

COUNTY OF SAN DIEGO SUSMP

Standard Urban Stormwater Mitigation Plan Requirements for Development Applications

January 8, 2011

Revised: August 1, 2012

Visit <http://www.sdcounty.ca.gov/dpw/watersheds/susmp/susmp.html> for updates.

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County of San Diego Standard Urban Stormwater Mitigation Plan (SUSMP)

SUMMARY

In January 2007, the California Regional Water Quality Control Board for the San Diego Region (Regional Water Board) reissued a municipal stormwater NPDES permit to San Diego area municipal Copermittees. The reissued permit updates and expands stormwater requirements for new developments and redevelopments. Stormwater treatment requirements have been made more widely applicable and more stringent; minimum standards for Low Impact Development (LID) have been added, and the Copermittees are required to develop and implement criteria for the control of runoff peaks and durations from development sites. Below is a chronology of regulatory updates pertaining to post-construction stormwater requirements.

| Stormwater Regulation Chronology | | |
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| Adoption Date | Document | Summary of Changes |
| July 16, 1990 | MS4 Permit | The Regional Water Quality Control Board (RWQCB) issued general stormwater requirements to all jurisdictions within the County of San Diego via the Municipal Separate Storm Sewer Systems (MS4) Permit. |
| February 21, 2001 | MS4 Permit | Land Development Standard Urban Stormwater Mitigation Plan (SUSMP) requirements were written into the MS4 Permit during permit reissuance. |
| February 1, 2002 | WPO | The County of San Diego Watershed Protection, Stormwater Management, and Discharge Control Ordinance (WPO) and the County of San Diego Stormwater Standards Manual (SSM) became effective. |
| January 10, 2003 | WPO | The WPO was amended to include the new SUSMP requirements. SUSMP requirements become enforceable. |
| February 10, 2003 | County SUSMP | The County of San Diego's first local SUSMP becomes effective. The local SUSMP is based on the Model SUSMP created by the Copermittees and adopted by the RWQCB on June 12, 2002. This SUSMP provides guidance on how Source Control Best Management Practices (BMPs), Site Design BMPs and Treatment Control BMPs (TCBMPs) can be integrated into Priority Development Projects (PDPs). |
| August 5, 2003 | WPO | The WPO was amended to establish a new "equivalent methods" defense to some enforcement actions at major grading sites. Other minor ordinance revisions to update and streamline codes were also adopted. |
| January 24, 2007 | MS4 Permit | Low Impact Development (LID) and the Hydromodification Management Plan (HMP) requirements were written into the MS4 permit during permit reissuance. |
| March 12, 2008 | WPO | The WPO was amended to include the new requirements: LID, interim-HMP (50 acres or more) and advanced treatment at construction sites. The SSM was removed from the WPO. |
| March 24, 2008 | County SUSMP | County's local SUSMP was updated to integrate LID and interim-HMP (50 acres or more) requirements. |
| August 5, 2009 | WPO | Updated the definition of rainy season to be October 1st through April 30th. |
| January 13, 2010 | WPO | The WPO was amended to include a PDP category of pollutant generating projects greater than 1 acre. Minor amendments to add "municipal facilities" to Section 67.802(w)(1)(B), and to include "hillside developments" and "environmentally sensitive areas" to the list of redevelopment projects in Section 67.802(w)(2) were also included. |
| December 8, 2010 | WPO | The WPO was amended to integrate the final HMP criteria applicable to all PDP projects. Other changes include the statement that projects east of the Pacific/Salton divide will not be considered PDPs, therefore they are subject only to the State Construction General Permit (CGP). In addition, existing requirements for businesses to document their training and site review activities are modified such that documentation is required only for sites located in or near environmentally-sensitive areas, or as requested by the authorized enforcement official, such as a Department of Public Works Water Quality Inspector. Finally, some additional corrections and minor, non-substantive clarifications were included. |
| March 25, 2010 | County SUSMP | The County's local SUSMP has a significant update (unified LID Design approach). The local SUSMP update is based on the Copermittees' Model SUSMP revision, found adequate by the Regional Board on March 25, 2009. The update incorporates the Drainage Management Areas (DMA) methodology using LID facilities to meet the overlapping TCBMP, LID and HMP requirements. |
| January 8, 2011 | County SUSMP | The final HMP criteria was integrated into the County SUSMP and becomes an appendix to the SUSMP. Projects east of the Pacific/Salton divide will not be considered PDPs, but they are subject to the State CGP. The County's Maintenance Categories (1-4) were further defined. The TCBMP certification form was introduced into the SUSMP. |
| Current version | County SUSMP | The County SUSMP was updated with additional local requirements, clarifications and requested changes. Some of the major updates include: Integrating the updated TCBMP Certification page into the SUSMP, clarified that projects discharging directly to an exempt waterbody must discharge within the limits of inundation of the river due to the occurrence of the peak flow of the 10-year flooding event, enhanced the grandfathering discussion, enhanced the discussion of Tables 4-8 through 4-12. |

Low Impact Development is an integrated site design methodology that uses small-scale detention and retention to minimize pollutants conveyed by runoff and to mimic pre-project site hydrological conditions.

As required by the reissued permit, the Copermittees have prepared an updated Countywide Model SUSMP to replace the current countywide model SUSMP, which has been in effect since 2002. This SUSMP is consistent with the Model SUSMP and serves as the County's SUSMP. Applicable SUSMP requirements are incorporated into Priority Project plan(s) as part of the development plan approval process for discretionary projects. Similar requirements are incorporated into County CIP construction projects. To assist the land development community, to streamline project reviews, and to maximize cost-effective environmental benefits, this SUSMP incorporates a unified LID design procedure. This design procedure integrates site planning and design measures with engineered, small-scale Integrated Management Practices (IMPs) such as bioretention. By following the procedure, applicants can develop a single integrated design which complies with the complex and overlapping NPDES permit LID requirements, stormwater treatment requirements, and runoff peak-and-duration-control (hydromodification management) requirements.

Along with the detailed design procedure, this SUSMP includes design information and criteria for dispersal of runoff to landscaped areas and for pervious pavements, bioretention facilities, flow-through planters, infiltration trenches, infiltration basins, and cisterns. Where feasible and where allowed, water in cisterns may be directed to nonpotable uses, augmenting water supplies. Bioretention facilities and planter boxes can be designed with an impermeable barrier so that runoff does not saturate native soils; instead, runoff is filtered through an engineered soil mix before being captured in an underdrain and conveyed to off-site storm drains. This configuration may be needed where groundwater is high, is contaminated, or where increasing soil moisture may present a hazard to foundations or slope stability.

Applicants for development project approvals may choose not to use the unified LID design procedure; however, they will still need to demonstrate compliance with the applicable LID criteria, stormwater treatment criteria, and hydromodification management criteria. This SUSMP requires that runoff be infiltrated or else treated by bioretention facilities, planter boxes, filters, settling ponds, or constructed wetlands. In some special circumstances—retrofit of existing drainage systems, some pedestrian-oriented developments, and roadway widening projects—where it can also be demonstrated it is not feasible to construct any of these facilities, higher-rate surface biofilters or higher-rate vault based filtration units may be used.

Applicants for approval of Priority Development Projects must demonstrate compliance with the hydromodification management criteria in the NPDES permit, as detailed in the approved Hydromodification Management Plan (HMP) located in Appendix G of this document. Projects may demonstrate compliance with hydromodification criteria by using the integrated Low Impact Development (LID) design procedure, which is streamlined through use of San Diego County's BMP Sizing Calculator. For larger projects, the applicant may use the automated pond sizer, which is included in the BMP Sizing Calculator, or continuous simulation hydrologic computer models to simulate pre-project and post-project runoff, including the effect of

extended detention facilities to mitigate peak flows and durations. Applicants must also incorporate into their project design features to control pollutants from specified on-site sources, such as refuse areas, outdoor storage areas, and vehicle washing and repair facilities. The Copermittees have developed a table listing the types of sources to be controlled and for each, the corresponding source control measures required.

Applicants must also incorporate into their project design features to control pollutants from specified on-site sources, such as refuse areas, outdoor storage areas, and vehicle washing and repair facilities. A table has been included in this SUSMP listing the types of sources to be controlled and for each, the corresponding source control measures required.

This SUSMP provides the applicant with step-by-step instructions for preparing a Project Submittal for review by the municipal staff. The recommended steps are:

1. Assemble needed information.
2. Identify site opportunities and constraints.
3. Follow the LID Design Guidance to analyze the project for LID and to develop and document the drainage design.
4. Specify source controls using the sources/source control checklist in the appendix E.
5. Plan for ongoing maintenance of treatment and flow-control facilities.
6. Complete the Project Submittal.

The step-by-step instructions are augmented by an example checklist which municipal staff may use as a guide when reviewing the Project Submittal. These steps should be documented in the required project Storm Water Management Plan (SWMP).

As required by the reissued NPDES permit, the County implements a program to verify that approved stormwater treatment facilities are operating effectively. To facilitate implementation of these programs, this SUSMP includes instructions for applicants to prepare detailed maintenance plans.

This SUSMP is available for download in .PDF format at <http://www.sdcounty.ca.gov/dpw/watersheds/susmp/susmp.html>.

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Glossary

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| Best Management Practice (BMP) | Any procedure or device designed to minimize the quantity of pollutants that enter the storm drain system. BMPs may be referred to as “facilities”, “features”, and/or “controls”. |
| California Association of Stormwater Quality Agencies (CASQA) | Publisher of the California Stormwater Best Management Practices Handbooks, available at www.cabmphandbooks.com . Successor to the Storm Water Quality Task Force (SWQTF). |
| California BMP Method | A method for determining the required volume of stormwater treatment facilities. Described in Section 5.5.1 of the California Stormwater Best Management Practice Manual (New Development) (CASQA, 2003). |
| Conditions of Approval (COAs) | Requirements a municipality may adopt for a project in connection with a discretionary action (e.g., adoption of an EIR or negative declaration or issuance of a use permit). COAs may include features to be incorporated into the final plans for the project and may also specify uses, activities, and operational measures that must be observed over the life of the project. |
| Continuous Simulation Modeling | A method of hydrological analysis in which a set of rainfall data (typically hourly for 30 years or more) is used as input, and runoff rates are calculated on the same time step. The output is then analyzed statistically for the purposes of comparing runoff patterns under different conditions (for example, pre- and post-development-project). |
| Copermittees | See Dischargers. |
| Detention | The practice of holding stormwater runoff in ponds, vaults, within berms, or in depressed areas and letting it discharge slowly to the storm drain system. See definitions of infiltration and retention. |
| Directly Connected Impervious Area | Any impervious surface which drains into a catch basin, area drain, or other conveyance structure without first allowing flow across pervious areas (e.g. lawns). |
| Direct Discharge | Connection of project site runoff to an exempt receiving water body, which could include an exempt river reach, reservoir or lagoon. To qualify as a direct discharge, the discharge elevation from the project site outfall must be below the elevations detailed in the HMP Applicability section of this SUSMP. |
| Direct Infiltration | Pure “Infiltration Devices”, such as dry wells or infiltration trenches, designed to bypass unsaturated surface soils and transmit runoff directly to groundwater. Does not include some LID techniques that provide minimal infiltration at soil surface. |
| Dischargers | The agencies named in the stormwater NPDES permit (see definition): the County of San Diego; the Cities of Carlsbad, El Cajon, La Mesa, Poway, Solana Beach, Chula Vista, Encinitas, Lemon Grove, San Diego, Vista, Coronado, Escondido, National City, San Marcos, Del Mar, Imperial Beach, Oceanside, and Santee; the San Diego Unified Port District, and the San Diego County Regional Airport Authority. |

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| Drainage Management Areas | Areas delineated on a map of the development site showing how drainage is detained, dispersed, or directed to Integrated Management Practices. There are four types of Drainage Management Areas, and specific criteria apply to each type of area. See Chapter 4. |
| Drawdown time | The time required for a stormwater detention or infiltration device to drain and return to the dry-weather condition. For detention facilities, drawdown time is a function of basin volume and outlet orifice size. For infiltration devices, drawdown time is a function of basin volume and infiltration rate. |
| Environmentally Sensitive Areas | Areas that include but are not limited to all Clean Water Act Section 303(d) impaired water bodies; areas designated as Areas of Special Biological Significance by the State Water Resources Control Board (Water Quality Control Plan for the San Diego Basin (1994) and amendments); water bodies designated with the RARE beneficial use by the State Water Resources Control Board (Water Quality Control Plan for the San Diego Basin (1994) and amendments); areas designated as preserves or their equivalent under the Multi Species Conservation Program within the Cities and County of San Diego; and any other equivalent environmentally sensitive areas which have been identified by the County. |
| Final Hydromodification Criteria | Pursuant to NPDES permit Provision D.1.g., the Copermittees prepared Hydromodification Management criteria, which apply to all priority development projects. See Hydromodification Management Plan (HMP). The HMP is in effect as of January 14, 2011. The HMP is attached as Appendix G and is on the Project Clean Water website. |
| Flow Control | Control of runoff rates and durations as required by the Hydromodification Management Plan. |
| Head | In hydraulics, energy represented as a difference in elevation. In slow-flowing open systems, the difference in water surface elevation, e.g., between an inlet and outlet. |
| Higher-Rate Biofilter | A biofilter with a design surface loading rate higher than the 5 inches per hour rate specified in this document for bioretention facilities and planter boxes. |
| Hydrograph | Runoff flow rate plotted as a function of time. |
| Hydrologic Soil Group | Classification of soils by the Natural Resources Conservation Service (NRCS) into A, B, C, and D groups according to infiltration capacity. |
| Hydromodification Management Plan (HMP) | A Plan implemented by the dischargers so that post-project runoff shall not exceed estimated pre-project rates and/or durations, where increased runoff would result in increased potential for erosion or other adverse impacts to beneficial uses. Also see definition for flow control and Final Hydromodification Criteria. |
| Impervious surface | Any material that prevents or substantially reduces infiltration of water into the soil. See discussion of imperviousness in Chapter Two. |
| Infeasible | As applied to best management practices, impossible to implement because of technical constraints specific to the site. |

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| Infiltration | Seepage of runoff into surface soils underlying the site. See definition of Direct Infiltration and Retention. |
| Infiltration Device | Any structure, such as a dry well, that is designed to infiltrate stormwater into the subsurface and, as designed, bypasses the natural groundwater protection afforded by surface or near-surface soil. See definition for direct infiltration. |
| Integrated Management Practice (IMP) | A LID BMP that provides small-scale treatment, retention, and/or detention and is integrated into site layout, landscaping and drainage design. See Low Impact Development. |
| Integrated Pest Management (IPM) | An approach to pest management that relies on information about the life cycles of pests and their interaction with the environment. Pest control methods are applied with the most economical means and with the least possible hazard to people, property, and the environment. |
| Jurisdictional Urban Runoff Management Plan (JURMP) | A written description of the specific jurisdictional urban runoff management measures and programs that each Copermittee implements to comply with the stormwater NPDES permit and ensure pollutant discharges are reduced to the MEP and do not cause or contribute to a violation of water quality standards. See Stormwater Pollution Prevention Program. |
| Lead Agency | The public agency that has the principal responsibility for carrying out or approving a project. (CEQA Guidelines §15367). |
| Low Impact Development | An integrated site design methodology that uses small-scale detention and retention (Integrated Management Practices, or IMPs) to mimic pre-existing site hydrological conditions. |
| Maximum Extent Practicable (MEP) | Standard, established by the 1987 amendments to the Clean Water Act, for the implementation of municipal stormwater pollution prevention programs (see definition). According to the Act, municipal stormwater NPDES permits “shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants.” |
| National Pollutant Discharge Elimination System (NPDES) | As part of the 1972 Clean Water Act, Congress established the NPDES permitting system to regulate the discharge of pollutants from municipal sanitary sewers and industries. The NPDES was expanded in 1987 to incorporate permits for stormwater discharges as well. |
| Numeric Criteria | Sizing requirements for stormwater treatment facilities established in Provision D.1.d.(6)(c) of the San Diego RWQCB’s stormwater NPDES permit. |
| Operation and Maintenance (O&M) | Refers to requirements in the Stormwater NPDES Permit to inspect treatment BMPs and implement preventative and corrective maintenance in perpetuity. See Chapter Five. |

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| Parking Lot | A land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce. |
| Permeable Pavements | Pavements for roadways, sidewalks, or plazas that are designed to infiltrate a portion of rainfall, including pervious concrete, pervious asphalt, unit-pavers-on-sand, and crushed gravel. |
| Priority Development Project | A project subject to SUSMP requirements as defined in Chapter One. Also defined in Stormwater NPDES Permit Provision D.1.d.(1). |
| Project Area | The entire project area comprises all areas to be altered or developed by the project, plus any additional areas that drain on to areas to be altered or developed. |
| Project Submittal | Documents (i.e., Major or Minor Stormwater Management Plan) submitted to the County in connection with an application for development approval and demonstrating compliance with Stormwater NPDES Permit requirements for the project. |
| Proprietary | A proprietary device is one marketed under legal right of the manufacturer. |
| Redevelopment | <p>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.</p> <p>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 and reconfiguring surface parking lots and existing roadways; new sidewalk construction, pedestrian ramps, or bikelane on existing roads; and routine replacement of damaged pavement, such as pothole repair.</p> |
| Rational Method | A method of calculating runoff flows based on rainfall intensity, tributary area, and a factor representing the proportion of rainfall that runs off. |
| Regional (or Watershed) Stormwater Treatment Facility | A facility that treats runoff from multiple projects or parcels. |
| Regional Water Quality Control Board (Regional Water Board or RWQCB) | California RWQCBs are responsible for implementing pollution control provisions of the Clean Water Act and California Water Code within their jurisdiction. There are nine California RWQCBs. |
| Retention | The practice of holding stormwater in ponds or basins, or within berms or depressed areas, and allowing it to slowly infiltrate into underlying soils. Some portion will evaporate. See definitions for infiltration and detention. |
| Self-retaining area | An area designed to retain runoff. Self-retaining areas may include graded depressions with landscaping or pervious pavements and may also include tributary impervious areas up to a 2:1 impervious-to-pervious ratio for treatment and 1:1 impervious-to-pervious ratio for hydromodification flow-control. |

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| Self-treating area | A natural, landscaped, or turf area drains directly off site or to the public storm drain system. |
| Source Control | Land use or site planning practices, or structural or nonstructural measures that aim to prevent urban runoff pollution by reducing the potential for contamination at the source of pollution. Source control BMPs minimize the contact between pollutants and urban runoff. |
| Standard Industrial Classification (SIC) | A Federal government system for classifying industries by 4-digit code. It is being supplanted by the North American Industrial Classification System but SIC codes are still referenced by the Regional Water Board in identifying development sites subject to regulation under the NPDES permit. Information and an SIC search function are available at http://www.bls.gov/bls/NAICS.htm |
| Stormwater NPDES Permit | A permit issued by a Regional Water Quality Control Board (see definition) to local government agencies (Dischargers) placing provisions on allowable discharges of municipal stormwater to waters of the state. |
| Storm Water Pollution Prevention Plan (SWPPP) | A plan providing for temporary measures to control sediment and other pollutants during construction as required by the statewide stormwater NPDES permit for construction activities. |
| Stormwater Pollution Prevention Program | A comprehensive program of activities designed to minimize the quantity of pollutants entering storm drains. See Jurisdictional Urban Runoff Management Plan. |
| Standard Urban Stormwater Mitigation Plan (SUSMP) | Refers to various documents prepared in connection with implementation of the stormwater NPDES permit mandate to control pollutants from new development and redevelopment. |
| Treatment | Removal of pollutants from runoff, typically by filtration or settling. |
| Treatment Control (Structural) BMP | Any engineered system designed and constructed to remove pollutants from urban runoff. Pollutant removal is achieved by simple gravity settling of particulate pollutants, filtration, biological uptake, media adsorption or any other physical, biological, or chemical process. |
| Water Board | See Regional Water Quality Control Board. |
| Water Quality Volume (WQV) | For stormwater treatment control BMPs that depend on detention to work, the volume of water that must be detained to achieve maximum extent practicable pollutant removal. This volume of water must be detained for a specified drawdown time. |



How to Use the SUSMP

Review Chapters 1 and 2 to get a general understanding of the requirements. Then follow step-by-step instructions in Chapter 3 to prepare your Project Submittal.

This *Standard Urban Stormwater Mitigation Plan (SUSMP)* will help you ensure your project complies with the California Regional Water Quality Control Boards' requirements. Most applicants will require the assistance of a qualified civil engineer, architect, and/or landscape architect. Because every project is different, you should begin by checking specific requirements with County staff.

To use the *SUSMP*, start by reviewing [Chapter One](#) to find out whether and how stormwater quality requirements apply to your project. Chapter One also provides an overview of the process of planning, design, construction, operation, and maintenance leading to compliance.

If there are terms and issues you find puzzling, try finding answers in the glossary or in [Chapter Two](#). Chapter Two provides background on key stormwater concepts and water quality regulations, including design criteria.

Then proceed to [Chapter Three](#) and follow the step-by-step guidance to prepare a Project Submittal for your site.

[Chapter Four](#), the Low Impact Development Design Guide, includes design procedures, calculation procedures, and instructions for presenting your design and calculations in your Project Submittal.

In [Chapter Five](#) you'll find a detailed description of the process for ensuring operation and maintenance of your stormwater facilities over the life of the project. The chapter includes step-by-step instructions for preparing a Stormwater Facilities Operation and Maintenance Plan.

Throughout each Chapter, you'll find references and resources to help you understand the regulations, complete your Project Submittal, and design stormwater control measures for your project.

Construction-Phase Controls

Your Project Submittal for SUSMP compliance is a separate document from the Storm Water Pollution Prevention Plan (SWPPP). A SWPPP provides for temporary measures to control sediment and other pollutants during construction at sites that disturb one acre or more. See the Construction Handbook at www.cabmphandbooks.org or Caltrans at <http://www.dot.ca.gov/hq/construction/stormwater/stormwater1.htm> for more information on SWPPPs.

The most recent, updated version of this *SUSMP*, including updates and errata between editions, is on the County's Department of Public Work's website. The on-line *SUSMP* is in Adobe Acrobat format. If you are reading the Acrobat version on a computer with an internet connection, you can use hyperlinks to navigate the document and to access various references. The hyperlinks are throughout the text, as well as in "References and Resources" sections and in the [Bibliography](#). Some of these links (URLs) may be outdated. In that case, try entering portions of the title or other keywords into a web search engine.

► PLAN AHEAD TO AVOID THE THREE MOST COMMON MISTAKES

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

1. Not planning for compliance early enough. You should consider your strategy for stormwater quality compliance before completing a conceptual site design or sketching a layout of subdivision lots (Chapter 3).
2. Assuming proprietary stormwater treatment facilities will be adequate for compliance. Most aren't (Chapter 2).
3. Not planning for periodic inspections and maintenance of treatment and flow-control facilities. Consider who will own and who will maintain the facilities in perpetuity and how they will obtain access, and identify which arrangements are acceptable to the County (Chapter 5).

Policies and Procedures

Determine if your development project must comply with stormwater quality requirements, and review the steps to compliance.

A Low Impact Development Design Procedure

The San Diego Regional Water Board reissued a municipal stormwater NPDES permit to the County of San Diego in January 2007. The permit updates and expands stormwater requirements for new developments and redevelopments. Stormwater treatment requirements have been made more stringent, minimum standards for Low Impact Development (LID) have been added, and the County is required to develop and implement criteria for the control of runoff peaks and durations from development sites.

To assist the land development community, streamline project reviews, and maximize cost-effective environmental benefits, a unified LID design procedure has been developed. This design procedure integrates site planning and design measures with engineered, small-scale Integrated Management Practices (IMPs) such as bioretention. By following the procedure, applicants can develop a single integrated design which complies with the complex and overlapping NPDES permit LID requirements, stormwater treatment requirements, and flow-control (hydromodification management) requirements.

The design approach is detailed in Chapter 4. General instructions for preparing a complete Project Submittal are in Chapter 3, and specific local submittal requirements are available from County staff.

Applicants may choose not to use this design procedure, in which case they will need to demonstrate, in their submittal, compliance with applicable LID criteria, stormwater treatment criteria, and flow-control criteria. These criteria are described in Chapter 2 and in the NPDES permit.

Requirements for All Development Projects

All development projects must include control measures to reduce the discharge of stormwater pollutants to the maximum extent practicable.

In general, for projects that are not “Priority Development Projects,” this will include:

- Implementation of source control BMPs as listed in the Appendix E.
- Inclusion of some LID features that conserve natural features, set back development from natural water bodies, minimize imperviousness, maximize infiltration, and retain and slow runoff.
- Compliance with requirements for construction-phase controls on sediment and other pollutants.

County staff may also require additional controls appropriate to the project, which may include stormwater treatment controls. LID treatment controls such as infiltration or bioretention are preferred. See “Selection of Treatment Facilities” on page 44. If treatment facilities are included, provisions must be made to ensure their long-term maintenance.

Priority Development Projects

The NPDES permit requires that more specific runoff treatment controls be incorporated into Priority Development Projects. This requirement only pertains to projects in the areas west of the Pacific/Salton Divide. Projects located east of the Pacific/Salton Divide are not considered priority development projects.

► NEW DEVELOPMENT

Projects on previously undeveloped land are Priority Development Projects if they are in one or more of the categories listed in Table 1-1. If a project feature such as a parking lot falls into a Priority Development Project category, then the entire project footprint is subject to Priority Project requirements. To use the table, review each definition A through J. If any of the definitions match, the project is a Priority Development Project. Note some thresholds are defined by square footage of impervious area created; others by the total area of the development.

► PREVIOUSLY DEVELOPED SITES

Projects on previously developed sites (“redevelopment projects”) are Priority Development Projects if they create, add, or replace 5,000 square feet or more of impervious surface and also are in one of the categories listed in Table 1-1.

Local municipal staff may choose to designate projects not within the categories in Table 1-1 as Priority Development Projects, based on potential impacts to stormwater quality.

TABLE 1-1. Priority Development Projects.

| Is the project in any of these categories? | | |
|--|--------------------------------|---|
| Yes <input type="checkbox"/> | No <input type="checkbox"/> | A Housing subdivisions of 10 or more dwelling units. Examples: single-family homes, multi-family homes, condominiums, and apartments. |
| Yes <input type="checkbox"/> | No <input type="checkbox"/> | B Commercial—greater than one acre. Any development other than heavy industry or residential. Examples: hospitals; laboratories and other medical facilities; educational institutions; recreational facilities; municipal facilities; commercial nurseries; multi-apartment buildings; car wash facilities; mini-malls and other business complexes; shopping malls; hotels; office buildings; public warehouses; automotive dealerships; airfields; and other light industrial facilities. |
| Yes <input type="checkbox"/> | No <input type="checkbox"/> | C Heavy industry—greater than one acre. Examples: manufacturing plants, food processing plants, metal working facilities, printing plants, and fleet storage areas (bus, truck, etc.). |
| Yes <input type="checkbox"/> | No <input type="checkbox"/> | D Automotive repair shops. A facility categorized in any one of Standard Industrial Classification (SIC) codes 5013, 5014, 5541, 7532-7534, or 7536-7539. |
| Yes <input type="checkbox"/> | No <input type="checkbox"/> | E Restaurants. Any facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812), where the land area for development is greater than 5,000 square feet. Restaurants where land development is less than 5,000 square feet shall meet all SUSMP requirements except for structural treatment BMP and numeric sizing criteria requirements and hydromodification requirements. |
| Yes <input type="checkbox"/> | No <input type="checkbox"/> | F Hillside development greater than 5,000 square feet. Any development that creates 5,000 square feet of impervious surface which is located in an area with known erosive soil conditions, where the development will grade on any natural slope that is twenty-five percent or greater. |
| Yes <input type="checkbox"/> | No <input type="checkbox"/> | G Environmentally Sensitive Areas (ESAs). All development located within or directly adjacent to or discharging directly to an ESA (where discharges from the development or redevelopment will enter receiving waters within the ESA), which either creates 2,500 square feet of impervious surface on a proposed project site or increases the area of imperviousness of a proposed project site to 10% or more of its naturally occurring condition. “Directly adjacent” means situated within 200 feet of the ESA. “Discharging directly to” means outflow from a drainage conveyance system that is composed entirely of flows from the subject development or redevelopment site, and not commingled with flows from adjacent lands. |
| Yes <input type="checkbox"/> | No <input type="checkbox"/> | H Parking lots 5,000 square feet or more or with 15 or more parking spaces and potentially exposed to urban runoff. |
| Yes <input type="checkbox"/> | No <input type="checkbox"/> | I Street, roads, highways, and freeways. Any paved surface that is 5,000 square feet or greater used for the transportation of automobiles, trucks, motorcycles, and other vehicles. |
| Yes <input type="checkbox"/> | No <input type="checkbox"/> | J Retail Gasoline Outlets (RGOs) that are: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day. |

The “50% Rule” for previously developed projects. Projects on previously developed sites may also need to retrofit drainage of ALL impervious areas of the ENTIRE project site. For projects creating or replacing more than 5,000 square feet of impervious area:

- If the new project results in an increase of, or replacement of, 50% or more of the previously existing impervious surface, and the existing development was not subject to SUSMP requirements, then the entire project must be included in the treatment measure design.
- If less than 50% of the previously impervious surface is to be affected, only that portion must be included in the treatment measure design.

If a Redevelopment project feature such as a parking lot falls into a Priority Development Project category, then the entire project footprint is subject to Priority Project requirements.

Projects not subject to treatment requirements are limited to interior remodels, trenching and resurfacing associated with utility work, routine maintenance or repair, roof or exterior surface replacement, resurfacing and reconfiguring surface parking lots and existing roadways, new sidewalk construction, pedestrian ramps, or bike lanes on existing roads, and routine replacement of damaged pavement such as pothole repair. However, other requirements, including incorporation of appropriate source controls, still apply.

► POLLUTANT GENERATING PROJECTS WHICH DISTURB ONE ACRE OR MORE OF LAND

Projects that generate pollutants at levels greater than background levels, and disturb one acre or more of land, including housing subdivisions of 10 or more dwelling units are considered Priority Development Projects.

Compliance Process at a Glance

For the applicant for development project approval, stormwater compliance follows these general steps:

Discuss requirements during a pre-application meeting with County staff.

Review the instructions in this SUSMP before you prepare your tentative map, preliminary site plan, drainage plan, and landscaping plan.

Prepare your SWMP, which is typically made with your application for development approvals (entitlements).

Create your detailed project design, incorporating the features described in your SWMP.

In a table on your construction plans, list each stormwater compliance feature and facility, and the plan sheet where it appears.

Prepare a draft Stormwater Facility Operation and Maintenance Plan and submit it as required County.

Maintain stormwater facilities during construction and following construction in accordance with required warranties.

Following construction, formally transfer responsibility for maintenance to the owner.

The owner must ensure stormwater facilities remain functional and annually verify stormwater facilities are properly maintained in perpetuity.

Preparation of a complete and detailed SWMP is the key to cost-effective stormwater compliance and expeditious review of your project.

Phased Projects

When determining whether SUSMP requirements apply, a “project” should be defined consistent with California Environmental Quality Act (CEQA) definitions of “project.” That is, 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 and thereby resulting in increased flows and stormwater pollutants. “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 SUSMP thresholds.

CEQA
Preparers of CEQA documents
may wish to visit the following
Department of Planning and
Land Use website:
[http://cww.co.san-
diego.ca.us/dplu/Resource/rp_p
rocedures/rp_env_proc.html](http://cww.co.san-diego.ca.us/dplu/Resource/rp_procedures/rp_env_proc.html)

County staff may require, as part of an application for approval of a phased development project, a conceptual or master SWMP which describes and illustrates, in broad outline, how the drainage for the project will comply with the SUSMP requirements. The level of detail in the conceptual or master SWMP should be consistent with the scope and level of detail of the development approval being considered. The conceptual or master SWMP should specify that a more detailed SWMP for each later phase or portion of the project will be submitted with subsequent applications for discretionary approvals.

Note these minimum standards for SUSMP applicability are for the purpose of ensuring a consistent minimum level or “floor” for countywide implementation consistent with the requirements of the NPDES permit. The County may choose a more expansive interpretation of the NPDES permit’s applicability and may also choose to apply source control, treatment, and flow-control requirements to projects that would be exempt under these minimum standards.

New Subdivisions

If a tentative map approval would potentially entitle future owners to construct new or replaced impervious area which, in aggregate, could exceed one of the SUSMP thresholds (Table 1-1), then the applicant must take steps to ensure SUSMP requirements can and will be implemented as the subdivision is built out.

If the tentative map application does not include plans for site improvements, the applicant should nevertheless identify the type, size, location, and final ownership of stormwater treatment

and flow-control facilities adequate to serve common private roadways and any other 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 County may condition approval of the map on implementation of stormwater treatment and other SUSMP measures when construction occurs on the individual lots. At the County's discretion, this condition may be enforced by a grant deed of development rights or by a development agreement.

If the County deems it necessary, the future impervious area of one or more lots may be limited by a deed restriction. This might be necessary when a project is exempted from one or all SUSMP provisions because the total impervious area is below a threshold, or to ensure runoff from impervious areas added after the project is approved does not overload a stormwater treatment and flow-control facility.

The County may require subdivision maps to dedicate an "open space easement, as defined by Government Code Section 51075," to suitably restrict the future building of structures at each stormwater facility location if necessary.

In general, in new subdivisions stormwater treatment controls, infiltration devices, or flow-control facilities should not be located on individual single-family residential lots, particularly when those facilities manage runoff from other lots, from streets, or from common areas. A better alternative is to locate stormwater facilities on one or more separate, jointly owned parcels.

After consulting with local planning staff, applicants for subdivision approvals will propose one of the following four options, depending on project characteristics and local policies:

1. Show the number of parcels and the total impervious area to be created on all parcels could not, in the future, exceed any of the thresholds in Table 1-1.
2. Show that, for each and every lot, the intended use can be achieved with a design which disperses runoff from roofs, driveways, streets, and other impervious areas to self-retaining pervious areas, using the criteria in Chapter 4.
3. Prepare improvement plans showing drainage to treatment and/or flow-control facilities designed in accordance with this SUSMP, and commit to constructing the facilities prior to transferring the lots.
4. Prepare improvement plans showing drainage to treatment and/or flow-control facilities designed in accordance with this SUSMP, and provide appropriate legal instruments to ensure the proposed facilities will be constructed and maintained by subsequent owners.

For the option selected, County staff will determine the appropriate conditions of approval, easements, deed restrictions, or other legal instruments necessary to assure future compliance.

Private Development and Public Improvement Procedures

Private development and public improvement projects conducted within the County must address stormwater quality during the project planning, design, construction, and post-construction phases. The procedures for addressing stormwater quality are outlined in this SUSMP.

► PRIVATE DEVELOPMENT PROJECTS

Projects submitted to the County for review and approval may be subject to the requirements of the Municipal Permit. Development and redevelopment projects submitted for review and approval will be screened to determine the level of stormwater quality management required. Each proposed project is required to implement measures to ensure that:

1. Pollutant discharges and runoff flows from development are reduced to the maximum extent practicable; and

Receiving water quality objectives are not violated throughout the life of the project.

The process to address stormwater quality involves the development of a Storm Water Management Plan (SWMP) at the earliest stage of the project application process, which includes details of post-construction BMPs early in the design process, construction BMPs, and the implementation of a long-term post-construction maintenance program. A key element of the process is the selection of BMPs as described in Chapter 4.

Types of Permits

The County issues either a discretionary or ministerial permit. Both types of permits are required to address water quality. For priority development projects, the County will approve the SWMP project plan(s) as part of the development plan approval process for discretionary permits and prior to issuing permits for ministerial projects.

The following discretionary permits shall address stormwater management:

- a) Administrative Permit for Clearing
- b) Agricultural Exemption
- c) Lot Line Adjustment
- d) Final Map Modification
- e) Grading Plan (including Modification or Renewal)
- f) Improvement Plan (including Modification)
- g) Landscape Plan
- h) Major Use Permit (including Modification, Minor Deviation, or Extension)

- i) Minor Use Permit (including Modification, Minor Deviation, or Extension)
- j) Parcel Map Modification
- k) Reclamation Plan
- l) Site Plan (including Amendment)
- m) Solid Waste Facility Permit
- n) Tentative Map (including Resolution Amendment or Time Extension)
- o) Tentative Parcel Map
- p) Variance
- q) Watercourse Permit

The following ministerial permits shall address stormwater management:

- a) Building Permit
- b) Construction Right of Way Permit
- c) Encroachment Permit
- d) Excavation Permit
- e) On-site Wastewater System Permit
- f) Underground Tank Permit
- g) Well Permit

Submission of SWMP

Development and submittal of a SWMP is part of the Project Application and is prepared by the project proponent. This plan serves as the basis for a long-term solution to water quality improvements. Early consideration and planning of permanent BMPs ensures that water quality will be addressed for many years to come. Also, treatment BMPs are often difficult to add to the completed design of a development project without causing substantial changes to the project's character or viability. The earlier in the design process stormwater facilities are considered, the greater the chance a successful and efficient design can be accomplished.

The SWMP provides the needed information to address both stormwater and non-stormwater issues. The purpose of the SWMP is as follows:

- To provide all the information needed to fully and adequately characterize the existing water quality;
- To analyze the drainage, and develop effective post-construction stormwater protection, and;
- To ensure the effectiveness of the BMPs through proper maintenance and long-term fiscal responsibility.

Information from the SWMP will be used in formulating staff's CEQA responses and proposed conditions for the project. The SWMP serves as the proponent's plan for compliance with the County's SUSMP requirements. The SWMP is a living document and could require changes if any of the following conditions apply:

- The project evolves to a Priority Project;
- The plans submitted for a Grading Permit are substantially different than those submitted as part of initial application, or;
- A Stormwater Impact Analysis is needed.

For priority development projects, the SWMP requires additional information including a more detailed description of the project. Data from the project drainage report are utilized to determine the size of treatment BMPs and assess the need for temporary storage to capture increased runoff. Pollutants and conditions of concern derived from the San Diego Basin Plan are described in the SWMP. In addition, the SWMP requires projects to establish BMPs based on three categories: site design, source control and treatment control taking into account Low Impact Development and Hydromodification Plan (HMP) requirements. An example of a SWMP for priority development projects is included as Appendix C.

SWMP Process

The SWMP is formatted to follow this manual. The County requires that a SWMP at time of initial application contain the minimum project elements as identified below. The SWMP will be prepared by the project proponents and comply with the WPO.

- Owner's Certification
- STEP 1: Priority Development Project Determination;
- STEP 2: Project Stormwater Quality Determination;
- STEP 3: Hydromodification Determination;
- STEP 4: Pollutants of Concern Determination;
- STEP 5: LID and Site Design Strategies;

- STEP 6: Source Control BMPs;
- STEP 7: LID and Treatment Control Selection, and;
- STEP 8: Operation and Maintenance.

The SWMP will be prepared with the sections set forth in the example in Appendix C. Since the SWMP is a living document, the initial submission, provided during project initiations, need not include BMPs engineered in accordance to the drainage report nor a comprehensive maintenance plan. The BMPs should be conceptually sized and located. A SWMP addendum will be provided as part of the Grading Permit application. This addendum will include the properly engineered post-construction BMP and a refined maintenance plan. All treatment control BMPs will be incorporated in the design plans.

Review and Approval Process

County staff in the departments of Public Works and Planning & Land Use will review the SWMP as part of the overall project application. Review of the SWMP begins with the Stormwater Intake Form for Development Projects (Appendix B). As previously noted, information from the SWMP will be used in formulating CEQA responses and findings, findings of project code compliance, and in proposing conditions for the project.

Upon submittal of the project application staff will initiate a review. Staff will complete a draft Initial Study/Environmental Analysis Form (IS/EA Form), which addresses water quality issues.

During project review, and as part of the CEQA process, staff evaluates all discretionary applications for potential impacts to environmental resources, including stormwater. If a proposed project has been reviewed previously under CEQA, and a certified/approved environmental document exists for the project, staff reviews this documentation to determine if adequate information is included to address the requirements under the WPO. If no such information exists in the previous documentation, or the information does not adequately address the requirements under the WPO, and it is deemed necessary by staff on the basis of the type or scale of project, a Stormwater Impact Analysis Report is required for the project following the procedures outlined below.

Even if a project is exempt from the CEQA process, it still must be found in compliance with the WPO and go through the review process.

For those projects without any previous environmental documentation, or if insufficient documentation exists, staff reviews the project for stormwater issues in the following manner:

Prioritization

The project is reviewed using the County's desktop-based GIS application, existing regional land use maps, and other related resources including the prioritization criteria from Municipal Permit section (D.1.d. (2)), to determine the project's prioritization, and potential stormwater impacts from post-construction activities. The prioritization of projects will be used when determining which projects must meet SUSMP requirements. As part of this process, staff from the DPLU

and DPW review the SWMP, Preliminary Grading Plan or other hydrologic information submitted with the Project's application package, and determine what issues must be addressed.

Conditions of Project Approval

Recommendations from the SWMP regarding structural BMPs and the long-term maintenance for the project are used in formulating conditions of project approval. The conditions will typically specify that the requirements of the SWMP will be implemented. The conditions will be structured to assure that grading or other actions that could threaten water quality or contribute to contaminated stormwater run-off will not be allowed until all required BMPs and other actions are implemented to the satisfaction of the County.

In addition, if the proposed structural BMPs require long-term maintenance, the applicant will be required to take all necessary measures, to the satisfaction of the County that such ongoing maintenance will occur to prevent water quality pollution.

Non-Priority Projects

Projects that do not meet the priority project criteria are considered non-priority projects. As such, these projects need only to complete a Minor SWMP unless the County requires a SWMP for the project. All projects east of the Pacific/Salton Divide should complete a Minor SWMP. In addition, the following types of projects/permits typically address water quality via a Minor SWMP.

- Construction Right of Way Permits;
- Encroachment Permits;
- Minor Excavation Permits;
- Variances;
- Boundary Adjustments;
- Driveways for Single Private Residences;
- Minor Use Permits for Cellular Facilities, and;
- Residential Tentative Parcel Maps.

► CAPITAL IMPROVEMENT PROJECTS

The process of addressing stormwater quality for capital improvement projects (CIP) is essentially the same as land development projects. SUSMP requirements are incorporated into the project design and shown on the plans prior to bidding for construction contracts, or equivalent.

► CONSTRUCTION PHASE BMPS

This manual does not explicitly provide guidance for construction phase BMPS. All projects are required to address construction BMPS in accordance with ordinances, rule or regulation, statute, or other provisions of law. There is a requirement in the SWMP to provide a basic description of the BMPS proposed during construction. Projects that qualify under the definition of the Statewide General Construction Permit, are required to develop a Storm Water Pollution Prevention Plan as part of the Grading Permit process. Inspection procedures have been established to ensure compliance during the construction phase.

Compliance with Flow-Control Requirements

Priority Development Projects (Table 1-1) must be designed so that runoff rates and durations are controlled to maintain or reduce pre-project downstream erosion conditions and protect stream habitat.

► HMP APPLICABILITY REQUIREMENTS

To determine if a proposed project must implement hydromodification controls, refer to the HMP Decision Matrix in Figure 1-1. The HMP Decision Matrix can be used for all projects. For redevelopment projects, flow controls would only be required if the redevelopment project increases impervious area or peak flow rates as compared to pre-project conditions.

It should be noted that all Priority Development Projects will be subject to the Permit's LID and water quality treatment requirements even if hydromodification flow controls are not required.

As noted in Figure 1-1, projects may be exempt from HMP criteria under the following conditions.

- If the project is not a Priority Development Project.
- If the proposed project does not increase the impervious area and peak flows to any discharge location.
- If the proposed project discharges runoff directly to an exempt receiving water such as the Pacific Ocean, San Diego Bay, an exempt river reach, an exempt reservoir, or a tidally-influenced area.
- If the proposed project discharges to a stabilized conveyance system, which has the capacity for the ultimate Q_{10} , and extends to the Pacific Ocean, San Diego Bay, a tidally-influenced area, an exempt river reach or reservoir.
- If the contributing watershed area to which the project discharges has an impervious area percentage greater than 70 percent.
- If an urban infill project discharges to an existing hardened or rehabilitated conveyance system that extends beyond the “domain of analysis,” the potential for cumulative impacts in the watershed are low, and the ultimate receiving channel has a Low susceptibility to erosion as defined in the Southern California Coastal Water Research Project (SCCWRP) channel assessment tool.

If the proposed project decreases the pre-project impervious area and peak flows to each discharge location, then a flow-duration analysis is implicitly not required. If continuous simulation flow-frequency and flow duration curves were developed for such a scenario, the unmitigated post-project flows and durations would be less as compared to pre-project curves.

Proposed exemptions for projects discharging runoff directly to the Pacific Ocean, San Diego Bay or to hardened conveyance systems which transport runoff directly to the Pacific Ocean or San Diego Bay are referred to the 2007 Municipal Permit. Per the Permit, hardened conveyance systems can include existing concrete channels, storm drain systems, etc.

The Municipal Permit also contains language to support exemptions for projects located in highly urbanized areas where the impervious percentage exceeds 70 percent (as calculated for the sub-watershed between the project outfall downstream to the exempt receiving water).

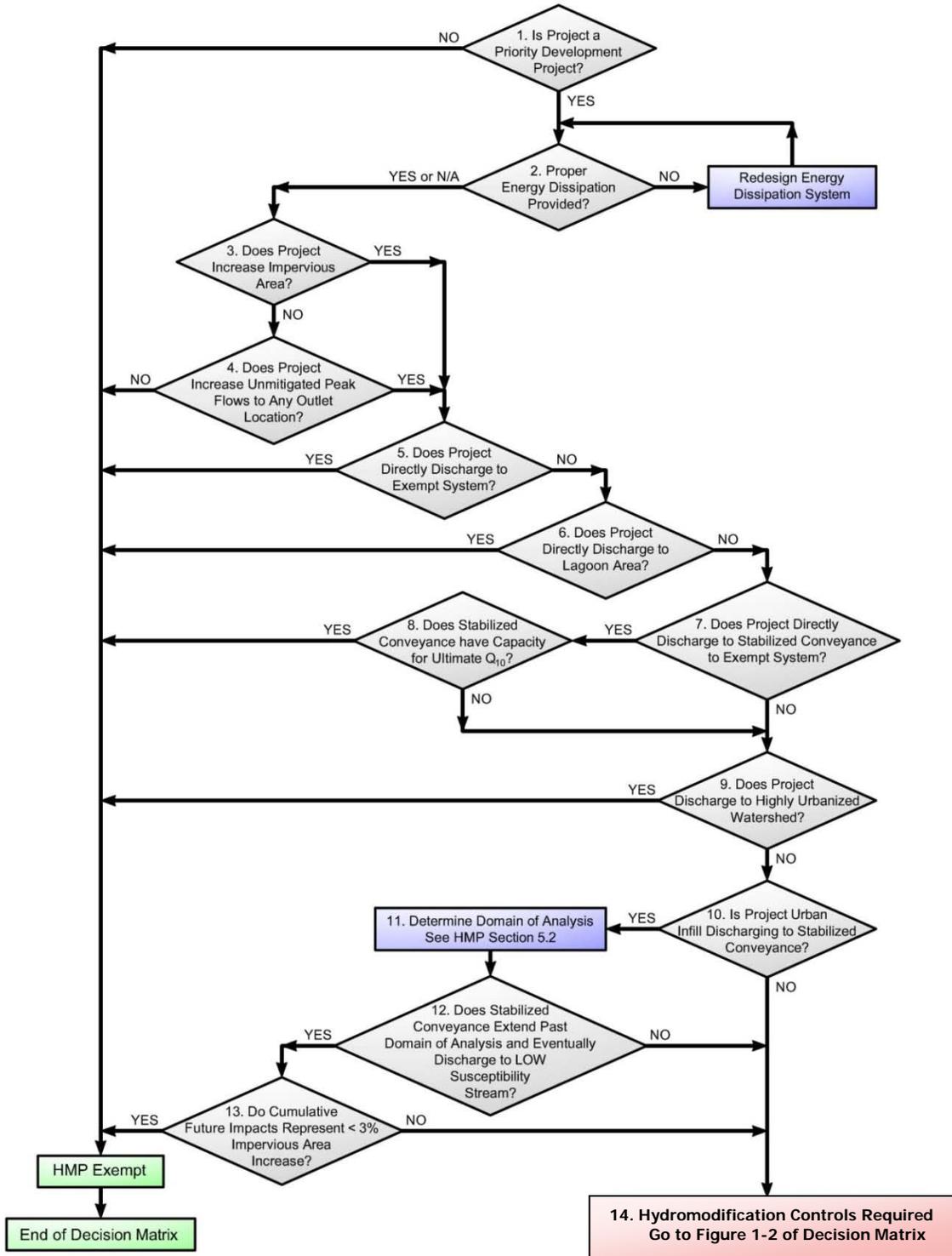


FIGURE 1-1. HMP Applicability Determination

- Figure 1-1, Node 1 – Hydromodification mitigation measures are only required if the proposed project is a Priority Development Project.
- Figure 1-1, Node 2 – Properly designed energy dissipation systems are required for all project outfalls to unlined channels. Such systems should be designed in accordance with the County of San Diego’s Drainage Design Manual to ensure downstream channel protection from concentrated outfalls.
- Figure 1-1, Nodes 3 and 4 – Projects may be exempt from hydromodification criteria if the proposed project reduces the pre-project impervious area and if unmitigated post-project outflows (outflows without detention routing) to each outlet location are less as compared to the pre-project condition. The pre and post-project hydrologic analysis should be conducted for the 2 and 10-year design storms and follow single-event methodology set forth in the San Diego Hydrology Manual. This scenario may apply to redevelopment projects in particular.
- Figure 1-1, Node 5 – Potential exemptions may be granted for projects discharging runoff directly to an exempt receiving water, such as the Pacific Ocean, San Diego Bay, an exempt river system (detailed in Table 1-2), or an exempt reservoir system (detailed in Table 1-3). To qualify for this exemption, projects must discharge runoff such that the outlet is located and the discharge occurs within the limits of inundation of the river due to the occurrence of the peak flow of the 10-year flooding event or below the normal operating water surface elevation of a reservoir system.
- Figure 1-1, Node 6 – For projects discharging runoff directly to a tidally-influenced lagoon, potential exemptions may also be granted. To qualify for this exemption, projects must discharge runoff at an elevation, to be determined by the governing municipality, below the typical water surface level in the lagoon system (such as the mean high tide elevation). County may grant, on a case-by-case basis, additional exemptions for projects discharging runoff in the immediate vicinity of lagoon systems provided that a stabilized, natural conveyance (non-hardened) is provided between the project discharge location and typical lagoon water surface elevation. Exemptions related to runoff discharging directly to tidally-influenced areas were drafted based upon precedent set in the Santa Clara HMP. Regarding the potential exemption, additional analysis would be required to assess the effects of the freshwater / saltwater balance and the resultant effects on lagoon-system biology. This assessment, which would be required by other permitting processes such as the Army Corps of Engineers, California Department of Fish and Game, etc., must be provided by a certified biologist or other specialist as approved the County. Such discharges would include an energy dissipation system (riprap, etc.) designed to mitigate 100-year outlet velocities based upon a free outfall condition. Such a design would be protective of the channel bed and bank from an erosion standpoint.
- Figure 1-1, Nodes 7 and 8 – For projects discharging runoff directly to a hardened conveyance or rehabilitated stream system that extends to exempt receiving waters detailed in Node 5, potential exemptions from hydromodification criteria may be

granted. Such hardened or rehabilitated systems could include existing storm drain systems, existing concrete channels, or stable engineered unlined channels. To qualify for this exemption, the existing hardened or rehabilitated conveyance system must continue uninterrupted to the exempt system. In other words, the hardened or rehabilitated conveyance system cannot discharge to an unlined, non-engineered channel segment prior to discharge to the exempt system. Additionally, the project proponent must demonstrate that the hardened or rehabilitated conveyance system has capacity to convey the 10-year ultimate condition flow through the conveyance system. The 10-year flow should be calculated based upon single-event hydrologic criteria as detailed in the San Diego County Hydrology Manual.

- Figure 1-1, Node 9 – As allowed per the Municipal Permit, projects discharging runoff to a highly urbanized watershed (defined as an existing, pre-project impervious percentage greater than 70 percent) may be eligible for an exemption from hydromodification criteria.

Watershed impervious area calculations for this potential exemption will be measured between the project site discharge location and the connection to a downstream exempt receiving conveyance system, such as the Pacific Ocean, San Diego Bay, or an exempt river system. If a tributary area connects with the main line drainage path between the project site and the exempt system, then the entire watershed area contributing to the tributary will be included in the calculation. Initial review of County land use indicates that this exemption will likely only apply in a limited number of urbanized coastal areas.

Percent imperviousness will be calculated based on an area-weighted average of impervious areas associated with commercial, industrial, single-family residential, multi-family residential, open space, and other miscellaneous areas (schools, churches, etc.) representative for the watershed. Representative percent imperviousness values for each land use type may correspond to values recommended in Table 3-1 of the County of San Diego's Hydrology Manual and detailed below or by more specific representative percent impervious calculations (using GIS, etc.), which are often required to represent impervious area percentages for park, school and church sites.

- Figure 1-1, Nodes 10 through 13 – For urban infill projects discharging runoff to an existing hardened or rehabilitated conveyance system, potential limited exemptions from hydromodification criteria may apply where the existing impervious area percentage in the watershed exceeds 40 percent. For the potential exemption application, the domain of analysis must be determined and the existing hardened or rehabilitated conveyance system must extend beyond the downstream terminus of the domain of analysis. The hardened or rehabilitated conveyance system must discharge to a receiving channel with a Low potential for channel susceptibility for this exemption to be granted (channel susceptibility determined using SCCWRP tool). Finally, continuous simulation sensitivity analysis shows that an exemption could only be granted if the potential future development impacts in the watershed would increase the watershed's impervious area percentage by less than 3 percent (as compared to the existing condition in the year 2010). If the potential future cumulative impacts in the watershed could increase the impervious area percentage by more than 3 percent (as compared to existing condition), then no exemption could be granted based on this item. Watershed impervious area calculations for this potential exemption, in which a project discharges to a watershed with an existing impervious areas greater than 40 percent, will be measured upstream from the outfall of the urban conveyance system (to a non-concrete, non-riprap-lined or non-engineered channel) to the contributing watershed boundary (the entire watershed contributing to the discharge outfall).

Percent imperviousness will be calculated based on an area-weighted average of impervious areas associated with commercial, industrial, single-family residential, multi-family residential, open space, and other miscellaneous areas (schools, churches, etc.) representative for the watershed. Representative percent imperviousness values for each land use type may correspond to values recommended in Table 3-1 of the County of San Diego's Hydrology Manual and detailed below or by more specific representative percent impervious calculations (using GIS, etc.), which are often required to represent impervious area percentages for park, school and church sites.

Exemptions related to runoff discharging directly to certain river reaches were initially based upon the majority TAC opinion that such river reaches were depositional (aggrading) and that the effects of cumulative watershed impacts to these reaches is minimal. Subsequent justifications for the river reach exemptions were the result of a flow duration curve analysis for the San Diego River.

Potential river reaches that would be exempt from hydromodification criteria include only those for which the contributing drainage area exceeds 100 square miles and which have a 100-year design flow in excess of 20,000 cfs. For reference, proposed Caltrans HMP criteria allows for river/creek exemptions for drainage areas of only 10 square miles.

Per recommendations from members of the TAC, San Diego River systems meeting the drainage area and peak flow criteria are typically aggrading (depositional) and have very wide floodplain areas when in the natural condition. In all cases, river reaches meeting the drainage area and peak flow criteria are located downstream of large reservoir systems which effectively block outflows for most storm events. In addition, the river systems meeting these criteria typically have very low gradients. The combination of low gradients, significant peak flow attenuation, and wide floodplain areas translate to a low potential for channel erosion at the upper limit of the proposed geomorphic flow range (10-year flow event).

All exempt river reaches, which are presented in Table 1-2, have drainage areas in excess of 100 square miles and 100-year flow rates in excess of 20,000 cfs. In addition, all proposed river reaches are subject to significant upstream reservoir flow regulation, have wide floodplain or stabilized channel areas, and low gradients. This combination of factors, in association with field observations and years of historical perspective from the TAC members, justifies exemptions for direct discharges to the exempt river reaches provided that properly sized energy dissipation is provided at the outfall location.

TABLE 1-2. Summary of Exempt River Reaches in San Diego County

| River | Downstream Limit | Upstream Limit |
|--------------------|--------------------------|--|
| Otay River | Outfall to San Diego Bay | Lower Otay Reservoir Dam |
| San Diego River | Outfall to Pacific Ocean | Confluence with San Vicente Creek |
| San Dieguito River | Outfall to Pacific Ocean | Lake Hodges Dam |
| San Luis Rey River | Outfall to Pacific Ocean | Upstream river limit of Basin Plan subwatershed 903.1 upstream of Bonsall and near Interstate 15 |
| Sweetwater River | Outfall to San Diego Bay | Sweetwater Reservoir Dam |

Table 1-3 provides a summary of exempt reservoirs in San Diego County. Large reservoirs can be exempt systems from a hydromodification standpoint since reservoir storm water inflow velocities are naturally mitigated by the significant tailwater condition in the reservoir. HMP exemptions would only be granted for projects discharging runoff directly to the exempt reservoirs. Each municipality must define “direct discharge” based on the project site conditions. To qualify for the potential exemption, the outlet elevation must be at or below either the normal operating water surface elevation or the reservoir spillway elevation and properly designed energy dissipation must be provided.

TABLE 1-3. Summary of Exempt Reservoirs in San Diego County

| Reservoir | Watershed |
|-----------------------|-----------------------|
| Barrett Lake | Tijuana River |
| El Capitan Reservoir | San Diego River |
| Lake Dixon | Escondido Creek |
| Lake Henshaw | San Luis Rey River |
| Lake Hodges | San Dieguito River |
| Lake Jennings | San Diego River |
| Lake Murray | San Diego River |
| Lake Poway | San Dieguito River |
| Lake San Marcos | San Marcos Creek |
| Lake Wohlford | Escondido Creek |
| Loveland Reservoir | Sweetwater River |
| Lower Otay Reservoir | Otay River |
| Miramar Lake | Los Penasquitos Creek |
| San Vicente Reservoir | San Diego River |
| Sweetwater Reservoir | Sweetwater River |
| Upper Otay Reservoir | Otay River |

The final exemption category focuses on small urban infill projects where the potential for future cumulative watershed impacts is minimal.

Urban infill projects may be exempt from HMP criteria if:

2. The potential future development impacts within the sub-watershed, as measured from the entire sub-watershed area draining to the existing conveyance system outfall, would not increase the composite impervious area percentage of the sub-watershed by more than 3 percent

The project discharges runoff to an existing hardened or rehabilitated conveyance system (storm drain, concrete channel, or engineered vegetated channel) that extends beyond the Domain of Analysis determined for the project site, and

The stabilized conveyance system eventually discharges to a channel with a Low susceptibility to erosion, as designed by the SCCWRP channel assessment tool.

► FLOW CONTROL PERFORMANCE CRITERIA

Figures 1-2 and 1-3, which are part of the HMP Decision Matrix and are presented on the following pages, detail how lower flow thresholds would be determined for a project site. Figures 1-4 and 1-5, which detail the SCCWRP lateral and vertical channel susceptibility requirements, complete the HMP Decision Matrix.

The project applicant must first determine whether field investigations will be conducted pursuant to the SCCWRP channel screening tools. If the screening tools are not completed for a proposed project, then the site must mitigate peak flows and durations based on a pre-project condition lower flow threshold of $0.1Q_2$. While a project applicant would be held to the $0.1Q_2$ standard if channel screening tools and assessments are not conducted, less restrictive standards are possible for more erosion-resistant receiving channel sections if the screening tools are completed and the SCCWRP method indicates either a Medium or Low susceptibility to channel erosion.

In such a scenario, the project applicant would also use the critical shear stress calculator to assist in determination of the predicted lower flow threshold. The SCCWRP screening tools and critical shear stress calculator work in concert to determine the lower flow threshold for a given site. Lower flow limits determined by the calculator have been grouped into one of three thresholds – $0.1Q_2$, $0.3Q_2$ or $0.5Q_2$. “Low” susceptibilities from the SCCWRP tool generally correspond to the $0.5Q_2$ threshold, “Medium” susceptibilities generally correspond to the $0.3Q_2$ threshold, and “High” susceptibilities generally correspond to the $0.1Q_2$ threshold. The SCCWRP channel screening tools are required to identify channel conditions not considered by the critical shear stress calculator, which focuses on channel material and cross section. Conversely, the SCCWRP channel screening tools considers other channel conditions including channel braiding, mass wasting, and proximity to the erosion threshold. In cases where the critical shear stress calculator and the SCCWRP screening tools return divergent values, then the most conservative value shall be used as the lower flow threshold for the analysis.

Low-Impact Development (LID) and extended detention facilities are required to meet peak flow and duration controls as follows:

1. For flow rates ranging from 10 percent, 30 percent or 50 percent of the pre-project 2-year runoff event ($0.1Q_2$, $0.3Q_2$, or $0.5Q_2$) to the pre-project 10-year runoff event (Q_{10}), the post-project discharge rates and durations shall not deviate above the pre-project rates and durations by more than 10 percent over and more than 10 percent of the length of the flow duration curve. The specific lower flow threshold will depend on results from the SCCWRP channel screening study and the critical flow calculator.

For flow rates ranging from the lower flow threshold to Q_5 , the post-project peak flows shall not exceed pre-project peak flows. For flow rates from Q_5 to Q_{10} , post-project peak flows may exceed pre-project flows by up to 10 percent for a 1-year frequency interval. For example, post-project flows could exceed pre-project flows by up to 10 percent for the interval from Q_9 to Q_{10} or from $Q_{5.5}$ to $Q_{6.5}$, but not from Q_8 to Q_{10} .

This HMP recommends the use of LID facilities to satisfy both 85th percentile water quality treatment as well as HMP flow control criteria. The Copermittes and the consultant team have developed detailed standards for LID implementation. These standards are provided in the County Wide Model SUSMP.

The following methods may be used to meet mitigation requirements.

- Install BMPs that meet design requirements to control runoff from new impervious areas. BMPs including bioretention basins, vegetated swales, planter boxes, extended detention basins, etc. shall be designed pursuant to standard sizing and specification criteria detailed in the Model SUSMP and the HMP/LID Sizing Calculator to ensure compliance with hydromodification criteria.
- Use the automated San Diego Sizing Calculator to select and size LID treatment devices or flow control basins. The tool, akin to the sizing calculator developed for compliance with the Contra Costa HMP, uses pre-calculated sizing factors to determine required footprint sizes for flow control BMPs. The Sizing Calculator also includes an automated pond sizing tool to assist in the design of extended detention facilities for mitigation of hydromodification effects. Because of the Sizing Calculator's ease of implementation, and since hydromodification BMPs can also serve as treatment BMPs, it is anticipated that most project applicants will choose this option instead of seeking compliance through site-specific continuous simulation model preparation.
- Prepare continuous simulation hydrologic models and compare the pre-project and mitigated post-project runoff peaks and durations (with hydromodification flow controls) until compliance to flow control standards can be demonstrated. The project applicant will be required to quantify the long-term pre- and post-project runoff response from the site and establish runoff routing and stage-storage-discharge relationships for the planned flow control devices. Public domain software such as BMP Sizing Calculator, HSPF, HEC-HMS and SWMM can be used for preparation of a continuous simulation hydrologic analysis or approved proprietary software such as SDHM2011. The BMP Calculator uses only 3 designated rain gauges (Lake Wohlford, Oceanside, and Lindbergh). If an applicant is using the BMP Calculator they must use the gauge designated for the area that the project is within. If the applicant decides to use a closer rain gage, the only option is to use another model (SDHM2011, HSPF, HEC HMS, SWMM or other approved software) where the closest appropriate rain gauge (1 of the 19 approved) can be used.
- Points of compliance must be selected to conduct the comparisons of pre-project and post-project flows and durations. Generally, points of compliance are selected at locations along the project boundary where concentrated flows discharge from the project site. If a point of compliance is selected downstream of the project boundary, then the governing municipality should be consulted in advance of the hydromodification analysis. For projects which convey offsite runoff through the site, it is assumed that the offsite runoff would be separated from site runoff. If this is not the case, then the governing municipality should be consulted to further refine the points of compliance for the site (an interior project site point of compliance could be required in such a scenario).

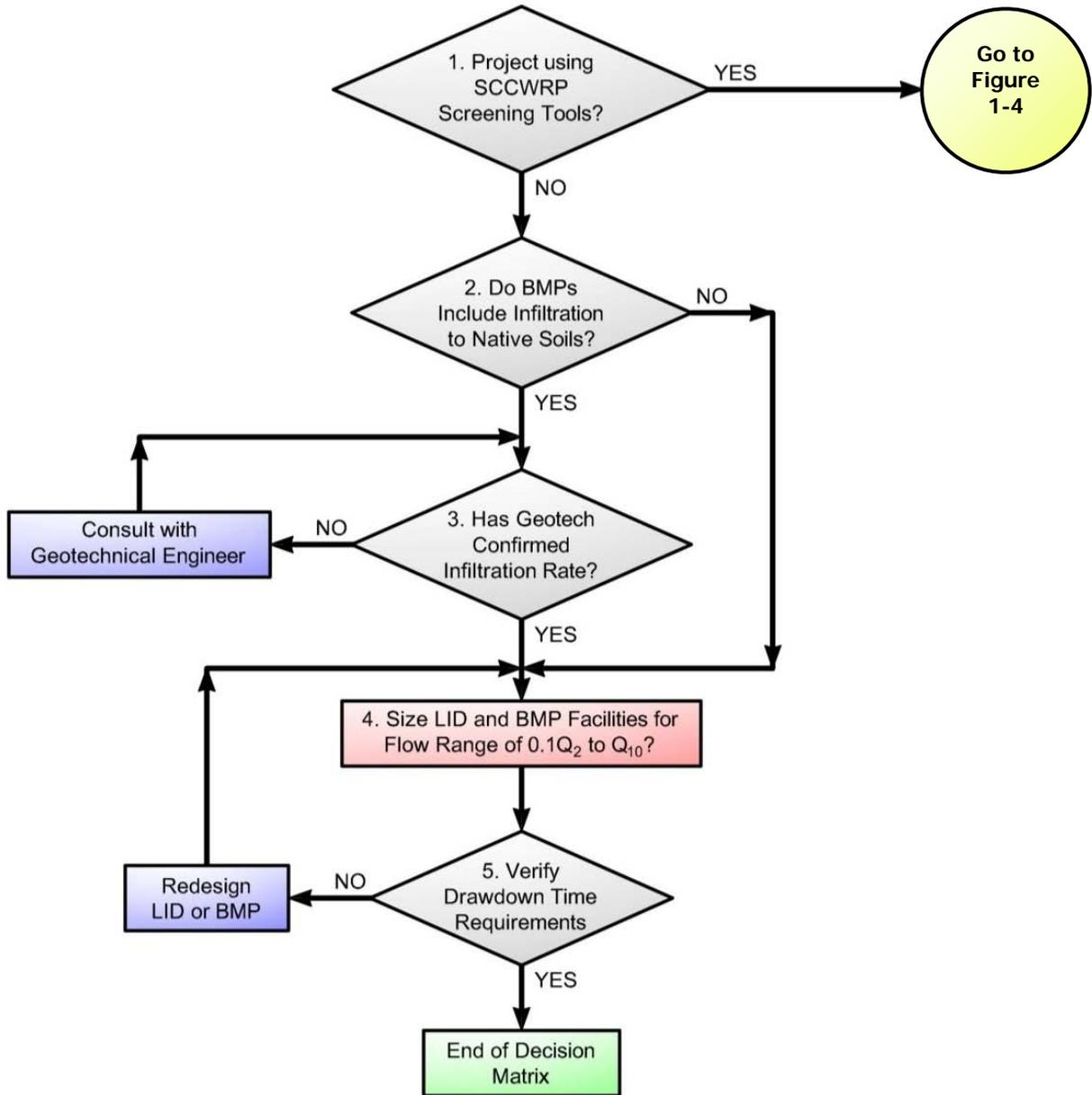


FIGURE 1-2. Mitigation Criteria and Implementation

- Figure 1-2, Node 1 – If the project applicant chooses to complete SCCWRP channel screening tools, then the applicant moves to Figures 1-4 and 1-5 to assess the vertical and lateral susceptibility of the receiving channel systems. Depending on the results of the SCCWRP screening tools and critical flow calculator, it is possible that lower flow thresholds in excess of $0.1Q_2$ may be used. If the project applicant chooses not to complete the SCCWRP channel assessment, then the applicant proceeds with Figure 1-2 of the Decision Matrix.
- Figure 1-2, Node 2 – If the project's LID or BMP approach accounts for the infiltration of runoff to native surrounding soils (below amended soil layers), then consultation with a geotechnical engineer is required (Box 3). If the project mitigation approach does not account for infiltration of runoff, then the applicant would proceed to Box 4.
- Figure 1-2, Node 3 – A geotechnical engineer should determine the allowable infiltration rates to be used for the design of each LID or BMP facility. The geotechnical assessment should also identify potential portions of the project which are feasible for infiltration of runoff.
- Figure 1-2, Node 4 – In this scenario, the SCCWRP channel assessment was not conducted. Therefore, the project applicant would be held to the $0.1Q_2$ lower flow threshold. LID and extended detention facilities must be sized so that the mitigated post project flows and durations do not exceed pre-project flows and durations for the geomorphically-significant flow range of $0.1Q_2$ to Q_{10} .
- Figure 1-2, Node 5 - The Decision Matrix includes language regarding a drawdown time requirements so that standards set forth by the County's Department of Environmental Health are met. As a side note, the County's Department of Environmental Health has stated that the drawdown requirement would be applied to underground vaults in addition to extended detention basins and the surface ponding areas of LID facilities. Proper maintenance of hydromodification mitigation facilities is essential to guard against potential vector issues as well potential safety issues resulting from long-term standing water. If mitigation facility outlets clog, then runoff will bypass the system and potentially result in additional erosion problems downstream of a site. The County Department of Environmental Health recently amended its drawdown time requirement to 96 hours.

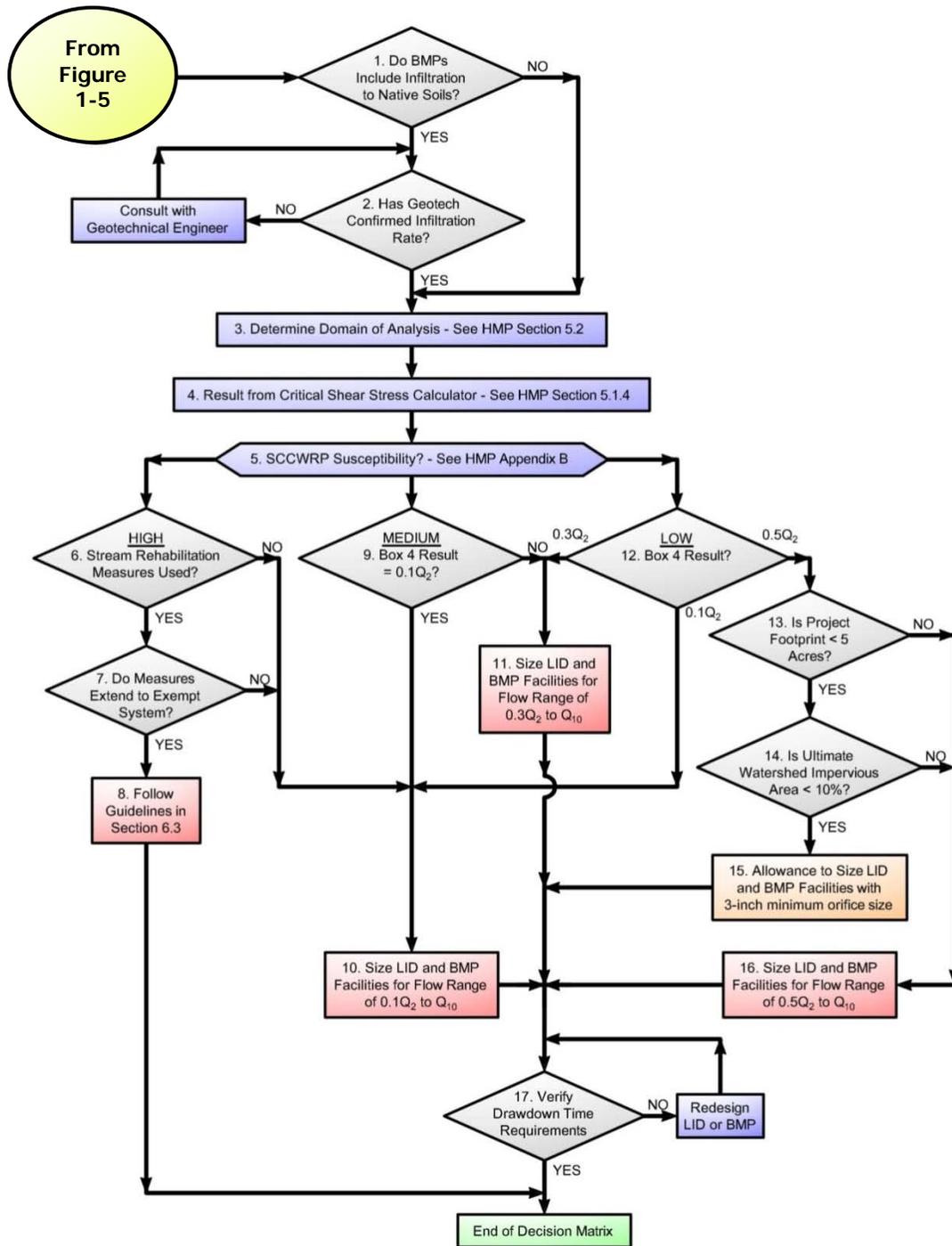


FIGURE 1-3. Mitigation Criteria and Implementation

- Figure 1-3, Node 1 – Use of Figure 1-3 assumes that the project applicant conducted the SCCWRP channel assessment. Box 1 would begin following completion of both the lateral and vertical susceptibility flow charts depicted in Figures 1-4 and 1-5. Box 1 is a decision box asking if the project’s LID or BMP approach accounts for the infiltration of runoff to native surrounding soils (below amended soil layers). If the answer is Yes, then consultation with a geotechnical engineer is required (Box 2). If the project mitigation approach does not account for infiltration of runoff, then the applicant would proceed to Box 3.
- Figure 1-3, Node 2 – A geotechnical engineer should determine the allowable infiltration rates to be used for the design of each LID or BMP facility. The geotechnical assessment should also identify potential portions of the project which are feasible for infiltration of runoff.
- Figure 1-3, Node 3 – Pursuant to criteria detailed in HMP Section 5.2, the Domain of Analysis is determined downstream and upstream of the project site. This determination is used to ascertain the required reach length for data collection (channel bed and bank material, channel cross section data, etc.) required for the critical flow calculator (see Box 4),
- Figure 1-3, Node 4 – Pursuant to criteria detailed in HMP Section 5.1.4, the project applicant would run the critical shear stress calculator to determine if the recommended critical flow threshold should be $0.1Q_2$, $0.3Q_2$, or $0.5Q_2$. This result will be compared to the result from the SCCWRP screening analysis (Box 5) to determine the final lower flow threshold for the project.
- Figure 1-3, Node 5 – Pursuant to criteria detailed in HMP Appendix B, the project applicant would determine both the lateral and vertical channel susceptibility rating per guidelines set forth by SCCWRP. If the lateral and vertical tools returned divergent results, then the more conservative result would be used. SCCWRP susceptibility ratings include “High,” “Medium” and “Low.”
- Figure 1-3, Node 6 – A project applicant would arrive at Box 6 if the SCCWRP channel susceptibility rating was determined to be “High.” This decision box inquires as to whether stream rehabilitation measures such as grade control and channel widening will be used as a mitigation measure instead of flow control. It should be noted that stream rehabilitation options are only allowed if the existing receiving channel susceptibility is considered to be “High.”

- Figure 1-3, Node 7 – Stream rehabilitation measures are only allowed if the proposed mitigation project extends to a downstream exempt system (such as an exempt river system). If the mitigation measure did not extend to an exempt system, then the potential for cumulative watershed impacts would be more pronounced.
- Figure 1-3, Node 8 – If stream rehabilitation measures are allowed, then guidelines outlined in Section 6.3 of the HMP should be followed to design the in-stream mitigation approach.
- Figure 1-3, Node 9 - A project applicant would arrive at Box 9 if the SCCWRP channel susceptibility rating was determined to be “Medium.” If the result from the critical shear stress calculator is also “Medium” (or $0.3Q_2$), then the lower flow threshold would be $0.3Q_2$ (Box 11). If the result from the critical shear stress calculator is “High” (or $0.1Q_2$), then the more conservative value would be used and the lower flow threshold would be $0.1Q_2$ (Box 10).
- Figure 1-3, Node 10 – For stream reaches determined by either the critical flow calculator or the SCCWRP screening tools to have a “High” susceptibility to erosion, LID and extended detention flow control facilities should be sized so that the mitigated post project flows and durations do not exceed pre-project flows and durations for the geomorphically-significant flow range of $0.1Q_2$ to Q_{10} .
- Figure 1-3, Node 11 - For stream reaches determined by either the critical flow calculator or the SCCWRP screening tools to have a “Medium” susceptibility to erosion, LID and extended detention flow control facilities should be sized so that the mitigated post project flows and durations do not exceed pre-project flows and durations for the geomorphically-significant flow range of $0.3Q_2$ to Q_{10} .
- Figure 1-3, Node 12 - A project applicant would arrive at Box 12 if the SCCWRP channel susceptibility rating was determined to be “Low.” If the result from the critical shear stress calculator is also “Low” (or $0.5Q_2$), then the lower flow threshold would be $0.5Q_2$ (Box 16 – note potential waiver in Box 13). If the result from the critical shear stress calculator is “High” (or $0.1Q_2$), then the more conservative value would be used and the lower flow threshold would be $0.1Q_2$ (Box 10). If the result from the critical flow calculator is “Medium” (or $0.3Q_2$), then the more conservative value would be used and the lower flow threshold would be $0.3Q_2$ (Box 11).
- Figure 1-3, Node 13 – In some limited situations, namely small developments in rural or lightly developed areas, an allowance for a minimum outlet orifice size may be granted when the receiving channel susceptibility is “Low.” This criteria may potentially be used for project footprints less than 5 acres. If the project footprint is greater than 5 acres, then the allowance may not be granted and the applicant would proceed to Box 16.

- Figure 1-3, Node 14 – The potential allowance discussed in Box 13 could only be granted if the ultimate potential impervious area in the sub-watershed is less than 10 percent. If there is potential for the sub-watershed impervious area to exceed 10 percent, then the minimum orifice size criteria may not be granted.
- Figure 1-3, Node 15 – If Boxes 12, 13, and 14 are satisfied, then mitigation facilities may be designed using a 3-inch minimum outlet orifice size.
- Figure 1-3, Node 16 - For stream reaches determined by either the critical flow calculator or the SCCWRP screening tools to have a “Low” susceptibility to erosion – and for projects where the minimum outlet orifice criteria does not apply - LID and extended detention flow control facilities should be sized so that the mitigated post project flows and durations do not exceed pre-project flows and durations for the geomorphically-significant flow range of $0.5Q_2$ to Q_{10} .
- Figure 1-3, Node 17 – For all hydromodification mitigation designs, the Decision Matrix includes language regarding drawdown time requirements so that standards set forth by the County’s Department of Environmental Health are met. As a side note, the County’s Department of Environmental Health has stated that the drawdown requirement would be applied to underground vaults in addition to extended detention basins and the surface ponding areas of LID facilities. Proper maintenance of hydromodification mitigation facilities is essential to guard against potential vector issues as well potential safety issues resulting from long-term standing water. If mitigation facility outlets clog, then runoff will bypass the system and potentially result in additional erosion problems downstream of a site. The County Department of Environmental Health recently amended its drawdown time requirement to 96 hours.

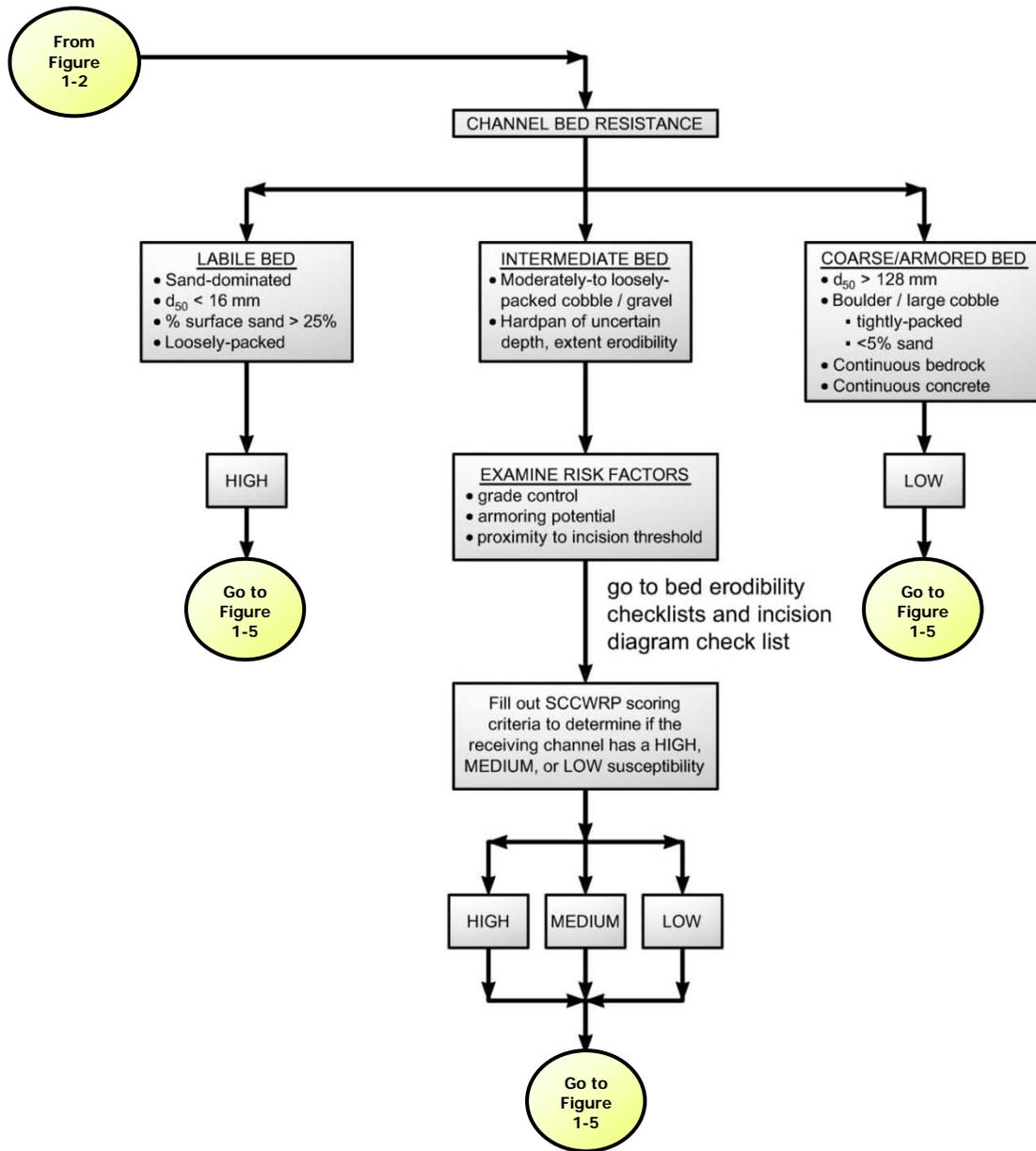


FIGURE 1-4. SCCWRP Vertical Susceptibility

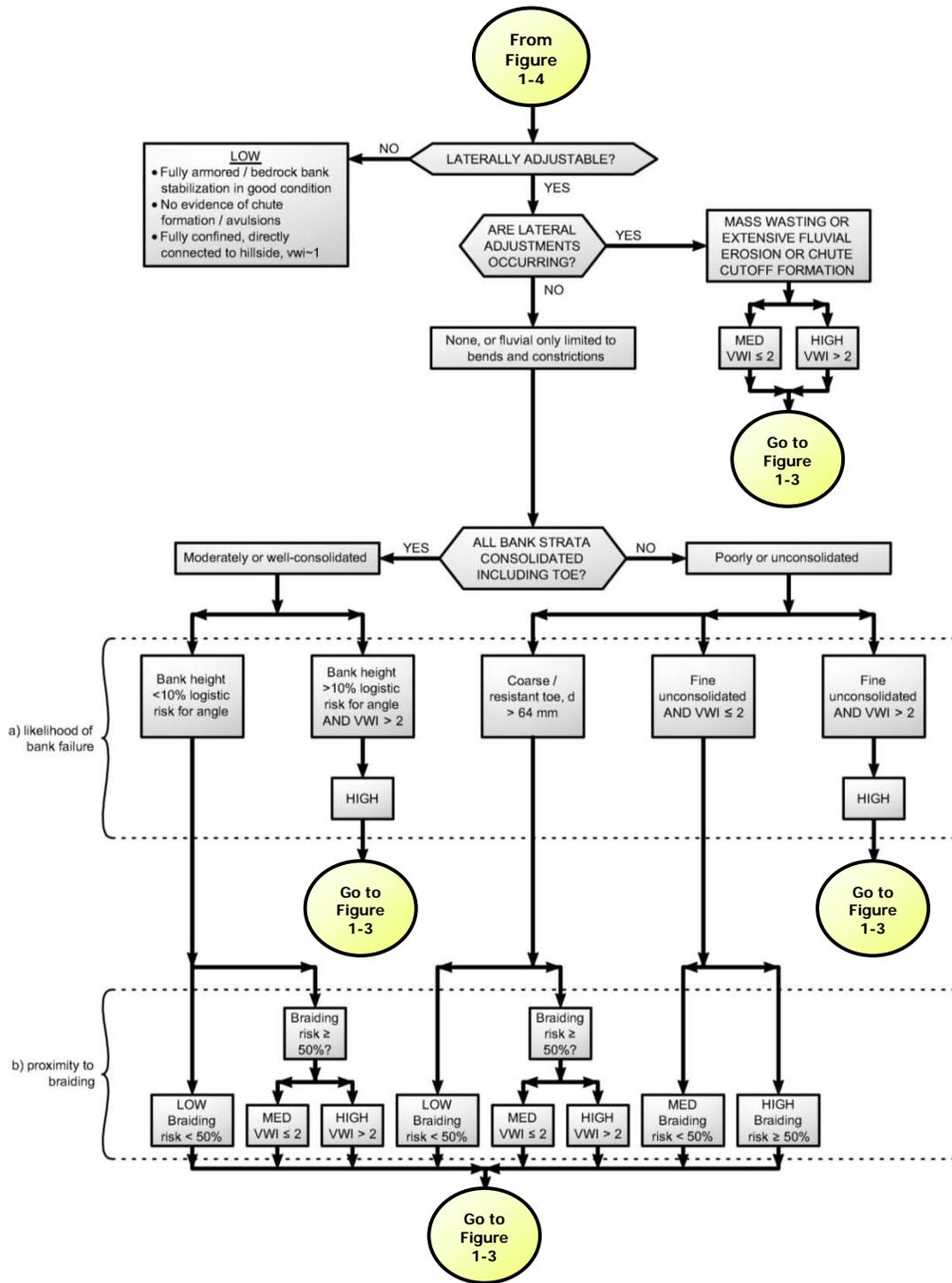


FIGURE 1-5. Lateral Channel Susceptibility

► GRANDFATHERING

Any County PDP approved on or after January 8, 2011, is subject to final HMP criteria*. All projects approved and for which grading or construction activities have commenced prior to January 8, 2011, are considered grandfathered into interim or pre-HMP requirements. Any approved projects or phases of projects that did not begin grading or construction before January 8, 2011, must comply with the County Code and final HMP requirements whenever feasible. A potential scenario for the application of “grandfathering” is set forth below (see scenario a).

Infeasibility

In certain circumstances, implementation of final HMP criteria may be infeasible for a project that received approvals prior to January 8, 2011, but where grading or construction did not begin until after that date.

Examples of “**prior lawful approval**”:

- “Private” Land Development projects: any approved project that has processed a Major SWMP during conditioning prior to January 8, 2011. (approved by the Director, Zoning Administrator, Planning Commission, or Board of Supervisors).
- “Public” CIP project: if a project had completed designs sufficient for environmental review and had a final approved CEQA document (e.g., NOE, MND, ND, or EIR approved by the Director of DPW or Board of Supervisors) before January 8, 2011.

In both cases even if a prior lawful approval exists, if the project had not started grading or construction prior to January 8, 2011, it can be evaluated for infeasibility. An **infeasibility analysis** is a written argument prepared by the project applicant documenting reasons why HMP compliance is believed to be infeasible; considering constraints such as technical, engineering, planning, etc. The analysis must state why the current HMP requirements cannot be met. Infeasibility determinations need to be reviewed on a case by case basis.

Two potential scenarios for the application of “infeasibility” are set forth below (see scenario c & d).

Any modification in the project design that requires permits/plans to be re-opened for County review after January 8, 2011 are subject to new HMP requirements. **Modifications** are any change in the design, calculations, or footprint of a project plan (see scenario f). Ministerial non-substantive changes such as a name change, engineer change, text update, security/bond change are not considered modifications (see scenario e).

* See, for example, Footnote 3, MS4 Permit Section D.1.d.

Vested Rights

Vested rights can arise in a number of ways under California laws. The Subdivision Map Act, Gov't Code Sec. 66410 et seq. sets forth circumstances whereby subdividers can obtain a vested right to proceed under requirements in effect at the time a tentative map application is deemed complete. (See, for example, Gov't Code §§ 66474.2 & 66498.1-66498.9.) Vested rights obtained in connection with a tentative map application do not always extend to subsequent discretionary permits or approvals needed to develop the subdivision. Vested rights may also arise when a developer has entered into a development agreement restricting the application of new requirements. (See, Gov't Code § 65964 et seq.) Additionally, vested rights may arise when a developer substantially relies on an issued permit, but then may be limited to work within the scope of that permit. (See, for example, *Avco Community Developers v. South Coast Reg'l Comm'n* (1976) 17 Cal. 3rd 785.) Consistent with the MS4 Permit, Section 67.803 of the County Code requires compliance with the new HMP requirements at the time a subsequent permit or approval to develop a subdivision such as a building or grading permit is sought. If source and treatment control BMPs necessary to comply with the new HMP requirements cannot be accommodated within the confines of existing lots, the subdivider may be compelled to remap the subdivision. This can be a time consuming and costly process. If a developer asserts a vested right to proceed with development based on prior HMP requirements, they must document the basis for their assertion so that it can be reviewed by Department of Planning and Land Use (DPLU) with the assistance of County Counsel.

Project Scenarios and Applicability of final HMP Requirements (see Figure 1-6)

If a priority development project is not exempt and does not meet the grandfathering, infeasibility or vested rights determinations above, then final HMP is required.

Three potential scenarios where a project must comply with the final HMP criteria are outlined below (see scenario b, f, and g).

- a) Project received prior lawful approval and started grading or construction activities prior to January 8, 2011. Project is considered grandfathered.
- b) Project did not receive prior lawful approval before January 8, 2011; therefore, project must address final HMP criteria or show that it is exempt.
- c) Private project processed a Major SWMP during conditioning and received prior lawful approval prior to January 8, 2011, but did not start grading or construction activities; or CIP project had completed designs sufficient for environmental review and had final approved CEQA document. Project must submit an infeasibility analysis to demonstrate infeasibility or demonstrate a vested right.
- d) Project had prior lawful approval and began grading prior to July 14, 2010; however, one phase of development has not begun grading as of January 8, 2011. Project can submit an infeasibility analysis to demonstrate infeasibility. Segments (constructed

- road, constructed buildings) constructed prior to January 8, 2011, are considered grandfathered.
- e) Project has prior lawful approval; however, the project must revise permit for a ministerial change (contractor or ownership change). Only an amendment page and copy of the previously approved SWMP is required. Project does not need to meet final HMP.
 - f) Project has prior lawful approval; however, the project proposes a design modification and the SWMP must be re-submitted and evaluated for water quality impacts. Project must address final HMP criteria or show that it is exempt or that there is a vested right.
 - g) Project received prior lawful approval before January 8, 2011, however, permit or signed plans have expired so that a new permit is required. Project must address the current HMP criteria or show that it is exempt or has a vested right to proceed.

Figure 1.

- SWMP or CIP-CEQA Approval
- ◆ Grading/Building Permit

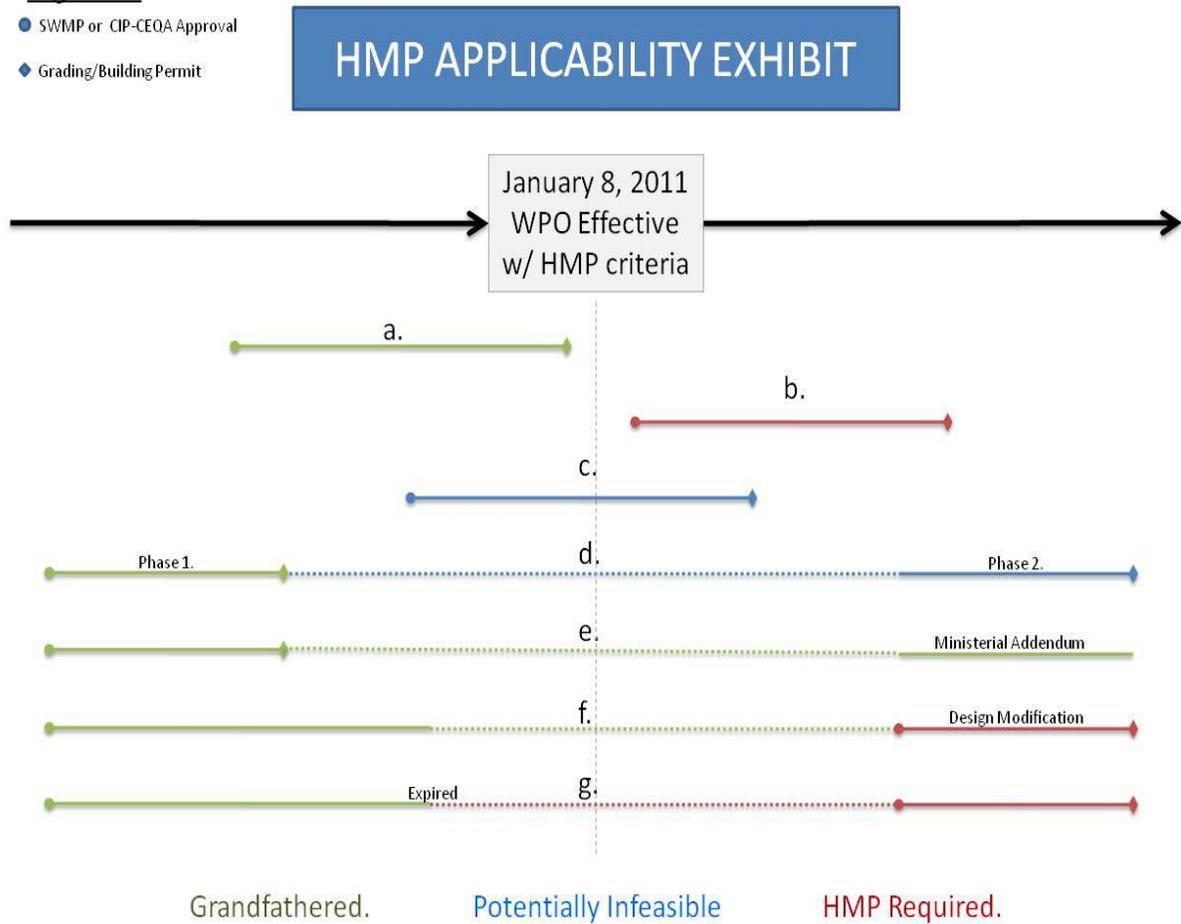


FIGURE 1-6. HMP Applicability Exhibit

Waivers from Numeric Sizing Criteria

The NPDES permit allows for a project to be waived from numeric sizing criteria for stormwater treatment only if all available treatment facilities have been considered and found infeasible. County staff must inform the Water Board within 5 days of granting a waiver. Other SUSMP requirements—including site designs to minimize imperviousness and source control BMPs—will still apply.

Experience has shown implementation of LID facilities, as described in Chapter 4, is feasible on nearly all development sites. However, the use of LID to retrofit existing drainage systems, to manage runoff from sites smaller than one acre in pedestrian-oriented developments, or to manage runoff from widened portions of roadways, sometimes presents special challenges. In these special situations, applicants should see the discussion of “Selection of Stormwater Treatment Facilities” in Chapter 2 and evaluate the options described on page 46 in order

(depending on the specific characteristics of the project and as determined by local development review staff). All the options listed meet the numeric sizing criteria in the NPDES permit.

If infeasibility of all these options can be established, County review staff may determine eligibility of the project for a waiver.

References and Resources:

- RWQCB Order R9-2007-0001 (Stormwater NPDES Permit)
- Project Clean Water web page

Concepts and Criteria

Technical background and explanations of policies and design requirements

The Regional Water Board reissued a municipal stormwater NPDES permit to San Diego County, its 18 cities, the San Diego Unified Port District, and the San Diego Regional Airport Authority in January 2007. The permit mandates a comprehensive program to prevent stormwater pollution. That program now includes street sweeping, maintenance of storm drains, business inspections, public outreach, construction site inspections, monitoring and studies of stream and ocean health, and control of runoff pollutants from new developments and redevelopments.

Permit Provision D.1.d. requires the County to regulate projects in specific categories (Table 1-1) to:

1. Reduce discharges of pollutants to the maximum extent practicable.
2. Prevent runoff discharges from causing or contributing to a violation of water quality standards.

The Copermittees have created a Low Impact Development (LID) design procedure (Chapter 4) that ensures consistent and thorough implementation of the Regional Water Board's requirements. This chapter explains the technical background of the LID approach and how it was derived.

The previous permit, issued in 2001, included a requirement to control the post-development peak storm water runoff rates and velocities to maintain or reduce pre-development downstream erosion and protect stream habitat. The 2007 permit includes, in addition to this ongoing requirement, a new requirement to develop a hydromodification management plan (HMP) to identify and define a methodology and performance criteria to ensure flow rates and durations do not exceed pre-project runoff where increased runoff could cause erosion or other significant adverse impacts to beneficial uses.

As required by the NPDES permit, the County has adopted interim hydromodification criteria. See Chapter One.

Water-Quality Regulations

Provision D.1 requires the County to condition development approvals on incorporation of specified stormwater controls.

Provision D.1 requires applicable new developments and redevelopments:

- Design the site to conserve natural areas, existing trees and vegetation and soils, to maintain natural drainage patterns, to minimize imperviousness, to detain runoff, and to infiltrate runoff where feasible
- Cover or control sources of stormwater pollutants
- Treat runoff prior to discharge. Provision E.10 states: “Urban runoff treatment and/or mitigation must occur prior to the discharge of urban runoff into a receiving water. Federal regulations at 40 CFR 131.10(a) state that in no case shall a state adopt waste transport or waste assimilation as a designated use for any waters of the U.S.”
- Ensure runoff does not exceed pre-project peaks and durations where increases could affect downstream habitat or other beneficial uses
- Maintain treatment and flow-control facilities

The County maintains a database to track approved installations of treatment facilities and to verify facilities are maintained. The County’s annual report to the Regional Water Board includes a list of development projects subject to SUSMP conditions and descriptions of those projects that:

- Received a waiver from SUSMP criteria; and
- Used hydrologic controls used to meet HMP requirements, including a description of the controls;

The County must also report the number of violations and enforcement actions taken upon development projects. The County’s program is subject to audit by the Regional Water Board.

The County—not the Regional Water Board or its staff—is charged with ensuring development projects comply with the D.1 requirements. Regional Water Board staff sometimes review stormwater controls and hydromodification impacts in connection with applications for Clean Water Act Section 401 water-quality certification, which is required for projects that involve work, such as dredging or placement of fill, within streams, creeks, or other waters of the US.

► MAXIMUM EXTENT PRACTICABLE

[Clean Water Act Section 402\(p\)\(3\)\(iii\)](#) sets the standard for stormwater controls as “maximum extent practicable,” but doesn’t define that term. As implemented, “maximum extent practicable” is ever-changing and varies with conditions.

Many stormwater controls, including LID facilities, have proven to be practicable in most site development projects. To achieve fair and effective implementation, criteria and guidance, requirements for controls must be detailed and specific—while also offering the right amount of flexibility or exceptions for special cases. The NPDES permit includes various standards, including hydrologic criteria, which have been found to comprise “maximum extent practicable.” This SUSMP is to be continuously improved and refined based on the experience of County planners and engineers, with input from land developers and development professionals. By following the SUSMP, applicants can ensure their project design meets “maximum extent practicable.”

► BEST MANAGEMENT PRACTICES

Clean Water Act Section 402(p) and USEPA regulations (40 CFR 122.26) specify a municipal program of “management practices” to control stormwater pollutants. Best Management Practice (BMP) refers to any kind of procedure, activity or device designed to minimize the quantity of pollutants that enter the storm drain system. BMPs are typically used in place of assigning numeric effluent limits. The criteria for source control BMPs and treatment and flow-control facilities are crafted to fulfill “maximum extent practicable.”

To minimize confusion, this guidebook refers to “facilities,” “features,” or “controls” to be incorporated into development projects. All of these are BMPs.

Pollutants of Concern

NPDES Permit Provision D.1.d.(3) requires each Copermittee to develop and implement a procedure for pollutants of concern to be identified for each Priority Development Project. The Copermittees have considered this requirement jointly and have determined the LID design procedures in Chapters 3 and 4 of the model and this SUSMP fully address the need to identify pollutants of concern insofar as that identification may affect the selection of source control BMPs and treatment facilities.

Documentation of the approach to identifying pollutants of concern and selecting BMPs and facilities follows.

► GROUPING OF POTENTIAL POLLUTANTS OF CONCERN

Urban runoff from a developed site has the potential to contribute pollutants, including oil and grease, suspended solids, metals, gasoline, pesticides, and pathogens to the storm water conveyance system and receiving waters. For the purposes of identifying pollutants of concern and associated storm water BMPs, pollutants are grouped in nine general categories as follows:

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

- Nutrients are inorganic substances, such as nitrogen and phosphorus. They commonly exist in the form of mineral salts that are either dissolved or suspended in water. Primary sources of nutrients in urban runoff are fertilizers and eroded soils. Excessive discharge of nutrients to water bodies and streams can 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 water body, loss of oxygen in the water, release of toxins in sediment, and the eventual death of aquatic organisms.
- Metals are raw material components in non-metal products such as fuels, adhesives, paints, and other coatings. Primary sources of metal pollution in storm water are typically commercially available metals and metal products. Metals of concern include cadmium, chromium, copper, lead, mercury, and zinc. Lead and chromium have been used as corrosion inhibitors in primer coatings and cooling tower systems. At low concentrations naturally occurring in soil, metals are not toxic. However, at higher concentrations, 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.
- Organic compounds are carbon-based. Commercially available or naturally occurring organic compounds are 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 be discharged to storm drains. 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) are general waste products on the landscape. The presence of trash & debris may have a significant impact on the recreational value of a water body and aquatic habitat. Excess organic matter can create a high biochemical oxygen demand in a stream and thereby lower its water quality. Also, in areas where stagnant water exists, the presence of excess organic matter can promote septic conditions resulting in the growth of undesirable organisms and the release of odorous and hazardous compounds such as hydrogen sulfide.
- Oxygen-Demanding Substances includes biodegradable organic material as well as chemicals that react with dissolved oxygen in water to form other compounds. Proteins, carbohydrates, and fats are examples of biodegradable organic compounds. Compounds such as ammonia and hydrogen sulfide are examples of oxygen-demanding compounds. The oxygen demand of a substance can lead to depletion of dissolved oxygen in a water body and possibly the development of septic conditions.

- Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids. Introduction of these pollutants to the water bodies are very possible 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 water body, as well as the water quality.
- Bacteria and Viruses are ubiquitous microorganisms that thrive under certain environmental conditions. Their proliferation is typically caused by the transport of animal or human fecal wastes from the watershed. Water, containing excessive bacteria and viruses can alter the aquatic habitat and create a harmful environment for humans and aquatic life. Also, the decomposition of excess organic waste causes increased growth of undesirable organisms in the water.
- Pesticides (including herbicides) are chemical compounds commonly used to control nuisance growth or prevalence of organisms. Excessive application of a pesticide may result in runoff containing toxic levels of its active component.

► IDENTIFYING POLLUTANTS OF CONCERN BASED ON LAND USES

Table 2-1 associates pollutants with the categories of Priority Development Projects. Pollutants associated with any hazardous material sites that have been remediated or are not threatened by the proposed project are not considered a pollutant of concern.

► WATERSHEDS WITH SPECIAL POLLUTANT CONCERNS

Local receiving water conditions may require specialized attention. The three local conditions to consider include:

- Ocean waters designated as an “Area of Special Biological Significance” (ASBS)
- 303(d) listed waters; and
- Waters with established TMDLs.

TABLE 2-1. Anticipated and Potential Pollutants Generated by Land Use Type.

| Priority Project Categories | General Pollutant Categories | | | | | | | | |
|----------------------------------|------------------------------|-----------|--------------|-------------------|----------------|-----------------------------|--------------|--------------------|------------|
| | Sediment | Nutrients | Heavy Metals | Organic Compounds | Trash & Debris | Oxygen Demanding Substances | Oil & Grease | Bacteria & Viruses | Pesticides |
| Detached Residential Development | X | X | | | X | X | X | X | X |
| Attached Residential Development | X | X | | | X | P(1) | P(2) | P | X |
| Commercial Development >one acre | P(1) | P(1) | X | P(2) | X | P(5) | X | P(3) | P(5) |
| Heavy Industry | X | | X | X | X | X | X | | |
| Automotive Repair Shops | | | X | X(4)(5) | X | | X | | |
| Restaurants | | | | | X | X | X | X | P(1) |
| Hillside Development >5,000 ft2 | X | X | | | X | X | X | | X |
| Parking Lots | P(1) | P(1) | X | | X | P(1) | X | | P(1) |
| Retail Gasoline Outlets | | | X | X | X | X | X | | |
| Streets, Highways & Freeways | X | P(1) | X | X(4) | X | P(5) | X | X | P(1) |

X = anticipated
P = potential
(1) A potential pollutant if landscaping exists on-site.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves food or animal waste products.
(4) Including petroleum hydrocarbons.
(5) Including solvents.

The State Water Resources Control Board's California Ocean Plan identifies thirty-four locations along the California coast as Areas of Special Biological Significance (ASBS). The Ocean Plan prohibits the discharge of wastes into these locations, thus barring discharges associated with industrial activities, publicly owned treatment works, and other traditional point discharges. In 2004 the SWRCB informed affected municipal stormwater programs throughout the state that urban runoff contained a waste and was subject to the prohibition. In March 2008, the SWRCB released a draft *Special Protections for Selected Storm Water and Nonpoint Source Discharges into Areas of Special Biological Significance* that defines design criteria for treating stormwater discharges and elimination of dry-weather discharges associated with non-stormwater sources. San Diego County contains two ASBS locations, the La Jolla ASBS and the San Diego-Scripps ASBS. These locations are adjacent and extend from the northern bluffs of La Jolla through the UC San Diego campus of the Scripps Institute of Oceanography. Proposed development in the watershed of an ASBS may be prohibited; however, the project proponent should immediately contact the County for further guidance in contending with ASBS prohibitions.

The NPDES Permit identifies several receiving waters as impaired for constituents or water quality effects pursuant to Section 303(d) of the Clean Water Act. Placement of a water onto the list requires the Regional Board to make further analysis of the impairment and development of total maximum daily loads (TMDLs) for addressing the impairment. The 303(d) listing in itself does not demand that a project proponent select BMPs on the basis of the impairment; however, the project proponent should be cognizant of the impairment and the future implications a TMDL might have upon the proposed land use.

Once a TMDL is established it may impose conditions on development either through an implementation plan and schedule for the listed water, or through special conditions required of the municipality affected by the numeric criteria of the TMDL. At this time, several 303(d) listings in San Diego County are at various stages of TMDL development with only four TMDLs having been adopted by the Regional Board. However, there are approximately 190 pending TMDLs in the county.

The adopted TMDLs in the San Diego area include:

- Diazinon for Chollas Creek;
- Nitrogen and phosphorous for Rainbow Creek;
- Dissolved copper for Shelter Island Yacht Basin, and
- Indicator bacteria for beaches and creeks in the San Diego Region.

The applicant should meet with County staff to determine if any project characteristics or watershed characteristics affect selection and design of BMPs. Except in rare circumstances, the use of the LID Design Guide (Chapter 4) and the Stormwater Pollutant Sources/Source Control Checklist (Appendix E) will ensure your project complies with all stormwater requirements.

Selection of Permanent Source Control BMPs

Based on identification of potential pollutants of concern associated with various types of facilities, the Copermittees have developed a Stormwater Pollutant Sources/Source Control Checklist (Appendix E) of “maximum extent practicable” source controls associated with each facility type. This approach ensures appropriate BMPs are applied to potential sources of each pollutant of concern.

Selection of Stormwater Treatment Facilities

The model SUSMP updated in early 2008 groups pollutants of concern by how easily they are removed by various treatment processes (Table 2-2).

The same document also includes a general comparison of how various types of treatment facilities perform for each group of pollutants (Table 2-3).

TABLE 2-2. Grouping of potential Pollutants of Concern by fate during stormwater treatment

| Pollutant | Coarse Sediment and Trash | Pollutants that tend to associate with fine particles during treatment | Pollutants that tend to be dissolved following treatment |
|-------------------|---------------------------|--|--|
| Sediment | X | X | |
| Nutrients | | X | X |
| Heavy Metals | | X | |
| Organic Compounds | | X | |
| Trash & Debris | X | | |
| Oxygen Demanding | | X | |
| Bacteria | | X | |
| Oil & Grease | | X | |
| Pesticides | | X | |

TABLE 2-3. Groups of Pollutants and relative effectiveness of treatment facilities

| Pollutants of Concern | Bioretention Facilities (LID) | Settling Basins (Dry Ponds) | Wet Ponds and Constructed Wetlands | Infiltration Facilities or Practices (LID) | Media Filters | Higher-rate biofilters* | Higher-rate media filters* | Trash Racks & Hydro-dynamic Devices | Vegetated Swales |
|--|-------------------------------|-----------------------------|------------------------------------|--|---------------|-------------------------|----------------------------|-------------------------------------|------------------|
| Coarse Sediment and Trash | High | High | High | High | High | High | High | High | High |
| Pollutants that tend to associate with fine particles during treatment | High | High | High | High | High | Medium | Medium | Low | Medium |
| Pollutants that tend to be dissolved following treatment | Medium | Low | Medium | High | Low | Low | Low | Low | Low |

*See page 42 for a discussion of selection of treatment facilities in special situations.

► PREFERRED TREATMENT FACILITIES

Based on this analysis, the County has determined that the following types of facilities are appropriate for treatment of runoff potentially containing most pollutants of concern. These types of facilities can be used for stormwater treatment and hydromodification flow control for all land uses in all watersheds, except where site-specific constraints make them infeasible.

- Infiltration Devices or practices, including dry wells, infiltration trenches, infiltration basins, and other facilities that infiltrate runoff to native soils (sized to detain and infiltrate a volume equivalent to the 85th percentile 24-hour event water quality runoff event – greater capacity required to provide hydromodification flow control).
- Bioretention facilities that detain stormwater and filter it slowly through soil or sand (sized with a surface area at least 0.04 times the effectively impervious tributary area for water quality treatment – a larger sizing factor is required to provide hydromodification flow control).

The recommended design procedure in Chapter 4 integrates LID practices—optimizing the site design, using pervious surfaces, and dispersing of runoff to adjacent pervious areas—with the use of infiltration devices and bioretention facilities to meet NPDES permit LID requirements, treatment requirements, and flow-control requirements in a cost-effective, unified design.

► ALTERNATIVE TREATMENT FACILITIES

Alternative treatment facilities, including media filters and extended detention basins are less effective at removing pollutants and should be used only as described in Alternatives to Integrated LID Design (page 95), or in combination with more effective facilities. Extended detention basins, wet ponds, and wetlands or other facilities using settling should be sized to detain a volume equivalent to runoff from the tributary area generated by the 85th percentile 24-hour event water quality runoff event – greater capacity required to provide hydromodification flow control.

Oil/water separators (“water quality inlets”), storm drain inlet filters, and hydrodynamic separators, including vortex separators and continuous deflection separators (“CDS units”), are less effective means of stormwater treatment, although they may be used in series with more effective facilities.

Underground vaults typically lack the detention time required for settling of fine particles associated with stormwater pollutants. They also require frequent maintenance and may retain stagnant water, potentially providing habitat for mosquitoes. Because vaults may be “out of sight, out of mind,” experience shows that the required maintenance may not occur.

Lack of space, in itself, is not a suitable justification for using a less-effective treatment on a development site, because the uses of the site and the site design can be altered as needed to accommodate bioretention facilities or planter boxes. In most cases, these effective facilities can be fit into required landscaping setbacks, easements, or other unbuildable areas.

Where possible, drainage to inlets, and drainage away from overflows and underdrains, should be by gravity. Where site topography makes it infeasible to accommodate gravity-fed facilities in the project design, the design flow may be captured in a vault or sump and pumped via force main to an effective facility.

The following situations sometimes present special challenges:

- Portions of sites which are not being developed or redeveloped, but which must be retrofit to meet treatment requirements in accordance with Provision D.1.d.(1)(a) which states in part: “Where redevelopment results in an increase of, or replacement of, more than fifty percent of the impervious surface of a previously existing development, the numeric sizing criteria applies to the entire development.”
- Sites smaller than one acre approved for development or redevelopment as part of the County’s stated objective to preserve or enhance a pedestrian-oriented “smart-growth” type of urban design. The County may choose to identify areas where this objective applies, based on General Plans or zoning.
- Roadway widening projects.

In these special situations, the following types of facilities should each be evaluated in priority order (depending on the specific characteristics of the site and as determined by County staff) until a feasible design is found.

1. Bioretention areas or planter boxes fed by gravity.
2. Capture of the design flow in a vault or sump and pumping to bioretention areas or planter boxes.
3. A subsurface sand or media filter with a maximum design surface loading rate of 5 inches per hour and a minimum media depth of 18 inches. The sand surface must be made accessible for periodic inspection and maintenance (for example, via a removable grating).
4. A higher-rate surface biofilter, such as a tree-pit-style unit. The grading and drainage design should minimize the area draining to each unit and maximize the number of discrete drainage areas and units.
5. A higher-rate vault-based filtration unit (for example, vaults with replaceable cartridge filters filled with inorganic media).

Proprietary Devices

Many currently available proprietary devices do not meet the County’s requirements when used alone for stormwater treatment. Consult with County staff before proposing these devices.

Many proprietary stormwater treatment devices are currently marketed, and new brands will be introduced. Applicants and applicants’ engineers and design professionals should review with County staff any proposals for using proprietary devices for stormwater treatment before they commence work on preliminary site layout, drainage plans, grading plans, or landscape plans.

Hydrology for NPDES Compliance

► 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 is usually calculated as a function of the ratio of impervious area to total area (rational method). The ratio correlates to the runoff factor, usually designated “C”. Increased flows resulting from urban development tend to increase the frequency of small-scale flooding downstream.

Imperviousness links urban land development to degradation of aquatic ecosystems in two ways.

First, the combination of paved surfaces and piped runoff efficiently collects urban pollutants and transports them, in suspended or dissolved form, to surface waters. These pollutants may originate as airborne dust, be washed from the atmosphere during rains, or may be generated by automobiles and outdoor work activities.

Second, increased peak flows and runoff durations typically cause erosion of stream banks and beds, transport of fine sediments, and disruption of aquatic habitat. Measures taken to control stream erosion, such as hardening banks with riprap or concrete, may permanently eliminate habitat. By reducing infiltration to groundwater, imperviousness may also reduce dry-weather stream flows.

Imperviousness has two major components: rooftops and transportation (including streets, highways, and parking areas). The transportation component is usually larger and is more likely to be directly connected to the storm drain system.

The effects of imperviousness can be mitigated by disconnecting impervious areas from the drainage system and by encouraging detention and retention of runoff near the point where it is generated. Detention and retention reduce peak flows and volumes and allow pollutants to settle out or adhere to soils before they can be transported downstream.

► LOW IMPACT DEVELOPMENT REQUIREMENTS

The NPDES permit requires LID be used on all projects to minimize directly connected impervious area and promote infiltration. For Priority Development Projects, the minimum standards are:

- Drain a portion of impervious areas into pervious areas, if any.

- Design and construct pervious areas, if any, to effectively receive and infiltrate runoff from impervious areas, taking into account soil conditions, slope, and other pertinent factors.
- Construct a portion of paved areas with low traffic and appropriate soil conditions with permeable surfaces.

To demonstrate compliance with these minimum standards the LID design procedure in Chapter 4 incorporates these requirements into an integrated design which also meets sizing requirements for stormwater treatment facilities and flow-control (hydromodification management) requirements.

► SIZING REQUIREMENTS FOR STORMWATER TREATMENT FACILITIES

The guidance in Chapter 4 was crafted to ensure LID facilities comply with the NPDES permit's hydraulic sizing requirements for stormwater treatment facilities and flow-control facilities. The municipal permit requires all Priority Development Projects to implement treatment control facilities. The technical background follows.

Most runoff is produced by frequent storms of small or moderate intensity and duration. Treatment facilities are designed to treat smaller storms and the first flush of larger storms—approximately 80% of average annual runoff.

The NPDES permit identifies two types of treatment facilities—volume-based and flow-based.

Volume-based facilities must be designed to infiltrate, filter, or treat the volume of runoff produced from a 24-hour 85th percentile storm event as determined from the County of San Diego's 85th Percentile Precipitation Isopluvial Map. As shown on the map, rainfall depths vary from about 0.55" to 1.55".

For flow-based facilities, the NPDES permit specifies the rational method be used to determine flow. The rational method uses the equation

$Q = CiA$, where

Q = flow

C = weighted runoff factor between 0 and 1

i = rainfall intensity

A = area

The permit identifies two alternatives for calculating rainfall intensity:

1. the 85th percentile rainfall intensity times two, or
2. 0.2 inches per hour.

It is typically found that both methods yield similar results. The 0.2 inches per hour rainfall intensity should be used for sizing flow-based treatment facilities within the County's jurisdiction.

The 0.2 inches per hour criterion is the basis for a consistent countywide sizing factor for bioretention facilities when used for stormwater treatment only (i.e., not for flow control). The factor is based on maintaining a minimum percolation rate of 5 inches per hour through the engineered soil mix. The sizing factor is the ratio of the design intensity of rainfall on tributary impervious surfaces (0.2 inches/hour) to the design percolation rate in the facility (5 inches/hour), or 0.04 (dimensionless).

► FLOW-CONTROL (HYDROMODIFICATION MANAGEMENT)

The NPDES permit specifies for applicable projects:

... post-project runoff flow rates and durations shall not exceed pre-project runoff flow rates and durations where the increased discharge flow rates and durations will result in increased potential for erosion or other significant adverse impacts to beneficial uses, attributable to changes in flow rates and durations.

Refer to Appendix G to review the final Hydromodification Management Plan (HMP) developed by the San Diego Copermittees and approved by the RWQCB in July 2010. A summary of the HMP document is provided in Chapter 1 of this document.

Criteria for Infiltration Devices

The NPDES permit restricts the design and location of “infiltration devices” that, as designed, may bypass filtration through surface soils before reaching groundwater. These devices include:

- Infiltration basins.
- Infiltration trenches (includes French drains).
- Unlined retention basins (i.e., basins with no outlets).
- Unlined or open-bottomed vaults or boxes installed below grade (dry wells).

Infiltration devices may not be used in:

- Areas of industrial or light industrial activity; areas subject to high vehicular traffic (25,000 or greater average daily traffic on main roadway or 15,000 or more average daily traffic on any intersecting roadway);

- Automotive repair shops;
- Car washes;
- Fleet storage areas (bus, truck, etc.);
- Nurseries;
- Other areas with pollutant sources that could pose a threat to groundwater, as designated by each Permittee.

The vertical distance from the base of any infiltration device to the seasonal high groundwater mark shall be at least 10 feet. Infiltration devices shall be located a minimum of 100 feet horizontally from any known water supply wells.

In addition, infiltration devices are not recommended where:

- The infiltration device would receive drainage from areas where chemicals are used or stored, where vehicles or equipment are washed, or where refuse or wastes are handled.
- Surface soils or groundwater are polluted.
- The facility could receive sediment-laden runoff from disturbed areas or unstable slopes.
- Increased soil moisture could affect the stability of slopes or foundations.
- Soils are insufficiently permeable to allow the device to drain within 96 hours.

► MOST LID FEATURES AND FACILITIES ARE NOT INFILTRATION DEVICES

Self-treating and self-retaining areas, pervious pavements, bioretention facilities, and planter boxes are not considered to be infiltration devices.

Bioretention facilities work by percolating runoff through 18 inches or more of engineered soil. This removes most pollutants before the runoff is allowed to seep into native soils below. Further pollutant removal typically occurs in the unsaturated (vadose) zone before moisture reaches groundwater.

Where there is concern about the effects of increased soil moisture on slopes or foundations, an impermeable barrier may be added so the facility is “flow through” and all treated runoff is underdrained away from the facility. See the design sheets for Bioretention Facilities and Flow-Through Planters in Chapter 4.

Environmental and Economic Benefit Perspective

The San Diego Region has varied topography consisting of coastal plain, central mountain-valley, and eastern mountain valley areas. Elevations range from sea level at the Pacific Ocean to approximately 6,000 feet at the summit of Palomar Mountain. Temperature averages about 65 degrees Fahrenheit and average annual precipitation is between 10 and 13 inches.

San Diego County comprises 10 major stream systems: San Onofre Creek, Santa Margarita River, San Luis Rey River, San Marcos Creek, Escondido Creek, San Dieguito River, San Diego River, Sweetwater River, Otay River, and the Tijuana River. Almost all stream systems in the San Diego region have both perennial and ephemeral reaches. In addition, most of these streams have been impacted by impoundments and/or channelization. There are few undisturbed stream reaches left in San Diego County.

San Diego County is approximately 2.7 million acres and roughly 1.8 million acres (66 percent) is developed or in use. Much of the remaining land is preserved from future development.

Impervious surfaces now cover much of the land, and storm drains pipe runoff from urban areas directly into streams. As in many of California's urban areas, growth and development have caused changes in the timing and intensity of stream flows. These changes can then lead to more frequent flooding, destabilized stream banks, armoring of streambanks with riprap and concrete, loss of streamside trees and vegetation, and the destruction of stream habitat.

The remaining habitat in the region is composed of sensitive coastal sage scrub, chaparral, woodlands, and grasslands. Human encroachment and habitat loss threaten close to 300 species of plants and animals in California. Many of those reside in southern California and range from native grasslands to the Fairy Shrimp.

Once altered, natural streams and their ecosystems cannot be fully restored. However, it is possible to stop, and partially reverse, the trend of declining habitat and preserve some ecosystem values for the benefit of future generations.

This is an enormous, long-term effort. Managing runoff from a single development site may seem inconsequential, but by changing the way most sites are developed (and redeveloped), we may be able to preserve and enhance existing stream ecosystems in urban and urbanizing areas.

References and Resources:

- [RWQCB Order R9-2007-0001 \(Stormwater NPDES Permit\)](#)
- [County of San Diego Low Impact Development Handbook](#)
- [Clean Water Act Section 402\(p\)](#)
- [40 CFR 122.26](#)
- [San Diego Regional Water Quality Control Board—TMDLs](#)
- [State Water Resources Control Board—Ocean Standards](#)
- [Site Planning for Urban Stream Protection](#) (Scheuler, 1995).
- [“Application of Water-Quality Engineering Fundamentals to the Assessment of Stormwater Treatment Devices”](#) (Salvia, 2000).

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Preparing Your Project Submittal

Step-by-step assistance to demonstrate compliance.

Your Project Submittal will demonstrate your project complies with all applicable requirements in the stormwater NPDES permit—to minimize imperviousness, retain or detain stormwater, slow runoff rates, incorporate required source controls, treat stormwater prior to discharge, control runoff rates and durations, and provide for operation and maintenance of treatment and flow-control facilities.

Typically, your SWMP must be coordinated with your application for discretionary approvals and must have sufficient detail to ensure the stormwater design, site plan, and landscaping plan are congruent.

A complete and thorough SWMP will facilitate quicker review and fewer cycles of review. The County requires a submittal for every applicable project.

The County requires a SWMP submittal for SUSMP projects and a SWMP template is provided in Appendix C. County staff may use a checklist such as the following example to evaluate your SWMP:

EXAMPLE MAJOR SWMP CHECKLIST

CONTENTS OF EXHIBIT

Show all of the following on drawings:

- Existing natural hydrologic features (depressions, watercourses, floodplains, relatively undisturbed areas) and significant natural resources. (Step 1 in the following step-by-step instructions)
- Soil types and depth to groundwater. (Step 1)
- Existing and proposed site drainage network and connections to drainage off-site. (Step 3)
- Proposed design features and surface treatments used to minimize imperviousness. (Step 3)
- Entire site divided into separate drainage areas, with each area identified as self-treating, self-retaining (zero-discharge), draining to a self-retaining area, or draining to an IMP. (Step 3)
- For each drainage area, types of impervious area proposed (roof, plaza/sidewalk, and streets/parking) and area of each. (Step 3)
- Proposed locations and sizes of treatment or flow-control facilities. (Step 3)
- Potential pollutant source areas, including refuse areas, outdoor work and storage areas, etc. listed in the Appendix E and corresponding required source controls. (Step 4)

CONTENTS OF REPORT

Include all of the following in a report:

- Narrative analysis or description of site features and conditions that constrain, or provide opportunities for, stormwater control. (Step 2)
- Narrative description of site design characteristics that protect natural resources. (Step 3)
- Narrative description and/or tabulation of site design characteristics, building features, and pavement selections that reduce imperviousness of the site. (Step 3)
- Tabulation of proposed pervious and impervious area, showing self-treating areas, self-retaining areas, and areas tributary to each treatment or flow-control facility. (Step 3)
- Preliminary designs, including calculations, for each infiltration device, treatment, or flow-control facility. Elevations should show sufficient hydraulic head for each. (Step 3)
- A table of identified pollutant sources and for each source, the source control measure(s) used to reduce pollutants to the maximum extent practicable. See worksheet in the Appendix E. (Step 4)
- General maintenance requirements for infiltration devices, treatment, and flow-control facilities (Step 5)
- Means by which facility maintenance will be financed and implemented in perpetuity. (Step 5)
- Statement accepting responsibility for interim operation & maintenance of facilities (Step 5).
- Identification of any conflicts with codes or requirements or other anticipated obstacles to implementing the proposed facilities in the submittal (Step 6).
- Construction Plan SUSMP Checklist (Step 6).
- Certification by a civil engineer, architect, and landscape architect (Step 6).

Step by Step

Plan and design your stormwater controls integrally with the site planning and landscaping for your project. It's best to start with general project requirements and preliminary site design concepts, then prepare the detailed site design, landscape design, and stormwater control design simultaneously. This will help ensure that your site plan, landscape plan, and SWMP are congruent.

Suggested coordination with site and landscape design



Begin with general project requirements and program.

The following step-by-step procedure should optimize your design by identifying the best opportunities for stormwater controls early in the design process.

The recommended steps are:

1. Assemble needed information.
2. Identify site opportunities and constraints.
3. Follow the LID design guidance in Chapter 4 to analyze your project for LID and to develop and document your drainage design.
4. Specify source controls using the sources/source control checklist in the Appendix E.
5. Plan for ongoing maintenance of treatment and flow-control facilities.
6. Complete the SWMP.

Sketch conceptual site layout, building locations, and circulation.

Revise site layout, building locations, and circulation to accommodate LID design. Develop landscaping plan.

County staff may recommend you prepare and submit a preliminary site design prior to formally applying for planning and zoning approvals. Your preliminary site design should incorporate a conceptual plan for site drainage, including self-treating and self-retaining areas and the location and approximate sizes of any treatment facilities. This additional up-front design effort will save time and avoid potential delays later in the review process.

Submit Site Plan, Landscape Plan, and SUSMP Submittal

Step 1: Assemble Needed Information

To select types and locations of treatment facilities, the designer needs to know the following site characteristics:

- 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, any outcrops or other significant geologic features.
- Zoning, including requirements for setbacks and open space.
- Public Works Standards or other local codes governing minimum street widths, sidewalk construction, allowable pavement types, and drainage. These codes may conflict with Low Impact Development objectives to minimize imperviousness and to maintain or restore natural site hydrology. The County will review and revise codes to resolve these conflicts where it is possible to do so.
- Soil types (including hydrologic soil groups) and depth to groundwater, which may determine whether infiltration devices are a feasible option for managing site runoff. Depending on site location and characteristics, and on the selection of treatment and flow-control facilities, 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 municipal storm drain system can be located from site inspection, municipal storm drain maps, and plans for previous development.
- Existing vegetative cover and impervious areas, if any.

References and Resources

- [*Site Planning for Urban Stream Protection*](#) (Scheuler 1995).
- [*Start at the Source*](#) (BASMAA 1999), p. 36

Step 2: Identify Constraints & Opportunities

Review the information collected in Step 1. Identify the principal constraints on site design and selection of treatment and flow-control facilities as well as opportunities to reduce imperviousness and incorporate facilities 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, restricted right-of-way, 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 bioretention facilities), and differences in elevation (which can provide hydraulic head). Note stormwater treatment facilities should not be located within protected riparian areas.

Prepare a brief narrative describing site opportunities and constraints. This narrative will help you as you proceed with LID design and explain your design decisions to others.

Step 3: Prepare and Document Your LID Design

Use the Low Impact Development Design Guide (Chapter 4) to analyze your project for LID, design and document drainage, and specify preliminary design details for integrated management practices. Follow the detailed instructions in Chapter 4 to ensure your project complies with NPDES permit LID requirements (Provision D.1.d.(4)) and stormwater treatment requirements in Provision D.1.d.(6)). The LID Design Guide has been designed so that hydromodification management requirements are also met via this unified design procedure. Chapter 4 includes calculation procedures and formats for presenting your calculations.

As shown in the example checklist (page 50), your SWMP may need to include a drawing showing:

- The entire site divided into separate drainage management areas (DMAs), with each area identified as one of the following: self-treating, self-retaining, draining to a self-retaining area, or draining to an IMP. Each area should be clearly marked with a unique identifier.
- For each drainage area, the types of impervious area proposed, and the area of each.
- Proposed locations and sizes of treatment facilities. Each facility should be clearly marked with a unique identifier.

Compliance
The design criteria for DMAs in Chapter 4 ensure the required volume of flow from all developed portions of the project, including landscaped areas, is infiltrated, filtered, or treated (Provision D.1.d.(6)(a)).

Your SWMP may need to include:

- Tabulation of proposed self-treating areas, self-retaining areas, areas draining to self-retaining areas, and areas draining to IMPs, and the corresponding IMPs identified on the Exhibit.
- Calculations, in the format shown in Chapter 4, showing the minimum square footage required and proposed square footage for each IMP.
- Preliminary designs for each IMP. The design sheets and accompanying drawings in Chapter 4 may be used or adapted for this purpose.

The following may also be required, or may be advisable to assist the reviewer to understand your design:

- A narrative overview of your design and how your design decisions optimize the site layout, use pervious surfaces, disperse runoff from impervious surfaces, and drain impervious surfaces to engineered IMPs. See Chapter 4.
- A narrative briefly describing each drainage management area (DMA), its drainage, and where drainage will be directed.

- A narrative briefly describing each IMP. Include any special characteristics or features distinct from the design sheets in Chapter 4.

References and Resources

- [Chapter 4](#)
- *County of San Diego Low Impact Development Handbook*
- Your municipality's *General Plan*
- Your municipality's Zoning Ordinance and Development Codes
- *Low Impact Development Manual* (Prince George's County, Maryland, 1999).
- *Bioretention Manual* (Prince George's County, Maryland, rev. 2002)
- *Site Planning for Urban Stream Protection* (Schueler, 1995b).
- *Low Impact Development Technical Guidance Manual for Puget Sound* (Puget Sound Action Team, 2005)
- *LID for Big Box Retailers* (Low Impact Development Center, 2006)

Step 4. Specify Source Control BMPs

Some everyday activities – such as trash recycling/disposal and washing vehicles and equipment – generate pollutants that tend to find their way into storm drains. These pollutants can be minimized by applying source control BMPs.

Source control BMPs include permanent, structural features that must be incorporated into your project plans and operational BMPs, such as regular sweeping and “housekeeping,” that must be implemented by the site’s occupant or user. The maximum extent practicable standard typically requires both types of BMPs. In general, operational BMPs cannot be substituted for a feasible and effective permanent BMP.

Use the following procedure to specify source control BMPs for your site:

► IDENTIFY POLLUTANT SOURCES

Review the first column in the Pollutant Sources/Source Control Checklist (Appendix E). Check off the potential sources of pollutants that apply to your site.

► NOTE LOCATIONS ON SUBMITTAL DRAWING

Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist (Appendix E). Show the location of each pollutant source and each permanent source control BMP in your submittal drawing.

► PREPARE A TABLE AND NARRATIVE

Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist (Appendix E). Now, create a table using the format in Table 3-1. In the left column, list each potential source on your site (from Appendix E, Column 1). In the middle column, list the corresponding permanent, structural BMPs (from Columns 2 and 3, Appendix E) used to prevent pollutants from entering runoff. Accompany this table with a narrative that explains any special features, materials, or methods of construction that will be used to implement these permanent, structural BMPs.

► IDENTIFY OPERATIONAL SOURCE CONTROL BMPs

TABLE 3-1. Format for table of permanent and operational source control measures.

| <i>Potential source of runoff pollutants</i> | <i>Permanent source control BMPs</i> | <i>Operational source control BMPs</i> |
|--|--------------------------------------|--|
| | | |
| | | |

To complete your table, refer once again to the Pollutant Sources/Source Control Checklist (Appendix E, Column 4). List in the right column of your table the operational BMPs that should be implemented as long as the anticipated activities continue at the site. The same BMPs may also be required as a condition of a use permit or other revocable discretionary approval for use of the site.

References and Resources

- [Appendix E](#): Stormwater Pollutant Sources/Source Control Checklist
- RWQCB Order R9-2007-0001, Provision D.1.d.(5)
- [Start at the Source](#), Section 6.7: Details, Outdoor Work Areas
- [California Stormwater Industrial/Commercial Best Management Practice Handbook](#)
- *Urban Runoff Quality Management* (WEF/ASCE, 1998) Chapter 4: Source Controls

Step 5: Stormwater Facility Maintenance

As required by NPDES Permit Provision D.1.c.(5), the County will require submittal of proof of a mechanism under which ongoing long-term maintenance of stormwater treatment and flow-control facilities will be conducted. The County may require one of more of the following items be included in your SWMP:

1. A means to finance and implement facility maintenance in perpetuity.
2. Acceptance of responsibility for maintenance from the time the facilities 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 treatment and flow-control facilities you have selected.

The County may also require that you prepare and submit a detailed plan that sets forth a maintenance schedule for each of the treatment and flow-control facilities built on your site.

Details of these requirements, and instructions for preparing a detailed operation and maintenance plan, are in Chapter 5.

References and Resources

- [Chapter 5](#)
- Operation, Maintenance, and Management of Stormwater Management Systems (Watershed Management Institute, 1997)

Step 6: Complete Your SWMP

County staff will provide specific instructions for the content and format of your SWMP. Your SWMP should document the information gathered and decisions made in Steps 1-5. A clear, complete, well-organized SWMP will make it possible to confirm your design meets the minimum requirements of the NPDES permit, the WPO, and this *SUSMP*.

► COORDINATION WITH SITE, ARCHITECTURAL, AND LANDSCAPING PLANS

Before completing your SWMP, ensure your stormwater control design is fully coordinated with the site plan, grading plan, and landscaping plan being proposed for the site.

Information submitted and presentations to design review committees, planning commissions, and other decision-making bodies must incorporate relevant aspects of the stormwater design. In particular, ensure:

- Curb elevations, elevations, grade breaks, and other features of the drainage design are consistent with the delineation of DMAs.
- The top edge (overflow) of each bioretention facility is level all around its perimeter—this is particularly important in parking lot medians.
- The resulting grading and drainage design is consistent with the design for parking and circulation.
- Bioretention facilities and other IMPs do not create conflicts with pedestrian access between parking and building entrances.
- Vaults and utility boxes can be accommodated outside bioretention facilities and will not be placed within bioretention facilities.
- The visual impact of stormwater facilities, including planter boxes at building foundations and any terracing or retaining walls required for the stormwater control design, is shown in renderings and other architectural drawings.
- Landscaping plans, including planting plans, show locations of bioretention facilities and other IMPs, and the plant requirements are consistent with the engineered soils and conditions in the bioretention facilities.
- Renderings and representation of street views incorporate any stormwater facilities located in street-side buffers and setbacks

► CONSTRUCTION PLAN SUSMP CHECKLIST

When you submit construction plans for County review and approval, the reviewer will compare that submittal with your earlier SWMP. By creating a Construction Plan SWMP Checklist for your project, you can facilitate the reviewer's comparison and speed review of your project. Table 3-2 shall be placed on all project plans that have treatment control and LID BMPs.

TABLE 3-2. Format for Construction Plan SUSMP Checklist.

| Treatment Control BMP's ¹ | | | |
|---|-------|----------------------|-----------|
| Description / Type | Sheet | Maintenance Category | Revisions |
| | | | |
| | | | |
| | | | |
| ¹ BMPs designed to treat stormwater (e.g., LID and hydromod) shall be considered TCBMPs. | | | |

* BMP's approved as part of Stormwater Management Plan (SWMP) dated xx/xx/xx on file with DPW.
 Any changes to the above BMP's will require SWMP revision and Plan Change approvals.

Here's how:

1. Create a table similar to Table 3-2. Number and list each measure or BMP you have specified in your SWMP in Columns 1 and Maintenance Category in Column 3 of the table. Leave Column 2 blank. Incorporate the table into your SWMP.
2. When you submit construction plans, duplicate the table (by photocopy or electronically). Now fill in Column 2, 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.

Note that the updated table—or Construction Plan SUSMP Checklist—is only a reference tool to facilitate comparison of the construction plans to your SWMP. Planning Department staff can advise you regarding the process required to propose changes to your approved SWMP.

► CERTIFICATION

The County requires that your SWMP be certified by a civil engineer.

The certification states: “The selection, sizing, and preliminary design of stormwater treatment and other control measures in this plan have been prepared under the direction of the following Registered Civil Engineer and meet the requirements of Regional Water Quality Control Board Order R9-2007-0001 and subsequent amendments.”

► SWMP OUTLINE AND CONTENTS

SWMP outline and contents are provided in the Major SWMP (Appendix C).

► EXAMPLE SWMPS

Example SWMPs may be available from staff at the County. Your submittal will reflect the unique character of your own project and should meet the requirements identified in this *SUSMP*. County staff can assist you to determine how specific requirements apply to your project.

Low Impact Development Design Guide

Guidance for designing and documenting your LID site drainage, stormwater treatment facilities, and flow-control facilities

Follow the Low Impact Development (LID) design in this SUSMP to achieve compliance with the stormwater treatment requirements as well as the LID requirements in the stormwater NPDES permit.

This will require careful documentation of:

- Pervious and impervious areas in the planned project.
- Drainage from each of these areas.
- Locations, sizes, and types of proposed treatment facilities.

Your SWMP must include calculations showing the site drainage and proposed LID treatment facilities meet the criteria in this *SUSMP*.

This Low Impact Development Design Guide will help you:

- Analyze your project and identify and select options for implementing LID techniques to meet runoff treatment requirements—and flow-control requirements, if they apply.
- Design and document drainage for the whole site and document how that design meets this *SUSMP*'s stormwater treatment criteria.
- Specify preliminary design details and integrate your LID drainage design with your paving and landscaping design.

Alternatives to LID design are discussed in the final section of this chapter.

Analyze Your Project for LID

Conceptually, there are four LID strategies for managing runoff from buildings and paving:

1. Optimize the site layout by preserving natural drainage features and designing buildings and circulation to minimize the amount of roofs and paving.

Use pervious surfaces such as turf, gravel, or pervious pavement—or use surfaces that retain rainfall, such as vegetated roofs. All drainage from these surfaces is considered to be “self-retained” (a detailed definition corresponding to this concept is on page 101. No further management of runoff is necessary. An emergency overflow should be provided for extreme events.

Disperse runoff from impervious surfaces on to adjacent pervious surfaces (e.g., direct a roof downspout to disperse runoff onto a lawn).

Drain impervious surfaces to engineered Integrated Management Practices (IMPs), such as bioretention facilities, planter boxes, cisterns, or infiltration trenches. IMPs infiltrate runoff to groundwater and/or percolate runoff through engineered soil and allow it to drain away slowly. Depending on site conditions and local regulations, it may be possible to harvest and reuse rainwater in conjunction with IMPs.

A combination of two or more strategies may work best for your project. With forethought in design, the four strategies can provide multiple, complementary benefits to your development. Pervious surfaces reduce heat island effects and temperature extremes. Landscaping improves air quality, creates a better place to live or work, and upgrades value for rental or sale. Retaining natural hydrology helps preserve and enhance the natural character of the area. LID drainage design can also conserve water and reduce the need for drainage infrastructure.

Table 4-1 includes ideas for applying LID strategies to site conditions and types of development.

TABLE 4-1. Ideas for Runoff Management

| <i>Site Features and Design Objectives</i> | <i>Vegetated Roof</i> | <i>Self-retaining Areas</i> | <i>Pervious Pavement</i> | <i>Bioretention Facility</i> | <i>Flow-through Planter</i> | <i>Infiltration Device</i> | <i>Cistern with bioretention</i> |
|--|-----------------------|-----------------------------|--------------------------|------------------------------|-----------------------------|----------------------------|----------------------------------|
| Clayey native soils | ✓ | | | ✓ | ✓ | | ✓ |
| Permeable native soils | ✓ | | ✓ | ✓ | ✓ | ✓ | |
| Very steep slopes | ✓ | | | | ✓ | | |
| Shallow groundwater | ✓ | | | | ✓ | | |
| Avoid saturating subsurface soils | ✓ | | ✓ | | ✓ | | |
| Connect to roof downspouts | | ✓ | | ✓ | ✓ | ✓ | ✓ |
| Parking lots/islands and medians | | | ✓ | ✓ | | ✓ | |
| Sites with extensive landscaping | | ✓ | ✓ | ✓ | | | |
| Densely developed sites with limited space/landscape | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| Fit IMPs into landscape and setback areas | | | | ✓ | | | ✓ |
| Make drainage a design feature | | ✓ | | ✓ | | | ✓ |
| Convey as well as treat stormwater | | | | ✓ | | | |

► OPTIMIZE THE SITE LAYOUT

To minimize stormwater-related impacts, apply the following design principles to the layout of newly developed and redeveloped sites.

Conserve natural areas, soils, and vegetation. Define the development envelope and protected areas, identifying areas that are most suitable for development and areas that should be left undisturbed. Use the following guideline to determine the least sensitive areas of the site, in order of increasing sensitivity:

1. Areas devoid of vegetation, including previously graded areas and agricultural fields.
2. Areas of non-native vegetation, disturbed habitats and eucalyptus woodlands where receiving waters are not present.
3. Areas of chamise or mixed chaparral, and non-native grasslands.
4. Areas containing coastal scrub communities.
5. All other upland communities.
6. Occupied habitat of sensitive species and all wetlands (as both are defined by the local jurisdiction).

Within each of the previous categories, hillside areas should be considered more sensitive than flatter areas.

Coordination
Chapter one includes a presentation of how review of your project's site design and landscape design is coordinated with review for compliance with stormwater NPDES requirements.

Where possible, conform the site layout along natural landforms, avoid excessive grading and disturbance of vegetation and soils, and replicate the site's natural drainage patterns. Set back development from creeks, wetlands, and riparian habitats. Preserve significant trees, especially native trees and shrubs, and identify locations for planting additional native or drought tolerant trees and large shrubs. Concentrate development on portions of the site with less permeable soils, and preserve areas that can promote infiltration.

For all types of development, limit overall coverage of paving and roofs. Where allowed by local zoning and design standards—and provided public safety and a walkable environment are not compromised—this can be accomplished by designing compact, taller structures, narrower and shorter streets and sidewalks, 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.

Detain and retain runoff throughout the site. On flatter sites, it typically works best to intersperse landscaped areas and IMPs 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 IMPs in lower areas.

Use drainage as a design element. Use depressed landscape areas, vegetated buffers, and bioretention areas as amenities and focal points within the site and landscape design. Bioretention areas can be almost any shape and should be located at low points. Bioretention areas shaped as swales can detain and treat low runoff flows and also convey higher flows.

► USE PERVIOUS SURFACES

Consider a vegetated roof. Although not yet widely used in California, vegetated or “green” roofs are growing in popularity. Potential benefits include longer roof life, lower heating and cooling costs, and better sound insulation, in addition to air quality and water quality benefits. For SUSMP compliance purposes, vegetated roofs are considered not to produce increased runoff or runoff pollutants (i.e., any runoff from a vegetated roof requires no further treatment or detention). For more information on vegetated roofs, see www.greenroofs.org.

Consider permeable pavements and surface treatments. Inventory paved areas on your preliminary site plan. Identify where permeable pavements, such as crushed aggregate, turf block, unit pavers, pervious concrete, or pervious asphalt could be substituted for impervious concrete or asphalt paving.

► DISPERSE RUNOFF TO ADJACENT PERVIOUS AREAS

Look for opportunities to direct runoff from impervious areas to adjacent landscaping. The design, including slopes and soils, must reflect a reasonable expectation that an inch of rainfall will soak into the soil and produce no runoff. For example, a lawn or garden depressed 3-4" below surrounding walkways or driveways provides a simple but functional landscape design element.

For sites subject to stormwater treatment requirements only, a 2:1 maximum ratio of impervious to pervious area is acceptable. Be sure soils will drain adequately.

Under some circumstances, it may be allowable to direct runoff from impervious areas to pervious pavement (for example, from roof downspouts to a parking lot paved with crushed aggregate or turf block). The pore volume of pavement and base course must be sufficient to retain an inch of rainfall, including runoff from the tributary area. The slopes and soils must be compatible with infiltrating that volume without producing runoff.

► DIRECT RUNOFF TO INTEGRATED MANAGEMENT PRACTICES

Project Clean Water has developed design criteria for the following IMPs:

- Bioretention facilities, which can be configured as swales, free-form areas, or planters to integrate with your landscape design.
- Flow-through planters, which can be used near building foundations and other locations where infiltration to native soils is not desired.
- Infiltration devices, which can be used only where soils are permeable.
- Cisterns, in combination with a bioretention facility.

See the design sheets at the end of this chapter.

It may be possible to create a site-specific design that uses cisterns to achieve stormwater flow control, stormwater treatment, and rainwater reuse for irrigation or indoor uses (water

harvesting). Such a design could expand the multiple benefits of LID to include water conservation. Keep in mind:

- Facilities must meet criteria for capturing and treating the volume specified by Equation 4-8 below. This volume must be allowed to empty within 24 hours so runoff from additional storms, which may follow, is also captured and treated. Additional volume may be required if the system also stores runoff for longer periods for reuse.
- Storage of water for longer than minimum standards set forth by local jurisdictions (96 hours for County Department of Environmental Health) creates the potential for mosquito harborage. Cisterns and vaults must be designed to prevent entry by mosquitoes.
- Indoor uses of non-potable water may be restricted or prohibited. Check with County staff.

Some references and resources for water harvesting appear at the end of this chapter.

Finding the right location for treatment facilities on your 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 IMPs 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 of your site's treatment and flow-control facilities within this same area, or within utility easements or other non-buildable areas.
- Planter boxes and bioretention areas must be level or nearly level all the way around. Bioretention areas configured as swales may be gently sloped in the linear direction, but opposite sides must be at the same elevation.
- For effective, low-maintenance operation, locate facilities so drainage into and out of the device is by gravity flow. Pumped systems are feasible, but are expensive, require more maintenance, are prone to untimely failure, and can cause mosquito control problems. Most IMPs require 3 feet or more of head.
- If the property is being subdivided now or in the future, the facility should be in a common, accessible area. In particular, avoid locating facilities on private residential lots. Even if the facility will serve only one site owner or operator, make sure the facility is located for ready access by inspectors from the County and local mosquito control agency.
- The facility must be accessible to equipment needed for its maintenance. Access requirements for maintenance will vary with the type of facility selected. Planter

boxes and bioretention areas will typically need access for the same types of equipment used for landscape maintenance.

To complete your analysis, include in your SWMP a brief narrative documenting the site layout and site design decisions you made. This will provide background and context for how your design meets the quantitative LID design criteria.

Develop and Document Your Drainage Design

The design documentation procedure begins with careful delineation of pervious areas and impervious areas (including roofs) throughout the site. The procedure accounts for how runoff from each delineated area is managed. For areas draining to IMPs, the procedure ensures each IMP is appropriately sized.

The procedure results in a space-efficient, cost-efficient LID design for meeting SUSMP requirements on most residential and commercial/industrial developments. The procedure arranges documentation of drainage design and IMP sizing in a consistent format for presentation and review.

This procedure 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 your site.

You should be able to complete the needed calculations using only the project's site development plan.

► STEP 1: DELINEATE DRAINAGE MANAGEMENT AREAS

This is the key first step. You must divide the entire project area into individual, discrete Drainage Management Areas (DMAs). Typically, lines delineating DMAs follow grade breaks and roof ridge lines. The Exhibit, tables, text, and calculations in your SWMP will illustrate, describe, and account for runoff from each of these areas.

Use separate DMAs for each surface type (e.g., landscaping, pervious paving, or roofs). Each DMA must be assigned a single hydrologic soil group. Assign each DMA an identification number and determine its size in square feet.

► STEP 2: CLASSIFY DMAS AND DETERMINE RUNOFF FACTORS

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

1. Self-treating areas.
2. Self-retaining areas (also called “zero-discharge” areas).
3. Areas that drain to self-retaining areas.
4. Areas that drain to IMPs.

Self-treating areas are landscaped or turf areas that do not drain to IMPs, but rather drain directly off site or to the storm drain system. Examples include upslope undeveloped areas

Rationale
Pollutants in rainfall and windblown dust will tend to become entrained in the vegetation and soils of landscaped areas, so no additional treatment is needed. It is assumed the self-treating landscaped areas will produce runoff less than or equal to the pre-project site condition.

which are ditched and drained around a development and grassed slopes which drain off-site to a street or storm drain. In general, self-treating areas include no impervious areas, unless the impervious area is very small (5% or less) in relationship to the receiving pervious area and slopes are gentle enough to ensure runoff will be absorbed into the vegetation and soil. Criteria for self-treating areas are in the design sheet “Self Treating and Self-Retaining Areas” at the end of this chapter.

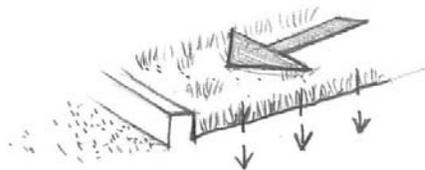


FIGURE 4-1. Self-treating areas are entirely pervious and drain directly off-site or to the storm drain system.

Self-retaining areas are designed to retain the first one inch of rainfall without producing any runoff. The technique works best on flat, heavily landscaped sites. It may be used on mild slopes if there is a reasonable expectation that a one-inch rainfall event would produce no runoff.

To create self-retaining turf and landscape areas in flat areas or on terraced slopes, berm the area or depress the grade into a concave cross-section so that these areas will retain the first inch of rainfall. Specify slopes, if any, toward the center of the pervious area. Inlets of area drains, if any, should be set 3 inches above the low point to allow ponding.

Criteria for self-retaining areas are in the design sheet “Self Treating and Self-Retaining Areas” following this chapter.

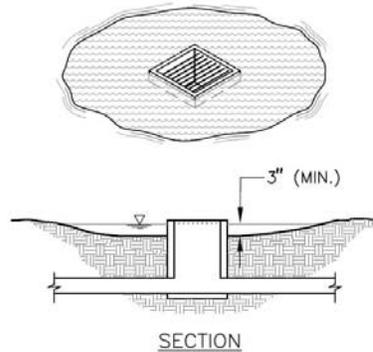


FIGURE 4-2. Self-retaining areas. Berm or depress the grade to retain at least an inch of rainfall and set inlets of any area drains at least 3 inches above low point to allow ponding.

Areas draining to self-retaining areas. Runoff from impervious or partially pervious areas can be managed by routing it to self-retaining pervious areas. For example, roof downspouts can be directed to lawns, and driveways can be sloped toward landscaped areas. The maximum ratio is 2 parts impervious area for every 1 part pervious area for water quality treatment and 1 part impervious areas for every 1 part pervious for hydromodification flow-control.

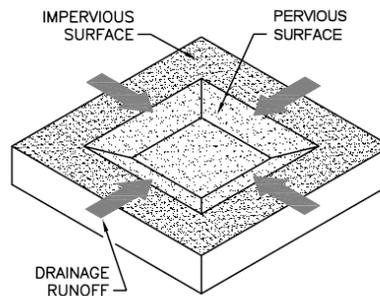


FIGURE 4-3. Relationship of impervious to pervious area for self-retaining areas. Ratio: ***pervious*** \geq $\frac{1}{2}$ ***impervious for treatment***. ***pervious = impervious for hydromodification***

The drainage from the impervious area must be directed to and dispersed within the pervious area, and the entire area must be designed to retain an inch of rainfall without flowing off-site. For example, if the maximum ratio of 2 parts impervious area into 1 part pervious area is used, then the pervious area must absorb 3 inches of water over its surface before overflowing to an off-site drain to retain an inch of rainfall.

A partially pervious area may be drained to a self-retaining area. For example, a driveway composed of unit pavers may drain to an adjacent lawn. In this case, the maximum ratios are:

$$(\text{Runoff factor}) \times (\text{tributary area}) \leq 2 \times (\text{self-retaining area}) \quad \text{Equation 4-1}$$

Use the runoff factors in Table 4-2.

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.

Under some circumstances, pervious pavement (e.g., crushed stone, pervious asphalt, or pervious concrete) can be self-retaining. Adjacent roofs or impervious pavement may drain on to the pervious pavement in the same maximum ratios as described above.

To design a pervious pavement to be a self-treating area, ensure:

- The gravel base course is a minimum of four or more inches deep.
- The base course is not to be under-drained.
- A qualified engineer has been consulted regarding infiltration rates, pavement stability, and suitability for the intended traffic.

Runoff from self-treating and self-retaining areas does not require any further treatment or flow control.

TABLE 4-2. Runoff factors for surfaces draining to IMPs.

| Surface | Runoff Factor |
|--|---------------|
| Roofs | 1.0 |
| Concrete | 1.0 |
| Pervious Concrete | 0.1 |
| Porous Asphalt | 0.1 |
| Grouted Unit Pavers | 1.0 |
| Solid Unit Pavers on granular base, min. 3/16 inch joint space | 0.2 |
| Crushed Aggregate | 0.1 |
| Turfblock | 0.1 |
| Amended, mulched soil | 0.1 |
| Landscape | 0.1 |

Areas draining to IMPs are multiplied by a sizing factor to calculate the required size of the IMP. On most densely developed sites—such as commercial and mixed-use developments and small-lot residential subdivisions—most DMAs will drain to IMPs.

More than one drainage area can drain to the same IMP. However, because the minimum IMP sizes are determined by ratio to drainage area size, a drainage area may not drain to more than one IMP. See Figures 4-4 and 4-5.

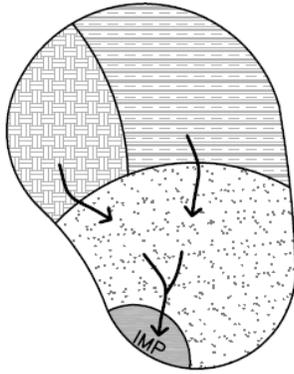


FIGURE 4-4. MORE THAN ONE
Drainage Management Area can drain to a single IMP.

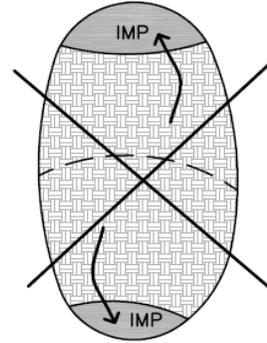


FIGURE 4-5. ONE DRAINAGE
Management Area cannot drain to more than one IMP.
Use a grade break to divide the DMA.

Where possible, design site drainage so only impervious roofs and pavement drain to IMPs. This yields a simpler, more efficient design and also helps protect IMPs from becoming clogged by sediment.

If it is necessary to include turf, landscaping, or pervious pavements within the area draining to an IMP, list each surface as a separate DMA. A runoff factor (similar to a “C” factor used in the rational method) is applied to account for the reduction in the quantity of runoff. For example, when a turf or landscaped drainage management area drains to an IMP, the resulting increment in IMP size is:

$$\Delta (\text{Area}) = (\text{pervious area}) \times (\text{runoff factor}) \times (\text{sizing factor}).$$

Use the runoff factors in Table 4-2.

► **STEP 3: TABULATE DRAINAGE MANAGEMENT AREAS**

- Tabulate self-treating areas in the format shown in Table 4-3.
- Tabulate self-retaining areas in the format shown in Table 4-4.
- Tabulate areas draining to self-retaining areas in the format shown in Table 4-5. Check to be sure the total product of (square feet of tributary area × runoff factor) for all DMAs draining to a receiving self-retaining area is no greater than a 2:1 ratio for treatment and 1:1 ration for hydromodification to the square footage of the receiving self-retaining area itself.

- Compile a list of DMAs draining to IMPs. Proceed to Step 4 to check the sizing of the IMPs.

TABLE 4-3. Format for Tabulating Self-Treating Areas

| <i>DMA Name</i> | <i>Area (square feet)</i> |
|-----------------|---------------------------|
| | |

TABLE 4-4. Format for Tabulating Self-Retaining Areas

| <i>DMA Name</i> | <i>Area (square feet)</i> |
|-----------------|---------------------------|
| | |

TABLE 4-5. Format for Tabulating Areas Draining to Self-Retaining Areas

| <i>DMA Name</i> | <i>Area (square feet)</i> | <i>Post-project surface type</i> | <i>Runoff factor</i> | <i>Receiving self-retaining DMA</i> | <i>Receiving self-retaining DMA Area (square feet)</i> |
|-----------------|---------------------------|----------------------------------|----------------------|-------------------------------------|--|
| | | | | | |

► STEP 4: SELECT AND LAY OUT IMPS ON SITE PLAN

Select from the list of IMPs in Table 4-6. Illustrations, designs, and design criteria for the IMPs are in the “IMP Design Details and Criteria” at the end of this chapter.

Once you have laid out the IMPs, calculate the square footage you have set aside on your site plan for each IMP.

► STEP 5: REVIEW SIZING FOR EACH IMP

For each of the IMPs, use the appropriate “water quality only” sizing factor from Table 4-6. Sizing factors for integrated facilities that provide both water quality treatment and hydromodification flow control are presented in Tables 4-8 through 4-12.

TABLE 4-6. IMP Sizing

| | |
|---|--|
| Bioretention Facilities | Sizing Factor for Area = 0.04 |
| Flow-through Planters | Sizing Factor for Area = 0.04 |
| Infiltration trench or Infiltration Basin | See Step 6 to Calculate Min. Volume |
| Cistern with Bioretention | See Step 6 to Calculate Min. Volume of Cistern; then use 0.04 to calculate minimum size of bioretention area |

► STEP 6: CALCULATE MINIMUM AREA AND VOLUME OF EACH IMP

A. FOR “WATER QUALITY TREATMENT ONLY”

The minimum area of bioretention facilities and flow-through planters is found by summing up the contributions of each tributary DMA and multiplying by the adjusted sizing factor for the IMP. Note that if the IMP is designed to provide hydromodification flow control, then sizing factors from Tables 4-8 through 4-12 should be used in lieu of the “water quality only” sizing factors presented in Table 4-6.

Equation 4-7

$$Min. IMP Area = \sum \left(\begin{matrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{matrix} \right) \times \left(\begin{matrix} IMP \\ Sizing \\ Factor \end{matrix} \right)$$

DMA = Drainage Management Area

IMP = Integrated Management Practice

Use the format of Table 4-7 to present the calculations of the required minimum area and volumes for bioretention areas and planter boxes:

TABLE 4-7. Format for presenting calculations of minimum IMP Areas for bioretention areas and planter boxes.

| DMA Name | DMA Area (square feet) | Post-project surface type | DMA Runoff factor | DMA Area × runoff factor | Soil Type: IMP Name | | | |
|--------------|------------------------|---------------------------|-------------------|--------------------------|---------------------|--------------|---------------|-----------------|
| | | | | | IMP Sizing factor | Minimum Area | Proposed Area | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Total | | | | | 0.04 | | | IMP Area |

To size dry wells, infiltration basins, or infiltration trenches for the “water quality treatment only” option, use the following procedure:

1. Use the County of San Diego's 85th Percentile Isopluvial Map to determine the minimum unit volume.
2. Determine the weighted runoff factor ("C" factor) for the area tributary to the facility. The factors in Table 4-2 may be used.
3. Multiply the weighted runoff factor times the tributary area times the minimum unit volume.

Equation 4-8

$$\text{Volume} = [\text{Tributary Area}] \times [\text{weighted runoff factor}] \times [\text{unit volume}]$$

4. Select a facility depth.
5. Determine the required facility area. Dry wells may be designed as an open vault or with rock fill. If rock fill is used, assume a porosity of 40%.
6. Ensure the facility can infiltrate the entire volume within 96 hours.

To size a cistern or vault in series with a bioretention facility:

1. Use Equation 4-8 to calculate the required cistern or vault volume.
2. Design a discharge orifice for a drawdown time of 24 hours.
3. Determine the maximum discharge from the orifice.
4. The minimum area of the bioretention facility must treat this flow based on a percolation rate of 5" per hour through the engineered soil.

B. FOR "WATER QUALITY TREATMENT AND HYDROMODIFICATION"

Tables 4-8 through 4-12 summarize sizing factors that may be used to provide minimum sizing criteria for IMP facilities. Sizing factors detailed in the tables represent minimum surface area and volumetric sizing factors which would be required to meet both the 85th percentile water quality treatment and hydromodification flow control criteria.

To use the sizing factor approach, Drainage Management Area (DMAs) are initially delineated to quantify all areas draining to an IMP. DMAs are defined as areas with a unique combination of soil type and slope type and multiple DMAs can drain to an IMP facility. Post-project surface cover conditions are quantified for each DMA using the surface cover coefficient in Table 4-2. Often times, impervious DMAs (with a high runoff coefficient) and pervious DMAs (with a low runoff coefficient) both drain to the same IMP. In addition, alternate surface cover conditions such as porous pavement require definition with a separate surface cover coefficient.

The minimum area of the IMP facility is determined by summing the products of each DMA area and surface cover coefficient draining to the IMP and then multiplying by the applicable

sizing factor (based on rain gauge, soil type, slope, low flow threshold, and IMP type and summarized in Tables 4-8 through 4-12).

This approach assumes the DMA pre-project cover is pervious and that development results in no significant diversion of drainage area as compared to the pre-project condition. For this approach to work for a project containing existing impervious area, the new impervious areas must be separated from the existing impervious area and drained to an IMP facility designed to treat the new impervious area only.

C. STORAGE VOLUME REQUIREMENTS FOR FLOOD CONTROL, WATER QUALITY AND HYDROMODIFICATION FACILITIES

1. If facility is sized for hydromodification only:

10 Year Water Surface Elevation (WSEL) with orifice at outlet structure to meet lower flow threshold per hydromodification requirements.

2. If facility is sized for water quality only:

Water quality volume is equivalent to the 85% percentile 24-hour event.

3. If facility is sized for flood control only:

100 year flood frequency {note it is unlikely that new facilities would be sized to only satisfy flood control purposes. In addition certain jurisdictions require flood control for other frequencies (5, 10, 25, & 50 year flood) besides the 100. In those cases the outlet structure should be designed to detain other frequencies as well}.

4. If facility is sized for hydromodification and water quality:

Must meet both 1 (size to meet 10 year WSEL & hydromodification outlet structure) and 2 (WQ volume).

5. If facility is sized for hydromodification and flood control:

Must meet both 1 (size to meet 10 year WSEL & hydromodification outlet structure) and 3 (100 year flood frequency).

6. If facility is sized for water quality and flood control:

Volume equal to 2 (85% water quality volume) plus the 3 (100 year flood frequency).

7. If facility is sized for flood control, water quality & hydromodification:

Must meet all 1 (outlet structure to meet lower flow threshold per Hydromod requirements), 2 (WQ volume) and 3 (Size to meet flood control volume).

TABLE 4-8. Sizing Factors for Bioretention Facilities

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|--------|
| 0.5Q2 | A | Flat | Lindbergh | 0.060 | 0.0500 | N/A |
| 0.5Q2 | A | Moderate | Lindbergh | 0.055 | 0.0458 | N/A |
| 0.5Q2 | A | Steep | Lindbergh | 0.045 | 0.0375 | N/A |
| 0.5Q2 | B | Flat | Lindbergh | 0.093 | 0.0771 | N/A |
| 0.5Q2 | B | Moderate | Lindbergh | 0.085 | 0.0708 | N/A |
| 0.5Q2 | B | Steep | Lindbergh | 0.065 | 0.0542 | N/A |
| 0.5Q2 | C | Flat | Lindbergh | 0.100 | 0.0833 | 0.0600 |
| 0.5Q2 | C | Moderate | Lindbergh | 0.100 | 0.0833 | 0.0600 |
| 0.5Q2 | C | Steep | Lindbergh | 0.075 | 0.0625 | 0.0450 |
| 0.5Q2 | D | Flat | Lindbergh | 0.080 | 0.0667 | 0.0480 |
| 0.5Q2 | D | Moderate | Lindbergh | 0.080 | 0.0667 | 0.0480 |
| 0.5Q2 | D | Steep | Lindbergh | 0.060 | 0.0500 | 0.0360 |
| 0.5Q2 | A | Flat | Oceanside | 0.070 | 0.0583 | N/A |
| 0.5Q2 | A | Moderate | Oceanside | 0.065 | 0.0542 | N/A |
| 0.5Q2 | A | Steep | Oceanside | 0.060 | 0.0500 | N/A |
| 0.5Q2 | B | Flat | Oceanside | 0.098 | 0.0813 | N/A |
| 0.5Q2 | B | Moderate | Oceanside | 0.090 | 0.0750 | N/A |
| 0.5Q2 | B | Steep | Oceanside | 0.075 | 0.0625 | N/A |
| 0.5Q2 | C | Flat | Oceanside | 0.075 | 0.0625 | 0.0450 |
| 0.5Q2 | C | Moderate | Oceanside | 0.075 | 0.0625 | 0.0450 |
| 0.5Q2 | C | Steep | Oceanside | 0.060 | 0.0500 | 0.0360 |
| 0.5Q2 | D | Flat | Oceanside | 0.065 | 0.0542 | 0.0390 |
| 0.5Q2 | D | Moderate | Oceanside | 0.065 | 0.0542 | 0.0390 |
| 0.5Q2 | D | Steep | Oceanside | 0.050 | 0.0417 | 0.0300 |
| 0.5Q2 | A | Flat | L Wohlford | 0.050 | 0.0417 | N/A |
| 0.5Q2 | A | Moderate | L Wohlford | 0.045 | 0.0375 | N/A |
| 0.5Q2 | A | Steep | L Wohlford | 0.040 | 0.0333 | N/A |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|--------|
| 0.5Q2 | B | Flat | L Wohlford | 0.048 | 0.0396 | N/A |
| 0.5Q2 | B | Moderate | L Wohlford | 0.045 | 0.0375 | N/A |
| 0.5Q2 | B | Steep | L Wohlford | 0.040 | 0.0333 | N/A |
| 0.5Q2 | C | Flat | L Wohlford | 0.065 | 0.0542 | 0.0390 |
| 0.5Q2 | C | Moderate | L Wohlford | 0.065 | 0.0542 | 0.0390 |
| 0.5Q2 | C | Steep | L Wohlford | 0.050 | 0.0417 | 0.0300 |
| 0.5Q2 | D | Flat | L Wohlford | 0.055 | 0.0458 | 0.0330 |
| 0.5Q2 | D | Moderate | L Wohlford | 0.055 | 0.0458 | 0.0330 |
| 0.5Q2 | D | Steep | L Wohlford | 0.045 | 0.0375 | 0.0270 |
| 0.3Q2 | A | Flat | Lindbergh | 0.060 | 0.0500 | N/A |
| 0.3Q2 | A | Moderate | Lindbergh | 0.055 | 0.0458 | N/A |
| 0.3Q2 | A | Steep | Lindbergh | 0.045 | 0.0375 | N/A |
| 0.3Q2 | B | Flat | Lindbergh | 0.098 | 0.0813 | N/A |
| 0.3Q2 | B | Moderate | Lindbergh | 0.090 | 0.0750 | N/A |
| 0.3Q2 | B | Steep | Lindbergh | 0.070 | 0.0583 | N/A |
| 0.3Q2 | C | Flat | Lindbergh | 0.110 | 0.0917 | 0.0660 |
| 0.3Q2 | C | Moderate | Lindbergh | 0.110 | 0.0917 | 0.0660 |
| 0.3Q2 | C | Steep | Lindbergh | 0.085 | 0.0708 | 0.0510 |
| 0.3Q2 | D | Flat | Lindbergh | 0.100 | 0.0833 | 0.0600 |
| 0.3Q2 | D | Moderate | Lindbergh | 0.100 | 0.0833 | 0.0600 |
| 0.3Q2 | D | Steep | Lindbergh | 0.070 | 0.0583 | 0.0420 |
| 0.3Q2 | A | Flat | Oceanside | 0.070 | 0.0583 | N/A |
| 0.3Q2 | A | Moderate | Oceanside | 0.065 | 0.0542 | N/A |
| 0.3Q2 | A | Steep | Oceanside | 0.060 | 0.0500 | N/A |
| 0.3Q2 | B | Flat | Oceanside | 0.098 | 0.0813 | N/A |
| 0.3Q2 | B | Moderate | Oceanside | 0.090 | 0.0750 | N/A |
| 0.3Q2 | B | Steep | Oceanside | 0.075 | 0.0625 | N/A |
| 0.3Q2 | C | Flat | Oceanside | 0.100 | 0.0833 | 0.0600 |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|--------|
| 0.3Q2 | C | Moderate | Oceanside | 0.100 | 0.0833 | 0.0600 |
| 0.3Q2 | C | Steep | Oceanside | 0.080 | 0.0667 | 0.0480 |
| 0.3Q2 | D | Flat | Oceanside | 0.085 | 0.0708 | 0.0510 |
| 0.3Q2 | D | Moderate | Oceanside | 0.085 | 0.0708 | 0.0510 |
| 0.3Q2 | D | Steep | Oceanside | 0.065 | 0.0542 | 0.0390 |
| 0.3Q2 | A | Flat | L Wohlford | 0.050 | 0.0417 | N/A |
| 0.3Q2 | A | Moderate | L Wohlford | 0.045 | 0.0375 | N/A |
| 0.3Q2 | A | Steep | L Wohlford | 0.040 | 0.0333 | N/A |
| 0.3Q2 | B | Flat | L Wohlford | 0.060 | 0.0500 | N/A |
| 0.3Q2 | B | Moderate | L Wohlford | 0.055 | 0.0458 | N/A |
| 0.3Q2 | B | Steep | L Wohlford | 0.045 | 0.0375 | N/A |
| 0.3Q2 | C | Flat | L Wohlford | 0.075 | 0.0625 | 0.0450 |
| 0.3Q2 | C | Moderate | L Wohlford | 0.075 | 0.0625 | 0.0450 |
| 0.3Q2 | C | Steep | L Wohlford | 0.060 | 0.0500 | 0.0360 |
| 0.3Q2 | D | Flat | L Wohlford | 0.065 | 0.0542 | 0.0390 |
| 0.3Q2 | D | Moderate | L Wohlford | 0.065 | 0.0542 | 0.0390 |
| 0.3Q2 | D | Steep | L Wohlford | 0.050 | 0.0417 | 0.0300 |
| 0.1Q2 | A | Flat | Lindbergh | 0.060 | 0.0500 | N/A |
| 0.1Q2 | A | Moderate | Lindbergh | 0.055 | 0.0458 | N/A |
| 0.1Q2 | A | Steep | Lindbergh | 0.045 | 0.0375 | N/A |
| 0.1Q2 | B | Flat | Lindbergh | 0.100 | 0.0833 | N/A |
| 0.1Q2 | B | Moderate | Lindbergh | 0.095 | 0.0792 | N/A |
| 0.1Q2 | B | Steep | Lindbergh | 0.080 | 0.0667 | N/A |
| 0.1Q2 | C | Flat | Lindbergh | 0.145 | 0.1208 | 0.0870 |
| 0.1Q2 | C | Moderate | Lindbergh | 0.145 | 0.1208 | 0.0870 |
| 0.1Q2 | C | Steep | Lindbergh | 0.120 | 0.1000 | 0.0720 |
| 0.1Q2 | D | Flat | Lindbergh | 0.160 | 0.1333 | 0.0960 |
| 0.1Q2 | D | Moderate | Lindbergh | 0.160 | 0.1333 | 0.0960 |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|--------|
| 0.1Q2 | D | Steep | Lindbergh | 0.115 | 0.0958 | 0.0690 |
| 0.1Q2 | A | Flat | Oceanside | 0.070 | 0.0583 | N/A |
| 0.1Q2 | A | Moderate | Oceanside | 0.065 | 0.0542 | N/A |
| 0.1Q2 | A | Steep | Oceanside | 0.060 | 0.0500 | N/A |
| 0.1Q2 | B | Flat | Oceanside | 0.103 | 0.0854 | N/A |
| 0.1Q2 | B | Moderate | Oceanside | 0.090 | 0.0750 | N/A |
| 0.1Q2 | B | Steep | Oceanside | 0.075 | 0.0625 | N/A |
| 0.1Q2 | C | Flat | Oceanside | 0.130 | 0.1083 | 0.0780 |
| 0.1Q2 | C | Moderate | Oceanside | 0.130 | 0.1083 | 0.0780 |
| 0.1Q2 | C | Steep | Oceanside | 0.110 | 0.0917 | 0.0660 |
| 0.1Q2 | D | Flat | Oceanside | 0.130 | 0.1083 | 0.0780 |
| 0.1Q2 | D | Moderate | Oceanside | 0.130 | 0.1083 | 0.0780 |
| 0.1Q2 | D | Steep | Oceanside | 0.065 | 0.0542 | 0.0390 |
| 0.1Q2 | A | Flat | L Wohlford | 0.050 | 0.0417 | N/A |
| 0.1Q2 | A | Moderate | L Wohlford | 0.045 | 0.0375 | N/A |
| 0.1Q2 | A | Steep | L Wohlford | 0.040 | 0.0333 | N/A |
| 0.1Q2 | B | Flat | L Wohlford | 0.090 | 0.0750 | N/A |
| 0.1Q2 | B | Moderate | L Wohlford | 0.085 | 0.0708 | N/A |
| 0.1Q2 | B | Steep | L Wohlford | 0.065 | 0.0542 | N/A |
| 0.1Q2 | C | Flat | L Wohlford | 0.110 | 0.0917 | 0.0660 |
| 0.1Q2 | C | Moderate | L Wohlford | 0.110 | 0.0917 | 0.0660 |
| 0.1Q2 | C | Steep | L Wohlford | 0.090 | 0.0750 | 0.0540 |
| 0.1Q2 | D | Flat | L Wohlford | 0.100 | 0.0833 | 0.0600 |
| 0.1Q2 | D | Moderate | L Wohlford | 0.100 | 0.0833 | 0.0600 |
| 0.1Q2 | D | Steep | L Wohlford | 0.075 | 0.0625 | 0.0450 |

Q_2 = 2-year pre-project flow rate based upon partial duration analysis of long-term hourly rainfall records
 Q_{10} = 10-year pre-project flow rate based upon partial duration analysis of long-term hourly rainfall records
A = Surface area sizing factor
 V_1 = Surface volume sizing factor: $V_1 = (10/12) \times A$ (V_1 is based on 10" of ponding)
 V_2 = Subsurface volume sizing factor: $V_2 = A \times 1.5 \times 0.4$ (storage volume for 1.5' depth with 40% void ratio)

TABLE 4-9. Sizing Factors for Bioretention Plus Cistern Facilities

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|-----|
| 0.5Q2 | A | Flat | Lindbergh | 0.020 | 0.1200 | N/A |
| 0.5Q2 | A | Moderate | Lindbergh | 0.020 | 0.1000 | N/A |
| 0.5Q2 | A | Steep | Lindbergh | 0.020 | 0.1000 | N/A |
| 0.5Q2 | B | Flat | Lindbergh | 0.020 | 0.3900 | N/A |
| 0.5Q2 | B | Moderate | Lindbergh | 0.020 | 0.2000 | N/A |
| 0.5Q2 | B | Steep | Lindbergh | 0.020 | 0.1200 | N/A |
| 0.5Q2 | C | Flat | Lindbergh | 0.020 | 0.1200 | N/A |
| 0.5Q2 | C | Moderate | Lindbergh | 0.020 | 0.1200 | N/A |
| 0.5Q2 | C | Steep | Lindbergh | 0.020 | 0.1000 | N/A |
| 0.5Q2 | D | Flat | Lindbergh | 0.020 | 0.1000 | N/A |
| 0.5Q2 | D | Moderate | Lindbergh | 0.020 | 0.1000 | N/A |
| 0.5Q2 | D | Steep | Lindbergh | 0.030 | 0.0800 | N/A |
| 0.5Q2 | A | Flat | Oceanside | 0.020 | 0.1600 | N/A |
| 0.5Q2 | A | Moderate | Oceanside | 0.020 | 0.1400 | N/A |
| 0.5Q2 | A | Steep | Oceanside | 0.030 | 0.1200 | N/A |
| 0.5Q2 | B | Flat | Oceanside | 0.020 | 0.1900 | N/A |
| 0.5Q2 | B | Moderate | Oceanside | 0.025 | 0.1600 | N/A |
| 0.5Q2 | B | Steep | Oceanside | 0.035 | 0.1400 | N/A |
| 0.5Q2 | C | Flat | Oceanside | 0.030 | 0.1400 | N/A |
| 0.5Q2 | C | Moderate | Oceanside | 0.035 | 0.1400 | N/A |
| 0.5Q2 | C | Steep | Oceanside | 0.040 | 0.1200 | N/A |
| 0.5Q2 | D | Flat | Oceanside | 0.035 | 0.1200 | N/A |
| 0.5Q2 | D | Moderate | Oceanside | 0.040 | 0.1200 | N/A |
| 0.5Q2 | D | Steep | Oceanside | 0.040 | 0.1000 | N/A |
| 0.5Q2 | A | Flat | L Wohlford | 0.025 | 0.1800 | N/A |
| 0.5Q2 | A | Moderate | L Wohlford | 0.040 | 0.1400 | N/A |
| 0.5Q2 | A | Steep | L Wohlford | 0.040 | 0.0800 | N/A |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|-----|
| 0.5Q2 | B | Flat | L Wohlford | 0.040 | 0.2100 | N/A |
| 0.5Q2 | B | Moderate | L Wohlford | 0.040 | 0.2000 | N/A |
| 0.5Q2 | B | Steep | L Wohlford | 0.040 | 0.1400 | N/A |
| 0.5Q2 | C | Flat | L Wohlford | 0.040 | 0.1400 | N/A |
| 0.5Q2 | C | Moderate | L Wohlford | 0.040 | 0.1400 | N/A |
| 0.5Q2 | C | Steep | L Wohlford | 0.040 | 0.1000 | N/A |
| 0.5Q2 | D | Flat | L Wohlford | 0.040 | 0.1000 | N/A |
| 0.5Q2 | D | Moderate | L Wohlford | 0.040 | 0.1000 | N/A |
| 0.5Q2 | D | Steep | L Wohlford | 0.040 | 0.0800 | N/A |
| 0.3Q2 | A | Flat | Lindbergh | 0.020 | 0.1200 | N/A |
| 0.3Q2 | A | Moderate | Lindbergh | 0.020 | 0.1000 | N/A |
| 0.3Q2 | A | Steep | Lindbergh | 0.020 | 0.1000 | N/A |
| 0.3Q2 | B | Flat | Lindbergh | 0.020 | 0.5900 | N/A |
| 0.3Q2 | B | Moderate | Lindbergh | 0.020 | 0.3600 | N/A |
| 0.3Q2 | B | Steep | Lindbergh | 0.020 | 0.1800 | N/A |
| 0.3Q2 | C | Flat | Lindbergh | 0.020 | 0.1800 | N/A |
| 0.3Q2 | C | Moderate | Lindbergh | 0.020 | 0.1800 | N/A |
| 0.3Q2 | C | Steep | Lindbergh | 0.020 | 0.1400 | N/A |
| 0.3Q2 | D | Flat | Lindbergh | 0.020 | 0.1400 | N/A |
| 0.3Q2 | D | Moderate | Lindbergh | 0.020 | 0.1400 | N/A |
| 0.3Q2 | D | Steep | Lindbergh | 0.020 | 0.0800 | N/A |
| 0.3Q2 | A | Flat | Oceanside | 0.020 | 0.1600 | N/A |
| 0.3Q2 | A | Moderate | Oceanside | 0.020 | 0.1400 | N/A |
| 0.3Q2 | A | Steep | Oceanside | 0.020 | 0.1200 | N/A |
| 0.3Q2 | B | Flat | Oceanside | 0.020 | 0.2200 | N/A |
| 0.3Q2 | B | Moderate | Oceanside | 0.020 | 0.1800 | N/A |
| 0.3Q2 | B | Steep | Oceanside | 0.020 | 0.1600 | N/A |
| 0.3Q2 | C | Flat | Oceanside | 0.020 | 0.1600 | N/A |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|-----|
| 0.3Q2 | C | Moderate | Oceanside | 0.020 | 0.1600 | N/A |
| 0.3Q2 | C | Steep | Oceanside | 0.025 | 0.1400 | N/A |
| 0.3Q2 | D | Flat | Oceanside | 0.020 | 0.1400 | N/A |
| 0.3Q2 | D | Moderate | Oceanside | 0.025 | 0.1400 | N/A |
| 0.3Q2 | D | Steep | Oceanside | 0.030 | 0.1200 | N/A |
| 0.3Q2 | A | Flat | L Wohlford | 0.020 | 0.1800 | N/A |
| 0.3Q2 | A | Moderate | L Wohlford | 0.025 | 0.1400 | N/A |
| 0.3Q2 | A | Steep | L Wohlford | 0.030 | 0.0800 | N/A |
| 0.3Q2 | B | Flat | L Wohlford | 0.025 | 0.2600 | N/A |
| 0.3Q2 | B | Moderate | L Wohlford | 0.025 | 0.2400 | N/A |
| 0.3Q2 | B | Steep | L Wohlford | 0.030 | 0.1800 | N/A |
| 0.3Q2 | C | Flat | L Wohlford | 0.030 | 0.1800 | N/A |
| 0.3Q2 | C | Moderate | L Wohlford | 0.030 | 0.1800 | N/A |
| 0.3Q2 | C | Steep | L Wohlford | 0.035 | 0.1400 | N/A |
| 0.3Q2 | D | Flat | L Wohlford | 0.030 | 0.1400 | N/A |
| 0.3Q2 | D | Moderate | L Wohlford | 0.035 | 0.1400 | N/A |
| 0.3Q2 | D | Steep | L Wohlford | 0.040 | 0.1000 | N/A |
| 0.1Q2 | A | Flat | Lindbergh | 0.020 | 0.1200 | N/A |
| 0.1Q2 | A | Moderate | Lindbergh | 0.020 | 0.1000 | N/A |
| 0.1Q2 | A | Steep | Lindbergh | 0.020 | 0.1000 | N/A |
| 0.1Q2 | B | Flat | Lindbergh | 0.020 | 0.5400 | N/A |
| 0.1Q2 | B | Moderate | Lindbergh | 0.020 | 0.7800 | N/A |
| 0.1Q2 | B | Steep | Lindbergh | 0.020 | 0.3400 | N/A |
| 0.1Q2 | C | Flat | Lindbergh | 0.020 | 0.3600 | N/A |
| 0.1Q2 | C | Moderate | Lindbergh | 0.020 | 0.3600 | N/A |
| 0.1Q2 | C | Steep | Lindbergh | 0.020 | 0.2400 | N/A |
| 0.1Q2 | D | Flat | Lindbergh | 0.020 | 0.2600 | N/A |
| 0.1Q2 | D | Moderate | Lindbergh | 0.020 | 0.2600 | N/A |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|-----|
| 0.1Q2 | D | Steep | Lindbergh | 0.020 | 0.1600 | N/A |
| 0.1Q2 | A | Flat | Oceanside | 0.020 | 0.1600 | N/A |
| 0.1Q2 | A | Moderate | Oceanside | 0.020 | 0.1400 | N/A |
| 0.1Q2 | A | Steep | Oceanside | 0.020 | 0.1200 | N/A |
| 0.1Q2 | B | Flat | Oceanside | 0.020 | 0.5100 | N/A |
| 0.1Q2 | B | Moderate | Oceanside | 0.020 | 0.3400 | N/A |
| 0.1Q2 | B | Steep | Oceanside | 0.020 | 0.2400 | N/A |
| 0.1Q2 | C | Flat | Oceanside | 0.020 | 0.2600 | N/A |
| 0.1Q2 | C | Moderate | Oceanside | 0.020 | 0.2600 | N/A |
| 0.1Q2 | C | Steep | Oceanside | 0.020 | 0.2000 | N/A |
| 0.1Q2 | D | Flat | Oceanside | 0.020 | 0.2000 | N/A |
| 0.1Q2 | D | Moderate | Oceanside | 0.020 | 0.2000 | N/A |
| 0.1Q2 | D | Steep | Oceanside | 0.020 | 0.1800 | N/A |
| 0.1Q2 | A | Flat | L Wohlford | 0.020 | 0.1800 | N/A |
| 0.1Q2 | A | Moderate | L Wohlford | 0.020 | 0.1400 | N/A |
| 0.1Q2 | A | Steep | L Wohlford | 0.020 | 0.0800 | N/A |
| 0.1Q2 | B | Flat | L Wohlford | 0.020 | 0.4400 | N/A |
| 0.1Q2 | B | Moderate | L Wohlford | 0.020 | 0.4000 | N/A |
| 0.1Q2 | B | Steep | L Wohlford | 0.020 | 0.3200 | N/A |
| 0.1Q2 | C | Flat | L Wohlford | 0.020 | 0.3200 | N/A |
| 0.1Q2 | C | Moderate | L Wohlford | 0.020 | 0.3200 | N/A |
| 0.1Q2 | C | Steep | L Wohlford | 0.020 | 0.2200 | N/A |
| 0.1Q2 | D | Flat | L Wohlford | 0.020 | 0.2400 | N/A |
| 0.1Q2 | D | Moderate | L Wohlford | 0.020 | 0.2400 | N/A |
| 0.1Q2 | D | Steep | L Wohlford | 0.020 | 0.1800 | N/A |

Q_2 = 2-year pre-project flow rate based upon partial duration analysis of long-term hourly rainfall records
 Q_{10} = 10-year pre-project flow rate based upon partial duration analysis of long-term hourly rainfall records
A = Bioretention surface area sizing factor
 V_1 = Cistern volume sizing factor

TABLE 4-10. Sizing Factors for Bioretention Plus Vault Facilities

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|-----|
| 0.5Q2 | A | Flat | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | A | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | A | Steep | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | B | Flat | Lindbergh | 0.040 | 0.3600 | N/A |
| 0.5Q2 | B | Moderate | Lindbergh | 0.040 | 0.2400 | N/A |
| 0.5Q2 | B | Steep | Lindbergh | 0.040 | 0.1400 | N/A |
| 0.5Q2 | C | Flat | Lindbergh | 0.040 | 0.1600 | N/A |
| 0.5Q2 | C | Moderate | Lindbergh | 0.040 | 0.1600 | N/A |
| 0.5Q2 | C | Steep | Lindbergh | 0.040 | 0.1200 | N/A |
| 0.5Q2 | D | Flat | Lindbergh | 0.040 | 0.1400 | N/A |
| 0.5Q2 | D | Moderate | Lindbergh | 0.040 | 0.1400 | N/A |
| 0.5Q2 | D | Steep | Lindbergh | 0.040 | 0.1000 | N/A |
| 0.5Q2 | A | Flat | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | A | Moderate | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | A | Steep | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | B | Flat | Oceanside | 0.040 | 0.2100 | N/A |
| 0.5Q2 | B | Moderate | Oceanside | 0.040 | 0.1800 | N/A |
| 0.5Q2 | B | Steep | Oceanside | 0.040 | 0.1400 | N/A |
| 0.5Q2 | C | Flat | Oceanside | 0.040 | 0.1400 | N/A |
| 0.5Q2 | C | Moderate | Oceanside | 0.040 | 0.1400 | N/A |
| 0.5Q2 | C | Steep | Oceanside | 0.040 | 0.1200 | N/A |
| 0.5Q2 | D | Flat | Oceanside | 0.040 | 0.1400 | N/A |
| 0.5Q2 | D | Moderate | Oceanside | 0.040 | 0.1400 | N/A |
| 0.5Q2 | D | Steep | Oceanside | 0.040 | 0.1200 | N/A |
| 0.5Q2 | A | Flat | L Wohlford | N/A | N/A | N/A |
| 0.5Q2 | A | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.5Q2 | A | Steep | L Wohlford | N/A | N/A | N/A |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|-----|
| 0.5Q2 | B | Flat | L Wohlford | 0.040 | 0.2600 | N/A |
| 0.5Q2 | B | Moderate | L Wohlford | 0.040 | 0.2200 | N/A |
| 0.5Q2 | B | Steep | L Wohlford | 0.040 | 0.1200 | N/A |
| 0.5Q2 | C | Flat | L Wohlford | 0.040 | 0.1400 | N/A |
| 0.5Q2 | C | Moderate | L Wohlford | 0.040 | 0.1400 | N/A |
| 0.5Q2 | C | Steep | L Wohlford | 0.040 | 0.1000 | N/A |
| 0.5Q2 | D | Flat | L Wohlford | 0.040 | 0.1200 | N/A |
| 0.5Q2 | D | Moderate | L Wohlford | 0.040 | 0.1200 | N/A |
| 0.5Q2 | D | Steep | L Wohlford | 0.040 | 0.0800 | N/A |
| 0.3Q2 | A | Flat | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | A | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | A | Steep | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | B | Flat | Lindbergh | 0.040 | 0.4500 | N/A |
| 0.3Q2 | B | Moderate | Lindbergh | 0.040 | 0.3200 | N/A |
| 0.3Q2 | B | Steep | Lindbergh | 0.040 | 0.1800 | N/A |
| 0.3Q2 | C | Flat | Lindbergh | 0.040 | 0.1800 | N/A |
| 0.3Q2 | C | Moderate | Lindbergh | 0.040 | 0.1800 | N/A |
| 0.3Q2 | C | Steep | Lindbergh | 0.040 | 0.1400 | N/A |
| 0.3Q2 | D | Flat | Lindbergh | 0.040 | 0.1600 | N/A |
| 0.3Q2 | D | Moderate | Lindbergh | 0.040 | 0.1600 | N/A |
| 0.3Q2 | D | Steep | Lindbergh | 0.040 | 0.1200 | N/A |
| 0.3Q2 | A | Flat | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | A | Moderate | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | A | Steep | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | B | Flat | Oceanside | 0.040 | 0.2500 | N/A |
| 0.3Q2 | B | Moderate | Oceanside | 0.040 | 0.2000 | N/A |
| 0.3Q2 | B | Steep | Oceanside | 0.040 | 0.1600 | N/A |
| 0.3Q2 | C | Flat | Oceanside | 0.040 | 0.1600 | N/A |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|-----|
| 0.3Q2 | C | Moderate | Oceanside | 0.040 | 0.1600 | N/A |
| 0.3Q2 | C | Steep | Oceanside | 0.040 | 0.1400 | N/A |
| 0.3Q2 | D | Flat | Oceanside | 0.040 | 0.1400 | N/A |
| 0.3Q2 | D | Moderate | Oceanside | 0.040 | 0.1400 | N/A |
| 0.3Q2 | D | Steep | Oceanside | 0.040 | 0.1200 | N/A |
| 0.3Q2 | A | Flat | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | A | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | A | Steep | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | B | Flat | L Wohlford | 0.040 | 0.2900 | N/A |
| 0.3Q2 | B | Moderate | L Wohlford | 0.040 | 0.2600 | N/A |
| 0.3Q2 | B | Steep | L Wohlford | 0.040 | 0.1600 | N/A |
| 0.3Q2 | C | Flat | L Wohlford | 0.040 | 0.1600 | N/A |
| 0.3Q2 | C | Moderate | L Wohlford | 0.040 | 0.1600 | N/A |
| 0.3Q2 | C | Steep | L Wohlford | 0.040 | 0.1200 | N/A |
| 0.3Q2 | D | Flat | L Wohlford | 0.040 | 0.1200 | N/A |
| 0.3Q2 | D | Moderate | L Wohlford | 0.040 | 0.1200 | N/A |
| 0.3Q2 | D | Steep | L Wohlford | 0.040 | 0.0800 | N/A |
| 0.1Q2 | A | Flat | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | A | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | A | Steep | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | B | Flat | Lindbergh | 0.040 | 0.5900 | N/A |
| 0.1Q2 | B | Moderate | Lindbergh | 0.040 | 0.5000 | N/A |
| 0.1Q2 | B | Steep | Lindbergh | 0.040 | 0.3200 | N/A |
| 0.1Q2 | C | Flat | Lindbergh | 0.040 | 0.3400 | N/A |
| 0.1Q2 | C | Moderate | Lindbergh | 0.040 | 0.3400 | N/A |
| 0.1Q2 | C | Steep | Lindbergh | 0.040 | 0.2400 | N/A |
| 0.1Q2 | D | Flat | Lindbergh | 0.040 | 0.2600 | N/A |
| 0.1Q2 | D | Moderate | Lindbergh | 0.040 | 0.2600 | N/A |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|-----|
| 0.1Q2 | D | Steep | Lindbergh | 0.040 | 0.1800 | N/A |
| 0.1Q2 | A | Flat | Oceanside | N/A | N/A | N/A |
| 0.1Q2 | A | Moderate | Oceanside | N/A | N/A | N/A |
| 0.1Q2 | A | Steep | Oceanside | N/A | N/A | N/A |
| 0.1Q2 | B | Flat | Oceanside | 0.040 | 0.4300 | N/A |
| 0.1Q2 | B | Moderate | Oceanside | 0.040 | 0.3400 | N/A |
| 0.1Q2 | B | Steep | Oceanside | 0.040 | 0.2400 | N/A |
| 0.1Q2 | C | Flat | Oceanside | 0.040 | 0.2600 | N/A |
| 0.1Q2 | C | Moderate | Oceanside | 0.040 | 0.2600 | N/A |
| 0.1Q2 | C | Steep | Oceanside | 0.040 | 0.2000 | N/A |
| 0.1Q2 | D | Flat | Oceanside | 0.040 | 0.2200 | N/A |
| 0.1Q2 | D | Moderate | Oceanside | 0.040 | 0.2200 | N/A |
| 0.1Q2 | D | Steep | Oceanside | 0.040 | 0.1600 | N/A |
| 0.1Q2 | A | Flat | L Wohlford | N/A | N/A | N/A |
| 0.1Q2 | A | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.1Q2 | A | Steep | L Wohlford | N/A | N/A | N/A |
| 0.1Q2 | B | Flat | L Wohlford | 0.040 | 0.4300 | N/A |
| 0.1Q2 | B | Moderate | L Wohlford | 0.040 | 0.3800 | N/A |
| 0.1Q2 | B | Steep | L Wohlford | 0.040 | 0.2800 | N/A |
| 0.1Q2 | C | Flat | L Wohlford | 0.040 | 0.2800 | N/A |
| 0.1Q2 | C | Moderate | L Wohlford | 0.040 | 0.2800 | N/A |
| 0.1Q2 | C | Steep | L Wohlford | 0.040 | 0.2000 | N/A |
| 0.1Q2 | D | Flat | L Wohlford | 0.040 | 0.2200 | N/A |
| 0.1Q2 | D | Moderate | L Wohlford | 0.040 | 0.2200 | N/A |
| 0.1Q2 | D | Steep | L Wohlford | 0.040 | 0.1400 | N/A |

Q_2 = 2-year pre-project flow rate based upon partial duration analysis of long-term hourly rainfall records
 Q_{10} = 10-year pre-project flow rate based upon partial duration analysis of long-term hourly rainfall records
A = Bioretention surface area sizing factor
 V_1 = Vault volume sizing factor

TABLE 4-11. Sizing Factors for Flow-Through Planters

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|--------|
| 0.5Q2 | A | Flat | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | A | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | A | Steep | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | B | Flat | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | B | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | B | Steep | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | C | Flat | Lindbergh | 0.115 | 0.0958 | 0.0690 |
| 0.5Q2 | C | Moderate | Lindbergh | 0.115 | 0.0958 | 0.0690 |
| 0.5Q2 | C | Steep | Lindbergh | 0.080 | 0.0667 | 0.0480 |
| 0.5Q2 | D | Flat | Lindbergh | 0.085 | 0.0708 | 0.0510 |
| 0.5Q2 | D | Moderate | Lindbergh | 0.085 | 0.0708 | 0.0510 |
| 0.5Q2 | D | Steep | Lindbergh | 0.065 | 0.0542 | 0.0390 |
| 0.5Q2 | A | Flat | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | A | Moderate | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | A | Steep | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | B | Flat | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | B | Moderate | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | B | Steep | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | C | Flat | Oceanside | 0.075 | 0.0625 | 0.0450 |
| 0.5Q2 | C | Moderate | Oceanside | 0.075 | 0.0625 | 0.0450 |
| 0.5Q2 | C | Steep | Oceanside | 0.065 | 0.0542 | 0.0390 |
| 0.5Q2 | D | Flat | Oceanside | 0.070 | 0.0583 | 0.0420 |
| 0.5Q2 | D | Moderate | Oceanside | 0.070 | 0.0583 | 0.0420 |
| 0.5Q2 | D | Steep | Oceanside | 0.050 | 0.0417 | 0.0300 |
| 0.5Q2 | A | Flat | L Wohlford | N/A | N/A | N/A |
| 0.5Q2 | A | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.5Q2 | A | Steep | L Wohlford | N/A | N/A | N/A |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|--------|
| 0.5Q2 | B | Flat | L Wohlford | N/A | N/A | N/A |
| 0.5Q2 | B | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.5Q2 | B | Steep | L Wohlford | N/A | N/A | N/A |
| 0.5Q2 | C | Flat | L Wohlford | 0.070 | 0.0583 | 0.0420 |
| 0.5Q2 | C | Moderate | L Wohlford | 0.070 | 0.0583 | 0.0420 |
| 0.5Q2 | C | Steep | L Wohlford | 0.050 | 0.0417 | 0.0300 |
| 0.5Q2 | D | Flat | L Wohlford | 0.055 | 0.0458 | 0.0330 |
| 0.5Q2 | D | Moderate | L Wohlford | 0.055 | 0.0458 | 0.0330 |
| 0.5Q2 | D | Steep | L Wohlford | 0.045 | 0.0375 | 0.0270 |
| 0.3Q2 | A | Flat | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | A | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | A | Steep | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | B | Flat | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | B | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | B | Steep | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | C | Flat | Lindbergh | 0.130 | 0.1083 | 0.0780 |
| 0.3Q2 | C | Moderate | Lindbergh | 0.130 | 0.1083 | 0.0780 |
| 0.3Q2 | C | Steep | Lindbergh | 0.100 | 0.0833 | 0.0600 |
| 0.3Q2 | D | Flat | Lindbergh | 0.105 | 0.0875 | 0.0630 |
| 0.3Q2 | D | Moderate | Lindbergh | 0.105 | 0.0875 | 0.0630 |
| 0.3Q2 | D | Steep | Lindbergh | 0.075 | 0.0625 | 0.0450 |
| 0.3Q2 | A | Flat | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | A | Moderate | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | A | Steep | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | B | Flat | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | B | Moderate | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | B | Steep | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | C | Flat | Oceanside | 0.105 | 0.0875 | 0.0630 |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|--------|
| 0.3Q2 | C | Moderate | Oceanside | 0.105 | 0.0875 | 0.0630 |
| 0.3Q2 | C | Steep | Oceanside | 0.085 | 0.0708 | 0.0510 |
| 0.3Q2 | D | Flat | Oceanside | 0.090 | 0.0750 | 0.0540 |
| 0.3Q2 | D | Moderate | Oceanside | 0.090 | 0.0750 | 0.0540 |
| 0.3Q2 | D | Steep | Oceanside | 0.070 | 0.0583 | 0.0420 |
| 0.3Q2 | A | Flat | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | A | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | A | Steep | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | B | Flat | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | B | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | B | Steep | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | C | Flat | L Wohlford | 0.085 | 0.0708 | 0.0510 |
| 0.3Q2 | C | Moderate | L Wohlford | 0.085 | 0.0708 | 0.0510 |
| 0.3Q2 | C | Steep | L Wohlford | 0.060 | 0.0500 | 0.0360 |
| 0.3Q2 | D | Flat | L Wohlford | 0.065 | 0.0542 | 0.0390 |
| 0.3Q2 | D | Moderate | L Wohlford | 0.065 | 0.0542 | 0.0390 |
| 0.3Q2 | D | Steep | L Wohlford | 0.050 | 0.0417 | 0.0300 |
| 0.1Q2 | A | Flat | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | A | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | A | Steep | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | B | Flat | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | B | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | B | Steep | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | C | Flat | Lindbergh | 0.250 | 0.2083 | 0.1500 |
| 0.1Q2 | C | Moderate | Lindbergh | 0.250 | 0.2083 | 0.1500 |
| 0.1Q2 | C | Steep | Lindbergh | 0.185 | 0.1542 | 0.1110 |
| 0.1Q2 | D | Flat | Lindbergh | 0.200 | 0.1667 | 0.1200 |
| 0.1Q2 | D | Moderate | Lindbergh | 0.200 | 0.1667 | 0.1200 |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V ₁ | V ₂ |
|----------------------|------------|----------|------------|-------|----------------|----------------|
| 0.1Q ₂ | D | Steep | Lindbergh | 0.130 | 0.1083 | 0.0780 |
| 0.1Q ₂ | A | Flat | Oceanside | N/A | N/A | N/A |
| 0.1Q ₂ | A | Moderate | Oceanside | N/A | N/A | N/A |
| 0.1Q ₂ | A | Steep | Oceanside | N/A | N/A | N/A |
| 0.1Q ₂ | B | Flat | Oceanside | N/A | N/A | N/A |
| 0.1Q ₂ | B | Moderate | Oceanside | N/A | N/A | N/A |
| 0.1Q ₂ | B | Steep | Oceanside | N/A | N/A | N/A |
| 0.1Q ₂ | C | Flat | Oceanside | 0.190 | 0.1583 | 0.1140 |
| 0.1Q ₂ | C | Moderate | Oceanside | 0.190 | 0.1583 | 0.1140 |
| 0.1Q ₂ | C | Steep | Oceanside | 0.140 | 0.1167 | 0.0840 |
| 0.1Q ₂ | D | Flat | Oceanside | 0.160 | 0.1333 | 0.0960 |
| 0.1Q ₂ | D | Moderate | Oceanside | 0.160 | 0.1333 | 0.0960 |
| 0.1Q ₂ | D | Steep | Oceanside | 0.105 | 0.0875 | 0.0630 |
| 0.1Q ₂ | A | Flat | L Wohlford | N/A | N/A | N/A |
| 0.1Q ₂ | A | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.1Q ₂ | A | Steep | L Wohlford | N/A | N/A | N/A |
| 0.1Q ₂ | B | Flat | L Wohlford | N/A | N/A | N/A |
| 0.1Q ₂ | B | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.1Q ₂ | B | Steep | L Wohlford | N/A | N/A | N/A |
| 0.1Q ₂ | C | Flat | L Wohlford | 0.135 | 0.1125 | 0.0810 |
| 0.1Q ₂ | C | Moderate | L Wohlford | 0.135 | 0.1125 | 0.0810 |
| 0.1Q ₂ | C | Steep | L Wohlford | 0.105 | 0.0875 | 0.0630 |
| 0.1Q ₂ | D | Flat | L Wohlford | 0.110 | 0.0917 | 0.0660 |
| 0.1Q ₂ | D | Moderate | L Wohlford | 0.110 | 0.0917 | 0.0660 |
| 0.1Q ₂ | D | Steep | L Wohlford | 0.080 | 0.0667 | 0.0480 |

Q₂ = 2-year pre-project flow rate based upon partial duration analysis of long-term hourly rainfall records
 Q₁₀ = 10-year pre-project flow rate based upon partial duration analysis of long-term hourly rainfall records
 A = Surface area sizing factor
 V₁ = Surface volume sizing factor
 V₂ = Subsurface volume sizing factor

TABLE 4-12. Sizing Factors for Infiltration Devices

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|-----|
| 0.5Q2 | A | Flat | Lindbergh | 0.040 | 0.1040 | N/A |
| 0.5Q2 | A | Moderate | Lindbergh | 0.040 | 0.1040 | N/A |
| 0.5Q2 | A | Steep | Lindbergh | 0.035 | 0.0910 | N/A |
| 0.5Q2 | B | Flat | Lindbergh | 0.058 | 0.1495 | N/A |
| 0.5Q2 | B | Moderate | Lindbergh | 0.055 | 0.1430 | N/A |
| 0.5Q2 | B | Steep | Lindbergh | 0.050 | 0.1300 | N/A |
| 0.5Q2 | C | Flat | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | C | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | C | Steep | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | D | Flat | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | D | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | D | Steep | Lindbergh | N/A | N/A | N/A |
| 0.5Q2 | A | Flat | Oceanside | 0.045 | 0.1170 | N/A |
| 0.5Q2 | A | Moderate | Oceanside | 0.045 | 0.1170 | N/A |
| 0.5Q2 | A | Steep | Oceanside | 0.040 | 0.1040 | N/A |
| 0.5Q2 | B | Flat | Oceanside | 0.065 | 0.1690 | N/A |
| 0.5Q2 | B | Moderate | Oceanside | 0.065 | 0.1690 | N/A |
| 0.5Q2 | B | Steep | Oceanside | 0.060 | 0.1560 | N/A |
| 0.5Q2 | C | Flat | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | C | Moderate | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | C | Steep | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | D | Flat | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | D | Moderate | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | D | Steep | Oceanside | N/A | N/A | N/A |
| 0.5Q2 | A | Flat | L Wohlford | 0.050 | 0.1300 | N/A |
| 0.5Q2 | A | Moderate | L Wohlford | 0.050 | 0.1300 | N/A |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|-----|
| 0.5Q2 | A | Steep | L Wohlford | 0.040 | 0.1040 | N/A |
| 0.5Q2 | B | Flat | L Wohlford | 0.078 | 0.2015 | N/A |
| 0.5Q2 | B | Moderate | L Wohlford | 0.075 | 0.1950 | N/A |
| 0.5Q2 | B | Steep | L Wohlford | 0.065 | 0.1690 | N/A |
| 0.5Q2 | C | Flat | L Wohlford | N/A | N/A | N/A |
| 0.5Q2 | C | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.5Q2 | C | Steep | L Wohlford | N/A | N/A | N/A |
| 0.5Q2 | D | Flat | L Wohlford | N/A | N/A | N/A |
| 0.5Q2 | D | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.5Q2 | D | Steep | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | A | Flat | Lindbergh | 0.040 | 0.1040 | N/A |
| 0.3Q2 | A | Moderate | Lindbergh | 0.040 | 0.1040 | N/A |
| 0.3Q2 | A | Steep | Lindbergh | 0.035 | 0.0910 | N/A |
| 0.3Q2 | B | Flat | Lindbergh | 0.058 | 0.1495 | N/A |
| 0.3Q2 | B | Moderate | Lindbergh | 0.055 | 0.1430 | N/A |
| 0.3Q2 | B | Steep | Lindbergh | 0.050 | 0.1300 | N/A |
| 0.3Q2 | C | Flat | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | C | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | C | Steep | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | D | Flat | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | D | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | D | Steep | Lindbergh | N/A | N/A | N/A |
| 0.3Q2 | A | Flat | Oceanside | 0.045 | 0.1170 | N/A |
| 0.3Q2 | A | Moderate | Oceanside | 0.045 | 0.1170 | N/A |
| 0.3Q2 | A | Steep | Oceanside | 0.040 | 0.1040 | N/A |
| 0.3Q2 | B | Flat | Oceanside | 0.065 | 0.1690 | N/A |
| 0.3Q2 | B | Moderate | Oceanside | 0.065 | 0.1690 | N/A |
| 0.3Q2 | B | Steep | Oceanside | 0.060 | 0.1560 | N/A |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|-----|
| 0.3Q2 | C | Flat | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | C | Moderate | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | C | Steep | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | D | Flat | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | D | Moderate | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | D | Steep | Oceanside | N/A | N/A | N/A |
| 0.3Q2 | A | Flat | L Wohlford | 0.050 | 0.1300 | N/A |
| 0.3Q2 | A | Moderate | L Wohlford | 0.050 | 0.1300 | N/A |
| 0.3Q2 | A | Steep | L Wohlford | 0.040 | 0.1040 | N/A |
| 0.3Q2 | B | Flat | L Wohlford | 0.078 | 0.2015 | N/A |
| 0.3Q2 | B | Moderate | L Wohlford | 0.075 | 0.1950 | N/A |
| 0.3Q2 | B | Steep | L Wohlford | 0.065 | 0.1690 | N/A |
| 0.3Q2 | C | Flat | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | C | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | C | Steep | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | D | Flat | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | D | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.3Q2 | D | Steep | L Wohlford | N/A | N/A | N/A |
| 0.1Q2 | A | Flat | Lindbergh | 0.040 | 0.1040 | N/A |
| 0.1Q2 | A | Moderate | Lindbergh | 0.040 | 0.1040 | N/A |
| 0.1Q2 | A | Steep | Lindbergh | 0.035 | 0.0910 | N/A |
| 0.1Q2 | B | Flat | Lindbergh | 0.058 | 0.1495 | N/A |
| 0.1Q2 | B | Moderate | Lindbergh | 0.055 | 0.1430 | N/A |
| 0.1Q2 | B | Steep | Lindbergh | 0.050 | 0.1300 | N/A |
| 0.1Q2 | C | Flat | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | C | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | C | Steep | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | D | Flat | Lindbergh | N/A | N/A | N/A |

| Lower Flow Threshold | Soil Group | Slope | Rain Gauge | A | V1 | V2 |
|----------------------|------------|----------|------------|-------|--------|-----|
| 0.1Q2 | D | Moderate | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | D | Steep | Lindbergh | N/A | N/A | N/A |
| 0.1Q2 | A | Flat | Oceanside | 0.045 | 0.1170 | N/A |
| 0.1Q2 | A | Moderate | Oceanside | 0.045 | 0.1170 | N/A |
| 0.1Q2 | A | Steep | Oceanside | 0.040 | 0.1040 | N/A |
| 0.1Q2 | B | Flat | Oceanside | 0.065 | 0.1690 | N/A |
| 0.1Q2 | B | Moderate | Oceanside | 0.065 | 0.1690 | N/A |
| 0.1Q2 | B | Steep | Oceanside | 0.060 | 0.1560 | N/A |
| 0.1Q2 | C | Flat | Oceanside | N/A | N/A | N/A |
| 0.1Q2 | C | Moderate | Oceanside | N/A | N/A | N/A |
| 0.1Q2 | C | Steep | Oceanside | N/A | N/A | N/A |
| 0.1Q2 | D | Flat | Oceanside | N/A | N/A | N/A |
| 0.1Q2 | D | Moderate | Oceanside | N/A | N/A | N/A |
| 0.1Q2 | D | Steep | Oceanside | N/A | N/A | N/A |
| 0.1Q2 | A | Flat | L Wohlford | 0.050 | 0.1300 | N/A |
| 0.1Q2 | A | Moderate | L Wohlford | 0.050 | 0.1300 | N/A |
| 0.1Q2 | A | Steep | L Wohlford | 0.040 | 0.1040 | N/A |
| 0.1Q2 | B | Flat | L Wohlford | 0.078 | 0.2015 | N/A |
| 0.1Q2 | B | Moderate | L Wohlford | 0.075 | 0.1950 | N/A |
| 0.1Q2 | B | Steep | L Wohlford | 0.065 | 0.1690 | N/A |
| 0.1Q2 | C | Flat | L Wohlford | N/A | N/A | N/A |
| 0.1Q2 | C | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.1Q2 | C | Steep | L Wohlford | N/A | N/A | N/A |
| 0.1Q2 | D | Flat | L Wohlford | N/A | N/A | N/A |
| 0.1Q2 | D | Moderate | L Wohlford | N/A | N/A | N/A |
| 0.1Q2 | D | Steep | L Wohlford | N/A | N/A | N/A |

Q₂ = 2-year pre-project flow rate based upon partial duration analysis of long-term hourly rainfall records

Q₁₀ = 10-year pre-project flow rate based upon partial duration analysis of long-term hourly rainfall records

A = Surface area sizing factor

V₁ = Infiltration volume sizing factor

► STEP 7: DETERMINE IF AVAILABLE SPACE FOR IMP IS ADEQUATE

Sizing and configuring IMPs may be an iterative process. After computing the minimum IMP area using Steps 1 – 6, review the site plan to determine if the reserved IMP area is sufficient. If so, the planned IMPs will meet the SUSMP sizing requirements. If not, revise the plan accordingly. Revisions may include:

- Reducing the overall imperviousness of the project site.
- Changing the grading and drainage to redirect some runoff toward other IMPs which may have excess capacity.
- Making tributary landscaped DMAs self-treating or self-retaining.
- Expanding IMP surface area.

► STEP 8: COMPLETE YOUR SUMMARY REPORT

Present your IMP sizing calculations in tabular form. All TCBMPs must be shown in tabular form on grading and improvement plans. Adapt the following format as appropriate to your project. Coordinate your presentation of DMAs and calculation of minimum IMP sizes with the DMA Exhibit (labeled to show delineation of DMAs and locations of IMPs) in your project's Major SWMP. It is also helpful to incorporate a brief description of each DMA and each IMP.

Sum the total area of all DMAs and IMPs listed and show it is equal to the total project area. This step may include adjusting the square footage of some DMAs to account for area used for IMPs.

Format:

Project Name:

Project Location:

APN or Subdivision Number:

Total Project Area (square feet):

Mean Annual Precipitation at Project Site:

I. Self-treating areas:

| <i>DMA Name</i> | <i>Area (square feet)</i> |
|-----------------|---------------------------|
| | |

II. Self-retaining areas:

| <i>DMA Name</i> | <i>Area (square feet)</i> |
|-----------------|---------------------------|
| | |

III. Areas draining to self-retaining areas:

| <i>DMA Name</i> | <i>Post-project surface type</i> | <i>Runoff factor</i> | <i>Area (square feet)</i> | <i>Receiving self-retaining DMA</i> | <i>Receiving self-retaining DMA Area (square feet)</i> |
|-----------------|----------------------------------|----------------------|---------------------------|-------------------------------------|--|
| | | | | | |

IV. Areas draining to IMPs (repeat for each IMP):

| <i>DMA Name</i> | <i>DMA Area (square feet)</i> | <i>Post-project surface type</i> | <i>DMA Runoff factor</i> | <i>DMA Area × runoff factor</i> | <i>Soil Type:</i> | <i>IMP Name</i> | | |
|---------------------|-------------------------------|----------------------------------|--------------------------|---------------------------------|-------------------|--------------------------|-------------------------------|--------------------------------|
| | | | | | | <i>IMP Sizing factor</i> | <i>Minimum Area or Volume</i> | <i>Proposed Area or Volume</i> |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| <i>Total</i> | | | | | | | | <i>IMP Area</i> |

Specify Preliminary Design Details

In your SWMP, describe your IMPs in sufficient detail to demonstrate the area, volume, and other criteria of each can be met within the constraints of the site.

Ensure these details are consistent with preliminary site plans, landscaping plans, and architectural plans submitted with your application for planning and zoning approvals.

Following are design sheets for:

- Self-treating and self-retaining areas

- Pervious pavements
- Bioretention facilities
- Flow-through planter
- Infiltration trenches and infiltration basins
- Cistern with bioretention facility

These design sheets include recommended configurations and details, and example applications, for these IMPs. The information in these design sheets must be adapted and applied to the conditions specific to the development project such as unstable slopes or the lack of available head. Designated County staff have final review and approval authority over the project design.

Keep in mind that proper and functional design of the IMP is the responsibility of the applicant. Effective operation of the IMP throughout the project's lifetime will be the responsibility of the property owner.

Alternatives to Integrated LID Design

If you believe design of features and facilities as described above is infeasible for your development site, consult with County staff before preparing an alternative design for stormwater treatment, flow control, and LID compliance.

For all alternative designs, the applicant must prepare a complete SWMP, including a drawing showing the entire site divided into discrete Drainage Management Areas, text and tables showing how drainage is routed from each DMA to a treatment facility, and calculations demonstrating the design achieves the applicable design criteria for each stormwater treatment facility. Alternative treatment facilities are limited to the circumstances and selection criteria identified beginning on page 42. The SWMP must also show how the project meets the minimum LID criteria (page 43) and ensures runoff rates, durations, and velocities are controlled to maintain or reduce downstream erosion conditions and protect stream (NPDES Permit Provision D.1.d.(10)). Alternative treatment facilities shall have high or medium removal efficiencies (see Table 2-3) for the primary pollutants of concern. The primary pollutants of concern are defined as pollutants anticipated from the development category (Table 2-1) that are also listed or proposed to be listed on the 303d list for the receiving water body to which the site drains (page 37).

► DESIGN OF ALTERNATIVE TREATMENT FACILITIES

Here are criteria and design considerations for some alternative treatment facilities:

Sand Filters. To ensure effectiveness is not compromised by compacting or clogging of the filter surface, sand filters must be maintained frequently.

The following criteria apply to sand filters:

- Calculate the design flow using the rational method with an intensity of 0.2"/hour and the “C” factors for “treatment only” from Table 4-2.
- To determine the required filter surface area, divide the design flow by an allowable design surface loading rate of 5"/hour.
- The minimum depth of filter media is 18". The media should be washed sand, with gradation similar to that specified for fine aggregate in ASTM C-33.
- The entire filter area must be accessible for easy maintenance without the need to enter a confined space.

A typical filter design includes a gravel drain layer and a perforated pipe underdrain. Filter fabric may be used to prevent the filter media from entering the gravel layer.

The design should not include any permanent pool or other standing water. Instead of including a pretreatment basin, consider the following features in the area tributary to the filter to reduce the potential for filter clogging:

- Limit the size of the Drainage Management Area.
- Include only impervious areas in the DMA.
- Stabilize slopes and eliminate sources of sediment in the DMA.
- Provide screens for trash and leaves at storm drain inlets.

For additional design considerations and details, see *Design of Stormwater Filtering Systems* by Richard A. Claytor and Thomas R. Schueler, The Center for Watershed Protection, 1996, and *California Stormwater BMP Handbooks* Fact Sheet TC-40, Media Filter.

Sand filters do not provide adequate hydromodification flow controls.

Extended (“Dry”) Detention Basins. The required detention volume for water quality treatment is based on the 85th percentile 24-hour storm depth. The steps to calculate the required detention volume are:

1. Use the County of San Diego's 85th Percentile Isopluvial Map to determine the unit basin volume.
2. Determine the weighted runoff factor (“C” factor) for the area tributary to the basin. The factors in Table 4-2 may be used.
3. Multiply the weighted runoff factor times the tributary area times the unit basin volume.

For maximum effectiveness the basin should not be sized substantially larger than this volume. If the basin is to be used for hydromodification flow control, then the BMP Sizing Calculator pond sizer or a continuous simulation model must be used to prove the basin meets peak flow and flow duration criteria.

For design considerations and details, see the [California Stormwater Best Management Practice Handbooks](#), Fact Sheet TC-22, “Extended Detention Basins.” The basin outlet should be designed for a 24-hour drawdown time.

As noted in Fact Sheet TC-22, “dry” detention basins may not be practicable for drainage areas less than 5 acres. The potential for mosquito harborage is a concern. In the design, do not create any areas that will hold standing water for time periods in excess of the maximum vector control detention time (96 hours for the County of San Diego).

“Wet” Detention Ponds and Constructed Wetlands. The required water quality detention volume is determined as with a “dry” detention basin. Before proceeding with design, contact the local mosquito control agency to coordinate the design and plan ongoing inspection and maintenance of the facility for mosquito control. For design considerations and details, see the [California Stormwater Best Management Practices Handbooks](#), Fact Sheet TC-20, “Wet Ponds,” and Fact Sheet TC-21, “Constructed Wetlands.”

Vegetated Swales. Design recommendations for conventional vegetated swales are in the [California Stormwater Best Management Practices Handbooks](#). The conventional swale design uses available on-site soils and does not include an underdrain system. Where soils are clayey, there is little infiltration. Treatment occurs as runoff flows through grass or other vegetation before exiting at the downstream end. Recommended detention times are on the order of 10 minutes. It should be noted that such designs would not provide the required hydromodification flow control benefit.

Conventional vegetated swales may be used to meet NPDES permit treatment requirements and LID requirements (see page 43). The following should be incorporated in the design:

- Determine the weighted runoff factor (“C” factor) for the area tributary to the swale. The factors in Table 4-2 may be used.
- Calculate the design flow by multiplying the weighted runoff factor times the tributary area times either (1) 0.2 inches of rainfall per hour, or (2) twice the 85th percentile hourly rainfall intensity.
- When sizing the swale, use a value of 0.25 for Manning’s “n”.
- Ensure that all flow enters the swale near its highest point and that no flow short-circuits treatment by entering the swale along its length.
- The swale should be a minimum 100 feet in length.

- Longitudinal slopes should not exceed 2.5%; on flatter slopes, incorporate measures to avoid prolonged surface ponding.

Consider using linear-shaped bioretention areas (see page 107) in place of conventional vegetated swales because:

- Conventional swale design has resulted in standing water and associated nuisances.
- Conventional swales often don't obtain even the design residence time because of the length required and because proper design requires runoff enter the swale at the upstream end rather than at various locations along its length, and
- Bioretention areas provide a more flexible drainage design, more effective practicable treatment, and more effective flow control within the same footprint.

In the western part of San Diego County (west of the Pacific Ocean drainage divide), rock swales would not generally provide adequate water quality treatment. In the eastern portion of the County, rock swales could potentially be used as part of the water quality treatment design given the prevalence of high-infiltration sandy soils and the harsh climatic conditions which prevent vegetation establishment. Implementation of rock swales would require approval from the governing municipality. The design of vegetated strips, if allowed by the governing municipality, should follow Caltrans design guidance.

► TREATMENT FACILITIES FOR SPECIAL CIRCUMSTANCES

Higher-rate surface filters and vault-based proprietary filters can only be used in the circumstances described beginning on page 41 and when sand filters, extended “dry” detention basins, and “wet” detention ponds or constructed wetlands have been found infeasible.

For surface filters, the grading and drainage design should minimize the area draining to each unit and maximize the number of discrete drainage areas and units. Proprietary facilities should be installed consistent with the manufacturer's instructions.

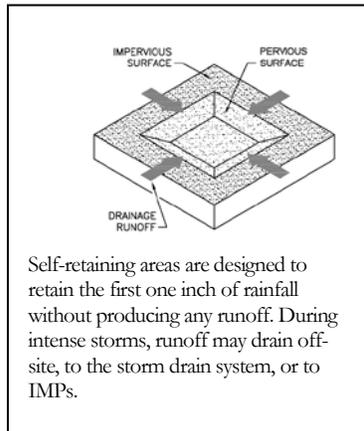
Such facilities do not provide hydromodification flow control benefit.

References and Resources:

- [RWQCB Order R9-2007-0001 \(Stormwater NPDES Permit\)](#)
- [Low Impact Development Center](#)
- [County of San Diego Low Impact Development Handbook](#)
- [California Best Management Practices Handbook](#)
- [Design of Stormwater Filtering Systems](#) (Clayton and Scheuler, 1996)
- [American Rainwater Catchment Systems Association](#)
- [Water Conservation Alliance of Southern Arizona](#)
- [Rainwater Harvesting for Drylands and Beyond](#)
- [The Texas Manual on Rainwater Harvesting](#)
- *Managing Wet Weather With Green Infrastructure: Municipal Handbook,*

Self-Treating and Self-Retaining Areas

► CRITERIA



Best Uses

- Heavily landscaped sites

Advantages

- Complements site landscaping

Limitations

- Requires substantial square footage
- Grading requirements must be coordinated with landscape design

LID design seeks to manage runoff from roofs and paving so effects on water quality and hydrology are minimized. Runoff from landscaping, however, does not need to be managed the same way.

Runoff from landscaping can be managed by creating self-treating and self-retaining areas.

Self-treating areas are natural, landscaped, or turf areas that drain directly off site or to the storm drain system. Examples include upslope undeveloped areas that are ditched and drained around a development and grassed slopes that drain offsite to a street or storm drain. Self-treating areas may not drain on to adjacent paved areas.

Where a landscaped area is upslope from or surrounded by paved areas, a self-retaining area (also called a zero-discharge area) may be created. Self-retaining areas are designed to retain the first one inch of rainfall without producing any runoff. The technique works best on flat, heavily landscaped sites. It may be used on mild slopes if there is a reasonable expectation that the first inch of rainfall would produce no runoff.

To create self-retaining turf and landscape areas in flat areas or on terraced slopes, berm the area or depress the grade into a concave cross-section so that these areas will retain the first inch of rainfall. Inlets of area drains, if any, should be set 3 inches above the low point to allow ponding.

Areas draining to self retaining areas. Drainage from roofs and paving can be directed to self-retaining areas and allowed to infiltrate into the soil. The maximum allowable ratio is 2 parts impervious: 1 part pervious for water quality treatment and a ratio of 1 part impervious: 1 part pervious for Hydromodification flow-control.

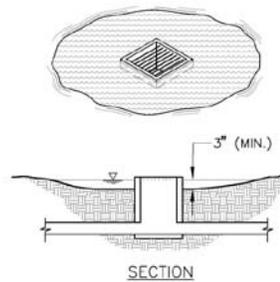
The self-retaining area must be bermed or depressed to retain an inch of rainfall including the flow from the tributary impervious area.

► DETAILS

Drainage from self-treating areas must flow to off-site streets or storm drains without flowing on to paved areas.

Pavement within a self-treating area cannot exceed 5% of the total area.

In self-retaining areas, overflows and area drain inlets should be set high enough to ensure ponding over the entire surface of the self-retaining area. The area drain inlets must have a grate elevation set so that 1" of rainfall from the entire area (both impervious and pervious areas) does not produce any runoff. If the self-retaining area itself was flat, and there was 2 parts impervious draining to the 1 part pervious (self-retaining area), then the grate elevation of the area drain would need to be 3" high. However, the total area draining to the self-retaining area and the slope of the self-retaining area will govern the height of the area drain inlet grate. The overall goal is to produce no runoff from 1" of rainfall over the entire tributary and self-retaining area itself.



Set overflows and area drain inlets high enough to ensure ponding (3" deep) over the surface of the self-retaining area.

Self-retaining areas should be designed to promote even distribution of ponded runoff over the area.

Leave enough reveal (from pavement down to landscaped surface) to accommodate buildup of turf or mulch.

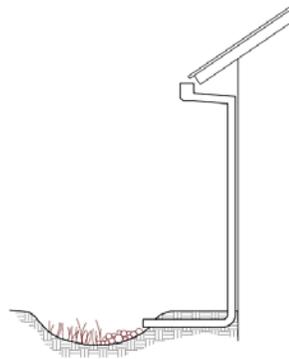
► APPLICATIONS

Lawn or landscaped areas adjacent to streets can be considered self-treating areas.

Self-retaining areas can be created by depressing lawn and landscape below surrounding sidewalks and plazas.

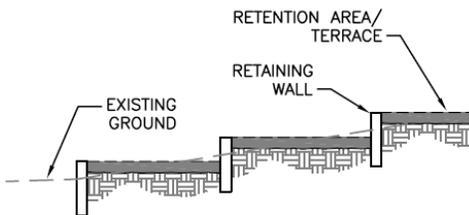
Runoff from walkways or driveways in parks and park-like areas can sheet-flow to self-retaining areas.

Roof leaders can be connected to self-retaining areas by piping beneath plazas and walkways. If necessary, a “bubble-up” can be used.



Connecting a roof leader to a self-retaining area. The head from the eave height makes it possible to route roof drainage some distance away from the building.

Self-retaining areas can be created by terracing mild slopes. The elevation difference promotes subsurface drainage.



Mild slopes can be terraced to create self-retaining areas.

► DESIGN CHECKLIST FOR SELF-TREATING AREAS

- The self-treating area is at least 95% lawn or landscaping (not more than 5% impervious).
- Re-graded or re-landscaped areas have amended soils, vegetation, and irrigation as may be required to maintain soil stability and permeability.
- Runoff from the self-treating area does not enter an IMP or another drainage management area, but goes directly to the storm drain system.

▶ DESIGN CHECKLIST FOR SELF-RETAINING AREAS

- Area is bermed all the way around or graded concave. Slopes do not exceed 4%.
- Entire area is lawn, landscaping, or pervious pavement (see criteria in Chapter 4).
- Area has amended soils, vegetation, and irrigation as may be required to maintain soil stability and permeability.
- Any area drain inlets are at least 3 inches above surrounding grade in order to retain 1" of runoff from the entire tributary area.
- Overflow in excess of 1" of rainfall must be safely conveyed towards an acceptable conveyance system.
- Infiltration rate is sufficient to ensure the self-retaining area will drain completely within 96 hours. Soil infiltration feasibility has been confirmed by a geotechnical engineer.
- Set back from structures 10' or as recommended by structural or geotechnical engineer.

▶ DESIGN CHECKLIST FOR AREAS DRAINING TO SELF-RETAINING AREAS

- Ratio of tributary impervious area to self-retaining area is not greater than 2:1 for water quality treatment and a ratio of 1:1 for hydromodification flow-control.
- Roof leaders collect runoff and route it to the self-retaining area.
- Paved areas are sloped so drainage is routed to the self-retaining area.
- Inlets are designed to protect against erosion and distribute runoff across the area.

Pervious Pavements

► CRITERIA

Impervious roadways, driveways, and parking lots account for much of the hydrologic impact of land development. In contrast, pervious pavements allow rainfall to collect in a gravel or sand base course and infiltrate into native soil.

Pervious pavements are designed to transmit rainfall through the surface to storage in a base course. For example, a 4-inch-deep base course provides approximately 1.6 inches of storage. Runoff stored in the base course infiltrates to native soils over time. Except in the case of solid pavers, the surface course provides additional storage.

Areas with the following pervious pavements may be regarded as “self-treating” and require no additional treatment or flow control if they drain off-site (not to an IMP).

- Pervious concrete
- Porous asphalt
- Crushed aggregate (gravel)
- Open pavers with grass or plantings
- Open pavers with gravel
- Artificial turf

Areas with these pervious pavements can also be self-retaining areas and may receive runoff from impervious areas if they are bermed or depressed to retain the first one inch of rainfall, including runoff from the tributary impervious area.

Solid unit pavers—such as bricks, stone blocks, or precast concrete shapes—are considered to reduce runoff compared to impervious pavement, when the unit pavers are set in sand or gravel with d " gaps between the pavers. Joints must be filled with an open-graded aggregate free of fines.

Best Uses

- Areas with permeable native soils
- Low-traffic areas
- Where aesthetic quality can justify higher cost

Advantages

- Variety of surface treatments can complement landscape design

Limitations

- Initial cost
- Placement requires specially trained crews
- Geotechnical concerns, especially in clay soils
- Concerns about pavement strength and surface integrity
- Some municipalities do not allow in public right of way

When draining pervious pavements to an IMP, use the runoff factors in Table 4-2.

► DETAILS

Permeable pavements can be used in clay soils; however, special design considerations, including an increased depth of base course, typically apply and will increase the cost of this option. Geotechnical fabric between the base course and underlying clay soil is recommended.

Pavement strength and durability typically determines the required depth of base course. If underdrains are used, the outlet elevation must be a minimum of 3 inches above the bottom elevation of the base course.

Pervious concrete and porous asphalt must be installed by crews with special training and tools. Industry associations maintain lists of qualified contractors.

Parking lots with crushed aggregate or unit pavers may require signs or bollards to organize parking.

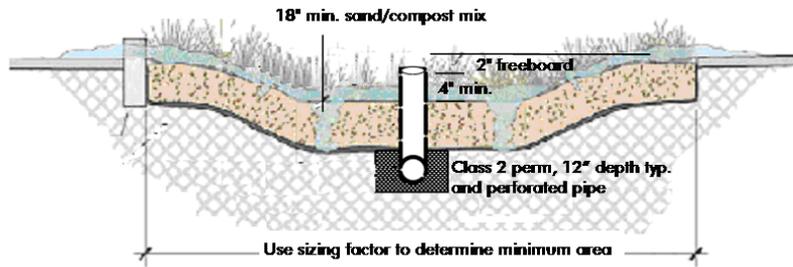
► DESIGN CHECKLIST FOR PERVIOUS PAVEMENTS

- No erodible areas drain on to pavement.
- Subgrade is uniform. Compaction is minimal.
- Reservoir base course is of open-graded crushed stone. Base depth is adequate to retain rainfall and support design loads.
- If a subdrain is provided, outlet elevation is a minimum of 3 inches above bottom of base course.
- Subgrade is uniform and slopes are not so steep that subgrade is prone to erosion.
- Rigid edge is provided to retain granular pavements and unit pavers.
- Solid unit pavers are installed with open gaps filled with open-graded aggregate free of fines.
- Permeable pavements are installed by industry-certified professionals according to vendor's recommendations.
- Selection and location of pavements incorporates Americans with Disabilities Act requirements, site aesthetics, and uses.

Resources

- Southern California Concrete Producers www.concreteresources.net.
- California Asphalt Pavement Association <http://www.californiapavements.org/stormwater.html>
- Interlocking Concrete Pavement Institute <http://www.icpi.org/>
- *Start at the Source Design Manual for Water Quality Protection*, pp. 47-53. www.basmaa.org
- *Porous Pavements*, by Bruce K. Ferguson. 2005. ISBN 0-8493-2670-2.

Bioretention Facilities



Bioretention facility configured for treatment-only requirements. Bioretention facilities can be rectangular, linear, or nearly any shape.

Bioretention detains runoff in a surface reservoir, filters it through plant roots and a biologically active soil mix, and then infiltrates it into the ground. Where native soils are less permeable, an underdrain conveys treated runoff to storm drain or surface drainage.

Bioretention facilities can be configured in nearly any shape. When configured as linear swales, they can convey high flows while percolating and treating lower flows.

Bioretention facilities can be configured as in-ground or above-ground planter boxes, with the bottom open to allow infiltration to native soils underneath. If infiltration cannot be allowed, use the sizing factors and criteria for the Flow-Through Planter.

► CRITERIA

For development projects subject only to runoff treatment requirements, the following criteria apply:

| Parameter | Criterion |
|-----------------------------------|---|
| Soil mix depth | 18 inches minimum |
| Soil mix minimum percolation rate | 5 inches per hour minimum sustained (10 inches per hour initial rate recommended) |
| Soil mix surface area | 0.04 times tributary impervious area (or equivalent) |

Best Uses

- Commercial areas
- Residential subdivisions
- Industrial developments
- Roadways
- Parking lots
- Fit in setbacks, medians, and other landscaped areas

Advantages

- Can be any shape
- Low maintenance
- Can be landscaped

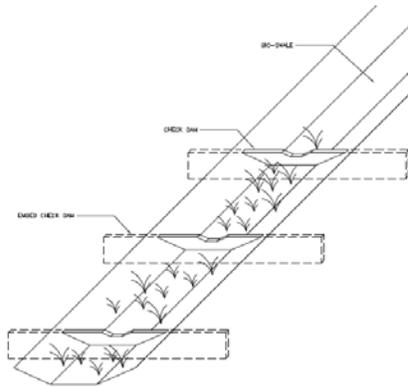
Limitations

- Require 4% of tributary impervious square footage
- Typically requires 3-4 feet of head
- Irrigation typically required

| Parameter | Criterion |
|-------------------------|--|
| Surface reservoir depth | 6 inches minimum; may be sloped to 4 inches where adjoining walkways. |
| Underdrain | Required in Group “C” and “D” soils. Perforated pipe embedded in gravel (“Class 2 permeable” recommended), connected to storm drain or other accepted discharge point. |

► DETAILS

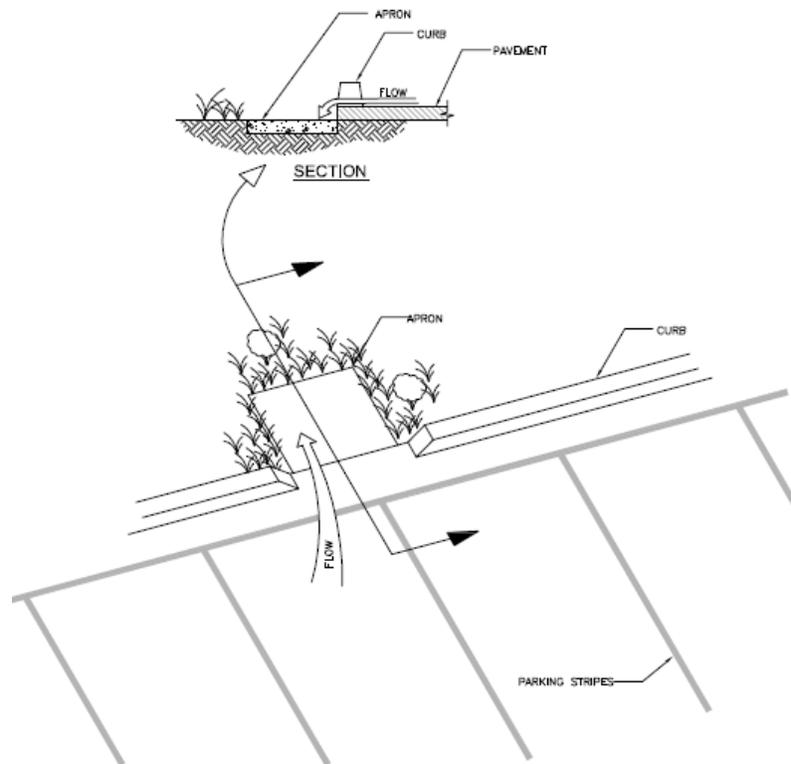
Plan. On the surface, a bioretention facility should be one level, shallow basin—or a series of basins. As runoff enters each basin, it should flood and fill throughout before runoff overflows to the outlet or to the next downstream basin. This will help prevent movement of surface mulch and soil mix.



Use check dams for linear bioretention facilities (swales) on a slope.

In a linear swale, check dams should be placed so that the lip of each dam is at least as high as the toe of the next upstream dam. A similar principle applies to bioretention facilities built as terraced roadway shoulders.

Inlets. Paved areas draining to the facility should be graded, and inlets should be placed, so that runoff remains as sheet flow or as dispersed as possible. Curb cuts should be wide (12" is recommended) to avoid clogging with leaves or debris. Allow for a minimum reveal of 4"-6" between the inlet and soil mix elevations to ensure turf or mulch buildup does not block the inlet. In addition, place an apron of stone or concrete, a foot square or larger, inside each inlet to prevent vegetation from growing up and blocking the inlet.



Where runoff is collected in pipes or gutters and conveyed to the facility, protect the landscaping from high-velocity flows with energy-dissipating rocks. In larger installations, provide cobble-lined channels to better distribute flows throughout the facility.

Upturned pipe outlets can be used to dissipate energy when runoff is piped from roofs and upgradient paved areas.

Soil mix. The required soil mix is similar to a loamy sand. It must maintain a minimum percolation rate of 5" per hour throughout the life of the facility, and it must be suitable for maintaining plant life. Typically, on-site soils will not be suitable due to clay content.

Storage and drainage layer. "Class 2 permeable," Caltrans specification 68-1.025, is recommended. Open-graded crushed rock, washed, may be used, but requires 4"-6" washed pea gravel be substituted at the top of the crushed rock gravel layers. Do not use filter fabric to separate the soil mix from the gravel drainage layer or the gravel drainage layer from the native soil.

Underdrains. No underdrain is required where native soils beneath the facility are Hydrologic Soil Group A or B. For treatment-only facilities where native soils are Group C or D, a

perforated pipe must be bedded in the gravel layer and must terminate at a storm drain or other approved discharge point.

Outlets. In treatment-only facilities, outlets must be set high enough to ensure the surface reservoir fills and the entire surface area of soil mix is flooded before the outlet elevation is reached. In swales, this can be achieved with appropriately placed check dams.

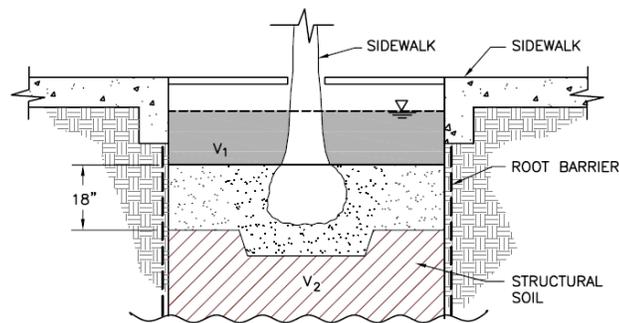
The outlet should be designed to exclude floating mulch and debris.

Vaults, utility boxes and light standards. It is best to locate utilities outside the bioretention facility—in adjacent walkways or in a separate area set aside for this purpose. If utility structures are to be placed within the facility, the locations should be anticipated and adjustments made to ensure the minimum bioretention surface area and volumes are achieved. Leaving the final locations to each individual utility can produce a haphazard, unaesthetic appearance and make the bioretention facility more difficult to maintain.

Emergency overflow. The site grading plan should anticipate extreme events and potential clogging of the overflow and route emergency overflows safely.

Trees. Bioretention areas can accommodate small or large trees. There is no need to subtract the area taken up by roots from the effective area of the facility. Extensive tree roots maintain soil permeability and help retain runoff. Normal maintenance of a bioretention facility should not affect tree lifespan.

The bioretention facility can be integrated with a tree pit of the required depth and filled with structural soil. If a root barrier is used, it can be located to allow tree roots to spread throughout the bioretention facility while protecting adjacent pavement. Locations and planting elevations should be selected to avoid blocking the facility's inlets and outlets.



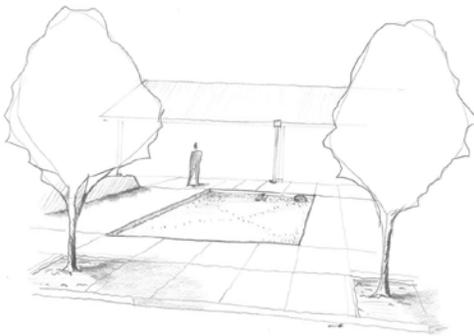
Bioretention facility configured as a tree well.
The root barrier is optional.

► APPLICATIONS

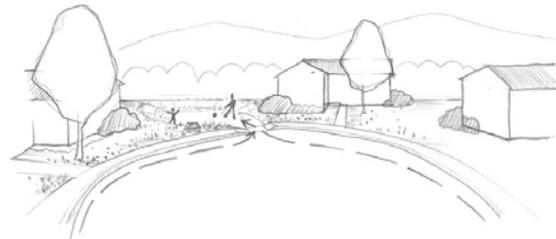
Multi-purpose landscaped areas. Bioretention facilities are easily adapted to serve multiple purposes. The loamy sand soil mix will support turf or a plant palette suitable to the location and a well-drained soil.

Example landscape treatments:

- Lawn with sloped transition to adjacent landscaping.
- Swale in setback area
- Swale in parking median
- Lawn with hardscaped edge treatment
- Decorative garden with formal or informal plantings
- Traffic island with low-maintenance landscaping
- Raised planter with seating
- Bioretention on a terraced slope



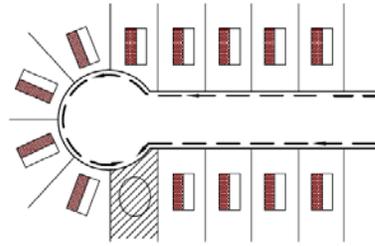
Bioretention facility configured as a recessed decorative lawn with hardscaped edge.



Bioretention facility configured and planted as a lawn/ play area.

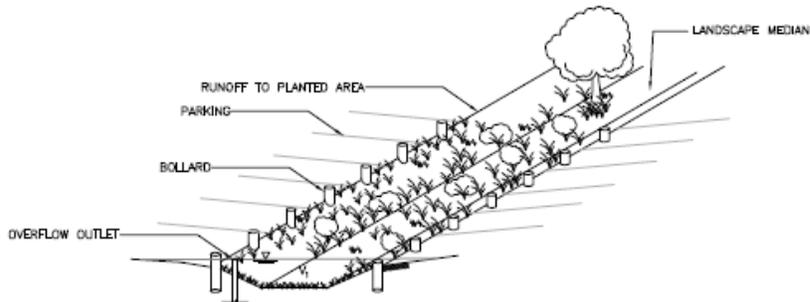
Residential subdivisions. Some subdivisions are designed to drain roofs and driveways to the streets (in the conventional manner) and then drain the streets to bioretention areas, with one bioretention area for each 1 to 6 lots, depending on subdivision layout and topography.

If allowed by the local jurisdiction, bioretention areas can be placed on a separate, dedicated parcel with joint ownership.



Bioretention facility receiving drainage from individual lots and the street in a residential subdivision.

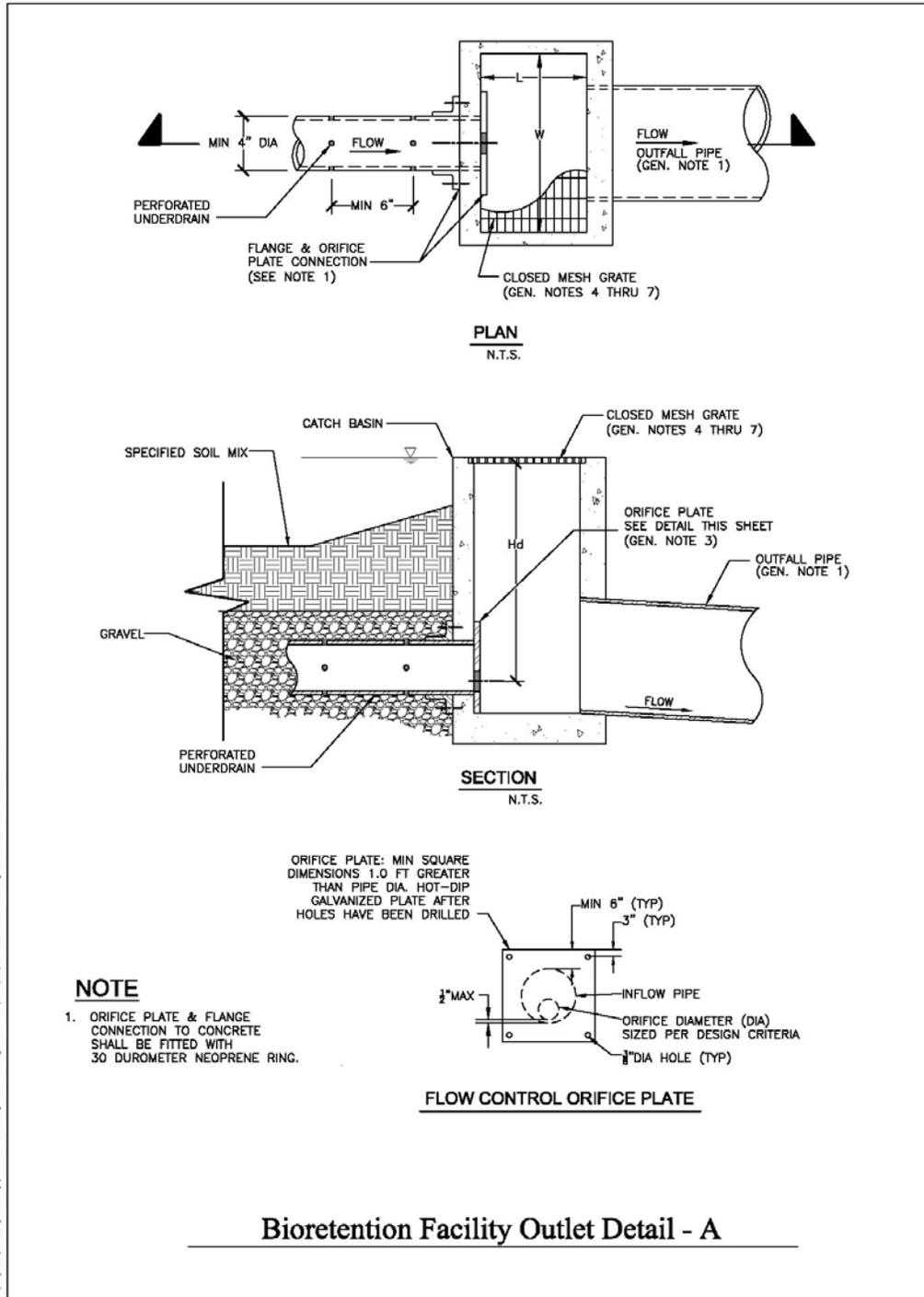
Sloped sites. Bioretention facilities must be constructed as a basin, or series of basins, with the circumference of each basin set level. It may be necessary to add curbs or low retaining walls.



Bioretention facility configured as a parking median. Note use of bollards in place of curbs, eliminating the need for curb cuts.

Design Checklist for Bioretention

- Volume or depth of surface reservoir meets or exceeds minimum.
- 18" depth "loamy sand" soil mix with minimum long-term percolation rate of 5"/hour.
- Area of soil mix meets or exceeds minimum.
- Perforated pipe underdrain bedded in "Class 2 perm" with connection and sufficient head to storm drain or discharge point (except in "A" or "B" soils).
- No filter fabric.
- Underdrain has a clean-out port consisting of a vertical, rigid, non-perforated PVC pipe, with a minimum diameter of 6 inches and a watertight cap.
- Location and footprint of facility are shown on site plan and landscaping plan.
- Bioretention area is designed as a basin (level edges) or a series of basins, and grading plan is consistent with these elevations. If facility is designed as a swale, check dams are set so the lip of each dam is at least as high as the toe of the next upstream dam.
- Inlets are 12" wide, have 4"-6" reveal and an apron or other provision to prevent blockage when vegetation grows in, and energy dissipation as needed.
- Overflow connected to a downstream storm drain or approved discharge point.
- Emergency spillage will be safely conveyed overland.
- Plantings are suitable to the climate and a well-drained soil.
- Irrigation system with connection to water supply.
- Vaults, utility boxes, and light standards are located outside the minimum soil mix surface area.
- When excavating, avoid smearing of the soils on bottom and side slopes. Minimize compaction of native soils and "rip" soils if clayey and/or compacted. Protect the area from construction site runoff.



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Flow-through Planter



Portland 2004 Stormwater Manual

Flow-through planters treat and detain runoff without allowing seepage into the underlying soil. They can be used next to buildings and on slopes where stability might be affected by adding soil moisture.

Flow-through planters typically receive runoff via downspouts leading from the roofs of adjacent buildings. However, they can also be set in-ground and receive sheet flow from adjacent paved areas.

Pollutants are removed as runoff passes through the soil layer and is collected in an underlying layer of gravel or drain rock. A perforated-pipe underdrain is typically connected to a storm drain or other discharge point. An overflow inlet conveys flows which exceed the capacity of the planter.

► CRITERIA

Treatment only. For development projects subject only to runoff treatment requirements, the following criteria apply:

| Parameter | Criterion |
|-----------------------------------|---|
| Soil mix depth | 18 inches minimum |
| Soil mix minimum percolation rate | 5 inches per hour minimum sustained (10 inches per hour initial rate recommended) |

Best Uses

- Management of roof runoff
- Next to buildings
- Dense urban areas
- Where infiltration is not desired

Advantages

- Can be used next to structures
- Versatile
- Can be any shape
- Low maintenance

Limitations

- Can be used for flow-control only on sites with “C” and “D” soils
- Requires underdrain
- Requires 3-4 feet of head

| Parameter | Criterion |
|-------------------------|---|
| Soil mix surface area | 0.04 times tributary impervious area (or equivalent) |
| Surface reservoir depth | 6" minimum; may be sloped to 4" where adjoining walkways. |
| Underdrain | Typically used. Perforated pipe embedded in gravel ("Class 2 permeable" recommended), connected to storm drain or other accepted discharge point. |

► DETAILS

Configuration. The planter must be level. To avoid standing water in the subsurface layer, set the perforated pipe underdrain and orifice as nearly flush with the planter bottom as possible.

Inlets. Protect plantings from high-velocity flows by adding rocks or other energy-dissipating structures at downspouts and other inlets.

Soil mix. The required soil mix is similar to a loamy sand. It must maintain a minimum percolation rate of 5" per hour throughout the life of the facility, and it must be suitable for maintaining plant life. Typically, on-site soils will not be suitable due to clay content.

Gravel storage and drainage layer. "Class 2 permeable," Caltrans specification 68-1.025, is recommended. Open-graded crushed rock, washed, may be used, but requires 4"-6" of washed pea gravel be substituted at the top of the crushed rock layer. **Do not use filter fabric** to separate the soil mix from the gravel drainage layer.

Emergency overflow. The planter design and installation should anticipate extreme events and potential clogging of the overflow and route emergency overflows safely.

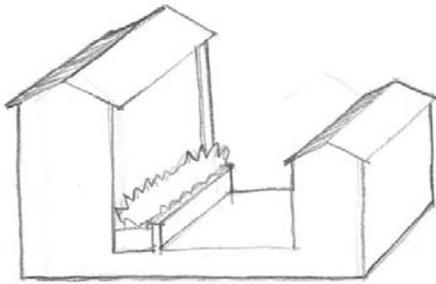
► APPLICATIONS

Adjacent to buildings. Flow-through planters may be located adjacent to buildings, where the planter vegetation can soften the visual effect of the building wall. A setback with a raised planter box may be appropriate even in some neo-traditional pedestrian-oriented urban streetscapes.

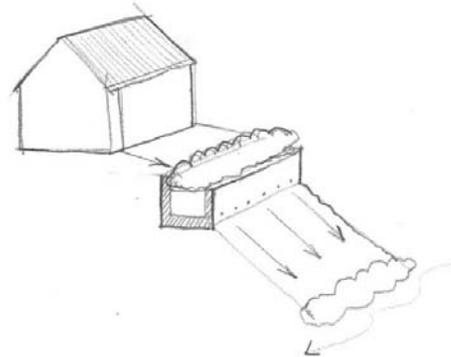
At plaza level. Flow-through planters have been successfully incorporated into podium-style developments, with the planters placed on the plaza level and receiving runoff from the tower roofs above. Runoff from the plaza level is typically managed separately by additional flow-through planters or bioretention facilities located at street level.

Steep slopes. Flow-through planters provide a means to detain and treat runoff on slopes that cannot accept infiltration from a bioretention facility. The planter can be built into the slope similar to a retaining wall. The design should consider the need to access the planter for periodic

maintenance. Flows from the planter underdrain and overflow must be directed in accordance with local requirements. It is sometimes possible to disperse these flows to the downgradient hillside.



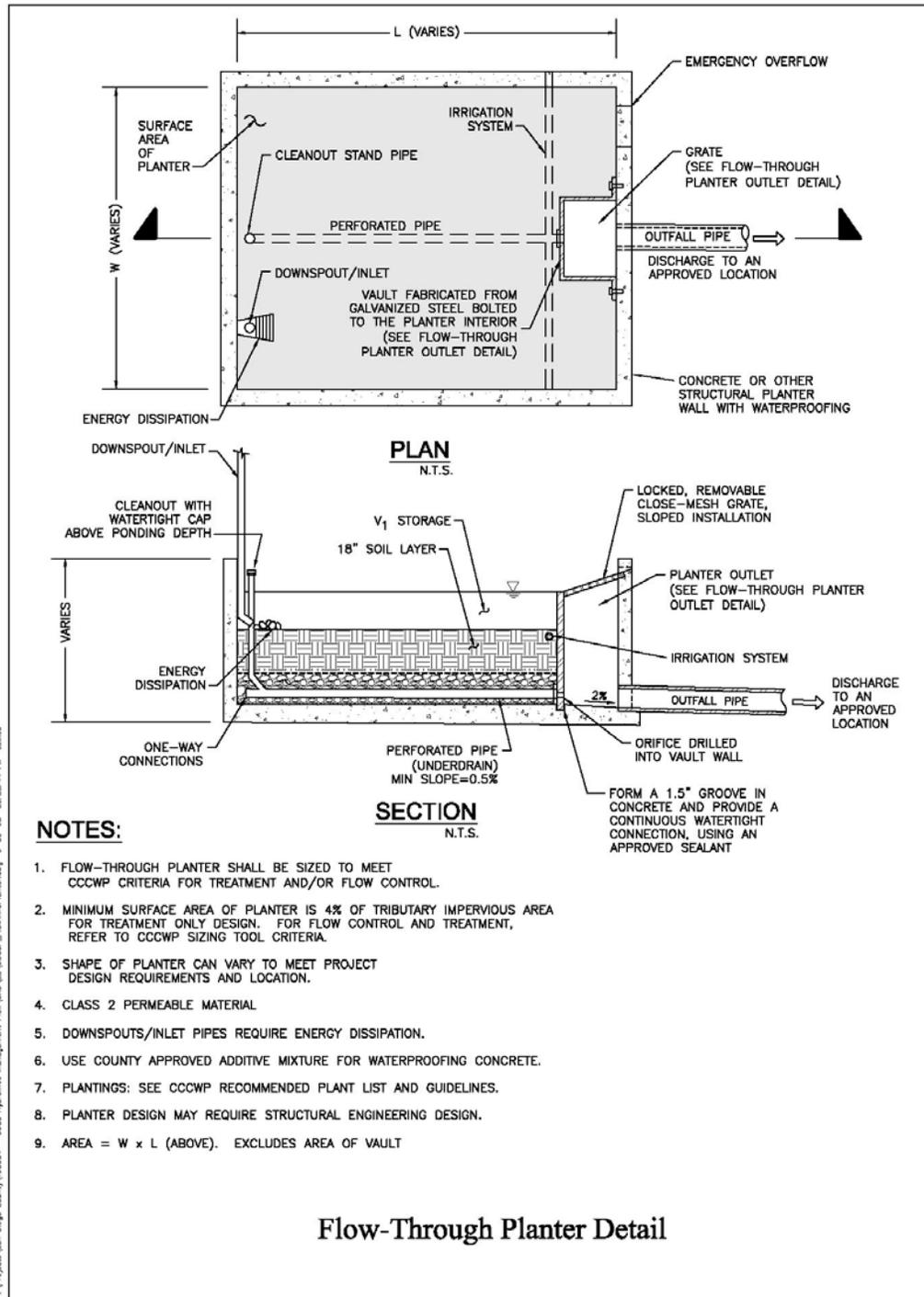
Flow-through planter on the plaza level of a podium-style development.



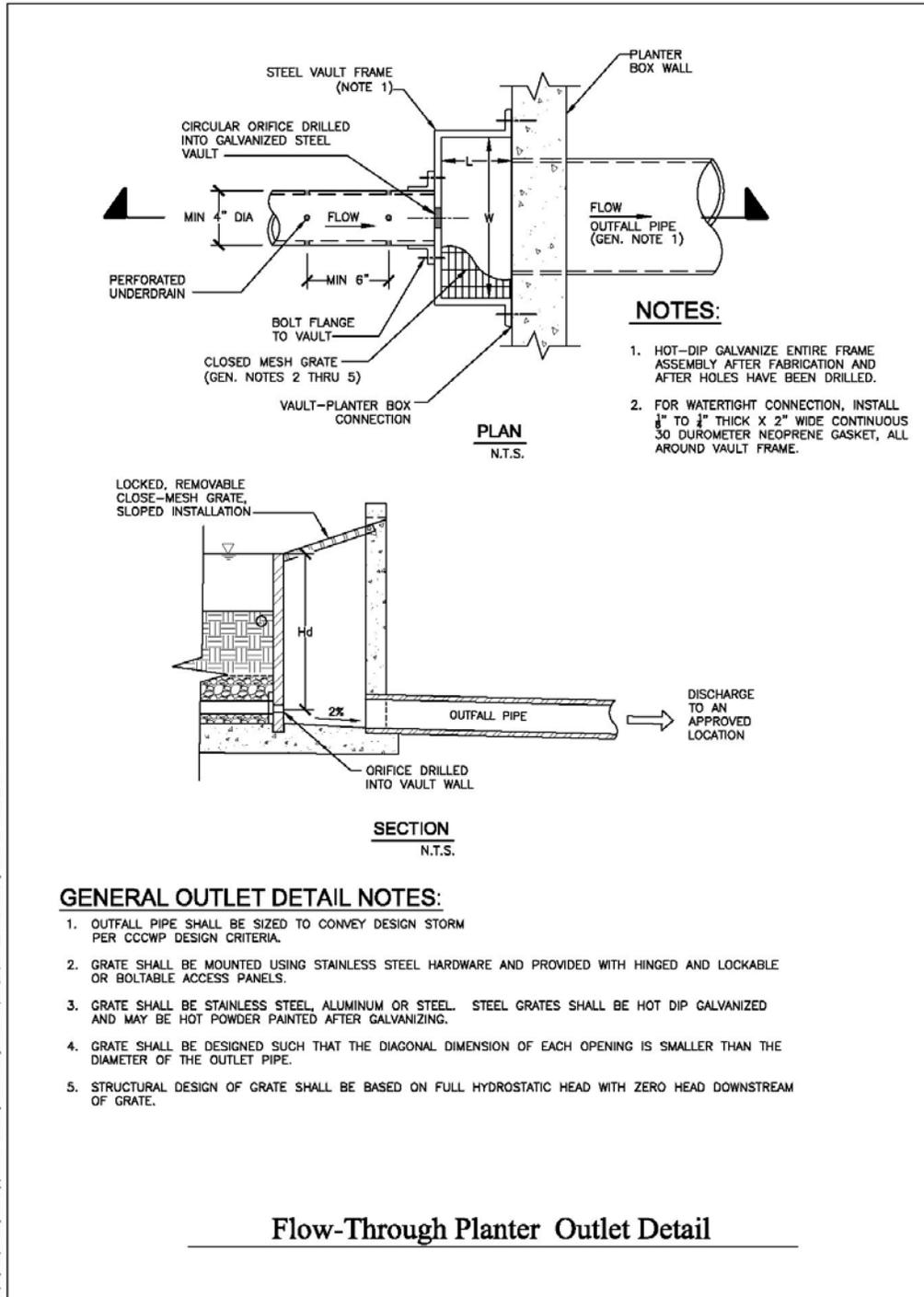
Flow-through planter built into a hillside. Flows from the underdrain and overflow must be directed in accordance with local requirements.

Design Checklist for Flow-through Planter

- Reservoir depth is 4-6" minimum.
- 18" depth "loamy sand" soil mix with minimum long-term infiltration rate of 5"/hour.
- Area of soil mix meets or exceeds minimum.
- "Class 2 perm" drainage layer.
- No filter fabric.
- Perforated pipe underdrain with outlet located flush or nearly flush with planter bottom. Connection with sufficient head to storm drain or discharge point.
- Underdrain has a clean-out port consisting of a vertical, rigid, non-perforated PVC pipe, with a minimum diameter of 6 inches and a watertight cap.
- Overflow connected to a downstream storm drain or approved discharge point.
- Location and footprint of facility are shown on site plan and landscaping plan.
- Planter is set level.
- Emergency spillage will be safely conveyed overland.
- Plantings are suitable to the climate and a well-drained soil.
- Irrigation system with connection to water supply.



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Infiltration Trenches and Infiltration Basins

The typical infiltration trench is a prefabricated structure, such as an open-bottomed vault or box, placed in an excavation or boring. The vault may be empty, which provides maximum space efficiency, or may be filled in rock.

An infiltration basin has the same functional components—a volume to store runoff and sufficient area to infiltrate that volume into the native soil—but is open rather than covered.

► CRITERIA

Infiltration trenches and infiltration basins must be designed with the minimum volume calculated by Equation 4-8 using a unit volume based on the County of San Diego's 85th Percentile Isopluvial Map.

Consult with the local jurisdiction engineer regarding the need to verify soil permeability and other site conditions are suitable for infiltration trenches and infiltration basins. Some proposed criteria are on Page 5-12 of Caltrans' 2004 *BMP Retrofit Pilot Study Final Report* (CTSW-RT-01-050).

The infiltration rate and infiltrative area must be sufficient to drain a full facility within 96 hours.

► DETAILS

Infiltration trenches should be sited to allow for the potential future need for removal and replacement.

In locations where native soils are coarser than a medium sand, the area directly beneath the facility should be over-excavated by two feet and backfilled with sand as a groundwater protection measure.

Best Uses

- Alternative to bioretention in areas with permeable soils

Advantages

- Compact footprint
- Can be installed in paved areas

Limitations

- Can be used only on sites with "A" and "B" soils
- Requires minimum of 10' from bottom of facility to seasonal high groundwater
- Not suitable for drainage from some industrial areas or arterial roads
- Must be maintained to prevent clogging.

Design Checklist for Infiltration trench

- Volume and infiltrative area meet or exceed minimum.
- Overflow connected to a downstream storm drain or approved discharge point.
- Emergency spillage will be safely conveyed overland.
- Depth from bottom of the facility to seasonally high groundwater elevation is $\geq 10'$.
- Areas tributary to the facility do not include automotive repair shops; car washes; fleet storage areas (Bus, truck, etc.); nurseries, or other uses that may present an exceptional threat to groundwater quality.
- Underlying soils are in Hydrologic Soil Group A or B. Infiltration rate is sufficient to ensure a full basin will drain completely within 96 hours. Soil infiltration rate has been confirmed.
- Set back from structures 10' or as recommended by structural or geotechnical engineer

Cistern with Bioretention Facility

A cistern in series with a bioretention facility can meet treatment requirements where space is limited. In this configuration, the cistern is equipped with a flow-control orifice and the bioretention facility is sized to treat a trickle outflow from the cistern.

► CRITERIA

Cistern. The cistern must detain the volume calculated by Equation 4-8 and must include an orifice or other device designed for a 24-hour drawdown time.

Bioretention facility. See the design sheet for bioretention facilities. The area of the bioretention facility must be sized to treat the maximum discharge flow, assuming a percolation rate of 5" per hour through the engineered soil.

Use with sand filter. A cistern in series with a sand filter can meet treatment requirements. See the discussion of treatment facility selection in Chapter 2 and the design guidance for sand filters in Chapter 4.

► DETAILS

Flow-control orifice. The cistern must be equipped with an orifice plate or other device to limit flow to the bioretention area.

Preventing mosquito harborage. Cisterns should be designed to drain completely, leaving no standing water. Drains should be located flush with the bottom of the cistern. Alternatively—or in addition—all entry and exit points, should be provided with traps or sealed or screened to prevent mosquito entry. Note mosquitoes can enter through openings $\frac{1}{16}$ " or larger and will fly for many feet through pipes as small as $\frac{1}{4}$ ".

Exclude debris. Provide leaf guards and/or screens to prevent debris from accumulating in the cistern.

Ensure access for maintenance. Design the cistern to allow for cleanout. Avoid creating the need for maintenance workers to enter a confined space. Ensure the outlet orifice can be easily accessed for cleaning and maintenance.

Best Uses

- In series with a bioretention facility to meet treatment requirement in limited space.
- Management of roof runoff
- Dense urban areas

Advantages

- Storage volume can be in any configuration

Limitations

- Somewhat complex to design, build, and operate
- Requires head for both cistern and bioretention facility

► APPLICATIONS

Shallow ponding on a flat roof. The “cistern” storage volume can be designed in any configuration, including simply storing rainfall on the roof where it falls and draining it away slowly. See the County of San Diego’s 85th percentile isopluvial diagrams for required average depths.

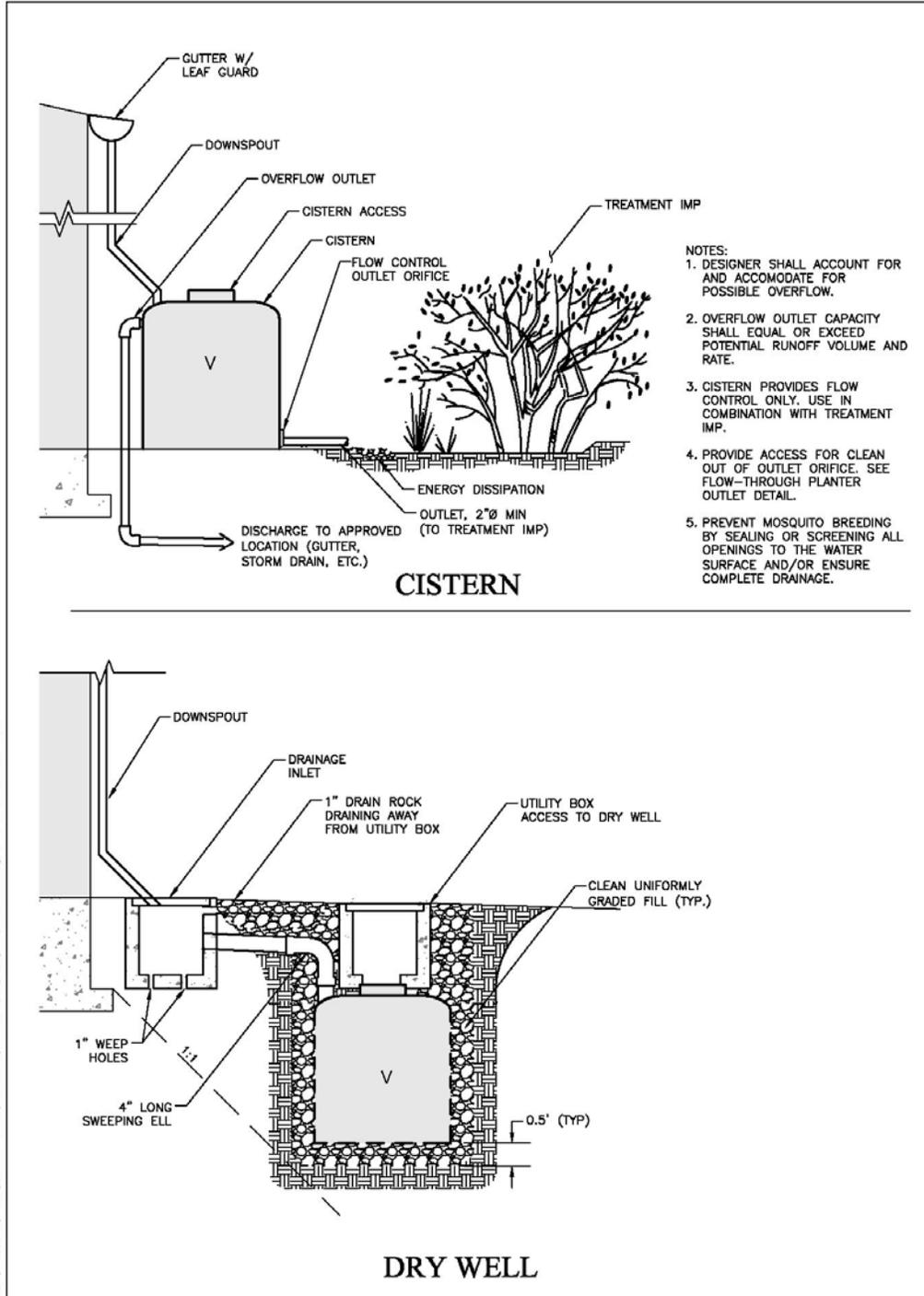
Cistern attached to a building and draining to a planter. This arrangement allows a planter box to be constructed with a smaller area.

Vault with pumped discharge to bioretention facility. In this arrangement, runoff from a parking lot and/or building roofs can be captured and detained underground and then pumped to a bioretention facility on the surface. Alternatively, treatment can be accomplished with a sand filter. See the discussion of selection of stormwater treatment facilities in Chapter 2.

Water harvesting or graywater reuse. It may be possible to create a site-specific design that uses cisterns to achieve stormwater flow control, stormwater treatment, and rainwater reuse for irrigation or indoor uses (water harvesting). Facilities must meet criteria for capturing and treating the volume specified by Equation 4-8. This volume must be allowed to empty within 24 hours so runoff from additional storms, which may follow, is also captured and treated. Additional volume may be required if the system also stores runoff for longer periods for reuse. Indoor uses of non-potable water may be restricted or prohibited. Check with County staff.

Design Checklist for Cistern

- Volume meets or exceeds minimum.
- Outlet with orifice or other flow-control device restricts flow and is designed to provide a 24-hour drawdown time.
- Outlet is piped to a bioretention facility designed to treat the maximum discharge from the cistern orifice.
- Cistern is designed to drain completely and/or sealed to prevent mosquito harborage.
- Design provides for exclusion of debris and accessibility for maintenance.
- Overflow connected to a downstream storm drain or approved discharge point.
- Emergency spillage will be safely conveyed overland.



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Operation & Maintenance of Stormwater Facilities

How to prepare a customized Stormwater Maintenance Plan for the treatment control BMPs on your site.

The stormwater NPDES Permit requires the County to verify all treatment and flow-control facilities are adequately maintained. Facilities you install as part of your project will be verified for effectiveness and proper performance. The County will also verify the ongoing function of stormwater management features that are not treatment or flow control facilities, such as permeable pavements and limitations on impervious area.

Operation and maintenance of stormwater facilities is a seven-stage process:

1. Determine who will own the facility and be responsible for the maintenance of treatment facilities. Identify the means by which ongoing maintenance will be assured (for example, a maintenance agreement that runs with the land).
2. Identify typical maintenance requirements, and allow for these requirements in your project planning and preliminary design.
3. Prepare a maintenance plan for the site incorporating detailed requirements for each treatment and flow-control facility.
4. Complete the Treatment Control BMP Certification to ensure all facilities indicated in the SWMP are built to their proper specification.
5. Maintain the facilities from the time they are constructed until ownership and maintenance responsibility is formally transferred.
6. Formally transfer operation and maintenance responsibility to the site owner, occupant or in some cases to the County. A warranty, secured by a bond, or other financial instrument, may be required to secure against lack of performance due to flaws in design or construction.

7. Maintain the facilities in perpetuity and comply with the County’s self-inspection, reporting, and verification requirements.

See the schedule for these stages in Table 5-1.

Stage 1: Ownership and Responsibility

You must specify a means to ensure maintenance of treatment and flow-control facilities in perpetuity.

Depending on the intended use of your site and the maintenance category you project falls into, this may require one or more of the following:

- Execution of a maintenance notification that “runs with the land” (Category 1 BMP’s).
- Creation and execution of an agreement by the owner or Home Owner’s Association (HOA) to maintain the facilities as well as an access easement and annual inspection fee (Category 2 BMP’s).
- Inclusion of the BMP(s) into a watershed specific Community Facility District or the formation of an individual district (Category 3 BMP’s).
- Dedication of fee title or easement transferring ownership of the facility (and the land under it) to the County (Category 4 BMP’s).

Ownership and maintenance responsibility for treatment and flow-control facilities should be discussed at the beginning of project planning, typically at the pre-application meeting for planning and zoning review. Experience has shown provisions to finance and implement maintenance of treatment and flow-control facilities can be a major stumbling block to project approval, particularly for small residential subdivisions. (See “New Subdivisions” in Chapter 1.)

► PRIVATE OWNERSHIP AND MAINTENANCE

The County requires that a maintenance agreement be executed.

TABLE 5-1. Schedule for planning operation and maintenance of stormwater treatment BMPs

| <i>Stage</i> | <i>Description</i> | <i>Schedule</i> |
|--------------|---|--|
| 1 | Determine facility ownership and maintenance responsibility | Discuss with project review staff at pre-application meeting |
| 2 | Identify typical maintenance requirements | In initial submittal, coordinate with the project review team. |
| 3 | Develop detailed operation and maintenance plan | As required by County |
| 4 | Interim operation and maintenance of facilities | During and following construction including |

| | | |
|---|---|---|
| | | warranty period |
| 5 | Formal transfer of operation & maintenance responsibility | On sale and transfer of property or permanent occupancy |
| 6 | Ongoing maintenance and compliance with inspection & reporting requirements | In perpetuity |

Applicants must propose for County determination the appropriate maintenance mechanism for selected BMPs. The BMPs should fit into one of the following categories:

► FIRST CATEGORY

Treatment control BMPs that are minor in nature, have minimal maintenance responsibilities, and are typical for residential land uses. The proposed BMPs inherently "take care of themselves", or property owners can naturally be expected to do so as an incident of taking care of their property. The owner will perform ongoing maintenance with County's reduced oversight. A "Maintenance Notification" that records with the property is required for all Category 1 BMPs. At a minimum, responsible party provides annual documentation to the County verifying that the BMPs are maintained and functioning properly.

Typical Category 1 BMPs:

- Vegetated Swales
- Bioretention Area
- Flow-through Planter
- Cistern with Bioretention Area
- Trash Racks
- Private Road Drain-inserts
- Self-retaining Areas

Category 1 Mechanisms to Assure Maintenance:

1. Stormwater Ordinance Requirement: The WPO requires this ongoing maintenance. In the event that the mechanisms below prove ineffective, or in addition to enforcing those mechanisms, civil action, criminal action or administrative citation could also be pursued for violations of the ordinance.
8. Public Nuisance Abatement: Under the WPO failure to maintain a BMP would constitute a public nuisance, which may be abated under the Uniform Public Nuisance Abatement Procedure. This provides an enforcement mechanism

additional to the above, and would allow costs of maintenance to be billed to the owner, a lien placed on the property, and the tax collection process to be used.

9. Notice to Purchasers. Section 67.813(e) of the WPO requires developers to provide clear written notification to persons acquiring land upon which a BMP is located, or others assuming a BMP maintenance obligation, of the maintenance duty.
10. Conditions in Ongoing Land Use Permits: For those applications (listed in WPO Section 67.803(c)) upon whose approval ongoing conditions may be imposed, a condition will be added which requires the owner of the land upon which the stormwater facility is located to maintain that facility in accordance with the requirements specified in the maintenance plan (Attachment F in the Major SWMP). Failure to perform maintenance may then be addressed as a violation of the permit, under the ordinance governing that permit process.
11. Subdivision Public Report: Tentative Map and Tentative Parcel Map approvals will be conditioned to require that, prior to approval of a Final or Parcel Map, the subdivider shall provide evidence to the Director of Public Works, that the subdivider has requested the California Department of Real Estate to include in the public report to be issued for the sales of lots within the subdivision, a notification regarding the maintenance requirement. (The requirement for this condition would not be applicable to specific subdivisions which are exempt from regulation under the Subdivided Lands Act, or for which no public report will be issued.)
12. BMP Maintenance Notification: An agreement will be entered into with the County, which will function three ways:
 - (a) It will notify new landowners of the presence and location of the BMP(s);
 - (b) It will include an agreement by the landowner, to maintain the BMP(s) in accordance with the maintenance plan (this obligation would be passed on to future purchasers or successors of the landowner, as a covenant); and
 - (c) It will require annual verification by the landowner of maintenance of the BMPs.

Funding:

None Required.

► SECOND CATEGORY

Treatment control BMPs that are moderately complex, are typical for commercial, industrial, or large multi-residential land uses, and the County needs to assure ongoing maintenance. The nature of the proposed BMPs indicates that it is appropriate for property owners or HOA to be given primary responsibility for maintenance, on a perpetual basis. Responsible party must provide annual documentation to the County verifying that the BMPs are maintained and functioning properly. However, if property owner/HOA fails to perform maintenance, the

County (in a "backup" role) may step in and perform backup maintenance; therefore security funding is required. Security for "backup" maintenance after the interim period (5 years) would not be provided, however primary owner/HOA maintenance responsibility would remain.

Typical Category 2 BMPs [First category plus:]

- Settling Basins (Dry Ponds)
- Infiltration Devices
- Media Filters
- Higher-rate Media Filters
- Higher-rate Biofilters
- Hydrodynamic Separator Systems

Category 2 Mechanisms to Assure Maintenance

1. Stormwater Ordinance Requirement: The WPO requires this ongoing maintenance. In the event that the mechanisms below prove ineffective, or in addition to enforcing those mechanisms, civil action, criminal action or administrative citation could also be pursued for violations of the ordinance.
13. Public Nuisance Abatement: Under the WPO failure to maintain a BMP would constitute a public nuisance, which may be abated under the Uniform Public Nuisance Abatement Procedure. This provides an enforcement mechanism additional to the above, and would allow costs of maintenance to be billed to the owner, a lien placed on the property, and the tax collection process to be used.
14. Notice to Purchasers. Section 67.813(e) of the WPO requires developers to provide clear written notification to persons acquiring land upon which a BMP is located, or others assuming a BMP maintenance obligation, of the maintenance duty.
15. Conditions in Ongoing Land Use Permits: For those applications (listed in WPO Section 67.803(c)) upon whose approval ongoing conditions may be imposed, a condition will be added which requires the owner of the land upon which the stormwater facility is located to maintain that facility in accordance with the requirements specified in the maintenance plan. Failure to perform maintenance may then be addressed as a violation of the permit, under the ordinance governing that permit process.
16. Subdivision Public Report: Tentative Map and Tentative Parcel Map approvals will be conditioned to require that, prior to approval of a Final or Parcel Map, the subdivider shall provide evidence to the Director of Public Works, that the subdivider

has requested the California Department of Real Estate to include in the public report to be issued for the sales of lots within the subdivision, a notification regarding the maintenance requirement. (The requirement for this condition would not be applicable to specific subdivisions which are exempt from regulation under the Subdivided Lands Act, or for which no public report will be issued.)

17. BMP Maintenance Agreement with Easement and Covenant: An agreement will be entered into with the County, which will function three ways:
- (a) It will commit the land to being used only for purposes of the BMP;
 - (b) It will include an agreement by the landowner, to maintain the BMPs in accordance with the maintenance plan (this obligation would be passed on to future purchasers or successors of the landowner, as a covenant); and
 - (c) It will include an easement giving the County the right to enter onto the land (and any necessary adjacent land needed for access) to maintain the BMPs.

This would be required of all applications listed in WPO Section 67.803 with Category 2 BMPs. In the case of subdivisions, this easement and covenant would be recorded on or prior to the Final or Parcel Map.

Funding:

Developer would provide the County with security to substantiate the maintenance agreement; security would remain in place for an interim period of 5 years. The amount of the security would equal the estimated cost of 2 years of maintenance activities. The security can be a Cash Deposit, Letter of Credit or other form acceptable to the County. If at any time, owners fail to maintain BMPs and the County must perform any of the maintenance activities, then owners shall pay all of County's costs incurred in performing the maintenance as defined in the maintenance agreement.

► THIRD CATEGORY

Treatment control BMPs that are highly complex in nature, maybe associated with large commercial or industrial land uses, and the County must assume ongoing maintenance for operational and safety purposes. Category 3 BMPs are constructed and owned by the private sector but the responsibility to maintain is handed over to the County's Flood Control District. The County can assume responsibility of certain privately constructed and owned Category 3 treatment control BMPs provided that there is no overlap with an environmental mitigation requirement or conflicting resource agency permit(s). In order for the County to be willing to take on this responsibility the developer must meet the following general requirements:

- A. Right of access.
- B. Sufficient work area including safe egress and ingress to the facility.

- C. Engineering report documenting the need for the required maintenance activities including a description of the proposed maintenance activities and the costs.
- D. Environmental documents showing that the facility can be adequately maintained per facility requirements.
- E. Copies of any Resource agency permits associated with the private development.
- F. Permanent funding mechanism must be established to ensure the perpetual maintenance of the facility.

Typical Category 3 BMPs [Second category plus]:

- Settling Basins (Dry Ponds)
- Wet Ponds and Constructed Wetlands
- County road drain-inserts

Category 3 Mechanisms to Assure Maintenance:

1. Dedication of BMP to County for maintenance: The developer would be required to dedicate to the County all necessary easements for maintenance, including access, over the property on which the BMP is located. This could be an immediate dedication, or for cases where the County would not want to assume responsibility for the facility for some time (e.g., until after construction is completed), then an Irrevocable Offer of Dedication (IOD) could be used instead.
18. County Maintenance Documentation: Where the County has assumed maintenance responsibility, internal County program documentation would memorialize the required maintenance.

Funding:

Under the authority of County Flood Control, the primary funding mechanism will be a special assessment by inclusion into a watershed specific Community Facility District (CFD) or through the formation of an individual CFD. The assessment will be collected with property tax. Because this primary funding mechanism may require substantial amount of time to establish and collect assessments, a developer fee is required to cover the initial maintenance period of 2 years.

► FOURTH CATEGORY

Treatment control BMPs of varying complexity, are typical for municipal land uses or public use or benefit, and the County will perform ongoing maintenance. Also includes proposed BMPs that are recognized from the beginning as deserving of public ownership and maintenance; normally, these would serve a public need and benefit larger in scope than an individual development project. In addition, BMP's in publically initiated projects are included under this category.

Typical Category 4 BMPs:

- Vegetated Swales
- Bioretention Areas
- Settling Basins
- Infiltration Devices
- Higher-rate Media Filters / Biofilters
- Hydrodynamic Separator Systems
- Trash Racks

Category 4 Mechanisms to Assure Maintenance:

1. Dedication of BMP to County: The developer would be required to dedicate the BMP (and the property on which it is located and any necessary access) to the County. This could be an immediate dedication, or for cases where the County would not want to assume responsibility for the facility for some time (e.g., until after construction is completed), then an IOD could be used instead.
19. County Maintenance Documentation: Internal County or Flood Control District maintenance program documentation would memorialize the required maintenance.

Funding:

A permanent source will be implemented; options include gas tax, TransNet, General Fund, or new special taxes or fees.

► DETERMINATION OF APPROPRIATE MAINTENANCE MECHANISM(S):

Table 5.1 Determination of Appropriate Maintenance Mechanism(s)

| Increased risk, complexity, cost or other maintenance factors | | | | |
|---|---|---|---|--|
| (Private Responsibility) | | | (Public Responsibility) | |
| | First Category | Second Category | Third Category | Fourth Category |
| Importance of Maintenance | Minimal maintenance; inherent in BMP or property stewardship. Minimum, annual maintenance verification is required | Need to make sure private owners maintain, and provide County ability to step in & perform maintenance through easement | Warrants County Flood Control to assume responsibility, with funding related to project | County responsibility for maintenance and funding (beyond project) |
| Typical BMPs | Vegetated Swales; Bioretention; Flow-through Planter; Cistern with Bioretention; Trash Racks; Private Road Drain Inserts. | [First category plus:] Settling Basins; Infiltration Devices; Media Filters; High-rate Biofilters; Hydrodynamic Separator Systems. | [Second category plus:] Settling Basins; Wet Ponds and Constructed Wetlands. | Any County owned and maintained treatment control BMP. |
| Mechanisms | 1. Stormwater Ordinance* requirement [section 67.813(a)&(b)], with code enforcement | 6. Recorded easement agreement with covenant binding on successors | 1. Easement dedication to FCD. 2. Inclusion into a watershed specific Community Facility District (CFD) or individual formation of benefit area/CFD 3. County Flood Control maintenance documentation | 1. Land owned or dedicated to County or Flood Control District (FCD). 2. FCD / County maintenance documentation |
| | 2. Nuisance abatement with costs charged back to property owner | | | |
| | 3. Condition in ongoing permit such as a Major Use Permit (if project has MUP) | | | |
| | 4. Notice to new purchasers [67.813(e)] | | | |
| | 5. Subdivision public report “white papers” to include notice of maintenance responsibility | | | |
| | 6. Recorded Maintenance Notification | | | |
| Funding Source(s) | None necessary | Security (Cash deposit, Letter of Credit, or other acceptable to County) for interim period. Agreement for security to contain provisions for release or refund, if not used. | Start-up interim: Developer fee covering 24 months of costs Permanent: FCD Tax Assessment per FCD Act Sec 105-17.5 | Varies: gas tax for BMP in road ROW, Transnet for CIP projects, Special funding or General funding for others. |

* County of San Diego Watershed Protection, Stormwater Management, and Discharge Control Ordinance (S.D.Co.Code Sec. 67.801 et seq.)

► COUNTY REVIEW OF MAINTENANCE PLAN

County staff reviews the Operation and Maintenance Plan as part of the overall project application and for compliance with the WPO. These reviews include the departments of Public Works for engineering and cost estimates and Planning & Land Use for environmental concerns. Information from the maintenance plan will be used in formulating CEQA responses and findings, findings of project code compliance, and in proposing conditions for the project. The County has the final authority for deciding what is required in the maintenance plan and when a proposed maintenance plan is adequate.

Staff reviewing the maintenance proposals will pay careful attention to the BMPs proposed, to:

- a) Select the appropriate BMPs in view of ongoing maintenance costs; and
- b) Determine whether it is appropriate for the BMPs to remain in private ownership and responsibility, or to be taken over by the County (or Flood Control District).

Stage 2: General Maintenance Requirements

Include in your SWMP a general description of anticipated facility maintenance requirements. This will help ensure that:

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

Fact sheets available on the Project Clean Water web page describe general maintenance requirements for the types of stormwater facilities featured in the LID Design Guide (Chapter 4). You can use this information to specify general maintenance requirements in your SWMP.

Maintenance fact sheets for conventional stormwater facilities are available in the California Stormwater BMP Handbooks.

Stage 3: Detailed Maintenance Plan

Prepare a detailed maintenance plan and submit it as required by the County. Include a maintenance plan with the initial SWMP and incorporate solutions to any problems or changes that occurred during project construction.

Your final maintenance plan should be kept on-site for use by maintenance personnel and during site inspections.

► YOUR DETAILED MAINTENANCE PLAN: STEP BY STEP

The following step-by-step guidance will help you prepare your detailed maintenance plan.

Preparation of the plan will require familiarity with your stormwater facilities as they have been or will be constructed and a fair amount of “thinking through” plans for their operation and maintenance.

► STEP 1: DESIGNATE RESPONSIBLE INDIVIDUALS

To begin creating your detailed maintenance plan, designate and identify:

- The individual who will have direct responsibility for the maintenance of stormwater controls. This individual should be the designated contact with County inspectors and should sign self-inspection reports and any correspondence with the County regarding verification inspections.
- Employees or contractors who will report to the designated contact and are responsible for carrying out BMP operation and maintenance.
- The corporate officer authorized to negotiate and execute any contracts that might be necessary for future changes to operation and maintenance or to implement remedial measures if problems occur.
- Your designated respondent to problems, such as clogged drains or broken irrigation mains, that would require immediate response should they occur during off-hours.

Updated contact information must be provided to the County immediately whenever a property is sold and whenever designated individuals or contractors change.

Draw or sketch an organization chart to show the relationships of authority and responsibility between the individuals responsible for maintenance. This need not be elaborate, particularly for smaller organizations.

Describe how funding for BMP 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 your organization will accommodate initial training of staff or contractors regarding the purpose, mode of operation, and maintenance requirements for the stormwater facilities on your site. Also, describe how your organization will ensure ongoing training as needed and in response to staff changes.

► STEP 2: SUMMARIZE DRAINAGE AND BMPS

Incorporate the following information from your SWMP into your maintenance plan:

- Figures delineating and designating pervious and impervious areas.
- Figures showing locations of stormwater facilities on the site.
- Tables of pervious and impervious areas served by each facility.

Review the SWMP narrative, if any, that describes each facility and its tributary drainage area and update the text to incorporate any changes that may have occurred during planning and zoning review, building permit review, or construction. Incorporate the updated text into your maintenance plan.

► STEP 3: DOCUMENT FACILITIES "AS BUILT"

Include the following information from final construction drawings:

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

In the maintenance plan, note field changes to design drawings, including changes to any of the following:

- Location and layouts of inflow piping, flow splitter boxes, and piping to off-site 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)

► STEP 4: PREPARE MAINTENANCE PLANS FOR EACH FACILITY

Prepare a maintenance plan, schedule, and inspection checklists (routine, annual, and after major storms) for each facility. Plans and schedules for two or more similar facilities on the same site may be combined.

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

- Specific information noted in Steps 2 and 3, above.
- Other input from the facility designer, County staff, or other sources.
- Operation and Maintenance Fact Sheets (available on the Project Clean Water website).

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

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

- Pumps or other mechanical equipment.
- Proprietary devices used as 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 your maintenance plan or as a separate document.

► STEP 5: COMPILE MAINTENANCE PLAN

The following general outline is provided as an example. Check with the County for specific requirements.

- I. Inspection and Maintenance Log
- II. Updates, Revisions and Errata
- III. Introduction
 - A. Narrative overview describing the site; drainage areas, routing, and discharge points; and treatment facilities.
- IV. Responsibility for Maintenance
 - A. General
 - (1) Name and contact information for responsible individual(s).

- (2) Organization chart or charts showing organization 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
 - (1) Sources of funds for maintenance
 - (2) Budget category or line item
 - (3) Description of procedure and process for ensuring adequate funding for maintenance
- B. Staff Training Program
- C. Records
- D. Safety
- V. Summary of Drainage Areas and Stormwater Facilities
 - A. Drainage Areas
 - (1) Drawings showing pervious and impervious areas (copied or adapted from initial SWMP).
 - (2) Designation and description of each drainage area and how flow is routed to the corresponding facility.
 - B. Treatment and Flow-Control Facilities
 - (1) Drawings showing location and type of each facility
 - (2) General description of each facility (Consider a table if more than two facilities)
 - (1) Area drained and routing of discharge.
 - (2) Facility type and size
- VI. Facility Documentation
 - A. “As-built” drawings of each facility (design drawings in the draft Plan)
 - B. Manufacturer’s data, manuals, and maintenance requirements for pumps, mechanical or electrical equipment, and proprietary facilities (include a “placeholder” in the draft plan for information not yet available).
 - C. Specific operation and maintenance concerns and troubleshooting

VII. Maintenance Schedule or Matrix

A. Maintenance Schedule for each facility 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 your maintenance plan. One copy must be submitted to the County, and at least one copy kept on-site. Here are some suggestions for formatting the maintenance 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 maintenance plan can be made if the hard copy is lost or damaged.

► STEP 6: UPDATES

Your maintenance plan will be a living document.

Operation and maintenance personnel may change; mechanical equipment may be replaced, and additional maintenance procedures may be needed. Throughout these changes, the maintenance plan must be kept up-to-date.

Updates may be transmitted to the County at any time. However, at a minimum, updates to the maintenance plan must accompany the annual inspection report.

Stage 4: Treatment Control BMP Certification Form

After TCBMP construction, complete a TCBMP Certification form (located in Attachment G of the Major SWMP) to verify with the County that all constructed TCBMPs on the record plans match the approved TCBMPs in the most current SWMP. TCBMP Certification must be completed and verified for permit closure.

The form requires the following information:

- Copy of the final accepted SWMP and any approved addendum.
- Copy of the most current plan showing the Stormwater TCBMP Table, plans/cross-section sheets of the TCBMPs and the location of each verified as-built TCBMP.
- Photograph of each TCBMP.

- GPS coordinates of each TCBMP.
- Copy of the recorded Maintenance Notification / Agreement for all TCBMPs.
- Recorded number and dates for all Category 2 TCBMP access easements.

Stage 5: Interim Maintenance

Applicants will typically be required to warranty stormwater facilities against lack of performance due to flaws in design or construction. The warranty may need to be secured by a bond or other financial instrument.

Stage 6: Transfer Responsibility

As part of the detailed maintenance plan, note the expected date when responsibility for operation and maintenance will be transferred. Notify the County when this transfer of responsibility takes place.

Stage 7: Operation & Maintenance Verification

The County implements an operation and maintenance verification program, including periodic site inspections.

Contact County staff to determine the frequency of inspections, whether self-inspections are allowed, and applicable fees, if any.

References and Resources

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