

LOGO

COUNTYWIDE MODEL SUSMP

*Standard Urban Stormwater Mitigation Plan
Requirements for Development Applications*

DRAFT June 12, 2008

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Countywide Model SUSMP

Project Clean Water

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This Model SUSMP is to be adapted for local use by:

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Glossary

Best Management Practice (BMP)	Any procedure or device designed to minimize the quantity of pollutants that enter the storm drain system. See Chapter Two for a discussion of the various types of BMPs.
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).
Compensatory Mitigation	Treatment of an equivalent pollutant loading or quantity of stormwater runoff or other equivalent water quality benefit, created where no other requirement for treatment exists, in lieu of on-site treatment facilities.
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.
Design Storm	A synthetic rainstorm defined by rainfall intensities and durations.
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 Infiltration	Infiltration via methods or devices, such as dry wells or infiltration trenches, designed to bypass unsaturated surface soils and transmit runoff directly to groundwater.
Dischargers	Also called Copermittees. The agencies named in the stormwater NPDES permit (see definition): City of Carlsbad, City of Chula Vista, City of Coronado, City of Del Mar, City of El Cajon, City of Encinitas, City of Escondido, City of Imperial Beach, City of La Mesa, City of Lemon Grove, City of National City, City of Oceanside, City of Poway, City of San Diego, City of San Marcos, City of Santee, City of Solana Beach, City of Vista, County of San Diego, San Diego Unified Port District, and the San Diego County Regional Airport Authority.

Drawdown time	The time required for a stormwater detention or infiltration facility 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 facilities, 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 Copermitttees.
Exemption	Exemption from the requirement to provide compensatory mitigation may be allowed for projects that meet certain criteria set by the RWQCB. These projects must, however, show impracticability (see definition of impracticable) of on-site treatment facilities and also show that the costs of compensatory mitigation would place an “undue burden” on the project.
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.
Hydrograph	Runoff flow rate plotted as a function of time.
Hydrograph Modification Management Plan (HMP)	A Plan implemented by the dischargers so that post-project runoff from Priority Projects 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.
Hydrologic Soil Group	Classification of soils by the Natural Resources Conservation Service (NRCS) into A, B, C, and D groups according to infiltration capacity.
Impervious surface	Any material that prevents or substantially reduces infiltration of water into the soil. See discussion of imperviousness in Chapter Two.
Impracticable	As applied to on-site treatment facilities, technically infeasible (see definition) or excessively costly, as demonstrated by set criteria.
Infeasible	As applied to on-site treatment facilities, impossible to implement because of technical constraints specific to the site.

Indirect Infiltration	Infiltration via facilities, such as swales and bioretention areas, expressly designed to hold runoff and allow it to infiltrate into surface soils. Runoff may reach groundwater indirectly or may be underdrained through subsurface pipes.
Infiltration	Seepage of runoff through soil to mix with groundwater. See definition of retention.
Infiltration Device	Any structure 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 facility (BMP) that provides small-scale treatment, retention, 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.
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 replicate 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). Also see Chapter Two.
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 4.d(1). of the 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.
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 runoff, including pervious concrete, pervious asphalt, unit-pavers-on-sand, and crushed gravel.
Percentile Rainfall Intensity	A method of determining design rainfall intensity. Storms occurring over a long period are ranked by rainfall intensity. The storm corresponding to a given percentile yields the design rainfall intensity.
Planned Unit Development (PUD)	Allows land to be developed in a manner that does not conform to existing zoning requirements. Allows greater flexibility and innovation because the PUD is regulated as one unit rather than each component lot being regulated separately.
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 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. San Diego County is under the jurisdiction of the RWQCB for the San Diego Region .
Retention	The practice of holding stormwater in ponds or basins and allowing it to slowly infiltrate to groundwater. 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 (1:1 for projects subject to flow-control requirements).
Source Control	A facility or procedure intended to prevent pollutants from entering 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 Control Plan	A plan specifying and documenting permanent site features and facilities designed to control pollutants for the life of the project.
Stormwater Control Operation & Maintenance Plan	A plan detailing operation and maintenance requirements for stormwater treatment and flow-control facilities incorporated into a project. An acceptable Stormwater Control Operation and Maintenance Plan must be submitted before the building permit is made final and a Certificate of Occupancy is issued.
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.
Stormwater Pollution Prevention Program	A comprehensive program of activities designed to minimize the quantity of pollutants entering storm drains. See Chapter One.
Treatment	Removal of pollutants from runoff, typically by filtration or settling.
WEF Method	A method for determining the minimum design volume of stormwater treatment facilities, recommended by the Water Environment Federation and American Society of Civil Engineers. Described in <i>Urban Runoff Quality Management</i> (WEF/ASCE, 1998).
Water Board	See Regional Water Quality Control Board.
Water Quality Volume (WQV)	For stormwater treatment facilities 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

Read the Overview to get a general understanding of the requirements. Then follow the step-by-step instructions to prepare your project-specific SUSMP.

THIS *Standard Urban Stormwater Mitigation Plan (SUSMP)* will help you ensure that your project complies with the California Regional Water Quality Control Boards' requirements. Most applicants will require the assistance of a qualified civil engineer, architect, or landscape architect. Because every project is different, you should begin by scheduling a pre-application meeting with municipal planning staff.

I C O N K E Y	
	Helpful Tip
	Submittal Requirement
	Terms to Look Up
	References & Resources

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 entire 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-specific SUSMP for your site.

[Chapter Four](#), the Low Impact Development Design Guide, includes a design procedures, calculation procedures, and instructions for presenting your design and calculations in your project-specific SUSMP.

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.

Local Requirements
 Cities, towns, or the County may have requirements that differ from, or are in addition to, this county-wide model SUSMP.

Throughout each Chapter, you’ll find references and resources to help you understand the regulations, complete your Stormwater Control Plan, and design stormwater control measures for your project.

The most recent, updated version of the *Model SUSMP*, including updates and errata between editions, is on the Project Clean Water website. The on-line *Model 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 (marked by the  icon) 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.

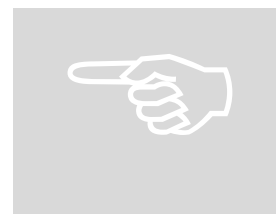
Construction-Phase Controls

Your project-specific SUSMP 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 Project Clean Water website for information on requirements for construction-phase controls.

► 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 think about 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 your municipality (Chapter 5).



Policies and Procedures

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

Priority Development Projects

The NPDES permit refers to regulated projects as “Priority Development Projects.”

► NEW DEVELOPMENT

Projects on previously developed land are subject to stormwater quality requirements if they are in one or more of the categories listed in Table 1-1. 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 and 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 site. For sites 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.

Interior remodels, routine maintenance or repair, roof or exterior surface replacement, and repaving are not subject to treatment requirements.

Compliance Process at a Glance

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

1. Discuss SUSMP requirements during a pre-application meeting with municipal staff.
2. Review the instructions in this *SUSMP* before you prepare your tentative map, preliminary site plan, drainage plan, and landscaping plan.
3. Prepare a project-specific SUSMP and submit it with your application for development approvals (entitlements).
4. Following development approval, create your detailed project design, incorporating the features described in your project-specific SUSMP.
5. In a table on your construction plans, list each SUSMP feature and facility and the plan sheet where it appears.
6. Prepare a draft Stormwater Facility Operation and Maintenance Plan and submit it with your application for building permits.

7. Maintain stormwater facilities during construction and following construction in accordance with required warranties.
8. Following construction, formally transfer responsibility for maintenance to the owner or permanent occupant.
9. The occupant or owner must periodically verify stormwater facilities are properly maintained.

Preparation of a complete and detailed project-specific SUSMP is the key to cost-effective stormwater compliance and expeditious review of your project. Instructions for preparing a project-specific SUSMP are in Chapter 3.



SUSMPs for Phased Projects

When determining whether SUSMP requirements apply, a “project” should be defined consistent with 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.

Local Requirements

Cities, towns, or the County may have requirements that differ from, or are in addition to, this countywide model SUSMP. Check with local planning and community development staff.

CEQA

See the Project Clean Water website for guidance on how to document stormwater impacts and mitigations in Initial Studies and Environmental Impact Reports.

Municipal staff may require, as part of an application for approval of a phased development project, a conceptual or master project SUSMP 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 project SUSMP should be consistent with the scope and level of detail of the development approval being considered. The conceptual or master project SUSMP should specify that a more detailed SUSMP 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.

Individual municipalities 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.

SUSMPs for New Subdivisions

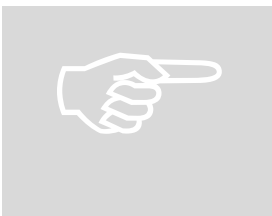
If a tentative map approval would potentially entitle future owners to construct new or replaced impervious area which, in aggregate, could exceed one of the SUSMP thresholds (Table 1-1), then the applicant must take steps to ensure SUSMP requirements can and will be implemented as the subdivision is 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 municipality may condition approval of the map on implementation of stormwater treatment and other SUSMP measures when construction occurs on the individual lots. This condition may be enforced by a grant deed of development rights or by a development agreement.

If a municipality 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.

Subdivision maps should 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.

In general, stormwater treatment 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, municipal staff will determine the appropriate conditions of approval, easements, deed restrictions, or other legal instruments necessary to assure future compliance.

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 downstream erosion conditions and protect stream habitat.

For projects disturbing areas smaller than 50 acres, this can be accomplished by implementing Low Impact Development (LID) design using the design criteria and procedures in Chapter 4.

Priority Development Projects disturbing 50 acres or more must meet the following interim hydromodification standard:



“...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 increased flow rates and durations.”

Project Clean Water is developing a Hydromodification Management Plan (HMP) in compliance with Provision D.1.g of the NPDES Permit. As required, the Program has adopted interim hydromodification criteria which will be superseded after the HMP is accepted by the Regional Water Board.

Compliance with the interim hydromodification criteria can be achieved by one of the following options:

1. Use a continuous simulation hydrologic computer model such as USEPA’s Hydrograph Simulation Program—Fortran (HSPF) to simulate pre-project and post-project runoff, including the effect of proposed IMPs, detention basins, or other stormwater management facilities, and demonstrate the standard is achieved.
2. Use Low Impact Development Integrated Management Practices to manage hydrograph modification impacts, using design procedures, criteria, and sizing factors (ratios of LID IMP volume or area to tributary area) specified by the Co-permittees.
3. Identify an exemption applicable to the site.

► OPTION 1: CONTINUOUS SIMULATION

Prepare an analysis of pre-project and post-project runoff following the instructions in the memoranda “Using Continuous Simulation to Size Stormwater Control Facilities” (May 9, 2008) and “Development of Interim Hydromodification Criteria” (October 30, 2007). Both memoranda are available on the Project Clean Water website.

Before preparing the analysis, discuss with municipal staff the required documentation for your submittal, which will include assumptions and modeling parameters used in the analysis and a graphical presentation demonstrating compliance with the following:

1. For flow rates from 20% of the pre-project 5-year runoff event (0.2Q5) to the pre-project 10-year runoff event (Q10), the post-project discharge rates and durations shall not deviate above the pre-project rates and durations by more than 10% over and more than 10% of the length of the flow duration curve.
2. For flow rates from 0.2Q5 to Q5, the post-project peak flows shall not exceed pre-project peak flows. For flow rates from Q5 to Q10, post-project peak flows may exceed pre-project flows by up to 10% for a 1-year frequency interval. For example, post-project flows could exceed pre-project flows by up to 10% for the interval from Q9 to Q10 or from Q5.5 to Q6.5, but not from Q8 to Q10. (Note that the 0.2Q5 end of the range may be modified).

► OPTION 2: LID INTEGRATED MANAGEMENT PRACTICES

Low Impact Development Integrated Management Practices, such as bioretention facilities, planter boxes, and dry wells, can achieve the hydromodification standard. However, Project Clean Water has not yet prepared design criteria and sizing factors for these facilities. Project proponents may use Option 1 to demonstrate their IMPs meet the interim criteria.

► OPTION 3: EXEMPTION FROM HYDROMODIFICATION MANAGEMENT

Exemption from the IHC is allowed for development projects when any of the following conditions are met:

1. The project would discharge into channels that are concrete-lined or significantly hardened (e.g., with rip-rap, sackcrete, etc.) downstream to their outfall in bays or the ocean;
2. The project would discharge into underground storm drains discharging directly to bays or the ocean;
3. The project would discharge to a channel where the watershed areas below the project's discharge points are highly impervious (e.g. >70%); or
4. The applicant conducts an assessment incorporating sediment transport modeling across the range of geomorphically-significant flows that demonstrates project flows and sediment reductions will not detrimentally affect the receiving water. A May 15, 2008 memorandum, "Geomorphic Analysis for Interim Hydrograph

Modification Plan” is available on the Project Clean Water website.

Grandfathering. Projects with prior lawful approval (such as a development agreement, vested tentative map, or a building or grading permit) or has started construction before March 25, 2008, may not have to meet the interim hydromodification management requirements. Verify with your County project manager who will confirm with County Counsel.

Note these are interim requirements and will be superseded following approval of the HMP by the Regional Water Board sometime after mid-2009. At that time, updated hydromodification criteria will apply to all Priority Development Projects.

Waivers from Treatment Requirements

The NPDES permit allows for a project to be waived from stormwater treatment requirements only if all available treatment facilities have been considered and found infeasible. 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. Also see the discussion of “Selection of Stormwater Treatment Facilities” in Chapter 2.

Determinations of eligibility for waivers will be made by local development review staff.

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, and the San Diego Unified Port District 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 Copermittees 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) approach 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 a 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 Copermittees have adopted interim hydromodification criteria. See Chapter One.

Water-Quality Regulations

Provision D.1 requires San Diego County and the co-permittees to condition development approvals on incorporation of specified stormwater controls. The municipalities each maintain a database to track approved installations of treatment facilities and to verify facilities are maintained. The Copermittees' 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;
- Used hydrologic controls used to meet HMP requirements, including a description of the controls;
- Have an area of 50 acres or greater, thus subject to IHC; and
- The number of violations and enforcement actions taken upon development projects.

The municipalities—not the Regional Board or its staff—are 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.

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 from the site
- Ensure runoff does not exceed pre-project peaks and durations
- Maintain treatment and flow-control facilities

► 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, have proven to be practicable in most development projects. To achieve fair and effective implementation, criteria and guidance, the 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 model SUSMP is to be continuously improved and refined based on the experience of municipal planners and engineers, with input from land developers and development professionals. By following the model 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 procedures in Chapters 3 and 4 of this model 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.

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

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 > 100,000 ft ²	P(1)	P(1)		P(2)	X	P(5)	X	P(3)	P(5)
Automotive Repair Shops			X	X(4)(5)	X		X		
Restaurants					X	X	X	X	
Hillside Development > 5,000 ft ²	X	X			X	X	X		X
Parking Lots	P(1)	P(1)	X		X	P(1)	X		P(1)
Streets, Highways & Freeways	X	P(1)	X	X(4)	X	P(5)	X		
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.									

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 municipality 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.

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
- Copper, lead, and zinc for Chollas Creek.

The project proponent should meet with local municipal representatives to determine if any specialty conditions exist that might affect the selection and design of BMPs. In most cases, the general approach for determining pollutants of concern will be sufficient for addressing treatment BMPs; however, source controls associated with each of the pollutants may be warranted, especially as TMDLs for bacteria, trash, and pathogens are developed from the 303(d) list.

Selection of Permanent Source Control BMPs

Based on identification of potential pollutants of concern associated with various types of facilities, the Co-permittees have developed a matrix (Appendix) 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	

Based on this analysis, the Copermittees have determined that the following types of facilities can meet the “maximum extent practicable” standard:

- Bioretention facilities, planter boxes, and other facilities using filtration through soil or sand (sized with a surface area at least 0.04 times the effectively impervious tributary area).
- Dry wells, infiltration trenches, infiltration basins, and other facilities using infiltration to native soils.

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 Wetlands	Infiltration Facilities or Practices (LID)	Media Filters	High-rate biofilters	High-rate media filters	Trash Racks & Hydro-dynamic Devices
Coarse Sediment and Trash	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
Pollutants that tend to be dissolved following treatment	Medium	Low	Medium	High	Low	Low	Low	Low

- Extended detention basins, constructed wetlands or other facilities using settling (sized according to the volume-based criterion, with a detention time of 48 hours).

Research and regulatory staff have determined that oil/water separators (“water quality inlets”) and storm drain inlet filters do not meet the “maximum extent practicable” standard. When used as a sole method of stormwater treatment, hydrodynamic separators, including vortex separators and continuous deflection separators (“CDS units”), do not meet the “maximum extent practicable” requirement, although they may be used in series with other facilities.

Underground vaults typically lack the detention time required for removal of pollutants associated with fine particles. They also require frequent maintenance and may retain stagnant water, potentially providing harborage 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, because the uses of the site and the site design can be altered as needed to accommodate swales, planter boxes, or bioretention areas. 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 “zero-lot-line” development or redevelopment as part of a municipality’s stated objective to preserve or enhance a pedestrian-oriented “smart-growth” type of urban design. Municipalities are encouraged to identify areas where this objective applies, based on General Plans or zoning.

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 the municipal stormwater coordinator) until a feasible design is found. Additional guidance on facility selection and design is contained in the attached memo.

1. Swales, planter boxes, or bioretention areas fed by gravity.
2. Capture of the design flow in a vault or sump and pumping to swales, planter boxes, or bioretention areas.
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.

Proprietary Devices
 Most currently available proprietary devices do not meet the “maximum extent practicable” standard when used alone for stormwater treatment. Consult with municipal 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 municipal 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 making drainage less efficient—that is, 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.

► SIZING REQUIREMENTS FOR STORMWATER TREATMENT FACILITIES

NPDES permit criteria for sizing stormwater treatment facilities and flow-control facilities are based on simulation of runoff from a long-term (30-year or more) rainfall record. This is different from the “event-based” or “design storm” hydrology typically used to size drainage and flood-control facilities.

This guidance (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 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, and
2. 0.2 inches per hour.

It is typically found that both methods yielded similar results. The 0.2 inches per hour rainfall intensity should be used for sizing flow-based treatment facilities within the Copermittees' 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 (HYDROGRAPH MODIFICATION 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.

Under current Interim Hydromodification Criteria, the requirement applies to projects disturbing 50 acres or more, and applicants may select among three options for compliance: Use a continuous simulation model to compare pre-project and post-project runoff, use LID facilities with sizing

factors and design criteria developed by the Co-permittees, or identify a specified exemption. See Chapter One.

The technical background for the Interim Hydromodification Criteria is in the memorandum “Development of Interim Hydromodification Criteria” (October 30, 2007) and other technical documents available on the Project Clean Water website.

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 of foundations.
- Soils are insufficiently permeable to allow the device to drain within 72 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 a coastal plain, central mountain-valley, and eastern mountain valley area. Elevation ranges from sea level at the Pacific Ocean to approximately 6,000 feet at the summit of Palomar Mountain. Temperatures average about 65 degrees Fahrenheit and average annual precipitation is between 10 and 13 inches.

San Diego County is comprised of 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 components. 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. Approximately 34 percent of land in the region is vacant, undeveloped, or unused. Much of this 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.

Preparing Your Project-Specific SUSMP

Step-by-step assistance to document compliance.

Your project-specific SUSMP 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 from the site, control runoff rates and durations if required, and provide for operation and maintenance of treatment and flow-control facilities.

ICON KEY

-  Helpful Tip
 -  Submittal Requirement
 -  Terms to Look Up
 -  References & Resources
-

Your SUSMP must be submitted 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 project SUSMP will facilitate quicker review and fewer cycles of review. Every San Diego County municipality requires a project-specific SUSMP for every applicable project.

Your project-specific SUSMP will consist of a report and an exhibit.

Municipal staff will use the following checklist to evaluate your SUSMP:



PROJECT-SPECIFIC SUSMP CHECKLIST

CONTENTS OF EXHIBIT

Show all of the following on drawings:

- Existing natural hydrologic features (depressions, watercourses, 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 Appendix D 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, 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 Appendix D. (Step 4)
- General maintenance requirements for infiltration, 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 project-specific SUSMP (Step 6).
- Construction Plan SUSMP Checklist (Step 6).
- Certification by a civil engineer, architect, and landscape architect (Step 6).

Step by Step

Suggested coordination with site and landscape design



Begin with general project requirements and program.

Sketch conceptual site layout, building locations, and circulation.

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

Submit Site Plan, Landscape Plan, and Stormwater Control Plan

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 ensure prepare the detailed site design, landscape design, and SUSMP simultaneously. This will help ensure that your site plan, landscape plan, and SUSMP are congruent.

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:

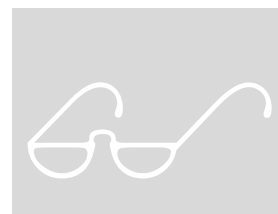
1. Assemble needed information.
2. Identify site opportunities and constraints.
3. Follow the LID design guidance in Chapter 4 to analyze your project for LID and to develop and document your drainage design.
4. Specify source controls using the table in the Appendix.
5. Plan for ongoing maintenance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

Municipal 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.

Step 1: Assemble Needed Information

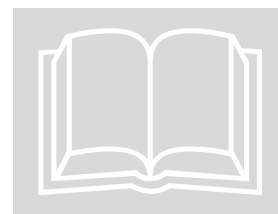
To select types and locations of treatment facilities, the designer needs to know the following site characteristics:

- 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.
- Soil types (including hydrologic soil groups) and depth to groundwater, which may determine whether infiltration is a feasible option for managing site runoff. Depending on site location and characteristics, and on the selection of 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, 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).



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.

Chapter 4 includes calculation procedures and formats for presenting your calculations.

As shown in the checklist (page 1), your Exhibit must show:

- The entire site divided into separate drainage areas, with each area identified as 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.

Your SUSMP report must 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 5, 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.

Also include in your SUSMP report:

- 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 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)

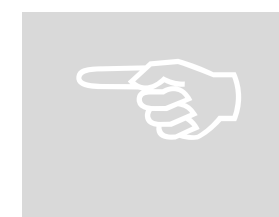
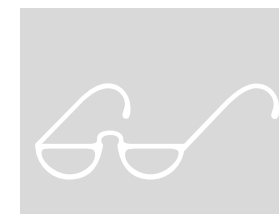


Step 4. Specify Source Control BMPs

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). Check off the potential sources of pollutants that apply to your site.

► NOTE LOCATIONS ON STORMWATER CONTROL PLAN EXHIBIT

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

► PREPARE A TABLE AND NARRATIVE

Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist (Appendix). Now, create a table using the format in Table 3-1. In the left column, list each potential source on your site (from Appendix, Column 1). In the middle column, list the corresponding permanent, structural BMPs (from Columns 2 and 3, Appendix) 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.



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

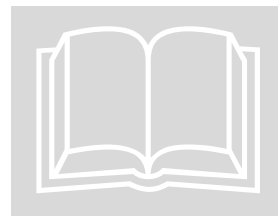
<i>Potential source of runoff pollutants</i>	<i>Permanent source control BMPs</i>	<i>Operational source control BMPs</i>

► IDENTIFY OPERATIONAL SOURCE CONTROL BMPS

To complete your table, refer once again to the Pollutant Sources/Source Control Checklist (Appendix, 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](#), 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.e., your local municipality will periodically verify that treatment and flow-control facilities on your site are maintained and continue to operate as designed.

To make this possible, your municipality will require that you include in your project-specific SUSMP:

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.

Your local municipality will also require that you prepare and submit a detailed Stormwater Facilities Operation and Maintenance 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 Stormwater Facilities 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: SUSMP Report

Your project-specific SUSMP Report should document the information gathered and decisions made in Steps 1-5. A clear, complete, well-organized report will make it possible to confirm your design meets the minimum requirements of the NPDES permit, the municipal stormwater pollution prevention ordinance, and this *SUSMP*.

► COORDINATION WITH SITE, ARCHITECTURAL, AND LANDSCAPING PLANS

Before completing your project-specific SUSMP exhibit and report, 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 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 City review and approval, the plan checker will compare that submittal with your project-specific SUSMP. By creating a Construction Plan SUSMP Checklist for your project, you will facilitate the plan checker’s comparison and speed review of your project.

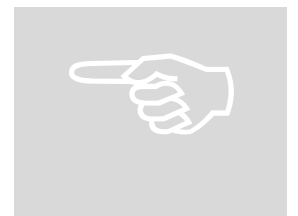
TABLE 3-2. Format for Construction Plan SUSMP Checklist.

<i>SUSMP Page #</i>	<i>BMP Description</i>	<i>See Plan Sheet #s</i>



Here’s how:

1. Create a table similar to Table 3-2. Number and list each measure or BMP you have specified in your SUSMP in Columns 1 and 2 of the table. Leave Column 3 blank. Incorporate the table into your SUSMP.
2. When you submit construction plans, duplicate the table (by photocopy or electronically). Now fill in Column 3, identifying the plan sheets where the BMPs are shown. List all plan sheets on which the BMP appears. Submit the updated table with your construction plans.



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

► CERTIFICATION

Your local municipality may require that your project-specific SUSMP be certified by an architect, landscape architect, or civil engineer.

Your certification should state: “The selection, sizing, and preliminary design of stormwater treatment and other control measures in this plan meet the requirements of Regional Water Quality Control Board Order R9-2007-0001 and subsequent amendments.”

► SAMPLE OUTLINE AND CONTENTS

- I. Project Setting
 - A. Project Name, Location, Description
 - B. Existing site features and conditions
 - C. Opportunities and constraints for stormwater control
- II. Low Impact Development Design Strategies
 - A. Optimization of site layout
 - (1) Limitation of development envelope
 - (2) Preservation of natural drainage features
 - (3) Setbacks from creeks, wetlands, and riparian habitats
 - (4) Minimization of imperviousness
 - (5) Using drainage as a design element
 - B. Use of permeable pavements
 - C. Dispersal of runoff to pervious areas
 - D. Use of Integrated Management Practices
- III. Documentation of Drainage Design
 - A. Drainage Management Areas
 - (1) Tabulation

- (2) Descriptions
- B. Integrated Management Practices
 - (1) Tabulation and Sizing Calculations
 - (2) Descriptions
- IV. Source Control Measures
 - A. Description of site activities and potential sources of pollutants
 - B. Table showing sources, permanent source controls, and operational source controls
- V. Facility Maintenance Requirements
 - A. Ownership and responsibility for maintenance in perpetuity.
 - (1) Commitment to execute any necessary agreements.
 - (2) Statement accepting responsibility for operation and maintenance of facilities until that responsibility is formally transferred.
 - B. Summary of maintenance requirements for each stormwater facility.
- VI. Construction Plan SUSMP Checklist
- VII. Certifications

Attachment: SUSMP Exhibit

► EXAMPLE STORMWATER CONTROL PLANS

Example project-specific SUSMPs may be available from staff at your municipality. Your SUSMP will reflect the unique character of your own project and should meet the requirements identified in this *SUSMP*. Municipal 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*

Your project-specific SUSMP—to be submitted with your application for planning and zoning approvals (entitlements)—must show how your project will comply with applicable stormwater treatment standards.

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 project-specific SUSMP must include calculations showing the site drainage and proposed treatment and flow-control 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.
2. Use pervious surfaces such as turf, gravel, or pervious pavement—or use surfaces that retain rainfall, such as “green roofs.” All drainage from these surfaces is considered to be “self-retained.” No further management of runoff is necessary. An emergency overflow should be provided for extreme events.
3. Disperse runoff from impervious surfaces on to adjacent pervious surfaces (e.g., direct a roof downspout to disperse runoff onto a lawn).
4. Drain impervious surfaces to engineered Integrated Management Practices (IMPs), such as bioretention facilities, planter boxes, or dry wells. IMPs infiltrate runoff to groundwater and/or percolate runoff through engineered soil and allow it to drain away slowly.

A combination of two or more strategies may work best for your project.

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

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. Ideas for Runoff Management

<i>Site Features and Design Objectives</i>	<i>Green Roof</i>	<i>Self-retaining Areas</i>	<i>Pervious Pavement</i>	<i>Bioretention Facility</i>	<i>Flow-through Planter</i>	<i>Dry Well</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.
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.

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.

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.

For all types of development, limit overall coverage of paving and roofs. 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 swales, 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 swales can detain and treat low runoff flows and also convey higher flows.

► USE PERVIOUS SURFACES

Consider a green roof. Although not yet widely used in California, 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, green roofs are considered not to produce increased runoff or runoff pollutants (i.e., any runoff from a green roof requires no further treatment or detention). For more information on green 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.

- Crushed aggregate, or gravel,
- Turf block
- Unit pavers
- Pervious concrete and pervious asphalt

► 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. If flow-control requirements apply, the impervious-to-pervious ratio must be limited to 1:1. 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 enough 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.
- Dry wells and other infiltration facilities, which can be used only where soils are permeable.
- Cisterns, in combination with a bioretention facility.

See the design sheets beginning on page ____.

Finding the right location for treatment and flow-control 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. 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 local municipality 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. Swales, 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 SUSMP 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 project-specific SUSMP 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

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.

upslope undeveloped areas 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

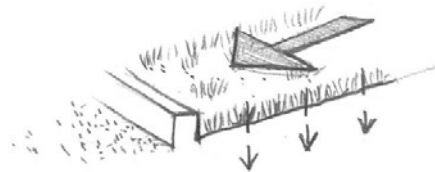


FIGURE 4-1. Self-treating areas are entirely pervious and drain directly off-site or to the storm drain system.

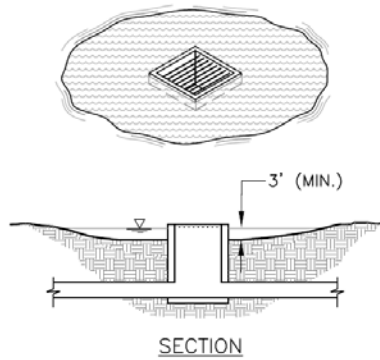


FIGURE 4-2. Self-retaining areas. Berm or depress the grade to retain at least an inch of rainfall and set inlets of any area drains at least 3 inches above low point to allow ponding.

areas, 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.

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.

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.

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.

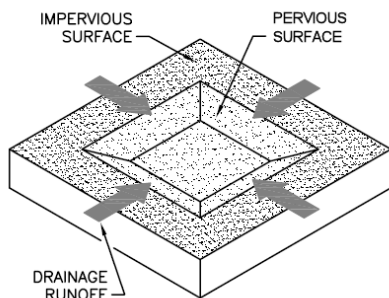


FIGURE 4-3. Relationship of impervious to pervious area for self-retaining areas. Ratio: $pervious \geq \frac{1}{2} impervious$

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:

(Runoff factor) x (tributary area) \leq 2 x (self-retaining area) *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.

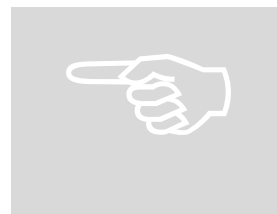
Under some circumstances, pervious pavement (e.g., crushed stone, pervious asphalt, or pervious concrete) can be self-retaining. Adjacent roofs or impervious pavement may drain on to the pervious pavement in the same maximum ratios as described above. A gravel base course four or more inches deep will ensure an adequate proportion of rainfall is infiltrated into native soils (including clay soils) rather than producing runoff. The base course should not be underdrained. Consult with a qualified engineer 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.

Surface	Factor
Roofs	1.0
Concrete	1.0
Pervious Concrete	0.1
Porous Asphalt	0.1
Grouted Unit Pavers	1.0
Unit Pavers, Tight Pack	0.8
Unit Pavers with Gaps	0.2
Crushed Aggregate	0.1
Turfblock	0.1
Amended, mulched soil	0.1
Landscape	0.1

Areas draining to IMPs are used 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.



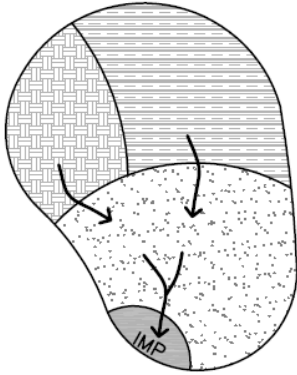


FIGURE 4-4. MORE THAN ONE
Drainage Management Area can drain to a single IMP.

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.

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:

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

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 amount of (square feet of tributary area \times runoff factor) for all DMAs draining to a receiving self-retaining area is no greater than a 1:1 ratio to the square footage of the receiving self-retaining area itself. A 2:1 ratio may be used on sites not subject to flow-control requirements.

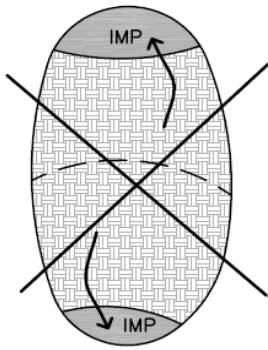


FIGURE 4-5. ONE DRAINAGE
Management Area cannot drain to more than one IMP.
Use a grade break to divide the DMA.

- 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” beginning on Page ____.

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

► STEP 5: OBTAIN SIZING FACTORS FOR EACH IMP

For each of the IMPs, obtain the appropriate sizing factor from Table 4-6.

TABLE 4-6. IMP Sizing Factors

Bioretention Facility Surface Area	0.04
Flow-through Planter Surface Area	0.04

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

The minimum area of each IMP is found by summing up the contributions of each tributary DMA and multiplying by the adjusted sizing factor for the IMP.

Equation 4-7

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

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 or Volume	Proposed Area or Volume
<i>Total</i>					0.04			<i>IMP Area</i>

To size dry wells, infiltration basins, or infiltration trenches, 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

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

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 72 hours.

To size a cistern in series with a bioretention facility:

1. Use Equation 4-8 to calculate the required cistern 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.

► 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. Adapt the following format as appropriate to your project. Coordinate your presentation of DMAs and calculation of minimum IMP sizes with the Stormwater Control Plan exhibit (labeled to show delineation of DMAs and locations of IMPs) and with your Stormwater Control Plan report, which should 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:

IMPs designed for (treatment only or treatment-and-flow-control):



I. Self-treating areas:

DMA Name *Area (square feet)*

--	--

II. Self-retaining areas:

DMA Name *Area (square feet)*

--	--

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>
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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>					0.04		<i>IMP Area</i>

Specify Preliminary Design Details

In your Stormwater Control Plan, 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
- Dry wells 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. Local planning, building, and public works officials 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 LID Design

If you believe LID design is infeasible for your development site, review the criteria for the selection of stormwater treatment facilities on page _____. Then consult with municipal staff before preparing an alternative design for stormwater treatment.

For all alternative designs, the applicant must submit a complete Stormwater Control Plan, including an exhibit 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 facility.

Here are criteria and design considerations for the “next best” alternatives:

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.

Extended (“Dry”) Detention Basins. The required detention volume 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.

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 72 hours or more.

“Wet” Detention Ponds and Constructed Wetlands. The required 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.”

Higher-rate surface filters and vault-based filters. As described on page 2-___, these facilities may be used only in specific types of projects where other alternatives, including the alternative facilities described above, have proven 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.

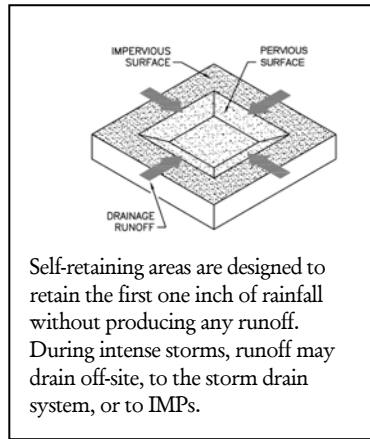
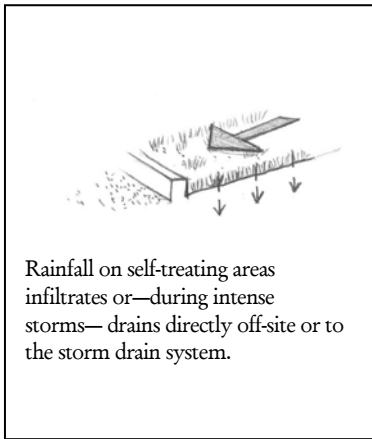
References and Resources:

- RWQCB Order R9-2007-0001 (Stormwater NPDES Permit)
- *County of San Diego Low Impact Development Handbook*



Self-Treating and Self-Retaining Areas

► CRITERIA



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

Best Uses

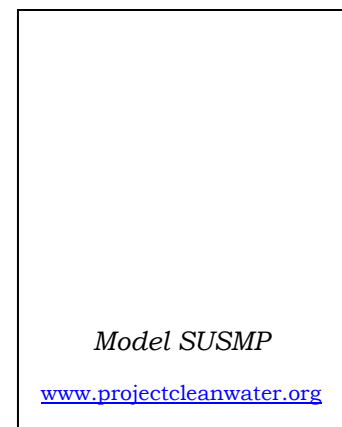
- Heavily landscaped sites

Advantages

- No maintenance verification requirement
- Complements site landscaping

Limitations

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



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 ratios allowable ratio is 2 parts impervious: 1 part pervious.

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.

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

Leave enough reveal (elevation difference) to accommodate buildup of turf or mulch.

► APPLICATIONS

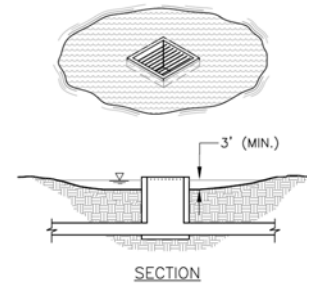
Lawn or landscaped areas adjacent to streets can be considered self-treating areas.

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

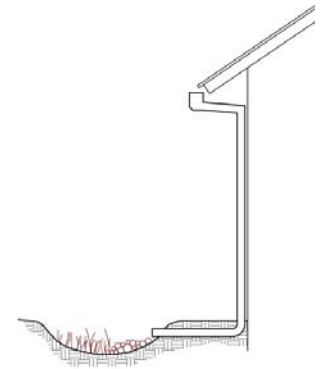
Runoff from walkways or driveways in parks and park-like areas can sheet-flow to self-retaining areas.

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

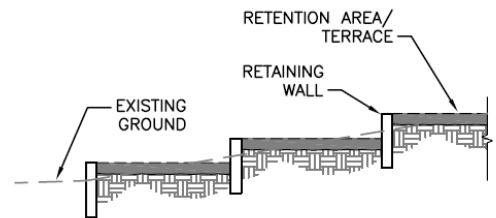
Self-retaining areas can be created by terracing mild slopes. The elevation difference promotes subsurface drainage.



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



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.



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.

- ▶ DESIGN CHECKLIST FOR AREAS DRAINING TO SELF-RETAINING AREAS
 - Ratio of tributary impervious area to self-retaining area is not greater than 2:1.
 - 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.

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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.

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

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 $\frac{3}{8}$ " gaps between the pavers. Joints must be filled with an open-graded aggregate free of fines.

Best Uses

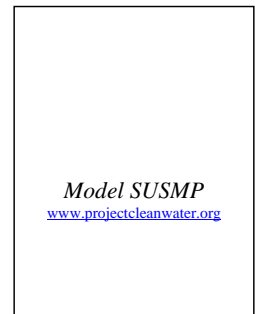
- Areas with permeable native soils
- Low-traffic areas
- Where aesthetic quality can justify higher cost

Advantages

- No maintenance verification requirement
- 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



Use the following runoff factors for solid unit pavers:

Site requirement	Runoff Factor
Treatment only	0.2
Treatment and flow-control	0.5

Areas with pervious pavements can be self-retaining areas receiving 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.

► 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

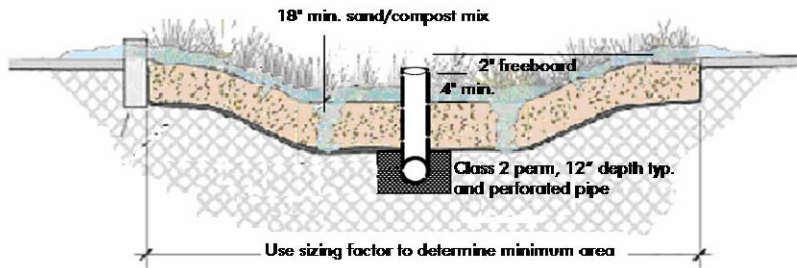
<http://www.icpi.org/>

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.

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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

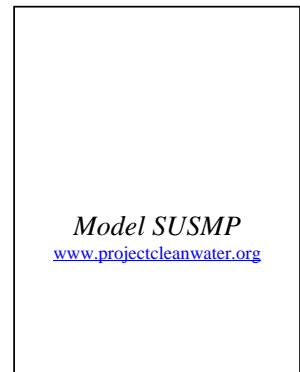
- Commercial areas
- Residential subdivisions
- Industrial developments
- Roadways
- Parking lots
- Fit in setbacks, medians, and other landscaped areas

Advantages

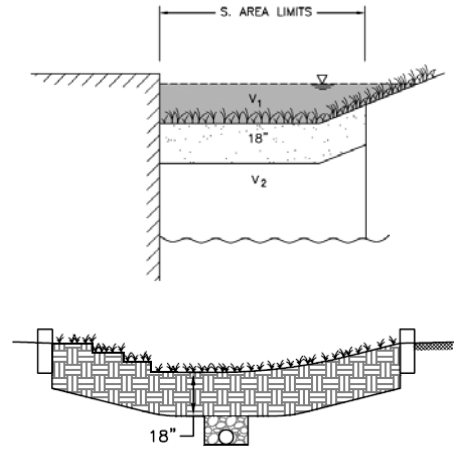
- Can be any shape
- Low maintenance
- Can be landscaped

Limitations

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

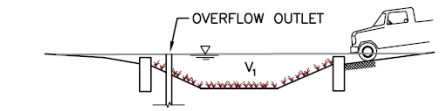


Parameter	Criterion
Surface reservoir depth	6 inches minimum; may be sloped to 4 inches where adjoining walkways.
Underdrain	Required in Group "C" and "D" soils. Perforated pipe embedded in gravel ("Class 2 permeable" recommended), connected to storm drain or other accepted discharge point.

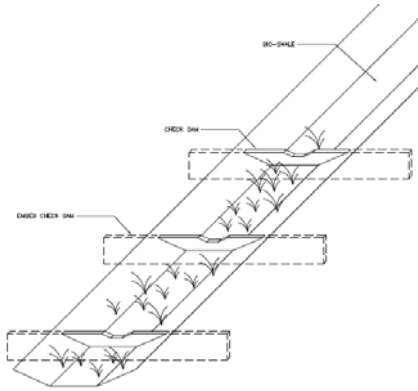


► DETAILS

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.



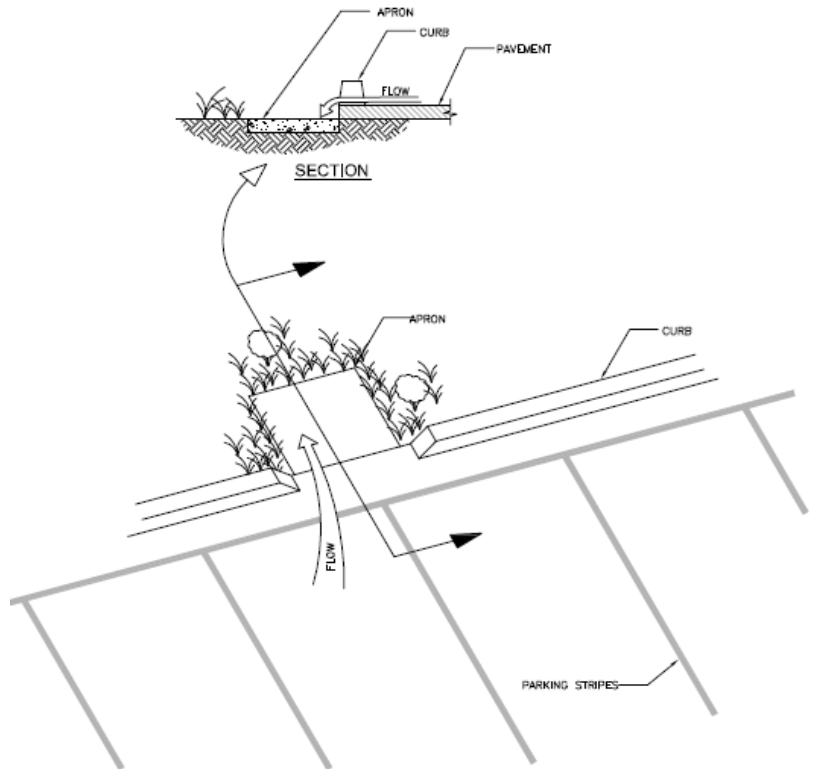
Configuring bioretention facilities for treatment and flow control to achieve the required surface reservoir volume V1: Sloped and vertical sides (top) stepped-back sides (middle) or allowing flooding of adjacent landscaping and pavement (bottom).



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



Recommended design details for bioretention facility inlets (see text).

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.

“Bubble ups” 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.

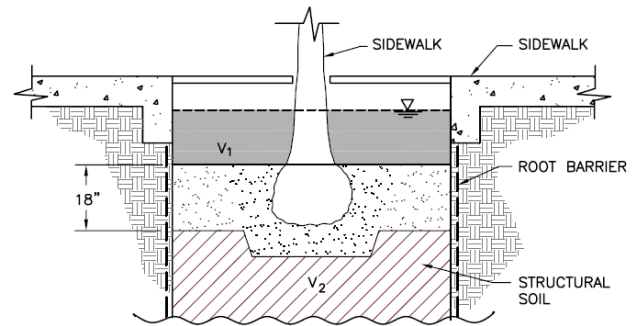
The outlet should be designed to exclude floating mulch and debris.

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. See Appendix B for additional guidance on soil, plant selection, and irrigation.

Example landscape treatments:

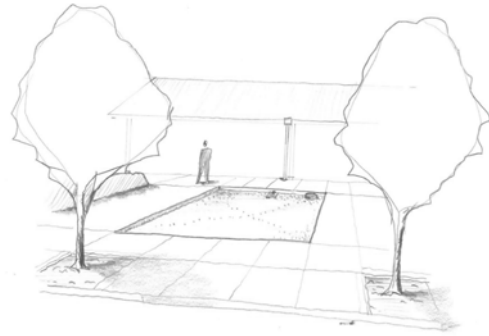
- Lawn with sloped transition to



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

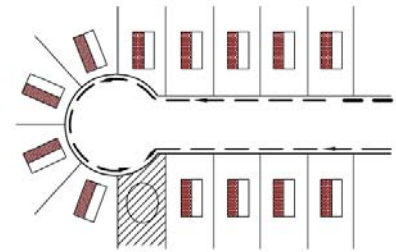
adjacent landscaping.

- 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.

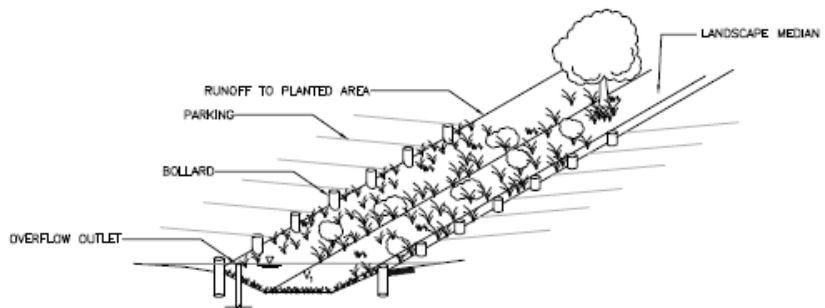
Residential subdivisions. In the design of many subdivisions, it has proven easiest and most effective to drain roofs and driveways to the streets (in the conventional manner) and then drain the streets to bioretention areas, with one bioretention area for each 1 to 6 lots, depending on subdivision layout and topography.



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

Bioretention areas can be placed on a separate, dedicated parcel with joint ownership. Project Clean Water has available model agreements and model provisions for CC&Rs to provide for maintenance of facilities owned individually or jointly by property owners.

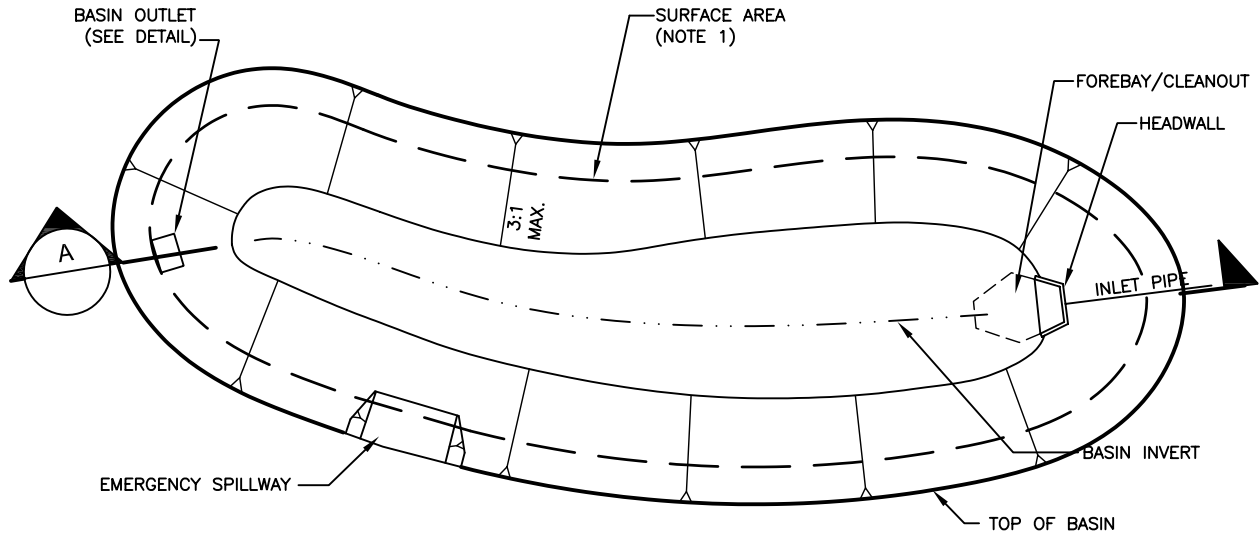
Sloped sites. Bioretention facilities must be constructed as a basin, or series of basins, with the circumference of each basin set level. It may be necessary to add curbs or low retaining walls during final grading if elevations have not been determined with sufficient precision during design.



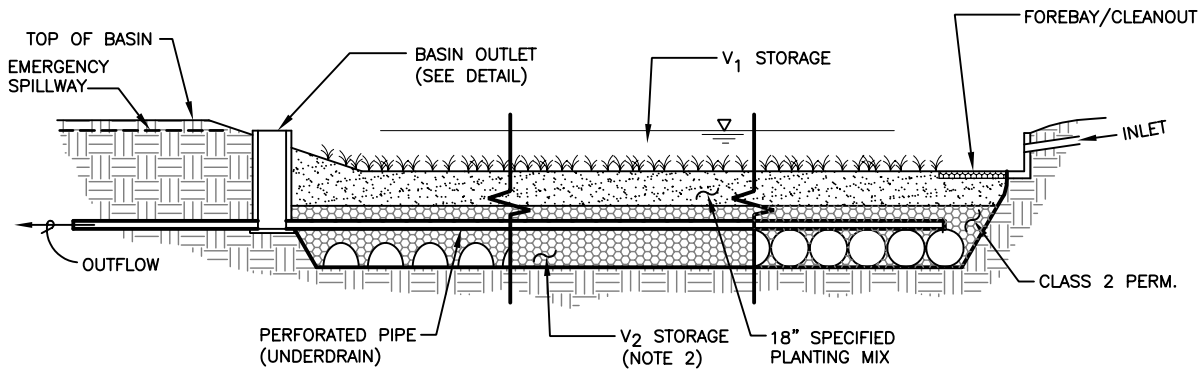
Bioretention facility configured as a parking median. Note use of bollards in place of curbs, eliminating the need for curb cuts.

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.



PLAN VIEW
NOT TO SCALE



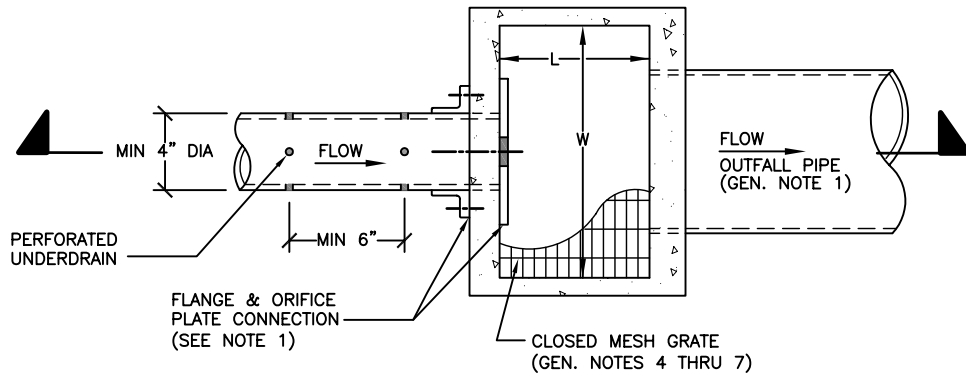
A SECTION
NOT TO SCALE

NOTE

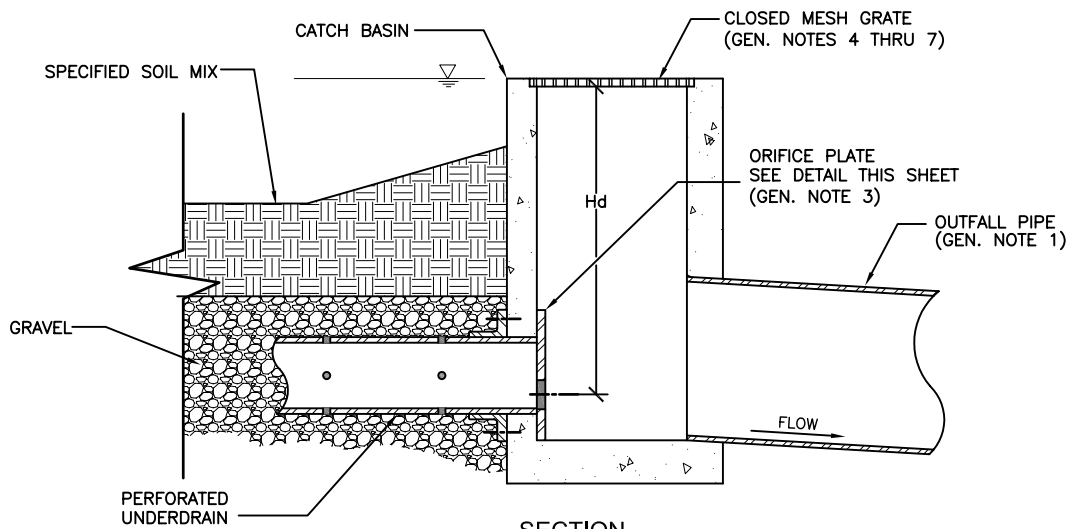
1. SURFACE AREA LIMIT DETERMINED BY EXTENT OF SPECIFIED PLANTING MIX, WHICH IS GOVERNED BY THE OUTLET SPILL ELEVATION. FOR REQUIRED SURFACE AREA REFER TO THE FACTORS AND EQUATIONS IN THE STORMWATER C.3 GUIDEBOOK.
2. V₂ STORAGE ACCOMPLISHED WITH INFILTRATION ARCHES, PERFORATED PIPES, CLASS 2 PERM OR OTHER AT THE DESIGNERS DISCRETION.

Bioretention Facility

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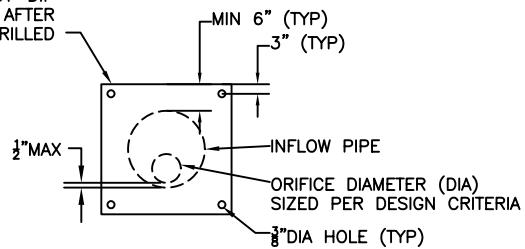


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SECTION
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ORIFICE PLATE: MIN SQUARE DIMENSIONS 1.0 FT GREATER THAN PIPE DIA. HOT-DIP GALVANIZED PLATE AFTER HOLES HAVE BEEN DRILLED



FLOW CONTROL ORIFICE PLATE

NOTE

- ORIFICE PLATE & FLANGE CONNECTION TO CONCRETE SHALL BE FITTED WITH 30 DUROMETER NEOPRENE RING.

Bioretention Facility Outlet Detail - A

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 must be 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:

Best Uses

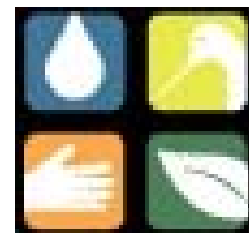
- Management of roof runoff
- Next to buildings
- Dense urban areas
- Where infiltration is not desired

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



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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)
Surface reservoir depth	6" minimum; may be sloped to 4" where adjoining walkways.
Underdrain	Required. 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

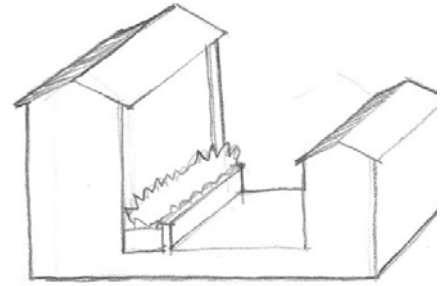
Adjacent to buildings. Flow-through planters may be located adjacent to buildings, where the planter vegetation can soften the visual effect of the building wall. A setback with a raised planter box may be appropriate even in some neo-traditional pedestrian-oriented urban streetscapes.

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.

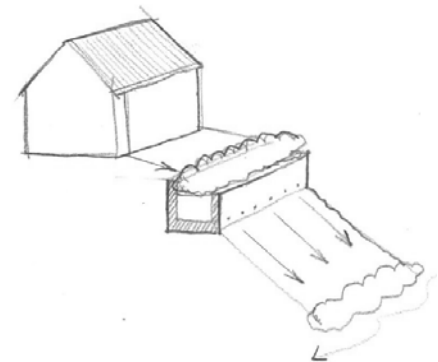
Steep slopes. Flow-through planters provide a means to detain and treat runoff on slopes that cannot accept infiltration from a bioretention facility. The planter can be built into the slope similar to a retaining wall. The design should consider the need to access the planter for periodic maintenance.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

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.

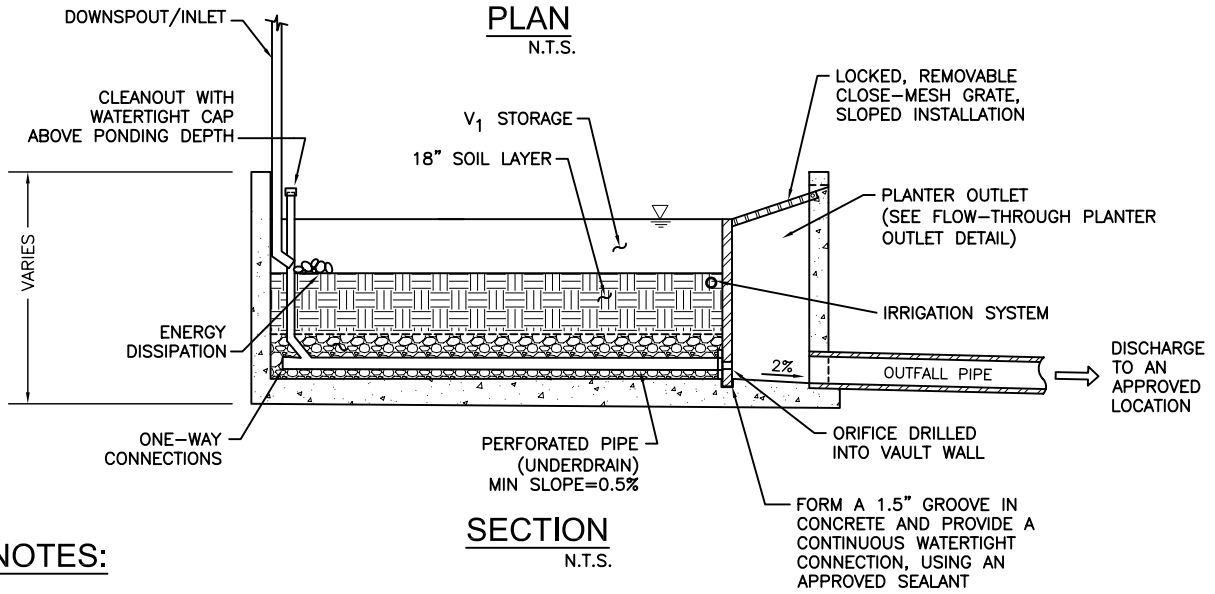
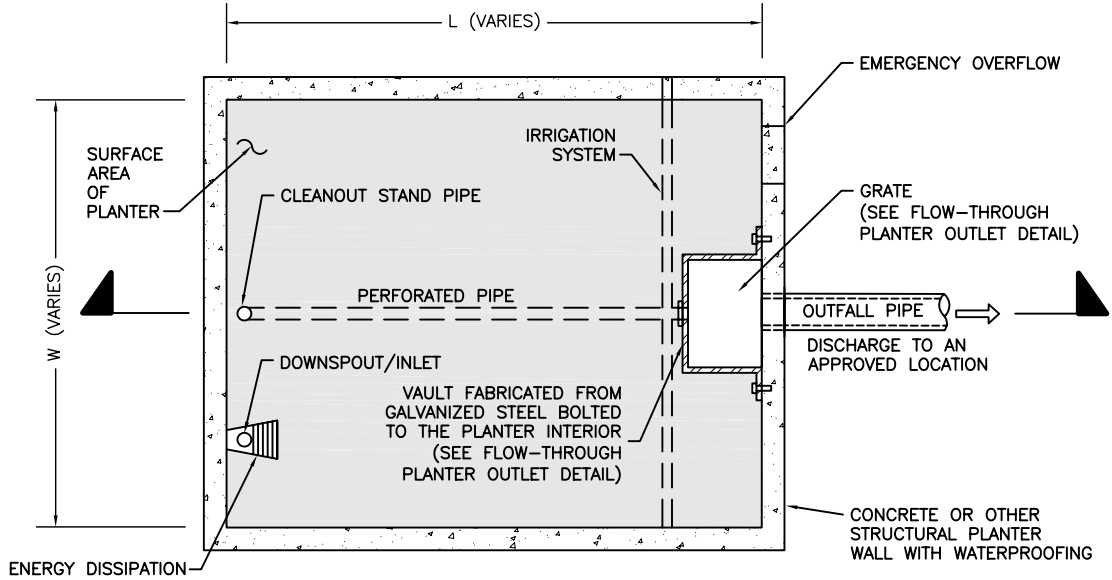


Flow-through planter on the plaza level of a podium-style development.



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

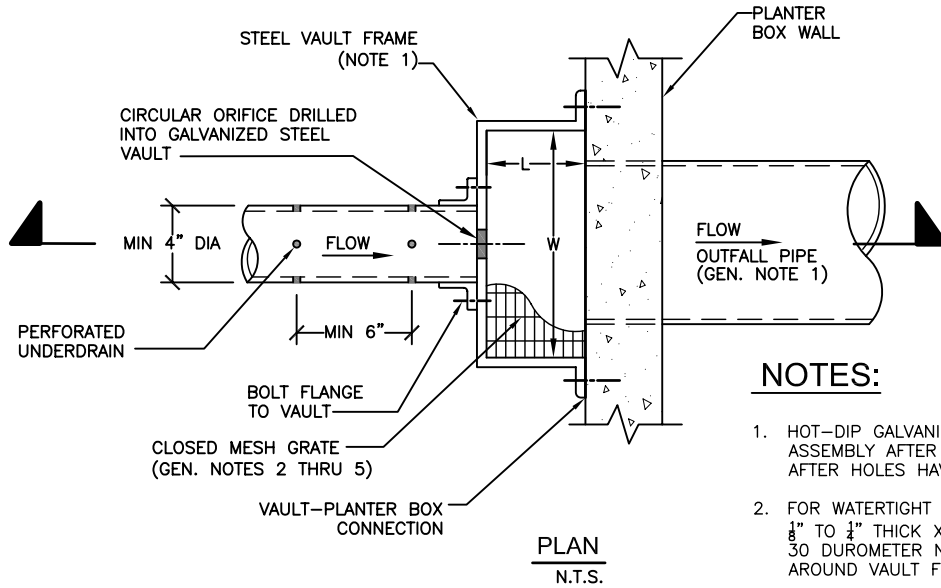
- Emergency spillage will be safely conveyed overland.
- Plantings are suitable to the climate and a well-drained soil.
- Irrigation system with connection to water supply.



NOTES:

1. FLOW-THROUGH PLANTER SHALL BE SIZED TO MEET CCCWP CRITERIA FOR TREATMENT AND/OR FLOW CONTROL.
2. MINIMUM SURFACE AREA OF PLANTER IS 4% OF TRIBUTARY IMPERVIOUS AREA FOR TREATMENT ONLY DESIGN. FOR FLOW CONTROL AND TREATMENT, REFER TO CCCWP SIZING TOOL CRITERIA.
3. SHAPE OF PLANTER CAN VARY TO MEET PROJECT DESIGN REQUIREMENTS AND LOCATION.
4. CLASS 2 PERMEABLE MATERIAL
5. DOWNSPOUTS/INLET PIPES REQUIRE ENERGY DISSIPATION.
6. USE COUNTY APPROVED ADDITIVE MIXTURE FOR WATERPROOFING CONCRETE.
7. PLANTINGS: SEE CCCWP RECOMMENDED PLANT LIST AND GUIDELINES.
8. PLANTER DESIGN MAY REQUIRE STRUCTURAL ENGINEERING DESIGN.
9. AREA = W x L (ABOVE). EXCLUDES AREA OF VAULT

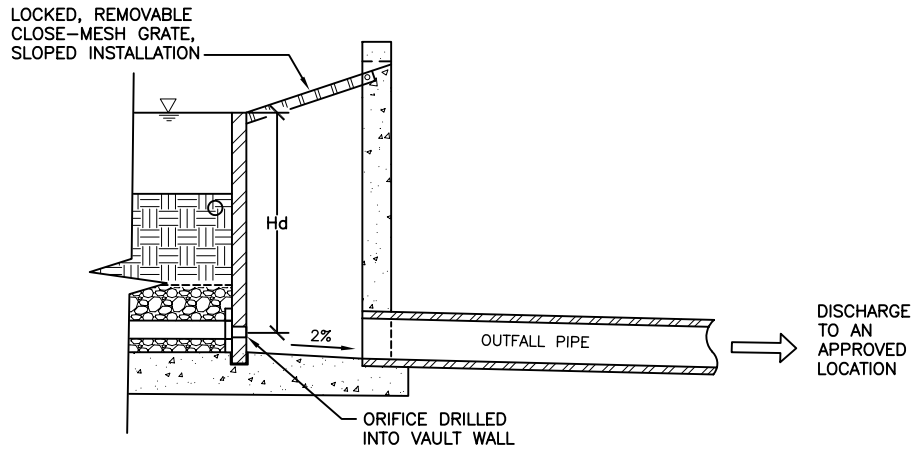
Flow-Through Planter Detail



NOTES:

1. HOT-DIP GALVANIZE ENTIRE FRAME ASSEMBLY AFTER FABRICATION AND AFTER HOLES HAVE BEEN DRILLED.
2. FOR WATERTIGHT CONNECTION, INSTALL $\frac{1}{8}$ " TO $\frac{1}{4}$ " THICK X 2" WIDE CONTINUOUS 30 DUROMETER NEOPRENE GASKET, ALL AROUND VAULT FRAME.

PLAN
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SECTION
N.T.S.

GENERAL OUTLET DETAIL NOTES:

1. OUTFALL PIPE SHALL BE SIZED TO CONVEY DESIGN STORM PER CCCWP DESIGN CRITERIA.
2. GRATE SHALL BE MOUNTED USING STAINLESS STEEL HARDWARE AND PROVIDED WITH HINGED AND LOCKABLE OR BOLTABLE ACCESS PANELS.
3. GRATE SHALL BE STAINLESS STEEL, ALUMINUM OR STEEL. STEEL GRATES SHALL BE HOT DIP GALVANIZED AND MAY BE HOT POWDER PAINTED AFTER GALVANIZING.
4. GRATE SHALL BE DESIGNED SUCH THAT THE DIAGONAL DIMENSION OF EACH OPENING IS SMALLER THAN THE DIAMETER OF THE OUTLET PIPE.
5. STRUCTURAL DESIGN OF GRATE SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF GRATE.

Flow-Through Planter Outlet Detail

Dry Wells and Infiltration Basins

The typical dry well 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

Dry wells 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 dry wells 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 72 hours.

► DETAILS

Dry wells 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

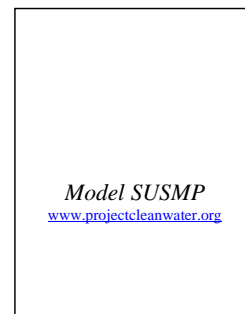
- Alternative to bioretention in areas with permeable soils

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 Dry Well

- 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 72 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

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

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the outlet orifice can be easily accessed for cleaning and maintenance.

► APPLICATIONS

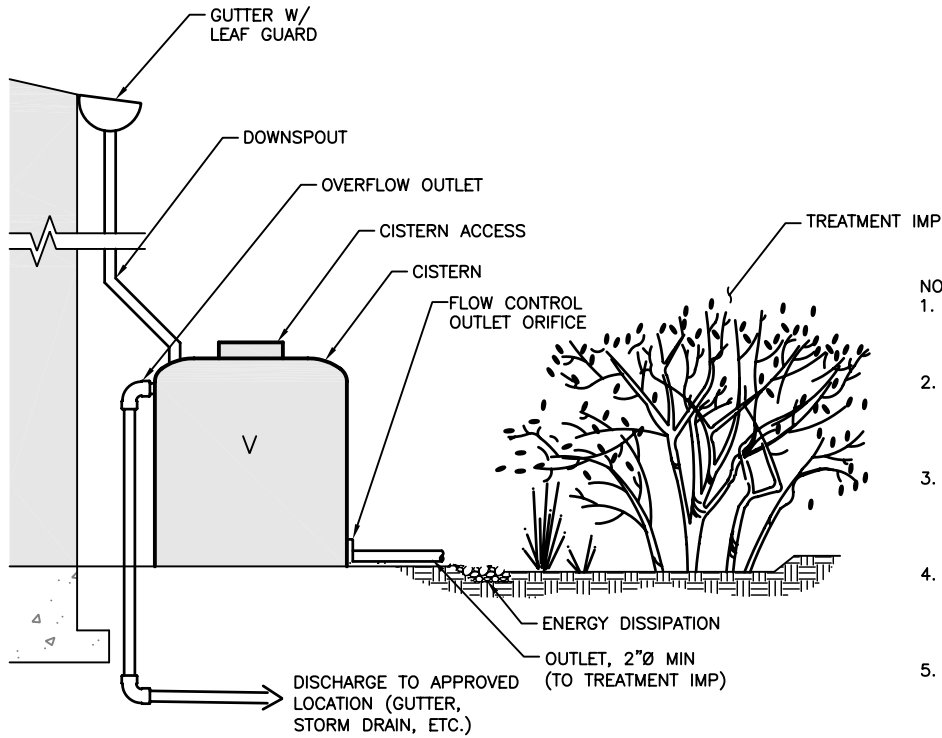
Shallow ponding on a flat roof. The “cistern” storage volume can be designed in any configuration, including simply storing rainfall on the roof where it falls and draining it away slowly. See the County of San Diego’s 85th percentile isopluvial diagrams for required average depths.

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.

Design Checklist for Cistern

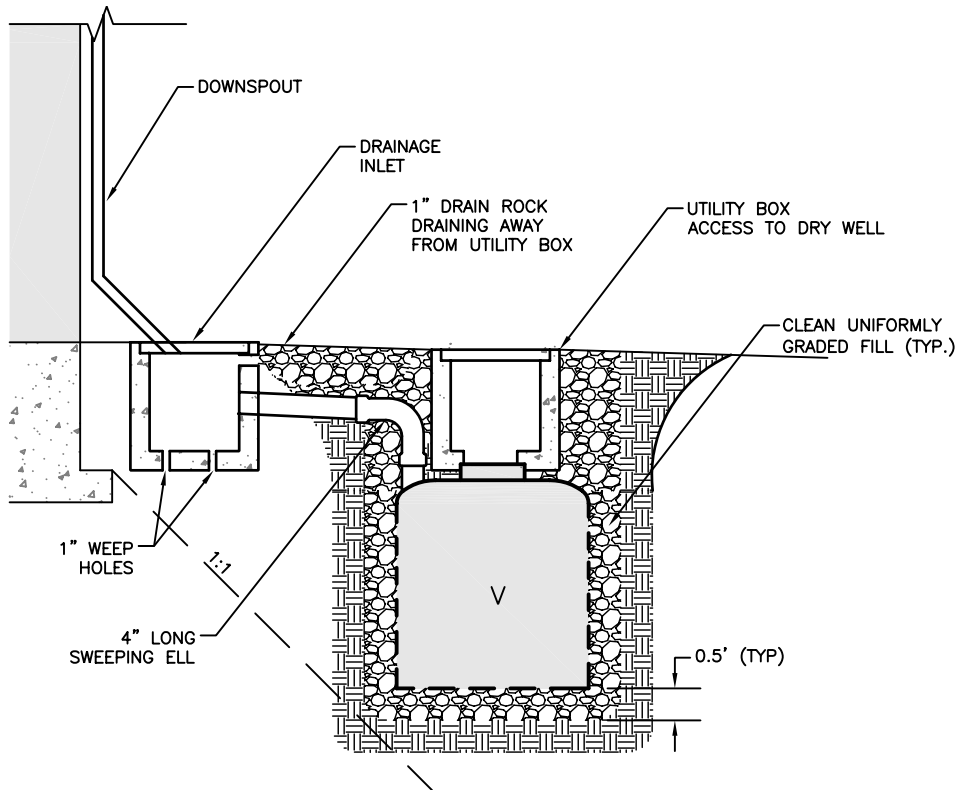
- Volume meets or exceeds minimum.
- Outlet with orifice or other flow-control device restricts flow and is designed to provide a 24-hour drawdown time.
- Outlet is piped to a bioretention facility designed to treat the maximum discharge from the cistern orifice.
- Cistern is designed to drain completely 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.



NOTES:

1. DESIGNER SHALL ACCOUNT FOR AND ACCOMMODATE FOR POSSIBLE OVERFLOW.
2. OVERFLOW OUTLET CAPACITY SHALL EQUAL OR EXCEED POTENTIAL RUNOFF VOLUME AND RATE.
3. CISTERN PROVIDES FLOW CONTROL ONLY. USE IN COMBINATION WITH TREATMENT IMP.
4. PROVIDE ACCESS FOR CLEAN OUT OF OUTLET ORIFICE. SEE FLOW-THROUGH PLANTER OUTLET DETAIL.
5. PREVENT MOSQUITO BREEDING BY SEALING OR SCREENING ALL OPENINGS TO THE WATER SURFACE AND/OR ENSURE COMPLETE DRAINAGE.

CISTERN



DRY WELL

Operation & Maintenance of Stormwater Facilities

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

The stormwater NPDES Permit requires each Copermittee 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. This is a six-stage process:

1. Determine who will own the facility and be responsible for the maintenance of any structural treatment BMPs and document this in your Stormwater Maintenance Plan. The Stormwater Maintenance Plan must also 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, allow for these requirements in your project planning and preliminary design, and document the typical maintenance requirements in your Stormwater Maintenance Plan.
3. Prepare a Stormwater Maintenance Plan (SMP) for the site incorporating detailed requirements for each treatment and flow-control facility. A draft SMP must be submitted with the building permit application. A final SMP must be submitted for review and approved by the County prior to building permit final and issuance of a certificate of occupancy.

4. Maintain the facilities from the time they are constructed until ownership and maintenance responsibility is formally transferred.
5. Formally transfer operation and maintenance responsibility to the site owner or occupant. 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. A typical warranty period will cover two rainy seasons.
6. Maintain the facilities in perpetuity and comply with your municipality's self-inspection, reporting, and verification requirements.

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

Stage 1: Ownership and Responsibility

Your Stormwater Control Plan must specify a means to finance and implement maintenance of treatment and flow-control facilities in perpetuity.

Depending on the intended use of your site and the policies of your municipality, this may require one or more of the following:

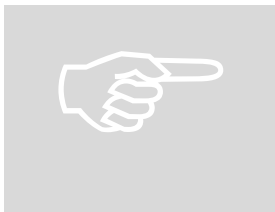
- Execution of a maintenance agreement that “runs with the land.”
- Creation of a homeowners association (HOA) and execution of an agreement by the HOA to maintain the facilities as well as an annual inspection fee.
- Formation of a new community facilities district or other special district, or addition of the properties to an existing special district.
- Dedication of fee title or easement transferring ownership of the facility (and the land under it) to the municipality.



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

<i>Stage</i>	<i>Description</i>	<i>Where documented</i>	<i>Schedule</i>
1	Determine facility ownership and maintenance responsibility	Stormwater Control Plan	Discuss with planning staff at pre-application meeting
2	Identify typical maintenance requirements	Stormwater Control Plan	Submit with planning & zoning application
3	Develop detailed operation and maintenance plan	Stormwater Maintenance Plan	Submit draft with Building Permit application; final due before applying for a Certificate of Occupancy
4	Interim operation and maintenance of facilities	As required by municipal Stormwater Maintenance verification program	During and following construction including warranty period
5	Formal transfer of operation & maintenance responsibility	As required by municipal Stormwater Maintenance verification program	On sale and transfer of property or permanent occupancy
6	Ongoing maintenance and compliance with inspection & reporting requirements	As required by municipal Stormwater Maintenance verification program	In perpetuity

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 “SUSMPs for New Subdivisions” in Chapter 1.)



► PRIVATE OWNERSHIP AND MAINTENANCE





The municipality may require—as a condition of project approval—that a maintenance agreement to be executed.

Project Clean Water has available the following model documents:

- Operation and Maintenance Agreement for a Single Parcel with a Stormwater Management Facility
- Operation and Maintenance Agreement for Subdivisions with Stormwater Management Facilities
- Operation and Maintenance Agreement for Subdivisions with Stormwater Management Facilities and a Homeowners Association
- CC&R and Subdivision Map Provisions for Subdivisions with Stormwater Management Facilities
- CC&R Provisions for Subdivisions with Stormwater Management Facilities and a Homeowners Association

The model agreements “run with the land,” so the agreement executed by a developer is binding on the owners of the subdivided lots. The agreement must be recorded prior to conveyance of the subdivided property.

The model agreements provide the municipality may collect a management and/or inspection fee established by the standard fee schedule. In addition, the agreements provide that, if the property owner fails to maintain the stormwater facility, the municipality may enter the property, restore the stormwater facility to good working order and obtain reimbursement, including administrative costs, from the property owner. To augment and enforce these requirements, the County established a two-tiered Community Facilities District (Mello-Roos) throughout the unincorporated area to cover the costs of inspections and, if necessary, maintenance and repair of individual facilities. Some cities and towns may have similar districts.

I C O N K E Y	
	Helpful Tip
	Submittal Requirement
	Terms to Look Up
	References & Resources

stormwater facility, the municipality may enter the property, restore the stormwater facility to good working order and obtain reimbursement, including administrative costs, from the property owner. To augment and enforce these requirements, the County established a two-tiered Community Facilities District (Mello-Roos) throughout the unincorporated

► TRANSFER TO PUBLIC OWNERSHIP

Municipalities may sometimes choose to have a treatment and flow-control facility deeded to the public in fee or as an easement and maintain the facility as part of the municipal storm drain system. The municipality may recoup the costs of maintenance through a special tax, assessment district, or similar mechanism.

Locating an IMP in a public right-of-way or easement creates an additional design constraint—along with hydraulic grade, aesthetics, landscaping, and circulation. However, because sites typically drain to the street, it may be possible to locate a bioretention swale parallel with the edge of the parcel. The facility may complement, or substitute for, an underground storm drain system.

Local

Requirements

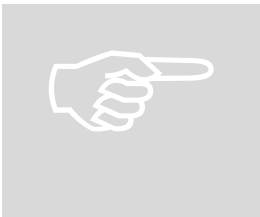
Cities, towns, or the County may have requirements that differ from, or are in addition to, this countywide model SUSMP. Check with local planning and community development staff.

Even if the facility is to be conveyed to the municipality after construction is complete, it is still the responsibility of the builder to identify general operation and maintenance requirements, prepare a detailed operation and maintenance plan, and to maintain the facility until that responsibility is formally transferred.

Stage 2: General Maintenance Requirements

Include in your project-specific SUSMP 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 project-specific SUSMP.

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

Stage 3: Stormwater Facilities SMP

Submit a draft SMP with construction documents when you apply for permits to begin grading or construction on the site. Revise your draft SMP in response to any comments from your municipality, and incorporate new information and changes developed during project construction. Submit a revised, final SMP before construction is complete.



Your Final Stormwater Control Maintenance Plan must be submitted to and approved by the County before your building permit can be made final and a certificate of occupancy issued.

Your SMP must be kept on-site for use by maintenance personnel and during site inspections. It is also recommended that a copy of the project-specific SUSMP be kept onsite as a reference.

The detailed SMP should incorporate solutions to any problems noted or changes that occurred during construction. For this reason, the detailed SMP may be submitted at the end of the construction period, before the application for final building permit and Certificate of Occupancy.

► TOOLS AND ASSISTANCE

The following step-by-step instructions will help you prepare your Stormwater Maintenance Plan. You may use, adapt, and assemble these documents to prepare your own Plan which will be customized to the specific needs of your site.

These include:

- A form for stating or updating key contact information.
- An example Inspection and Maintenance Log.
- A format for an independent inspector's annual inspection report.

Additional useful references, including links to additional documents, are available in "References and Resources" below.

► YOUR SMP: STEP BY STEP

The following step-by-step guidance will help you prepare each required section of your Stormwater Maintenance Plan.

Preparation of the plan will require familiarity with your stormwater facilities as they have been constructed and a fair amount of “thinking through” plans for their operation and maintenance. The text and forms provided here will assist you, but are no substitute for thoughtful planning.

► STEP 1: DESIGNATE RESPONSIBLE INDIVIDUALS

To begin creating your SMP, your organization must designate and identify:

- The individual who will have direct responsibility for the maintenance of stormwater controls. This individual should be the designated contact with municipal inspectors and should sign self-inspection reports and any correspondence with the municipality 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.



It is recommended to use the form available on the Project Clean Water website to list this information. Updated contact information must be provided to the municipality immediately whenever a property is sold and whenever designated individuals or contractors change. Complete a new form—and mail or fax a copy to the municipality—whenever this occurs.

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 project-specific SUSMP into your SMP:

- 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 project-specific SUSMP narrative 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 SMP.

► 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 project-specific SUSMP.
- Design information or calculations submitted in the detailed design phase (i.e., not included in the project-specific SUSMP.)
- Specifications of construction for facilities, including sand or soil, compaction, pipe materials and bedding.

In the final SMP, 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 CUSTOMIZED MAINTENANCE PLANS

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, municipal staff, or other sources.
- BMP 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 SMP or as a separate document.

► STEP 5: COMPILE SMP

Your SMP should follow this general outline:

- 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 project-specific SUSMP).
- (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 SMP. One copy must be submitted to the County, and at least one copy kept on-site. Here are some suggestions for formatting the SMP:

- 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 SMP can be made if the hard copy is lost or damaged.

► STEP 6: UPDATES

Your Stormwater 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 SMP must be kept up-to-date.

Updates may be transmitted to the County at any time. However, at a minimum, updates to the SMP must accompany the annual inspection report. These updates should be placed in reverse chronological order (most recent at the top) in Section 1 of the binder. If the entire SMP is updated, as it should be from time to time, these updates should be removed from the first section, but may be filed (perhaps in the back of the binder) for possible future reference.

Stage 4: Interim Maintenance

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

Stage 5: Transfer Responsibility

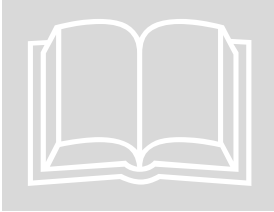
As part of the detailed SMP, note the expected date when responsibility for operation and maintenance will be transferred. Notify the municipality when this transfer of responsibility takes place.

Stage 6: Operation & Maintenance Verification

Each municipality will implement a Stormwater Treatment Measures Operation and Maintenance Verification Program, including periodic site inspections.

Local stormwater ordinances state municipalities may require an annual certificate of compliance certifying operation and maintenance of treatment and flow-control facilities. To obtain a certificate of compliance, the responsible party must request and pay for an inspection from the municipality each year. Alternatively, owners or lessees may arrange for inspection by a private company authorized by the municipality. Based on

the results of the inspection, the municipality may issue a certificate, issue a conditional certificate requiring correction of noted deficiencies by a specific date, or deny the certificate.



References and Resources

- *Urban Runoff Quality Management* (WEF/ASCE, 1998). pp 186-189.
- *Stormwater Management Manual* (Portland, 2004). Chapter 3.
- *California Storm Water Best Management Practice Handbooks* (CASQA, 2003).
- *Best Management Practices Guide* (Public Telecommunications Center for [Hampton Roads](#), 2002).
- Operation, Maintenance, and Management of Stormwater Management Systems (Watershed Management Institute, 1997)

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- Washington Department of Ecology. 2001. *Stormwater Management Manual for Western Washington*. www.ecy.wa.gov/biblio/9911.html
- Watershed Management Institute. 1997. *Operation, Maintenance, and Management of Stormwater Management Systems*.
- WEF/ASCE. 1998. Water Environment Foundation/American Society of Civil Engineers. *Urban Runoff Quality Management*. WEF Manual of Practice No. 23, ASCE Manual and Report on Engineering Practice No. 87. ISBN 1-57278-039-8 ISBN 0-7844-0174-8. 259 pp. Access: Order from WEF or ASCE, www.wef.org or www.asce.org.

APPENDIX—STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions on pages ___ of the *Countywide Model SUSMP*):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your Project-Specific SUSMP drawings.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in a table in your Project-Specific SUSMP. Use the format shown in Table 3-1 on page ___ of the *Countywide Model SUSMP*. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternatives.

IF THESE SOURCES WILL BE ON THE PROJECT SITE THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on SUSMP Drawings	3 Permanent Controls—List in SUSMP Table and Narrative	4 Operational BMPs—Include in SUSMP Table and Narrative
<input type="checkbox"/> A. On-site storm drain inlets	<input type="checkbox"/> Locations of inlets.	<input type="checkbox"/> Mark all inlets with the words “No Dumping! Flows to Bay” or similar.	<input type="checkbox"/> Maintain and periodically repaint or replace inlet markings. <input type="checkbox"/> Provide stormwater pollution prevention information to new site owners, lessees, or operators. <input type="checkbox"/> See applicable operational BMPs in Fact Sheet SC-44, “Drainage System Maintenance,” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com <input type="checkbox"/> Include the following in lease agreements: “Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains.”

APPENDIX—STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on SUSMP Drawings	3 Permanent Controls—List in SUSMP Table and Narrative	4 Operational BMPs—Include in SUSMP Table and Narrative
<input type="checkbox"/> B. Interior floor drains and elevator shaft sump pumps		<input type="checkbox"/> State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.	<input type="checkbox"/> Inspect and maintain drains to prevent blockages and overflow.
<input type="checkbox"/> C. Interior parking garages		<input type="checkbox"/> State that parking garage floor drains will be plumbed to the sanitary sewer.	<input type="checkbox"/> Inspect and maintain drains to prevent blockages and overflow.
<input type="checkbox"/> D1. Need for future indoor & structural pest control		<input type="checkbox"/> Note building design features that discourage entry of pests.	<input type="checkbox"/> Provide Integrated Pest Management information to owners, lessees, and operators.

APPENDIX—STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on SUSMP Drawings	3 Permanent Controls—List in SUSMP Table and Narrative	4 Operational BMPs—Include in SUSMP Table and Narrative
<input type="checkbox"/> D2. Landscape/ Outdoor Pesticide Use	<input type="checkbox"/> Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained. <input type="checkbox"/> Show self-retaining landscape areas, if any. <input type="checkbox"/> Show stormwater treatment facilities.	<p>State that final landscape plans will accomplish all of the following.</p> <input type="checkbox"/> Preserve existing native trees, shrubs, and ground cover to the maximum extent possible. <input type="checkbox"/> Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. <input type="checkbox"/> Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. <input type="checkbox"/> Consider using pest-resistant plants, especially adjacent to hardscape. <input type="checkbox"/> To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	<input type="checkbox"/> Maintain landscaping using minimum or no pesticides. <input type="checkbox"/> See applicable operational BMPs in Fact Sheet SC-41, “Building and Grounds Maintenance,” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com <input type="checkbox"/> Provide IPM information to new owners, lessees and operators.
<input type="checkbox"/> E. Pools, spas, ponds, decorative fountains, and other water features.	<input type="checkbox"/> Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet.	<input type="checkbox"/> If the local municipality requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.	<input type="checkbox"/> See applicable operational BMPs in Fact Sheet SC-72, “Fountain and Pool Maintenance,” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

APPENDIX—STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on SUSMP Drawings	3 Permanent Controls—List in SUSMP Table and Narrative	4 Operational BMPs—Include in SUSMP Table and Narrative
<input type="checkbox"/> F. Food service	<input type="checkbox"/> For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment. <input type="checkbox"/> On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.	<input type="checkbox"/> Describe the location and features of the designated cleaning area. <input type="checkbox"/> Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.	<input type="checkbox"/>
<input type="checkbox"/> G. Refuse areas	<input type="checkbox"/> Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas. <input type="checkbox"/> If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area. <input type="checkbox"/> Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.	<input type="checkbox"/> State how site refuse will be handled and provide supporting detail to what is shown on plans. <input type="checkbox"/> State that signs will be posted on or near dumpsters with the words “Do not dump hazardous materials here” or similar.	<input type="checkbox"/> State how the following will be implemented: Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post “no hazardous materials” signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, “Waste Handling and Disposal” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

APPENDIX—STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on SUSMP Drawings	3 Permanent Controls—List in SUSMP Table and Narrative	4 Operational BMPs—Include in SUSMP Table and Narrative
<input type="checkbox"/> H. Industrial processes.	<input type="checkbox"/> Show process area.	<input type="checkbox"/> If industrial processes are to be located on site, state: “All process activities to be performed indoors. No processes to drain to exterior or to storm drain system.”	<input type="checkbox"/> See Fact Sheet SC-10, “Non-Stormwater Discharges” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com
<input type="checkbox"/> I. Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)	<input type="checkbox"/> Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area. <input type="checkbox"/> Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults. <input type="checkbox"/> Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.	<input type="checkbox"/> Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains. Where appropriate, reference documentation of compliance with the requirements of local Hazardous Materials Programs for: <ul style="list-style-type: none"> ▪ Hazardous Waste Generation ▪ Hazardous Materials Release Response and Inventory ▪ California Accidental Release (CalARP) ▪ Aboveground Storage Tank ▪ Uniform Fire Code Article 80 Section 103(b) & (c) 1991 ▪ Underground Storage Tank 	<input type="checkbox"/> See the Fact Sheets SC-31, “Outdoor Liquid Container Storage” and SC-33, “Outdoor Storage of Raw Materials ” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

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<p><input type="checkbox"/> J. Vehicle and Equipment Cleaning</p>	<p><input type="checkbox"/> Show on drawings as appropriate:</p> <p>(1) Commercial/industrial facilities having vehicle /equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.</p> <p>(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).</p> <p>(3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.</p> <p>(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.</p>	<p><input type="checkbox"/> If a car wash area is not provided, describe measures taken to discourage on-site car washing and explain how these will be enforced.</p>	<p>Describe operational measures to implement the following (if applicable):</p> <p><input type="checkbox"/> Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system.</p> <p><input type="checkbox"/> Car dealerships and similar may rinse cars with water only.</p> <p><input type="checkbox"/> See Fact Sheet SC-21, “Vehicle and Equipment Cleaning,” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com</p>
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<p><input type="checkbox"/> K. Vehicle/Equipment Repair and Maintenance</p>	<p><input type="checkbox"/> Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.</p> <p><input type="checkbox"/> Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.</p> <p><input type="checkbox"/> Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.</p>	<p><input type="checkbox"/> State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.</p> <p><input type="checkbox"/> State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.</p> <p><input type="checkbox"/> State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.</p>	<p>In the SUSMP report, note that all of the following restrictions apply to use the site:</p> <p><input type="checkbox"/> No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.</p> <p><input type="checkbox"/> No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.</p> <p><input type="checkbox"/> No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.</p>
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<p><input type="checkbox"/> L. Fuel Dispensing Areas</p>	<p><input type="checkbox"/> Fueling areas¹ shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.</p> <p><input type="checkbox"/> Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area¹.] The canopy [or cover] shall not drain onto the fueling area.</p>		<p><input type="checkbox"/> The property owner shall dry sweep the fueling area routinely.</p> <p><input type="checkbox"/> See the Business Guide Sheet, "Automotive Service—Service Stations" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com</p>
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¹ The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.

APPENDIX—STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

<p><input type="checkbox"/> M. Loading Docks</p>	<p><input type="checkbox"/> Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.</p> <p><input type="checkbox"/> Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.</p> <p><input type="checkbox"/> Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.</p>		<p><input type="checkbox"/> Move loaded and unloaded items indoors as soon as possible.</p> <p><input type="checkbox"/> See Fact Sheet SC-30, “Outdoor Loading and Unloading,” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com</p>
<p><input type="checkbox"/> N. Fire Sprinkler Test Water</p>		<p><input type="checkbox"/> Provide a means to drain fire sprinkler test water to the sanitary sewer.</p>	<p><input type="checkbox"/> See the note in Fact Sheet SC-41, “Building and Grounds Maintenance,” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com</p>

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<p>○ Miscellaneous Drain or Wash Water</p> <ul style="list-style-type: none"> <input type="checkbox"/> Boiler drain lines <input type="checkbox"/> Condensate drain lines <input type="checkbox"/> Rooftop equipment <input type="checkbox"/> Drainage sumps <input type="checkbox"/> Roofing, gutters, and trim. 		<ul style="list-style-type: none"> <input type="checkbox"/> Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system. <input type="checkbox"/> Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. <input type="checkbox"/> Rooftop mounted equipment with potential to produce pollutants shall be roofed and/or have secondary containment. <input type="checkbox"/> Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water. <input type="checkbox"/> Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff. 	
<ul style="list-style-type: none"> <input type="checkbox"/> P. Plazas, sidewalks, and parking lots. 			<ul style="list-style-type: none"> <input type="checkbox"/> Plazas, sidewalks, and parking lots shall be swept regularly to prevent the accumulation of litter and debris. Debris from pressure washing shall be collected to prevent entry into the storm drain system. Washwater containing any cleaning agent or degreaser shall be collected and discharged to the sanitary sewer and not discharged to a storm drain.