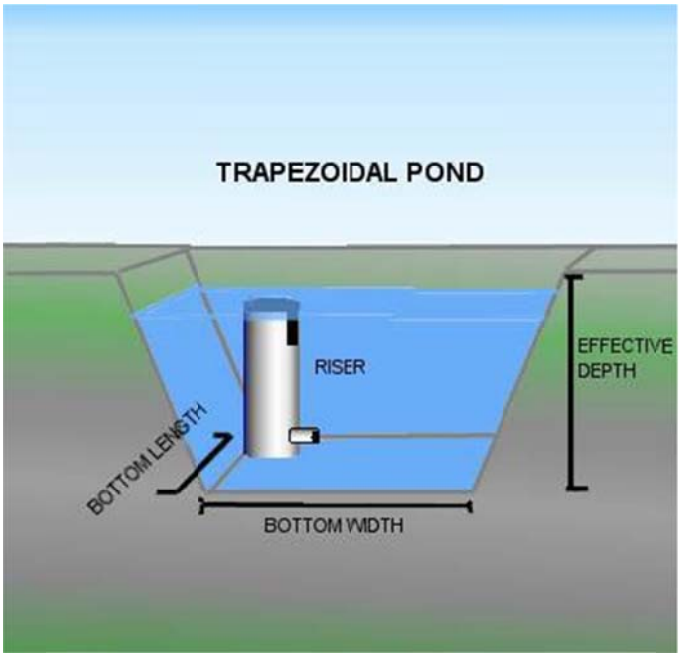
The user selects the impervious lateral basin land type by checking the appropriate box on the ***Available Impervious Coverage's (IMPLNDs)*** screen. This information is automatically placed in the ***Impervious Type (IMPLND)*** box above. Once entered, the land use type can be changed by clicking on the Change button on the right.

The user enters the number of acres represented by the lateral impervious basin land type. To model parking lot surface runoff dispersion onto adjacent lawn connect the Lateral I Basin (the parking lot) to the downstream Lateral Basin (the lawn). In the model's calculations surface runoff from the parking lot is added to the surface of the lawn (urban vegetation). The total surface runoff will then be directed to MS4 facility or receiving water selected by the user.

TRAPEZOIDAL POND ELEMENT



In SMRHM there is an individual pond (detention basin) element for each type of pond and hydrologic control facility. The pond element shown above is for a trapezoidal pond. This is the most common type of hydrologic control facility.



A trapezoidal pond has dimensions (bottom length and width, depth, and sideslopes) and an outlet structure consisting of a riser and one or more orifices to control the release of runoff from the pond. A trapezoidal pond includes the option to infiltrate surface runoff, if the soils are appropriate and there is sufficient depth to the underlying groundwater table.

The user has the option to specify that different outlets be directed to different downstream destinations, although usually all of the outlets go to a single downstream location.

Auto Pond will automatically size a trapezoidal pond to meet the required flow duration criteria.

NOTE: Auto Pond is available only in the Mitigated scenario.

Quick Pond can be used to instantly add pond dimensions and an outlet configuration without checking the pond for compliancy with flow duration criteria. Quick Pond is sometimes used to quickly create a scenario and check the model linkages prior to sizing the pond. Multiple clicks on the ***Quick Pond*** button incrementally increase the pond size.

The user can change the default name "Trapezoidal Pond 1" to another more appropriate name, if desired.

Precipitation and evaporation must be applied to the pond unless the pond is covered. The pond bottom elevation can be set to an elevation other than zero if the user wants to use actual elevations. All pond stage values are relative to the bottom elevation. Negative bottom elevations are not allowed.

The pond effective depth is the pond height (including freeboard) above the pond bottom. It is not the actual elevation of the top of the pond.

Pond sideslopes are in terms of horizontal distance over vertical. A standard 3:1 (H: V) sideslope would be given a value of 3. A vertical sideslope has a value of 0.

The pond bottom is assumed to be flat.

The pond outlet structure consists of a riser and zero to three orifices. The riser has a height (typically one foot less than the effective depth) and a diameter. The riser can have either a flat top or a weir notch cut into the side of the top of the riser. The notch can be either rectangular, V-shaped, or a Sutro weir. More information on the riser weir shapes and orifices is provided later in this guidance document.

After the pond is given dimensions and outlet information the user can view the resulting stage-storage-discharge table by clicking on the ***Open Table*** arrow in the lower right corner of the pond information screen. This table hydraulically defines the pond's characteristics.

The user can use either Auto Pond to size a pond or can manually size a pond. Follow the steps below for manual sizing a pond using an outlet configuration with one orifice and a riser with rectangular notch (this is usually the most efficient design):

1. Input a bottom orifice diameter that allows a discharge equal to the lower threshold (e.g., 10% of 2-year) Predevelopment flow for a stage equal to 2/3 the height of the riser. This discharge can be checked by reviewing the pond's stage-storage-discharge table.
2. Input a riser rectangular notch height equal to 1/3 of the height of the riser.

Initially set the riser notch width to 0.1 foot.

3. Run Predevelopment and Mitigated scenarios.
4. Go to Analysis screen and check flow duration results.
5. If pond passes flow duration criteria then decrease pond dimensions.
6. If pond fails flow duration criteria then change (in order of priority) bottom orifice diameter, riser notch width, pond dimensions.
7. Iterate until there is a good match between Predevelopment and Mitigated flow duration curves or fatigue sets in.

Pond input information:
Bottom Length (ft): Pond bottom length. Bottom Width (ft): Pond bottom width
Effective Depth (ft): Pond height from pond bottom to top of riser plus at least 0.5 foot extra
Left Sideslope (H/V): ratio of horizontal distance to vertical; 0 (zero) for vertical pond sides
Bottom Sideslope (H/V): ratio of horizontal distance to vertical; 0 (zero) for vertical pond sides
Right Sideslope (H/V): ratio of horizontal distance to vertical; 0 (zero) for vertical pond sides
Top Sideslope (H/V): ratio of horizontal distance to vertical; 0 (zero) for vertical pond sides
Riser Height (ft): Height of overflow pipe above pond bottom
Riser Diameter (in): Pond overflow pipe diameter
Riser Type (options): Flat or Notched
Notch Type: Rectangular, V-Notch, or Sutro.
For a rectangular notch:
Notch Height (feet): distance from the top of the weir to the bottom of the notch
Notch Width (feet): width of notch; cannot be larger than the riser circumference.

For more information on riser notch options and orifices see discussion in **OUTLET STRUCTURE CONFIGURATIONS** section.

Infiltration: Yes (infiltration into the underlying native soil)
Measured Infiltration Rate (in/hr): Native soil infiltration rate
Infiltration Reduction Factor: 1/Native soil infiltration rate safety factor (see page 69)
Use Wetted Surface Area (sidewalls): Yes, if infiltration through the pond sideslopes is allowed

If infiltration is used then the user should consult the Infiltration discussion on page 69.

NOTE: See Appendix C or consult with the local municipal permitting agency for additional considerations regarding infiltration and determination of the appropriate infiltration reduction factor.

A pond receives precipitation on and evaporation from the pond surface. The ***Precipitation Applied to Facility*** and ***Evaporation Applied to Facility*** boxes should be checked.

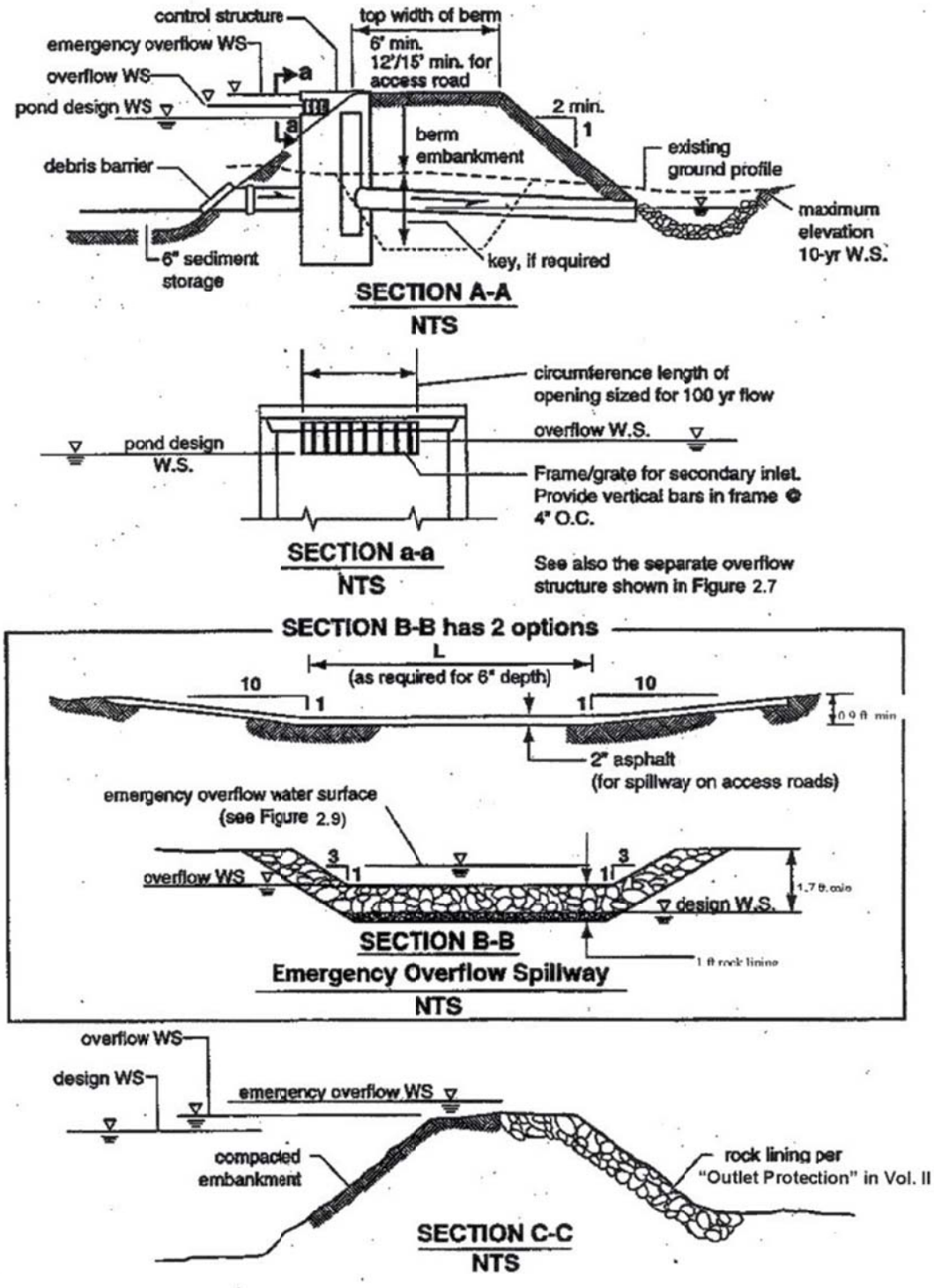
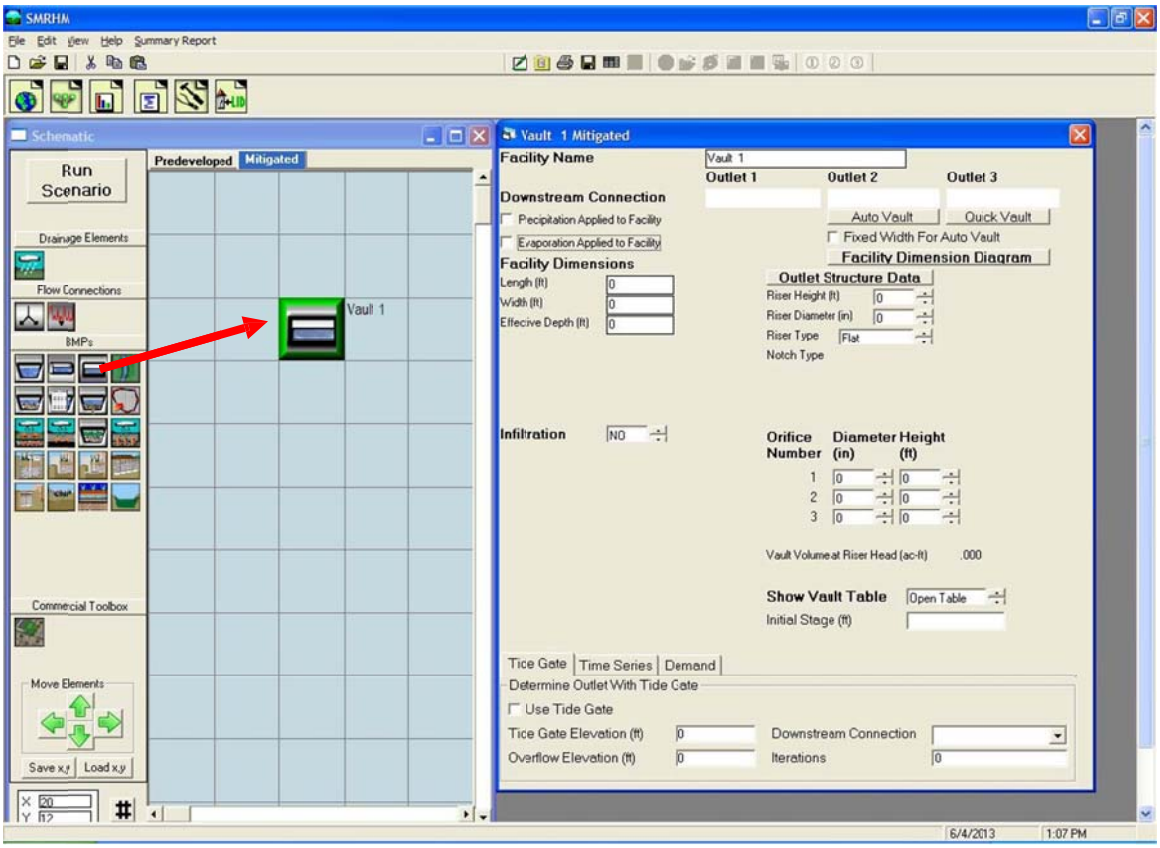


Figure 3.10 Typical Detention Pond Sections

NOTE: The detention pond section diagram shows the general configuration used in designing a *pond and its outlet structure. This diagram is from the Washington State Department of Ecology's 2005* Stormwater Management Manual for Western Washington. *Consult with the Copermittee with jurisdiction over project site on specific design requirements.*

VAULT ELEMENT

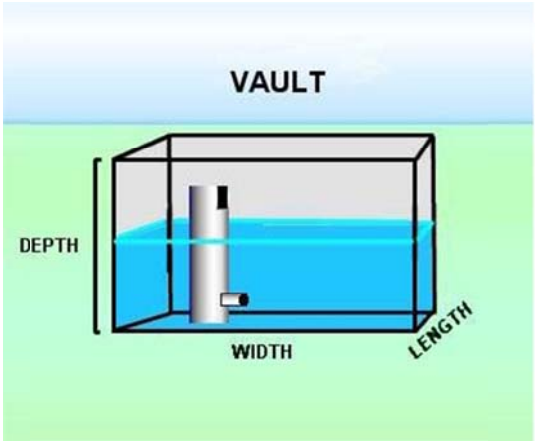


The storage vault has all of the same characteristics of the trapezoidal pond, except that the user does not specify the sideslopes (by definition they are zero) and the vault is assumed to have a lid (no precipitation or evaporation).

Auto Vault and Quick Vault work the same way as Auto Pond and Quick Pond. Go to page 48 to find information on how to manually size a vault or other HMP facility.

NOTE: Auto Vault is available only in the Mitigated scenario.

Vault input information:
Bottom Length (ft): Vault bottom length
Bottom Width (ft): Vault bottom width
Effective Depth (ft): Vault height from vault bottom to top of riser plus at least 0.5 foot extra
Riser Height (ft): Height of overflow pipe above vault bottom
Riser Diameter (in): Vault overflow pipe diameter
Riser Type (options): Flat or Notched
Notch Type: Rectangular, V-Notch, or Sutro



For a rectangular notch:
Notch Height (ft): distance from the top of the weir to the bottom of the notch
Notch Width (ft): width of notch; cannot be larger than the riser circumference

For more information on riser notch options and orifices see discussion in **OUTLET STRUCTURE CONFIGURATIONS** section.

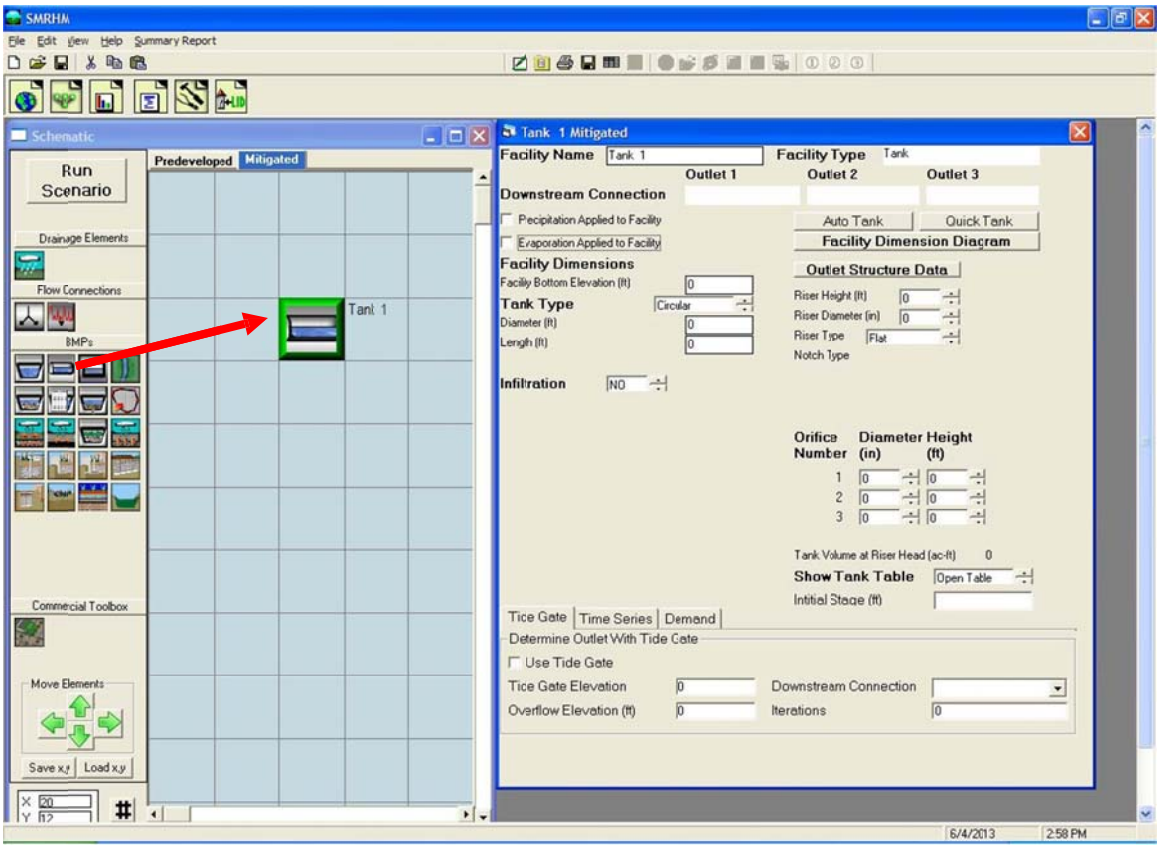
Infiltration: Yes (infiltration into the underlying native soil) Measured Infiltration Rate (in/hr): Native soil infiltration rate
Infiltration Reduction Factor: 1/Native soil infiltration rate safety factor (see page 69)
Use Wetted Surface Area (sidewalls): Yes, if infiltration through the vault sides is allowed

If infiltration is used then the user should consult the Infiltration discussion on page 69.

NOTE: See Appendix C or consult with the Copermittee with jurisdiction over the project site for additional considerations regarding infiltration and determination of the appropriate infiltration reduction factor.

A vault is usually covered and does not receive precipitation on and evaporation from the vault surface. The ***Precipitation Applied to Facility*** and ***Evaporation Applied to Facility*** boxes should not be checked unless the vault top is open to the atmosphere.

TANK ELEMENT

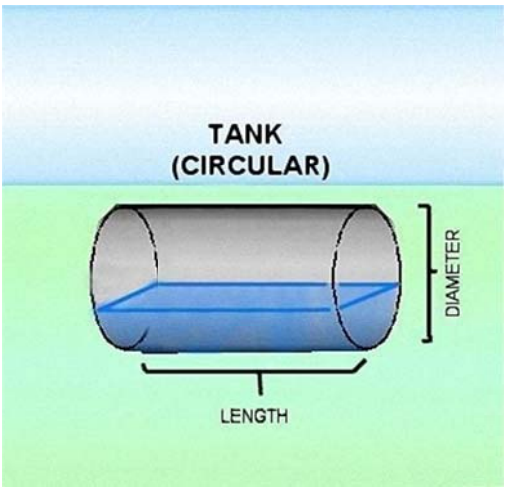


A storage tank is a cylinder placed on its side. The user specifies the tank's diameter and length.

Auto Tank and Quick Tank work the same way as Auto Pond and Quick Pond. Go to page 48 to find information on how to manually size a vault or other hydrologic control facility.

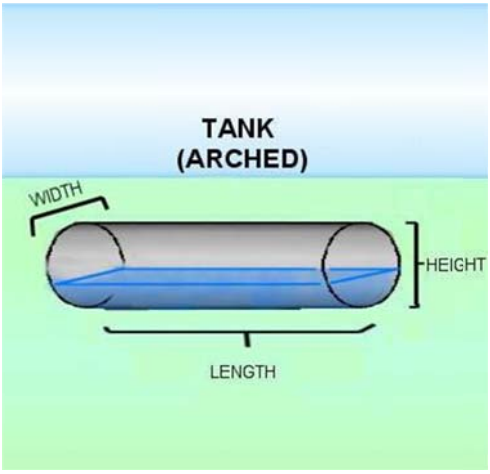
NOTE: Auto Tank is available only in the Mitigated scenario.

There is a Quick Tank option that creates a tank, but does not check for compliance with the flow duration criteria.



Tank input information:
Tank Type: Circular or Arched
For Circular:
Diameter (ft): Tank diameter
Length (ft): Tank length
For Arched:
Height (ft): Tank height

Width (ft): Tank width (at widest point)
Length (ft): Tank length
Riser Height (ft): Height of overflow pipe above tank bottom; must be less than tank diameter or height
Riser Diameter (in): Tank overflow pipe diameter
Riser Type (options): Flat or Notched
Notch Type: Rectangular, V-Notch, or Sutro
For a rectangular notch:
Notch Height (feet): distance from the top of the weir to the bottom of the notch
Notch Width (feet): width of notch; cannot be larger than the riser circumference



For more information on riser notch options and orifices see discussion in **OUTLET STRUCTURE CONFIGURATIONS** section.

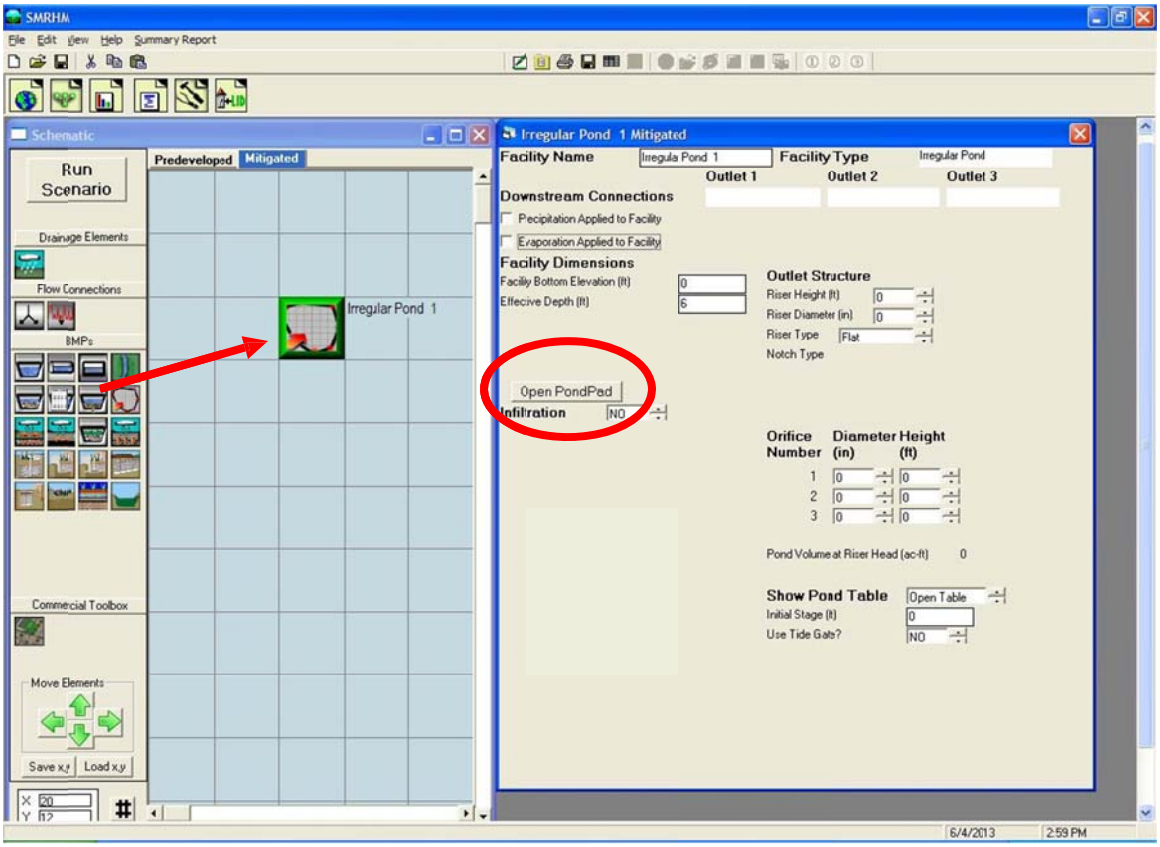
Infiltration: Yes (infiltration into the underlying native soil)
Measured Infiltration Rate (in/hr): Native soil infiltration rate
Infiltration Reduction Factor: 1/Native soil infiltration rate safety factor (see page 69)
Use Wetted Surface Area (sidewalls): Yes, if infiltration through the tank sides is allowed

If infiltration is used then the user should consult the Infiltration discussion on page 69.

NOTE: See Appendix C or consult with the Copermittee with jurisdiction over the project site for additional considerations regarding infiltration and determination of the appropriate infiltration reduction factor.

A tank is covered and does not receive precipitation on and evaporation from the tank surface. The ***Precipitation Applied to Facility*** and ***Evaporation Applied to Facility*** boxes should not be checked.

IRREGULAR POND ELEMENT

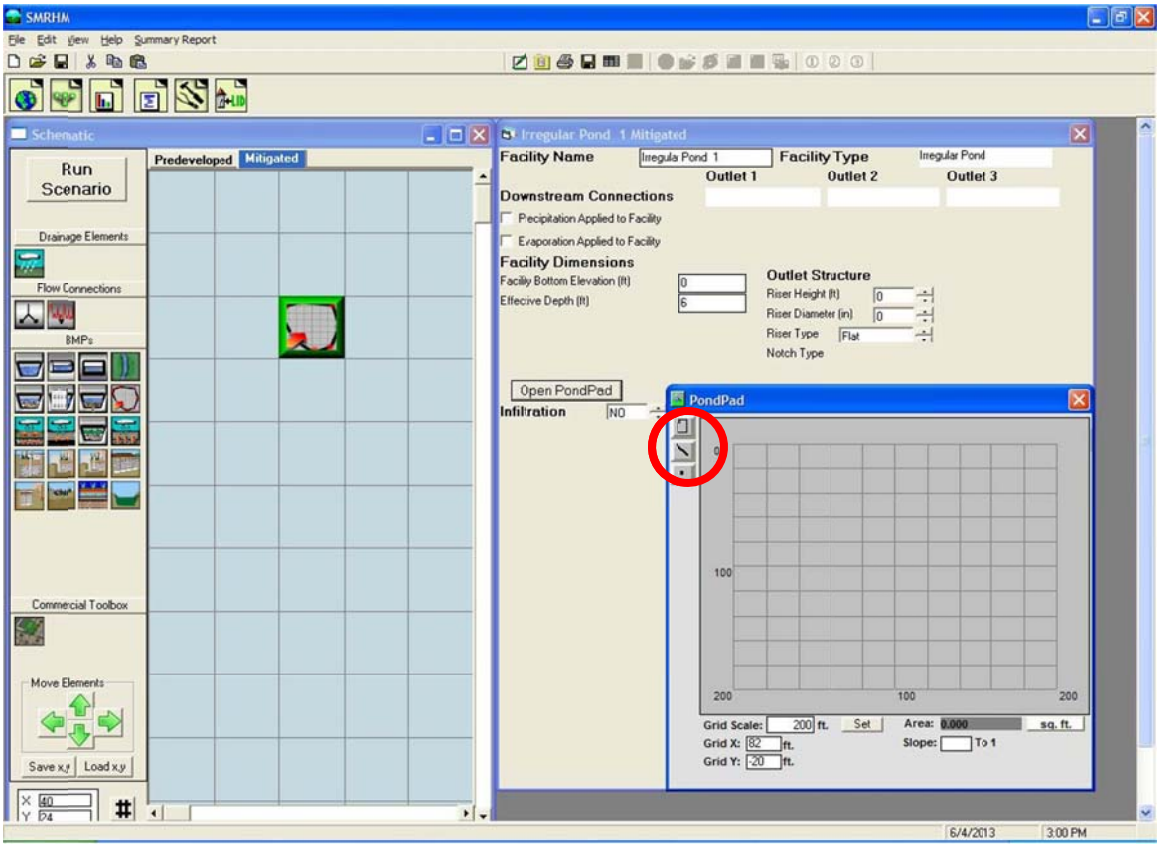


An irregular pond is any pond with a shape that differs from the rectangular top of a trapezoidal pond. An irregular pond has all of the same characteristics of a trapezoidal pond, but its shape must be defined by the user.

The Auto Pond option is not available for an irregular-shaped pond. Go to page 48 to find information on how to manually size an irregular pond or other HMP facility.

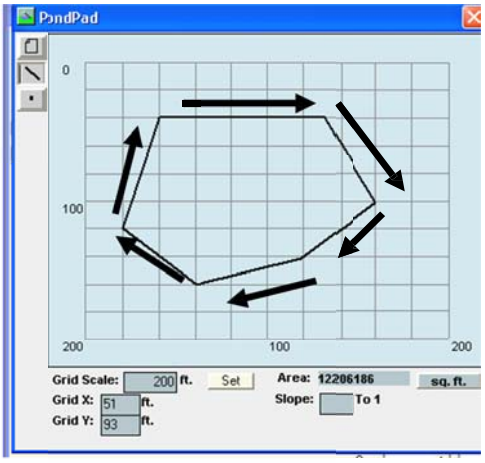
To create the shape of an irregular pond the user clicks on the ***Open PondPad*** button. This allows the user to access the PondPad interface (see below).

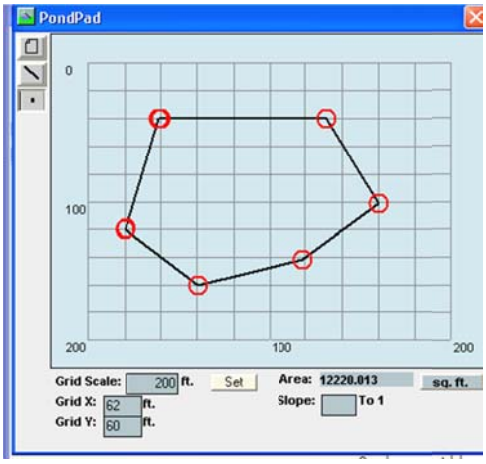
PondPad Interface



The PondPad interface is a grid on which the user can specify the outline of the top of the pond and the pond's sideslopes.

The user selects the ***Line*** button (second from the top on the upper left corner of the PondPad screen). Once the ***Line*** button is turned on the user moves the mouse over the grid to locate the pond's corner points. The user does this in a **clockwise** direction to outline the pond's top perimeter. The user can select individual points by clicking on the point button immediately below the line button. Once selected, any individual point can be moved or repositioned.





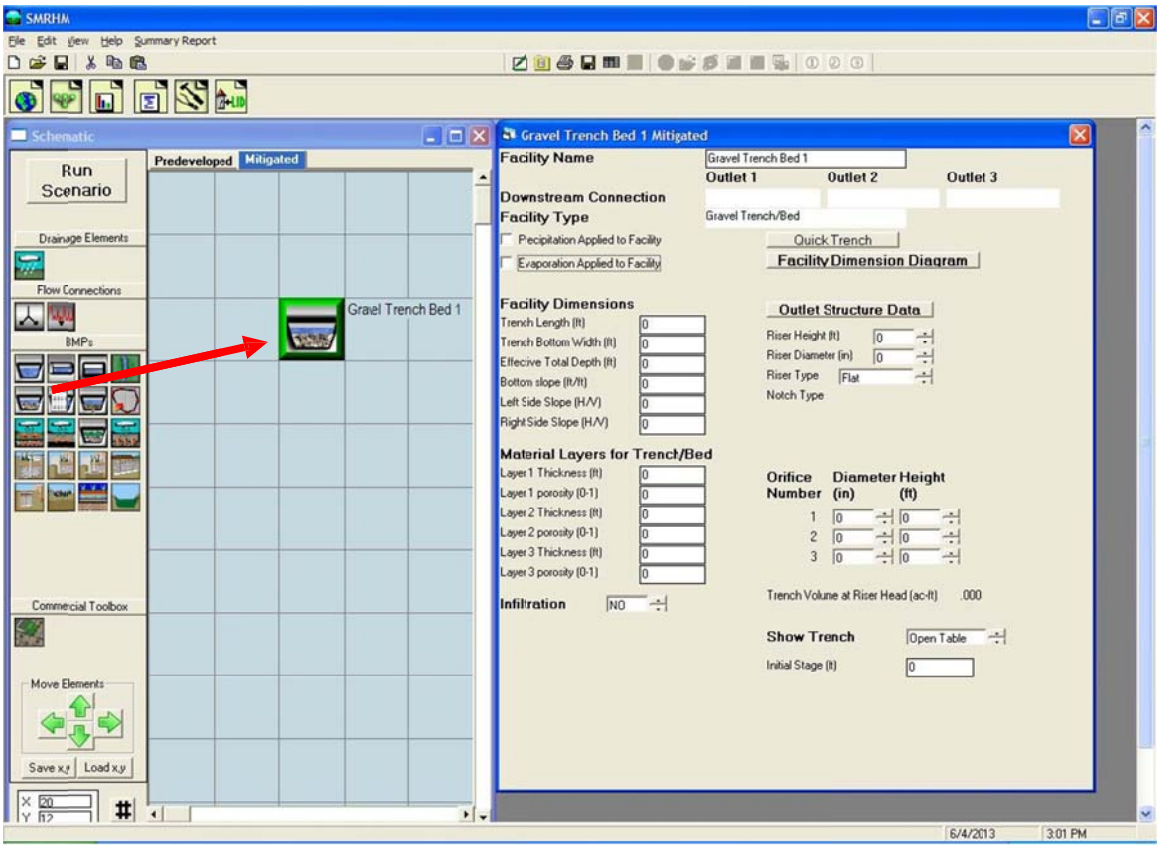
The default sideslope value is 3 (3:1). The sideslopes can be individually changed by right clicking on the specific side (which changes the line color from black to red) and then entering the individual sideslope value in the slope text box.

The grid scale can be changed by entering a new value in the grid scale box. The default value is 200 feet.

PondPad Controls and Numbers

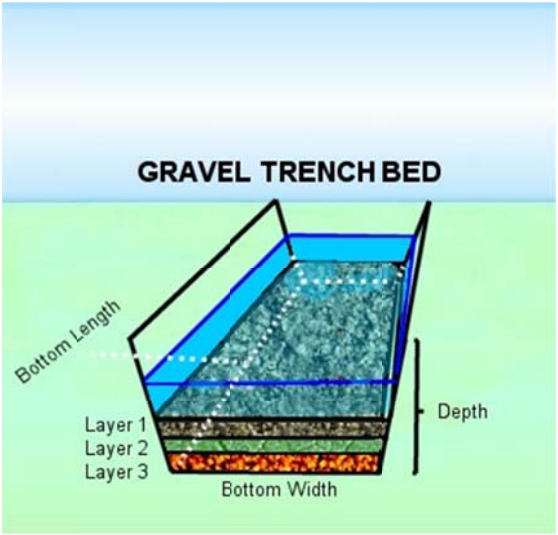
Clear:	The Clear button clears all of the lines on the grid
Line:	The Line button allows the user to draw new lines with the mouse
Point:	The Point button allows the user to move individual points to alter the pond shape and size
Sq Ft:	Converts the computed pond area from square feet to acres and back.
Grid Scale:	Changes the length of a grid line. Default grid scale is 200 feet
Grid X:	Horizontal location of the mouse pointer on the grid (0 is the upper left corner)
Grid Y:	Vertical location of the mouse pointer on the grid (0 is the upper left corner)
Area:	Top area of the pond (either in square feet or acres)
Slope:	Sideslope of the selected line (side of the pond)

GRAVEL TRENCH BED ELEMENT



The gravel trench bed is used to spread and infiltrate runoff, but also can have one or more surface outlets represented by an outlet structure with a riser and multiple orifices.

The user specifies the trench length, bottom width, total depth, bottom slope, and left and right sideslopes.



The material layers represent the gravel/rock layers and their design characteristics (thickness and porosity).

Quick Trench will instantly create a gravel trench bed with default values without checking it for compliancy with flow duration criteria.

The gravel trench bed input information:

Trench Length (ft): Trench bed length.

Trench Bottom Width (ft): Trench bed bottom width
Effective Total Depth (ft): Height from bottom of trench bed to top of riser plus at least 0.5 feet extra
Bottom Slope of Trench (ft/ft): Must be non-zero
Left Sideslope (ft/ft): H/V ratio of horizontal distance to vertical; 0 (zero) for vertical trench bed sides
Right Sideslope (ft/ft): H/V ratio of horizontal distance to vertical; 0 (zero) for vertical trench bed sides
Infiltration Rate (in/hr): Trench bed gravel or other media infiltration rate
Layer 1 Thickness (ft): Trench top media layer depth
Layer 1 Porosity: Trench top media porosity.
Layer 2 Thickness (ft): Trench middle media layer depth (Layer 2 is optional)
Layer 2 Porosity: Trench middle media porosity
Layer 3 Thickness (ft): Trench bottom media layer depth (Layer 3 is optional)
Layer 3 Porosity: Trench bottom media porosity
Riser Height (ft): Height of trench overflow pipe above trench surface
Riser Diameter (in): Trench overflow pipe diameter
Riser Type (options): Flat or Notched
Notch Type: Rectangular, V-Notch, or Sutro
For a rectangular notch:
Notch Height (feet): distance from the top of the weir to the bottom of the notch
Notch Width (feet): width of notch; cannot be larger than the riser circumference

For more information on riser notch options and orifices see discussion in **OUTLET STRUCTURE CONFIGURATIONS** section.

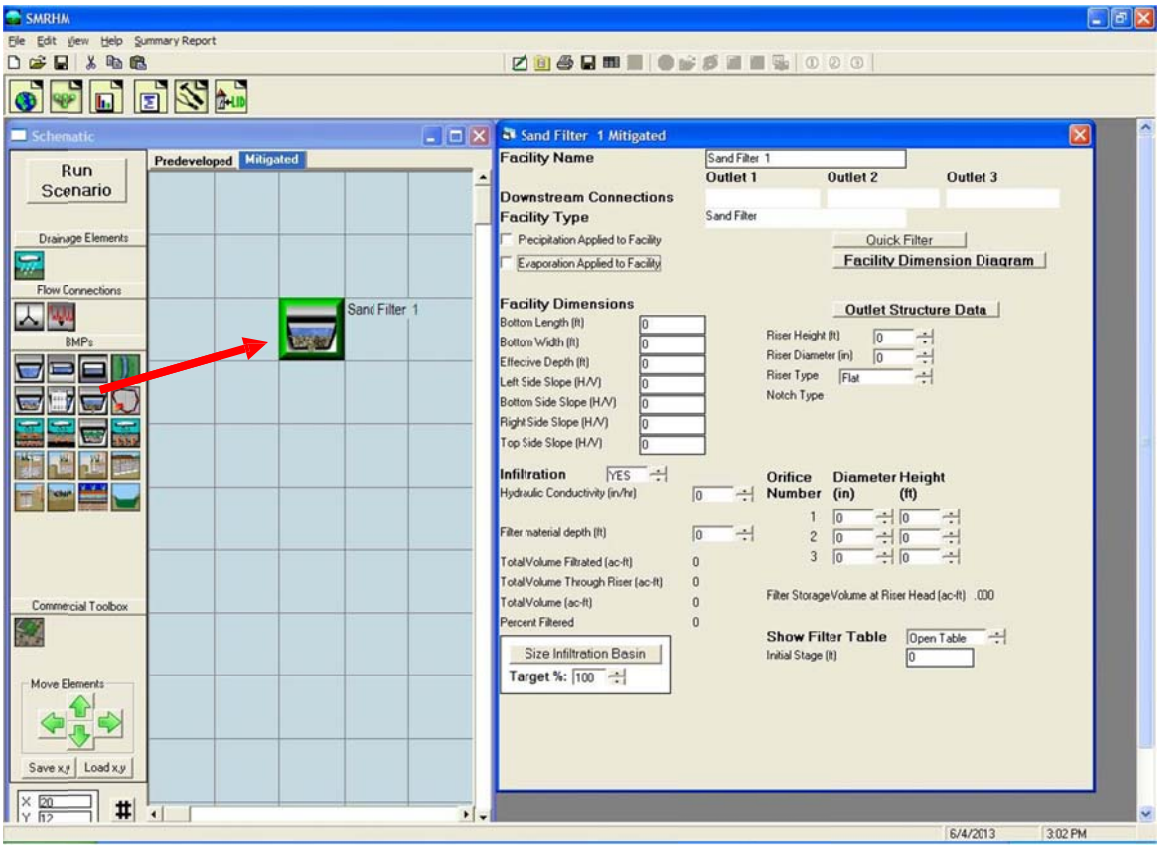
Native Infiltration: Yes (infiltration into the underlying native soil)
Measured Infiltration Rate (in/hr): Native soil infiltration rate
Infiltration Reduction Factor: 1/Native soil infiltration rate safety factor (see page 69)
Use Wetted Surface Area (sidewalls): Yes, if infiltration through the trench sideslopes is allowed.

If infiltration is used then the user should consult the Infiltration discussion on page 69.

NOTE: See Appendix C or consult with the Copermittee with jurisdiction over the project site for additional considerations regarding infiltration and determination of the appropriate infiltration reduction factor.

Gravel trench bed receives precipitation on and evaporation from the trench surface. The ***Precipitation Applied to Facility*** and ***Evaporation Applied to Facility*** boxes should be checked.

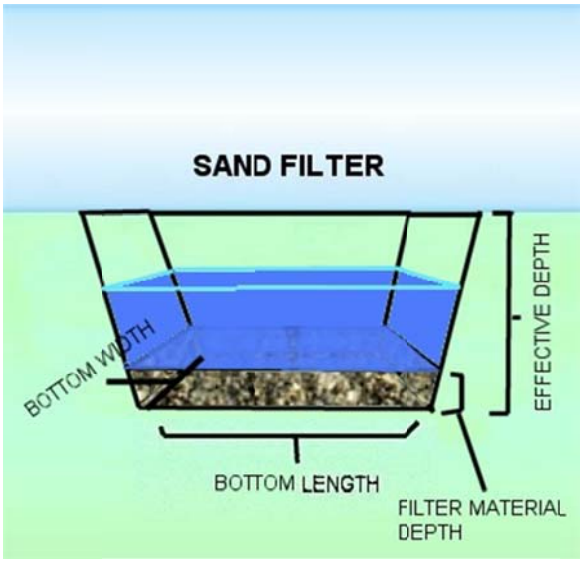
SAND FILTER ELEMENT



The sand filter is a water quality facility. It does not infiltrate surface runoff, but is used to filter runoff through a medium and send it downstream. It can also have one or more surface outlets represented by an outlet structure with a riser and multiple orifices.

The user must specify the facility dimensions (bottom length and width, effective depth, and sideslopes. The hydraulic conductivity of the sand filter and the filter material depth are also needed to size the sand filter (default values are 1.0 inch per hour and 1.5 feet, respectively).

NOTE: When using the sand filter element check with Appendix C or the Copermittee with jurisdiction over the project site to determine the required treatment standard (percent of the total runoff volume treated by the sand filter).



The filter discharge is calculated using the equation Q = K*I*A, where Q is the discharge in cubic feet per second (cfs). K equals the hydraulic conductivity (inches per hour). For sand filters K = 1.0 in/hr. Sand is the default medium. If another filtration material is used then the design engineer should enter the appropriate K value supported by documentation and approval by the reviewing authority.

Design of a sand filter requires input of facility dimensions and outlet structure characteristics, running the sand filter scenario, and then checking the volume calculations to see if the Percent Filtered equals or exceeds the treatment standard percentage. If the value is less than the treatment standard percentage then the user should increase the size of the sand filter dimensions and/or change the outlet structure. The sand filter input information:

Bottom Length (ft): Sand filter bottom length
Bottom Width (ft): Sand filter bottom width
Effective Depth (ft): Height from bottom of sand filter to top of riser plus at least 0.5 feet extra
Left Sideslope (ft/ft): H/V ratio of horizontal distance to vertical; 0 (zero) for vertical sand filter sides
Bottom Sideslope (ft/ft): H/V ratio of horizontal distance to vertical; 0 (zero) for vertical sand filter sides
Right Sideslope (ft/ft): H/V ratio of horizontal distance to vertical; 0 (zero) for vertical sand filter sides
Top Sideslope (ft/ft): H/V ratio of horizontal distance to vertical; 0 (zero) for vertical sand filter sides
Riser Height (ft): Height of sand filter overflow pipe above sand filter surface
Riser Diameter (in): Sand filter overflow pipe diameter
Riser Type (options): Flat or Notched
Notch Type: Rectangular, V-Notch, or Sutro
For a rectangular notch:
Notch Height (feet): distance from the top of the weir to the bottom of the notch
Notch Width (feet): width of notch; cannot be larger than the riser circumference.

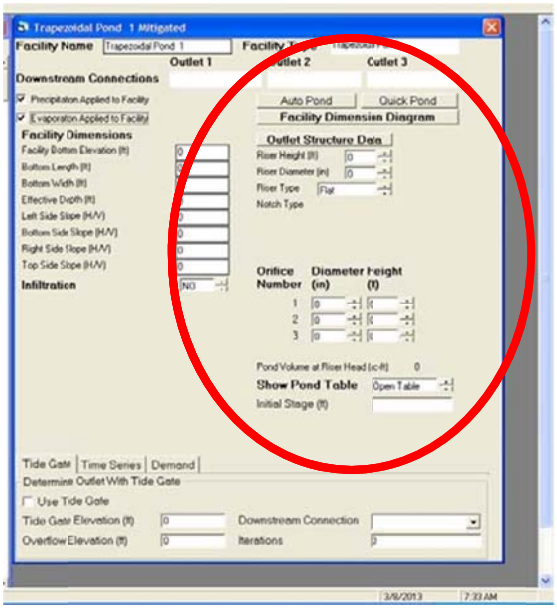
For more information on riser notch options and orifices see discussion in **OUTLET STRUCTURE CONFIGURATIONS** section.

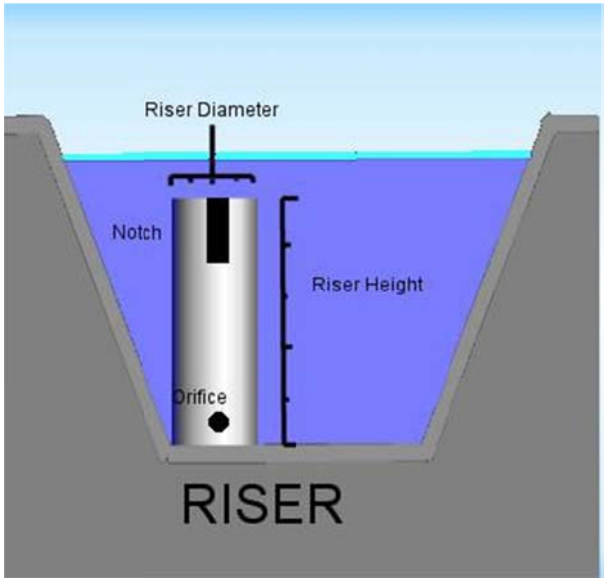
Infiltration: Yes (infiltration through the filter material)
Hydraulic Conductivity (in/hr): Filtration rate through the sand filter
Filter material depth (ft): Depth of sand filter material (for runoff filtration)

Sand filter receives precipitation on and evaporation from the sand filter surface. The ***Precipitation Applied to Facility*** and ***Evaporation Applied to Facility*** boxes should be checked.

OUTLET STRUCTURE CONFIGURATIONS

The trapezoidal pond, vault, tank, irregular pond, gravel trench bed, and sand filter all use a riser for the outlet structure to control discharge from the facility.

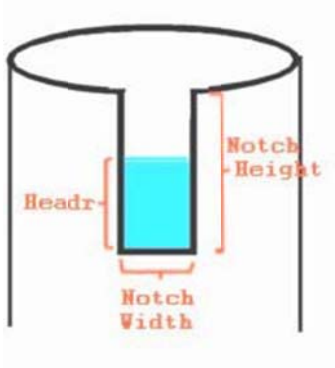




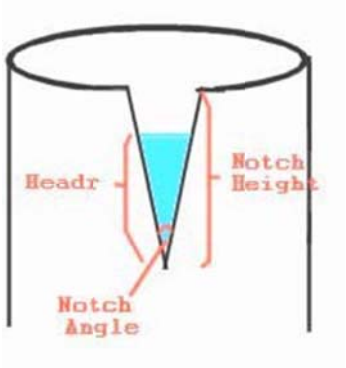
The riser is a vertical pipe with a height above pond bottom (typically one foot less than the effective depth). The user specifies the riser height and diameter.

The riser can have up to three round orifices. The bottom orifice is usually located at the bottom of the pond and/or above any dead storage in the facility. The user can set the diameter and height of each orifice.

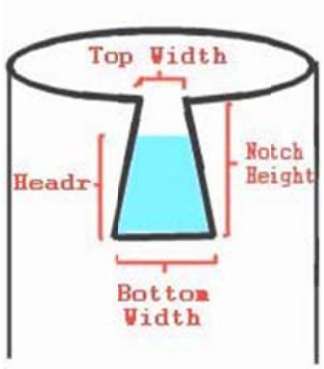
The user specifies the riser type as either flat or notched. The weir notch can be either rectangular, V-notch, or a Sutro weir. The shape of each type of weir is shown below.



Rectangular Notch



V-Notch



Sutro

By selecting the appropriate notch type the user is then given the option to enter the appropriate notch type dimensions.

Riser and orifice equations used in SMRHM are provided below.

Headr = the water height over the notch/orifice bottom.
q = discharge

Riser Head Discharge:

Head = water level above riser
q = 9.739 * Riser Diameter * Head ^ 1.5

Orifice Equation:
q = 3.782 * (Orifice Diameter) ^ 2 * SQRT(Headr)

Rectangular Notch:
b = NotchWidth *- (1- 0.2 * Headr)
where b >= 0.8
q = 3.33 * b * Headr ^ 1.5

Sutro:
Wh = Top Width + {(Bottom Width- Top Width)/Notch Height }* Headr
Wd = Bottom Width - Wh (the difference between the bottom and top widths)

Q1 = (rectangular notch q where Notch Width = Wh)
Q2 = (rectangular notch q where Notch Width = Wd)

q = Q1 + Q2 / 2

V-Notch:
Notch Bottom = height from bottom of riser to bottom of notch
Theta = Notch Angle

a = 2.664261 - 0.0018641 * Theta + 0.00005761 * Theta ^2
b = -0.48875 + 0.003843 * Theta - 0.000092124 * Theta ^2
c = 0.3392 - 0.0024318 * Theta + 0.00004715 * Theta ^2

Y over H = Headr / (NotchBottom + Headr)
Coef = a + b * Headr + c * Headr ^2

q = (Coef * Tan(Theta / 2)) * (Headr ^ (5 / 2))

These equations are provided from the Washington State Department of Ecology's 2005 *Stormwater Management Manual for Western Washington.* The outlet designs are shown

below. They have been reproduced from Volume III of the *Stormwater Management Manual for Western Washington* which has more information on the subject.

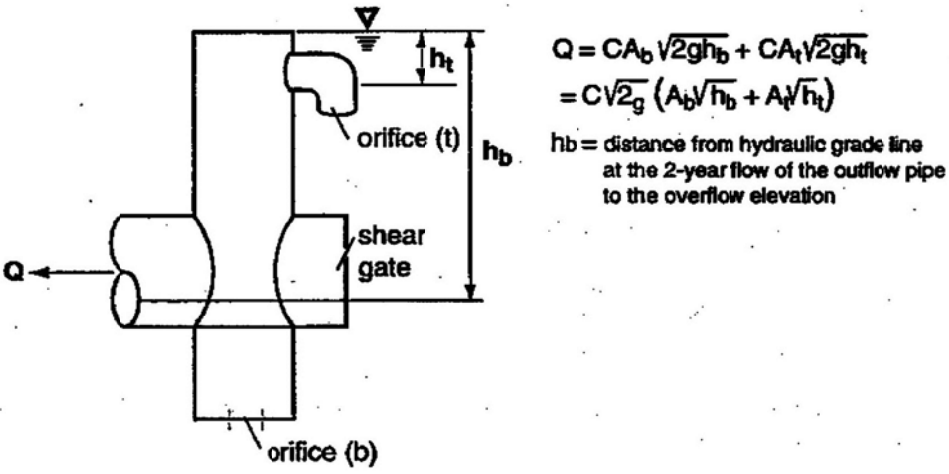


Figure 3.20 Simple Orifice

The diameter of the orifice is calculated from the flow. The orifice equation is often useful when expressed as the orifice diameter in inches:

$$d = \sqrt{\frac{36.88Q}{\sqrt{h}}} \qquad \text{(equation 5)}$$

where d = orifice diameter (inches)
Q = flow (cfs)
h = hydraulic head (ft)

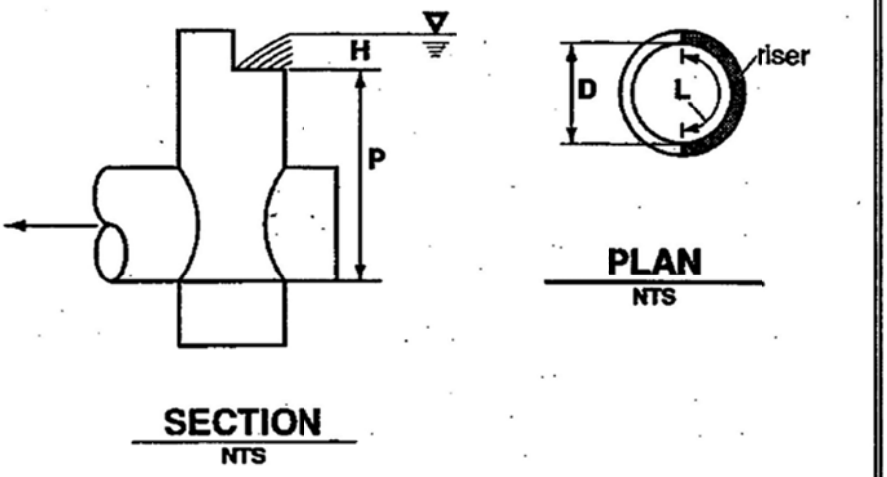


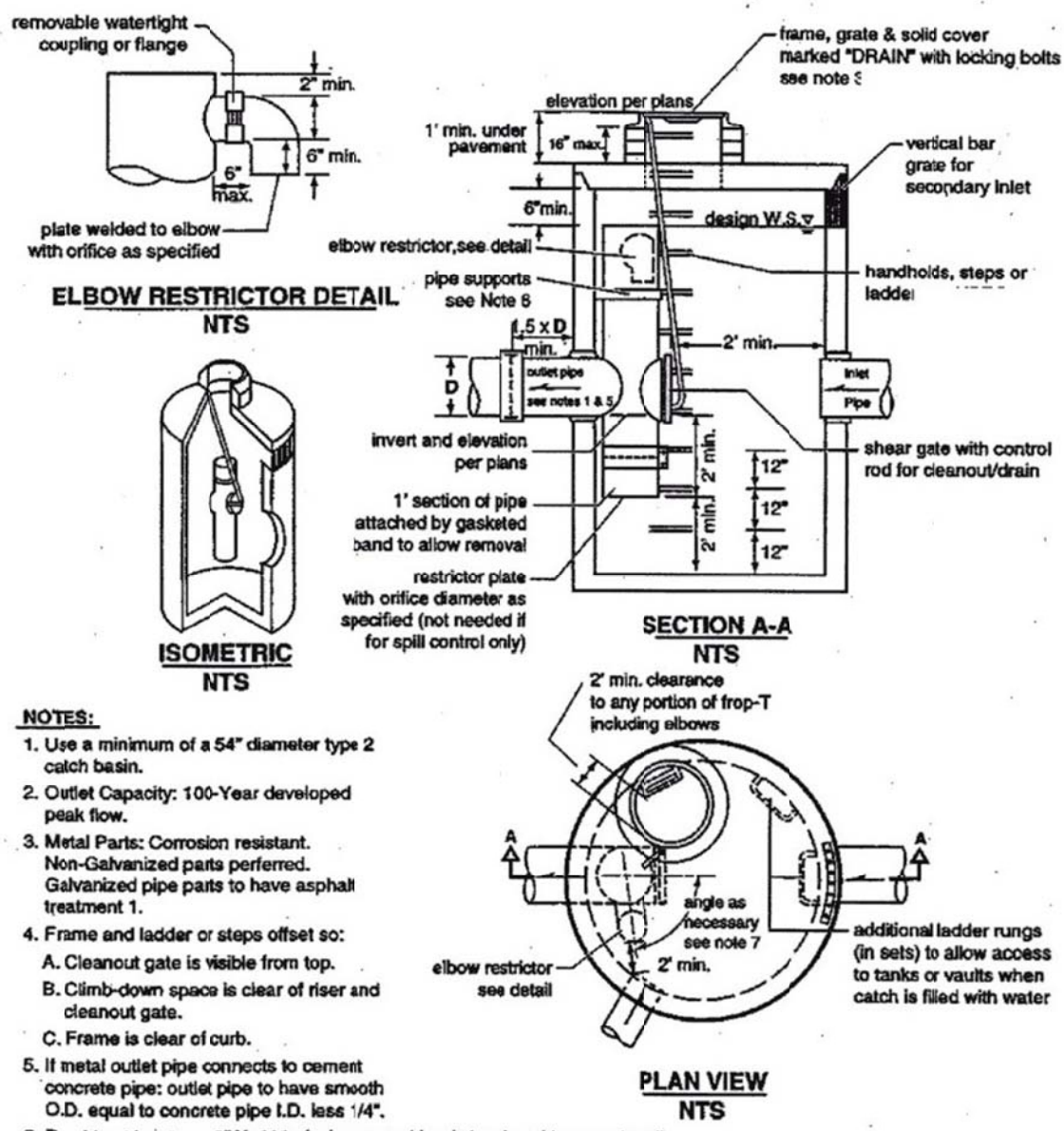
Figure 3.21 Rectangular, Sharp-Crested Weir

$$Q=C\,(L - 0.2H)H^{3/2} \qquad \text{(equation 6)}$$

where Q = flow (cfs)
C = 3.27 + 0.40 H/P (ft)
H, P are as shown above
L = length (ft) of the portion of the riser circumference as necessary not to exceed 50 percent of the circumference
D = inside riser diameter (ft)

Note that this equation accounts for side contractions by subtracting 0.1H from L for each side of the notch weir.

The physical configuration of the outlet structure should include protection for the riser and orifices to prevent clogging of the outlet from debris or sediment. Various outlet configurations are shown below. They have been reproduced from Volume III of the *Stormwater Management Manual for Western Washington* which has more information on the subject.



NOTES:

1. Use a minimum of a 54" diameter type 2 catch basin.
2. Outlet Capacity: 100-Year developed peak flow.
3. Metal Parts: Corrosion resistant. Non-Galvanized parts perferred. Galvanized pipe parts to have asphalt treatment 1.
4. Frame and ladder or steps offset so:
   A. Cleanout gate is visible from top.
   B. Climb-down space is clear of riser and cleanout gate.
   C. Frame is clear of curb.
5. If metal outlet pipe connects to cement concrete pipe: outlet pipe to have smooth O.D. equal to concrete pipe I.D. less 1/4".
6. Provide at least one 3" X .090 ¡ inchessupport bracket anchored to concrete wall. (maximum 3'-0" vertical spacing)
7. Locate elbow restrictor(s) as necessary to provide minimum clearance as shown.
8. Locate additional ladder rungs in structures used as access to tanks or vaults to allow access when catch basin is filled with water.

Figure 3.17 Flow Restrictor (TEE)

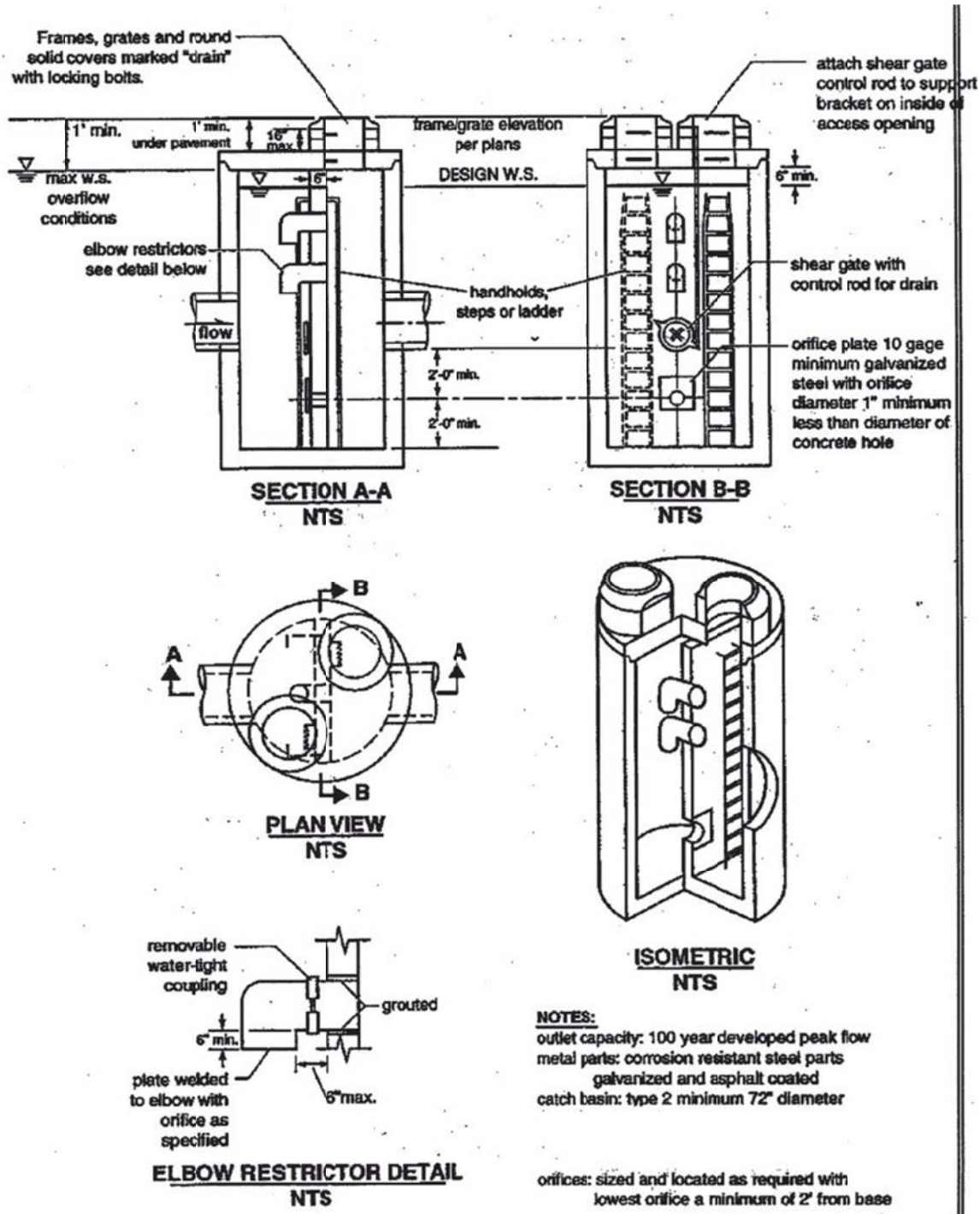
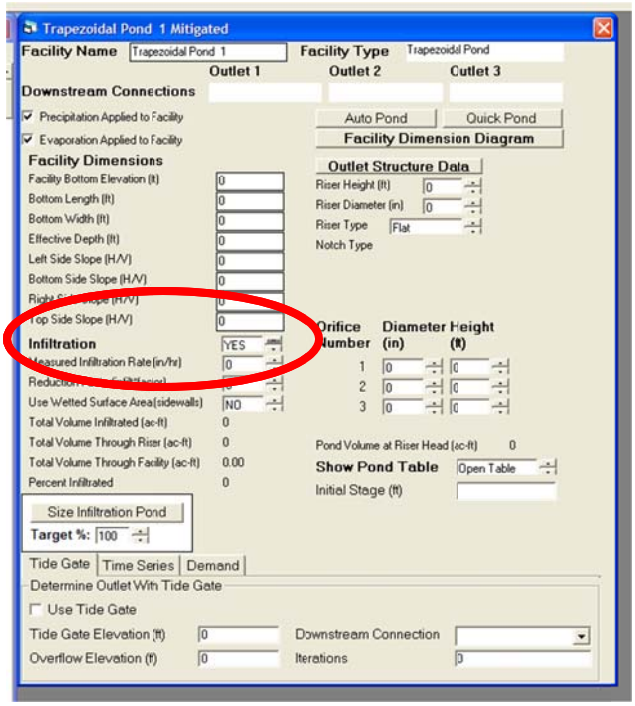


Figure 3.18 Flow Restrictor (Baffle)

Riser protection structures. Diagrams courtesy of Washington State Department of Ecology.

INFILTRATION



Infiltration of stormwater runoff is a recommended solution if certain conditions are met. These conditions include: a soils report, testing, groundwater protection, pre-settling, and appropriate construction techniques.

NOTE: See Appendix C or consult with the Copermittee with jurisdiction over the project site for additional considerations regarding infiltration and determination of the appropriate infiltration reduction factor.

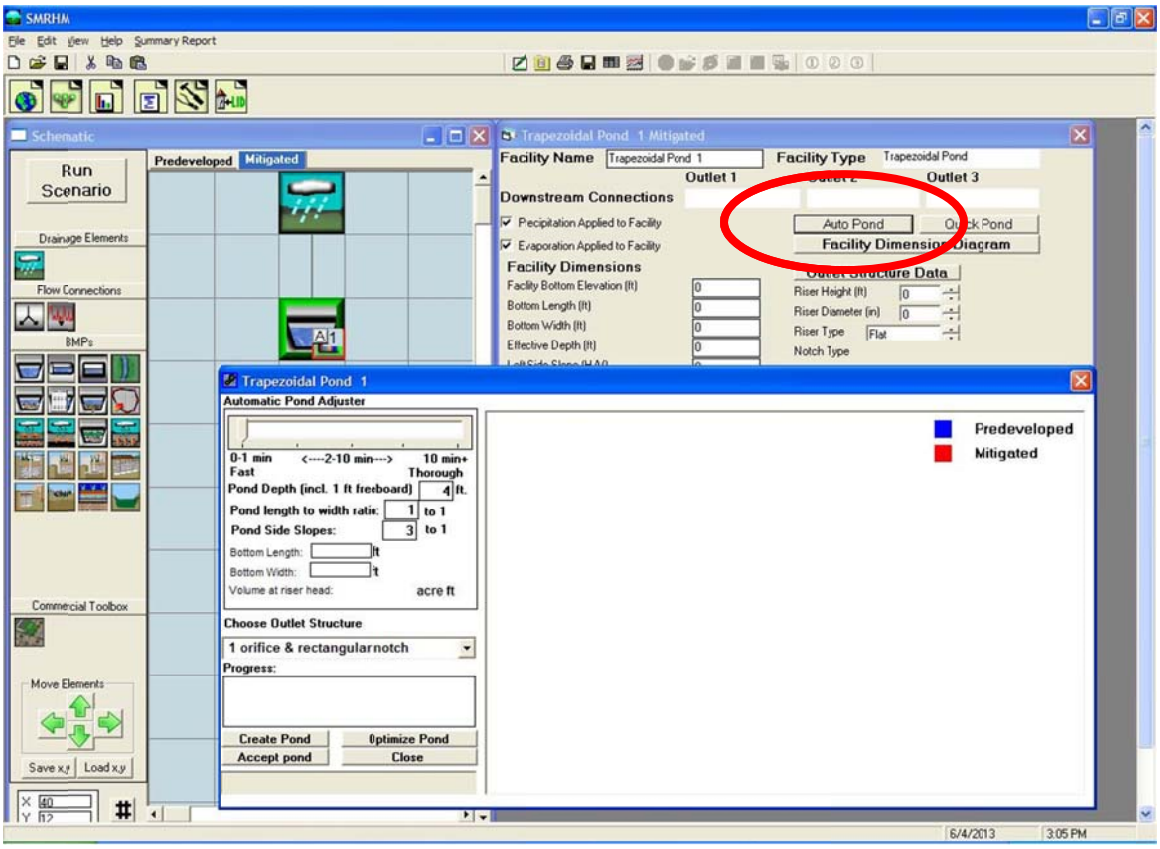
The user clicks on the Infiltration option arrow to change infiltration from ***NO*** to ***YES***. This activates the infiltration input options: measured infiltration rate, infiltration reduction factor, and whether or not to allow infiltration through the wetted sideslopes/walls.

The infiltration reduction factor is a multiplier for the measured infiltration rate and should have a value of 1.00 or less. It is the same as the inverse of a safety factor. For example, a safety factor of 2 is equal to a reduction factor of 0.50.

Infiltration occurs only through the bottom of the facility if the wetted surface area option is turned off. Otherwise the entire wetted surface area is used for infiltration.

After the model is run and flow is routed through the infiltration facility the total volume infiltrated, total volume through the riser, total volume through the facility, and percent infiltrated are reported on the screen. If the percent infiltrated is 100% then there is no surface discharge from the facility. The percent infiltrated can be less than 100% as long as the surface discharge does not exceed the flow duration criteria.

AUTO POND



Auto Pond automatically creates a pond size and designs the outlet structure to meet the flow duration criteria. The user can either create a pond from scratch or optimize an existing pond design.

Auto Pond requires that the Predevelopment and Mitigated basins be defined prior to using Auto Pond. Clicking on the ***Auto Pond*** button brings up the Auto Pond window and the associated Auto Pond controls.

Auto Pond controls:

Automatic Pond Adjuster: The slider at the top of the Auto Pond window allows the user to decide how thoroughly the pond will be designed for efficiency. The lowest setting (0-1 min) at the left constructs an initial pond without checking the flow duration criteria. The second setting to the right creates and sizes a pond to pass the flow duration criteria; however, the pond is not necessarily optimized. The higher settings increase the amount of optimization. The highest setting (farthest right) will size the most efficient (smallest) pond, but will result in longer computational time.

Pond Depth: Pond depth is the total depth of the pond and should include at least one foot of freeboard (above the riser). The pond's original depth will be used when optimizing an existing pond; changing the value in the Pond Depth text box will override any previous set depth value. The default depth is 4 feet.

Pond Length to Width Ratio: This bottom length to width ratio will be maintained regardless of the pond size or orientation. The default ratio value is 1.0.

Pond Sideslopes: Auto Pond assumes that all of the pond's sides have the same sideslope. The sideslope is defined as the horizontal distance divided by the vertical. A typical sideslope is 3 (3 feet horizontal to every 1 foot vertical). The default sideslope value is 3.

Choose Outlet Structure: The user has the choice of either one orifice or rectangular notch or three orifices. If the user wants to select another outlet structure option then the pond must be manually sized.

Create Pond: This button creates a pond when the user does not input any pond dimensions or outlet structure information. Any previously input pond information will be deleted.

Optimize Pond: This button optimizes an existing pond. It cannot be used if the user has not already created a pond.

Accept Pond: This button will stop the Auto Pond routine at the last pond size and discharge characteristics that produce a pond that passes the flow duration criteria. Auto Pond will not stop immediately if the flow duration criteria have not yet been met.

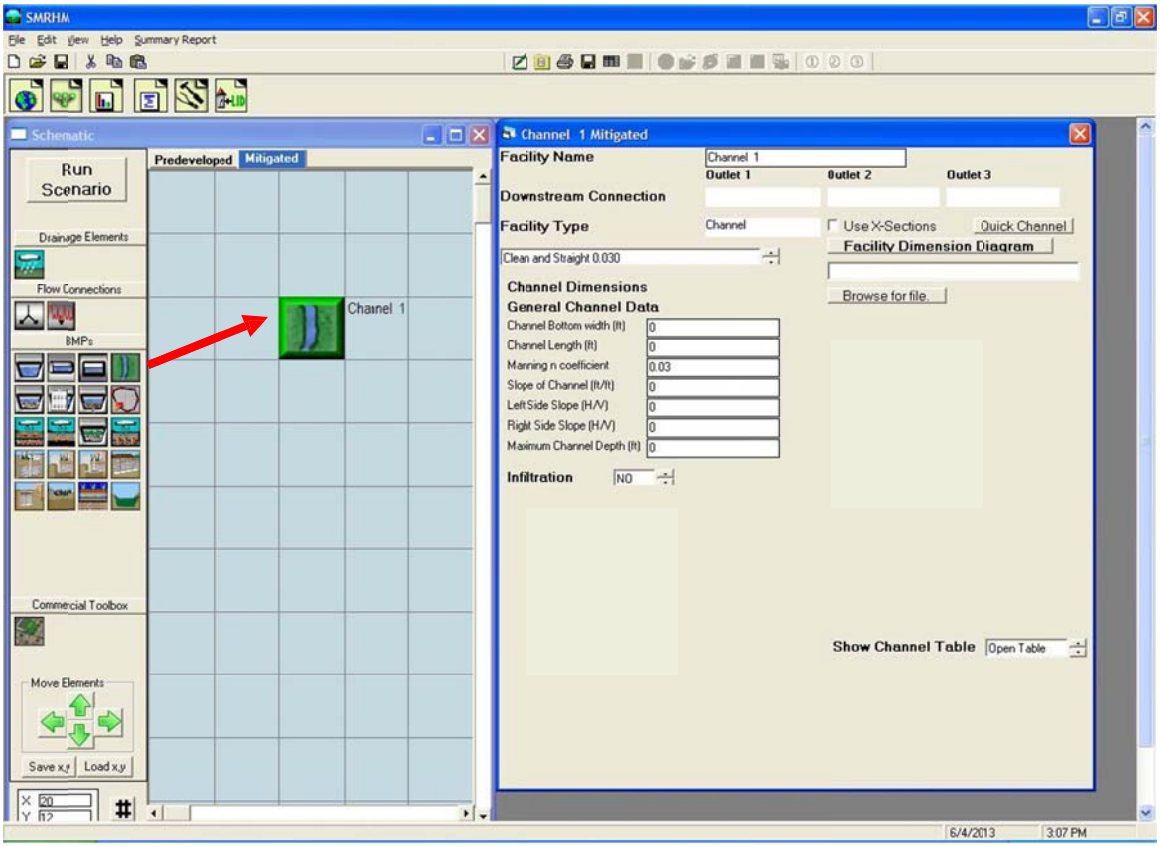
The bottom length and width and volume at riser head will be computed by Auto Pond; they cannot be input by the user.

Auto Vault and Auto Tank operates the same way as Auto Pond.

There are some situations where Auto Pond will not work. These situations occur when complex routing conditions upstream of the pond make it difficult or impossible for Auto Pond to determine which land use will be contributing runoff to the pond. For these situations the pond will have to be manually sized. Go to page 48 to find information on how to manually size a pond or other HMP facility.

NOTE: If Auto Pond selects a bottom orifice diameter smaller than the smallest diameter allowed by the Copermittee with jurisdiction over the project site then additional mitigating BMPs may be required to meet local hydromodification control requirements. Please see Appendix C or consult with the Copermittee with jurisdiction over the project site for more details. For manual sizing information see page 48.

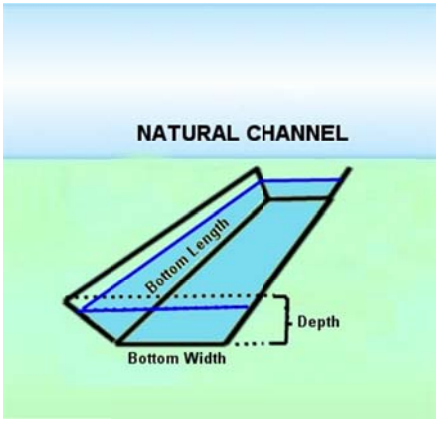
CHANNEL ELEMENT



The Channel element allows the user to route surface runoff from a land use basin or facility through an open channel to a downstream destination.

The channel cross section is represented by a trapezoid and is used with Manning's equation to calculate discharge from the channel. If a trapezoid does not accurately represent the cross section then the user should represent the channel with an independently calculated SSD Table element or use the Use X-Sections option.

The user inputs channel bottom width, channel length, channel bottom slope, channel left and right sideslopes, maximum channel depth, and the channel's roughness coefficient (Manning's n value). The user can select channel type and associated Manning's n from a table list directly above the Channel Dimension information or directly input the channel's Manning's n value.



The channel is used to represent a natural or artificial open channel through which water is routed. It can be used to connect a basin to a pond or a pond to a pond or multiple channels can linked together.

Channel input information:

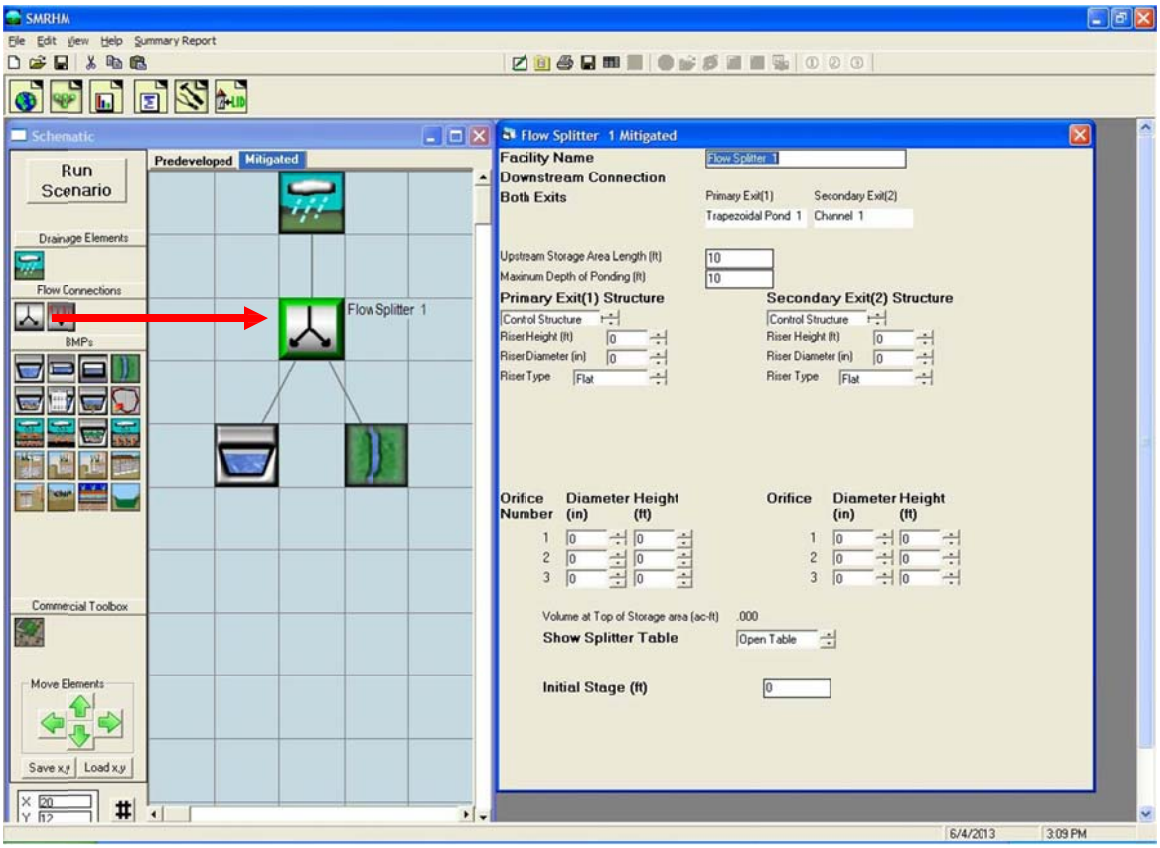
Channel Bottom Width (ft): Open channel bottom width
Channel Length (ft): Open channel length
Manning's n coefficient: Open channel roughness coefficient (user menu selected or input)
Slope of Channel (ft/ft): Open channel bottom slope
Left Sideslope of Channel (ft/ft): H/V ratio of horizontal distance to vertical; 0 (zero) for vertical channel sides
Right Sideslope of Channel (ft/ft): H/V ratio of horizontal distance to vertical; 0 (zero) for vertical channel sides
Maximum Channel Depth (ft): Height from bottom of channel to top of channel bank.

Infiltration: Yes (infiltration into the underlying native soil)
Measured Infiltration Rate (in/hr): Native soil infiltration rate
Infiltration Reduction Factor: 1/Native soil infiltration rate safety factor (see page 69)
Use Wetted Surface Area (sidewalls): Yes, if infiltration through the channel sideslopes is allowed.

If infiltration is used then the user should consult the Infiltration discussion on page 69.

NOTE: See Appendix C or consult with the Copermittee with jurisdiction over the project site for additional considerations regarding infiltration and determination of the appropriate infiltration reduction factor.

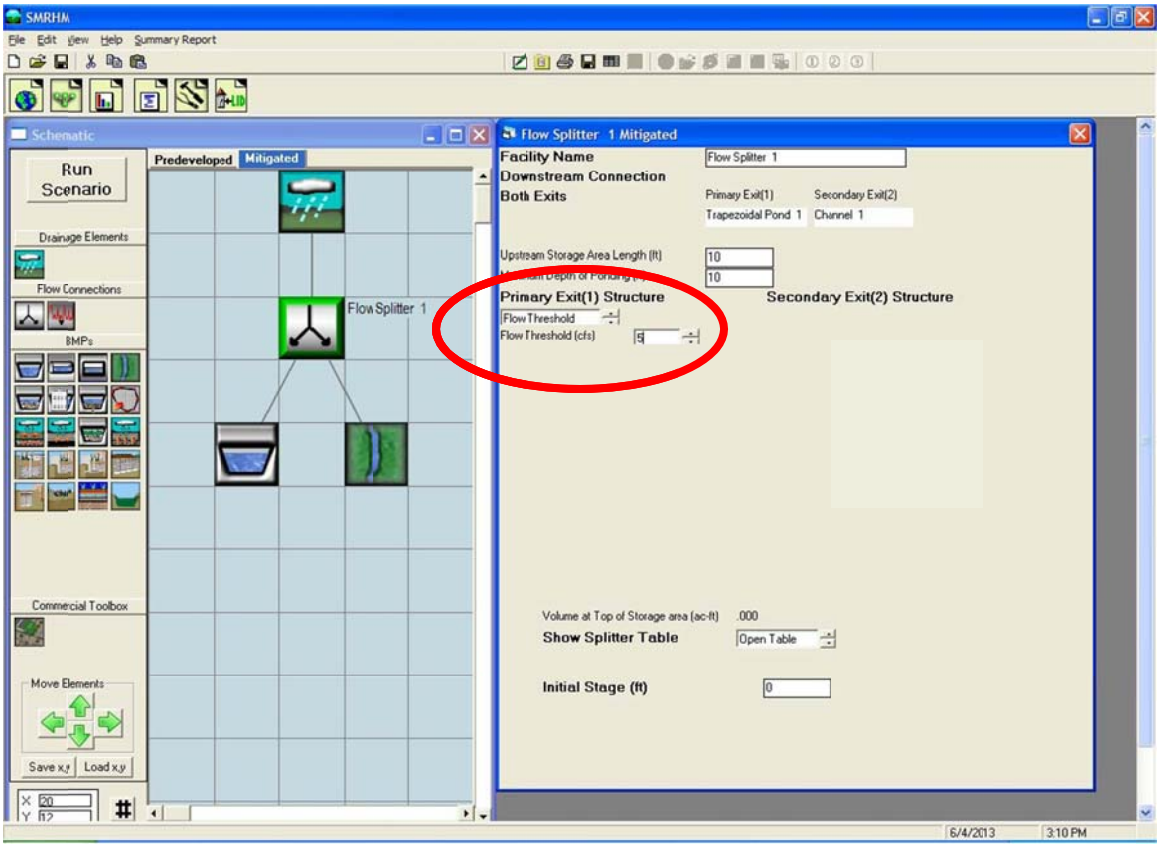
FLOW SPLITTER ELEMENT



The flow splitter divides the runoff and sends it to two different destinations. The splitter has a primary exit (exit 1) and a secondary exit (exit 2). The user defines how the flow is split between these two exits.

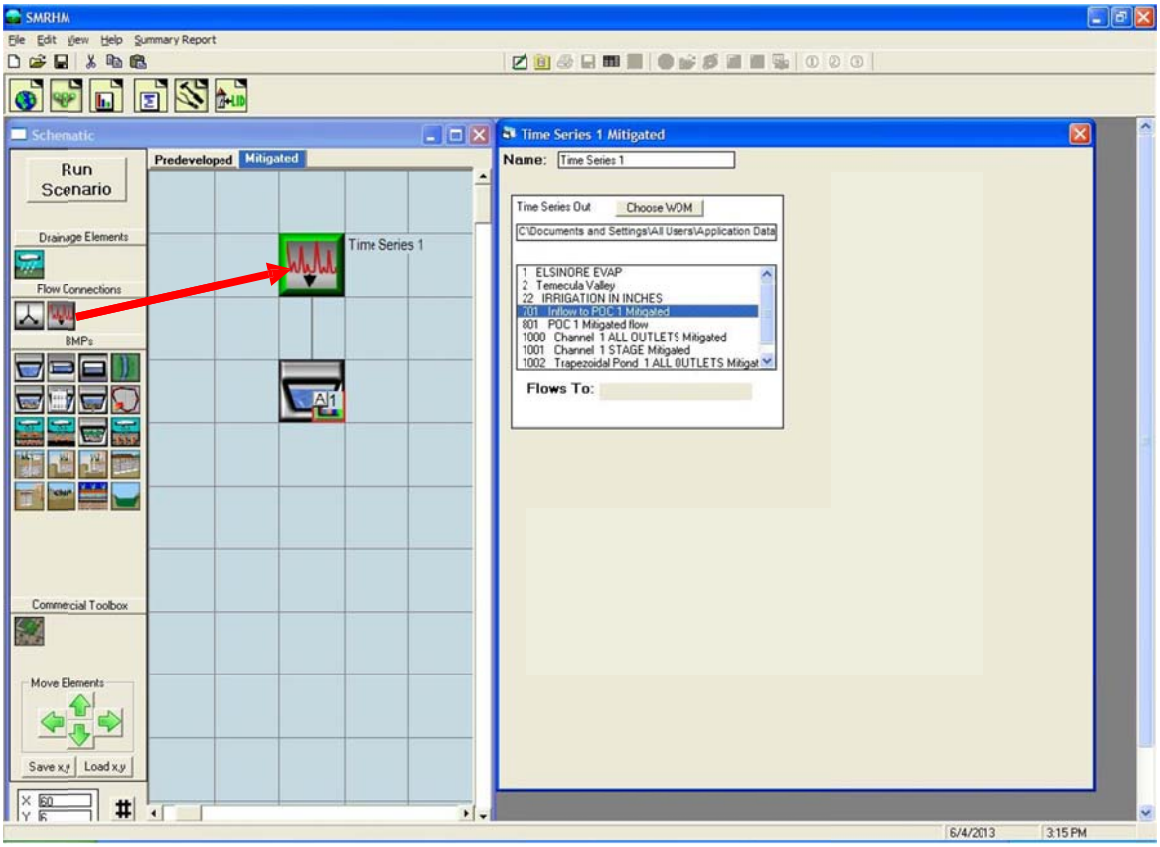
The user can define a flow control structure with a riser and from one to three orifices for each exit. The flow control structure works the same way as the pond outlet structure, with the user setting the riser height and diameter, the riser weir type (flat, rectangular notch, V-notch, or Sutro), and the orifice diameter and height.

For more information on riser notch options and orifices see discussion in **OUTLET STRUCTURE CONFIGURATIONS** section.



The second option is that the flow split can be based on a flow threshold. The user sets the flow threshold value in cubic feet per second (cfs) for exit 1 at which flows in excess of the threshold go to exit 2. For example, if the flow threshold is set to 5 cfs then all flows less than or equal
to 5 cfs go to exit 1. Exit 2 gets only the excess flow above the 5 cfs threshold (total flow minus exit 1 flow).

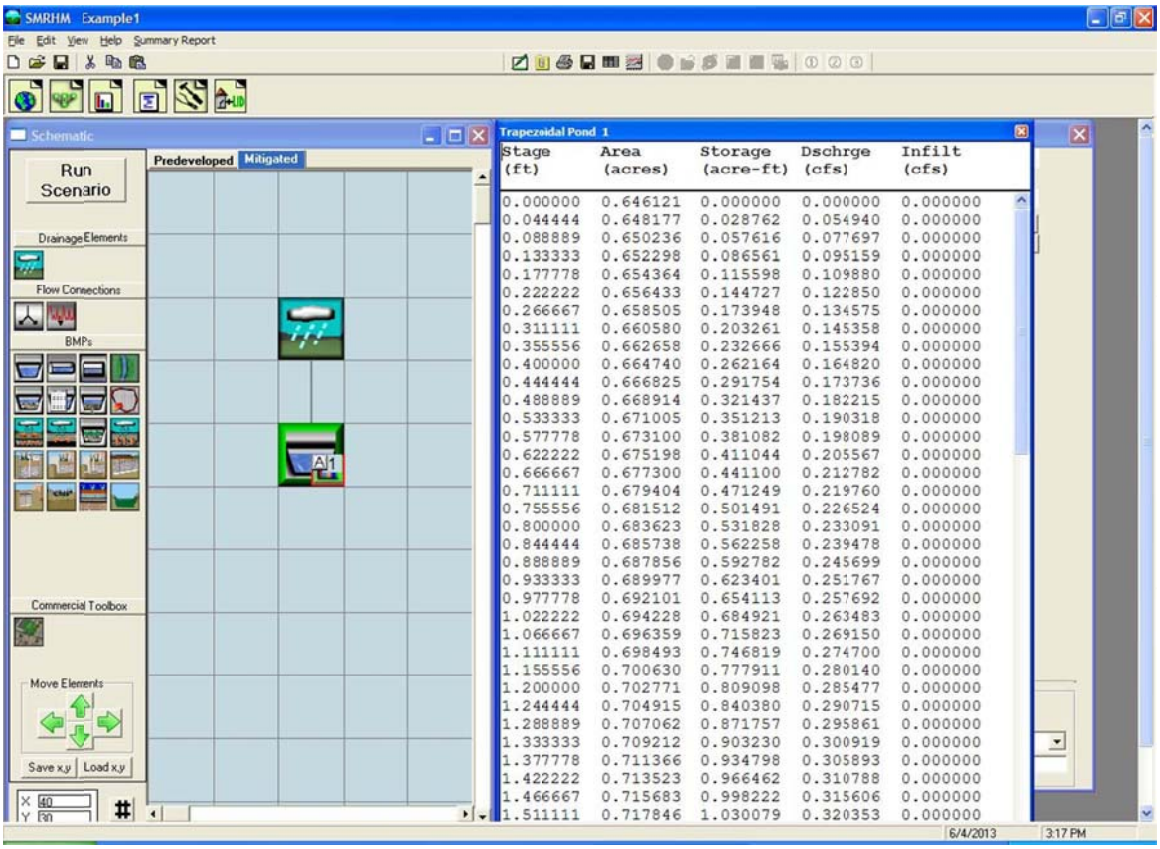
TIME SERIES ELEMENT



SMRHM uses time series of precipitation, evaporation, and runoff stored in its database (HSPF WDM file). The user has the option to create or use a time series file external from SMRHM in SMRHM. This may be a time series of flow values created by another HSPF model. An example is offsite runoff entering a project site. If this offsite runoff is in an existing WDM file and is the same period as SMRHM data and the same simulation time step (15-minute) then it can be linked to SMRHM model using the Time Series element.

To link the external time series to SMRHM the user clicks on the ***Choose WDM*** button and identifies the external WDM file. The external WDM's individual time series files are shown in the ***Time Series Out*** box. The selected input dataset is the time series that will be used by SMRHM.

STAGE-STORAGE-DISCHARGE TABLE

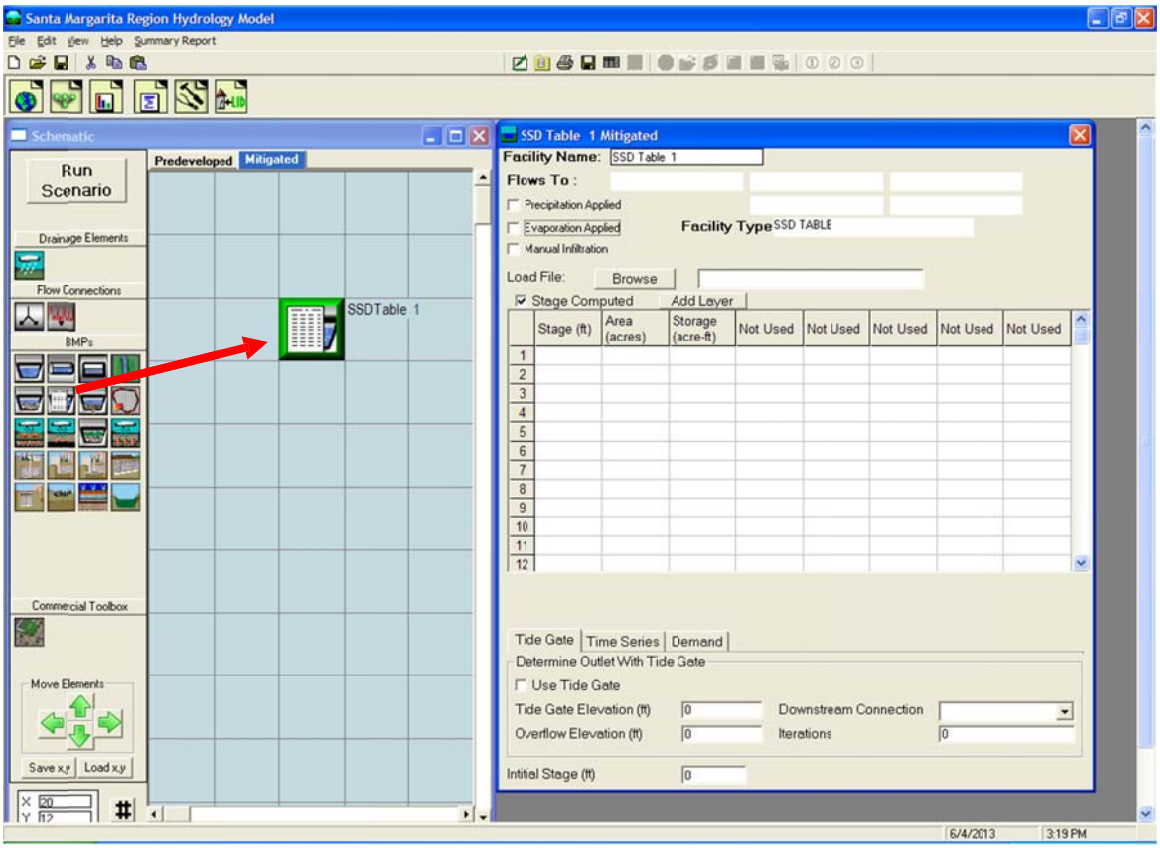


The stage-storage-discharge table hydraulically represents any facility that requires stormwater runoff routing. The table is automatically generated by SMRHM when the user inputs storage facility dimensions and outlet structure information. SMRHM generates 91 lines of stage, surface area, storage, surface discharge, and infiltration values starting at a stage value of zero (facility bottom height) and increasing in equal increments to the maximum stage value (facility effective depth).

When the user or SMRHM changes a facility dimension (for example, bottom length) or an orifice diameter or height, the model immediately recalculates the stage-storage- discharge table.

The user can input to SMRHM a stage-storage-discharge table created outside of SMRHM. To use a stage-storage-discharge table created out of SMRHM the SSD Table element is required. See the SSD Table element description below for more information on how to load such a table to SMRHM program.

SSD TABLE ELEMENT



The SSD Table is a stage-storage-discharge table externally produced by the user and is identical in format to the stage-storage-discharge tables generated internally by SMRHM for ponds, vaults, tanks, channels, etc.

The easiest way to create a SSD Table outside of SMRHM is to use a spreadsheet with a separate column for stage, surface area, storage, and discharge (in that order). Save the spreadsheet file as a comma-delimited file. A text file can also be created, if more convenient.

The SSD Table must use the following units: Stage: feet
Surface Area: acres
Storage: acre-feet
Discharge: cfs

A fifth column can be used to create a second discharge (cfs). This second discharge can be infiltration or a second surface discharge.

Certain rules apply to the SSD Table whether it is created inside or outside of SMRHM. These rules are:

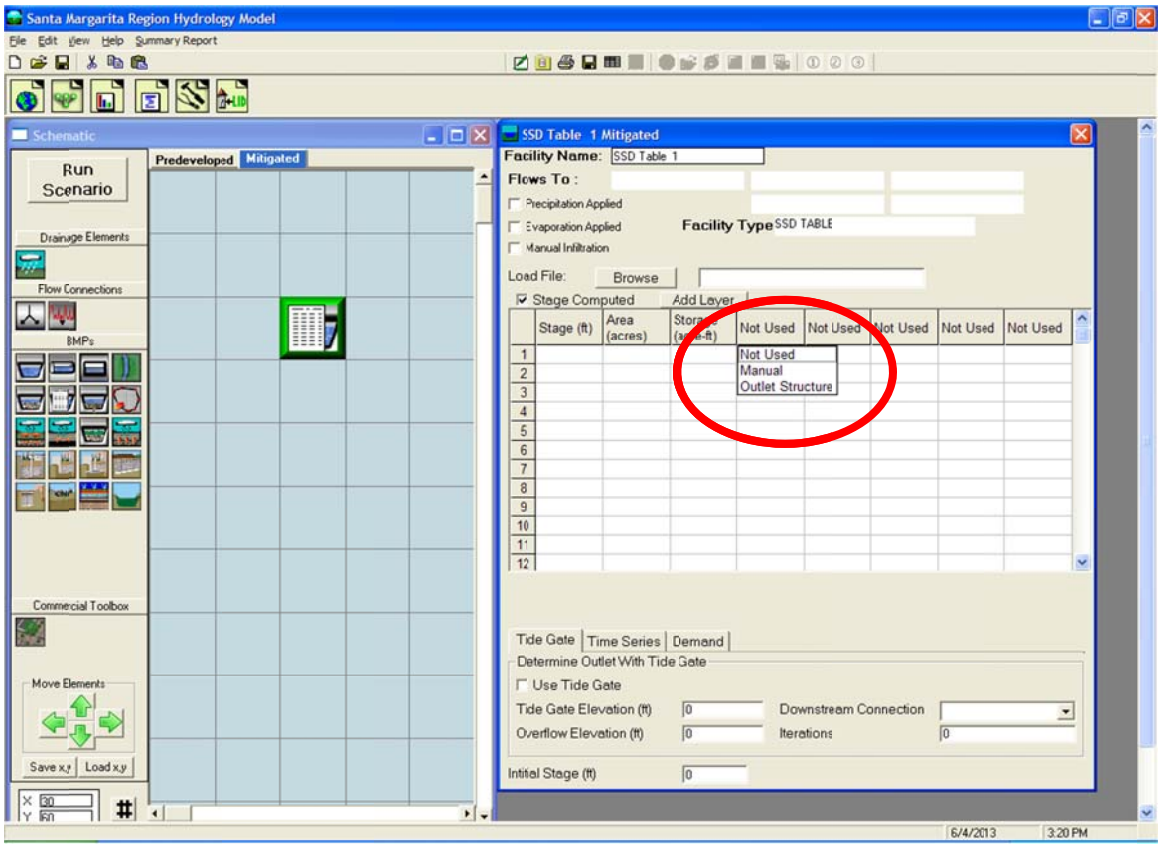
1. Stage (feet) must start at zero and increase with each row. The incremental increase does not have to be consistent.

2. Storage (acre-feet) must start at zero and increase with each row. Storage values should be physically based on the corresponding depth and surface area, but SMRHM does not check externally generated storage values.

3. Discharge (cfs) must start at zero. Discharge does not have to increase with each row. It can stay constant or even decrease. Discharge cannot be negative. Discharge should be based on the outlet structure's physical dimensions and characteristics, but SMRHM does not check externally generated discharge values.

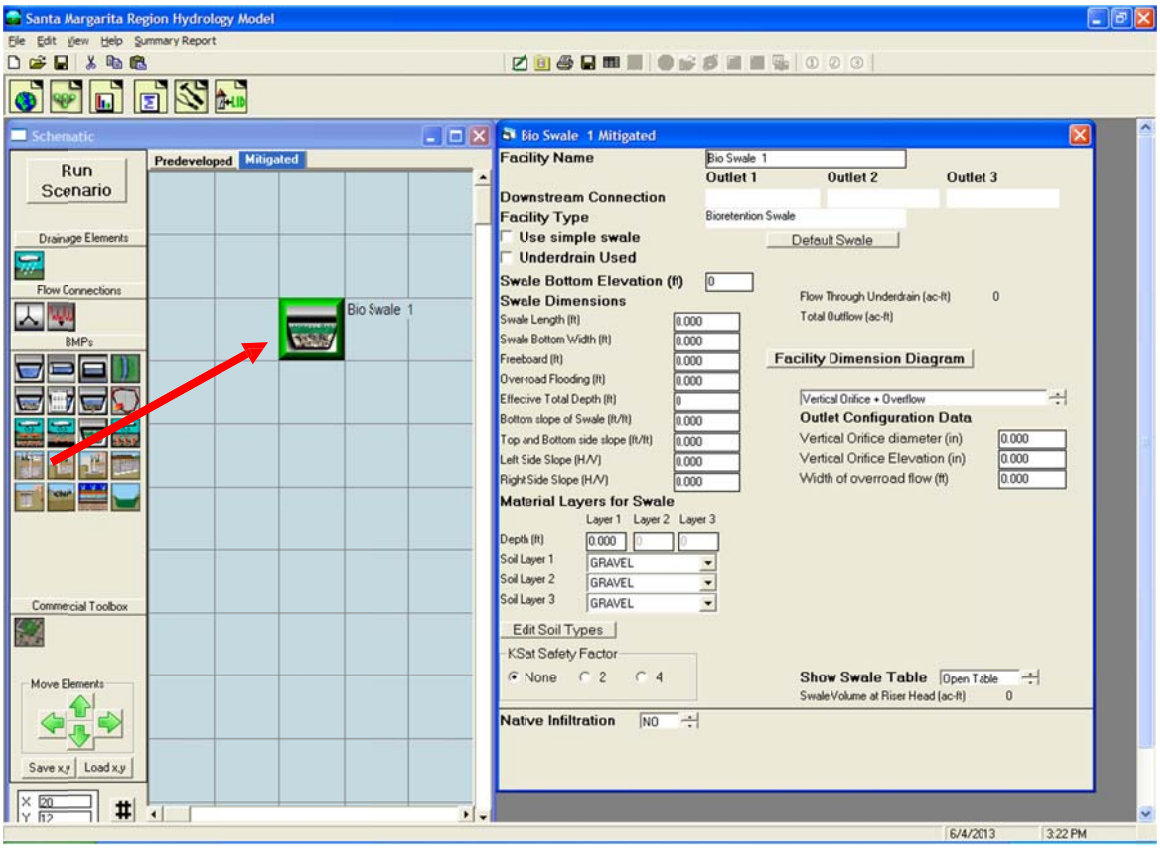
4. Surface area (acres) is only used if precipitation to and evaporation from the facility are applied.

To input an externally generated SSD Table, first create and save the table outside of SMRHM. Use the ***Browse*** button to locate and load the file into SMRHM.



The first three columns (Stage, Area, and Storage) will automatically show in the table. To use the additional columns (Column 4, 5, etc.) click on the ***Not Used*** at the head of the table and select the appropriate option. For externally calculated discharge (cfs) select ***Manual*** in Column 4. To have SMRHM calculate discharge based on outlet structure dimensions select ***Outlet Structure***. If infiltration is included then click on ***Not Used*** in Column 5 and select the appropriate option.

BIORETENTION ELEMENT



The Bioretention element represents a bioretention area or rain garden. In modeling shorthand terms SMRHM has abbreviated "bioretention" to the default name "bio swale". This name can be changed by the user.

The bioretention element has two available outlet structure configurations:

(1) vertical orifice plus overflow
(2) riser outlet

The user is required to enter the following information about the bioretention:

Swale Length (ft): length dimension of swale surface bottom

Swale Bottom Width (ft): width dimension of swale surface bottom

Effective Total Depth (ft): computed by SMRHM

Bottom Slope of Swale (ft/ft): the slope of the swale length; must be greater than zero

Left Sideslope (ft/ft): H/V ratio of horizontal distance to vertical; 0 (zero) for vertical swale sides

Right Sideslope (ft/ft): H/V ratio of horizontal distance to vertical; 0 (zero) for vertical swale sides

For the three amended soil material layers the user inputs:

Layer Thickness (feet): depth of amended soil
Type of amended soil: 24 different soil types are included; the user can also create their own soil type using the Edit Soil Type button

NOTE: Amended soil layers 2 and 3 are optional.

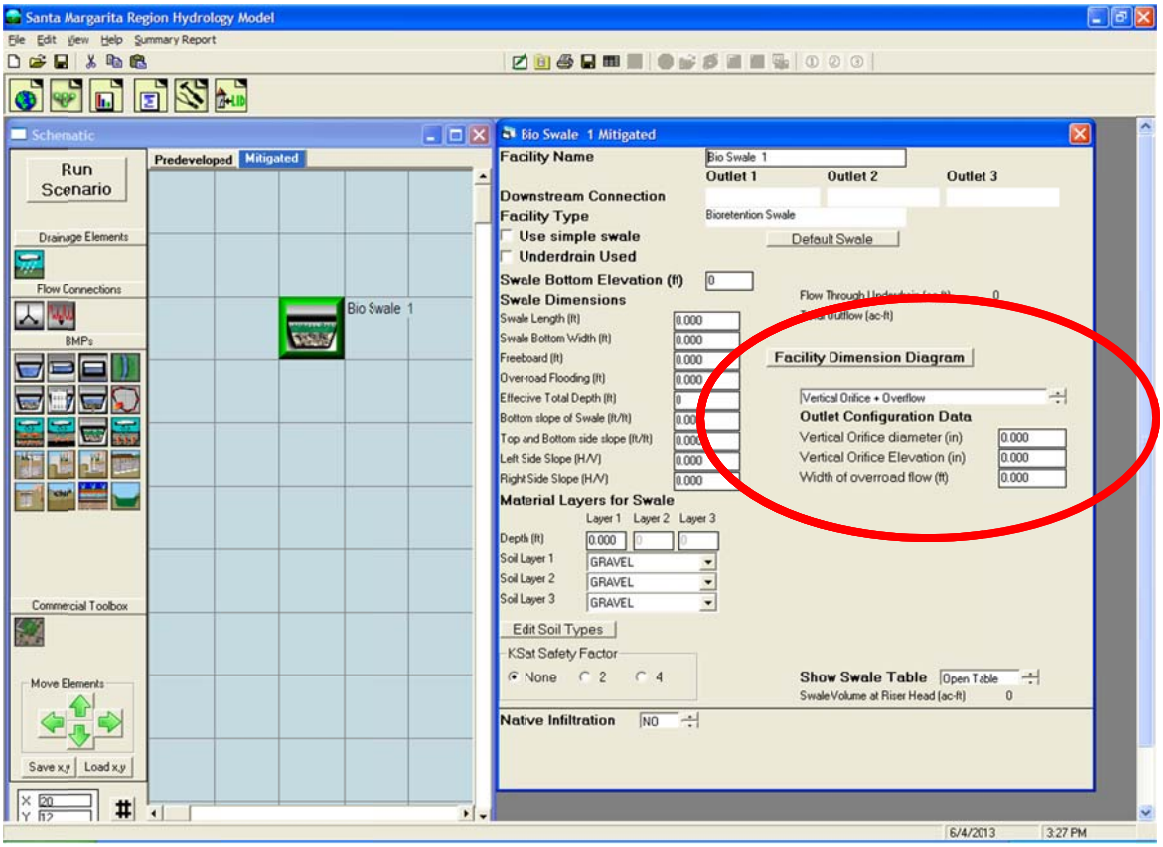
Infiltration to the native soil can be turned on by setting Native Infiltration to ***YES***. The parameters for native soil infiltration are:

Measured Infiltration Rate (inches per hour): infiltration rate of the native soil
Infiltration Reduction Factor: between 0 and 1 (1/Native soil infiltration rate safety factor (see page 69)
Use Wetted Surface Area (sidewalls): YES or NO; YES allows infiltration to the native soil through the sidewalls of the swale; otherwise all infiltration is through the bottom only

If infiltration is used then the user should consult the Infiltration discussion on page 69.

NOTE: See Appendix C or consult with the Copermittee with jurisdiction over the project site for additional considerations regarding infiltration and determination of the appropriate infiltration reduction factor.

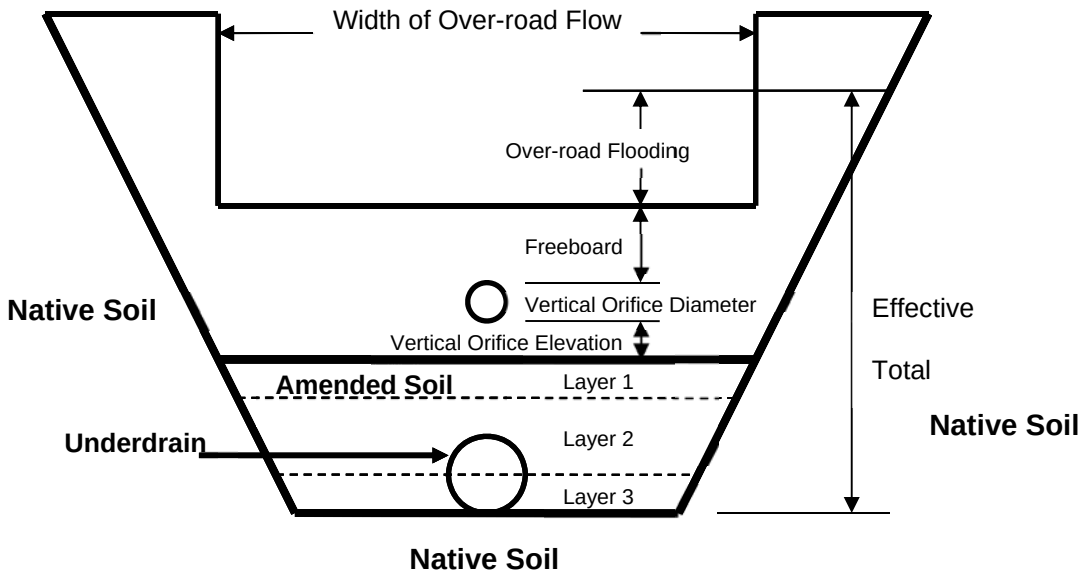
The user has two bioretention surface outlet configuration choices: (1) ***Vertical Orifice + Overflow*** or (2) ***Riser Outlet Structure***.



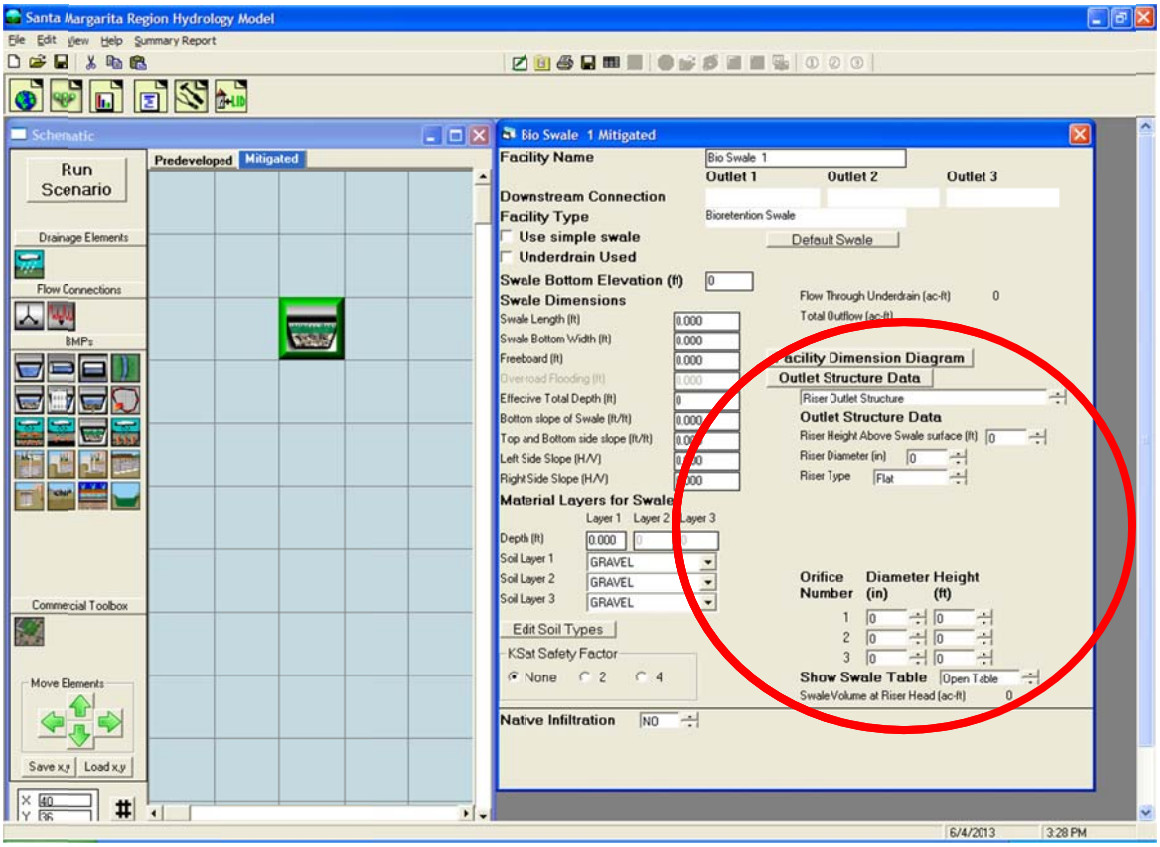
The input information required for the vertical orifice plus overflow is:

Vertical Orifice Diameter (inches): diameter of vertical opening below the weir
Vertical Orifice Elevation (inches): vertical distance from the top of the amended soil surface to the bottom of the vertical orifice
Width of Over-road Flow (feet): weir/street length

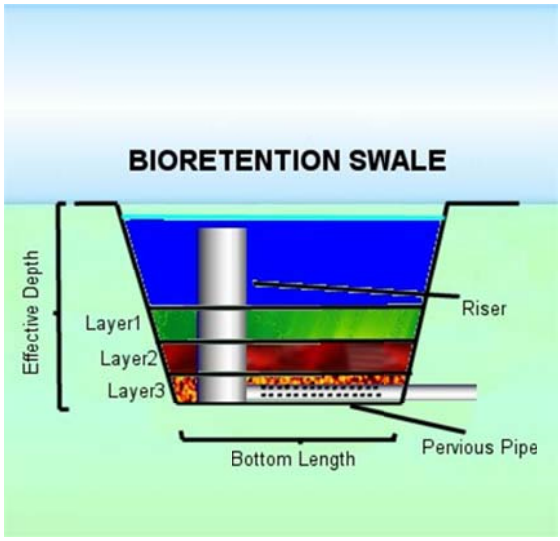
Diagram of bioretention with vertical orifice plus overflow:



Riser outlet structure option:



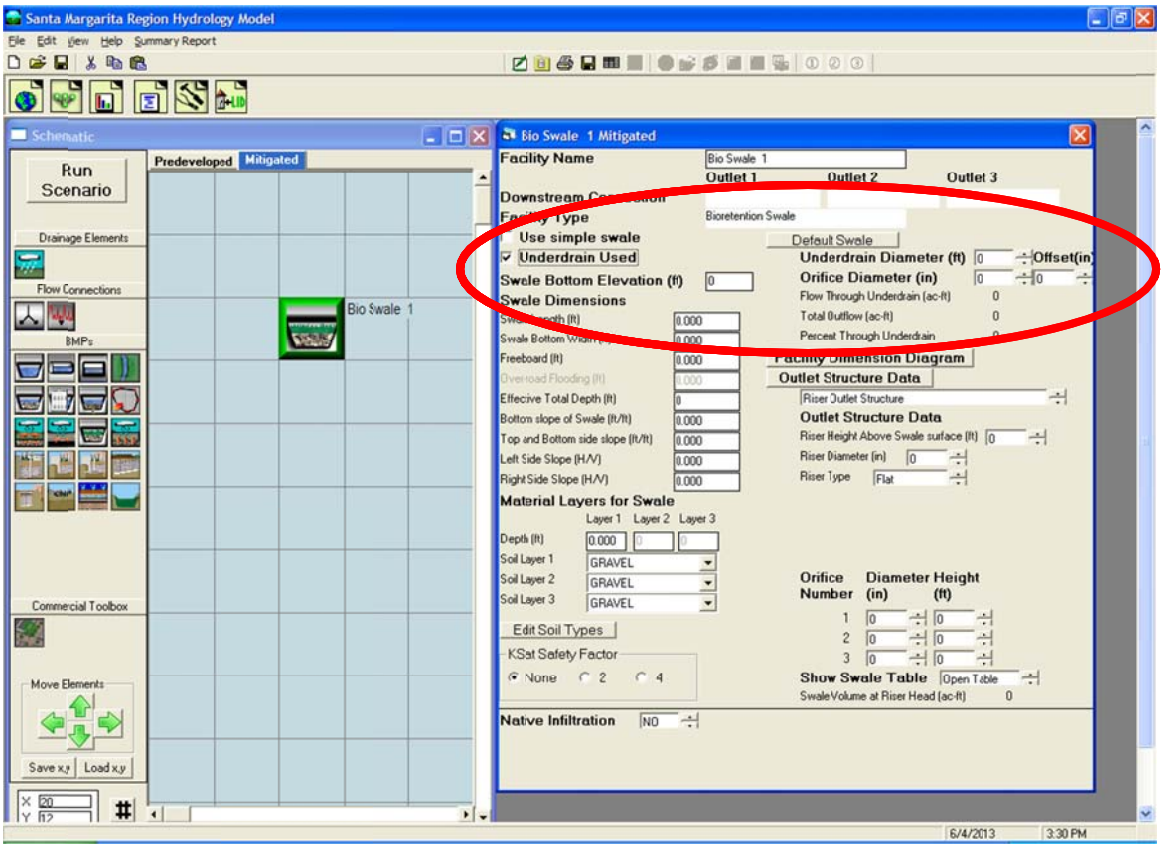
The input information required for the riser outlet structure is:



Riser Height above Swale Surface (feet): depth of surface ponding before the riser is overtopped
Riser Diameter (inches): diameter of the stand pipe
Riser Type: Flat or Notched
Notch Type: Rectangular, V-Notch, or Sutro
For a rectangular notch:
Notch Height (feet): distance from the top of the weir to the bottom of the notch
Notch Width (feet): width of notch; cannot be larger than the riser circumference

For more information on riser notch options and orifices see discussion in **OUTLET STRUCTURE CONFIGURATIONS** section.

To use the underdrain click the ***Underdrain Used*** box and input an underdrain pipe diameter (feet), underdrain outlet orifice diameter (inches), and offset (inches). The offset defines the height of the bottom of the underdrain pipe above the bottom of the lowest amended soil layer.

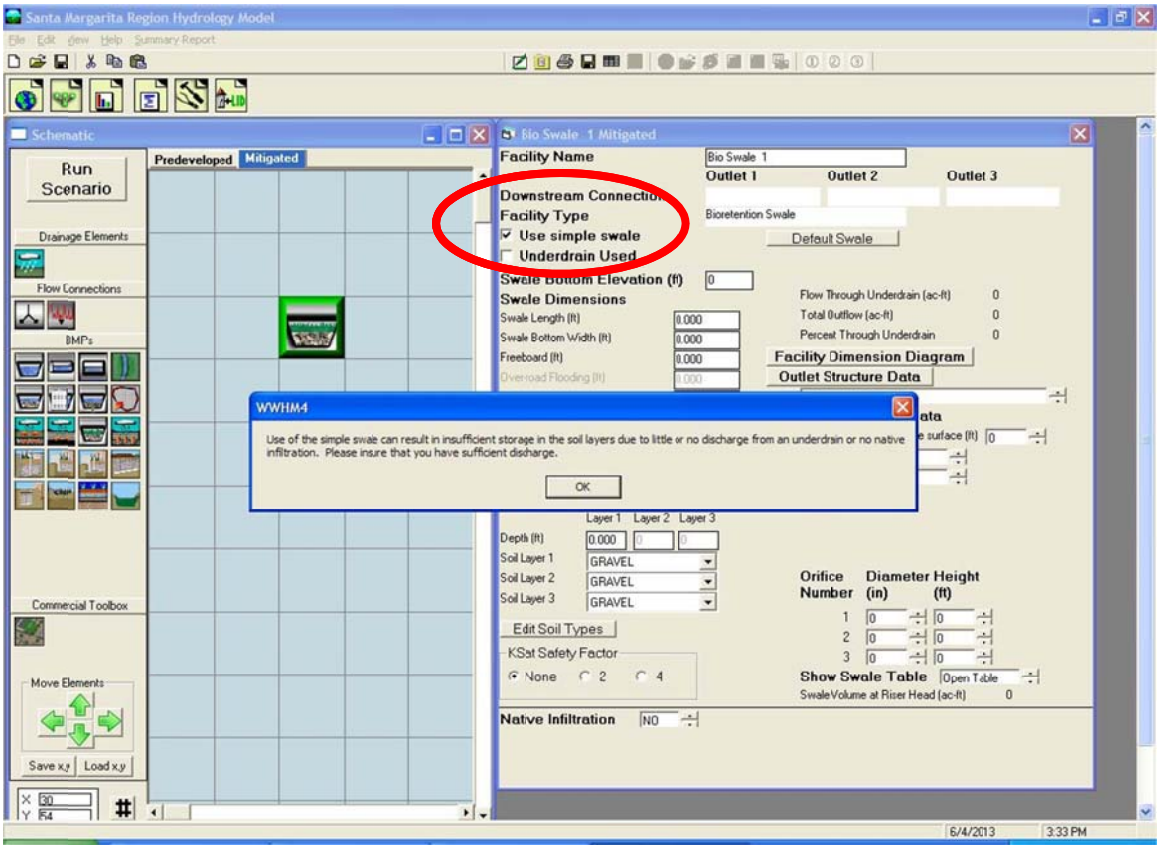


The amended soil layer fills with stormwater runoff from the top on down to where it can drain to the native soil (if Native Infiltration is set to ***YES***) and/or the underdrain pipe (if ***Underdrain Used*** box is checked).

Water enters the underdrain when the amended soil becomes saturated down to the top of the underdrain. The underdrain pipe fills and conveys stormwater runoff proportionally to the depth
of amended soil saturation. When the amended soil is fully saturated the underdrain pipe is at full capacity. Discharge from the underdrain pipe is controlled by the underdrain orifice diameter.

If native infiltration is turned on then native infiltration will start when/if stormwater runoff:

1. starts to fill the underdrain (if an underdrain is used).
2. enters the amended soil (if Use Wetted Surface Area (sidewalls) is set to ***YES***).
3. saturates the amended soil layer(s) to 2/3rds of the total amended soil depth (if there is no underdrain and Wetted Surface Area is set to ***NO***).



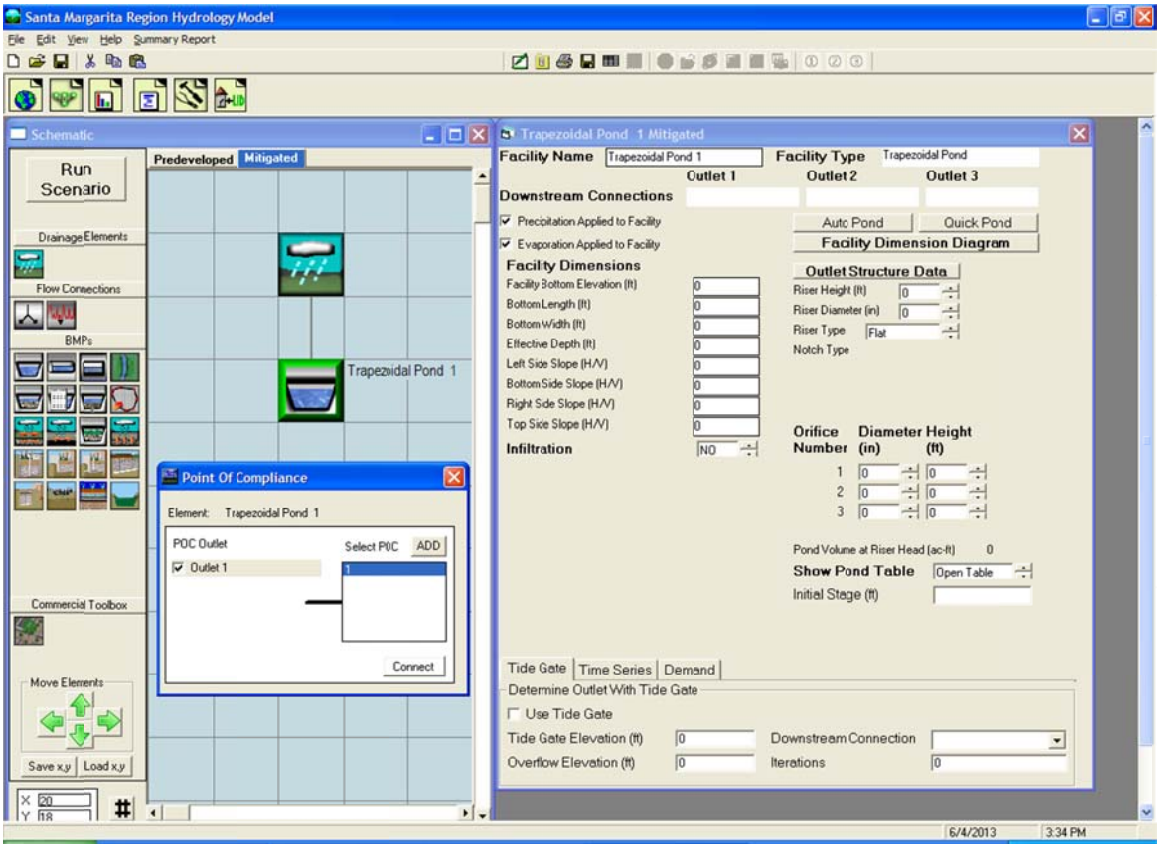
There is a simple swale option. It is computationally much faster than the standard bioretention. Before using the simple swale option read the note on the screen and the information below to understand the limitations of the simple swale.

The standard bioretention routine uses HSPF Special Actions to check the available amended soil storage and compares it with the stormwater runoff inflow rate. Because of the check done by HSPF Special Actions simulations using bioretention take much longer than simulations not using bioretention. Simulations that normally take only seconds may take multiple minutes when one or more bioretention facilities are added, depending on the computational speed of the computer used.

One solution to this problem is to use the simple swale option (check the Use Simple Swale box). The simple swale does not include HSPF Special Actions. It is less accurate than the standard swale. Tests have shown that the simple swale option should only be used when the swale area (and volume) is relatively small compared to the contributing basin area. If in doubt, model the bioretention both ways and see how close the simple swale answer is to the standard swale method. The standard swale method will always be more accurate than the simple swale.

POINT OF COMPLIANCE

SMRHM allows for multiple points of compliance (maximum of 59) in a single project. A point of compliance is defined as the location at which the Predevelopment and Mitigated flows will be analyzed for compliance with the flow control standard.

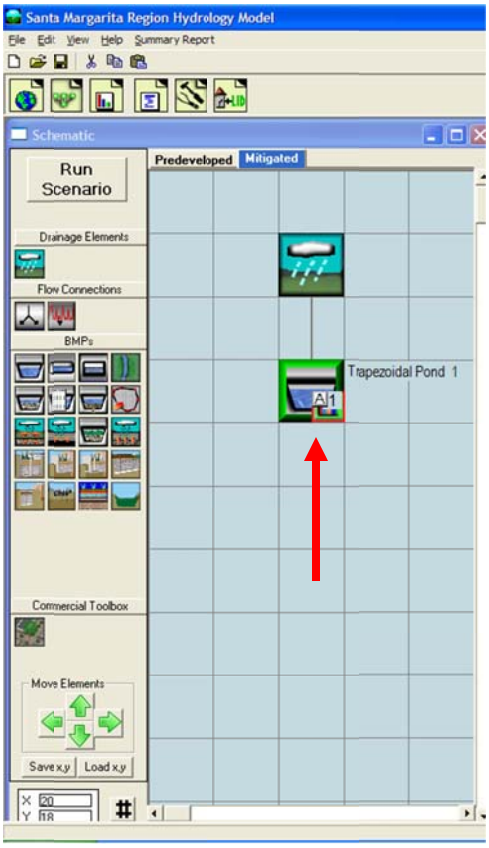


The point of compliance is selected by right clicking on the element at which the compliance analysis will be made. In the example above, the point of compliance analysis will be conducted at the outlet of the trapezoidal pond.

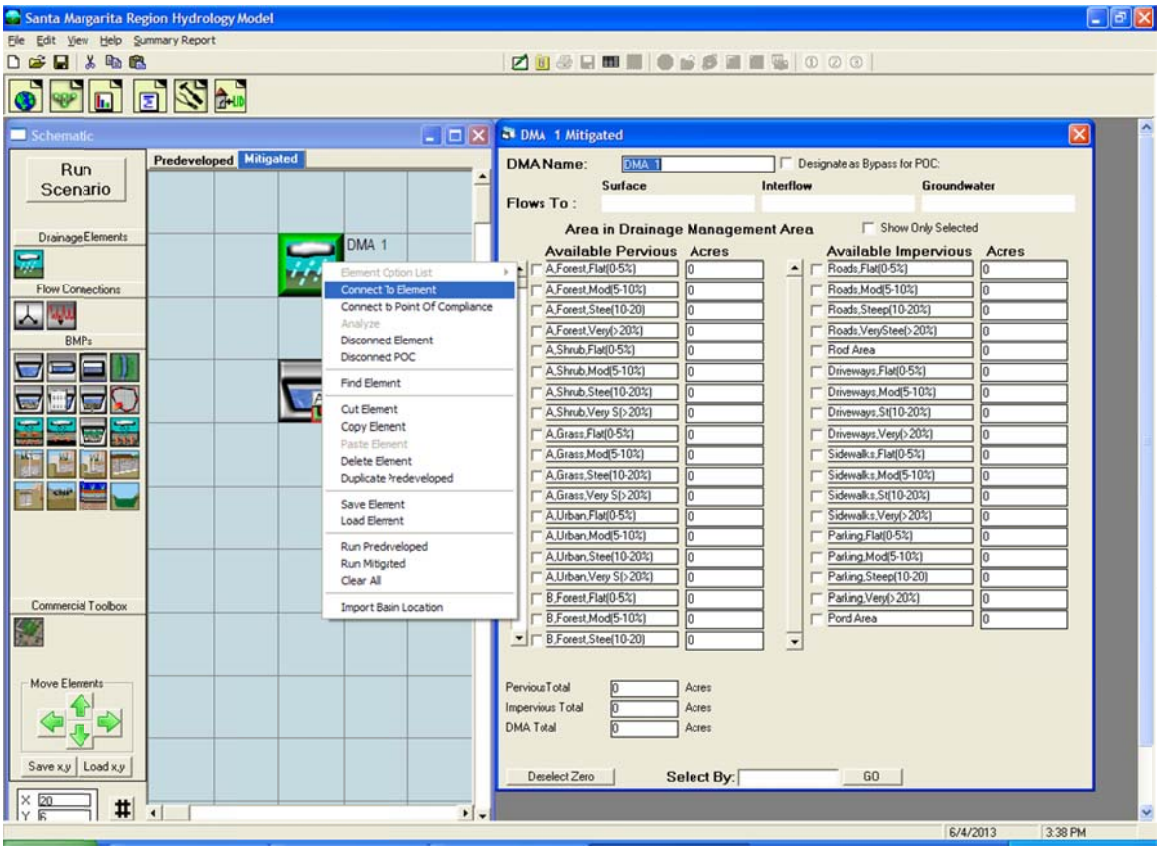
Additional points of compliance can be added by clicking on the ***ADD*** button and then highlighting the POC number to be used for the element. Once a POC number is added it cannot be removed, but if it is not used then it has no effect.

Once the point of compliance has been selected the element is modified on the Schematic screen to include a small box with the letter "A" (for Analysis) in the lower right corner. This identifies the outlet from this element as a point of compliance.

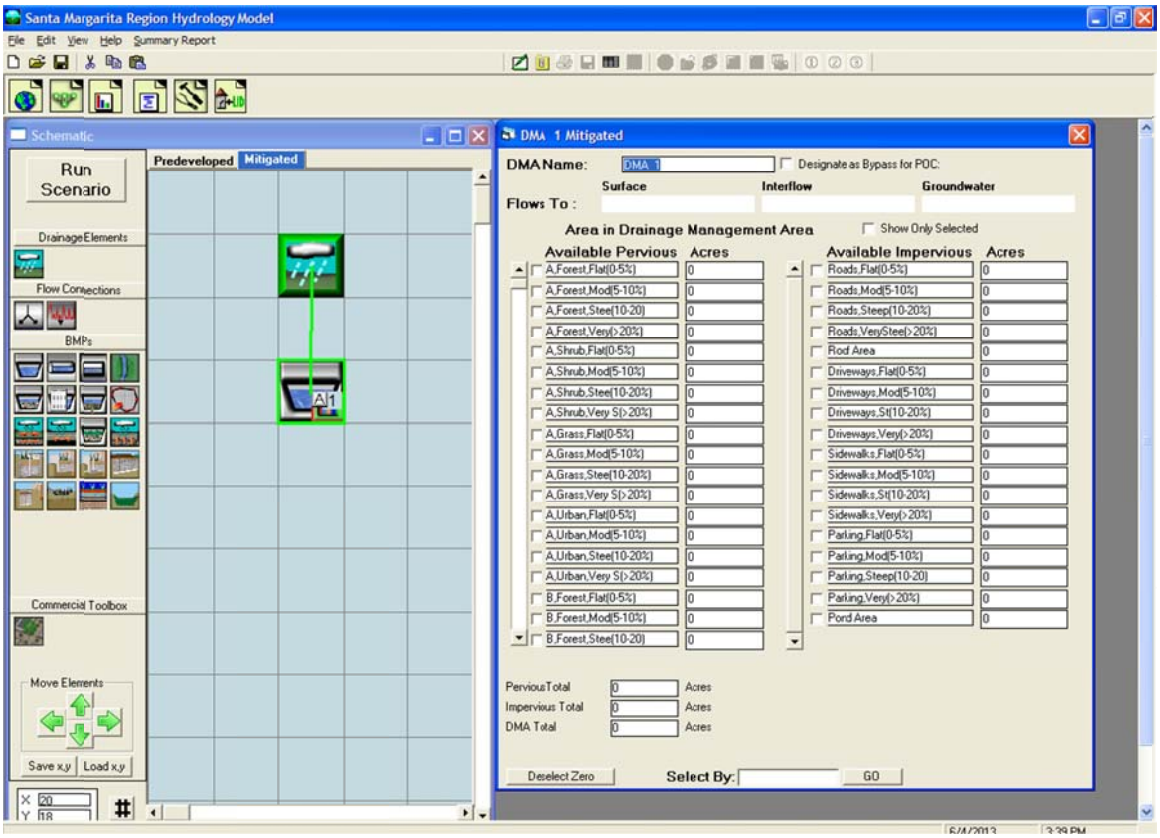
The number 1 next to the letter "A" is the number of the POC (POC 1).



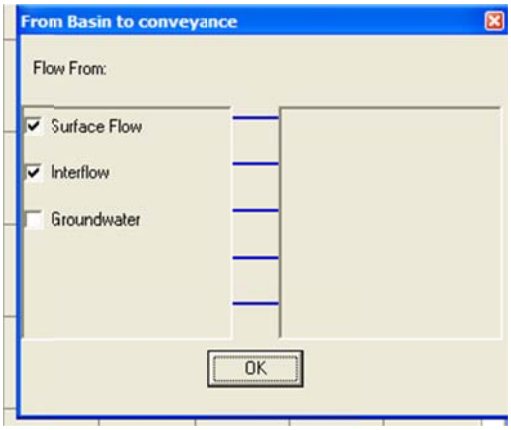
CONNECTING ELEMENTS



Elements are connected by right clicking on the upstream element (in this example DMA 1) and selecting and then left clicking on the ***Connect To Element*** option. By doing so SMRHM extends a line from the upstream element to wherever the user wants to connect that element.

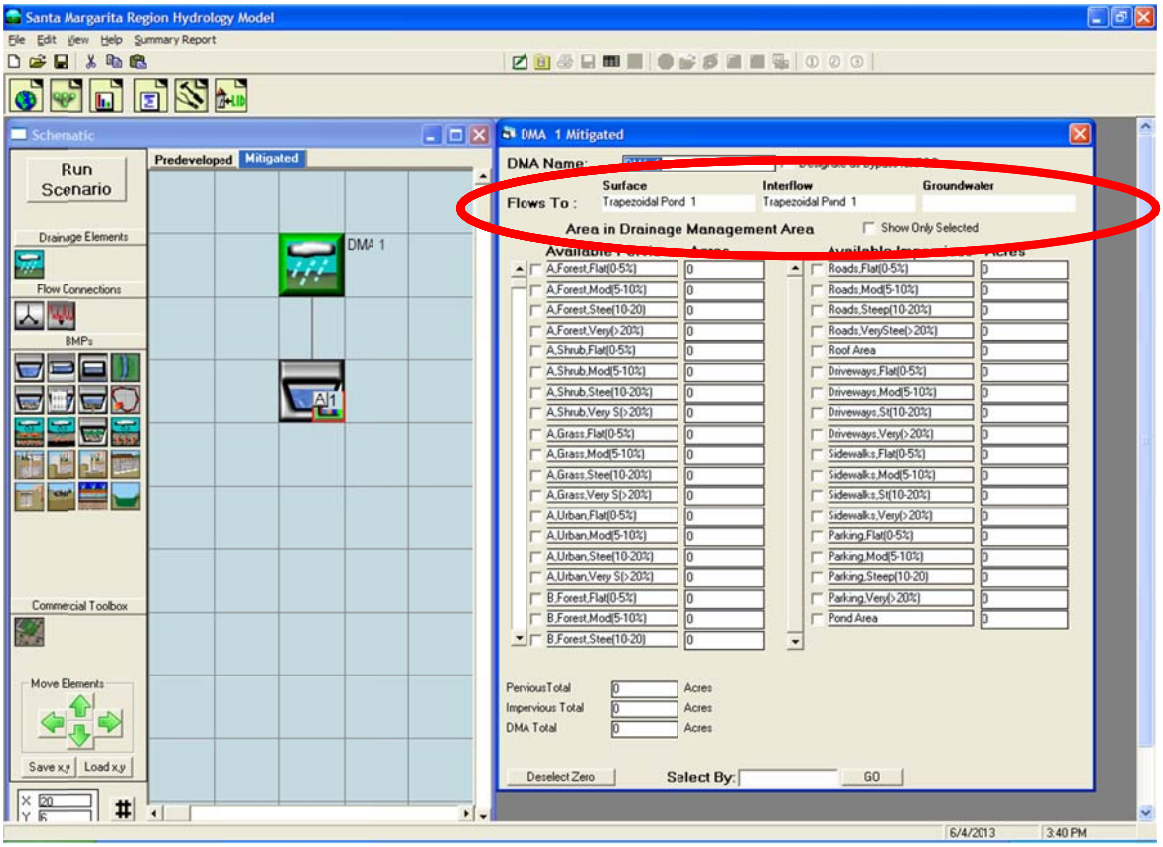


The user extends the connection line to the downstream element (in this example, a pond) and left clicks on the destination element. This action brings up the From Basin to Conveyance box that allows the user to specify which runoff components to route to the downstream element.



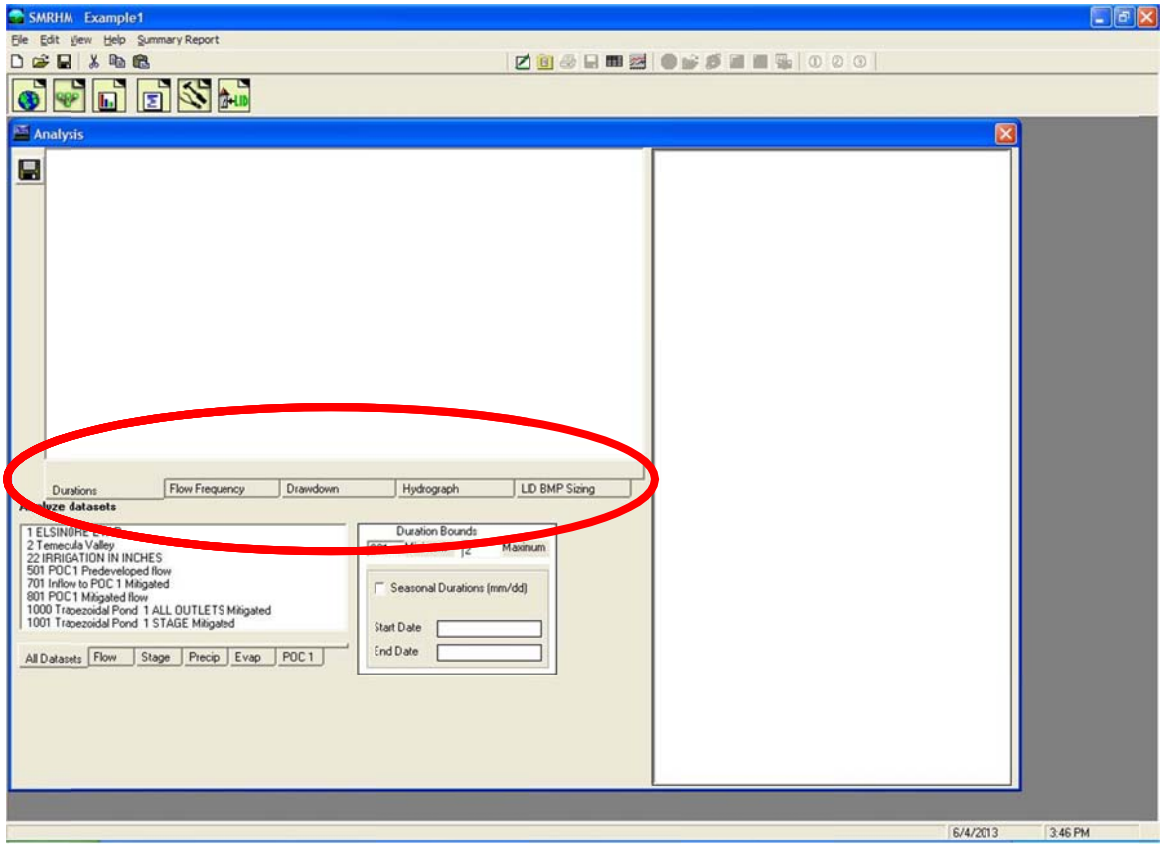
Stormwater runoff is defined in the SMRHM as surface flow plus interflow. Both boxes should be checked. Groundwater should not be checked for the standard land development mitigation analysis. Groundwater should only be checked when there is observed and documented base flow occurring from the upstream basin.

After the appropriate boxes have been checked click the ***OK*** button.

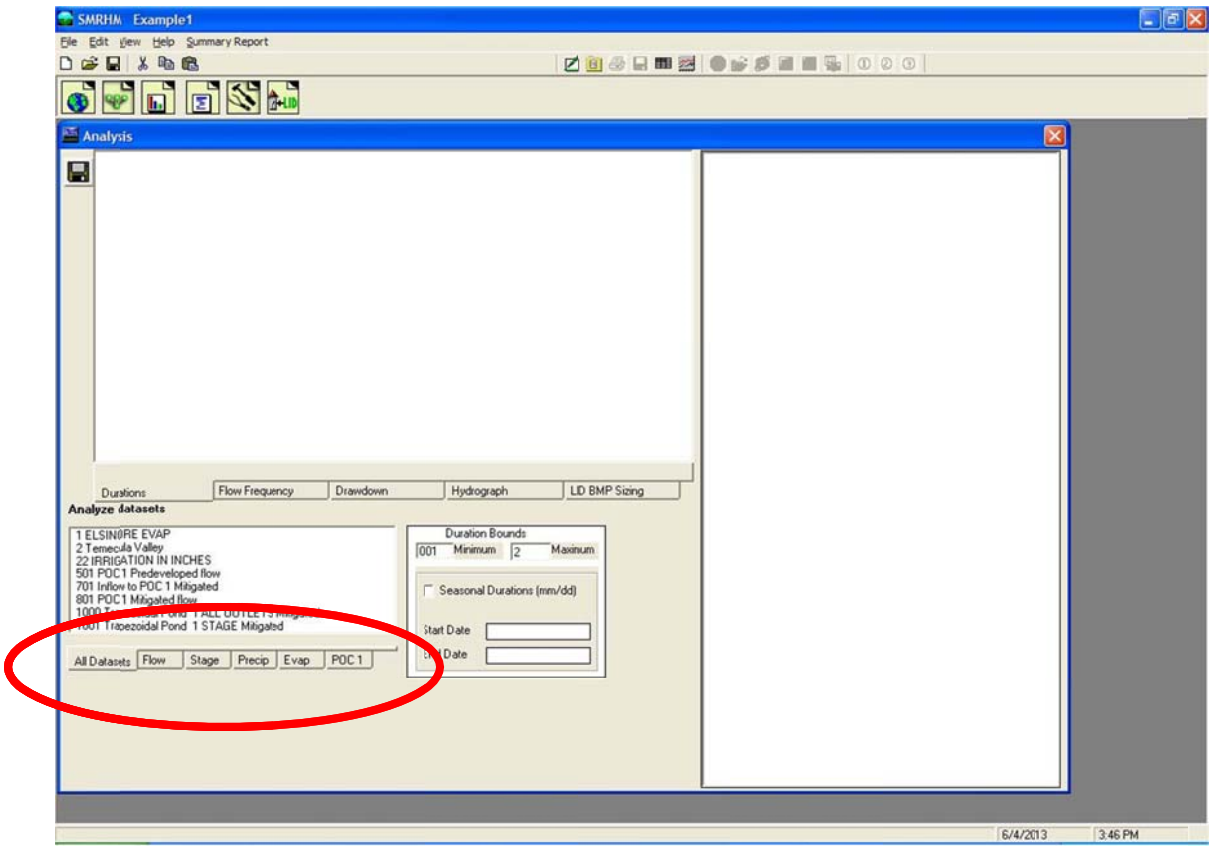


The final screen will look like the above screen. The basin information screen on the right will show that DMA 1 stormwater runoff flows to Trapezoidal Pond 1 (groundwater is not connected).

ANALYSIS SCREEN

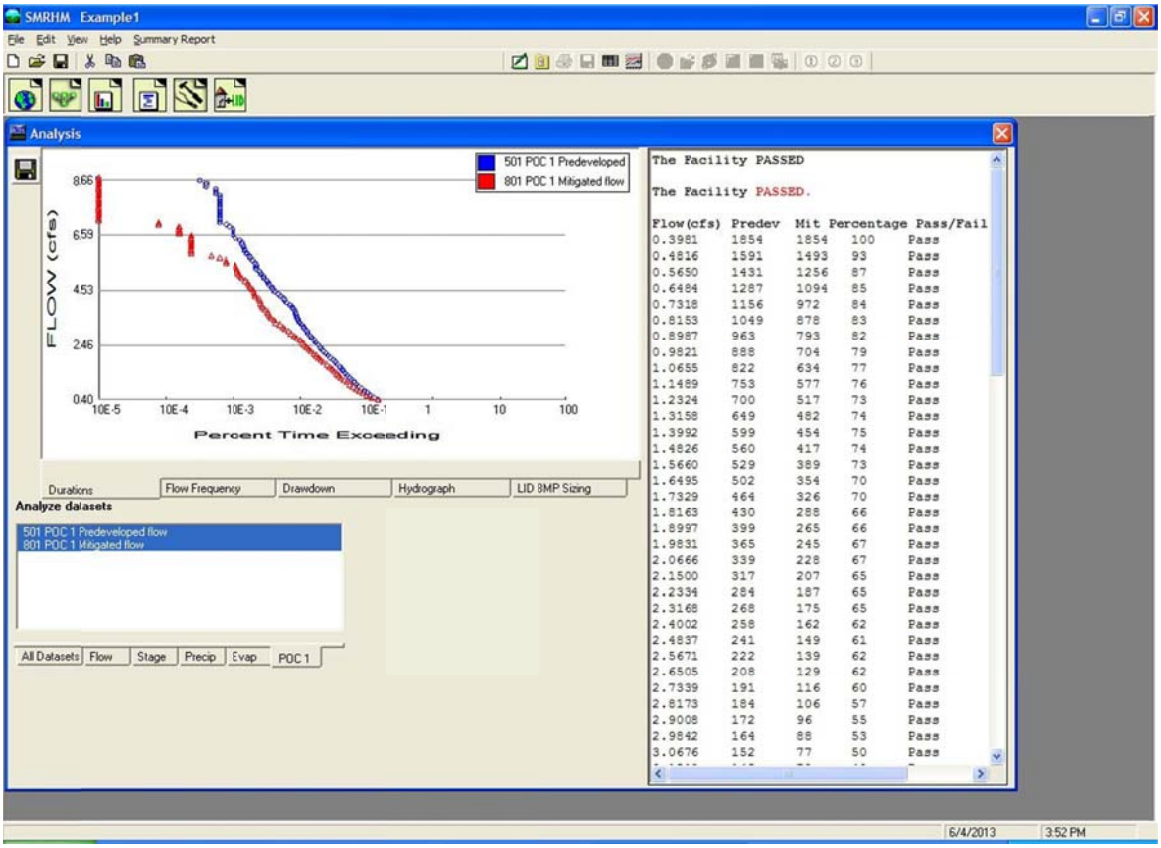


The ***Analysis*** tool bar button (third from the left) brings up the Analysis screen where the user can look at the results of the Predevelopment and Mitigated scenarios. The Analysis screen allows the user to analyze and compare flow durations, flow frequency, drawdown times, hydrographs, and LID BMP sizing by calculating V_{BMP} and Q_{BMP} using the Rational Method.



The user can analyze all time series datasets or just flow, stage, precipitation, evaporation, or point of compliance flows by selecting the appropriate tab below the list of the different datasets available for analysis.

FLOW DURATION



Flow duration at the point of compliance (POC 1) is the most common analysis. A plot of the flow duration values is shown on the left, the flow values on the right.

The flow duration flow range is from the lower threshold flow frequency value (10% of the 2-year value) to the upper threshold flow frequency value (10-year value). As shown in the flow duration table to the right of the flow duration curves, this flow range is divided into approximately 100 levels (flow values).

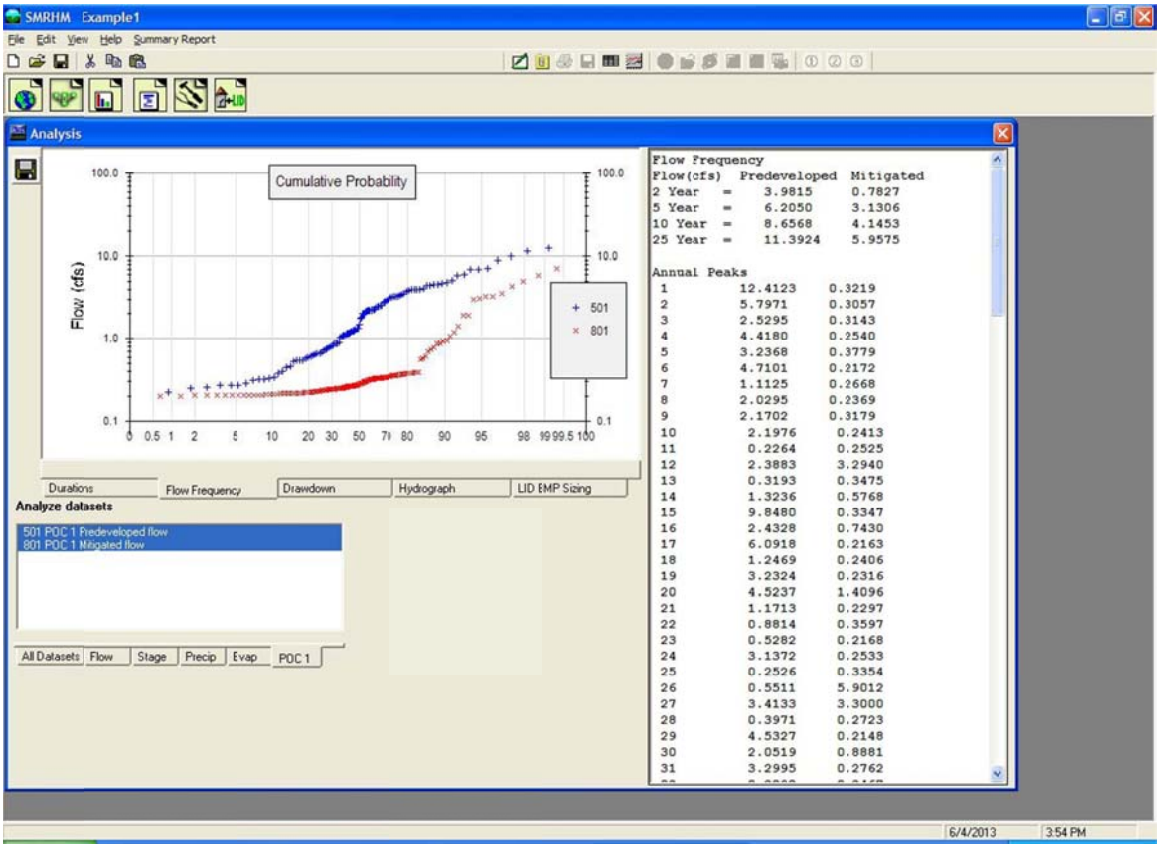
The division of the flow range into a large number of levels is important to make sure that the erosive flows do not increase between the lower threshold (10% of the 2-year flow) and the 2-year flow frequency value and between increasing flow frequency levels (3-year, 4-year, 5-year, etc.). The majority of the erosive flows occur between the 10% of the 2-year flow value and the 2-year flow frequency value. It is important to divide the flow levels in that range into multiple level steps to not miss any occasions when the Mitigated flows exceed the Predevelopment flows.

For each flow level/value SMRHM counts the number of times that the flow at the Point of Compliance for the Predevelopment scenario (Predev) exceeds that specific flow level/value. It does the same count for the Mitigated scenario flow (Mit). The total number of counts is the number of simulated 15-minute time steps that the flow exceeds that specific flow level/value.

The Percentage column is the ratio of the Dev count to the Predev count. This ratio must be less than or equal to 100% for flow levels/values between the lower threshold (10% of the 2-year flow) and the 5-year flow and 110% for flow levels/values between the 5-year flow and the upper threshold value.

If the percentage value does not exceed this maximum ratio (100% for the lower threshold to the 5-year flow value and 110% for the 5-year flow value to the 10-year value) then the Pass/Fail column shows a Pass for that flow level. If they are exceeded then a Fail is shown. A single Fail and the facility fails the flow duration criteria. The facility overall Pass/Fail is listed at the top of the flow duration table.

FLOW FREQUENCY



Flow frequency plots are shown on the left and the 2-, 5-, 10-, and 25-year frequency values are on the right. Flow frequency calculations are based on selecting partial duration flow values and ranking them by their Cunnane Plotting Position.

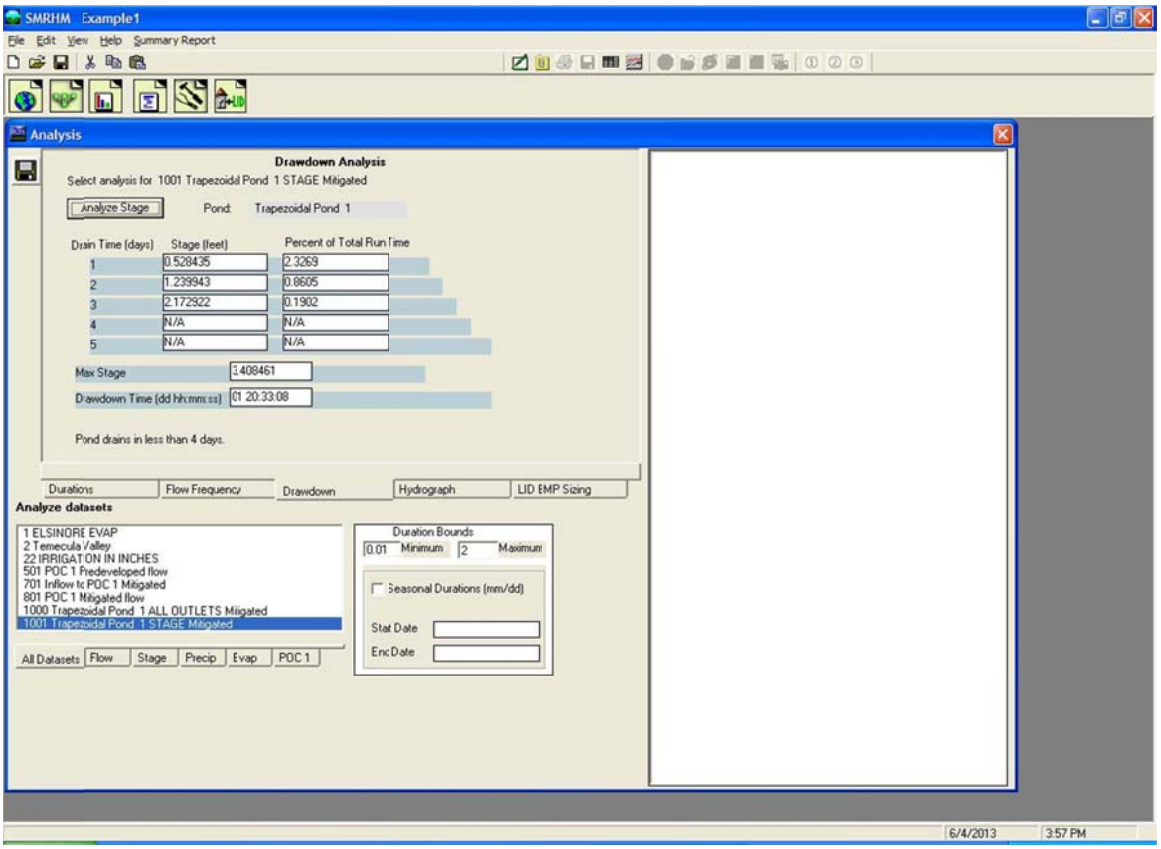
The Cunnane Plotting Position formula is:

Tr = (N+a)/(m-b) where Tr = return period (years)
m = rank (largest event, m = 1)
N = number of years
a = 0.2
b = 0.4

Probability = 1/Tr

The return period value, Tr, is used in SMRHM to determine the 2-year, 5-year, 10-year, and 25-year peak flow values. If necessary, the 2-year, 5-year, 10-year, and 25-year values are interpolated from the Tr values generated by Cunnane.

DRAWDOWN



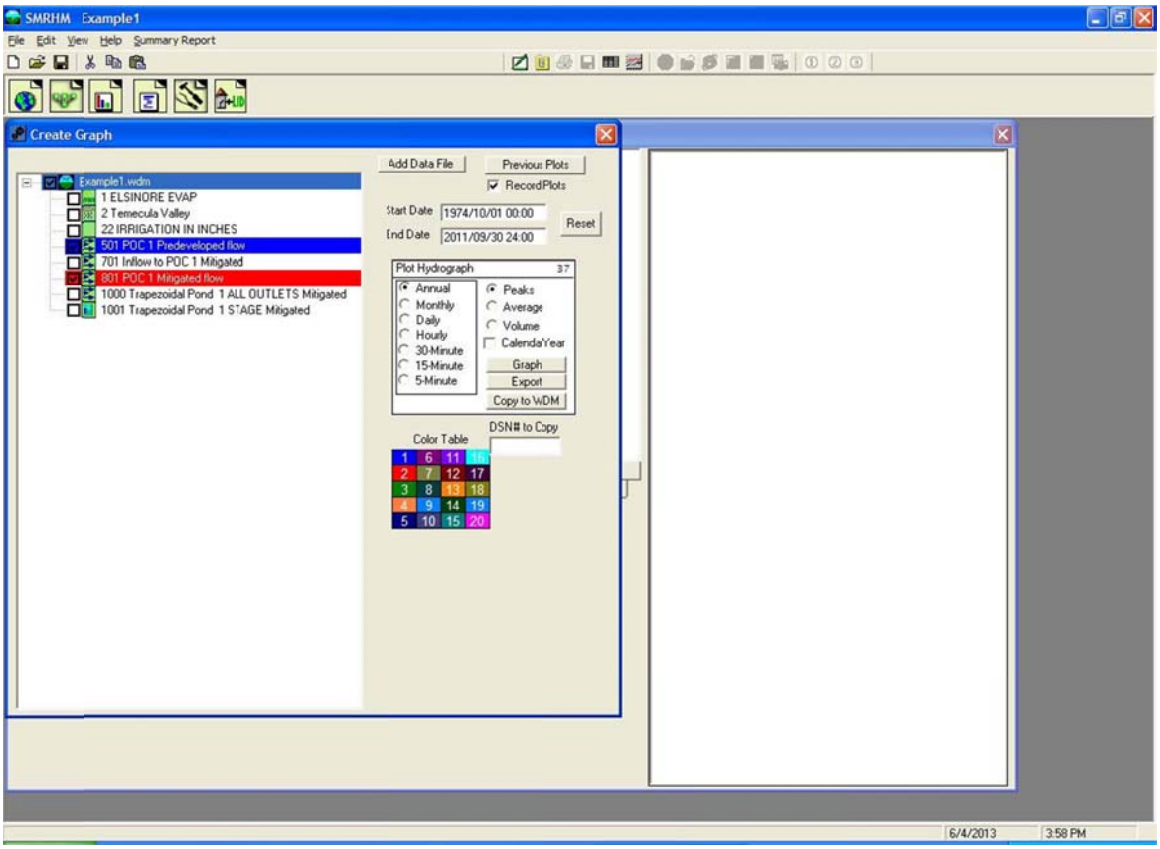
The drawdown screen is used to compute pond stages (water depths). These stages are summarized and reported in terms of drain/retention time (in days).

For this example, the maximum stage computed during the entire 30-50 year simulation period is 3.40 feet. This maximum stage has a drawdown time of 1 day, 20 hours, 33 minutes, 8 seconds (approximately 45 hours).

Ponds may have drain times in excess of the allowed maximum. This can occur when a pond has a small bottom orifice. If this is not acceptable then the user needs to change the pond outlet configuration, manually run the Mitigated scenario, and repeat the analyze stage computations. A situation may occur where it is not possible to have both an acceptable pond drawdown/ retention time and meet the flow duration criteria.

NOTE: The flow duration criteria take precedence unless the user is instructed otherwise by Appendix C or the Copermittee with jurisdiction over the project site .

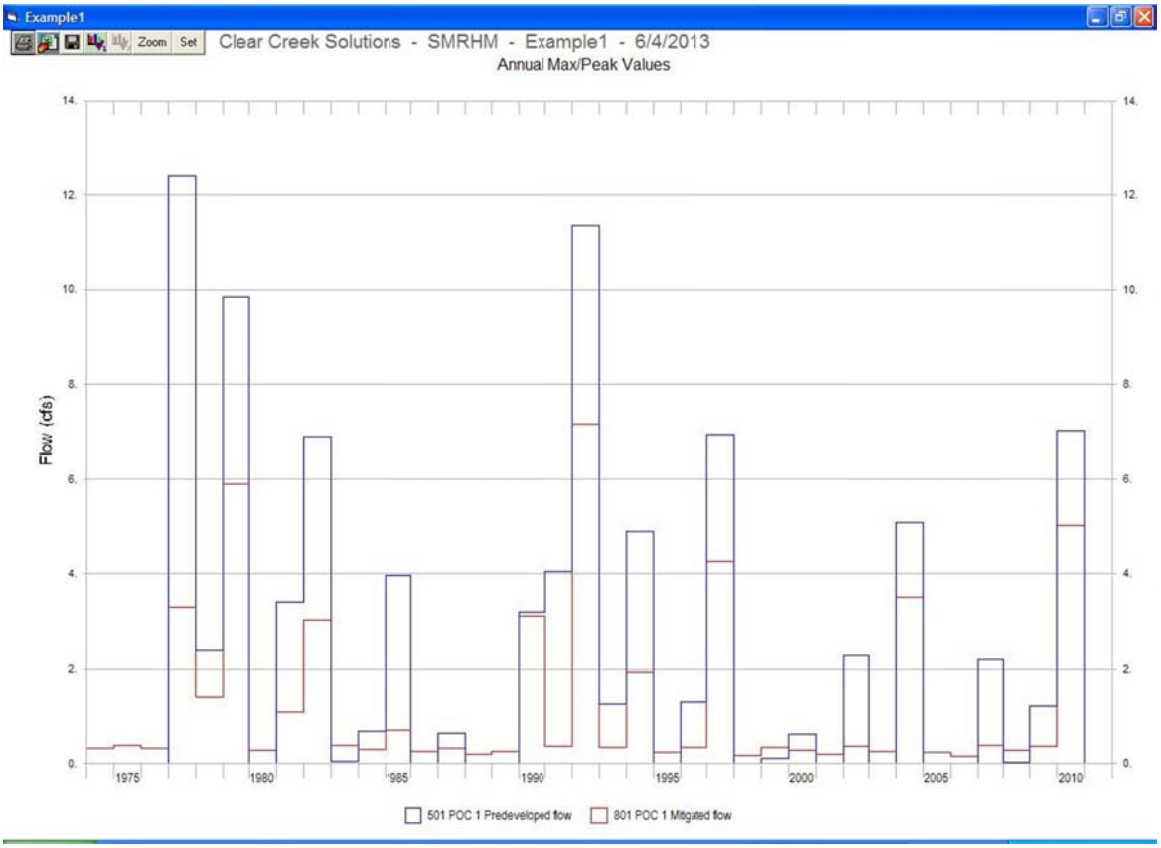
HYDROGRAPHS



The user can graph/plot any or all time series data by selecting the Hydrograph tab. The Create Graph screen is shown and the user can select the time series to plot, the time interval (yearly, monthly, daily, or 15-minute), and type of data (peaks, average, or volume).

The following numbering system is used for the flow time series:
500-599: Predevelopment flow (Predevelopment scenario)
700-799: Inflow to the POC (Mitigated runoff entering the BMP facility)
800-899: POC flow (Mitigated flow exiting the BMP facility)

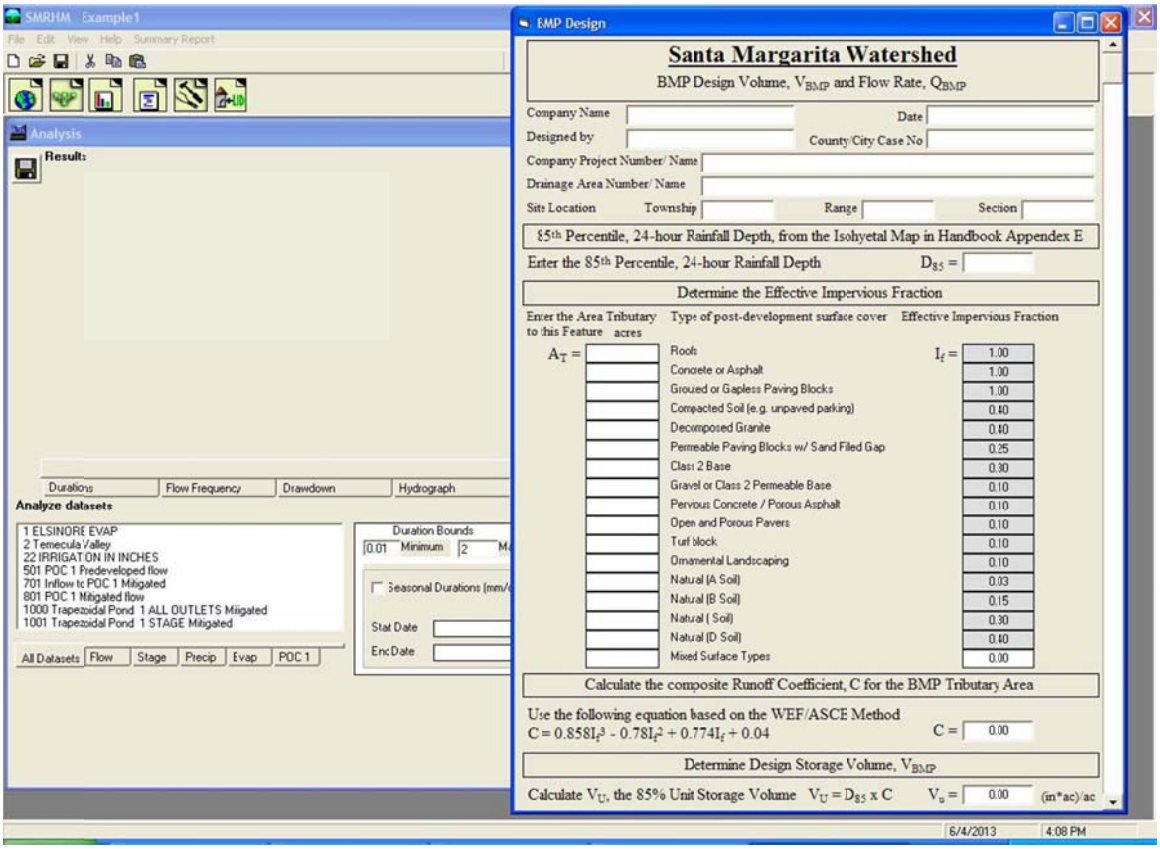
The selected time series are shown. To graph the selected time series the user clicks on the Graph button.



The hydrograph shows the yearly maximum/peak flow values for each time series for the entire simulation period (in this example, from 1974 through 2010).

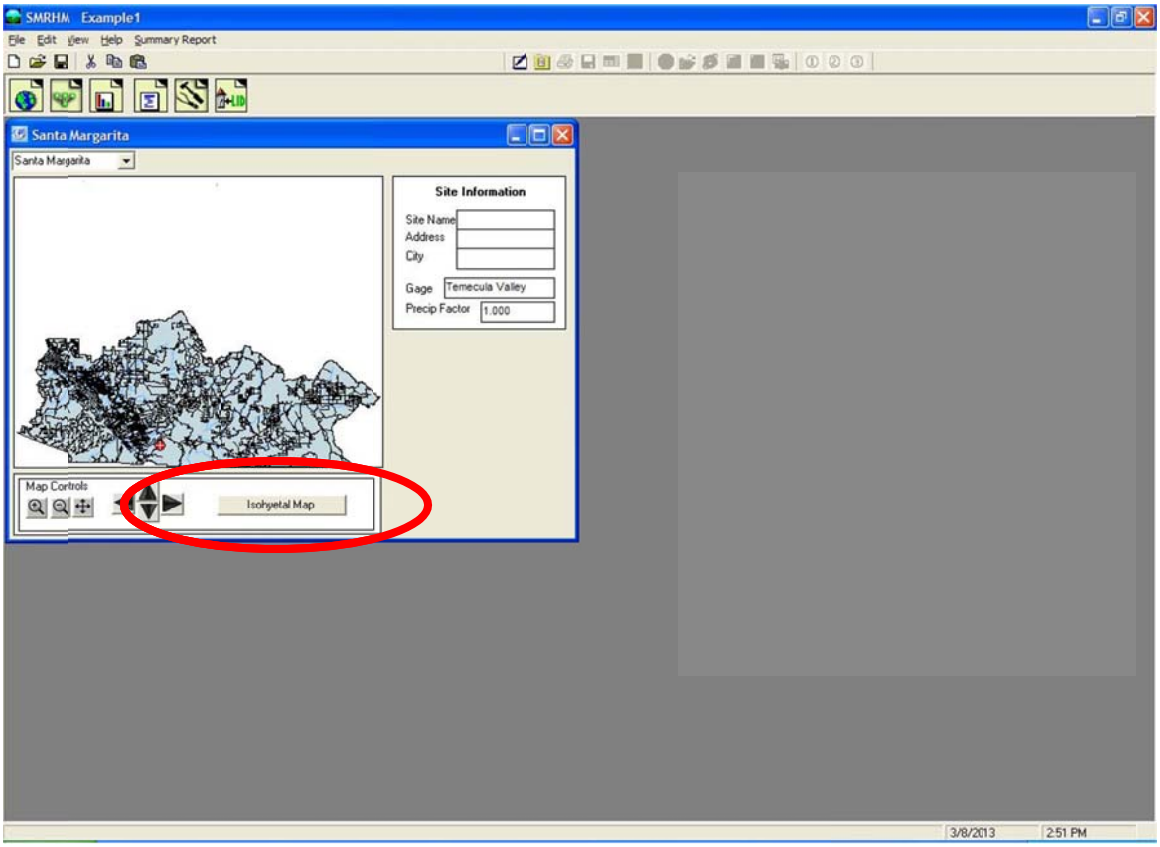
The graph can be either saved or printed.

LID BMP SIZING

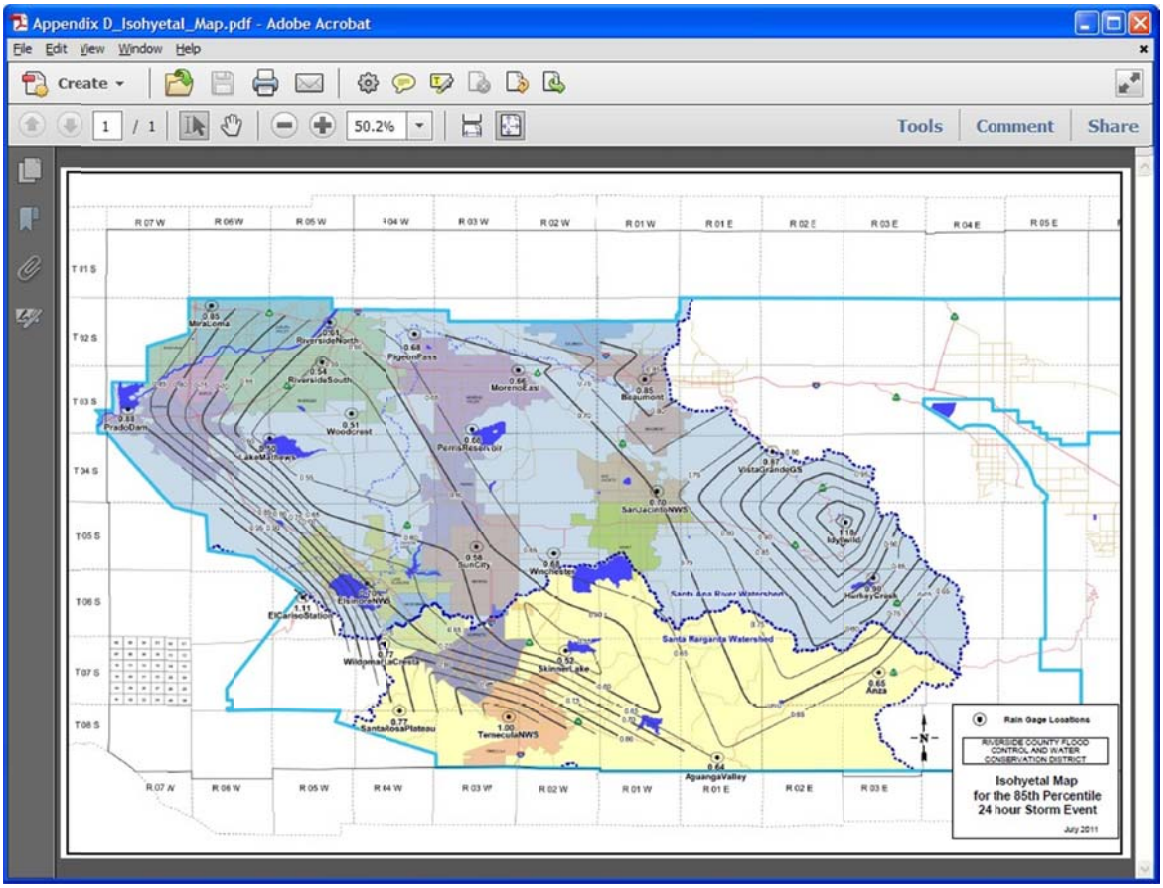


Riverside County and local municipalities use the Rational Method (Q = C*I*A) to calculate the LID BMP design volume, V_{BMP}, and flow rate, Q_{BMP}. These calculations are completely separate from the other runoff calculations produced by SMRHM using HSPF. See Riverside County's *Design Handbook for Low Impact Development Best Management Practices* (September 2011) for the most up-to-date information regarding BMP standards. The handbook should be consulted prior to the start of any SMRHM LID BMP modeling.

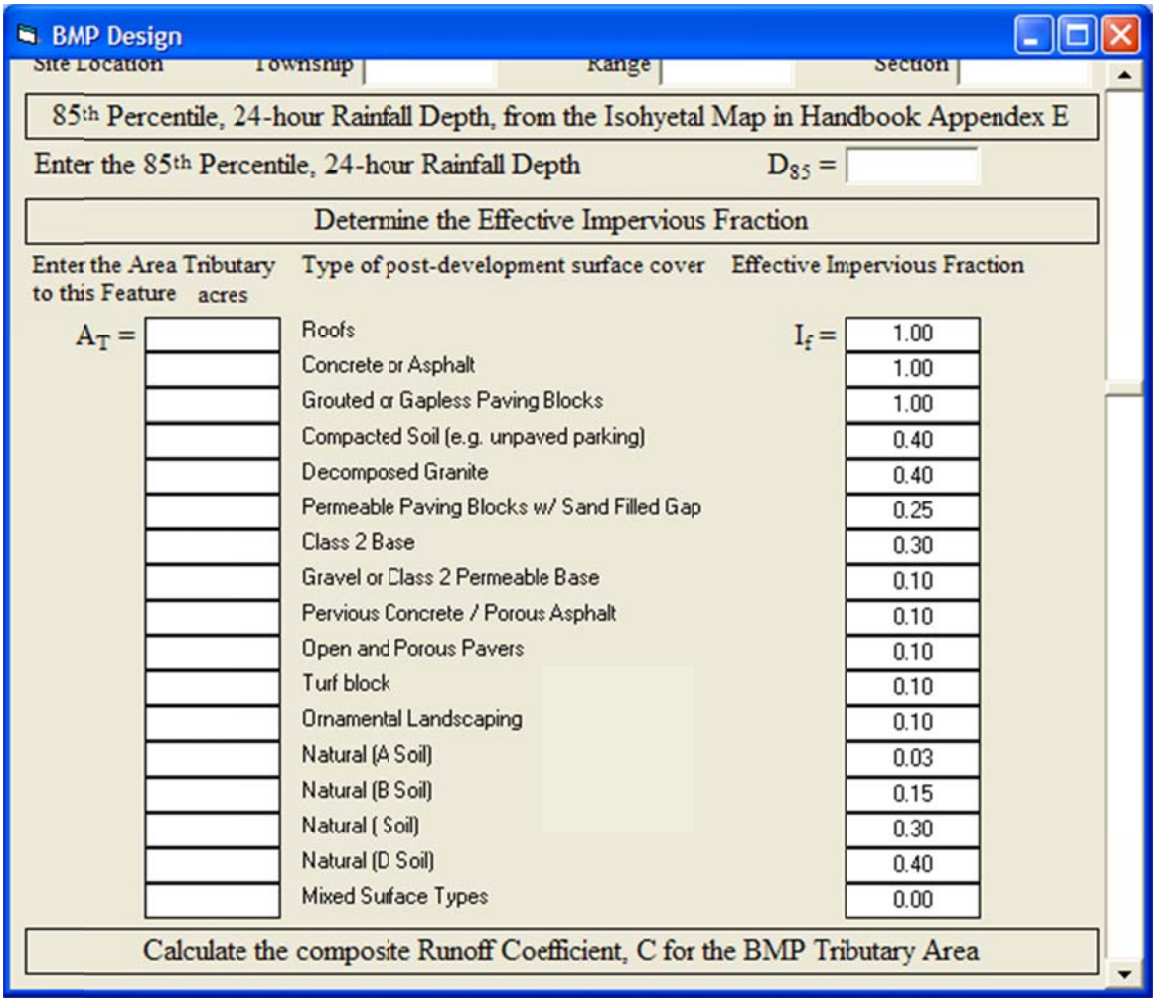
The calculation of the BMP design volume V_{BMP}, and flow rate Q_{BMP} is done on this screen. The user first enters the 85th percentile, 24-hour rainfall depth (D_{85}).



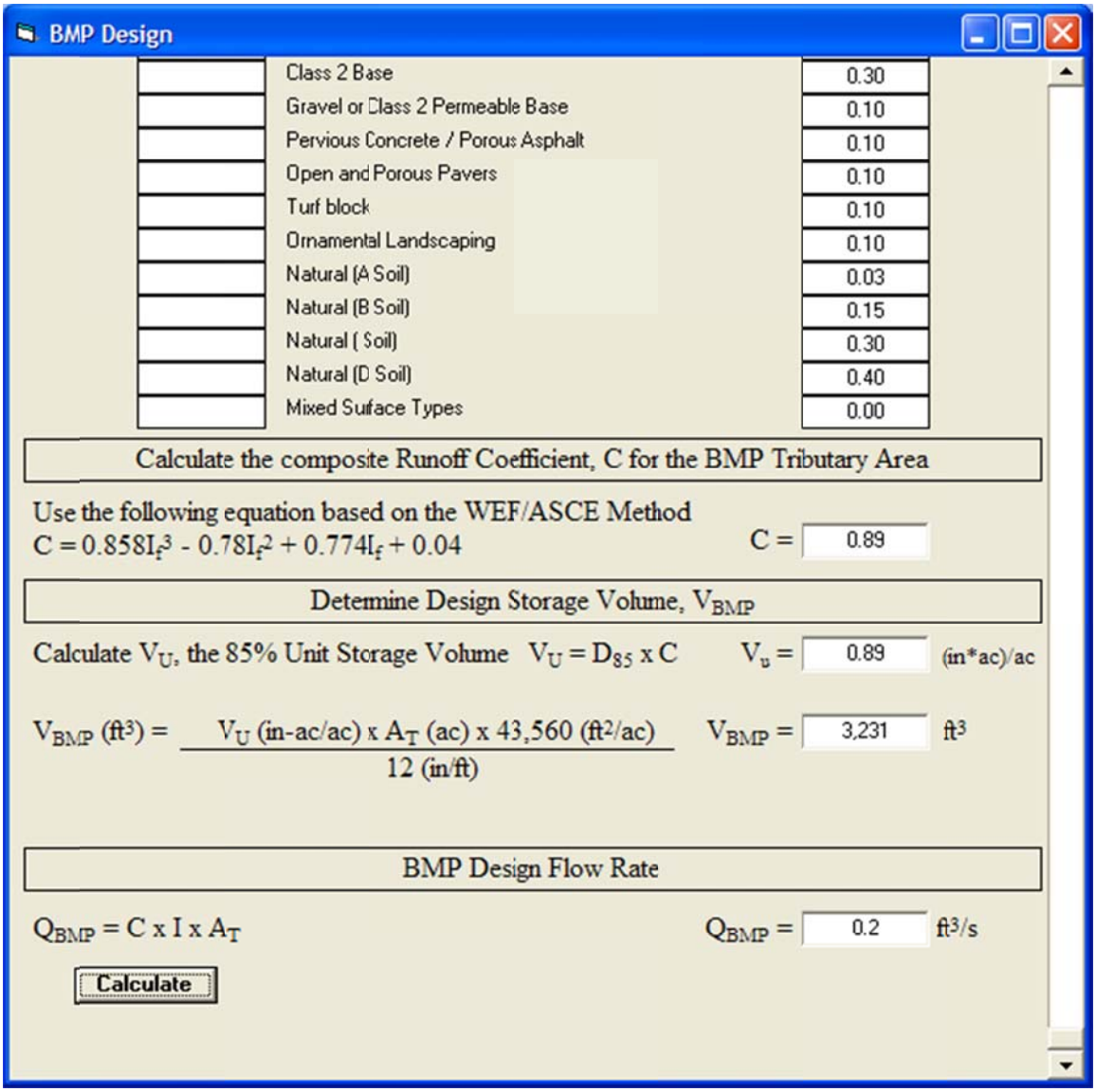
The D_{85} can be found for any location in the Santa Margarita Region from the ***Isohyetal Map*** button on the SMRHM map screen.



The D_{85} for the project site can be found on the isohyetal map based on the project's location.



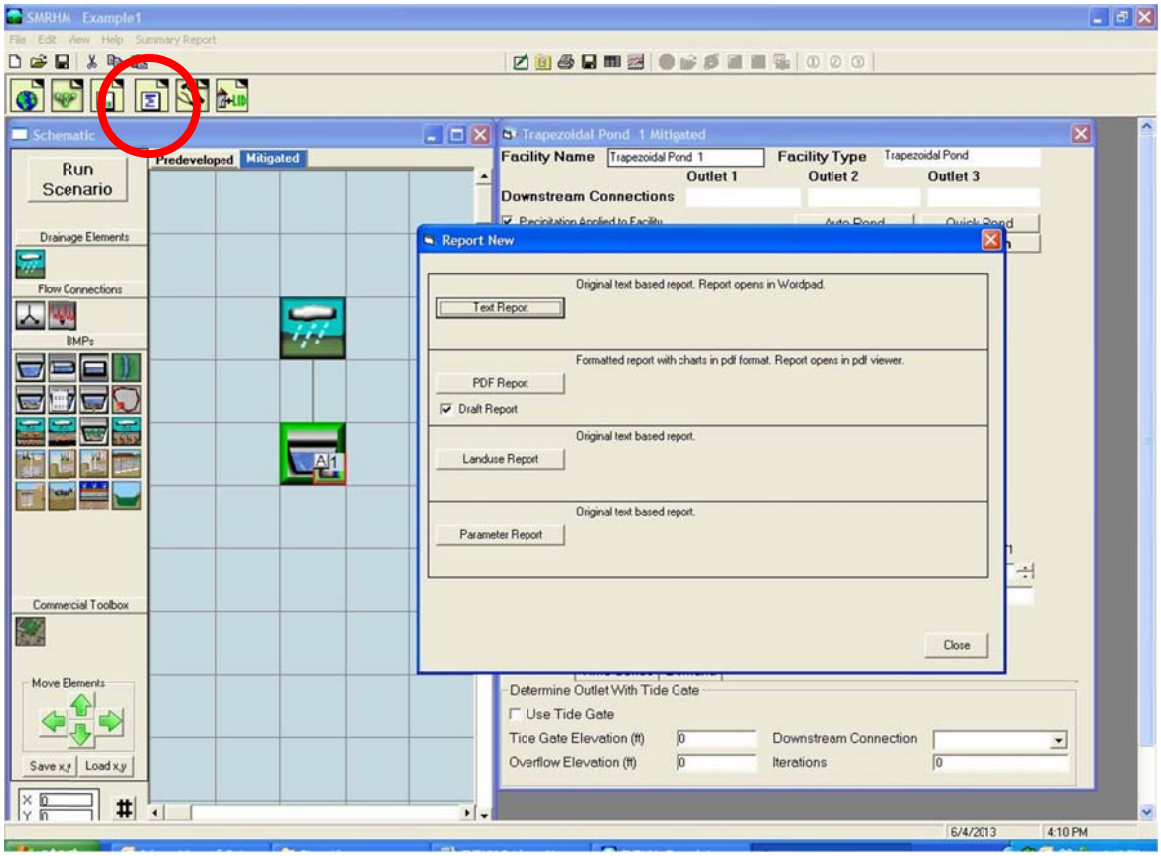
The effective impervious fraction is calculated in the model based on the tributary area (A_T) for the post-development land cover. The user inputs the number of acres of each land cover and the model calculates the runoff coefficient, C.



Click on the ***Calculate*** button at the bottom of the screen to calculate the BMP design volume, V_{BMP}, and flow rate, Q_{BMP}.

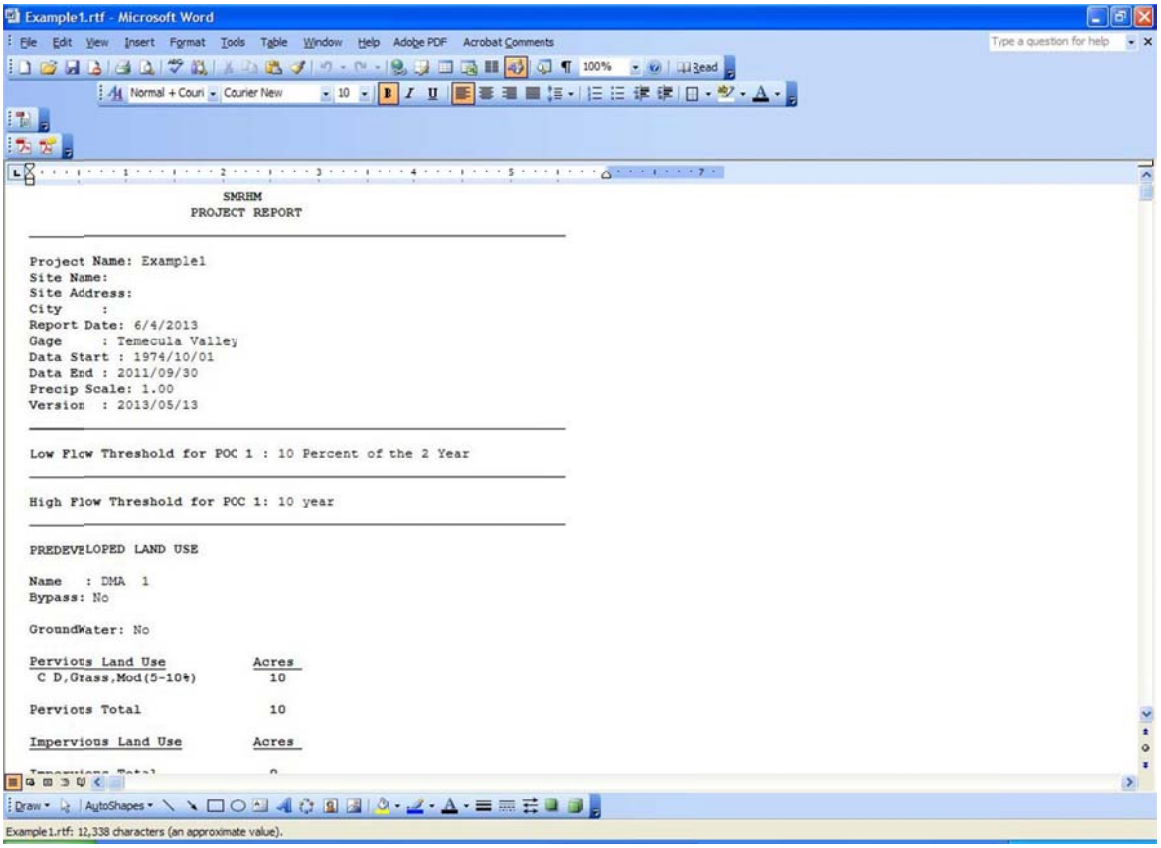
This page has been intentionally left blank.

REPORTS SCREEN



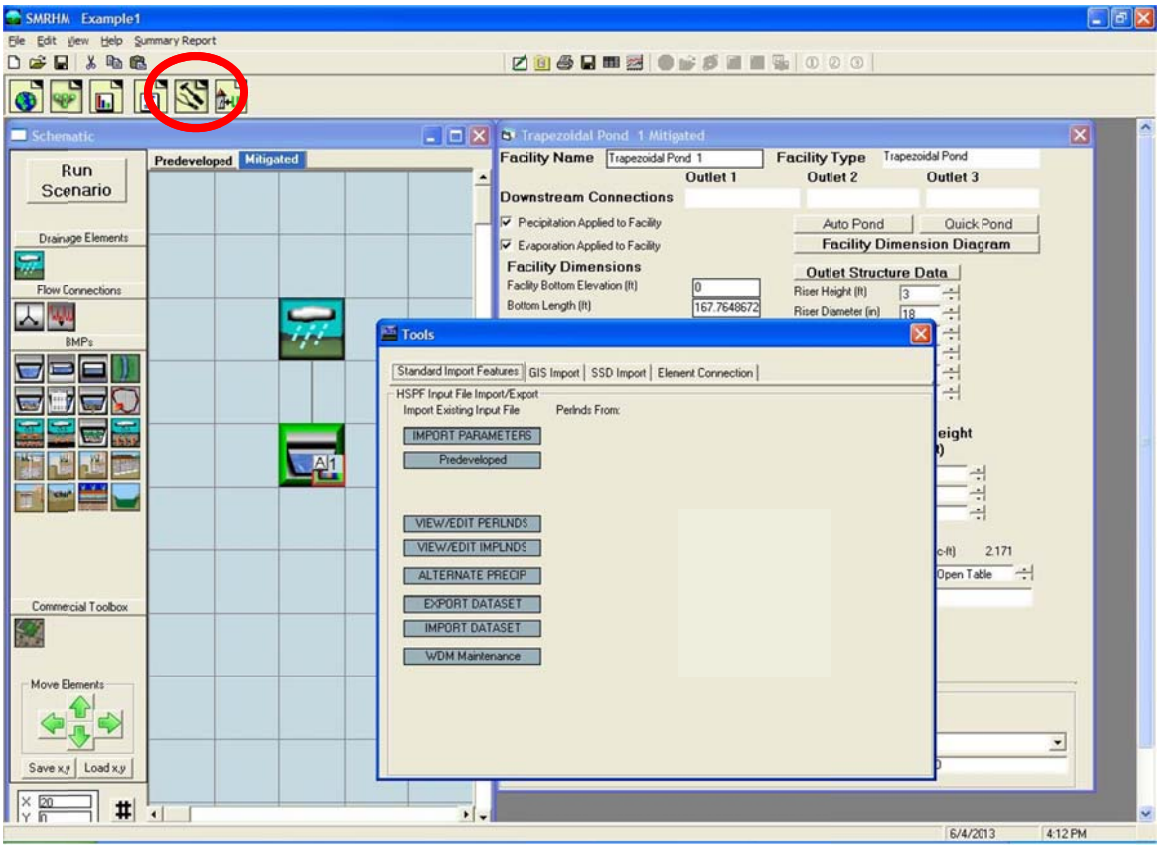
The ***Reports*** tool bar button (fourth from the left) brings up the Report screen where the user can look at all of the project input and output. The project report can be saved or printed.

The project report contains the project input information provided by the user and a summary of the project output information produced by SMRHM. The project report can be generated as either a Microsoft Word file or a PDF file.



This is an example of the project report in the format of a Microsoft Word file (RTF format).

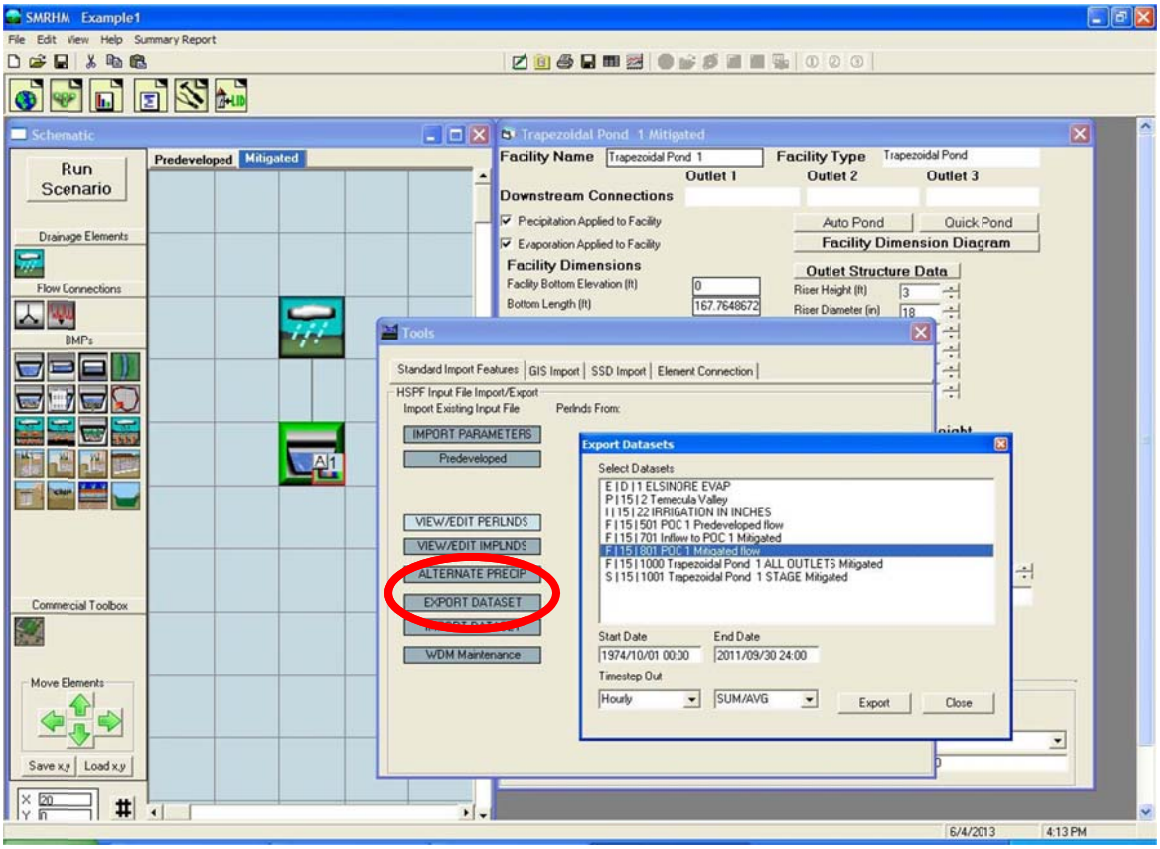
TOOLS SCREEN



The Tools screen is accessed with the ***Tools*** tool bar (second from the right). The two purposes of the Tools screen are:

(1) To allow users to view SMRHM HSPF PERLND parameter values. See Appendix A for a list of the SMRHM HSPF PERLND parameter values.

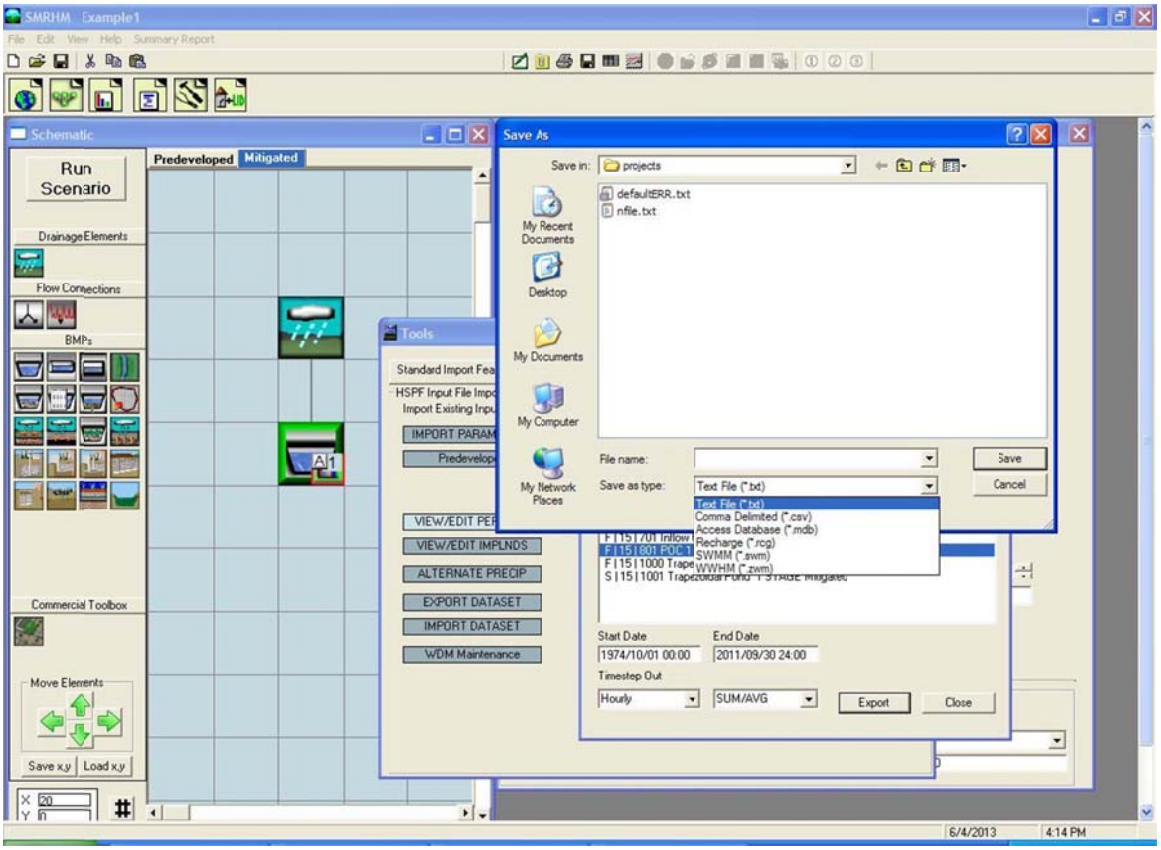
(2) To allow users to export time series datasets.



To export a time series dataset click on the ***Export Dataset*** box. The list of available time series datasets will be shown. The user can select the start and end dates for the data they want to export.

The time step (15-minute, daily, monthly, yearly) can also be specified. If the user wants daily, monthly, or yearly data the user is given the choice of either selecting the maximum, minimum, or the sum of the 15-minute values.

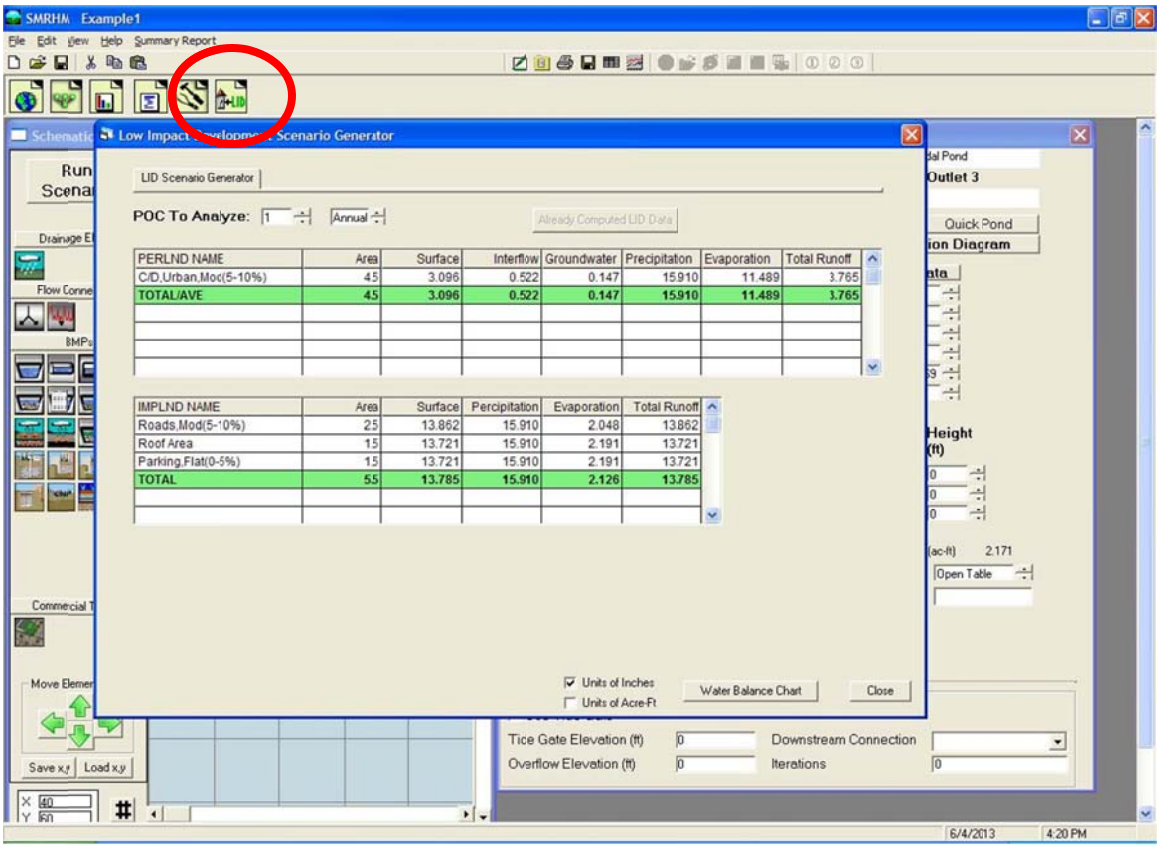
Click the ***Export*** button.



The user provides a file name and the format or type of file. The file type can be ASCII text, comma delimited, Access database, recharge, SWMM, or WWHM. Click ***Save*** to save the exported time series file.

This page has been intentionally left blank.

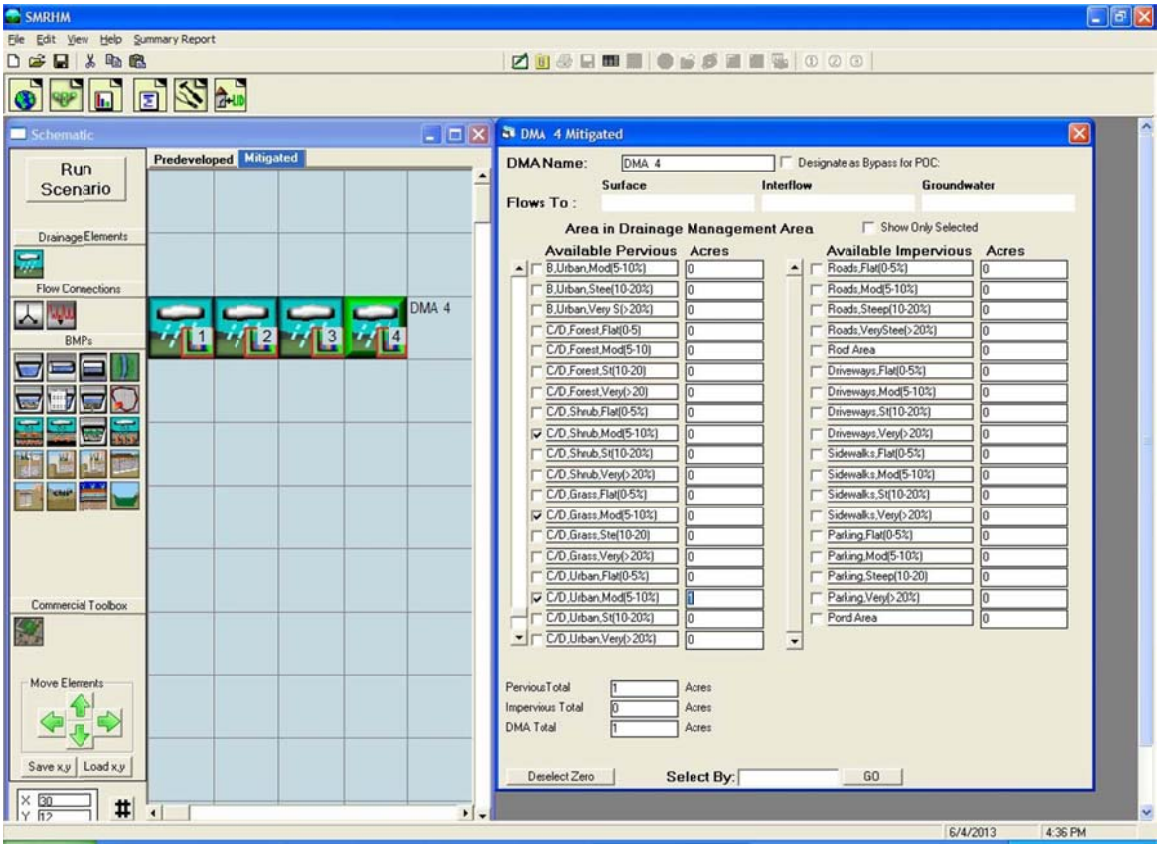
LID ANALYSIS SCREEN



The ***LID*** tool bar button (farthest on the right) brings up the Low Impact Development Scenario Generator screen.

The LID scenario generator can be used to compare the amount of runoff from different land types and combinations. The user can quickly see how changing the land use affects surface runoff, interflow, groundwater, and evapotranspiration.

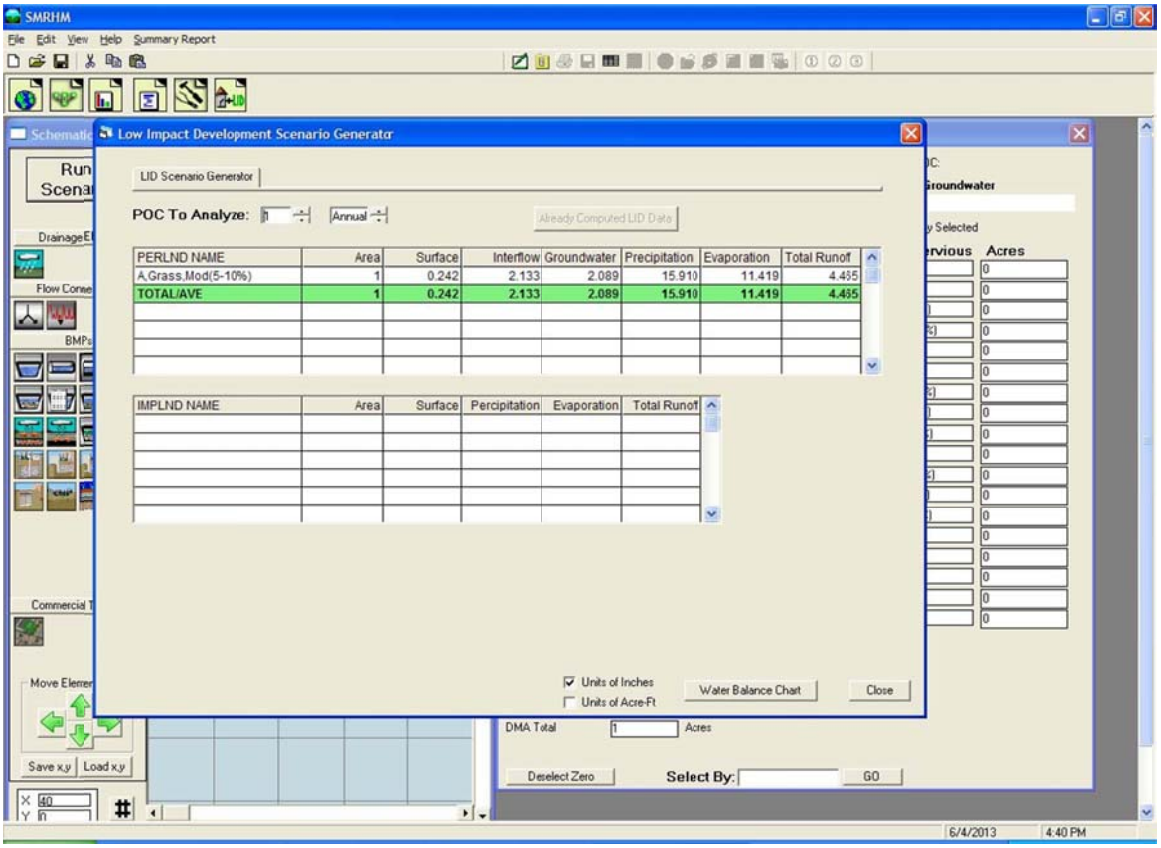
NOTE: The LID scenario generator works only in the Mitigated scenario.



The easiest way to compare different land use scenarios is to place all of them on the same Schematic Editor screen grid. Each DMA can then represent a different land use scenario. Because the LID scenario generator only compares runoff volume there is no need to do any routing through a MS4 facility or receiving water.

For this example the four DMAs are assigned the following land uses:
DMA 1: 1 acre A, Grass, Moderate (5-10%)
DMA 2: 1 acre C, Shrub, Moderate (5-10%)
DMA 3: 1 acre C, Grass, Moderate (5-10%)
DMA 4: 1 acre D, Urban, Moderate (5-10%)

Each basin is assigned a different POC (point of compliance) for the LID analysis.



Click on the ***Compute LID Base Data*** button to generate the LID analysis data and summarize the surface runoff, interflow, groundwater, precipitation, evaporation, and total runoff for all of the basins. The results will be shown for each basin in terms of its POC.

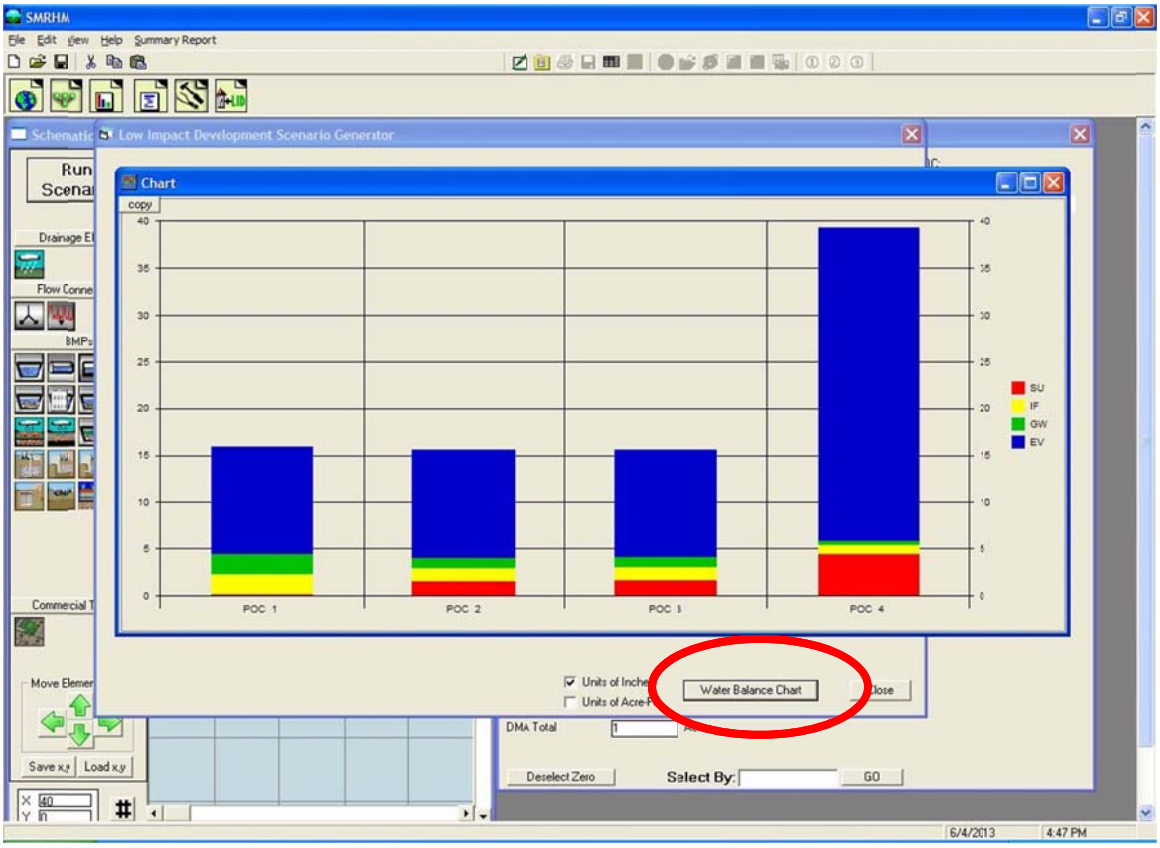
For DMA 1 (1 acre of A, Grass, Moderate slope) the distribution of the precipitation is:
Surface runoff = 0.242 inches per year
Interflow = 2.133 inches per year
Groundwater = 2.089 inches per year
Evaporation = 11.419 inches per year

The sum of the surface runoff + interflow + groundwater + evaporation equals 15.883 inches per year. The precipitation at this site equals 15.910 inches per year. The difference is because 2% of the groundwater goes to deep or inactive groundwater and is not included in the LID table.

To look at the other DMAs click on the ***Select POC To*** arrow and select the DMA of interest.

The LID analysis results can be presented in terms of either inches per year or acre-feet per year by checking the appropriate box in the lower right portion of the LID analysis screen.

To compare the different POCs side-by-side as bar charts click on the ***Water Balance Chart***.



The water balance chart graphically displays the runoff distribution for all four POCs side-by-side. In the bar chart the bottom red is the surface runoff. Above in yellow is interflow; then green for groundwater and blue for evapotranspiration.

DMA 1 (POC 1) is an A soil with grass land cover on a moderate slope and produces the least amount of surface runoff and interflow (the sum of surface and interflow is the total stormwater runoff).

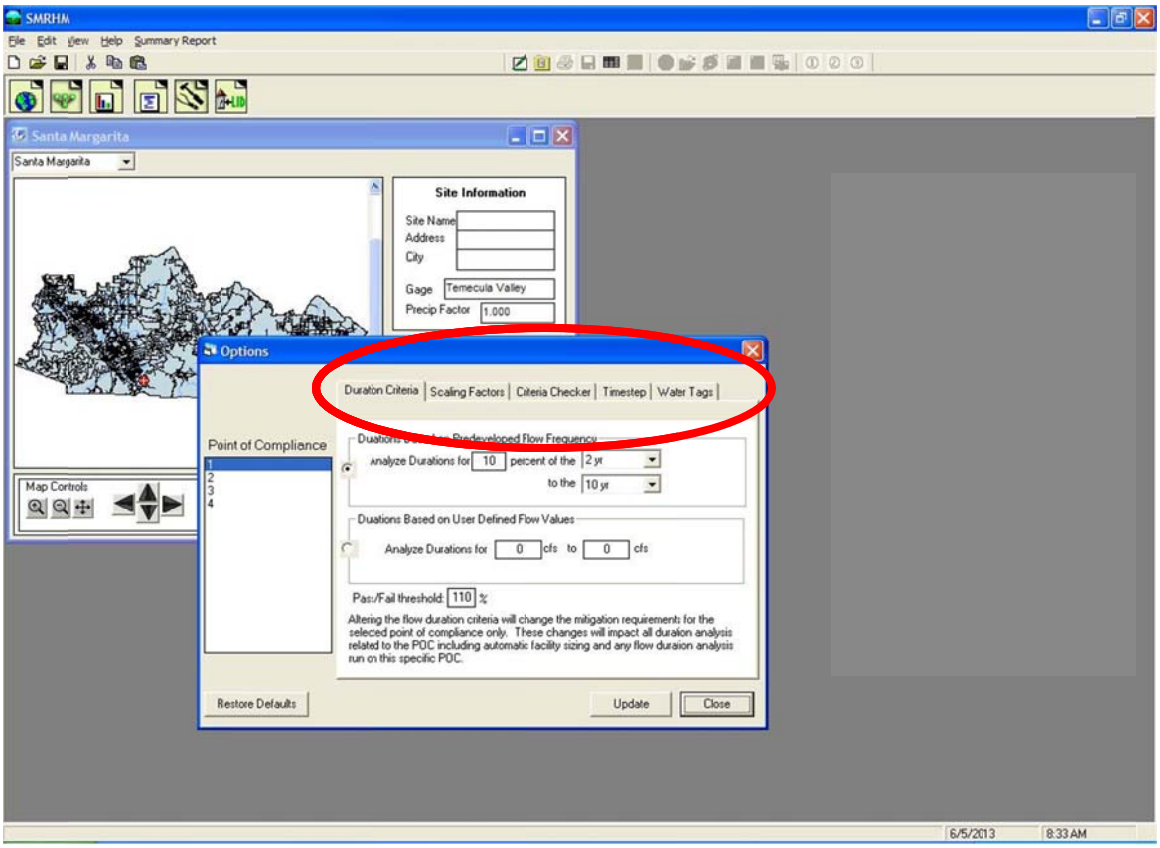
DMA 2 is a C soil with shrub land cover on a moderate slope; it produces more surface runoff and interflow than DMA 1.

DMA 3 is a C soil with grass land cover on a moderate slope; it produces more surface runoff and interflow than either DMA 1 or DMA 2.

DMA 4 is a D soil with urban land cover on a moderate slope. Urban land covers are irrigated. Urban produces the largest amount of surface runoff and interflow in addition to a large amount of evapotranspiration due to the addition of irrigation water.

A maximum of seven scenarios can be graphed at one time.

OPTIONS



Options can be accessed by going to ***View, Options***. This will bring up the Options screen and the ability to modify the built-in default duration criteria for flow duration matching and scaling factors for climate variables.

DURATION CRITERIA

The flow duration criteria are:

1. If the post-development flow duration values exceed any of the predevelopment flow levels between the lower threshold (10% of the two-year) and five-year predevelopment peak flow values then the flow duration standard has not been met.

2. If the post-development flow duration values exceed any of the predevelopment flow levels between the 5-year and the upper threshold (100% of the 10-year) predevelopment peak flow values more than 10 percent of the time (110 Percent Threshold) then the flow duration standard has not been met.

3. If more than 10 percent of the flow duration levels exceed the 100 percent threshold then the flow duration standard has not been met.

The duration criteria in SMRHM can be modified by the user if appropriate and the local municipal permitting agency allows (see NOTE below).

The user can conduct the duration analysis using either (1) durations based on Predevelopment flow frequency, or (2) durations based on user defined flow values.

If using durations based on Predevelopment flow frequency, the percent of the lower limit can be changed from the default of the 10% of the 2-year flow event to a higher or lower percent value. The lower and upper flow frequency limits (2-year and 10-year) also can be changed.

If using durations based on user defined flow values, click on that option and input the lower and upper flow values.

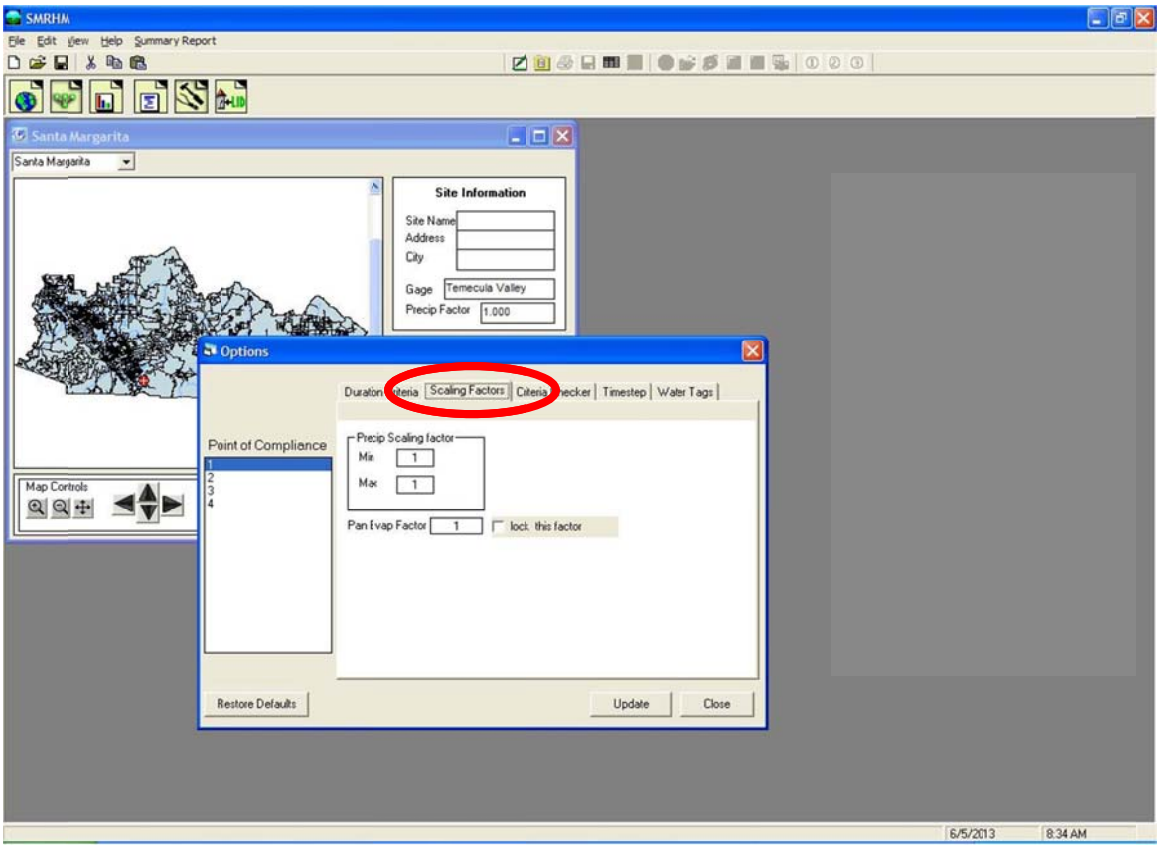
The default pass/fail threshold is 100% for the flows between 10% of the 2-year and 5-year flow. This value cannot be changed by the user.

The default pass/fail threshold is 110% for the flows between the 5-year and 10-year flow. This value can be changed by the user.

The duration criteria can be changed for a single POC. Click on the ***Update*** button once all of the changes have been made. To return to the default values click on the ***Restore Defaults*** button.

NOTE: Any change(s) to the default duration criteria must be approved by the Copermittee with jurisdiction over the project site or specified in Appendix C.

SCALING FACTORS



The user can change the scaling factors for precipitation (minimum and maximum) and pan evaporation.

NOTE: Any change in default scaling factors requires approval by the Copermittee with jurisdiction over the project site or Appendix C.

Click on the ***Update*** button once all of the changes have been made. To return to the default values click on the ***Restore Defaults*** button.

This page has been intentionally left blank.

TIPS AND TRICKS FOR LID PRACTICES AND FACILITIES

There are many different tips and tricks that can be used to tailor SMRHM to solve different stormwater runoff management problems. This section presents only a fraction of the tricks that we and others have found and used, but it should give you a good idea of the options and flexibility built into SMRHM.

The tips and tricks show how different LID/BMPs can be represented by SMRHM elements.

LID/BMP practices and facilities reduce the need for and the size of hydrologic control facilities. LID/BMP practices and facilities typically try to mimic the natural environment and provide source control and storage of runoff.

Riverside County's *Design Handbook for Low Impact Development Best Management Practices* (September 2011) include eight (8) practices that can be modeled using the comparable SMRHM elements. This handbook has the most up-to-date information regarding BMP standards and should be consulted prior to the start of any SMRHM LID BMP modeling.

The eight LID BMPs are:

1. Infiltration Basin
2. Infiltration Trench
3. Permeable Pavement
4. Bioretention (standard design)
5. Bioretention (vertical sideslopes)
6. Bioretention (planter box)
7. Sand Filter
8. Extended Detention Basin

Each of these eight LID BMPs are described below.

NOTE: Many of these LID/BMP practices and facilities rely on infiltration into native soils. See Appendix C or consult with the Copermittee with jurisdiction over the project site for additional considerations regarding infiltration and determination of an infiltration reduction factor, where appropriate.

INFILTRATION BASIN/POND

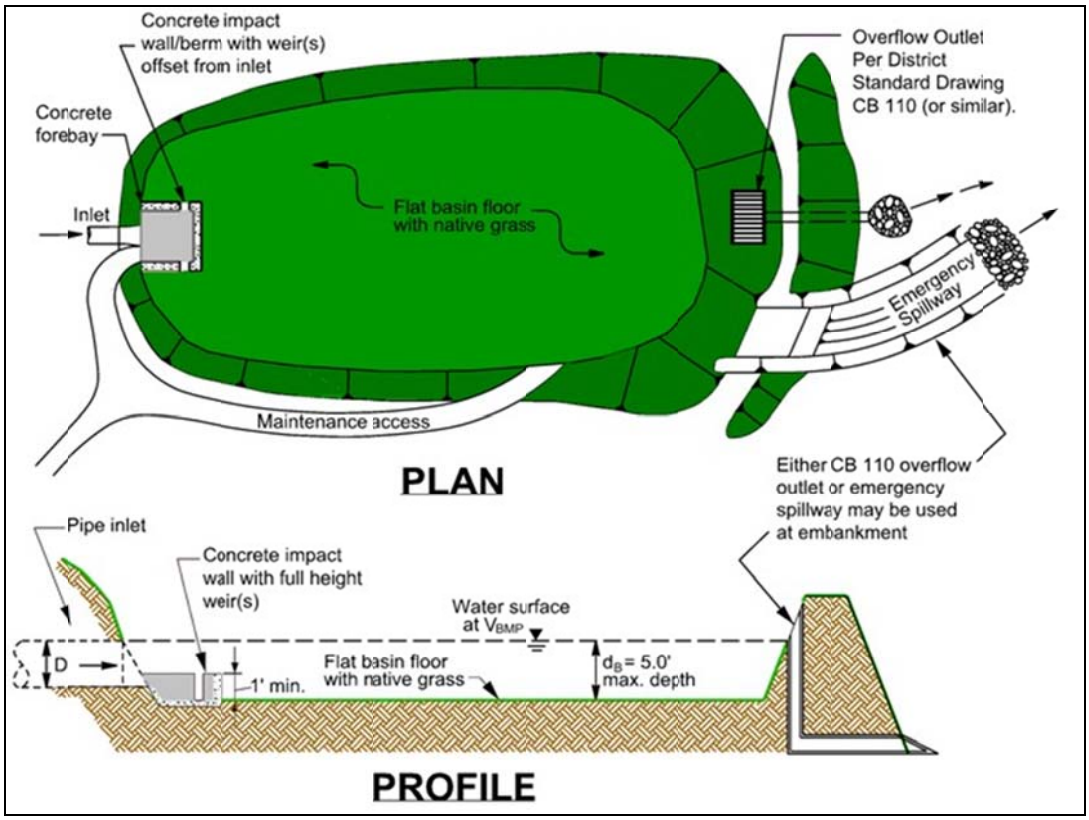
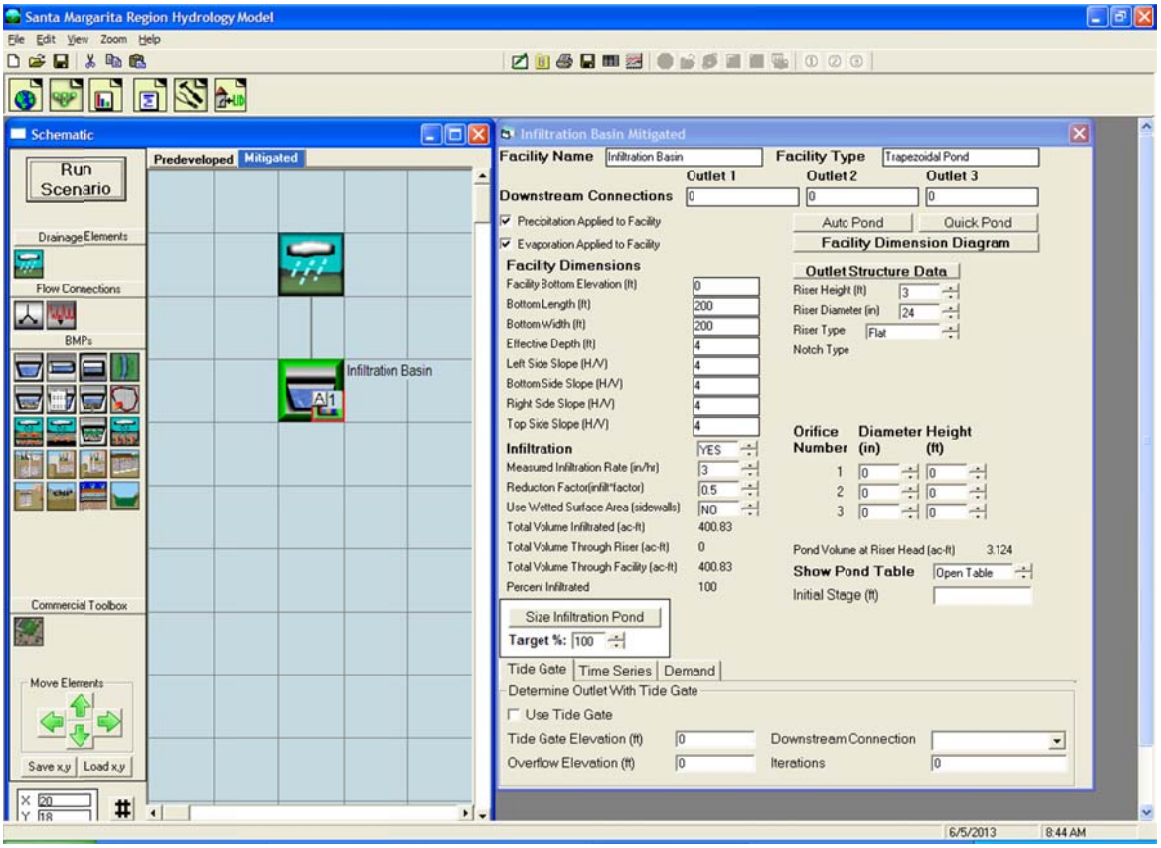


Figure courtesy of Riverside County Flood Control and Water Conservation District

An infiltration basin allows stormwater runoff to enter the basin above ground and then infiltrate through the bottom of the basin into the native soil beneath the basin. Overflow is controlled by an overflow outlet.

For the purpose of flow control the discharge from the overflow outlet should not exceed the predevelopment discharge from the project site for the flow duration range specified by the Copermittee with jurisdiction over the project site .

In SMRHM the infiltration basin is represented by the trapezoidal or irregular-shaped pond element.



The pond dimensions and parameters to adjust to represent an infiltration basin are:

Bottom Length (ft): Infiltration basin length
Bottom Width (ft): Infiltration basin width
Effective Depth (ft): Infiltration basin height from basin bottom to top of riser plus at least 1.0 foot of freeboard
Left Sideslope (H/V): ratio of horizontal distance to vertical for infiltration basin sides
Bottom Sideslope (H/V): ratio of horizontal distance to vertical for infiltration basin sides
Right Sideslope (H/V): ratio of horizontal distance to vertical for infiltration basin sides
Top Sideslope (H/V): ratio of horizontal distance to vertical for infiltration basin sides
Riser Height (ft): Height of infiltration basin/pond overflow pipe above basin soil surface
Riser Diameter (in): Infiltration basin overflow pipe diameter
Riser Type: Flat

Infiltration: Yes (infiltration into the underlying native soil)
Measured Infiltration Rate (in/hr): Native soil infiltration rate
Infiltration Reduction Factor: 1/Native soil infiltration rate safety factor (see page 69)
Use Wetted Surface Area (sidewalls): Yes, if infiltration through the basin sideslopes is allowed.

If infiltration is used then the user should consult the Infiltration discussion on page 69.

Any changes made by the user to the element dimensions and other input are not analyzed by SMRHM until the ***Run Scenario*** button is reclicked.

The Riverside County *Design Handbook for Low Impact Development Best Management Practices* specifies the following criteria for infiltration basins:

- Maximum drawdown time: 72 hrs
- Maximum tributary area: 50 ac
- Maximum depth: 5 ft
- Maximum sideslopes: 4 to 1

NOTE: See Appendix C or consult with the Copermittee with jurisdiction over the project site for additional considerations regarding infiltration and determination of the appropriate infiltration reduction factor.

An infiltration basin/pond receives precipitation on and evaporation from the basin surface area. The ***Precipitation Applied to Facility*** and ***Evaporation Applied to Facility*** boxes should be checked.

INFILTRATION TRENCH

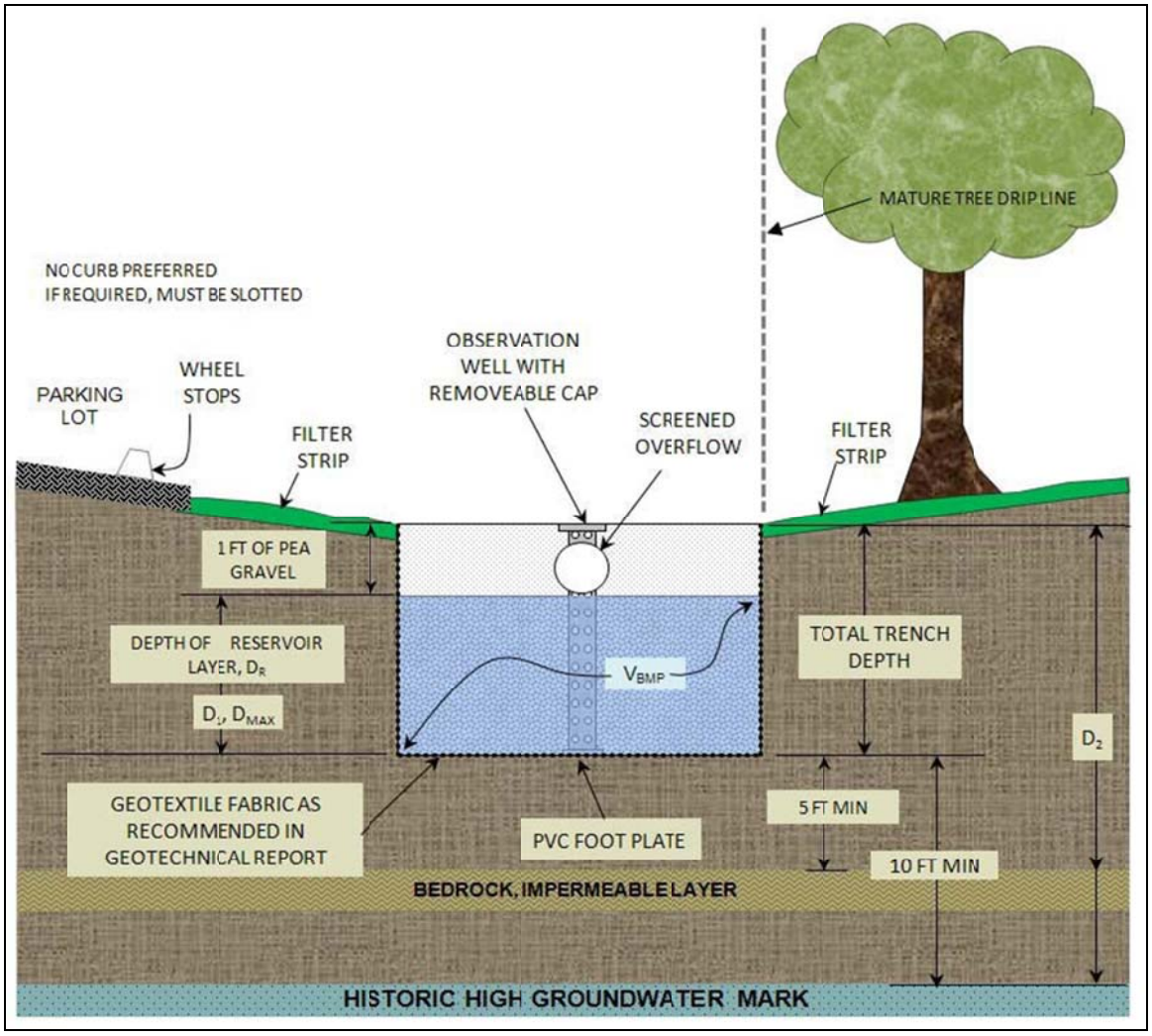
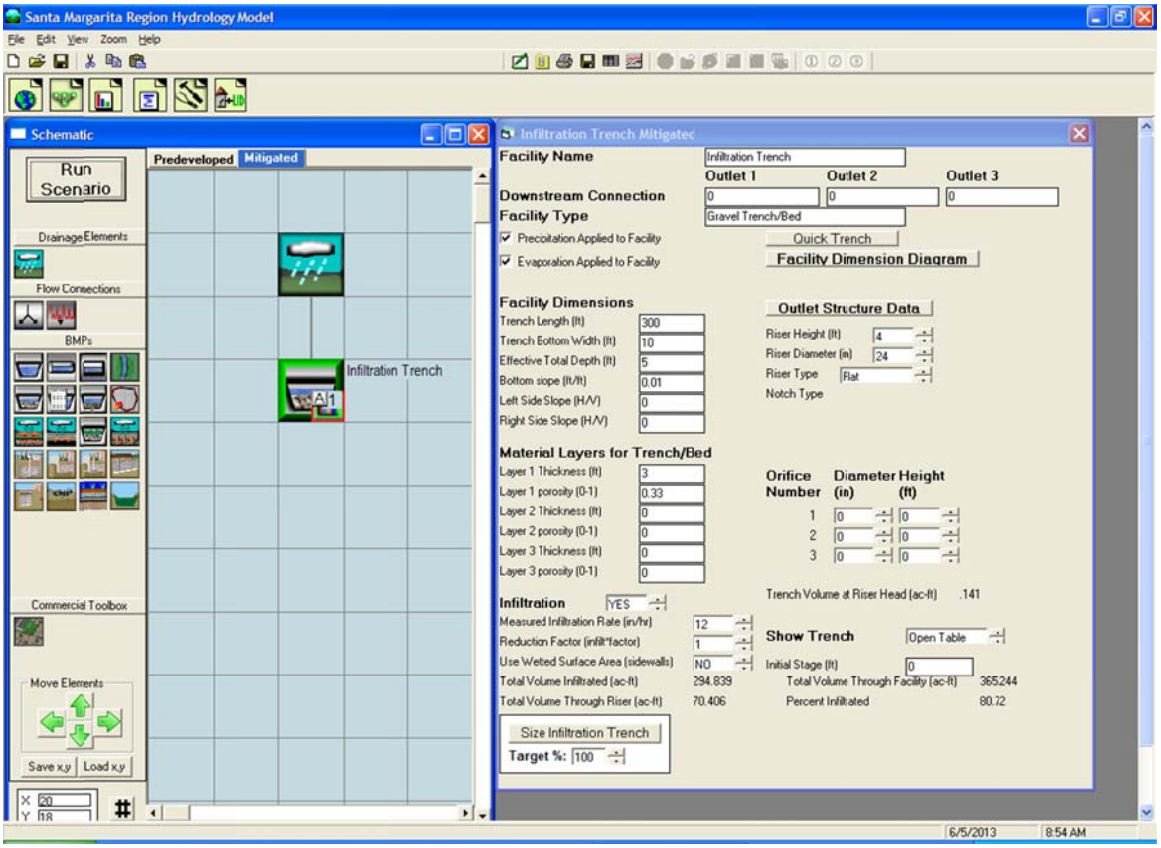


Figure courtesy of Riverside County Flood Control and Water Conservation District

An infiltration trench is similar to the infiltration basin. However, there is no bottom discharge pipe or underdrain. Water must infiltrate into the native soil underlying the gravel layer of the planter. Overflow is controlled by an overflow outlet.

For the purpose of flow control the discharge from the overflow outlet should not exceed the predevelopment discharge from the project site for the flow duration range specified by the local jurisdiction.

In SMRHM the infiltration trench is represented by the gravel trench bed element.



The gravel trench bed dimensions and parameters to adjust to represent an infiltration trench are:

Trench Length (ft): Infiltration trench length
Trench Bottom Width (ft): Infiltration trench width
Effective Total Depth (ft): Infiltration trench height from bottom of trench to top of riser plus at least 0.5 feet extra
Bottom Slope of Trench (ft/ft): Must be non-zero
Left Sideslope (ft/ft): 0 (zero) for vertical infiltration trench sides
Right Sideslope (ft/ft): 0 (zero) for vertical infiltration trench sides
Infiltration Rate (in/hr): Infiltration trench soil infiltration rate
Layer 1 Thickness (ft): Infiltration trench soil layer depth
Layer 1 Porosity: Infiltration trench soil porosity
Layer 2 Thickness (ft): Infiltration trench gravel layer depth
Layer 2 Porosity: Infiltration trench gravel porosity
Layer 3 Thickness (ft): Infiltration trench gravel layer depth
Layer 3 Porosity: Infiltration trench gravel porosity.

NOTE: Layers 2 and 3 are optional.

Riser Height (ft): Height of infiltration trench overflow pipe above trench bottom. If a weir is preferred instead of a riser, then set the riser height to the weir height and set the riser diameter to the weir length.

Riser Diameter (in): Infiltration trench overflow pipe diameter
Riser Type: Flat

Native Infiltration: Yes (infiltration into the underlying native soil)
Measured Infiltration Rate (in/hr): Native soil infiltration rate
Infiltration Reduction Factor: 1/Native soil infiltration rate safety factor (see page 69)

If infiltration is used then the user should consult the Infiltration discussion on page 69.

Any changes made by the user to the element dimensions and other input are not analyzed by SMRHM until the ***Run Scenario*** button is reclicked.

The Riverside County *Design Handbook for Low Impact Development Best Management Practices* specifies the following criteria for infiltration trenches:

- Max drawdown: 72 hrs
- Max tributary area: 10 ac
- Max depth: 8 ft
- Sideslope: 0 to 1 (vertical)
- Trench width must be greater than depth

NOTE: See Appendix C or consult with the Copermittee with jurisdiction over the project site for additional considerations regarding infiltration and determination of the appropriate infiltration reduction factor.

The infiltration trench receives precipitation on and evaporation from the trench surface. The ***Precipitation Applied to Facility*** and ***Evaporation Applied to Facility*** boxes should be checked.

PERMEABLE PAVEMENT

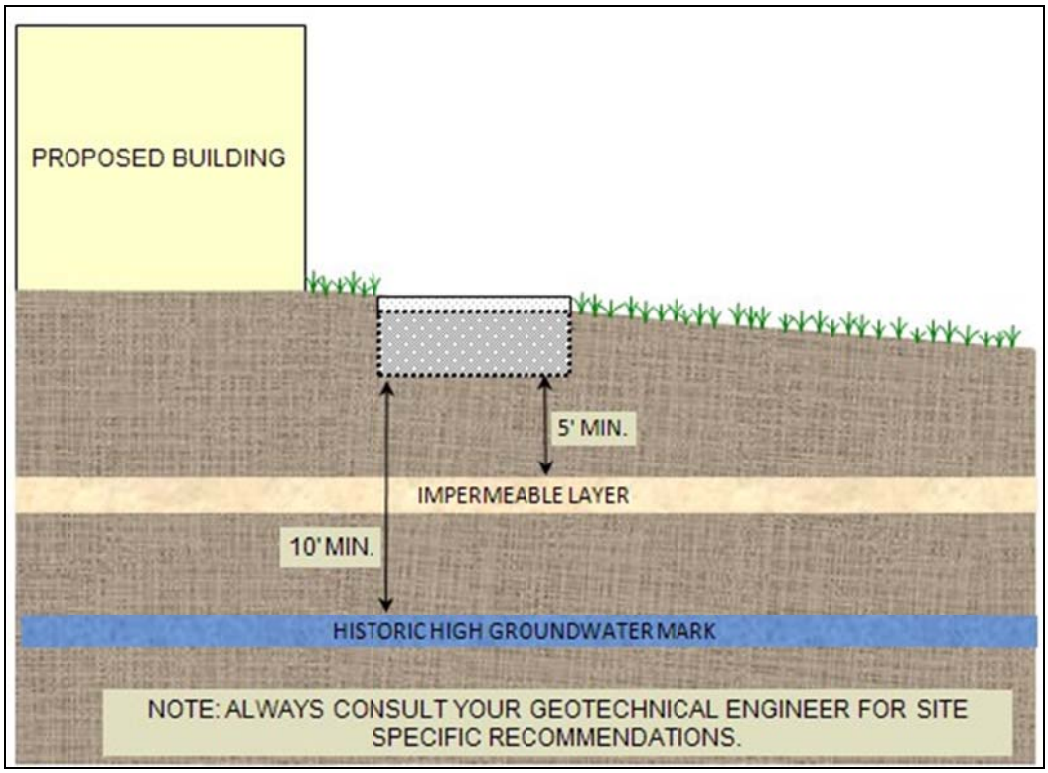


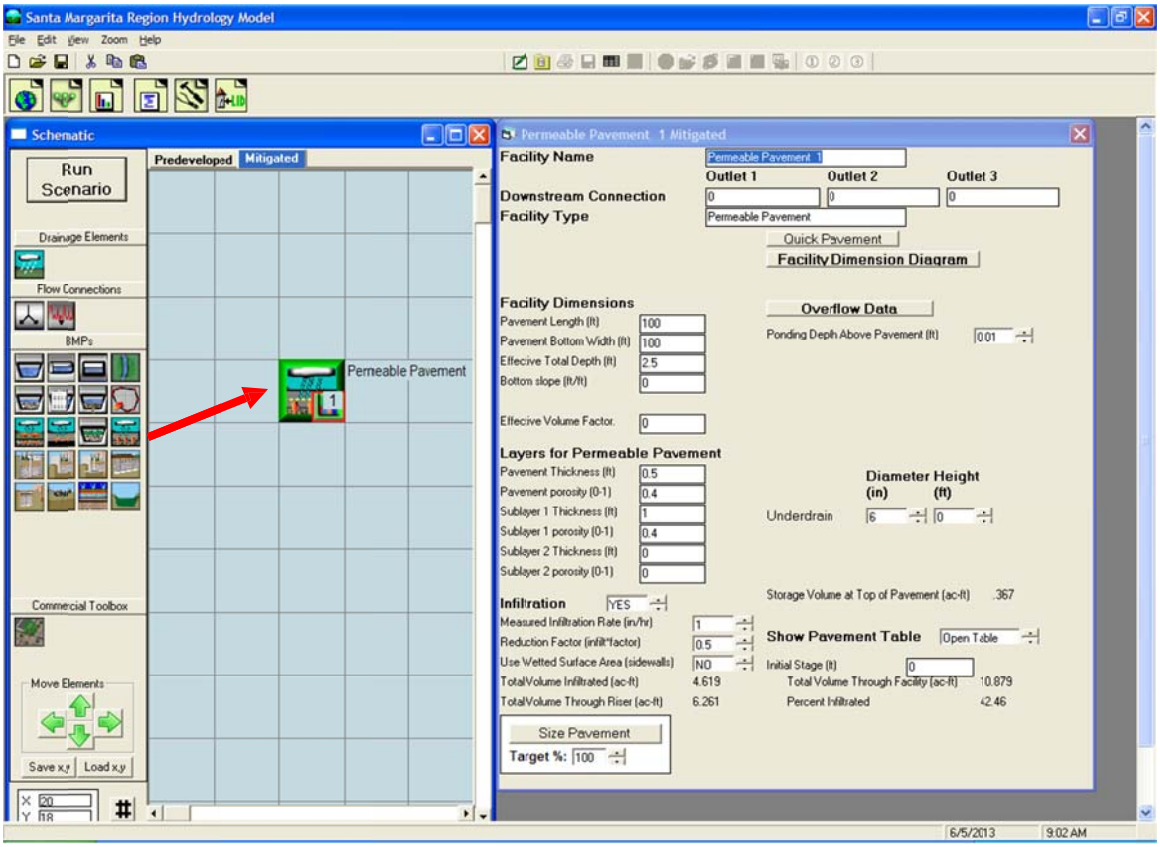
Figure courtesy of Riverside County Flood Control and Water Conservation District

Permeable pavement LID options include porous asphalt or concrete and grid/lattice systems (non-concrete) and paving blocks. The use of any of these LID options requires that certain minimum standards and requirements are met related to subgrade, geotextile material, separation or bottom filter layer, base material, wearing layer, drainage conveyance, acceptance testing, and surface maintenance.

NOTE: Permeable pavement can be used in place of conventional pavement for roadways, sidewalks, driveways, and parking lots. Check with Appendix C or the Copermittee with jurisdiction over the project site to find out under what conditions permeable pavement is allowed.

Permeable pavement can be represented by the permeable pavement element in SMRHM if the following three conditions are met:

1. The infiltration rate of the permeable pavement is greater than the peak rainfall rate.
2. The infiltration rate of the permeable pavement is greater than the underlying native soil.
3. There is subgrade layer of crushed rock/gravel between the permeable pavement and the native soil.



The permeable pavement dimensions and parameters are:

Pavement Length (ft): Roadway length
Pavement Bottom Width (ft): Roadway width
Effective Total Depth (ft): Height from bottom of permeable pavement subgrade to top of pavement plus at least 0.5 feet extra
Bottom Slope (ft/ft): Pavement slope or grade.

Effective Volume Factor: zero unless the bottom slope is greater than 2%.

The effective volume factor is a value between zero and 1.00. It is only used when the bottom slope is greater than 2%. The effective volume factor is the fraction ratio of the average maximum water depth behind a check dam in the gravel layer (Sublayer 1) compared to the maximum gravel layer depth (Sublayer 1). For example, if the average maximum water height is 6" and the gravel depth is 9" then the Effective Volume Factor = 0.67 (6/9). The effective volume factor is multiplied by the Sublayer 1 storage volume to determine the actual maximum volume available for stormwater runoff storage before the check dam is overtopped and the water in the gravel layer depth (Sublayer 1) proceeds to a downstream conveyance facility.

Pavement Thickness (ft): Permeable pavement layer depth
Pavement Porosity: Permeable pavement porosity
Sublayer 1 Thickness (ft): Subgrade gravel layer depth

Sublayer 1 Porosity: Subgrade gravel porosity.
Sublayer 2 Thickness (ft): Sand layer depth (if appropriate)
Sublayer 2 Porosity: Sand porosity
Ponding Depth above Pavement (ft): Height at which surface runoff occurs

NOTE: Check with Appendix C or the Copermittee with jurisdiction over the project site to find out if ponding on the surface of the pavement is allowed.

Underdrain Diameter (inches) and Height (feet) above bottom layer-native soil interface. The underdrain is optional.

Native Infiltration: Yes (infiltration into the underlying native soil)
Measured Infiltration Rate (in/hr): Native soil infiltration rate
Infiltration Reduction Factor: 1/Native soil infiltration rate safety factor (see page 69)

If infiltration is used then the user should consult the Infiltration discussion on page 69.

Any changes made by the user to the element dimensions and other input are not analyzed by SMRHM until the ***Run Scenario*** button is re-clicked.

The Riverside County *Design Handbook for Low Impact Development Best Management Practices* specifies the following criteria for permeable pavement:

- Max drawdown: 24 hrs
- Max tributary area: 10 ac
- Max reservoir (gravel subgrade) depth: 1 ft
- Max pavement slope: 0.03
- Permeable pavement bottom slope: zero
- Aggregate porosity: 0.40

NOTE: See Appendix C or consult with the Copermittee with jurisdiction over the project site for additional considerations regarding infiltration and determination of the appropriate infiltration reduction factor.

BIORETENTION (STANDARD DESIGN)

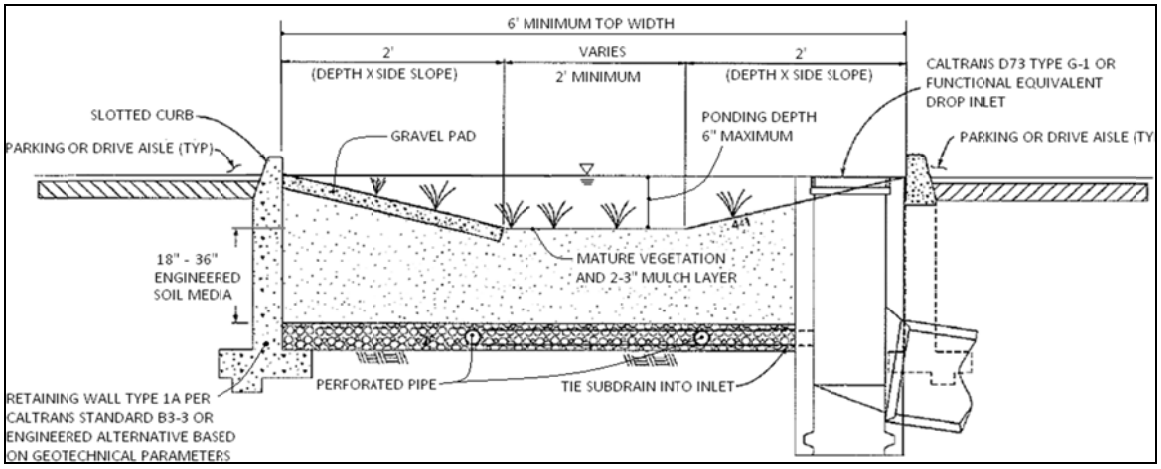
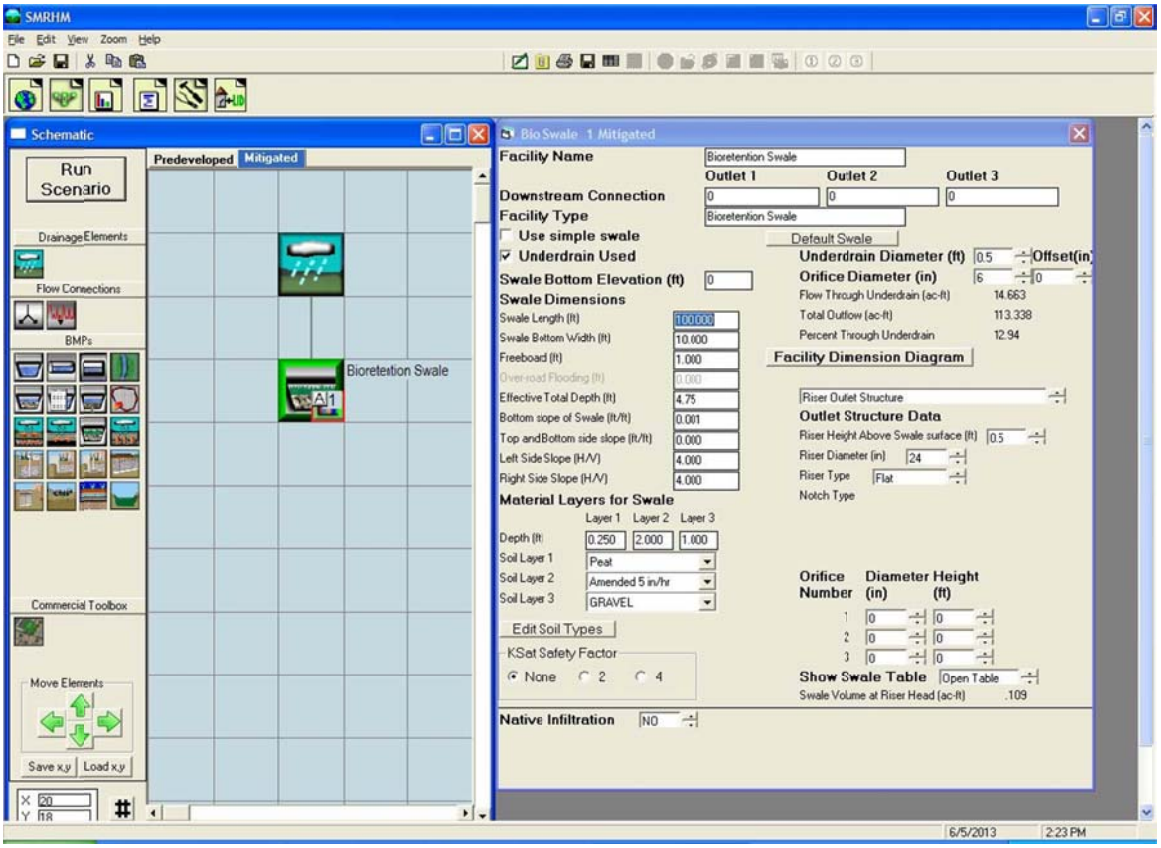


Figure courtesy of Riverside County Flood Control and Water Conservation District

Bioretention (standard design) allows stormwater runoff to enter the bioretention facility above ground and then infiltrate through the mulch layer, engineered soil media, and gravel storage layers before exiting through a discharge pipe.

For the purpose of flow control the discharge from the pipe should not exceed the predevelopment discharge from the project site for the flow duration range specified by the local jurisdiction.

In SMRHM the bioretention (standard design) is represented by the bioretention element.



The bioretention dimensions and parameters to adjust to represent the bioretention standard design are discussed on page 81.

The Riverside County *Design Handbook for Low Impact Development Best Management Practices* specifies the following criteria for bioretention (standard design):

- Minimum width: 6 ft
- Sideslope: 4 to 1
- Maximum ponding depth: 0.5 ft
- Mulch top layer: 2 to 3 inches deep (above amended soil layer)
- Minimum amended soil layer depth: 1.5 ft
- Maximum amended soil layer depth: 3 ft
- Maximum amended soil porosity: 0.30
- Maximum gravel layer: 1 ft (below amended soil layer)
- Gravel layer porosity: 0.40
- Minimum underdrain diameter: 0.5 ft
- No infiltration to native soil

BIORETENTION (VERTICAL SIDESLOPES)

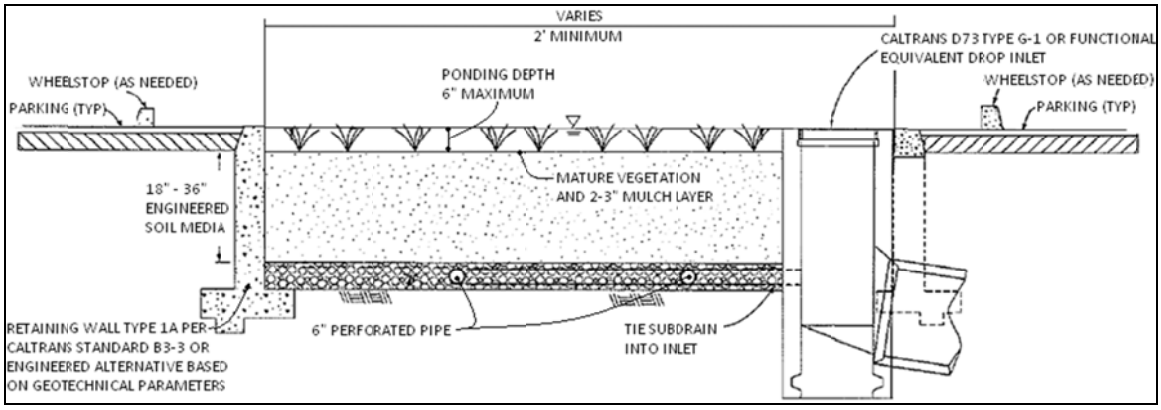
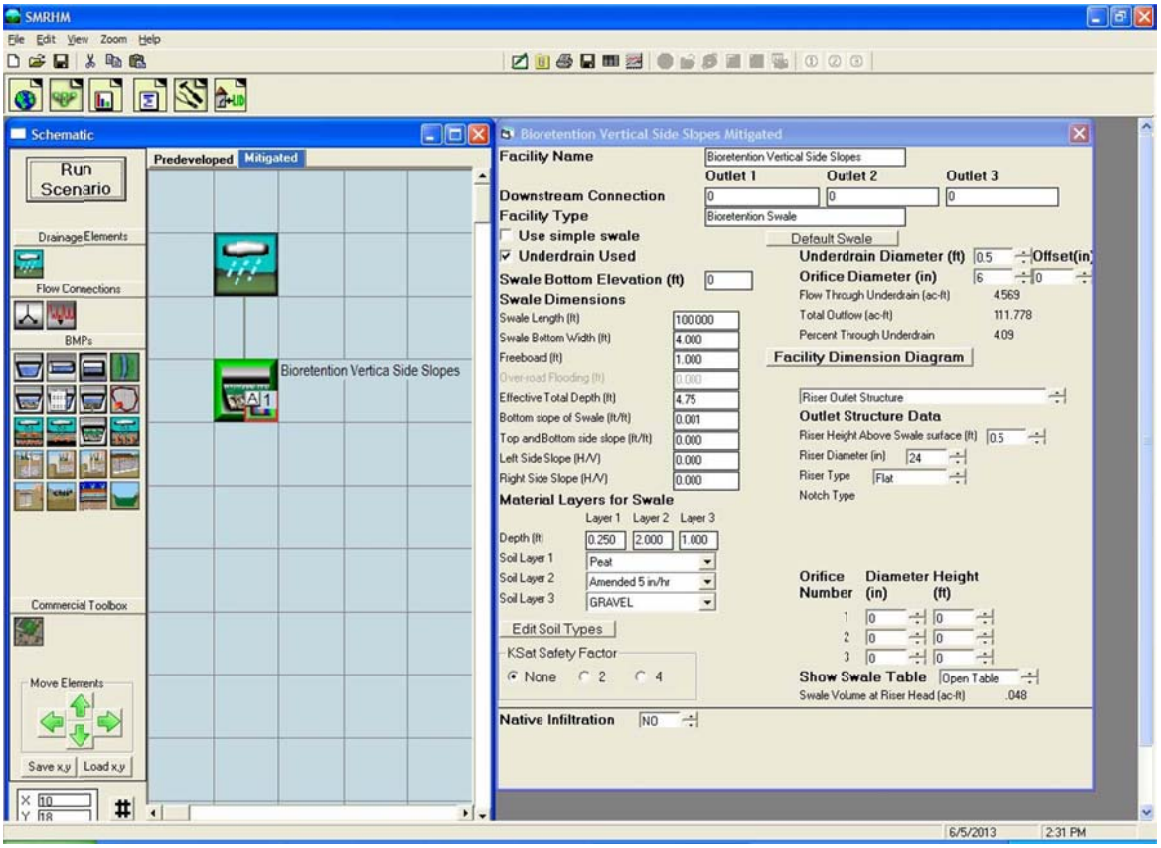


Figure courtesy of Riverside County Flood Control and Water Conservation District

Bioretention with vertical sideslopes allows stormwater runoff to enter the bioretention facility above ground and then infiltrate through the mulch layer, engineered soil media, and gravel storage layers before exiting through a discharge pipe.

For the purpose of flow control the discharge from the pipe should not exceed the predevelopment discharge from the project site for the flow duration range specified by the Copermittee with jurisdiction over the project site.

In SMRHM the bioretention (vertical sideslopes) is represented by the bioretention element.



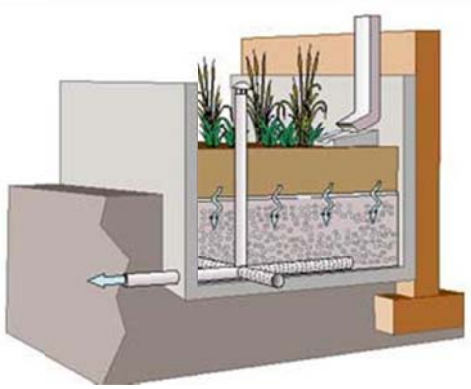
The bioretention dimensions and parameters to adjust to represent the bioretention standard design are discussed on page 81.

The Riverside County *Design Handbook for Low Impact Development Best Management Practices* specifies the following criteria for bioretention (vertical sideslopes):

- Minimum width: 2 ft
- Sideslope: 0 to 1
- Maximum ponding depth: 0.5 ft
- Mulch top layer: 2 to 3 inches deep (above amended soil layer)
- Minimum amended soil layer depth: 1.5 ft
- Maximum amended soil layer depth: 3 ft
- Maximum amended soil porosity: 0.30
- Maximum gravel layer: 1 ft (below amended soil layer)
- Gravel layer porosity: 0.40
- Minimum underdrain diameter: 0.5 ft
- No infiltration to native soil

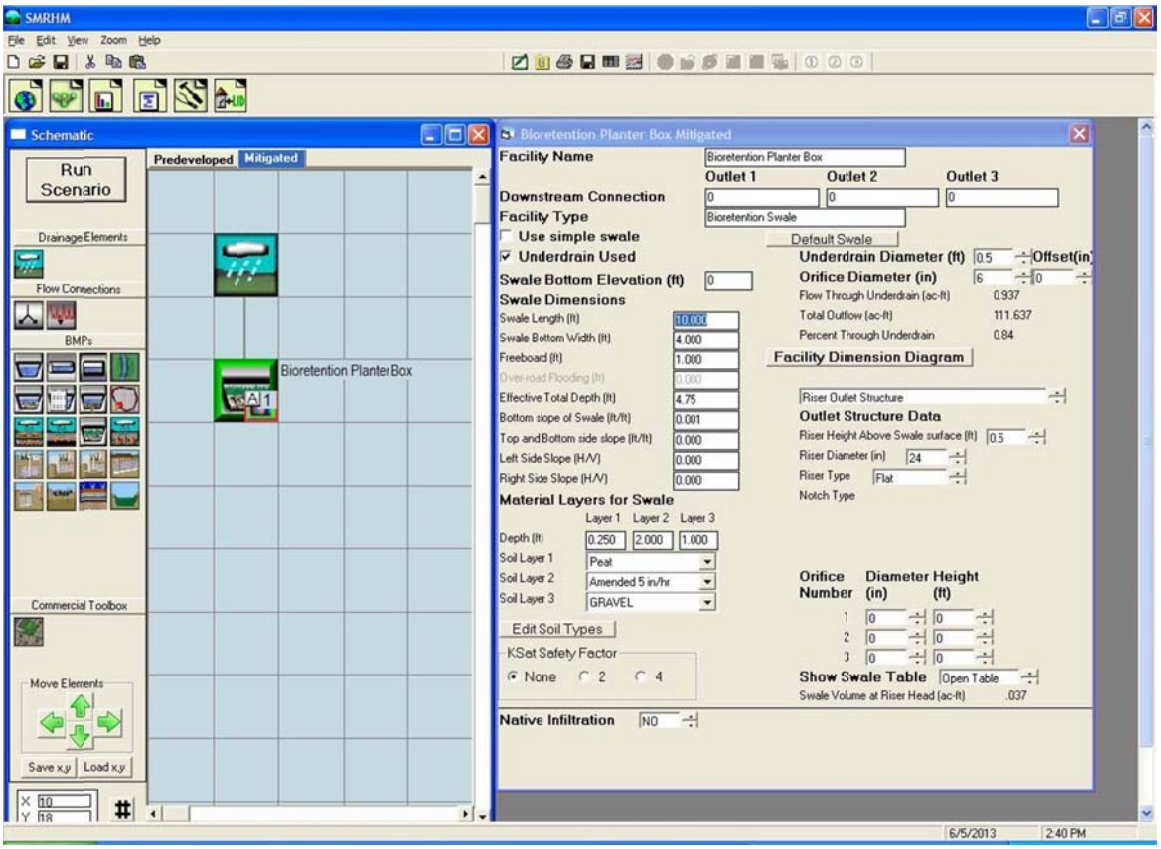
BIORETENTION (PLANTER BOX)

Bioretention in the form of a planter box allows stormwater runoff to enter the bioretention facility above ground and then infiltrate through the mulch layer, engineered soil media, and gravel storage layers before exiting through a discharge pipe.



For the purpose of flow control, the discharge from the pipe should not exceed the Predevelopment discharge from the project site for the flow duration range specified by the local jurisdiction.

In SMRHM the planter box bioretention is represented by the bioretention element.



The bioretention dimensions and parameters to adjust to represent the planter box bioretention are discussed on page 81.

The Riverside County *Design Handbook for Low Impact Development Best Management Practices* specifies the following criteria for planter box bioretention:

- Minimum width: 2 ft
- Sideslope: 0 to 1
- Maximum ponding depth: 0.5 ft
- Mulch top layer: 2 to 3 inches deep (above amended soil layer)
- Minimum amended soil layer depth: 1.5 ft
- Maximum amended soil layer depth: 3 ft
- Maximum amended soil porosity: 0.30
- Maximum gravel layer: 1 ft (below amended soil layer)
- Gravel layer porosity: 0.40
- Minimum underdrain diameter: 0.5 ft
- No infiltration to native soil

SAND FILTER BASIN

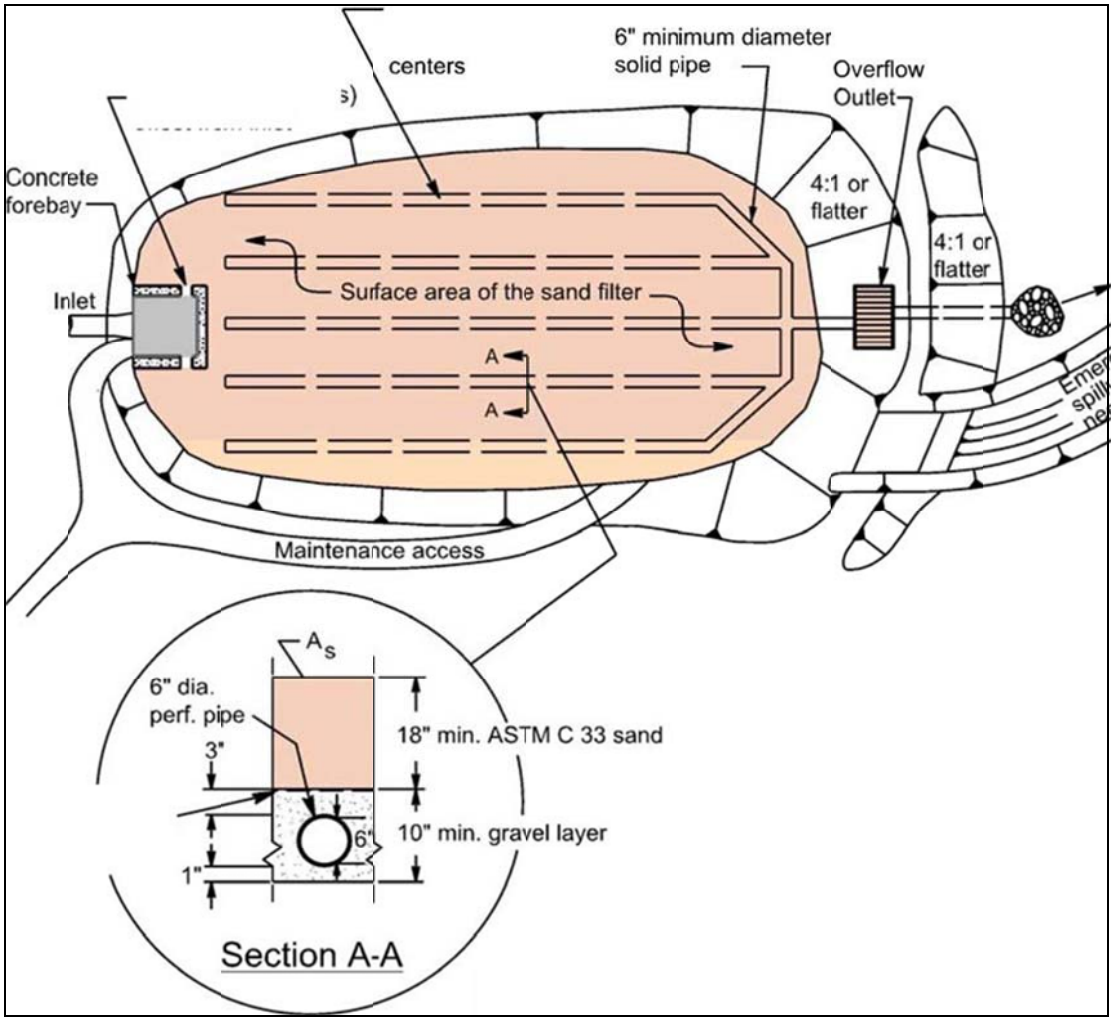
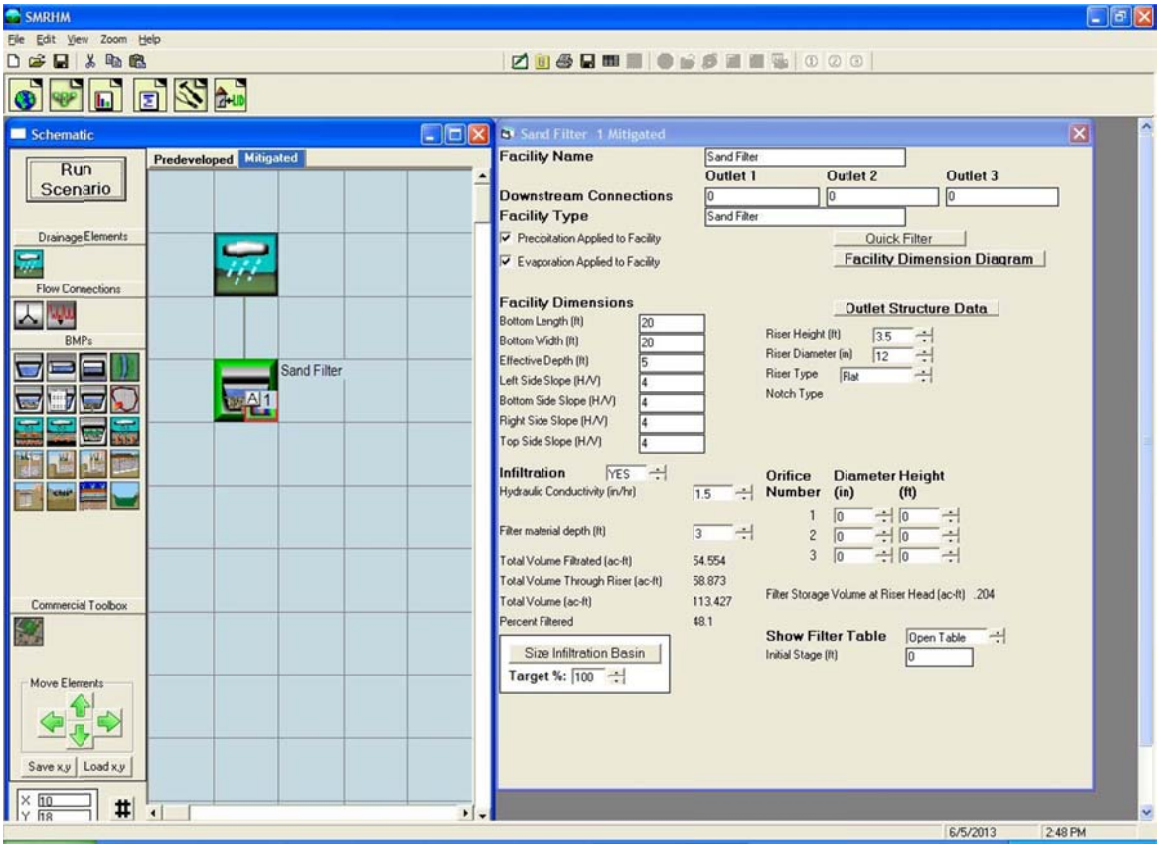


Figure courtesy of Riverside County Flood Control and Water Conservation District

A sand filter basin allows stormwater runoff to enter the sand filter above ground and then filtrate through the filter media before exiting through a discharge pipe.

In SMRHM the sand filter basin is represented by the sand filter element.



The sand filter dimensions and parameters to adjust to represent the sand filter basin are discussed on page 61.

The Riverside County *Design Handbook for Low Impact Development Best Management Practices* specifies the following criteria for the sand filter basin:

- Maximum tributary area: 25 ac
- Maximum basin depth: 5 ft
- Maximum Sideslope: 4 to 1
- Sand filter top below bottom orifice: min 4 in
- Sand filter top layer: min 18 in of sand
- Sand filter bottom layer: min 10 in of gravel
- Sand filter underdrain diameter: 6 in
- Sand filter underdrain bottom: 1 in above bottom gravel layer
- No infiltration to native soil

EXTENDED DETENTION BASIN

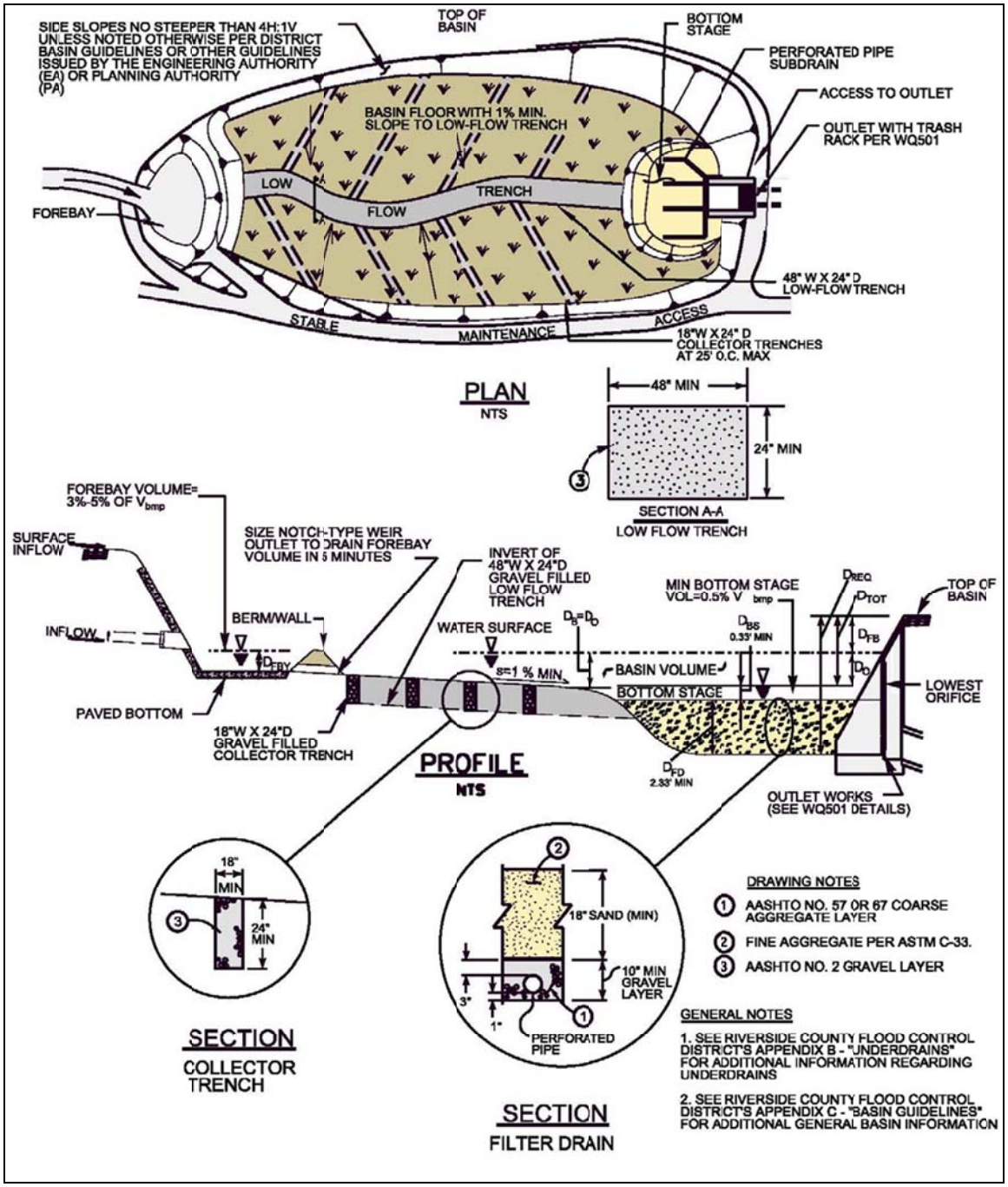
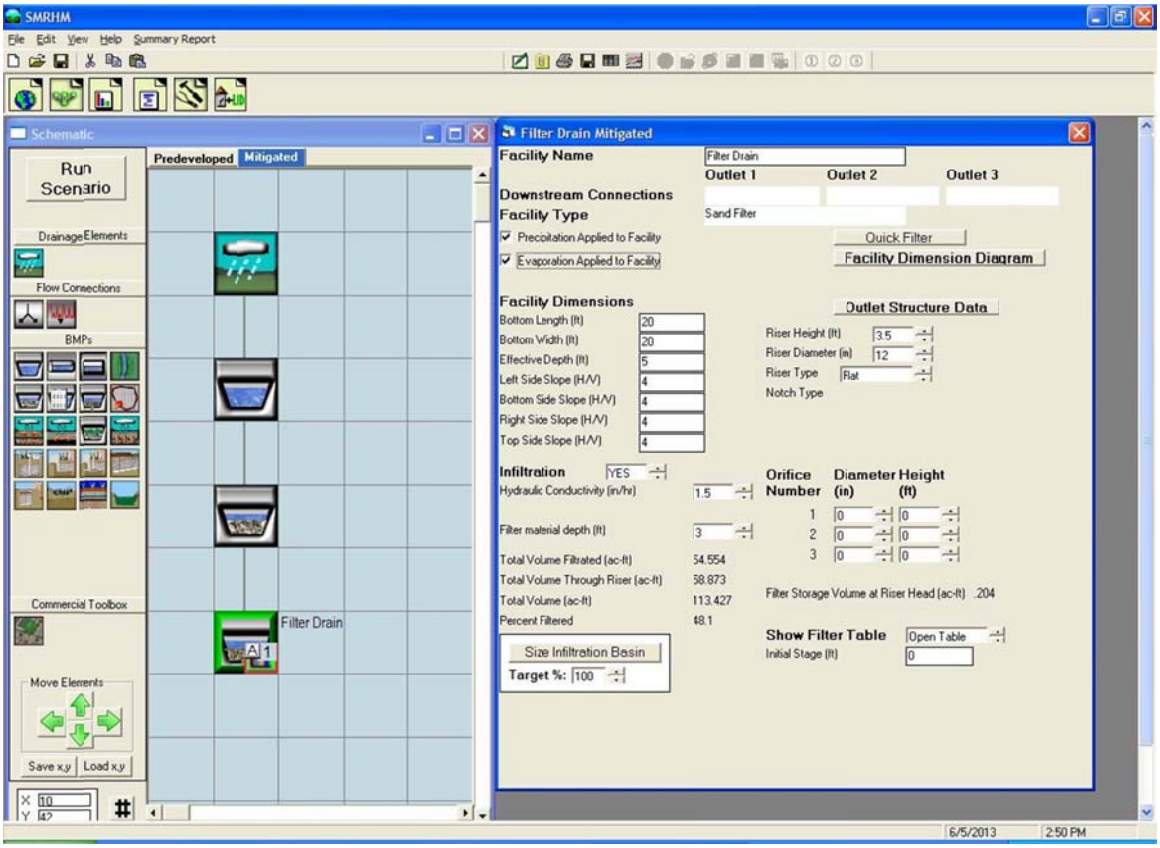


Figure courtesy of Riverside County Flood Control and Water Conservation District

The extended detention basin is a combination stormwater pond (forebay), gravel trench (connector trench), and sand filter (filter drain). In SMRHM there is not a single element that represents this combination.

In SMRHM the extended detention basin is represented by treatment train connecting a trapezoidal pond (or irregular pond) element to a gravel trench element to a sand filter element, in that order.

There is also the option of creating the extended detention basin's stage-storage- discharge table outside of SMRHM and inputting it as a SSD Table element.



The trapezoidal pond dimensions and parameters to adjust to represent the forebay are discussed on page 46.

The irregular pond dimensions and parameters to adjust to represent the forebay are discussed on page 56.

The gravel trench dimensions and parameters to adjust to represent the connector trench are discussed on page 59.

The sand filter dimensions and parameters to adjust to represent the filter drain are discussed on page 61.

The SSD element is discussed on page 78.

The Riverside County *Design Handbook for Low Impact Development Best Management Practices* specifies the following criteria for the extended detention basin:

- Minimum tributary area: 5 ac
- Maximum drawdown: 72 hrs
- Maximum Sideslope: 4 to 1
- Trench bottom slope: 1%
- Minimum filter drain depth: 2.33 ft

This page has been intentionally left blank.

APPENDIX A: DEFAULT SMRHM HSPF PERVIOUS PARAMETER VALUES

The default SMRHM HSPF pervious parameter values are found in SMRHM file defaultpersp.uci.

HSPF parameter documentation is found in the document:
Bicknell, B.R., J.C. Imhoff, J.L. Kittle Jr, T.H. Jobes, and A.S. Donigian Jr. 2001. Hydrological Simulation Program – Fortran, User's Manual for Version 12. AQUA TERRA Consultants. Mountain View, CA.

Table 1. SMRHM Pervious Land Types

PERLND No.	Soil Type	Land Cover	Land Slope
1	A	Forest	Flat (0-5%)
2	A	Forest	Moderate (5-10%)
3	A	Forest	Steep (10-20%)
4	A	Forest	Very Steep (>20%)
5	A	Shrub	Flat (0-5%)
6	A	Shrub	Moderate (5-10%)
7	A	Shrub	Steep (10-20%)
8	A	Shrub	Very Steep (>20%)
9	A	Grass	Flat (0-5%)
10	A	Grass	Moderate (5-10%)
11	A	Grass	Steep (10-20%)
12	A	Grass	Very Steep (>20%)
13	A	Urban	Flat (0-5%)
14	A	Urban	Moderate (5-10%)
15	A	Urban	Steep (10-20%)
16	A	Urban	Very Steep (>20%)
17	B	Forest	Flat (0-5%)
18	B	Forest	Moderate (5-10%)
19	B	Forest	Steep (10-20%)
20	B	Forest	Very Steep (>20%)
21	B	Shrub	Flat (0-5%)
22	B	Shrub	Moderate (5-10%)
23	B	Shrub	Steep (10-20%)
24	B	Shrub	Very Steep (>20%)
25	B	Grass	Flat (0-5%)
26	B	Grass	Moderate (5-10%)
27	B	Grass	Steep (10-20%)
28	B	Grass	Very Steep (>20%)
29	B	Urban	Flat (0-5%)
30	B	Urban	Moderate (5-10%)
31	B	Urban	Steep (10-20%)
32	B	Urban	Very Steep (>20%)
33	C/D	Forest	Flat (0-5%)
34	C/D	Forest	Moderate (5-10%)
35	C/D	Forest	Steep (10-20%)
36	C/D	Forest	Very Steep (>20%)
37	C/D	Shrub	Flat (0-5%)
38	C/D	Shrub	Moderate (5-10%)
39	C/D	Shrub	Steep (10-20%)
40	C/D	Shrub	Very Steep (>20%)
41	C/D	Grass	Flat (0-5%)
42	C/D	Grass	Moderate (5-10%)
43	C/D	Grass	Steep (10-20%)
44	C/D	Grass	Very Steep (>20%)

45	C/D	Urban	Flat (0-5%)
46	C/D	Urban	Moderate (5-10%)
47	C/D	Urban	Steep (10-20%)
48	C/D	Urban	Very Steep (>20%)

Table 2. SMRHM HSPF Pervious Parameter Values – Part I

PERLND No.	LZSN	INFILT	LSUR	SLSUR	KVARY	AGWRC
1	5.20	0.100	400	0.05	0.80	0.985
2	4.80	0.075	350	0.10	0.80	0.985
3	4.50	0.055	300	0.15	0.80	0.985
4	4.20	0.045	200	0.25	0.80	0.985
5	5.20	0.090	400	0.05	0.80	0.955
6	4.80	0.070	350	0.10	0.80	0.955
7	4.50	0.045	300	0.15	0.80	0.955
8	4.20	0.040	200	0.25	0.80	0.955
9	5.20	0.090	400	0.05	0.80	0.955
10	4.80	0.070	350	0.10	0.80	0.955
11	4.50	0.045	300	0.15	0.80	0.955
12	4.20	0.040	200	0.25	0.80	0.955
13	5.00	0.060	400	0.05	1.20	0.997
14	4.60	0.050	350	0.10	1.20	0.997
15	4.20	0.040	300	0.15	1.20	0.997
16	3.80	0.030	200	0.25	1.20	0.997
17	5.00	0.080	400	0.05	1.20	0.980
18	4.70	0.060	350	0.10	1.20	0.980
19	4.40	0.045	300	0.15	1.20	0.980
20	4.10	0.035	200	0.25	1.20	0.980
21	5.00	0.070	400	0.05	1.20	0.950
22	4.70	0.055	350	0.10	1.20	0.950
23	4.40	0.040	300	0.15	1.20	0.950
24	4.10	0.030	200	0.25	1.20	0.950
25	5.00	0.070	400	0.05	1.20	0.950
26	4.70	0.055	350	0.10	1.20	0.950
27	4.40	0.040	300	0.15	1.20	0.950
28	4.10	0.030	200	0.25	1.20	0.950
29	4.80	0.050	400	0.05	1.80	0.995
30	4.40	0.040	350	0.10	1.80	0.995
31	4.00	0.030	300	0.15	1.80	0.995
32	3.60	0.025	200	0.25	1.80	0.995
33	4.80	0.050	400	0.05	2.00	0.980
34	4.50	0.045	350	0.10	2.00	0.980
35	4.20	0.035	300	0.15	2.00	0.980
36	4.00	0.030	200	0.25	2.00	0.980
37	4.80	0.045	400	0.05	2.00	0.950
38	4.50	0.040	350	0.10	2.00	0.950
39	4.20	0.030	300	0.15	2.00	0.950
40	4.00	0.025	200	0.25	2.00	0.950
41	4.80	0.045	400	0.05	2.00	0.950
42	4.50	0.040	350	0.10	2.00	0.950
43	4.20	0.030	300	0.15	2.00	0.950
44	4.00	0.025	200	0.25	2.00	0.950
45	4.60	0.040	400	0.05	3.00	0.995

46	4.20	0.030	350	0.10	3.00	0.995
47	3.80	0.022	300	0.15	3.00	0.995
48	3.50	0.020	200	0.25	3.00	0.995

LZSN: Lower Zone Storage Nominal (inches)
INFILT: Infiltration (inches per hour)
LSUR: Length of surface flow path (feet)
SLSUR: Slope of surface flow path (feet/feet)
KVARY: Variable groundwater recession
AGWRC: Active Groundwater Recession Constant (per day)

Table 3. SMRHM HSPF Pervious Parameter Values – Part II

PERLND No.	INFEXP	INFILD	DEEPFR	BASETP	AGWETP
1	2.00	2.00	0.02	0.03	0.00
2	2.00	2.00	0.02	0.03	0.00
3	2.00	2.00	0.02	0.03	0.00
4	2.00	2.00	0.02	0.03	0.00
5	2.00	2.00	0.02	0.03	0.00
6	2.00	2.00	0.02	0.03	0.00
7	2.00	2.00	0.02	0.03	0.00
8	2.00	2.00	0.02	0.03	0.00
9	2.00	2.00	0.02	0.03	0.00
10	2.00	2.00	0.02	0.03	0.00
11	2.00	2.00	0.02	0.03	0.00
12	2.00	2.00	0.02	0.03	0.00
13	2.00	2.00	0.06	0.03	0.00
14	2.00	2.00	0.06	0.03	0.00
15	2.00	2.00	0.06	0.03	0.00
16	2.00	2.00	0.06	0.03	0.00
17	2.00	2.00	0.12	0.08	0.00
18	2.00	2.00	0.12	0.08	0.00
19	2.00	2.00	0.12	0.08	0.00
20	2.00	2.00	0.12	0.08	0.00
21	2.00	2.00	0.12	0.08	0.00
22	2.00	2.00	0.12	0.08	0.00
23	2.00	2.00	0.12	0.08	0.00
24	2.00	2.00	0.12	0.08	0.00
25	2.00	2.00	0.12	0.08	0.00
26	2.00	2.00	0.12	0.08	0.00
27	2.00	2.00	0.12	0.08	0.00
28	2.00	2.00	0.12	0.08	0.00
29	2.00	2.00	0.36	0.08	0.00
30	2.00	2.00	0.36	0.08	0.00
31	2.00	2.00	0.36	0.08	0.00
32	2.00	2.00	0.36	0.08	0.00
33	3.00	2.00	0.15	0.15	0.00
34	3.00	2.00	0.15	0.15	0.00
35	3.00	2.00	0.15	0.15	0.00
36	3.00	2.00	0.15	0.15	0.00
37	3.00	2.00	0.15	0.15	0.00
38	3.00	2.00	0.15	0.15	0.00
39	3.00	2.00	0.15	0.15	0.00
40	3.00	2.00	0.15	0.15	0.00
41	3.00	2.00	0.15	0.15	0.00
42	3.00	2.00	0.15	0.15	0.00
43	3.00	2.00	0.15	0.15	0.00
44	3.00	2.00	0.15	0.15	0.00
45	3.00	2.00	0.45	0.15	0.00

46	3.00	2.00	0.45	0.15	0.00
47	3.00	2.00	0.45	0.15	0.00
48	3.00	2.00	0.45	0.15	0.00

INFEXP: Infiltration Exponent
INFILD: Infiltration ratio (maximum to mean)
DEEPFR: Fraction of groundwater to deep aquifer or inactive storage
BASETP: Base flow (from groundwater) Evapotranspiration fraction
AGWETP: Active Groundwater Evapotranspiration fraction

Table 4. SMRHM HSPF Pervious Parameter Values – Part III

PERLND No.	CEPSC	UZSN	NSUR	INTFW	IRC	LZETP
1	see Table 6	1.00	0.35	4.50	0.80	see Table 7
2	see Table 6	0.80	0.35	4.00	0.50	see Table 7
3	see Table 6	0.60	0.35	3.00	0.45	see Table 7
4	see Table 6	0.50	0.35	2.00	0.40	see Table 7
5	see Table 6	0.90	0.30	4.00	0.70	see Table 7
6	see Table 6	0.70	0.30	3.20	0.45	see Table 7
7	see Table 6	0.50	0.30	2.60	0.40	see Table 7
8	see Table 6	0.40	0.30	1.80	0.35	see Table 7
9	see Table 6	0.80	0.25	4.00	0.70	see Table 7
10	see Table 6	0.70	0.25	3.20	0.45	see Table 7
11	see Table 6	0.55	0.25	2.60	0.40	see Table 7
12	see Table 6	0.30	0.25	1.80	0.35	see Table 7
13	see Table 6	0.70	0.25	3.00	0.40	see Table 7
14	see Table 6	0.50	0.25	2.40	0.35	see Table 7
15	see Table 6	0.35	0.25	1.60	0.30	see Table 7
16	see Table 6	0.30	0.25	1.00	0.30	see Table 7
17	see Table 6	1.00	0.35	4.00	0.80	see Table 7
18	see Table 6	0.80	0.35	3.00	0.50	see Table 7
19	see Table 6	0.60	0.35	2.00	0.45	see Table 7
20	see Table 6	0.50	0.35	0.80	0.40	see Table 7
21	see Table 6	0.90	0.30	3.00	0.70	see Table 7
22	see Table 6	0.70	0.30	2.40	0.45	see Table 7
23	see Table 6	0.50	0.30	1.60	0.40	see Table 7
24	see Table 6	0.40	0.30	0.60	0.35	see Table 7
25	see Table 6	0.80	0.25	3.00	0.70	see Table 7
26	see Table 6	0.70	0.25	2.40	0.45	see Table 7
27	see Table 6	0.55	0.25	1.60	0.40	see Table 7
28	see Table 6	0.30	0.25	0.60	0.35	see Table 7
29	see Table 6	0.70	0.25	2.00	0.40	see Table 7
30	see Table 6	0.50	0.25	1.20	0.35	see Table 7
31	see Table 6	0.35	0.25	0.80	0.30	see Table 7
32	see Table 6	0.30	0.25	0.60	0.30	see Table 7
33	see Table 6	1.00	0.35	2.00	0.80	see Table 7
34	see Table 6	0.80	0.35	1.50	0.50	see Table 7
35	see Table 6	0.60	0.35	1.00	0.45	see Table 7
36	see Table 6	0.50	0.35	0.40	0.40	see Table 7
37	see Table 6	0.90	0.30	2.00	0.70	see Table 7
38	see Table 6	0.70	0.30	1.20	0.45	see Table 7
39	see Table 6	0.50	0.30	0.80	0.40	see Table 7
40	see Table 6	0.40	0.30	0.40	0.35	see Table 7
41	see Table 6	0.80	0.25	2.00	0.70	see Table 7
42	see Table 6	0.70	0.25	1.20	0.45	see Table 7
43	see Table 6	0.55	0.25	0.80	0.40	see Table 7
44	see Table 6	0.30	0.25	0.40	0.35	see Table 7
45	see Table 6	0.70	0.25	1.00	0.40	see Table 7

46	see Table 6	0.50	0.25	0.70	0.35	see Table 7
47	see Table 6	0.35	0.25	0.50	0.30	see Table 7
48	see Table 6	0.30	0.25	0.35	0.30	see Table 7

CEPSC: Interception storage (inches)
UZSN: Upper Zone Storage Nominal (inches)
NSUR: Surface roughness (Manning's n)
INTFW: Interflow index
IRC: Interflow Recession Constant (per day)
LZETP: Lower Zone Evapotranspiration fraction

Table 5. SMRHM HSPF Pervious Parameter Values – Part VI

PERLND No.	CEPS	SURS	UZS	IFWS	LZS	AGWS	GWVS
1	0.00	0.00	0.01	0.00	0.50	0.30	0.01
2	0.00	0.00	0.01	0.00	0.50	0.30	0.01
3	0.00	0.00	0.01	0.00	0.50	0.30	0.01
4	0.00	0.00	0.01	0.00	0.50	0.30	0.01
5	0.00	0.00	0.01	0.00	0.50	0.30	0.01
6	0.00	0.00	0.01	0.00	0.50	0.30	0.01
7	0.00	0.00	0.01	0.00	0.50	0.30	0.01
8	0.00	0.00	0.01	0.00	0.50	0.30	0.01
9	0.00	0.00	0.01	0.00	0.50	0.30	0.01
10	0.00	0.00	0.01	0.00	0.50	0.30	0.01
11	0.00	0.00	0.01	0.00	0.50	0.30	0.01
12	0.00	0.00	0.01	0.00	0.50	0.30	0.01
13	0.00	0.00	0.01	0.00	3.50	1.50	0.10
14	0.00	0.00	0.01	0.00	3.50	1.50	0.10
15	0.00	0.00	0.01	0.00	3.50	1.50	0.10
16	0.00	0.00	0.01	0.00	3.50	1.50	0.10
17	0.00	0.00	0.01	0.00	0.50	0.30	0.01
18	0.00	0.00	0.01	0.00	0.50	0.30	0.01
19	0.00	0.00	0.01	0.00	0.50	0.30	0.01
20	0.00	0.00	0.01	0.00	0.50	0.30	0.01
21	0.00	0.00	0.01	0.00	0.50	0.30	0.01
22	0.00	0.00	0.01	0.00	0.50	0.30	0.01
23	0.00	0.00	0.01	0.00	0.50	0.30	0.01
24	0.00	0.00	0.01	0.00	0.50	0.30	0.01
25	0.00	0.00	0.01	0.00	0.50	0.30	0.01
26	0.00	0.00	0.01	0.00	0.50	0.30	0.01
27	0.00	0.00	0.01	0.00	0.50	0.30	0.01
28	0.00	0.00	0.01	0.00	0.50	0.30	0.01
29	0.00	0.00	0.01	0.00	3.50	1.50	0.10
30	0.00	0.00	0.01	0.00	3.50	1.50	0.10
31	0.00	0.00	0.01	0.00	3.50	1.50	0.10
32	0.00	0.00	0.01	0.00	3.50	1.50	0.10
33	0.00	0.00	0.01	0.00	0.50	0.30	0.01
34	0.00	0.00	0.01	0.00	0.50	0.30	0.01
35	0.00	0.00	0.01	0.00	0.50	0.30	0.01
36	0.00	0.00	0.01	0.00	0.50	0.30	0.01
37	0.00	0.00	0.01	0.00	0.50	0.30	0.01
38	0.00	0.00	0.01	0.00	0.50	0.30	0.01
39	0.00	0.00	0.01	0.00	0.50	0.30	0.01
40	0.00	0.00	0.01	0.00	0.50	0.30	0.01
41	0.00	0.00	0.01	0.00	0.50	0.30	0.01
42	0.00	0.00	0.01	0.00	0.50	0.30	0.01
43	0.00	0.00	0.01	0.00	0.50	0.30	0.01
44	0.00	0.00	0.01	0.00	0.50	0.30	0.01
45	0.00	0.00	0.01	0.00	3.50	1.70	0.10

46	0.00	0.00	0.01	0.00	3.50	1.70	0.10
47	0.00	0.00	0.01	0.00	3.50	1.70	0.10
48	0.00	0.00	0.01	0.00	3.50	1.70	0.10

CEPS: Initial interception storage (inches)
SURS: Initial surface runoff (inches)
UZS: Initial Upper Zone Storage (inches)
IFWS: Initial interflow (inches)
LZS: Initial Lower Zone Storage (inches)
AGWS: Initial Active Groundwater storage (inches)
GWVS: Initial Groundwater Vertical Slope (feet/feet)

Table 6. SMRHM HSPF Pervious Parameter Values: Monthly Interception Storage (inches)

PERLND No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18
2	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18
3	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18
4	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18
5	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.13
6	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.13
7	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.13
8	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.13
9	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12
10	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12
11	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12
12	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12
13	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
14	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
15	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
16	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
17	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18
18	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18
19	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18
20	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18
21	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.13
22	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.13
23	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.13
24	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.13
25	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12
26	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12
27	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12
28	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12
29	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
30	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11

31	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
32	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
33	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18
34	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18
35	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18
36	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18
37	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.13
38	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.13
39	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.13
40	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.13
41	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12
42	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12
43	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12
44	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12
45	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
46	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
47	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
48	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11

Table 7. SMRHM HSPF Pervious Parameter Values: Monthly Lower Zone Evapotranspiration

PERLND No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.60	0.60	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.65	0.60
2	0.60	0.60	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.65	0.60
3	0.60	0.60	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.65	0.60
4	0.60	0.60	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.65	0.60
5	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
6	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
7	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
8	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
9	0.40	0.40	0.40	0.45	0.50	0.55	0.55	0.55	0.55	0.55	0.45	0.40
10	0.40	0.40	0.40	0.45	0.50	0.55	0.55	0.55	0.55	0.55	0.45	0.40
11	0.40	0.40	0.40	0.45	0.50	0.55	0.55	0.55	0.55	0.55	0.45	0.40
12	0.40	0.40	0.40	0.45	0.50	0.55	0.55	0.55	0.55	0.55	0.45	0.40
13	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
14	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
15	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
16	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
17	0.60	0.60	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.65	0.60
18	0.60	0.60	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.65	0.60
19	0.60	0.60	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.65	0.60
20	0.60	0.60	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.65	0.60
21	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
22	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
23	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
24	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
25	0.40	0.40	0.40	0.45	0.50	0.55	0.55	0.55	0.55	0.55	0.45	0.40
26	0.40	0.40	0.40	0.45	0.50	0.55	0.55	0.55	0.55	0.55	0.45	0.40
27	0.40	0.40	0.40	0.45	0.50	0.55	0.55	0.55	0.55	0.55	0.45	0.40
28	0.40	0.40	0.40	0.45	0.50	0.55	0.55	0.55	0.55	0.55	0.45	0.40
29	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
30	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50

31	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
32	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
33	0.60	0.60	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.65	0.60
34	0.60	0.60	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.65	0.60
35	0.60	0.60	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.65	0.60
36	0.60	0.60	0.60	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.65	0.60
37	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
38	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
39	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
40	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
41	0.40	0.40	0.40	0.45	0.50	0.55	0.55	0.55	0.55	0.55	0.45	0.40
42	0.40	0.40	0.40	0.45	0.50	0.55	0.55	0.55	0.55	0.55	0.45	0.40
43	0.40	0.40	0.40	0.45	0.50	0.55	0.55	0.55	0.55	0.55	0.45	0.40
44	0.40	0.40	0.40	0.45	0.50	0.55	0.55	0.55	0.55	0.55	0.45	0.40
45	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
46	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
47	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50
48	0.50	0.50	0.50	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.55	0.50

This page has been intentionally left blank.

APPENDIX B: DEFAULT SMRHM HSPF IMPERVIOUS PARAMETER VALUES

The default SMRHM HSPF impervious parameter values are found in SMRHM file defaultpersp.uci.

HSPF parameter documentation is found in the document:
Bicknell, B.R., J.C. Imhoff, J.L. Kittle Jr, T.H. Jobes, and A.S. Donigian Jr. 2001. Hydrological Simulation Program – Fortran, User's Manual for Version 12. AQUA TERRA Consultants. Mountain View, CA.

Table 1. SMRHM Impervious Land Types

IMPLND No.	IMPLND Name	Land Slope
1	Roads	Flat (0-5%)
2	Roads	Moderate (5-10%)
3	Roads	Steep (10-20%)
4	Roads	Very Steep (>20%)
5	Roof Area	All
6	Driveways	Flat (0-5%)
7	Driveways	Moderate (5-10%)
8	Driveways	Steep (10-20%)
9	Driveways	Very Steep (>20%)
10	Sidewalks	Flat (0-5%)
11	Sidewalks	Moderate (5-10%)
12	Sidewalks	Steep (10-20%)
13	Sidewalks	Very Steep (>20%)
14	Parking	Flat (0-5%)
15	Parking	Moderate (5-10%)
16	Parking	Steep (10-20%)
17	Parking	Very Steep (>20%)

Table 2. SMRHM HSPF Impervious Parameter Values – Part I

IMPLND No.	LSUR	SLSUR	NSUR	RETSC
1	100	0.05	0.10	0.10
2	100	0.10	0.10	0.09
3	100	0.15	0.10	0.08
4	100	0.25	0.10	0.06
5	100	0.05	0.10	0.10
6	100	0.05	0.10	0.10
7	100	0.10	0.10	0.09
8	100	0.15	0.10	0.08
9	100	0.25	0.10	0.06
10	100	0.05	0.10	0.10
11	100	0.10	0.10	0.09
12	100	0.15	0.10	0.08
13	100	0.25	0.10	0.06
14	100	0.05	0.10	0.10
15	100	0.10	0.10	0.09
16	100	0.15	0.10	0.08
17	100	0.25	0.10	0.06

LSUR: Length of surface flow path (feet) for impervious area
SLSUR: Slope of surface flow path (feet/feet) for impervious area
NSUR: Surface roughness (Manning's n) for impervious area
RETSC: Surface retention storage (inches) for impervious area

Table 3. SMRHM HSPF Impervious Parameter Values – Part II

IMPLND No.	RETS	SURS
1	0.00	0.00
2	0.00	0.00
3	0.00	0.00
4	0.00	0.00
5	0.00	0.00
6	0.00	0.00
7	0.00	0.00
8	0.00	0.00
9	0.00	0.00
10	0.00	0.00
11	0.00	0.00
12	0.00	0.00
13	0.00	0.00
14	0.00	0.00
15	0.00	0.00
16	0.00	0.00
17	0.00	0.00

RETS: Initial surface retention storage (inches) for impervious area
SURS: Initial surface runoff (inches) for impervious area

This page has been intentionally left blank.

APPENDIX C: ADDITIONAL GUIDANCE FOR USING SMRHM

Scope and Purpose: This appendix includes guidance and background information that are not incorporated into the SMRHM software, but which the user needs to know in order to use SMRHM for designing projects in the participating jurisdictions. The three main topic areas in this appendix are flagged in the main guidance documentation text by specially formatted notes under the SMRHM elements or software features to which they are related:

Appendix C Topic	Relevant Sections in Guidance documentation
Infiltration Reduction Factor	Infiltration, page 69; applicable when specifying characteristics of a facility (pond, vault, tank, some LID elements) if "yes" is selected as the Infiltration option.
Flow Duration Outlet Structures (includes sizing of low-flow orifice and alternative configurations)	Outlet Structure Configurations, pages 63-68; applicable when specifying characteristics of a flow duration facility.
Drawdown (drain) time for flow duration facilities	Drawdown (Analysis screen), page 98.

This guidance was originally created by the stormwater programs of Alameda, Santa Clara, and San Mateo Counties. Please consult with the local municipal permitting agency for additional considerations.

Additional guidance and references are also discussed at the end of this appendix.

Infiltration Reduction Factor

The Western Washington Hydrology Model included this factor to reflect the requirement in the *Stormwater Management Manual for Western Washington* (SMMWW), to incorporate a Correction Factor (CF) to determine long-term infiltration rates; the inverse of the CF is the Infiltration Reduction Factor in SMRHM. The SMMWW gives three methods for determining CF: 1) a table providing empirical correlations between long-term infiltration rates and USDA Soil Textural Classification; 2) American Society of Testing and Materials (ASTM) gradation testing at full-scale infiltration facilities; or 3) In-situ infiltration tests, preferably using a Pilot Infiltration Test specified in an appendix of the SMMWW.

Application of a CF or safety factor attempts to account for clogging and the reduction in infiltration over time, which might apply to the bottom of a flow duration pond or the top layer of a bioretention facility. However, a safety factor is also used to account for uncertainties in the available estimate of in-situ infiltration rates. The SMMWW notes that its suggested CF values, which range from 2 to 4, "represent an average degree of long-term facility maintenance, TSS reduction through pretreatment, and site variability in the subsurface conditions", and that increases or decreases to these factors should be considered

for unusual situations.

Suggested safety factors in other texts and guidance generally range from 1 to 4. Santa Margarita Region County MS4 permits may require some form of tracking and verification for treatment and hydromodification facilities. In addition, designers should not be overly conservative in selecting a very high safety factor, since this might lead to over-controlled (lower) post-project flows and an increase risk of causing impacts from deposition or sedimentation in the receiving channels. In the absence of other guidance, it is suggested that the SMRHM Infiltration Reduction Factor not be less than 0.25 or greater than 0.5.

Note: Santa Margarita Region County stormwater programs may also restrict the use of infiltration for treatment purposes in certain conditions; since the flow duration facilities are also performing some treatment, designers should discuss treatment measure design with the applicable jurisdiction.

Flow Duration Outlet Structures – Practical Design Considerations

Low-flow Orifice Sizing

The diameter of the low-flow (bottom) orifice is an important design parameter for flow duration facilities, since flows discharged through this outlet should be at or below the project threshold for controlled flows (Qcp). However maintenance and/or other practical considerations may dictate a practical limit to how small this orifice may be, which may be larger than the optimal theoretical diameter determined by Auto Pond. As an example, Riverside County specifies a minimum orifice diameter of 1.0 inch.

While the user can manually set a minimum size for the low-flow orifice, doing so before running Auto Pond is not recommended as this may impair the program's ability to optimize the pond configuration. The following general approach is suggested for designing a pond when there is a small value for the low end of the flow matching range:

1. First estimate the minimum pond volume allowing Auto Pond to freely determine the diameter and placement of all orifices.
2. Then manually accept all of the pond settings except low-flow orifice diameter. Set the low-flow orifice to the desired minimum size, after consulting the local municipal permitting agency.
3. Manually run the mitigated scenario as described on page 48 and review the Analysis screen to check if the revised mitigated flow still passes the flow-duration criteria for curve matching. If so, proceed with the pond design using the revised outlet.
4. If the revised design shows Fail scoring at one or more flow levels, excess flow durations may be reduced somewhat by reducing the depth of the pond which lowers the head above the orifice. As an alternative, further mitigation can be applied to the low-flow orifice flow by adding an additional infiltration measure

downstream. This can be sized either approximately by estimating an average excess flow from the orifice or with the help of SMRHM by returning to the screen for the pond characteristics and specifying a different Downstream Connection for the bottom orifice, which is then connected to an additional element. With this revision to the post project scenario, the POC for the system would then be located at the downstream end of the additional low- flow mitigation.

Alternative Outlet Configurations

SMRHM has two default types of outlet configurations (multiple orifice or orifice plus weir notch) based on a standpipe riser structure detailed in the SMMWW. The entire standpipe is usually within a cylindrical enclosure or manhole to exclude trash and larger particles that could clog the outlet. The SMMWW notes that orifices can also be placed on a tee section or a vertical baffle within the same type of enclosure. An alternative configuration is a flat headwall with orifices and/or notches, protected by racks or gratings. This may be fabricated from a large steel plate, similar in construction to the extended detention outlets specified in the Denver (Colorado) manual referenced below. This alternative outlet can be simulated in the SMRHM as a very large diameter standpipe, where the width of the top notch is equal to the overflow width at the top of the plate between its supports.

Drawdown time and treatment/vector considerations

Flow duration control facilities are designed to detain stormwater runoff onsite for an extended period of time. The drawdown time is a concern to designers in relation to three areas of design besides hydromodification management:

1. Standing water for extended periods provides a potential habitat in which mosquitoes can breed. The Copermittees work with their local mosquito abatement or vector control agencies to develop guidelines for hydrologic control facility design; the Riverside County Design Handbook for Low Impact Development Best Management Practices identifies that hydrologic control facilities must achieve 100% drawdown within 72 hours. Provisions for access and inspection by vector control personnel are also required. Contact the local permitting agency for details of local vector control provisions, which apply to both treatment measures and flow duration facilities.

2. Stormwater runoff that is detained also undergoes water quality treatment through settling and/or infiltration of pollutants. The focus of water quality management is reducing mean annual loads and typical concentrations of pollutants in receiving waters, so treatment design focuses on typical storms which contain the bulk of annual stormwater runoff volume. The MS4 permit and guidance documents describe the Copermittees design criteria for volume based treatment measures, which apply to a wider range of projects than the hydromodification management requirements. Recommended drawdown times

for detention structures are typically at least 48 hours, but not to exceed 72 hours within Riverside County.

3. Flood control facility design criteria is intended to control peak flows for large sized storms (with expected recurrence intervals such as 25, 50 or 100 years). Hydrologic control facilities typically require capture and detention of a specified volume of stormwater runoff, which then is discharged out at flows that can be safely conveyed by downstream channels without undue risk of flooding. Hydrologic control facilities usually are required to drain within 24 hours after the end of the design storm in order to be empty for the next storm event. This concern that hydrologic control facility storage remains available for large events has led the Copermittees to require that any storage volume for water quality not be credited for flood control, a feature that is sometimes referred to as "dead storage".

Although many factors affect the drawdown time, the suggestions below may help SMRHM users in evaluating these other requirements. If flow duration control is required for a project site, it is recommended that the design process start by using SMRHM to obtain a preliminary design for the flow duration pond, vault, or tank. Then check the performance of the facility for vector control concerns, and against treatment and/or flood control design criteria as appropriate. The latter are both based on the concept of a single empirical "design storm" which does not directly correspond to the flow duration approach using frequency analysis in a long-term simulation. Stormwater runoff treatment design requires the use of volume-based runoff coefficients, which although similar in concept to runoff coefficients used for flood control, are determined differently. Runoff coefficients used for flood control were derived for large storms with some conservatism built-in to estimates of peak flow rates and water surface elevations. Runoff coefficients for stormwater runoff treatment have been adjusted to reflect runoff from small storms where a greater percentage of the rainfall is held within the catchment.

Vector Management

If the maximum allowed drawdown (72 hours) is seldom or never exceeded over the simulation period, then likelihood of mosquito breeding in the facility is very low and the design for the pond, vault or tank does not need to be modified. If a maximum allowed drawdown time is exceeded then the system may need to be redesigned to reduce the drawdown time. The designer should consider additional reductions in impervious area and/or LID elements to help reduce the facility size.

To evaluate the frequency and distribution of larger events in more detail, use the Hydrograph tool (page 99) to plot monthly peaks for several years at a time of the mitigated (post-project) scenario to get an idea of how often the discharge that corresponds to the maximum allowed drain time would be exceeded during warmer months, when mosquito development times are shortest.

Treatment Credit

Use the applicable design criteria to determine the minimum treatment volume for the post-project scenario. Look at the pond volume representing a 2-day drawdown in the SMRHM's flow duration drawdown table. If this is larger than the calculated treatment volume, no further treatment design is needed. If the pond volume is less than the treatment volume, or always drains in less than 2 days, most or all of the water quality criteria may still be met if the combination of infiltration loss and detainment captures 80% of the runoff from the site. Infiltration loss for each pond stage is shown in the Stage-Storage-Discharge table, accessed by selecting the "Open Table" option at the bottom of the main Pond screen.

Flood Control Detention

Design criteria must be obtained from the Copermittee with jurisdiction over the project site, as well as any other policies or restrictions that may apply to drainage design. A single design storm event can be imported as a time series (page 76) and applied to the post-project scenario instead of the simulated precipitation record. If additional live storage is needed, it may be added to upper levels of the same facility or provided elsewhere on the site.

Guidance by Other Agencies

Some agencies in other parts of the United States have developed extensive guidance for design of hydrologic control facilities. Two manuals are discussed below that provide detailed discussions or examples that may be helpful to users of SMRHM, although the suitability of these recommendations for Riverside County conditions has not been verified. These documents can help provide context and ideas for users for SMRHM, but adapting these ideas requires the exercise of professional engineering judgment. **Mention of the procedures and details in these documents does not imply any endorsement or guarantee that they will be appropriate for addressing the Hydromodification Management Standards in Santa Margarita Region.**

Stormwater Management Manual for Western Washington (SWMMWW) was prepared by the Washington Department of Ecology for implementation in 19 counties of Western Washington. The latest (2012) edition in 5 volumes is on the Web at: http://www.ecy.wa.gov/programs/wq/stormwater/manual.html.

Design recommendations from this manual were the basis for many features of the WWHM that have been carried over into SMRHM. Portions of Volume 3 (Hydrology) that may be of interest to project designers include:

- Pages 3-2 through 3-18 illustrate several types of roof downspout controls, simple pre-engineered designs for infiltrating and/or dispersing runoff from roof areas in order to reduce runoff volume and/or increase potential groundwater recharge.
- Pages 3-50 to 3-63 discuss outlet control structures, their maintenance and source equations modeled into WWHM and SMRHM

- Pages 3-75 to 3-93 regarding Infiltration Reduction Factor

Urban Storm Drain Criteria Manual by the Denver Urban Drainage and Flood Control District is on the Web at: http://www.udfcd.org/downloads/down_critmanual.htm.

Volume 3 covers design of stormwater runoff treatment measures, including extended detention basins on pages S-66 through S-77 and structural details shown on pages SD-1 to SD-16. Although these designs are not presented for hydromodification management control, the perforated plate design concept allows fine-tuning of drawdown times and is adaptable for use in flow duration facilities.

APPENDIX D: SMRHM REVIEWER CHECKLIST

SMRHM Reviewer Checklist:	**Yes**	**No**
1. Received SMRHM project (WHM and WH2) files?		
2. Received SMRHM WDM (WDM) file?		
3. Received SMRHM report (DOC) file?		
4. Project (WHM) file loads okay?		
5. Project location matches location on SMRHM screen?		
6. Predevelopment scenario runs okay?		
7. Mitigated scenario runs okay?		
8. Compare SMRHM Report screen with report file:		
a. Project location descriptions match?		
b. Precipitation gauges match?		
c. Precipitation scales match?		
d. Flow frequency results match?		
e. All flow duration values PASS?		
f. Any pervious (PERLND) land use changes?		
g. Any impervious (IMPLND) land use changes?		
h. Any scaling factor changes?		
i. Any duration criteria changes?		
j. pond dimensions match?		
k. pond outlet structure info matches?		
9. SMRHM pond dimensions match drawings?		
10. Infiltration set to YES for infiltration pond?		
11. Total SMRHM drainage area matches drainage maps/drawings?		
12. Mitigated drainage area(s) match Predevelopment?		
13. Predevelopment vegetation correct?		
14. Mitigated land use areas correct?		
15. Routing correct?		
16. Check facility drawdown (if included):		
a. Used POC Mitigated stage?		
b. Drawdown times okay?		
17. Options set to default values?		
18. Other issues?		
SMRHM submittal APPROVED?		

This page has been intentionally left blank.

APPENDIX E: SMRHM BACKGROUND

Effects of Hydromodification

Urbanization of a watershed modifies natural watershed and stream processes by altering the terrain, modifying the vegetation and soil characteristics, introducing pavement and buildings, installing drainage and flood control infrastructure, and altering the condition of channels through straightening, deepening, and armoring. These changes affect hydrologic characteristics in the watershed (rainfall interception, infiltration, runoff and channel flows), and affect the supply and transport of sediment in the MS4 and receiving waters. The change in runoff characteristics from a watershed caused by changes in land use conditions is called *hydrograph modification*, or simply hydromodification.

As the total area of impervious surfaces increases in previously undeveloped areas, infiltration of rainfall decreases, causing more water to run off the surface as overland flow at a faster rate. Storms that previously didn't produce runoff under rural conditions can produce erosive flows. The increase in the volume of runoff and the length of time that erosive flows occur ultimately intensify sediment transport, causing changes in sediment transport characteristics and the hydraulic geometry (width, depth, and slope) of channels. The larger runoff durations and volumes and the intensified erosion of streams can impair the beneficial uses of the stream channels.

Development of the SMRHM

The concept of designing a flow duration control facility is relatively new and, as described above, requires the use of a continuous simulation hydrologic model. To facilitate this design approach, Clear Creek Solutions (CCS) has created a user-friendly, automated modeling and flow duration control facility sizing software tool adapted from its Western Washington Hydrology Model (WWHM). The WWHM was developed in 2001 for the Washington State Department of Ecology to support Ecology's *Stormwater Management Manual for Western Washington*[1] and assist project proponents in complying with the Western Washington hydromodification control requirements. The SMRHM is adapted from WWHM Version 4, but has been modified to represent Riverside County hydrology and enhanced to be able to size other types of control measures and LID techniques for flow reduction as well.

SMRHM is a useful tool in the design process, but must be used in conjunction with local design guidance to ensure compliance for specific projects. The reader should refer to Appendix C and guidance from the Copermittee with jurisdiction over the project site for additional information and suggestions for using the SMRHM.

---

1 Washington State Department of Ecology. 2001. Stormwater Management Manual for Western Washington. Volume III: Hydrologic Analysis and Flow Control Design/BMPs. Publication No. 99-13. Olympia, WA.

SMRHM Overview

The SMRHM software architecture and methodology is the same as that developed for Bay Area Hydrology Model, San Diego Hydrology Model, South Orange County Hydrology Model, and WWHM and uses HSPF as its computational engine[2.] Like these models, SMRHM is a tool that generates flow duration curves for the pre- and post-project condition and then sizes a flow duration control pond/basin or vault and outlet structure to match the predevelopment curve. The software package consists of a user-friendly graphical interface with screens for input of predevelopment and post-project conditions; an engine that automatically loads appropriate parameters and meteorological data and runs continuous simulations of site runoff to generate flow duration curves; a module for sizing or checking the control measure to achieve the hydromodification control standard; and a reporting module.

The HSPF hydrology parameter values used in SMRHM are based on best professional judgment using our experience with calibrated watersheds in other parts of California. SMRHM uses the Riverside County long-term 15-minute precipitation data records selected to represent SMR rainfall patterns.

HSPF is the U.S. Geological Survey and U.S. Environmental Protection Agency continuous simulation hydrology software package maintained by AQUA TERRA Consultants. The HSPF continuous simulation hydrology model is preferred over single- event hydrology models because of its ability to compute and keep track of all of the individual components of the hydrologic cycle including surface runoff, interflow, groundwater, soil moisture, and evapotranspiration. HSPF, since its introduction in 1980, has become the industry standard for hydrologic modeling.

One of the major advantages of continuous simulation hydrologic modeling is the ability to accurately determine soil moisture conditions immediately prior to storm events. Single-event hydrologic models have to make assumptions about the antecedent soil moisture conditions – assumptions which are often not accurate or appropriate. This is an important distinction because antecedent soil moisture conditions play a major role in determining the amount and timing of runoff.

Not all continuous simulation hydrologic models handle the calculation of soil moisture conditions in the same level of detail. HSPF uses a potential evapotranspiration time series to compute actual evapotranspiration each time step. HSPF uses parameter values to determine the proportion of the actual evapotranspiration from interception storage, upper soil layer storage, lower soil zone layer storage, groundwater storage, and base flow. Other continuous simulation hydrologic models, SWMM included, use a much more simplified approach to determining soil moisture. Such simplified approaches do not accurately reflect the seasonal and daily variability of the actual evapotranspiration and its effects on soil moisture.

[2] SMRHM is based on WWHM Version 4.

SMRHM computes stormwater runoff for a site selected by the user. SMRHM runs HSPF in the background to generate a 15-minute runoff time series from the available rain gauge data over a number of years. Stormwater runoff is computed for both predevelopment and post-project land use conditions. Then, another part of the SMRHM routes the post-project stormwater runoff through a hydrologic control facility of the user's choice.

SMRHM uses the Predevelopment peak flood values from a partial duration series of individual peak events to compute the predevelopment 2-year through 25-year flood frequency values[3]. The post-project runoff 2-year through 25-year flood frequency values are computed at the outlet of the proposed hydrologic control facility. The model routes the post-project runoff through the hydrologic control facility. As with the predevelopment peak flow values, partial duration post-project flow values are selected by SMRHM to compute the developed 2-year through 25-year flood frequency.

The Predevelopment 2-year peak flow is multiplied by a percentage (10 percent) to set the lower limit of the erosive flows, in accordance with the current HMP performance criteria. The predevelopment 10-year peak flow is the upper limit. A comparison of the predevelopment and post-project flow duration curves is conducted for 100 flow levels between the lower limit and the upper limit. The model counts the number of 15-minute intervals that predevelopment flows exceed each of the flow levels during the entire simulation period. The model does the same analysis for the post-project mitigated flows.

LID BMPs have been recognized as opportunities to reduce and/or eliminate stormwater runoff at the source before it becomes a problem. They include compost-amended soils, bioretention, permeable pavement, green roofs, rain gardens, and vegetated swales. All of these approaches reduce stormwater runoff. SMRHM can be used to determine the magnitude of the reduction from each of these practices and the amount of stormwater runoff detention storage still required to meet HMP requirements.

[3] The actual flood frequency calculations are made using the Cunnane flood frequency equation.

Bioretention Modeling Methodology

The bioretention element is also known as a landscape swale or rain garden. The SMRHM bioretention element is a special conveyance feature with unique characteristics. The element uses the HSPF hydraulic algorithms to route runoff, but the HSPF routing is modified to represent the two different flow paths that runoff can take. The routing is dependent on the inflow to the swale and the swale soil capacity to absorb additional runoff. HSPF Special Actions is used to check the swale soil capacity to determine the appropriate routing option.

A bioretention facility is a swale in which the native soils have been excavated and replaced with amended soil. At the downstream end of the swale, a weir or riser controls the surface discharge from the swale and detains runoff, encouraging it to infiltrate into the amended soil. Infiltration from the amended soil to the native soil is also possible, depending on the properties of the native soil. Swales can include an underdrain pipe.

The amended soil placed in the swale is assumed to have storage capacity equal to its porosity and volume. Stormwater runoff infiltrates from the surface of the swale to the amended soil at an infiltration rate set by the user. The infiltration rate cannot exceed the available storage capacity of the amended soil. The available storage capacity is determined each time step by HSPF Special Actions. Once the amended soil is saturated then water has the opportunity to infiltrate into the underlying native soil at the native soil's infiltration rate. The native soil infiltration is input by the user and is assumed to be constant throughout the year.

Inflow to the swale can exceed the amended soil infiltration rate. When this occurs, the extra water ponds on the surface of the swale. The extra water can then infiltrate into the soil during the next time step or can flow out of the swale through its surface outlet if the ponding exceeds the surface outlet's storage.

Runoff in both the surface storage and amended soil storage is available for evapotranspiration. Surface storage evapotranspiration is set to the potential evapotranspiration; the amended soil evapotranspiration pan evaporation factor is set to 0.50 to reflect reduced evapotranspiration from the amended soil.

In the amended soil water movement through the soil column is dependent on soil layer characteristics and saturation rates for different discharge conditions.

Consider a simple two-layered bioretention facility designed with two soil layers with different characteristics. As water enters the facility at the top, it infiltrates into the soil based on the modified Green Ampt equation (Equation 1). The water then moves through the top soil layer at the computed rate, determined by Darcy's and Van Genuchten's equations. As the soil approaches field capacity (i.e., gravity head is greater than matric head), we can determine when water will begin to infiltrate into the second layer (lower layer) of the soil column. This occurs when the matric head is less than the gravity head in the first layer (top layer).

Since the two layers have different soil characteristics, water will move through the two layers at different rates. Once both layers have achieved field capacity then the layer that first becomes saturated is determined by which layer is more restrictive. This is determined by using Darcy's equation to compute flux for each layer at the current level of saturation. The layer with the more restrictive flux is the layer that becomes saturated for that time step. The next time step the same comparison is made.

The rate and location of water discharging from the soil layer is determined by the discharge conditions selected by the user.

There are four possible combinations of discharge conditions:

1. There is no discharge from the subsurface layers (except for evapotranspiration). This means that there is no underdrain and there is no infiltration into the native soil. Although this discharge condition is unlikely, we still need to be able to model it.

2. There is an underdrain, but no native infiltration. Discharge from the underdrain is computed based on head conditions for the underdrain. The underdrain is configured to have an orifice. (It is possible for the orifice to be the same diameter as the underdrain.) With a maximum of three soil layers determining head conditions for the orifice is complicated. Each modeled layer must overcome matric head before flow through the underdrain can begin. Once matric head is overcome by gravity head for all of the layers then the underdrain begins to flow. The flow rate is determined based on the ability of the water to move through the soil layers and by the discharge from the orifice, whichever is smaller. Head conditions are determined by computing the saturation level of the lowest soil layer first. Once the lowest soil layer is saturated and flow begins, then the gravity head is considered to be at the saturation level of the lowest soil layer. Once the lowest soil layer is saturated completely then the head will include the gravity head from the next soil layer above until gravity head from all soil layers is included. Gravity head from ponding on the surface is included in the orifice calculations only if all of the intervening soil layers are saturated.

3. There is native infiltration but no underdrain. Discharge (infiltration) into the native soil is computed based on a user entered infiltration rate in units of inches per hour. Specific head conditions are not used in determining infiltration into the native soil. Any impact due to head on the infiltration rate is considered to be part of the determination of the native soil infiltration rate. Because it is possible to have a maximum of three soil layers, each modeled layer must overcome matric head before infiltration to the native soil can begin. Once matric head is overcome by gravity head for all modeled layers, then infiltration begins at a maximum rate determined either by the ability of the water to move through the soil layers or by the ability of the water to infiltrate into the native soil, whichever is limiting.

4. There is both an underdrain and native infiltration. Underdrain flow and native infiltration are computed as discussed above. However, there is one other limitation to consider. In the case where the flow through the soil layer is less than the sum of the discharge through the underdrain and the native infiltration, then the flow through the soil layer becomes the limiting flow and must be divided between the native infiltration and the underdrain. This division is done based on the relative discharge rates of each.

Note that wetted surface area can be included in the discharge calculations by adding the infiltration through the wetted surface area to the lower soil layer and the upper surface layer individually. This is done by computing the portion of the wetted surface area that is part of the upper surface layer and computing the infiltration independently from the portion of the wetted surface area that is part of the lower soil layers.

There are several equations used to determine water movement from the surface of the bioretention facility, through the soil layers, and into an underdrain or native infiltration. The water movement process can be divided into three different zones:

1. Surface ponding and infiltration into the top soil layer (soil layer 1)
2. Percolation through the subsurface layers
3. Underdrain flow and native infiltration

The modified Green Ampt equation (Equation 1) controls the infiltration rate into the top soil layer:

$$f = K\left(1 + \frac{(\phi - \theta)(d + \varphi)}{F}\right) \qquad \text{(Equation 1)}$$

f = soil surface infiltration rate (cm/hr)
ϕ = soil porosity of top soil layer
θ = soil moisture content of top soil layer
φ = suction head at the wetting front (cm)
F = soil moisture content of the top soil layer (cm)
d = surface ponding depth (cm)
K = hydraulic conductivity based on saturation of top soil layer (cm/hr)

K (relative hydraulic conductivity) can be computed using the following Van Genuchten approximation equation:

Van Genuchten approximation of relative hydraulic conductivity

$$\frac{K(\theta)}{K_{sat}} = \left(\frac{\vartheta - \theta_r}{\phi - \theta_r}\right)^{1/2}\left[1 - \left(1 - \left(\frac{\theta - \theta_r}{\phi - \theta_r}\right)^{1/m}\right)^m\right]^2 \qquad \text{(Equation 2)}$$

where $K(\theta)$ = relative hydraulic conductivity,
K_{sat} = saturated hydraulic conductivity,
θ = water content, θ_r = residual water content,
ϕ = porosity, α = constant, n = constant, m = constant

A few issues arise when dealing with multiple subsurface soil layers. The K value used in Equation 1 must be computed from the top soil layer. Infiltration into the upper soil layer must not exceed the lesser of the maximum percolation rates for each of the soil layers. Finally, the rate of percolation of the top layer may be reduced because the layer or layers beneath the top layer cannot accept the percolation flux because of existing saturation levels.

Water storage and movement through the three subsurface layers will be computed using Darcy's equation as shown below:

$$q = -K \frac{\partial h}{\partial z} \qquad \textbf{(}\text{Equation 3)}$$

Where:

q = Darcy flux (cm/hr)

K = hydraulic conductivity of the porous medium (cm/hr)

h = total hydraulic head (cm)

z = elevation (cm)

The total head, h, is the sum of the matric head, ψ, and the gravity head, z:

$$h = \psi + z \ . \qquad \text{(Equation 4)}$$

Substituting for h yields:

$$q = -K \frac{d(\psi + z)}{dz} \ . \qquad \text{(Equation 5)}$$

Hydraulic conductivity and matric head vary with soil moisture content. These values can be computed by solving the Van Genuchten's equation (Equation 6) for both values. Note that $\psi = 0$ when the soil is saturated.

Van Genuchten Equation to calculate total head

$$h = -\frac{1}{\alpha}\left[\frac{1}{SE^{1/m}} - 1\right]^{1/n} + z \qquad \text{(Equation 6)}$$

where h = total hydraulic head, α = constant, SE = effective saturation, m = constant, n = constant, and z = elevation head

Effective saturation (SE) can be computed using the following Van Genuchten equation:

Van Genuchten Equation to calculate effective saturation

$$\frac{\theta - \theta_r}{\phi - \theta_r} = \left[\frac{1}{1 + (\alpha\psi)^n}\right]^m = SE \qquad \text{(Equation 7)}$$

where θ = water content, θ_r = residual water content,
ϕ = porosity,
α = constant = $y_b - 1$,
n = constant = $\lambda + 1$,
m = constant = $1 - \frac{1}{\lambda + 1}$,
λ = pore size distribution index,
y_b = bubbling pressure
ψ = pressure head = h-z, h = total hydraulic head,
z = elevation head, and SE = effective saturation

Ignoring z (elevation head) results in h = hm (matric head).

Evapotranspiration is an important component of the bioretention facility's hydrologic processes. Evapotranspiration removes water from bioretention surface ponding and the soil column during non-storm periods. The routine will satisfy potential evapo-transpiration (PET) demands in the same sequence as implemented in HSPF:

1. Water available from vegetation interception storage
2. Water available from surface ponding
3. Water available from the bioretention soil layers (top layer first)

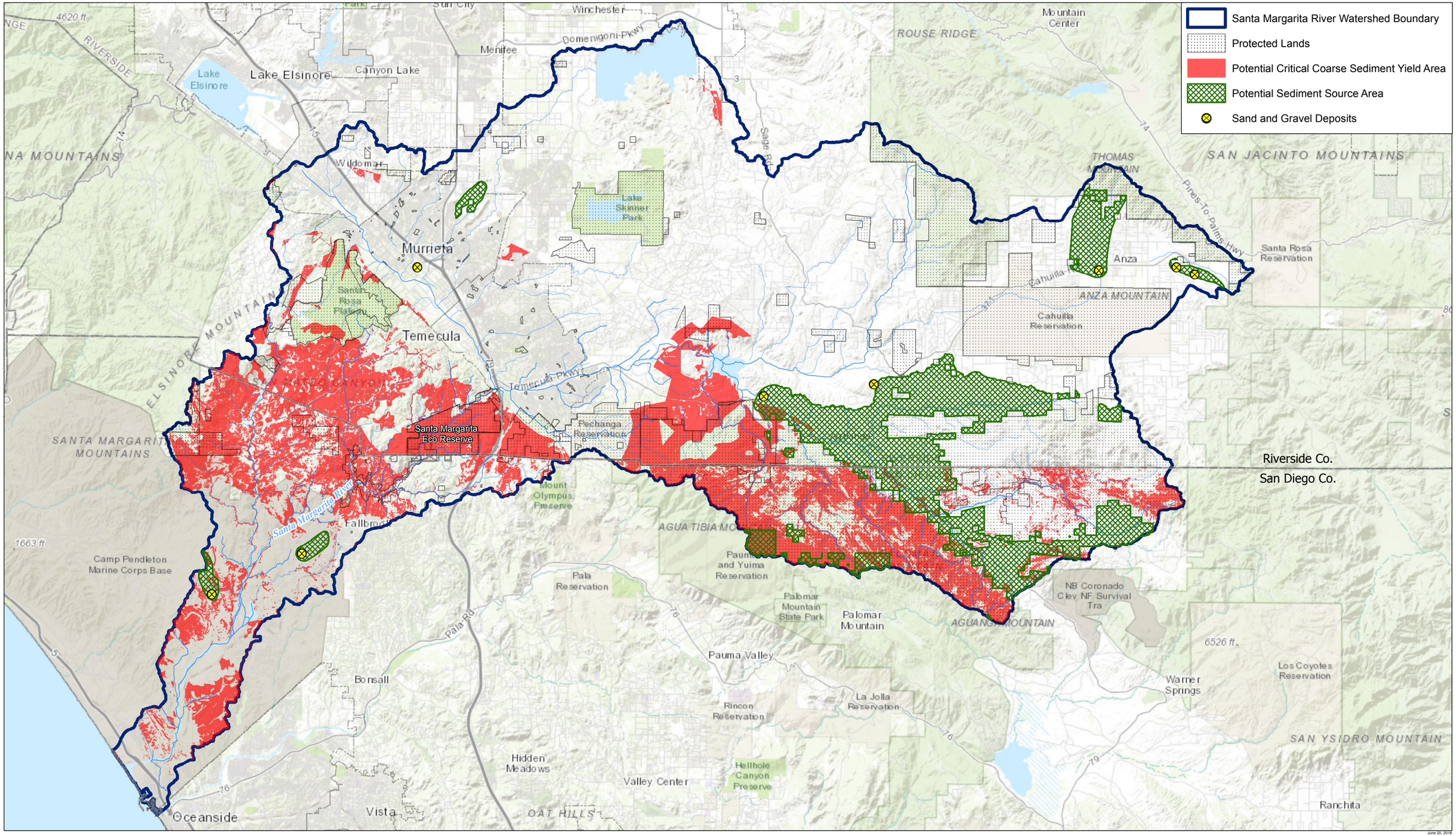
Water will be removed from vegetation interception storage and surface ponding and the bioretention soil layers (starting at the top layer) down to the rooting depth at the potential rate. Water is taken from the soil layers below the rooting depth based on a percentage factor to be determined. Without this factor there will be no way to remove water from below the rooting depth once it becomes completely saturated.

EXHIBIT G:

Santa Margarita Region Hydromodification Maps

1. **Map of Potential Critical Coarse Sediment Yield Areas and Potential Sediment Source Areas.**

2. **Hydromodification Exemption Exhibits are currently Unavailable. (Areas potentially exempt from hydromodification requirements are under review by the San Diego Water Board and will be incorporated if and when they are accepted.)**



Miles

Exhibit G-1

SANTA MARGARITA RIVER WATERSHED

POTENTIAL CRITICAL COARSE SEDIMENT YIELD AREAS AND POTENTIAL SEDIMENT SOURCE AREAS

EXHIBIT H:

Not Currently Used

EXHIBIT I:

Glossary

Regional MS4 Permit	Order No. R9-2013-0001 as amended by Order No. R9-2015-0001 and Order No. R9-2015-0100, an NPDES Permit issued by the San Diego Regional Water Quality Control Board.
Applicant	Public or private entity seeking the discretionary approval of new or replaced improvements from the Copermittee with jurisdiction over the project site. The Applicant has overall responsibility for the implementation and the approval of a Priority Development Project. The WQMP also uses the term "user" to refer to the applicant such as developer or project proponent, or the Registered Professional Civil Engineer responsible for submitting the Project-Specific WQMP, and designing the required BMPs.
Bed Sediment	Term to define the coarse-grained portion of the sediment load
Bed Sediment Load	The Bed Sediment (material that moves along the bed by sliding or saltating) and part of the suspended sediment load including particle size fractions in the channel Bed Sediments.
Best Management Practice (BMP)	Defined in 40 CFR 122.2 as schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. In the case of municipal storm water permits, BMPs are typically used in place of numeric effluent limits.
Biofiltration	Defined in the Regional MS4 Permit as practices that use vegetation and amended soils to detain and treat runoff from impervious areas. Treatment is through filtration, infiltration, adsorption, ion exchange, and biological uptake of pollutants.
Biofiltration BMP	A class of BMPs that use dense vegetation and biologically-active amended soils to detain and treat runoff from impervious areas. Treatment is through filtration, infiltration, adsorption, ion exchange, and biological uptake of pollutants. Biofiltration BMPs may be either partial retention or no retention BMPs. The Applicant may refer to Section 2.3.2 for more information on retention requirements.

Bioretention BMP	Engineered vegetated areas that are designed to receive and fully infiltrate runoff and provide additional treatment of infiltrated runoff through filtration, adsorption, ion exchange, and biological update of pollutants. Water retained by these BMPs is either evapotranspired by plants in the BMP, or slowly allowed to infiltrate into the underlying soils. The applicant may refer to Section 2.3.2 for more information on these BMPs.
BMP Fact Sheets	BMP Fact Sheets are available in the LID BMP Design Handbook. Individual BMP Fact Sheets include sitting considerations, and design and sizing guidelines for seven types of structural BMPs (infiltration basin, infiltration trench, permeable pavement, harvest-and-use, bioretention, extended detention basin, and sand filter).
California Stormwater Quality Association (CASQA)	Publisher of the California Stormwater Best Management Practices Handbooks, available at: www.cabmphandbooks.com.
CEQA	California Environmental Quality Act - a statute that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible.
CIMIS	California Irrigation Management Information System - an integrated network of 118 automated active weather stations all over California managed by the California Department of Water Resources.
Copermittees	The Regional MS4 Permit identifies the Cities of Murrieta, Temecula, and Wildomar, the County, and the District, as Copermittees for the SMR.
County	The abbreviation refers to the County of Riverside in this document.
Critical Shear Stress	Threshold above which motion of bed sediment is initiated.
CWA	Clean Water Act - is the primary federal law governing water pollution. Passed in 1972, the CWA established the goals of eliminating releases of high amounts of toxic substances into water, eliminating additional water pollution by 1985, and ensuring that surface waters would meet standards necessary for human sports and recreation by 1983. CWA Section 402(p) is the federal statute requiring NPDES permits for discharges from MS4s.

CWA Section 303(d) Waterbody	Impaired water in which water quality does not meet applicable water quality standards and/or is not expected to meet water quality standards, even after the application of technology based pollution controls required by the CWA. The discharge of urban runoff to these water bodies by the Copermittees is significant because these discharges can cause or contribute to violations of applicable water quality standards.
DCIA	Directly Connected Impervious Areas - those impervious areas that are hydraulically connected to the MS4 (i.e. street curbs, catch basins, storm drains, etc.) and thence to the structural BMP without flowing over pervious areas.
DCV	Design Capture Volume (DCV) is the volume of runoff produced from the Design Storm to be mitigated through LID Retention BMPs, Other LID BMPs and Volume Based Treatment Control BMPs, as appropriate.
Design Flow Rate	The design flow rate represents the minimum flow rate capacity that flow-based treatment control BMPs and Proprietary Biofiltration BMPs should treat to the MEP, when considered.
Design Storm	The Regional MS4 Permit has established the 85th percentile, 24-hour storm event as the "Design Storm". The applicant may refer to Exhibit A to identify the applicable Design Storm Depth (D85) to the project.
Discretionary Approval	A decision in which a Copermittee uses its land use planning authority in deciding whether and how to carry out or approve a project.
District	Riverside County Flood Control and Water Conservation District.
DMA	A Drainage Management Area - a delineated portion of a project site that is hydraulically connected to a common structural BMP or conveyance point. The Applicant may refer to Section 3.3 for further guidelines on how to delineate DMAs.
Drawdown Time	Refers to the amount of time for the BMP to empty from brim full. The specified or incorporated drawdown times are to ensure that adequate contact or detention time has occurred for treatment, while not creating vector or other nuisance issues. It is important to abide by the drawdown time requirements stated in the fact sheet for each specific BMP.
Effective Area	Area which 1) is suitable for a BMP (for example, if infiltration is potentially feasible for the site based on infeasibility criteria, infiltration must be allowed over this area) and 2) receives runoff from impervious areas.
Ep	stream erosion potential

Erosion	The process by which soil and rock are removed from the Earth's surface by exogenic processes such as wind or water flow, and then transported and deposited in other locations
ESA	An Environmental Sensitive Area (ESA) designates an area "in which plants or animals life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which would be easily disturbed or degraded by human activities and developments". (Reference: California Public Resources Code § 30107.5).
ET	Evapotranspiration (ET) is the loss of water to the atmosphere by the combined processes of evaporation (from soil and plant surfaces) and transpiration (from plant tissues). It is also an indicator of how much water crops, lawn, garden, and trees need for healthy growth and productivity
FAR	The Floor Area Ratio (FAR) is the total square feet of a building divided by the total square feet of the lot the building is located on.
Flow-Based BMP	Flow-based BMPs are flow-through treatment control BMPs that are sized to treat the design flow rate. Certain biofiltration BMPs can also be sized as flow-based BMPs.
Flow-Thru Treatment Control BMP	A type of structural BMP that provides treatment of stormwater pollutants of concern but does not meet criteria to be defined as retention or biofiltration. Flow-through treatment control BMPs, while designed to treat particular Pollutants, typically do not provide the same level of volume reduction as LID BMPs. As such, the Regional MS4 Permit and this WQMP require the use of LID BMPs wherever feasible, before Flow-Through Treatment BMPs can be considered or implemented.
FPPP	Facility Pollution Prevention Plan
GIS	Geographical Information System
HCOC	Hydrologic Condition of Concern - Exists when the alteration of a site's hydrologic regime caused by development would cause significant impacts on downstream channels and aquatic habitats, alone or in conjunction with impacts of other projects.
HMP	Hydromodification Management Plan – A 2014 plan that defined Performance Standards for PDPs to manage increases in runoff discharge rates and durations. Elements of this plan have been superseded by the Regional MS4 Permit. This WQMP describes the current standards.

Hydromodification Performance Standard	The Hydrologic Performance and Sediment Supply Performance Standards
HRU/GLU Analysis	Hydrologic Response Units/Geomorphic Landscape Units
HSG	Hydrologic Soil Groups – soil classification to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSGs are A (very low runoff potential/high infiltration rate), B, C, and D (high runoff potential/very low infiltration rate)
HSPF	Hydrologic Simulation Program FORTRAN, distributed by USEPA
Hydrologic Control BMPs	A technique, measure or structural control that is used for a given set of conditions to manage the quantity and flowrate of stormwater runoff
Hydrologic Performance Standard	The Hydrologic Performance Standard is an element of the Hydromodification Performance Standard. It consists of matching or reducing the flow duration curve of post-development conditions to that of pre-existing, naturally occurring conditions, for the range of geomorphically significant flows (10% of the 2-year runoff event up to the 10-year runoff event).
Hydromodification	The change in the natural watershed hydrologic processes and runoff characteristics (i.e., interception, infiltration, overland flow, interflow and groundwater flow) caused by urbanization or other land use changes that result in increased stream flows and sediment transport. In addition, alteration of stream and river channels, such as stream channelization, concrete lining, installation of dams and water impoundments, and excessive streambank and shoreline erosion are also considered Hydromodification, due to their disruption of natural watershed hydrologic processes.
IMP	Integrated Management Practices
JRMP	A separate Jurisdictional Runoff Management Plan (JRMP) has been developed by each Copermittee and identifies the local programs and activities that the Copermittee is implementing to meet the Regional MS4 Permit requirements.
K	Soil erosion factor
LEED	Leadership in Energy and Environmental Design

LID	Low Impact Development (LID) is a site design strategy with a goal of maintaining or replicating the pre-development hydrologic regime through the use of design techniques. LID site design BMPs help preserve and restore the natural hydrologic cycle of the site, allowing for filtration and infiltration which can greatly reduce the volume, peak flow rate, velocity, and pollutant loads of storm water runoff.
LID BMP	A type of stormwater BMP that is based upon Low Impact Development concepts. LID BMPs include retention and biofiltration BMPs. LID BMPs not only provide highly effective treatment of stormwater runoff, but also yield potentially significant reductions in runoff volume – helping to mimic the pre-project hydrologic regime. The applicant may refer to Chapter 2.
LID BMP Design Handbook	The LID BMP Design Handbook was developed by the Copermitees to provide guidance for the planning, design and maintenance of LID BMPs which may be used to mitigate the water quality impacts of PDPs within the County.
LID Harvest and Reuse BMP	BMPs used to facilitate capturing Stormwater Runoff for later use without negatively impacting downstream water rights or other Beneficial Uses. Harvest and use is considered a "LID Principle" as part of this WQMP.
LID Infiltration BMP	BMPs to reduce stormwater runoff by capturing and infiltrating the runoff into in-situ soils or amended onsite soils. Typical LID Infiltration BMPs include infiltration basins, infiltration trenches and pervious pavements.
LID Principles	Site design concepts that prevent or minimize the causes (or drivers) of post-construction impacts, and help mimic the pre-development hydrologic regime.
LID Retention BMP	BMPs to ensure full onsite retention without runoff of the DCV such as infiltration basins, bioretention, chambers, trenches, permeable pavement and pavers, harvest and reuse.
MEP	Maximum Extent Practicable - standard established by the 1987 amendments to the CWA for the reduction of Pollutant discharges from MS4s. Refer to Attachment C of the Regional MS4 Permit for a complete definition of MEP.
MF	Multi-family – zoning classification for parcels having 2 or more living residential units.

MS4	Municipal Separate Storm Sewer System (MS4) is a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or designated and approved management agency under section 208 of the CWA that discharges to waters of the United States; (ii) Designated or used for collecting or conveying storm water; (iii) Which is not a combined sewer; (iv) Which is not part of the Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.26.
MSHCP	Western Riverside County Multi-Species Habitat Conservation Plan
MUSLE	Modified Universal Soil Loss Equation. A mathematical model that describes soil erosion processes
New Development Project	Defined by the Regional MS4 permit as 'Priority Development Projects' if the project, or a component of the project meets the categories and thresholds described in Section 1.
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System - Federal program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 318, 402, and 405 of the CWA.
NRCS	Natural Resource Conservation Service
PDP	Priority Development Project - Includes New Development and Redevelopment project categories listed in Section E.3.b of the Regional MS4 Permit.
Priority Pollutants of Concern	Pollutants expected to be present on the project site and for which a downstream water body is also listed as Impaired under the CWA Section 303(d) list or by a TMDL.
Project-Specific WQMP	A plan specifying and documenting permanent LID Principles and Stormwater BMPs to control post-construction Pollutants and stormwater runoff for the life of the PDP, and the plans for operation and maintenance of those BMPs for the life of the project.

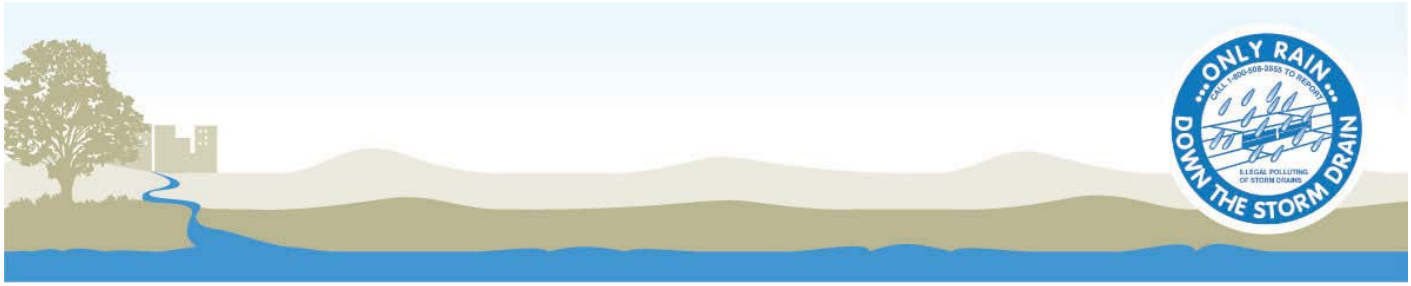
Proprietary Biofiltration BMP	Engineered vegetated biofiltration systems that have been designed by product vendors to receive and treat runoff from impervious areas. These BMPs typically achieve negligible volume reduction unless supplemented with infiltration to increase retention. Applicants may refer to Sections 2.3.2 and 2.3.6 for additional information and acceptance criteria for these BMPs.
Q or Qw	Flow
Qcp	Geomorphically critical flow – 10% of the 2-year flow
Qcrit - Qc	Critical flow
Receiving Waters	Waters of the United States.
Redevelopment Project	Defined by the Regional MS4 Permit as 'Priority Development Projects' if the project, or a component of the project meets the categories and thresholds described in Section 1. The creation and/or replacement of impervious surface on an already developed site. Examples include the expansion of a building footprint, road widening, the addition to or replacement of a structure. Replacement of impervious surfaces includes any activity where impervious material(s) are removed, exposing underlying soil during construction, except "routine maintenance" activities as defined below.
RGO	Retail Gasoline Outlets
Routine Maintenance	Routine maintenance activities include trenching and resurfacing associated with utility work; pavement grinding; resurfacing existing roadways, sidewalks, pedestrian ramps, or bike lanes on existing roads; and routine replacement of damaged pavement, such as pothole repair. These activities are excluded from the definition of redevelopment.
RWQCB	Regional Water Quality Control Board
San Diego Regional Board	San Diego Regional Water Quality Control Board - The term "Regional Board", as defined in Water Code section 13050(b), is intended to refer to the California Regional Water Quality Control Board for the San Diego Region as specified in Water Code Section 13200. State agency responsible for managing and regulating water quality in the SMR.
SCCWRP	Southern California Coastal Water Research Project
SDRWQCB	San Diego California Regional Water Quality Control Board
Sediment Supply BMP	Site design principles to preserve onsite first-order or higher order streams that have been identified as significant contributors of bed sediment load.
Sediment Supply Performance Standard	Consists of avoiding critical coarse sediment yield areas or implementing measures that allow critical coarse sediment to

	be discharged to receiving waters, such that there is no net impact to the receiving water.
SF	Parcels with a zoning classification for a single residential unit.
Site Design BMP	Site design BMPs prevent or minimize the causes (or drivers) of post-construction impacts, and help mimic the pre-development hydrologic regime. The term "LID Principle" is also used.
SMC	Southern California Stormwater Monitoring Coalition
SMR	The Santa Margarita Region (SMR) represents the portion of the Santa Margarita Watershed that is included within the County of Riverside.
SMR	Santa Margarita Region
SMRHM	Santa Margarita Region Hydrology Model
Source Control BMP	Source Control BMPs land use or site planning practices, or structural or nonstructural measures that aim to prevent runoff pollution by reducing the potential for contamination at the source of pollution. Source control BMPs minimize the contact between Pollutants and runoff.
Structural BMP	Structures designed to remove pollutants from stormwater runoff and mitigate hydromodification impacts.
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
Tentative Tract Map	Tentative Tract Maps are required for all subdivision creating five (5) or more parcels, five (5) or more condominiums as defined in Section 783 of the California Civil Code, a community apartment project containing five (5) or more parcels, or for the conversion of a dwelling to a stock cooperative containing five (5) or more dwelling units.
TMDL	Total Maximum Daily Load - the maximum amount of a Pollutant that can be discharged into a waterbody from all sources (point and non-point) and still maintain Water Quality Standards. Under CWA Section 303(d), TMDLs must be developed for all waterbodies that do not meet Water Quality Standards after application of technology-based controls.
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USEPA	United States Environmental Protection Agency
User	The person using this guidance document to analyze a project and prepare a WQMP
USGS	United States Geological Survey

Volume-Based BMP	Volume-Based BMPs applies to BMPs where the primary mode of pollutant removal depends upon the volumetric capacity such as detention, retention, and infiltration systems.
Wash Load	The portion of the total sediment load carried continuously in suspension by the flow, and generally consists of the finest particles.
Wet Season	The Regional MS4 Permit defines the wet season from October 1 through April 30.
WQMP	Water Quality Management Plan

EXHIBIT J:

"Other Development Project" Checklist



"Other Development Project" Water Quality Checklist

Submittal for the City of Wildomar

Attention: This submittal package only applies to "Other Development Projects" and does not apply to Priotiry Development Projects. Proceed only if the Applicabilty Checklist completed for your project categorizes project activities as an "Other Development Project"

SUBMITTAL PACKAGE COMPONENTS

This Submittal Package includes the following Forms:

- **Form 1: Project and Site Information**
  Identify project information, location, characteristics, and existing site characteristics.
- **Form 2: Applicability**
  Identify project type and determine submittal requirement.
- **Form 3: Site Design BMPs**
  Identify Site Design BMPs that will be implemented per the project site.
- **Form 4: Source Control BMPs**
  Identify Source Control BMPs that will be implemented per the project site.
- **Attachment 1: Stormwater Pollutant Sources & Source Control Checklist**
  Lookup table used for completion of Form 4.

INSTRUCTIONS

Project categorized as "Other Development Projects" are required to comply with the Site Design and Source Control BMPs documented in Section 1.5 of the 2018 Water Quality Management Plan for the City of Wildomar available on the City's website (http://www.cityofwildomar.org/).

Completion and submittal of this "Other Development Project Water Quality Checklist" and acceptance by the City of Wildomar satisfies the stormwater requirements for new and redevelopment projects categorized as "Other Development Projects." Complete each of the four sections based on the existing and proposed condition of the project site and submit to the City of Wildomar. Each section provides references and guidance on how to complete each step and demonstrate compliance.

Attention: The City of Wildomar may allow different means of demonstrating conformance with requirements that apply to "Other Development Projects." Consult with the City of Wildomar.

RECAP OF REQUIREMENTS

"Other Development Projects" are required to meet the following general requirements:

- Incorporation of applicable and feasible Site Design BMPs
- Incorporation of applicable and feasible Source Control BMPs

BMPs are defined as:

Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States.

Site Design BMPs are defined as:

Site design BMPs prevent or minimize the causes (or drivers) of post-construction impacts and help mimic the pre-development hydrologic regime.

Source Control BMPs are defined as:

Land use or site planning practices, or structural or nonstructural measures that aim to prevent runoff pollution by reducing the potential for contamination at the source of pollution. Source control BMPs minimize the contact between Pollutants and runoff.

FORM 1: PROJECT AND SITE INFORMATION

Completion Guidance: Use this form to provide basic site information that will be useful for completing subsequent steps and help the City of Wildomar review and track your project. Provide contact information for both the owner of the property where the project is occurring, and the preparer of this submittal (if different than owner).

OWNER'S INFORMATION		PREPARER'S INFORMATION	
Owner's Name	Insert Full Name Here	Preparer's Name	Insert Full Name Here
Mailing Address	Insert Address Line 1	Mailing Address	Insert Address Line 1
	Insert Address Line 2		Insert Address Line 2
	Insert Address Line 3		Insert Address Line 3
Telephone Number	Insert Phone Number	Telephone Number	Insert Phone Number

PROJECT INFORMATION	
Type of Project:	Insert Text Here (e.g. commercial, residential, etc.)
Planning Area:	Insert Planning Area if known
Community Name:	Insert Community Name if known
Development Name:	Insert Development Name if known
Project Description:	Insert Brief Description of Project Activities

PROJECT LOCATION	
Latitude & Longitude:	Insert coordinates here
Project Address:	Insert address here
Assessor's Parcel Number(s):	Insert text here

PROJECT CHARACTERISTICS	
Proposed or potential land use(s)	Insert text here
Proposed or Potential SIC[1] Code(s)	Insert text here
Total area of <u>proposed</u> Impervious Surfaces[2] within the Project Limits (Square feet)	Insert text here
Total Project Area (acres)[3]	Insert text here
Does the project consist of offsite road improvements?	☐ Y ☐ N
Does the project propose to construct unpaved roads?	☐ Y ☐ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☐ N

EXISTING SITE CHARACTERISTICS	
Total area of <u>existing</u> Impervious Surfaces within the project limits (Square feet)	Insert text here
Are there any natural hydrologic features (such as creeks beds, streams, or drainage features) on the project site?	☐ Y ☐ N Describe here

[1] Information and an SIC search function are available at https://www.osha.gov/pls/imis/sicsearch.html.

[2] Impervious surfaces are hard surfaces that prevent rainfall from being absorbed into the ground and include: rooftops, paved areas, and other hardscape features.

[3] The "project" is the whole of an action which has the potential for adding or replacing or resulting in the addition or replacement of roofs, pavement, or other impervious surfaces. The project area is the total footprint of the "project" activities and includes both impervious and pervious areas that are affected by the project.

FORM 2: APPLICABILITY

Completion Guidance: Use this form to document the applicable stormwater and submittal requirements. Projects using this submittal form should be categorizes as "Other Development Projects" meaning that all answers should be marked "No". If any "Yes" is marked review project information and check with the Copermittee, project is a PDP and cannot use this submittal template.

SECTION A: PROJECT INFORMATION (TO BE COMPLETED BY CITY STAFF)

Project File No.:

Project Name:

SECTION B: PROJECT TYPE IDENTIFICATION (TO BE COMPLETED BY THE OWNER/PREPARER)

Proposed Project Consists of or Includes:	Yes	No
New Development. The creation of 10,000 square feet or more of impervious surfaces (collectively over the entire project site) including commercial, industrial, residential, mixed-use, and public projects. New Development Projects include projects that are on public or private land which fall under the planning and building authority of the [Insert Jurisdiction].	☐	☐
Redevelopment. The creation, addition or replacement of 5,000 square feet or more of impervious surfaces (collectively over the entire project site) on sites with at least 10,000 square feet of existing impervious surfaces, including commercial, industrial, residential, mixed-use, and public development projects on public or private land.	☐	☐
Automotive repair shops. The creation, addition, or replacement of 5,000 square feet or more of impervious surfaces that include automotive repair shops that are categorized in any one of the following Standard Industrial Classification (SIC) Codes 5013–Motor vehicle supplies or parts, 5014–Tires & Tubes, 5541–Gasoline Service Stations, 7532–Top, Body & Upholstery Repair Shops and Paint Shops, 7533–Automotive Exhaust System Repair Shops, 7534–Tire Retreading and Repair Shops, 7536–Automotive Glass Replacement Shops, 7537–Automotive Transmission Repair Shops, 7538–General Automotive Repair Shops, 7539–Automotive Repair Shops, not elsewhere classified).	☐	☐
Restaurants. The creation, addition, or replacement of 5,000 square feet or more of impervious surfaces (collectively over the entire project site) at sites that support the selling of prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812).	☐	☐
All Hillside developments. The creation, addition, or replacement of 5,000 square feet or more of impervious surfaces (collectively over the entire project site) that include development on any natural slope that is 25% or greater.	☐	☐
Environmentally Sensitive Areas (ESAs). Developments or Redevelopments discharging directly to an ESA that add or replace 2,500 square feet or more of impervious surfaces. "Discharging directly to" includes flow that is conveyed 200 feet or less from the project to the ESA, or conveyed in a pipe of channel any distance as an isolated flow from the project to the ESA.	☐	☐
Parking lots. The creation, addition, or replacement of 5,000 square feet or more of impervious surfaces (collectively over the entire project site) consisting of land area or a facility for the temporary parking or storage of motor vehicles used personally for business or commerce.	☐	☐
Streets, roads, highways, and freeways. The creation, addition, or replacement of 5,000 square feet or more of impervious surfaces (collectively over the entire project site) consisting of any paved impervious surface used for the transportation of automobiles, trucks, motorcycles, and other vehicles.	☐	☐
Retail Gasoline Outlets (RGOs). The creation, addition, or replacement of 5,000 square feet or more of impervious surfaces that include Retail Gasoline Outlets that are either 5,000 square feet or more or have a project average daily traffic of 100 or more vehicles.	☐	☐
Pollutant Generating projects disturbing over 1 acre. Developments or Redevelopments that disturb over one acre of land and are expected to generate pollutants post construction.	☐	☐

If one or more boxes are checked "Yes" in Section B, project is a Priority Development Project (PDP).

☐ PDP subject to Site Design, Source Control, Pollutant Control, and Hydromodification Management Requirements. STOP! Project must submit a "Project-Specific WQMP."

If all boxes are checked "No" in Section B, project is an "Other Development Project". Check box below.

☐ Project subject to Site Design and Source Control requirements only. Complete this Submittal.

*Descriptions of SIC codes can be found at http://www.osha.gov/pls/imis/sicsearch.html.

FORM 3: SITE DESIGN BMPS

Completion Guidance: All development projects must implement Site Design BMPs. Site Design BMPs are used to reduce imperviousness and incorporate LID Principles into the project site and landscape design. Site Design BMPs should be considered during the earliest stages of project planning. Review project site plans and indicate the Site Design BMPs that will be implemented.

Review project plans and identify the applicable Site Design BMPs that will be implemented. "Yes" means the project will implement the BMP. "No" means the BMP is applicable to the project but it is not feasible to implement. "N/A" means the BMP is not applicable at the project site because the project does not include the feature that is addressed by the BMP

	Yes	No	N/A
Preserve Existing Drainage Patterns. Integrate existing drainage patterns, including drainage paths and natural depressions, into the site plan to preserve existing hydrologic function. Avoid excessive grading and disturbance of vegetation and soils. Set back improvements from creeks, wetlands, riparian habitats, and any other natural water bodies.	☐	☐	☐
Protect Existing Vegetation and Sensitive Areas. Avoid disturbing areas containing dense native vegetation or well-established trees where possible. Develop the site layout to avoid sensitive areas. Establish setbacks and buffer zones around areas that are to be protected.	☐	☐	☐
Preserve Natural Infiltration Capacity. Minimize compaction of the existing soils as possible and focus development in areas with less permeable or previously compacted soils. Preserve areas with undisturbed natural soils.	☐	☐	☐
Minimize Impervious Area. Limit impervious cover through identification of the smallest possible land area that can be practically impacted or disturbed during site development. Limit areas occupied by roofs and paving and substitute landscaping for pave areas where possible. Consider replacement of pavement with permeable pavements or other permeable surfaces and the use of green roofs.	☐	☐	☐
Disperse Runoff to Adjacent Pervious Areas or Small Collection Areas. Direct runoff from impervious areas to adjacent landscaping, other pervious areas, or small collection areas where such runoff may be retained. Use tree wells and landscaping areas to intercept, infiltrate, and evapotranspire precipitation and runoff from adjacent impervious areas.	☐	☐	☐
Utilize Native or Drought Tolerant Species in Site Landscaping. Whenever possible, use native or drought tolerant species within site landscaping instead of alternatives to reduce the overall demands for potable water use associated with irrigation.	☐	☐	☐
Implement Harvest and Use of Runoff. Consider the use of small rain barrels or tanks to capture roof runoff for irrigation of landscaping areas. Ensure that inlets are screened to prevent clogging and that barrels are drained to landscaping within 96 hours to minimize the potential for mosquito breeding.	☐	☐	☐

Provide a brief summary of site design BMPs used. Include a discussion / justification for **all** "No" or "N/A" answers shown above. Use more than one page as needed

Click or tap here to enter text.

FORM 4: SOURCE CONTROL BMPS

Completion Guidance: All development projects must implement Source Control BMPs. Source Control BMPs are used to minimize pollutants that may discharge to the MS4. Refer to Chapter 3 (Section 3.8) of the 2018 Water Quality Management Plan for additional information. Complete Section A and B of this form to identify Source Control BMPs for the project.

SECTION A: IDENTIFY POLLUTANT SOURCES

Review project site plans and identify the applicable pollutant sources. "Yes" indicates that the pollutant source is applicable to project site. "No" indicates that the pollutant source is not applicable to project site.

		Yes	No			Yes	No
1.	Storm Drain Inlets	☐	☐	9.	Outdoor storage areas	☐	☐
2.	Floor Drains	☐	☐	10.	Material storage areas	☐	☐
3.	Sump Pumps	☐	☐	11.	Fueling areas	☐	☐
4.	Pest Control/Herbicide Application	☐	☐	12.	Loading Docks	☐	☐
5.	Food Service Areas	☐	☐	13.	Fire Sprinkler Test/Maintenance water	☐	☐
6.	Trash Storage Areas	☐	☐	14.	Plazas, Sidewalks and Parking Lots	☐	☐
7.	Industrial Processes	☐	☐	15.	Pools, Spas, Fountains and other water features	☐	☐
8.	Vehicle and Equipment Cleaning and Maintenance/Repair Areas	☐	☐				

SECTION B: REQUIRED SOURCE CONTROL BMPS

List each Pollutant source identified in Section A in column 1 and fill in the corresponding Structural Source Control BMPs and Operational Control BMPs by referring to the Stormwater Pollutant Sources & Source Control Checklist included in Attachment 1. The resulting list of structural and operational source control BMPs must be implemented as long as the associated sources are present on the project site. Add additional rows as needed.

Pollutant Source (from A)	Structural Source Control BMP	Operational Source Control BMP
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here
Insert text here	Insert text here	Insert text here

Attachment 1: Stormwater Pollutant Sources/Source Control Checklist

Attachment 1

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section H of the 2018 SMR WQMP Template):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your WQMP Exhibit.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in your WQMP. Use the format shown in Table H.1 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	**… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE**		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on WQMP Drawings**	**3** **Permanent Controls—List in WQMP Table and Narrative**	**4** **Operational BMPs—Include in WQMP Table and Narrative**
❑ **A.** On-site storm drain inlets	❑ Locations of inlets.	❑ Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.	❑ Maintain and periodically repaint or replace inlet markings. ❑ Provide stormwater pollution prevention information to new site owners, lessees, or operators. ❑ See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com ❑ Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."
❑ **B.** Interior floor drains and elevator shaft sump pumps		❑ State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.	❑ Inspect and maintain drains to prevent blockages and overflow.
❑ **C.** Interior parking garages		❑ State that parking garage floor drains will be plumbed to the sanitary sewer.	❑ Inspect and maintain drains to prevent blockages and overflow.

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 **Potential Sources of Runoff Pollutants**	2 **Permanent Controls—Show on WQMP Drawings**	3 **Permanent Controls—List in WQMP Table and Narrative**	4 **Operational BMPs—Include in WQMP Table and Narrative**
❑ **D1.** Need for future indoor & structural pest control		❑ Note building design features that discourage entry of pests.	❑ Provide Integrated Pest Management information to owners, lessees, and operators.
❑ **D2.** Landscape/ Outdoor Pesticide Use	❑ Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained. ❑ Show self-retaining landscape areas, if any. ❑ Show stormwater treatment and hydrograph modification management BMPs.	State that final landscape plans will accomplish all of the following. ❑ Preserve existing native trees, shrubs, and ground cover to the maximum extent possible. ❑ Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. ❑ Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. ❑ Consider using pest-resistant plants, especially adjacent to hardscape. To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	❑ Maintain landscaping using minimum or no pesticides. ❑ See applicable operational BMPs in "What you should know for…..Landscape and Gardening" at: http://www.rcwatershed.org/about/materials-library/#1450469138395-bb76dd39-d810 ❑ Provide IPM information to new owners, lessees and operators.

Attachment 1
STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on WQMP Drawings**	**3** **Permanent Controls—List in WQMP Table and Narrative**	**4** **Operational BMPs—Include in WQMP Table and Narrative**
❑ **E.** Pools, spas, ponds, decorative fountains, and other water features.	❑ Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)	If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.	❑ See applicable operational BMPs in "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at: http://www.rcwatershed.org/about/materials-library/#1450469201433-f5f358c9-6008
❑ **F.** Food service	❑ For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment. ❑ On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.	❑ Describe the location and features of the designated cleaning area. ❑ Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.	❑ See the brochure, "The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://www.rcwatershed.org/about/materials-library/#1450389926766-61e8af0b-53a9 Provide this brochure to new site owners, lessees, and operators.
❑ **G.** Refuse areas	❑ Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas. ❑ If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area. ❑ Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.	❑ State how site refuse will be handled and provide supporting detail to what is shown on plans. ❑ State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.	❑ State how the following will be implemented: Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

Appendix 8
STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ **H.** Industrial processes.	❑ Show process area.	❑ If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."	❑ See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at: http://www.rcwatershed.org/about/materials-library/#1450389926766-61e8af0b-53a9
❑ **I.** Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)	❑ Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area. ❑ Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults. ❑ Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.	❑ Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains. Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for: ▪ Hazardous Waste Generation ▪ Hazardous Materials Release Response and Inventory ▪ California Accidental Release (CalARP) ▪ Aboveground Storage Tank ▪ Uniform Fire Code Article 80 Section 103(b) & (c) 1991 ▪ Underground Storage Tank www.cchealth.org/groups/hazmat/	❑ See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 **Potential Sources of Runoff Pollutants**	2 **Permanent Controls—Show on WQMP Drawings**	3 **Permanent Controls—List in WQMP Table and Narrative**	4 **Operational BMPs—Include in WQMP Table and Narrative**
❑ **J.** Vehicle and Equipment Cleaning	❑ Show on drawings as appropriate: (1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses. (2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use). (3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer. (4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.	❑ If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.	Describe operational measures to implement the following (if applicable): ❑ Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system. Refer to "Outdoor Cleaning Activities and Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at: http://www.rcwatershed.org/about/materials-library/#1450389926766-61e8af0b-53a9 ❑ Car dealerships and similar may rinse cars with water only.

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ **K.** Vehicle/Equipment Repair and Maintenance	❑ Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater. ❑ Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas. ❑ Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.	❑ State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area. ❑ State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements. ❑ State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.	In the Stormwater Control Plan, note that all of the following restrictions apply to use the site: ❑ No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains. ❑ No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately. ❑ No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment. Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations; "Outdoor Cleaning Activities;" and "Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants. Brochures can be found at: http://www.rcwatershed.org/about/materials-library/#1450389926766-61e8af0b-53a9

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ **L.** Fuel Dispensing Areas	❑ Fueling areas[6] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable. ❑ Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.		❑ The property owner shall dry sweep the fueling area routinely. ❑ See the Fact Sheet SD-30 , "Fueling Areas" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

[6] The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ **M.** Loading Docks	❑ Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer. ❑ Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation. ❑ Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.		❑ Move loaded and unloaded items indoors as soon as possible. ❑ See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ **N.** Fire Sprinkler Test Water		❑ Provide a means to drain fire sprinkler test water to the sanitary sewer.	❑ See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com
O. Miscellaneous Drain or Wash Water or Other Sources ❑ Boiler drain lines ❑ Condensate drain lines ❑ Rooftop equipment ❑ Drainage sumps ❑ Roofing, gutters, and trim. ❑ Other sources		❑ Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system. ❑ Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. ❑ Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment. ❑ Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water. ❑ Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff. ❑ Include controls for other sources as specified by local reviewer.	

Attachment 1
STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 **Potential Sources of Runoff Pollutants**	2 **Permanent Controls—Show on WQMP Drawings**	3 **Permanent Controls—List in WQMP Table and Narrative**	4 **Operational BMPs—Include in WQMP Table and Narrative**
❑ **P.** Plazas, sidewalks, and parking lots.			❑ Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.