County of San Luis Obispo
Low Impact Development Design Standards Manual

Strategies for Post-Construction Stormwater Management in New Development and Redevelopment

DRAFT

ver
October 1, 2008

County of San Luis Obispo
Low Impact Development Design Standards Manual

Strategies for Post-Construction Stormwater Management in New Development and Redevelopment

DRAFT

ver
October 1, 2008

Funding for this project has been provided in part through an agreement with the State Water Resources Control Board. The contents of this document do not necessarily reflect the views and policies of the State Water Resources Control Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use. (Gov. Code 7550. 40 CFR 31.20)

DRAFT

County of San Luis Obispo
Low Impact Development Design Standards Manual

Strategies for Post-Construction Stormwater Management in New Development and Redevelopment

Table of Contents

DRAFT

Ch 1: Introduction

1.1 Purpose of this Manual

The purpose of this manual is to provide guidance for developers, contractors, builders, designers, engineers, architects, planners, homeowners, and all others interested in learning how to address stormwater quality during the planning, design, and maintenance phases of new development and redevelopment projects in the unincorporated areas of San Luis Obispo (SLO) County. Project applicants should use this manual to determine the post-construction stormwater management application and maintenance requirements for their new development and redevelopment projects.

1.2 How to Use this Manual

This manual is a supplement to current County land use and development permit policies. It is meant to be used as a design aid for both the onsite and public improvement portions of projects; however, all improvements within the public right-of-way must be consistent with County Public Improvement Standards. Requests for adjustments to Design Standards, Standard Specifications or Standard Drawings for public improvements must follow the process identified in Section 1.2 "Design Adjustments" of the Public Improvement Standards.

Manual Overview

- Chapter 2 gives the background and regulatory requirements for stormwater quality and Low Impact Development (LID).
- Chapter 3 gives the steps for how to complete a successful project permit application.
- Chapter 4 provides instruction for planning and designing LID integrated management practices (IMPs).
- Chapter 5 provides instructions for stormwater pollution prevention Source Control Measures.
- Chapter 6 provides Hydromodification Planning Measures.
- Chapter 7 provides instructions for Treatment Control Measures.
- Chapter 8 outlines requirements for long-term maintenance.
- The appendices provide checklists, worksheets, plant selection guidelines, sample forms, and key links to other sources of reference materials to assist project applicants.

> Applicants should review the "Guide to Post-Construction Stormwater Management" first to determine the appropriate water quality, quantity and treatment controls needed for their specific discretionary or ministerial permit application.

Permit applicants should review the "Guide to Post-Construction Stormwater Management" in Appendix A first to determine the water quality, quantity, and treatment controls needed for their specific discretionary or ministerial permit application. Since LID designs are highly site-specific, only broad considerations can be provided in this manual. References with hyperlinks are provided to assist designers with detailed information for LID designs.

Ch 2: Background & Regulatory Requirements

2.1 The Impact of Development on Water Quality

Undeveloped natural landscape areas such as forests and grasslands act like sponges for rainfall. When natural landscape areas are covered with impervious (nonporous) surfaces like roads, parking lots, and roofs, this "sponge-like" function is lost and the amount of rainfall that can be absorbed is dramatically reduced. As shown in Figure 2-1, the percentage of **impervious surface area** of a site influences how much of a rain storm is infiltrated into the ground, evapotranspirated back into the atmosphere, or leaves the site as stormwater runoff.

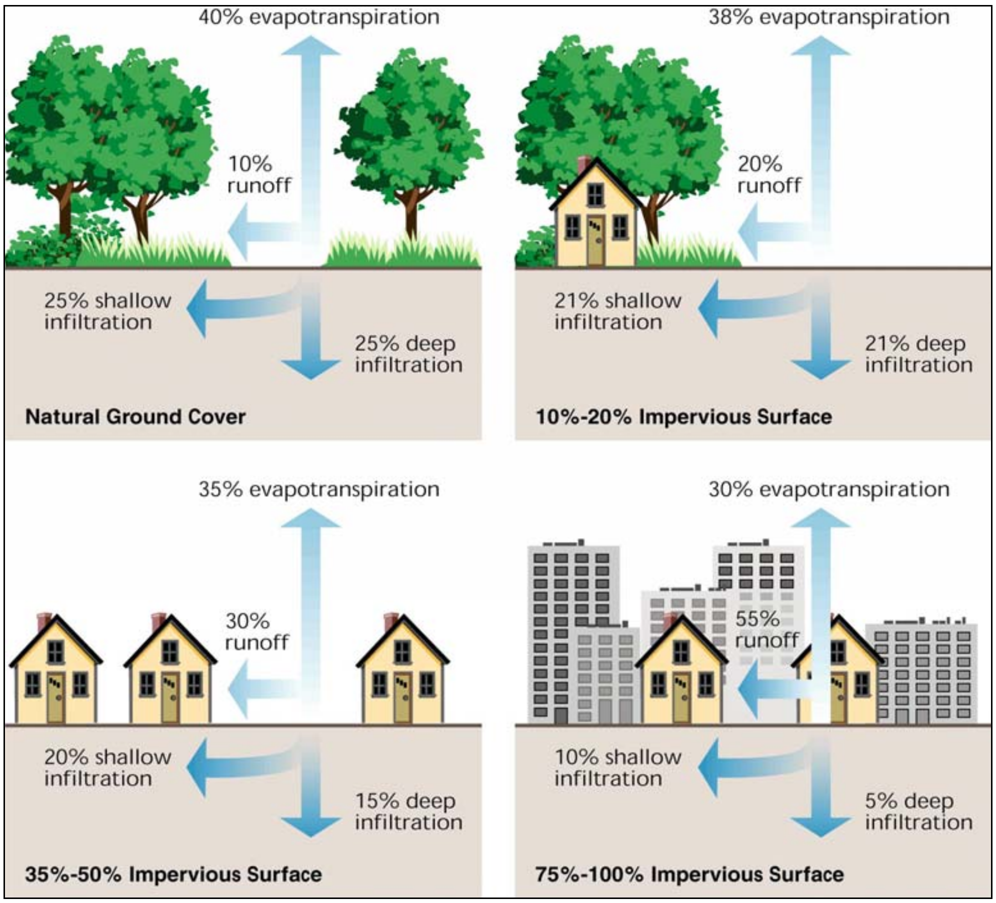


Figure 2-1 Relationship between impervious surface area, surface runoff, infiltration and evapotranspiration (Source: Stream Corridor Restoration: Principles, Processes, and Practices, FISWG 1998)

Increasing the amount of impervious surface area of a site can lead to a host of problems, including:

- Increased flooding frequencies and magnitudes;
- Increased erosion of streams and hillsides;
- Increased pollutant concentration levels in stormwater runoff; and
- Reduced groundwater recharge rates.

Development projects can also impact neighboring properties. Traditional stormwater management practices emphasize conveyance; that is, using street gutters, curbs, pipes and canals to remove water from the developed areas as quickly as possible, and engineered flood control measures such as dams, dikes, levees, and detention facilities to offset the impact of development. This transfers the immediate problems downstream by increasing the amount of runoff leaving sites. The compound effect of increased impervious surface area with more efficient collection and conveyance systems is flooding and erosion.


Figure 2-2 Bank scour along San Luis Obispo Creek (Source: www.fws.gov/contaminants/restorationplans/AvilaBeach/CreekPlan/CreekPlanPart2.pdf)

When runoff leaves a storm drain network and empties into a creek, its excessive volume and energy can scour creek banks, damaging streamside vegetation and harming aquatic habitat. Runoff that travels over impervious surfaces often picks up pollutants that accumulated on that surface as a result of everyday activities such as driving, maintaining vehicles and lawns, disposing of waste, washing cars and even walking pets. Polluted runoff may contain nutrients, pathogens, hydrocarbons, toxic organics, sediments, metals, trash, and debris. Increased creek and lake temperatures may result as the runoff picks up heat from paved surfaces. Pollutants and warmer water are carried to the storm drain system and are discharged directly to lakes, streams, and the ocean where pollutants can accumulate and degrade water quality and aquatic habitat for fish and wildlife.

The loss of infiltration from urbanization has also resulted in profound groundwater changes. As more surface area becomes covered with impervious surfaces, less water is able to seep back into the ground. Reduced groundwater recharge rates may result in lower base flows during dry weather as less groundwater available to move through the soil and into stream channels and aquifers.

To protect surface water quality and groundwater resources, new development and significant redevelopment projects should be designed, constructed, and maintained to minimize increases in runoff using Low Impact Development post-construction stormwater management strategies as the first choice alternative whenever possible.

2.2 Local Environmental and Economic Impacts

Polluted stormwater has measurable environmental and economic impacts, including increased flooding, public health, harm to aquatic life, (including coastal shellfisheries), aesthetic impacts, impacts to tourism and recreation, and harm to community water supplies.

Flooding

According to the County Local Hazard Mitigation Plan (www.slocountyoes.com/lhmp_bos.pdf), San Luis Obispo County has experienced severe flooding events that have resulted in loss of life and extensive property damage. Flooding can also inundate sewage treatment plants, prevent the safe passage of people and commodities, contaminate water supplies, damage agricultural resources, and result in accelerated rates of erosion.

Public Health

Stormwater can transport disease-causing bacteria, viruses, and protozoa. The County of San Luis Obispo Environmental Health Division consistently monitored 20 beach locations in 2007. Twenty percent of the samples taken during wet weather years received a grade of 'C' or 'D' according to Heal the Bay Foundation. The grade indicates the presence of total coliforms, fecal coliforms, enterococcus and fecal ratios observed in the overall number of samples taken. See http://www.healthebay.org/brc/annual/2007/counties/slo/analysis.asp for complete listing of San Luis Obispo County health advisories.

Harm to Aquatic Life

Urban runoff can harm aquatic life in many ways due to changes in water chemistry and habitat loss.

Nitrogen and Phosphorous promote toxic and non-toxic alga blooms that harm aquatic life by depleting the amount of oxygen in the water and by decreasing light penetration for photosynthetic organisms. These pollutants also promote unwanted weeds.

Parking lots and roads can have an accumulation of **oil and grease.** The oil and grease forms a film over water which spreads and makes oxygen transfer difficult and is toxic to aquatic animals and plants.

Metals such as lead, copper, cadmium, zinc, mercury, chromium, selenium and nickel are toxic to fish and other forms of aquatic life and can cause genetic defects.

Organics may lead to human and animal reproductive abnormalities.

Sediment can reduce the suitability of creeks for spawning beds, decrease the light available for photosynthetic organisms and increase the transport of heavy metals and nutrients that adhere to the sediment particles.

Trash in stormwater harms wildlife. The plastic loops that hold six-packs of beer or soda together can strangle gulls and plastic bags cause the death of marine animals through ingestion or entanglement.

Pathogens in stormwater also contaminate shellfish beds. Contaminated stormwater, along with pollution from other sources, have causes the closure of shellfish beds. According to the Morro Bay Estuary Program publication, "Estuary Tidings: A Report on the Health of the Morro Bay Estuary," two of the three harvesting parcels in Morro Bay are partially closed to shellfish harvesting by the California Department of Health Services (DHS). DHS is responsible for ensuring that harvested shellfish are safe. DHS has concluded that bay waters are clean enough to support commercial shellfish operations in portions of the three parcels but require mandatory closures immediately following rainfall events due to high bacteria levels.

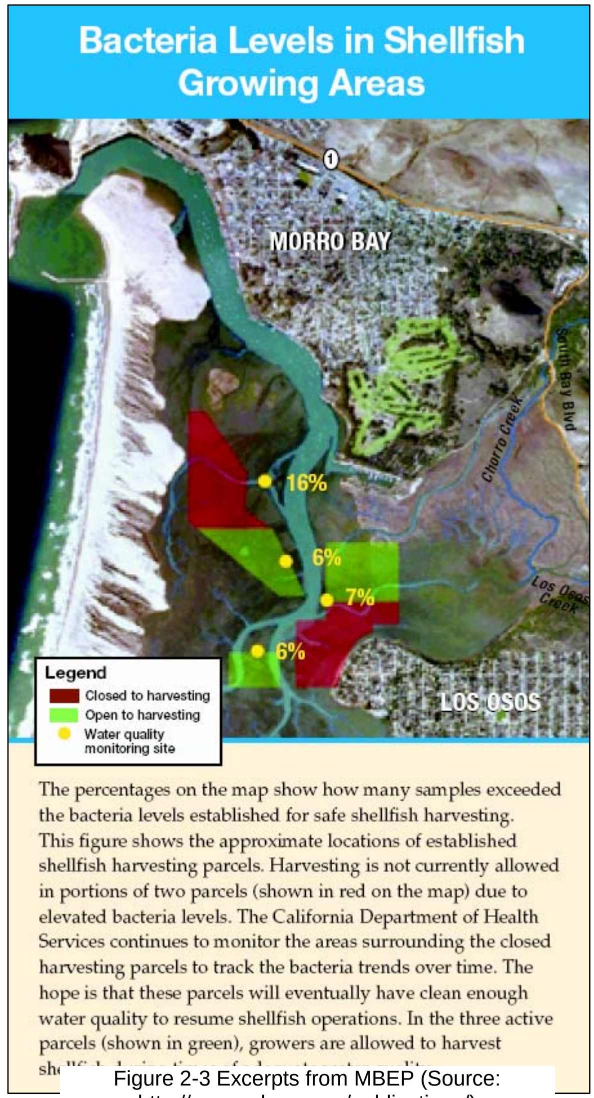


Figure 2-3 Excerpts from MBEP (Source: http://www.mbnep.org/publications/)

A key contributing factor is that levels of bacteria and viruses are usually 100 to 1,000 times greater in the bottom sediment, where shellfish live, than in the water above.

Aesthetic Impacts

The beauty of San Luis Obispo County's coastlines is world renown. The presence of cigarette butts, polystyrene cups, and other trash that storm sewers dump into the streams, lakes and the ocean creates an unwelcome eyesore. Sediment loads in these waters reduce water clarity.

Impacts to Tourism and Recreation.

Potential human illness and aesthetic losses result in more than unpleasantness. Coastal and recreational tourism are major components of the local economy. On a typical weekend, many visitors look to the Central Coast as a getaway destination. If the degradation of the water bodies that accept contaminated stormwater is allowed to continue, these locations will be less attractive for visitors and will deter people from making San Luis Obispo County a vacation or travel destination.

Harm to Community Water Supplies

Many groundwater basins within San Luis County are at or near overdraft. Excessive water withdrawals from our inland and coastal streams will have potentially significant environmental impacts, including impacts to riparian habitats and altering of stream flows potentially affecting anadromous fish.

2.3 Stormwater NPDES Regulatory Requirements

To address the impacts of development on water quality, the National Pollutant Discharge Elimination System (NPDES) Small Municipal Separate Storm Sewer System (MS4) General Permit requires the County (Permittee) to develop and implement a Stormwater Management Program (SWMP) that describes Best Management Practices (BMPs), measurable goals, and timetables for implementation in the following six program areas:

1. Public Education and Outreach
   The Permittee must educate the public in its permitted jurisdiction about the importance of the stormwater program and the public's role in the program.

2. Public Participation and Involvement
   The Permittee must comply with all State and local notice requirements when implementing a public involvement/participation program.

3. Illicit Discharge Detection and Elimination
   The Permittee must adopt and enforce ordinances or take equivalent measures that prohibit illicit discharges. The Permittee must also implement a program to detect illicit discharges.

4. Construction Site Stormwater Runoff Control
   The Permittee must develop a program to control the discharge of pollutants from construction sites greater than or equal to one acre in size within its permitted jurisdiction. The program must include inspections of construction sites and enforcement actions against violators.

5. Post-Construction Stormwater Management for New Development and Redevelopment
   The Permittee must require long-term post-construction BMPs that protect water quality and control runoff flow, to be incorporated into development and significant redevelopment projects.

Post-construction programs are most efficient when they stress (i) low impact design; (ii) source controls; and (iii) treatment controls.

6. Pollution Prevention/Good Housekeeping for Municipal Operations
The Permittee must examine its own activities and develop a program to prevent the discharge of pollutants from these activities. At a minimum, the program must educate staff on pollution prevention, and minimize pollutant sources.

This manual addresses the Post-Construction Stormwater Management aspect of the Stormwater Management Program. For this program area, the County is required to:

- Develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment projects that disturb greater than or equal to one acre including projects less than one acre that are part of a larger common plan of development that discharge into the municipal separate storm sewer system by ensuring that controls are in place that would prevent or minimize water quality impacts;
- Develop and implement strategies that include a combination of structural and/or non-structural BMPs;
- Use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment to the extent allowable under local law; and
- Ensure adequate long-term operation and maintenance of BMPs, and
- Comply with Attachment 4 of the General Permit. The complete text of Attachment 4 of the General Permit Attachment 4 is available at:
  http://www.swrcb.ca.gov/stormwtr/phase_ii_municipal.html

  The County must implement a post-construction program with design standards for the following types of discretionary development and redevelopment projects:

  - Single-Family Hillside Residences
  - 100,000 Square Foot Commercial Developments
  - Automotive Repair Shops
  - Retail Gasoline Outlets
  - Restaurants
  - Home Subdivisions with 10 or more housing units
  - Parking lots 5,000 square feet or more or with 25 or more parking spaces and potentially exposed to stormwater runoff

  The County must define appropriate numeric volumetric and flow treatment control design standards to mitigate (infiltrate, filter or treat) stormwater runoff.

2.4 Low Impact Development

In contrast to traditional stormwater management approaches, the guiding principle of Low Impact Development approaches is not conveyance. Low Impact Development (LID) uses a basic principle modeled after nature: **Manage rainfall at the source using uniformly distributed, decentralized micro-scale controls**. LID designs can reduce stormwater volumes, rates, pollutant loading, and downstream erosion associated with development while recharging the groundwater table.

The ability of LID to successfully mimic the site's predevelopment hydrology is a function of the region's climate regimes, the soil's ability to infiltrate runoff, the site's topography, the depth of the groundwater table, and the proportion of pervious area maintained on the site. While LID has the potential to reduce the impacts of development, it also can decrease the project's direct life-cycle costs by reducing the amount of infrastructure needed to convey stormwater and by decreasing the cost of maintaining stormwater infrastructure.

Ideally, upon development, an LID site would discharge and infiltrate the same volume of stormwater, at the same peak rate, duration and frequency, and maintain the same water quality that had been historically discharged from the site prior to development. In new developments and where possible in re-developments, LID focus is on site design. The project should:

- Minimize the impacts of increased stormwater runoff from impervious surfaces and land conversions by maintaining peak flow frequencies and durations of the site's predevelopment hydrologic condition;
- Retain and incorporate natural site features that promote infiltration of stormwater;
- Fit the terrain instead of grading the topography to fit the project's structures;
- Preserve existing drainage patterns, pervious areas, and sensitive habitat areas within the project limits;
- Minimize the extent of proposed impervious surfaces (roofing, parking lots, streets, etc.);
- Minimize the use of structural stormwater controls (pipes, inlets, etc.);
- Use multifunctional landscapes to infiltrate, store, and intercept as much runoff as possible and as close to the origin as possible; and
- Limit the connectivity of impervious areas.

Although all projects will be required to integrate LID concepts into project designs, it is recognized that not all sites will be able to effectively incorporate all LID practices. For instance, soil permeability, soil contamination, slope, and water table characteristics may limit the potential for local infiltration. Large urban projects with significant lot coverage may lack the area to offset their increased volume of runoff. The criteria for obtaining an LID waiver are provided in Chapter 3.

LID designs must be carefully integrated into projects with a thorough consideration of engineering and geotechnical limitations. LID is particularly well suited for the following project sites:

- Project sites situated in closed depressions;
- Project sites with permeable soil types;
- Project sites containing, situated adjacent to, or draining to wetlands, riparian areas, fish or wildlife areas and/or estuaries;
- Projects resulting in negative impacts caused by the increase in volume or rate of surface water leaving or arriving at the site;
- Project sites located in an area underlain by a critical aquifer recharge area; and
- Project sites with designated open space area requirements.

To adhere to the MS4 General Permit requirements and the County's sustainability goal of "*Meeting the needs of the present without compromising the ability of future generations to meet their own needs*", LID strategies have been incorporated into County policies and this manual. Provisions have been included to eliminate the requirement where infeasible or impractical.

LID has been successfully applied to government, residential, commercial, and industrial development and redevelopment projects. In areas with low impervious values and high porosity soils, LID can be a cost-efficient and effective method for managing runoff and protecting the environment. In areas with significant amounts of impervious surfaces and low porosity clay soils, incorporating LID may increase project costs and may not be feasible or appropriate.

2.5 Numeric Sizing Requirements

The Central Coast Regional Water Quality Control Board recognizes that:

- It is cost prohibitive to maintain the pre-development hydrologic regime everywhere at all times and still meet current development demands, and
- Impacts to receiving waters are real and measurable.

To maximize the return on stormwater investment, numeric sizing requirements were strategically selected to minimize cost while achieving key watershed health criteria including all of the following:

- Establishing groundwater recharge volume goals;
- Maintaining peak runoff rates consistent with pre-development rates;
- Establishing treatment control standards (volume and rate); and
- Minimizing directly connected impervious areas, where possible.

Land Use Ordinance Section 22.52 and Coastal Zone Land Use Ordinance Section 23.05.040 require that the control of drainage and drainage facilities minimize harmful effects of stormwater runoff and resulting inundation and erosion on proposed projects, and protect neighboring and downstream properties from drainage problems resulting from new development. Where conflicts exist between the ordinances and the thresholds provided herein, the ordinances shall control.

Groundwater Recharge Volume

Ideally, projects would be designed to recharge groundwater supplies at the historical rate. Section 22.52.100 requires projects to mitigate the impacts on recharge caused by the reduction in the permeability of soil areas on the site with logical exceptions. While on many sites it is currently impractical to construct retention facilities of the size necessary to replace the storage lost to development; it is often possible to retain the majority of the smaller, more frequent storm events using LID designs. Therefore, projects should infiltrate the initial runoff of each storm.

Projects shall infiltrate the initial runoff of each storm based upon the annual average rainfall as follows:

Table 2-1. Depth of Storm to Be Retained On-Site

AVERAGE ANNUAL RAINFALL	DEPTH OF RUNOFF TO BE TREATED PER IMPERVIOUS AREA ACRE
Less than or equal to 15 inches	0.50-inches
15 and less than or equal to 18 inches	0.75-inches
18 and less than or equal to 25 inches	1.00-inches
Greater than or equal to 25 inches	1.32-inches

This goal is not additive (i.e. the retention basin volume requirements specified in Public Improvement Standards Section 5.2.2A. “Retention Basins” can be used to meet groundwater recharge volume goals), although distributed, small-scale retention systems are preferred over a single retention basin.

Peak Runoff Rate
To reduce channel and slope erosion, runoff from a site should be discharged at a rate and volume compatible with the capacity of the natural streams it discharges to.

> *Runoff rates from the site for storms up to the 50 year, 10-hour intensity and duration storm shall not exceed the pre-developed 2 year discharge rate at each of the historic discharge locations.*

This goal is consistent with Titles 22.52.080 through 22.52.100 and 23.05.050 requirements which states that proposed projects are to include design provisions to retain off-site natural drainage patterns and, when required, limit peak runoff to predevelopment levels. Additionally, this threshold is consistent with the detention basin volume requirements specified in Section 5.2.2B "Detention Basins" of the Public Improvement Standards. Specific projects may have unique attributes that necessitate no detention (such as projects where detention would exacerbate flooding) or that could require detention volumes greater than the amount specified here (such as projects where discharge is limited based on downstream infrastructure that is unable to convey projected rates of runoff).

Channel Protection
Many channels receiving stormwater runoff are susceptible to degradation as a result of changes in the runoff and sediment regime due to the development tributary to the receiving channel.

The County of San Luis Obispo has several provisions to protect the downstream channel resources, including energy dissipation at discharge locations, detention and retention policies, peak runoff rate controls and creek setback criteria. However, the extended duration of discharge from detention basins has been attributed to adversely affect the shear stress of receiving channels. To compensate for this, detention facilities and receiving waters should be evaluated to determine if a multi-stage discharge outlet that would allow low flow discharges (i.e. 2 year peak runoff rate), intermittent flow discharges (5 or 10 year peak runoff rate) and high flow discharges (50 or 100 year peak runoff rate) would be appropriate.

The benefits associated with selecting a lower intermittent flow discharge design storm can decrease detention basin sizes, but also increase the risk of downstream flooding and therefore should be selected carefully.

It is recommended that project proponents discuss the appropriateness of multi-stage discharge outlets with the County early in the design process or at the pre-application meeting.

Treatment Control Standards
The need for treatment control is dependent on the designation of the project (See Chapter 3). If required, treatment control standards are either based on volume-based or flow-based treatment control Best Management Practices (BMPs).

The purpose of establishing a ***volumetric*** treatment control BMP is to provide confidence that volume-based treatment control BMPs are capable of capturing and treating a specified percentage of the annual runoff. This involves detaining the runoff for a duration long enough to address the pollutants of concern. The BMP detention time is either associated with the inherent infiltration rate of the soils on the site or a restriction applied to the BMP means of discharge (typically a pipe, plate or weir). Treatment control BMPs that use volumetric-based design requirements are listed in Table 2-2.

Table 2-2. Treatment Control BMP Minimum Detention Rates

VOLUMETRIC BMP (CALIFORNIA STORMWATER QUALITY ASSOCIATION BMP NUMBER)	TIME TO EMPTY (HOURS)
Constructed Wetlands (TC-21)	24
Infiltration Basins (Retention Basins) (TC-11) Wet ponds (Retention Basins with permanent Ponds) (TC-20) Extended Detention Basin (TC-22) Media Filters (2 chambered: settling basin & sand / absorptive filtering media) (TC-40)	48
Bioretention (TC-32)	72

A hydrograph analysis is required to demonstrate adequate detention times. Information on computing composite curve numbers to account for disconnected impervious areas and Low Impact Development design components is provided in Chapter 6 of this manual. Projects required to treat stormwater shall use the volumes generated using the stormwater depths provided in Table 2-3.

Table 2-3. Depth of Storm to Be Treated

AVERAGE ANNUAL RAINFALL	DEPTH OF RUNOFF TO BE TREATED PER IMPERVIOUS AREA ACRE
Less than or equal to 15 inches	0.50-inches
15 and less than or equal to 18 inches	0.75-inches
18 and less than or equal to 25 inches	1.00-inches
Greater than or equal to 25 inches	1.32-inches

The purpose of establishing a ***flow-based*** Treatment Control BMP rate is to provide confidence that the flow-based treatment control BMP is able to provide sufficient treatment to the runoff prior to it leaving the site. This generally involves a minimum contact time and maximum velocity and depth. See individual BMP design guidance for specifics.

The peak flow rate shall be determined using the Rational Method: $Q = C * I * A$ where:

- Q = Peak flow rate, cfs
- C = Runoff coefficient per Chapter 6
- I = 0.36 in/hr
- A = Drainage area in acres

The CCRWQCB requires Permittees to use Low Impact Development Integrated Management Practices (IMPs) to treat stormwater runoff where possible. Rainfall infiltrated into the soil (with proper pre-treatment), may be excluded from the volume and rate of runoff to be treated per this requirement.

The CCRWQCB will only allow conventional treatment control BMPs if the Permittee can demonstrate that the cost of incorporating LID is prohibitive because the “cost would exceed any benefit to be derived.” (State Water Resources Control Board Order No. WQ 2000-11.)

Additional information on treatment control measures is provided in Chapter 7.

<u>Directly Connected Impervious Areas</u>
To reduce adverse impacts to biological resources associated with surface water, directly connected impervious area should be minimized to the greatest extent possible.

Chapters 4, 5, and 6 provide techniques to disconnect directly connected impervious areas.

Ch 3: Preparing Permit Applications

3.1 The Development Review Process

To comply with Federal and State NPDES stormwater regulatory requirements, the County has integrated post-construction stormwater management into the development review process. This chapter outlines the County's development review process and gives step-by-step instructions for how to prepare permit applications for new development and redevelopment projects.

Figure 3-1 illustrates the process for addressing stormwater quality requirements in permit applications.

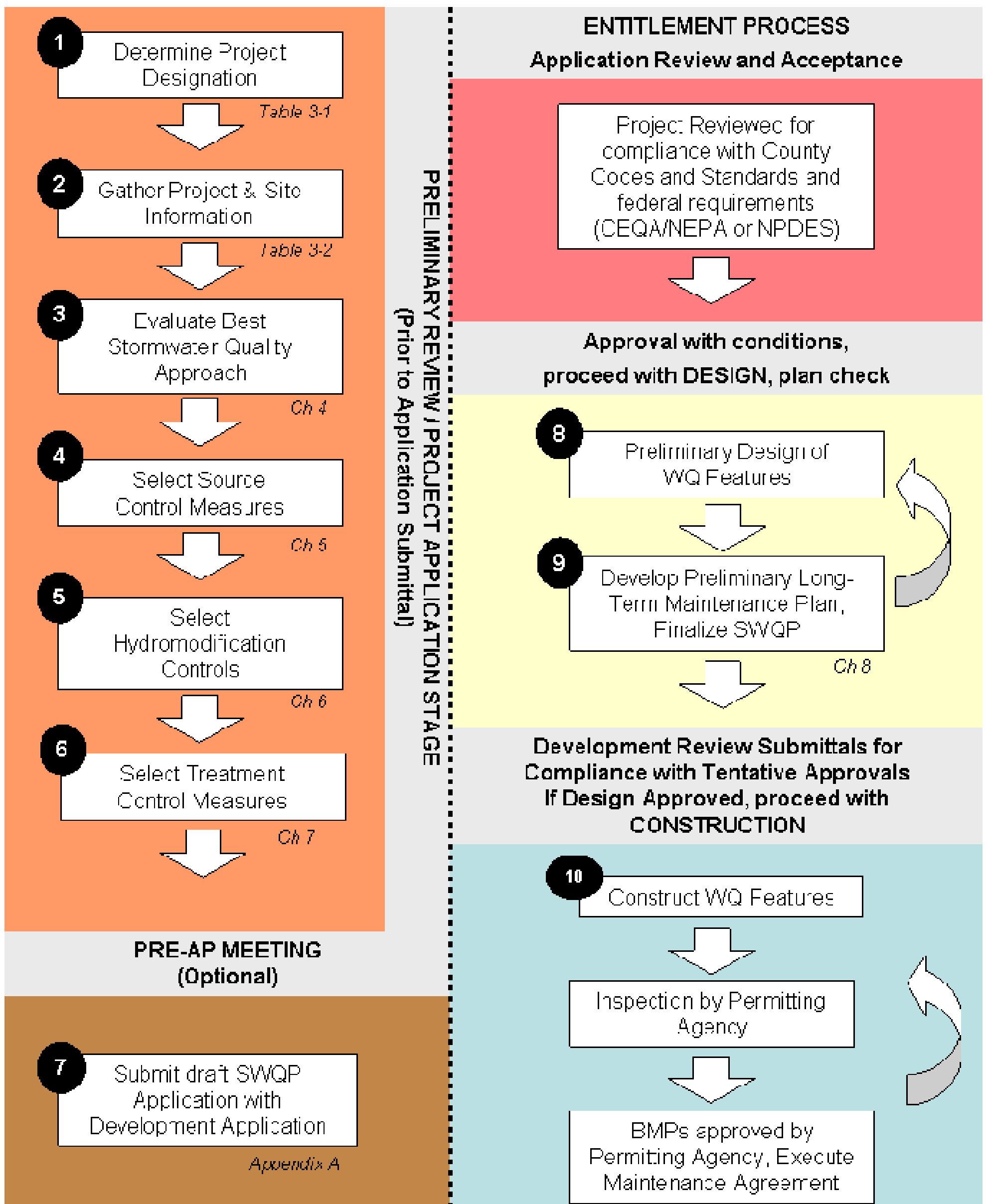


Figure 3-1: Process for Addressing Stormwater Quality Requirements

Stormwater management strategies should be considered early in site planning. Including stormwater management in the preliminary site plan can reduce overall project costs by minimizing rework and reducing infrastructure costs. Early planning enables more stormwater management flexibility.

The County's application process is designed to assure that post-construction stormwater controls are in place throughout the life of the project. The County requires additional documentation for erosion and sediment controls during construction.

3.2 Ten Steps in the Project Application Process

The ten steps outlined below must be followed to complete a successful project application. Subsequent chapters in this manual provide more detailed instructions on how to accomplish each step.

Step 1: Determine Project Designation

To determine if your project is a Priority Project, check the appropriate boxes from the table below:

Table 3-1. Project Designation Table

ITEM	DEVELOPMENT AND REDEVELOPMENT CATEGORY	YES	NO
1.	Single-family hillside residences on slopes greater than or equal to 10 percent		
2.	Commercial development where the land area for development is ≥ 100,000 sf		
3.	Automotive repair shop		
4.	Retail Gasoline Outlet		
5.	Restaurant where the land area for development or redevelopment ≥or 5,000 sf		
6.	Detached residential development of 10 or more units		
7.	Attached residential development of 10 or more units		
8.	Parking lots ≥ 5,000 sf or with at least 25 parking spaces AND potentially exposed to stormwater runoff		
9.	Discharging to Clean Water Act 303(d) receiving waters, Sensitive Resource Area (SRA), Sensitive Riparian Vegetation (SRV) or Wetlands (WET) Overlays		

If you answered **YES** to any of the above questions, your project is considered a **PRIORITY PROJECT** and will be required to submit a Stormwater Quality Plan (SWQP) and a Priority Project Stormwater Quality Application.

If you answered **NO** to all of the above questions and your project does not meet one of the established exceptions or exclusions **AND** your project disturbs greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, your project is considered a **STANDARD PROJECT**. Standard

Post-construction stormwater controls are required for all projects. The required documentation and level of processing may vary based on the project designation: "**Priority**", "**Standard**" or "**Exempt**". Exempt projects are not required to follow this manual. Please check with the Planning and Building Department to verify that a project meets the criteria to be considered "Exempt."

projects must submit a completed Stormwater Quality Standard Project Application.

Projects that disturb less than one acre and are not part of the larger common plan of development or sale, and do not meet any of the Table 3-1 descriptions, may be considered **EXEMPT** from meeting the stormwater quality requirements specified in this manual.

Consult with the Planning and Building Department staff to verify that your project meets the criteria to be considered "Exempt." Exempt project applicants are encouraged to implement practices that will reduce stormwater impacts associated with development. A list of suggested practices appropriate for homeowners is included on the back of the post-construction stormwater handout available at the Planning and Building Help Desk Counter.

Maintenance and utility projects are also typically considered "exempt" from meeting the post-construction requirements specified in this manual. Examples of exempt maintenance projects include routine overlays and slurry seals. Examples of exempt utility projects include the installation or repair of subsurface utilities or aerial utilities. Other types of exempt projects include installation of ADA ramps, small retaining walls, interior improvements and projects on private property that do not require a grading permit.

Industrial activities may be required to obtain an individual General NPDES Permit for Stormwater Discharges Associated with Industrial Activities. See State Water Resource Control Board web site at http://www.swrcb.ca.gov/water_issues/programs/stormwater/industrial.shtml for more information on obtaining individual General NPDES Permit for industrial activities.

Appendix A includes the forms needed for Standard and Priority Projects Stormwater Quality Applications.

Step 2: Gather Project and Site Information

Gather and evaluate the project and site information listed in Table 3-2. Table 3-2 provides a list of the most commonly needed information, its purpose, and its source. Note, this list is preliminary and more specific information may be required prior to final design.

Table 3-2: Commonly Needed Site Information

CATEGORY	DESCRIPTION	PURPOSE	SOURCE
Hydrologic	Creeks, wetlands, watercourses, seeps, springs, ponds, lakes, areas of 100-year floodplain, any contiguous natural areas, include locations of run-on.	Development location should balance site constraints and opportunities (on the least sensitive portion of a site and conserving the naturally vegetated areas to minimize environmental impacts in general and stormwater runoff impacts in particular).	Site inspections, topographic survey and existing maps such as US Geologic Survey (USGS) quadrangle maps, Federal Emergency Management Agency (FEMA) floodplain maps, and US Fish and Wildlife Service (USFWS) wetland inventory maps.
Receiving Water Limitations	Discharge locations, including existing drainage, developed drainage and storm drain connections, where applicable.	The stormwater plan should be designed considering the receiving water limitations based on the Clean Water Act 303 (d) list of impaired waterbodies.	Receiving water quality Clean Water Act 303(d) list for the Central Coast Region http://www.waterboards.ca.gov/water_issues/programs/tmdl/docs/303dlists2006/epa/r3_06_303d_reqtmdls.pdf US Geologic Survey (USGS) quadrangle maps

Table 3-2: Commonly Needed Site Information Continued

CATEGORY	DESCRIPTION	PURPOSE	SOURCE
Topographic	Steep slopes, outcrops, or other significant geologic features	The project needs to comply with any local restrictions on development of steep slopes and soils that are susceptible to erosion. Avoidance of such areas is advisable in order to reduce stormwater impacts.	Site inspections, a topographic survey of the site, geotechnical report.
Soil Types	Hydrologic soil groups and depth to groundwater	Determining the feasibility of onsite infiltration of stormwater.	Natural Resources Conservation Service (NRCS) Soils Survey maps http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
Effective Impervious Area (EIA)	Existing and proposed impervious surfaces, e.g., roof, sidewalk, street, parking lots	To measure the relationship that exists between watershed health and the percentage of impervious surface area within a watershed.	Site inspections, a topographic survey of the site.
Setbacks	Building, septic, open space, riparian, setbacks etc.	Development should be set back from creeks and riparian habitat as required by the local jurisdiction and the Central Coast Regional Water Quality Control Board.	County Dept. of Planning and Building County Code and Environmental requirements. www.sloplanning.org Water Quality Control Plan, Central Coast Region (Basin Plan) http://www.waterboards.ca.gov/centralcoast/BasinPlan/Index.htm
Known or suspected Environmentally Sensitive Areas	Biological and culturally sensitive areas	Mature trees and native vegetation offer stormwater control benefits. Their preservation, along with other sensitive areas, is recommended.	County Dept. of Planning and Building County Code and Environmental requirements. www.sloplanning.org
Hazardous areas	Hot spots	Determine suitable BMPs.	Current SLO Co Hazardous Waste Site List, Special Studies, See Appendix H.
Pollutants of Concern (POCs) in Site Runoff	Existing POCs at site and possible POCs after project completion.	Knowing the target POCs at a site is necessary to designs appropriate post-construction BMPs.	Project Site History (see above) Project Pollutant Generating Activities

Review the project and site information listed above to identify site constraints, the most appropriate stormwater treatment control measures, and opportunities to incorporate LID IMPs into the site and landscape design. Constraints might include impermeable soils, high groundwater, steep slopes, and geotechnical instability. Opportunities might include existing natural areas, localized depressions, and unbuildable portions of irregularly shaped parcels.

Step 3: Evaluate Best Stormwater Quality Approach

The project must demonstrate that it has included measures to reduce stormwater quality impacts. The best way to reduce stormwater quality issues over the life of a project is to employ good site planning techniques that:

- Minimize disturbance of natural drainage features and vegetation;
- Avoid protected sensitive areas and significant site features;
- Minimize the amount of directly connected and overall impervious surface area;
- Manage stormwater (quality and quantity) as close to the point of origin as possible; and
- Discharge site runoff at a rate and volume that maintains downstream receiving channel stability.

These strategies may decrease the project's retention or detention requirements as well as the need to incorporate costly mechanical, underground and/or "end-of-pipe" treatment systems into the project.

Table 3-3 is a checklist taken from the Project Stormwater Quality Application. The checklist can be used to determine if the project design reduces or eliminates stormwater quality issues. A **YES** response means that the item is addressed in the project. A narrative should be provided as part of the Stormwater Quality Application to discuss how, and when appropriate, where, the item is addressed in the plans. A **NO** response means the item in not addressed. A **NO** response will require a brief explanation for why the option was not selected. A **N/A** response means that the item does not pertain to the project.

Table 3-3A: Stormwater Approach Considerations

A. Minimize Direct Stormwater Impacts		Yes	No	N/A
1.	Has the project been designed to avoid or reduce impacts to receiving waters and historic flow paths, to increase the preservation of critical areas such as floodplains, wetlands, and areas with erosive or unstable soil conditions?			
2.	For roadway projects, have structures and bridges been designed or located to reduce work in live streams and minimize construction impacts? (Refer to section 4.3.1 of this manual for more information)			
3.	Is flow into natural open spaces conveyed in a non-concentrated manner?			
4.	Are disturbed slopes protected from erosion?			
5.	Have slope lengths or steepness been minimized by utilizing retaining walls, benches or terraces to shorten slope length?			
6.	Has top soil been preserved for re-distribution on disturbed slopes? (Refer to section 4.2.5 of this manual for more information)			
7.	Have areas subject to compaction been minimized (i.e. minimize site disturbance, deep till areas compacted during construction or will soil amending be required)?			
8.	Have landscaped areas been used to minimize the amount of runoff?			

Table 3-3B: Stormwater Approach Considerations

B. Minimize Directly Connected and Overall Impervious Surfaces		Yes	No	N/A
1.	Has the project been designed to minimize its impervious footprint (i.e. reduce street widths, street layouts, cul-de-sac design, parking, reduced setbacks and frontages)?			
2.	Can surfaces with greater porosity be substituted for impervious surfaces (i.e. replace traditional concrete and asphalt with permeable pavers or porous concrete)?			
3.	Where landscape is proposed, do rooftops, impervious sidewalks, walkways, trails and patios drain into adjacent landscape?			

Table 3-3C: Stormwater Approach Considerations

C. Increase the Travel Time of Water off the Site (Time of Concentration)		Yes	No	N/A
1.	Have grades been flattened for stormwater conveyance to the minimum sufficient to allow positive drainage?			
2.	Are swales utilized in lieu of pipe or hardened channels (i.e., shallow grade swales with sand or gravel substrate below the vegetation to promote infiltration and storage)?			
3.	Is the post-development Time of Concentration (Tc) greater than the Tc for the pre-development condition?			

Table 3-3D: Stormwater Approach Considerations

D. Reduce Risk of Channel Erosion		Yes	No	N/A
1.	Has the project mitigated project-related increases in downstream velocity, volume and/or sediment loading?			
2.	Has the project addressed all project-related stream encroachments, crossings, realignments, or other hydraulic changes upstream and downstream of the project?			
3.	Have energy dissipation devices been included at outlets?			
4.	Are all transitions between culvert outlets/headwalls/wingwalls and channel areas smooth to reduce turbulence and scour?			
5.	If appropriate, are detention facilities included to reduce peak discharges?			

See Chapters 4 and 5 for a detailed description of potentially suitable site design and source control measures. Chapter 6 provides measures to address project hydromodification impacts.

A pre-application meeting at this step is beneficial.

Step 4: Select Source Control Measures

Source control measures include activities, prohibition of practices, maintenance procedures, managerial practices, or operational practices that aim to prevent stormwater pollution by reducing the potential for contamination at the source of pollution. The goal of implementing source control measures is to:

- Prevent stormwater from contacting work and storage areas so it doesn't pick up pollutants
- Prevent pollutants from contacting surfaces that come into contact with stormwater runoff

All sources of potentially significant post-construction pollutant loading shall be identified. The introduction of pollutants from these sources into stormwater and non-stormwater discharges shall be prevented or reduced to the maximum extent practicable.

Table 3-4 identifies the source control measures and when they are required.

Table 3-4: Source Control Measures

SOURCE CONTROL MEASURE (SECTION REFERENCE)	REQUIREMENTS
Water Quality Markers (5.2.1)	Mandatory on all projects with inlets connected to storm drain system.
Alternative Building Materials (5.2.2)	Voluntary on all projects.
Clean Water Segregation (5.2.3)	Voluntary on all projects, but doing so will reduce water quality treatment requirements associated with priority projects.
Efficient Irrigation (5.2.4)	Voluntary on all projects.
Fueling Areas (5.3.1)	Mandatory on all projects with fueling areas.
Maintenance Bays and Docks (5.3.2)	Mandatory for 100,000 sf commercial developments with loading docks and retail gasoline outlets, automotive repair shops.
Trash Storage Areas (5.3.3)	Mandatory for all priority designation projects except single family residences.
Vehicle Washing Areas (5.3.4)	Mandatory for all priority designation projects except single family residences.
Material Storage Areas (5.3.5)	Mandatory for all priority designation projects except single family residences.
Pool/Spa/Fountain Discharge (5.3.6)	Clean out or designated land disposal area mandatory for projects with pools, spas or fountain discharges.
Outdoor Work and Processing Areas (5.3.7)	Mandatory for all priority designation projects except single family residences with outdoor work or processing area.
Pet Waste Management (5.3.8)	Voluntary on all projects.

Chapter 5 instructions and acceptable design criteria for various site-specific source control measures.

Step 5: Implement Hydromodification Measures

The use of ***runoff reduction measures*** can reduce the amount of treatment control measures required for a site.

The goal of implementing hydromodification measures is to mimic a site's predevelopment balance of runoff and infiltration. Two components satisfy hydromodification requirements: volume control and peak flow rate control.

Volume control requires that the post-developed project infiltrates the same volume of water as the pre-development condition for the design storm.

Peak flow rate control requires that the post-developed project retains the pre-development peak discharge rate for the design storm. Chapter 6 provides guidance on determining a site's pre-development condition and provides techniques that can be used to infiltrate, filter, store, evaporate, or detain runoff close to its source.

Depending on Project Category and site, these measures may be optional or one or more of these measures may be required.

Step 6: Select Treatment Control Measures

Stormwater treatment control measures are required for all Priority Projects. Treatment control measures are designed to reduce the concentration of pollutants in site runoff. The selection of a specific treatment control measure is based on a number of considerations, including:

- Type of pollutant targeted for removal
- Receiving water limitations
- Volume or flow rate of runoff to be treated
- Amount of space available within the project
- Site-specific conditions and associated limitations
    - Slopes
    - Depth to water table
    - Depth to bedrock/hardpan
    - Proximity to foundations/wells/septic systems
- Costs to construct and maintain

Chapter 7 provides several tools to aid in selecting an appropriate treatment control measure based on the type of pollutants expected. In general, "end of pipe" treatment approaches are costly and maintenance intensive and are the last least favorable option.

Applicants may request a waiver from the requirement to install Treatment Control Measures if they can demonstrate:

- The installation of stormwater treatment devices or flow control devices are impracticable for their particular site, or
- The applicant will financially support an alternative project that will provide other equivalent water quality benefits and

- An alternative compliance measure is approved by the Director of Public Works or Planning & Building

The CCRWQCB prefers natural/passive water quality control BMPs over mechanical and underground options, but will allow for mechanical and/or underground options when passive water quality control BMPs have been found to be infeasible.

Step 7: Prepare Application Submittals

All applicants are required to describe how existing runoff characteristics will be affected by the development project. The application shall contain measures for mitigating any adverse impacts to water quality. The submittal requirements vary based on the project designation.

Project Designation	Submittal Requirements
Standard	√ Standard Project Stormwater Quality Application (Appendix A)
Priority	√ Stormwater Quality Plan (Appendix B) √ Priority Project Stormwater Quality Application (Appendix A)

Step 7a: Priority Projects Submittals

The Stormwater Quality Plan (SWQP) is a document that describes how existing runoff characteristics will be affected by development and contains measures for mitigating any adverse impacts to water quality. The SWQP shall identify constraints, expected pollutants of concern, and site design measures that minimize impervious surfaces and redirect runoff from impervious surfaces to pervious surfaces, as well as source and treatment control BMP locations. In addition, the SWQP must be consistent with other application material (plans and reports). Things to consider when coordinating stormwater controls with other site construction plans include:

Excess fill. Excavation for landscape detention areas, swales and other BMPs, as well as over-excavation/replacement of clay soils with more permeable soils, can alter the cut-and-fill balance for site grading. By considering this issue early in the site design, it may be possible to avoid excessive export of soil from the site.

Soil Compaction during construction. Compaction from construction traffic can radically reduce the infiltration capacity of site soils. Construction staging plans should set aside and protect areas that will be used for infiltration BMPs.

Building Drainage. Building codes require that drainage from roofs and impervious areas be drained away from buildings. The UBC also specifies minimum size and slopes for runoff leaders and drain piping. Detailed designs for BMPs locating in or on the building, or that may affect the building foundations, must accommodate these codes while also meeting the minimum requirements for detention or flow stated in this handbook.

Control of Elevations. Distribution of overland flow to landscaped areas will require that grading and landscape plans be coordinated to provide adequate reveal (a drop required between pavement and vegetated areas to avoid ponding at edge of the paved surface) and prevent differential settling.

Drainage Plans. Water quality measures are typically sized for low flow conditions. They must be able to incorporate or bypass flood flows. Drainage basin release rates must consider detention times and water quality sizing discharge criteria which are likely to be different from flood control sizing criteria.

Landscape Plans. Bioretention areas, vegetated swales, wetlands, etc., require appropriate plant selection to function properly. Additionally, several of the source control BMPs require specific plant and irrigation selection.

Organizing Traffic and Parking. Your stormwater plan may call for depressing landscape areas below paved areas rather that setting them above paved areas and surrounding them with curbs. Striping or bollards may be needed to guide traffic.
Maintenance Procedures. Preservation of grades, drainage structures and landscaping, etc.
.

Stormwater Quality Plans (SWQPs) are required for all priority projects and shall accompany the Priority Project Stormwater Quality Application. The SWQP must meet the design requirements of the County and include sufficient information to evaluate the environmental characteristics of affected areas, the potential impacts of the proposed development on water resources, and the effectiveness and acceptability of measures proposed for managing stormwater runoff. The information to be provided in the SWQP is provided in Appendix A.

The SWQP shall be prepared under the direction of a professional civil engineer registered in the State of California. The plan shall be stamped, signed and include a certifying statement indicating that all stormwater BMPs have been designed to meet the County's stormwater quality requirements.

A professional civil engineer must certify that the improvements conform to the approved plans before final inspection or sign off. The certifying engineer shall provide proof that they have been trained on BMP design for water quality not more than two years prior to the signature date. Training conducted by an organization with stormwater BMP design expertise may be considered qualifying. Examples of organizations deemed qualified to provide stormwater BMP design training include:

- California Stormwater Quality Association
- American Society of Civil Engineers
- American Society of Landscape Architects
- American Public Works Association
- California Water Environment Association

If the plans include additional plants not listed in the County's approved plant list, landscape plans shall be prepared under the direction of a professional landscape architect registered in the State of California.

<u>Step 7b: Standard Project "Application" Submittals</u>
In lieu of providing a Stormwater Quality Plan, Standard Projects may address post-construction stormwater management as part of the preliminary drainage report. Applications must also include the Standard Project Stormwater Quality Application in order for the report to be deemed complete.

Within 30 days of receipt of Stormwater Quality Application (for both Priority and Standard projects), the application will be evaluated for completeness and, if necessary, additional information will be requested. Once found to be complete, an environmental determination will be made on the application to determine if significant environmental impacts could potentially result from the proposed project. Mitigation measures may be required to reduce impacts to a level of insignificance, or an Environmental Impact Report may be required. For discretionary projects, the Department will prepare a staff report to the Review Authority (e.g., the County Planning Commission, Subdivision Review Board) for the project's consideration. The Review Authority, based on County ordinances and policies, project facts, the environmental determination, and recommendations from other agencies, may approve, conditionally approve or deny the application. If the project is conditionally approved, proceed to Step 8.

Step 8: Submit Final Stormwater Quality Plan

Standard design guidelines (Chapters 4, 5, 6 and 7) are provided in this handbook. Alternative designs will be considered if documentation is provided that includes supporting calculations and testing results.

Priority projects will be required to implement all stormwater related conditions of approval and mitigation measures associated with the approved project in a Final Stormwater Quality Plan.

Standard projects will document final stormwater related features in a water quality section in their final drainage report.

Step 9: Establish Long-Term Maintenance

The long-term performance of BMPs depends on proper maintenance.

Prior to the occupancy of any building or grading permits requiring stormwater management BMPs, the property owner(s) shall enter into a formal written stormwater BMP operation and maintenance agreement with the County. The plan shall describe who is financially responsible for long-term maintenance. The required content of the Long-Term Maintenance Agreement is provided in Chapter 8.

Step 10: Construct Water Quality Features

While the owner is responsible for self-certification and inspection, the County will review water quality BMPs throughout construction. BMPs must be constructed according to the approved plans. BMPs relying on infiltration must be protected from contamination from construction site runoff.

DRAFT

Ch 4: Good Site Planning & Design Using LID Integrated Management Practices

4.1 Introduction to Good Site Planning & Design

New development and redevelopment projects that consider stormwater management early in the design process are much more successful in reducing the need for expensive stormwater treatment controls later. It is more efficient and cost-effective to prevent stormwater problems early rather than fixing them later.

Consider these fundamental Low Impact Design principles first to reduce project water quality impacts:

- Stormwater is rain, an important natural resource that is critically important for replenishing our streams, reservoirs, and groundwater supplies.
- LID post-development stormwater management systems use the natural features of the project site to mimic pre-development runoff characteristics (volume, rate, timing and pollutant loading).
- Using onsite storage, infiltration, transpiration and evaporation of stormwater reduces water quality impacts in contrast to discharging stormwater directly to waterbodies.
- Non-LID structural or maintenance-heavy practices (such as detention basins, hydrodynamic structures, water quality filters, etc) should be used after all LID (non-structural) integrated management practices have been fully explored and deemed technically infeasible, environmentally unsound, or too costly.

4.2 Planning Level Considerations

This section provides design guidelines to minimize stormwater impacts at the planning level.

<u>Guiding Principles</u>

When weighing potential development locations within a site, consider the constraints and opportunities for the site and adjacent properties. Ideally, the following considerations should be addressed:

- Follow the topographic contours to minimize soil and vegetation disturbance and the loss of topsoil and organic duff layer when laying out roads and lots.
- Avoid excessive grading, that is, grading beyond that which is necessary to construct the project.
- Limit removal of rock outcroppings, natural drainage courses, wildlife corridors, and mature native vegetation to the greatest extent possible.
- To reduce the extent of grading required and vegetation impacted, pads should not be built on compacted soil that is significantly raised above existing topography, unless no feasible alternatives exist given engineering constraints.

- Maintain buffers between developed areas and riparian corridors and shorelines
- Cluster development areas to maximize the area available for stormwater infiltration and to reduce the effective impervious area of a project.
- Discharge impervious areas to vegetated areas.
- Surface infiltration systems are preferred over subsurface systems.
- Bioretention areas or vegetated channels designed with detention are preferred only where full infiltration is not feasible.

4.2.1 Development Constraints and Opportunities

Description

Carefully consider the optimal location for the building site within the project area. The building site location can influence the site's overall potential for erosion, habitat disruption, and ability to infiltrate water. Integrate the development project into the site rather than modifying the site to fit the proposed development project. Inventory the environmental features of the site and adjacent properties to assess how the project will impact or be influenced by the surrounding areas. To determine the project's constraints and opportunities, the analysis should consider both site and watershed-wide features.

Applicability
These procedures are most suitable for new development projects or projects seeking to expand.

Limitations
Redevelopment and in-fill projects may have limited opportunity to incorporate these recommendations.

Design Criteria
To the extent possible, development should be located outside natural protection areas (as identified in the preliminary site assessment) and within designated buildable areas to minimize soil and vegetation disturbance and to take advantage of the site's natural ability to store and infiltrate stormwater. The following design criteria are intended to help foster a development plan that is compatible with the site:

- Conserve natural areas, soils and vegetation, preferably in contiguous blocks or linear corridors.
- Drain runoff from impervious areas through vegetated areas before leaving the site.
- Avoid stream crossings for roads and conveyance systems whenever possible.
- Integrate small, dispersed bioretention areas to capture, store, and infiltrate stormwater on-site.
- Maintain pre-development flow path lengths, groundwater recharge rates and natural drainage patterns, whenever possible.
- Minimize soil compaction where feasible.
- Minimize site disruption, where feasible.

Process

Develop a site constraints map that shows:

___ Creeks, wetlands, watercourses, seeps, springs, ponds, lakes and areas within the 100-year floodplain, including existing drainage patterns including locations of concentrated run-on and runoff.

___ Natural steep slopes, cliffs, outcrops, or other significant geologic features, as well as geotechnical hazard areas.

___ Tree conservation areas (include tree species, diameter at breast height, canopy cover and condition of ground cover and shrub layer).

___ Hydrologic soil groups and areas with high groundwater. Highlight the soils that provide the greatest opportunity for storage and partial infiltration.

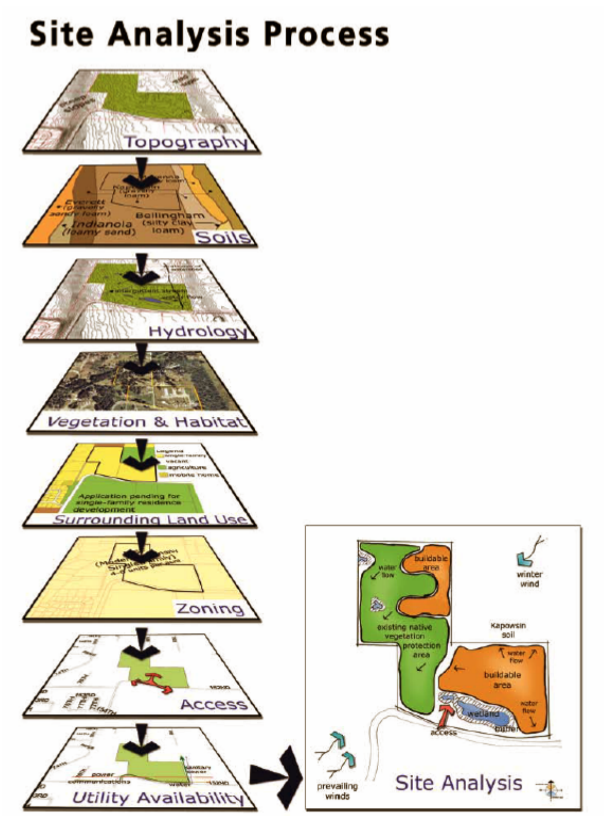
___ Existing impervious surfaces, e.g., roofs, sidewalks, streets, parking lots and overhead and underground utilities. Differentiate between streets with rates of 15,000 average daily travel (ADT) and streets with 25,000 ADT.

___ Archeological (use terminology such as “Environmentally Sensitive Area”) and biological sensitive areas, including potential wildlife movement corridors.

___ Existing fuel tanks (both on-site and within 500 feet of site)

___ Public and private wells and septic systems including leach lines (within 250 feet of the site)

Use the site information collected and design criteria to locate the most suitable areas for development on the site constraints map.



To determine the most suitable areas for development, you will also need to consider other constraints, such as visual, traffic, septic systems, easements, etc.

To receive an overview of the process and a checklist of information and materials you will need to provide, schedule a pre-application meeting with County planning staff.

Figure 4.2.1-1 – Site Analysis Process (excerpted from Puget Sound LID Manual, graphic by AHBL Engineering)

4.2.2 Landform Grading

Description

Landform grading is a technique that converts stable "engineered" slopes to stable, naturally functioning slopes that mimic nature. Concave slopes allow water and vegetation to concentrate at flow lines are created in a manner that minimizes gradients. Grasses and groundcovers are planted on the convex portions of the slopes. Landform grading is intended to reduce erosion potential, runoff, and water quality degradation associated with land form alteration (grading).

Applicability

Landform grading is suitable on all development projects that require significant cut and fill and where the average natural slope is ten percent or greater.

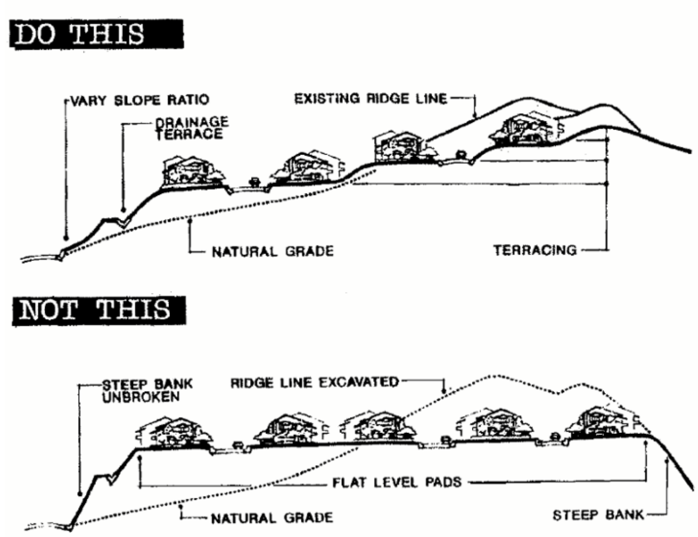
Limitations

Grading must be consistent with geotechnical engineering recommendations.

Design Criteria

The overall grading of the project should work together with the surrounding topography, existing vegetation, circulation, and land features as well as other elements of the total project site to minimize the erosion potential, runoff and water quality degradation associated with land form alteration (grading). Grading proposals should conform to the following standards:

- In lieu of one large pad, development proposed for hillsides should use smaller pads gradually terracing up hillsides, where feasible
- The use of long, continuous slopes with sharp, angular forms should be avoided. Slopes should retain a natural appearance
- Hillside development should conceal graded slopes and retaining walls, where possible. Retaining walls and all significantly graded slopes should be planted.
- Pads should not be built on compacted soil that is significantly raised above existing topography, unless no feasible alternatives exist given engineering constraints.
- Avoid creating directly connected impervious areas, where possible.
- Require compacted soils in areas receiving sheet flow runoff (such as yards, down slope of downspouts) be disked and amended with loam prior to planting.
- Ensure that concentrated flow paths have stable outlets able to handle the water expected to be received.



Source: White County Sample Mountain and Hillside protection ordinance

DRAFT

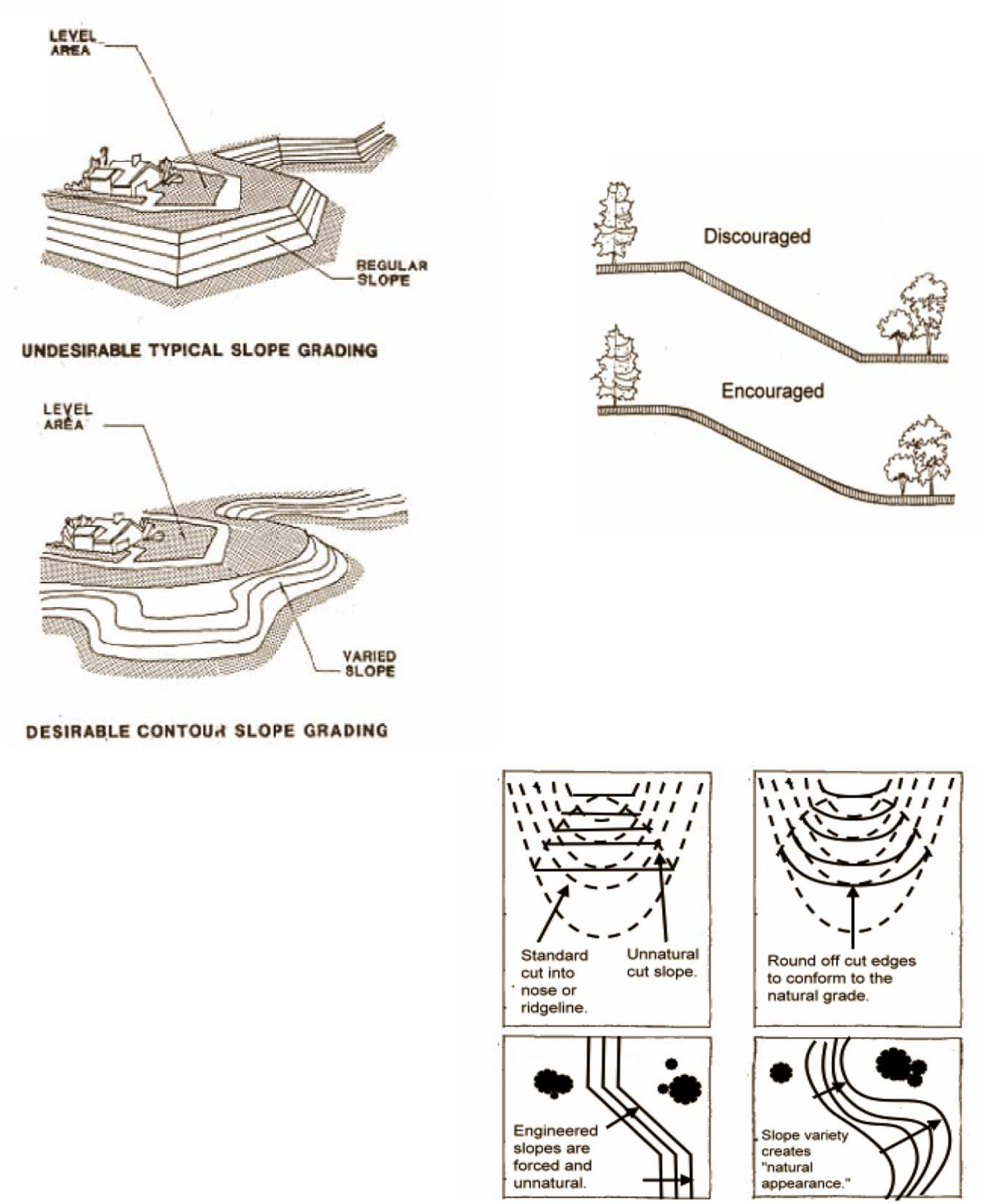


Figure 4.2.2-2
(Excerpted from City of Encinitas Grading Ordinance)

4.2.3 Clustered Development

Description

Clustered development maximizes open space and encourages site planning sensitive to the natural characteristics of the land. It also helps reduce the effective impervious area associated with development.

Applicability

Clustering may be used with nearly all development projects, but is most effectively used in the development of subdivision of larger parcels, where concentrating the allowable development on only a portion of the site allows preservation of sensitive resources. Incentives such as smaller lot size or bonus density increases over that permitted in the zone are often components of cluster development.

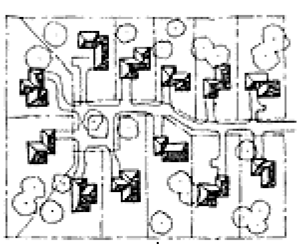
Limitations

Grading plans must comply with geotechnical engineering recommendations.

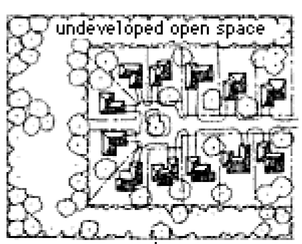
Design Criteria

To the extent possible,

- Preserve areas within or adjacent to identified sensitive areas (steep slopes, wetlands, riparian corridors, etc) or with high infiltration capacity.
- Run-on to preserved areas should mimic existing natural drainage patterns (i.e. if run-on formerly was conveyed to an area under sheet flow conditions, sheet flow conditions shall be maintained to the preserved area even after development of the surrounding area).
- Bioretention and open swale systems are integrated into landscaping.
- Road and driveway stormwater are dispersed to adjacent open space and landscaped areas.
- Pre-development flow path lengths in natural drainage patterns are maintained, or lengthened as necessary to prevent an increase in runoff rates.
- Native vegetation and soils are preserved or enhanced to disperse, store and infiltrate stormwater.



2 dwelling units/acre gross density
2 dwelling units/acre net density
12 dwelling units on 6 acres



2 dwelling units/acre gross density
4 dwelling units/acre net density
12 dwelling units on 3 acres

This site plan illustrates an example of cluster development on a rural site with retention of agricultural and natural features

Sources for Figures 2, 3, 4, and 5: Protecting Water Quality in Urban Areas: Best Management Practices for Minnesota, Ch. 3, Minnesota Pollution Control Agency, Division of Water Quality, St. Paul, MN, Oct. 1989.
Excerpted from City of Chesapeake, VA –Design Guidelines Manual

4.2.4 Parking Alternatives

Description
Nearly all rainfall falling onto parking areas constructed of impervious surfaces (asphalt and concrete) will runoff the site. As runoff travels over the parking surface, it picks up sediment, dust, oils and greases. The smooth surface of the pavement increases the rate and volume of runoff.

Reducing parking standards not only reduces impervious surface area, but also reduces parking related development cost and facilitates the provision of affordable housing and is intended to assure that the number and type of parking spaces specified does not exceed the number of parking spaces needed for the project.

Applicability
Parking alternatives are appropriate for adjacent developments with different peak demand periods and can be effective in compact and/or high density communities where dwelling units are within walking distance to transit and services.

Limitations
Reduction or elimination of off-street parking requirements for one neighborhood or commercial center may increase the parking density of adjacent neighborhoods or commercial centers. Shared parking agreements must include a contingency plan to accommodate changes in ownership, operations or other uses that might increase the parking demand in the future.

Design Criteria
- Parking requirements should reflect projected demand for parking and include an analysis of the potential impact of spillover parking on adjacent areas.
- Minimize off-street parking to meet or decrease Title 22 and 23 parking ratios. If additional parking beyond the parking ratios is permitted, consider using pervious materials or storied parking garages.
- Maximize the use of compact car spaces.
- Use parking garages where feasible.
- Use pervious parking surfaces.
- Use legally binding shared parking agreements when adjacent proposed land uses have peak parking demands at different times of the day or week.
- Incorporate bioretention areas into parking lots.

Parking Garage Source: http://www.slocountyhomes.com/uploaded_images/100_0210-726655.JPG

References
http://www.smartgrowth.state.md.us/pdf/Final%20Parking%20Paper.pdf
http://www.nonprofithousing.org/actioncenter/toolbox/parking/mythsandfacts.pdf

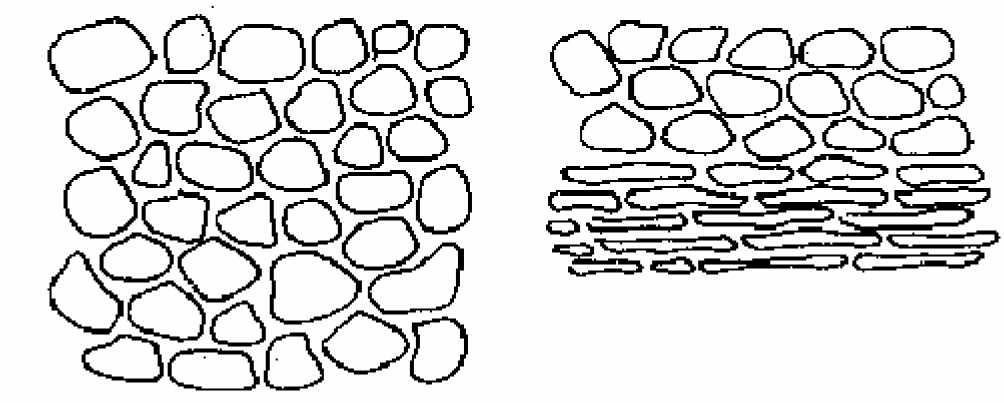
4.2.5 Conserve Top Soil

Description

DRAFT

Undisturbed top soil has characteristics (texture, structure and biology) well suited for infiltration and water treatment. When soil is compacted or otherwise disturbed, it can loose its texture, structure and biology.

The soil on the left has pore spaces indicate of healthy soil that allows the efficient exchange of air and water. The soil on the right is compacted and will restrict root growth, limit infiltration and air circulation in the soil.



Source: http://www.dpi.nsw.gov.au/agriculture/resources/soils/structure/compaction

Applicability
These procedures are suited for most sites.

Limitations
None

Design Criteria
To the extent possible,

- Top soil to be conserved in place shall be identified and delineated on the plans and in the field using orange construction fence around areas to be protected from heavy equipment.
- Areas requiring cuts shall have the native topsoil removed (to the depth of the top soil) and stockpiled for replacement to the surface of the area cut or used elsewhere on the site to amend areas with deficient topsoil. Stockpile depths shall not exceed 3 feet if left in staging area for more than 6 months. Stockpiled top soil shall be spread onto cut slopes that have been tilled to a depth of 6 inches. The top soil shall be placed in lifts not exceeding 1 foot. Compaction should be limited to the density of existing, undisturbed areas.
- Natural resource areas that have been disturbed may need to be replanted with native trees and vegetation.

References
http://www.cabmphandbooks.com/Documents/Construction/EC-2.pdf
http://www.compostwashington.org/PDF/SOIL_MANUAL.pdf

DRAFT

4.3 Common Area Design Considerations

The purpose of this section is to provide design guidelines for common areas. Common areas are usually maintained by a public agency, assessment district, or Home Owners Association. The following guidelines are intended to minimize stormwater impacts by incorporating stormwater friendly design principles into project plans.

Guiding Principles

- Reduce overall street lengths and widths in street and sidewalk layouts.
- Convey drainage in open swales rather than in closed conduits.
- Use medians, bulb-outs, cul-de-sacs and roadside swales to limit continuous flow paths over impervious surfaces.
- Use alternative pervious surfaces for driveways, alleys, low volume residential roads and parking lots rathter than traditional impervious surface materials.
- Minimize hardscaping by including sidewalks on one side of the street only and/or constructing sidewalks using pervious materials.
- Design stormwater outlets properly to prevent erosion.
- Cluster residential parking areas to maximize area available for non-structural stormwater conveyance (roadside swales).
- Plant trees are placed throughout commercial parking lots, along street frontages, and on residential lots.

4.3.1 Street and Sidewalk Layout

Description

Streets and roads are among the largest contributors to polluted stormwater runoff. LID practices reduce impervious area, maximize stormwater infiltration, and reduce pollutant loads.

Subdivision street and sidewalk layout influences the amount of impervious area significantly. As shown below, the overall impervious area associated with streets is significant. Various street configurations can also influence the connectivity of a neighborhood and the land available for open space.

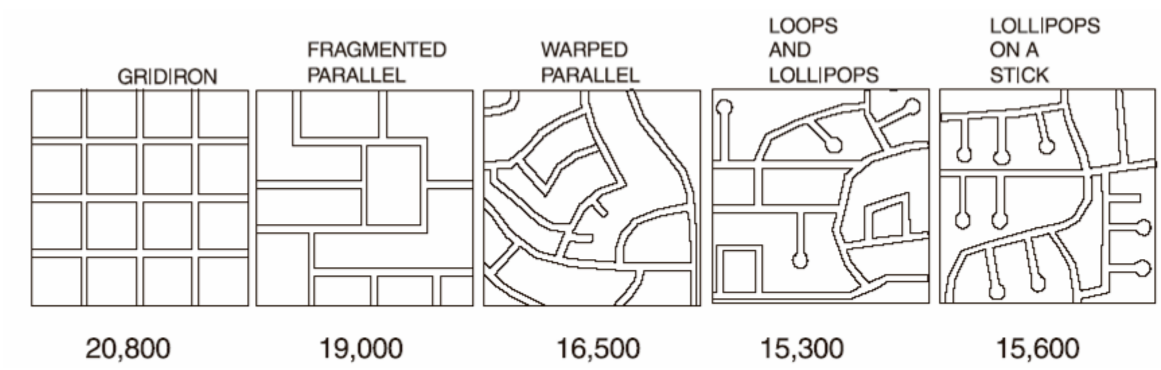


Figure 4.3.1-1 Comparison of linear feet of pavement associated with various street layout alternatives. Excerpted from NEMO LID Manual, originally adapted from ULI 1980

As shown in the City of Davis Bike Map, pedestrian and recreational facilities can also be used to meet stormwater and open space goals.

Source: RRM

Source: City of Davis Bike Map

<u>Applicability</u>
These procedures are suitable for all development projects, but must be weighed against other considerations, such as the amount of earthwork required or specific traffic patterns to the site and surrounding areas.

<u>Limitations</u>
The roadway system must follow County Improvement Standards and safely accommodate all users of the road including pedestrians, people requiring mobility aids, bicyclists, drivers and passengers of transit vehicles, trucks, automobiles and motorcycles. Requests to incorporate LID will require an exception in accordance with Section 1.2 “Design Adjustments” of the Public Improvement Standards. The minimum street widths for a particular project may be limited based on average traffic daily counts and/or terrain and size of vehicles requiring regular access to the site.

<u>Design Criteria</u>
To the extent possible,

- Provide pedestrian and bicycle path connections to encourage walking and cycling and increase access without adding significant impervious areas. Plot a likely “paths” exhibit using the lot layout to map pedestrian routes to schools, bus stop and neighborhood services.
- Reduce the length of residential streets by reviewing minimum lot widths and exploring alternative street layouts.
- Street location considerations should include natural drainage patterns and soil permeability and must provide for large vehicles, equipment, and emergency vehicles access where applicable.
-

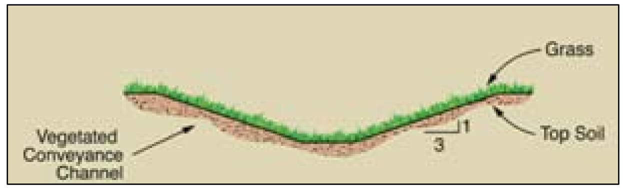
See the Public Improvement Standard Plans for minimum street widths for public roads and adjustment procedures.

<u>References</u>
http://www.completestreets.org/resources.html
http://www.walkinginfo.org/index.cfm

4.3.2 Vegetated Open Channels

Description

Vegetated open channels are shallow channels meant to blend into surrounding landscape while conveying stormwater runoff short distances, typically ending at a bioretention facility, detention or retention basin or to a level spreader. This design technique should be considered instead of storm drain pipe at locations where storm drain pipe is proposed.



www.omafra.gov.on.ca

Applicability

This practice should be considered on all projects with ground slopes less than 4 percent. Tributary areas to open channels may be limited to allow runoff to be conveyed in a non-erosive manner.

Limitations

Structures and pavements adjacent to vegetated open channels may require a moisture barrier to preserve their integrity. Pipe systems may be more appropriate on sites with steeps slopes or highly erodible soils. Depending on the tributary area, a high-flow drainage system may be necessary. Vegetated open channels are not appropriate at locations with high ground water table elevations. Grassed swales without underdrains may result in soggy, wet areas conducive to mosquito breeding.

Design Criteria

To the extent possible,

- Channels should be sized to maintain a low velocity during small storms and to accommodate secondary design storms (see Public Improvement Standard 5-1) without significant erosion or re-suspension of accumulated sediment.
- Channels should have shallow depths and gentle side slopes.
- Swales should be planted with native vegetation. The vegetation of channels located along a roadway and at driveways must conform to County Standard Plan A-5a and A-5b (no greater than 30 inches).
- Check dams may be used to increase detention time, slow the velocity of runoff, and allow sediment to settle out.
- Use pipe or subsurface stone recharge bed to accommodate driveways and intersecting roads. Infiltration is promoted by elevating the outlet of the channel above the flow line of the pipe or subsurface stone recharge bed.
- To obtain water quality treatment control benefit, the water surface elevation associated with water quality storms must not exceed the vegetation height AND the runoff should remain in the channel for a minimum of 10 minutes.

Channels adjacent to roads may require pavement edge stability measures (such as a flush curb), to keep the pavement edge from spalling.

References

http://www.stormwatercenter.net/Manual_Builder/Performance%20Criteria/Open%20Channels.htm
www.cabmphandbooks.com/Documents/Development/TC-30.pdf
http://www.epa.gov/owm/mtb/vegswale.pdf

4.3.3 Multi-Functional Landscapes

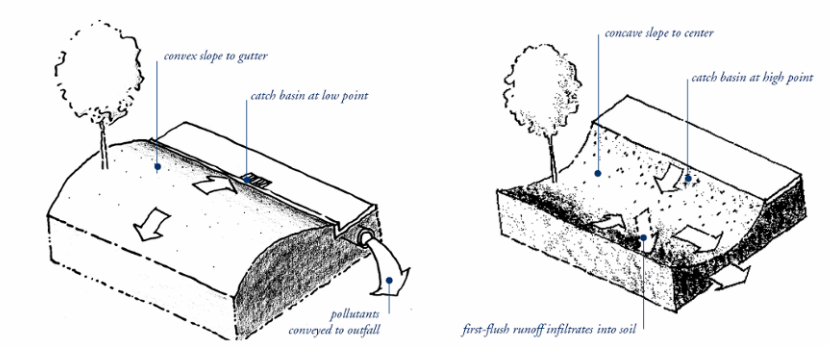
Areas proposed for landscaping can also be used to filter, treat and infiltrate stormwater runoff. Often this requires an interdisciplinary team to ensure the functionality of the landscaped areas. This team should be assembled early in the design process and consist of geotechnical engineers, landscape architects, architects and civil engineers.

This section includes LID practices that can be implemented in common areas or private yard areas to meet diverse functional needs.

4.3.3a Concave planted areas

Description

Most vegetated areas in parking lots, along roads or in landscaped medians can be designed to reduce the overall amount of runoff (and treatment required for that runoff) that leaves a site simply by using concave rather than raised landscaped areas. Concave landscape areas reduce overall effective impervious area, treat first flush runoff, and recharge groundwater supplies at locations where site engineering or subsurface soil conditions allow infiltration.



Conventional median design: convex surface **6.2f Concave median** Start at the source.

Applicability

This practice is suitable for all planted areas within roadway medians, parking lots islands and at the center of cul-de-sacs, with planting widths greater than 2 feet. It also applies to locations where retention/detention basins are necessary.

Limitations

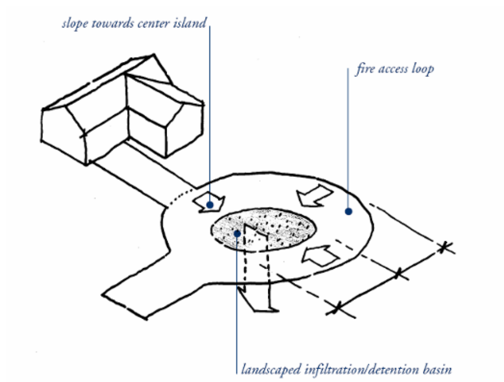
Structures and pavements adjacent to concave medians may require a moisture barrier to preserve their integrity. Depending on the tributary area, a high-flow drainage system may be necessary.

Design Criteria

To the extent possible,

- Concave, planted areas are favored over impervious or convex planted areas.
- Overflow drains or paths are placed strategically to allow some of the stormwater to percolate into the soil.

If necessary, replace existing soil with engineered soil mixtures designed to enhance retention and pollutant breakdown.

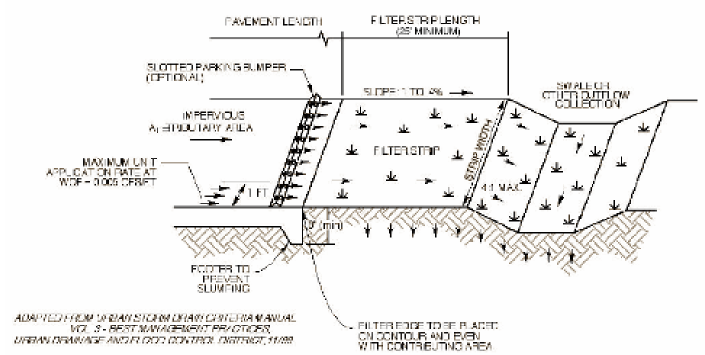


6.2g Cul-de-sac

References

http://scvurppp-w2k.com/pdfs/0203/c3_related_info/startatthesource/Start_At_The_Source_Full.pdf

4.3.3b Vegetated Filter Strips



SHEET FLOW CONTROL
NOT TO SCALE

<u>Description</u>
Filter strips are vegetated areas that are situated between an impervious area and a location where runoff will leave the site. The vegetation (typically grass) serves to slow runoff velocities and filter out pollutants.

<u>Applicability</u>
This practice should be considered on projects that receive sheet flow runoff and room available to provide at least 25 feet of filter strip slope length. The width of the filter strip should extend the length of the pervious area or level spreader tributary to it. Tributary areas should be less than 5 acres.

<u>Limitations</u>
Filter strips are not appropriate for use on unstable or steep slopes. Runoff with high contaminate levels should be treated prior to discharge over a filter strip.

<u>Design Criteria</u>
- Filter strip slope should not exceed 6%. Slopes between 2 and 4% are more ideal. Slopes less than 2% may create mosquito habitat.
- Slope should be disked to a depth of 6 inches to incorporate topsoil for plant growth.
- Strips should not be overly long (which tends to concentrate runoff).
- The top and toe of a filter strip should be level to prevent erosion and encourage sheet flow.
- Benching can be used in conjunction with level spreaders to restore sheet flow when greater filter strip lengths are required.

<u>References</u>
See California Stormwater BMP Handbook Vegetated Buffer Strip Treatment Control Fact Sheet at http://www.cabmphandbooks.com/Documents/Development/TC-31.pdf

4.3.3c Detention and Retention Basins

Shallow retention and detention basins may be suitable as playgrounds or picnic areas.

Small multi-functional detention area at Dove Creek (Atascadero, CA). Source Wallace Group.

Description

Detention basins temporarily store stormwater runoff and slowly release it through an outlet (control structure).

Retention basins temporarily store stormwater runoff until it can be infiltrated into the ground.

Applicability

This practice should be considered on all projects with the need to maintain pre-existing peak flows (detention) or pre-existing volumes (retention). Shallow, multi-functional basins are most appropriate for small tributary areas.

Limitations

Retention basins must adhere to Chapter 6 infiltration system requirements and County Public Works requirements.

Neither type of basin is appropriate for locations with steep terrain. High ground water elevations reduce the effectiveness of retention basins.

Design Criteria

- Distributed small basins are preferred over a single, large deep basin.
- Pre-treatment is required to prevent significant sediment loads from entering basins.
- Basins should completely drain within 72 hours (but no longer than 7 days) after the completion of a storm event to minimize the risk of mosquitoes. Under drains may be used in areas with inadequate infiltration rates.
- Basins not fenced and with public access must have 5:1 or flatter side slopes and ponding depths not greater than 2 feet.
- Forebays and microbasins may improve the water quality treatment capacity of the basin.
- Basins should be sized to store accumulated sediment.
- Measures to address overflows are required.
- Detention basin outlet should be designed to meter out post-development low flow discharge at a rate similar to pre-development conditions.
- Pilot channel may be of turf (for low velocity flows) or permanent turf mat (for higher velocity flows)

References

Public Improvement Standard Section 5.2.2 “Basins”
See California Stormwater BMP Handbook Infiltration Basin and Extended Detention Basin Treatment Control Fact Sheets at Detention basins:
http://www.cabmphandbooks.com/Documents/Municipal/TC-22.pdf
http://www.cabmphandbooks.com/Documents/Development/TC-11.pdf

4.3.4 Curb and Gutter Alternatives

Description
Curb, gutters and catch basin inlet systems are highly discouraged for use as stormwater collection systems because they concentrate flows and pollutants, increase velocities and discourage groundwater recharge.

Applicability
Alternatives to curb and gutter are encouraged in parking lots and in low- and medium-density residential zones where soils and slopes permit.

Limitations
Drainage inlets may be more appropriate in localized areas subject to frequent flooding during minor rain events. Curb and gutter systems may be required in urban settings, or where a new road must tie into an existing collector road. Additionally, where high-speed traffic and pedestrian use occur in the same vicinity, a curbs and gutter system may be necessary to provide distinct area for each use.

Design Criteria
- Where curb and gutters have been designated as a means of separation between pedestrians and motorized traffic, consider the following hydrid LID/conventional stormwater management approaches:
  - The ability to place a vegetated channel between the sidewalk and the roadway.
  - The potential to incorporate a two-foot side concrete strip constructed along the edge of the pavement at the same surface elevation of the pavement. This concrete strip gives drivers a visual cue of the edge of the driving surface and helps protect the vegetated channel from tire ruts.
  - Implementing a curb and gutter system on one side of the road and allowing the road to drain to the other side of the road (road will have super-elevation instead of crowned section).
- Where curb and gutter systems are required for drainage purposes, curb cuts can be spaced strategically to allow runoff to enter adjacent channels. Curb cuts initially discharge into a surface feature (such as a planter or sand filter) where there is an opportunity to infiltrate runoff instead of conveying it directly to a subsurface drainage network. The frequency of curb cut openings is determined to minimize the spread width of stormwater on the road during primary storm events or to keep the volume and velocity of discharge passing through the curb cut from being erosive in the vegetated swale.
- Parking lots that incorporate sumped vegetation areas can use wheel stops in lieu of curb systems to protect the vegetated area from traffic intrusion while allowing parking lot runoff to be drained into the vegetation.
- The design shall provide an emergency overflow path.

References
For more information on Curb-cuts, see San Diego Co. LID Handbook Fact Sheet 17.
http://www.co.san-diego.ca.us/dplu/docs/LID-Handbook.pdf

Lower Columbia River Field Guide to Water Quality Friendly Development
http://www.lcrep.org/fieldguide/examples/curbalternatives.htm

Idaho Department of Environmental Quality Best Management Practices Catalog
http://www.deq.state.id.us/water/data_reports/storm_water/catalog/sec_3/bmps/34.pdf

4.3.5 Alternative Parking Surfaces

Description
Impervious surfaces increase the amount of surface runoff and contribute to heat island effects and pollutant loading as stormwater runs over the impervious surface.

Permeable pavement surfaces may be used to replace traditionally impervious surfaces. Examples of materials that have increased permeability include:

- Unit pavers
- Granular Materials
- Poured-in-place materials
- Porous Concrete or asphalt

Porous concrete and asphalt are similar to traditional concrete and asphalt except that these products are made without the fines.

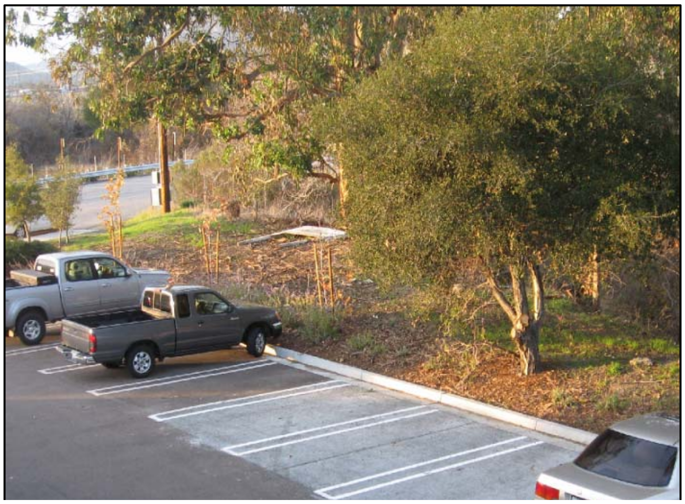
Applicability
These procedures are suitable for parking lots and driveways with generally flat surfaces. Alternative parking surfaces are most cost effective in areas with native sandy soils.

Limitations
The designer must certify that any porous surface proposed for use is able to provide adequate structural integrity for the intended purpose. These materials are not suitable for areas with a hard pan soils, high water table or in commercial/industrial areas of any soil type that have the potential for hazardous spills to occur on the parking surface. Development projects in areas with native clay soils require a subsurface drainage system.

Paving surfaces must accommodate pedestrian (including ADA requirements), bicycle and auto traffic while allowing infiltration and storage of stormwater.

Design Criteria

- Replace traditional impervious parking surfaces with an alternative pervious surface such as porous concrete, porous asphalt, permeable pavers, turf pave, etc. Pavers should have rigid edge systems to prevent movement of paving stones.
- Vegetate parking overhang areas or the area between the tire paths.
- Surface and stone recharge bed must be suitable for design traffic load.



Source Wallace Group. Porous concrete was used in lieu of traditional asphalt to protect the oak tree adjacent to the parking lot.

- An underdrain is required for soils with limited infiltration rates.
- Terraced infiltration beds are required if porous concrete and asphalt are used on steep hills.
- Pre-treatment is advised in areas with high sediment loads.

The ability of porous concrete and asphalt to exchange air and water makes it especially suitable for use around trees.

References
For more information on porous concrete, porous asphalt, permeable pavers, turf pave, please see
http://www.cabmphandbooks.com/Documents/Development/SD-20.pdf
http://icpi.org/design/permeable_pavers.cfm
http://www.redwoodcity.org/cds/engineering/pdf/DesignGuidelinesforPermeablePavements.pdf

National Ready Mixed Concrete Association,
http://www.perviouspavement.org/

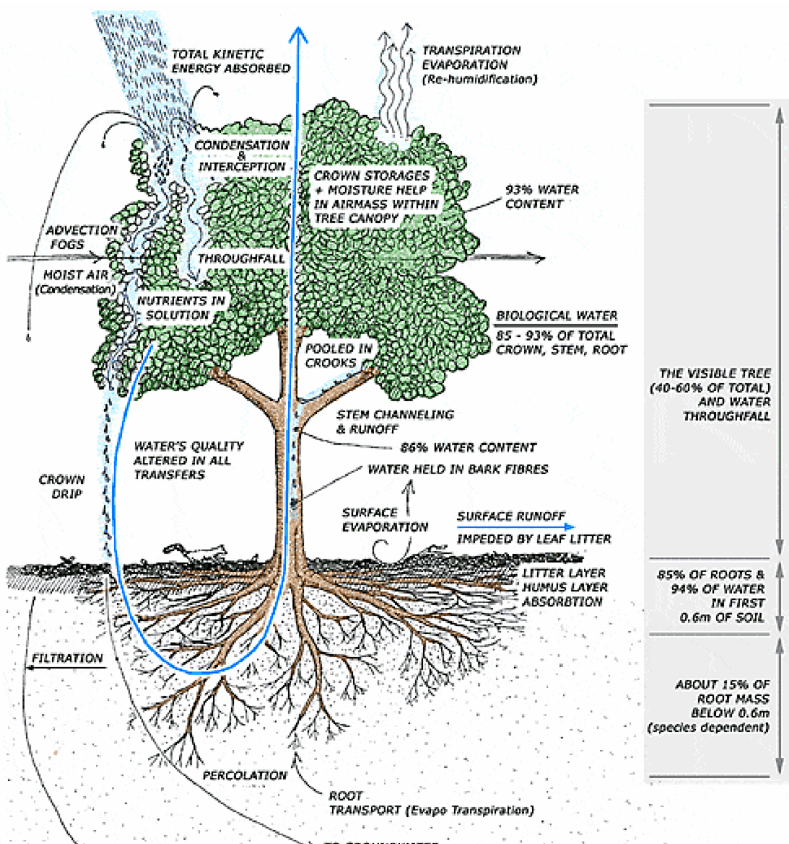
Georgia Stormwater Management Manual
http://www.georgiastormwater.com/vol2/3-3-7.pdf

4.3.7 Interceptor Trees

Description
Trees are effective in intercepting light storm events by temporarily capturing, storing and evaporating rain water from their leaves, branches and trunk bark.

Applicability
Interceptor trees are well suited for parking lots but can be incorporated into much of a project's landscaped areas.

Limitations
Trees should not be planted where they will interfere with utility lines (both surface and subsurface facilities) or create a fire hazard. Certain trees should not be used as their roots are known to damage adjacent impervious hardscapes. Consider the potential impacts of tree shade on adjacent structures and landscaping.



http://www.water-sos.org/sketches/trees-500pix.gif

Design Criteria
Broadleaf evergreens and conifers intercept more rainfall than deciduous species. Trees that grow well in winter in San Luis Obispo County include:

- Cedrus deodara / Deodar Cedar
- Cupaniopsis anacardioides / Carrot Wood
- Ilex altaclarensis 'Wilsonii' / Wilson Holly
- Laurus nobilis 'Saratoga' / Sweet Bay
- Olea europaea / Olive (male specimens only)
- Pittosporum undulatum / Victorian Box
- Quercus ilex / Holly Oak
- Quercus suber / Cork Oak
- Quercus virginiana / Southern Live Oak
- Rhus lancea / African Sumac
- Tristania conferta / Brisbane Box
- Umbellularia californica / California Bay

Use native or drought tolerant plants to decrease the need for supplemental irrigation. Root barriers are suggested if trees will not be irrigated once established.

Resources:
US Forest Service Center for Urban Forest Research
http://www.fs.fed.us/psw/programs/cufr/research/studies.php?TopicID=4

Trans-Agency Resources for Environmental and Economic Sustainability
http://www.treepeople.org/

Rainfall interception and water loss from semiarid tree canopies
rangeland.tamu.edu/people/wilcox/RLEM%20689/7-transpiration%20interception/Owens%20et%20al.2006.pdf

4.4 Building/Lot Level Design Considerations

The purpose of this section is to provide design guidelines appropriate for building or lot level considerations. Lot-level considerations are key to reducing the impacts associated with "first flush". First flush describes the initial high pollutant load that occurs during the first (few) rainstorms of the season. The increased pollutant loading is a result of the rainfall-runoff process that mobilizes pollutants deposited on exposed areas that are dislodged and entrained in the initial runoff. First flush is most easily controlled at the individual lot level.

The following guidelines are intended to minimize stormwater impacts by incorporating stormwater friendly design principles into lot level or site specific project plans.

Guiding Principles
- Reduce building footprint.
- Disconnect impervious surfaces.
- Amend soils.
- Use rainwater harvesting practices:
  - Disperse rooftops, impervious sidewalks, walkways, trails and patios into adjacent landscaping.

    - Incorporate bioretention facilities.
    - Incorporate rainfall reuse systems (i.e. rain barrels) at locations with unavoidable large contiguous impervious areas.
- Use level spreading of flow (sheet flow) into natural open space areas.
- Incorporate vegetated roofs.

4.4.1 Reduce Building Footprint/Foundation Excavation

Description
By minimizing the footprint and excavation associated with constructing a building, a greater area can be used to preserve some of the hydrologic functions for a site. Building footprints can be minimized by using pillars or pin foundations.

Applicability
These procedures are suitable on all development projects but are most easily applied on large lots in rural areas.

Limitations
In areas with heavy clay soils, there is significant runoff from undeveloped areas and the addition of impervious areas may not significantly increase the amount of runoff. Building height restrictions may limit allowable structure heights which lead to increased structural footprints.

Design Criteria
To the extent possible, go up and not out and minimize construction area.

References
Diamond Pier Pin Foundations
http://www.pinfoundations.com/green.htm

4.4.2 Disconnect Impervious Surfaces

Description
Impervious areas that drain into the stormwater system are considered “connected impervious areas.” These areas can be “disconnected” by directing the runoff to a landscaped area instead. Traditionally “connected” impervious areas well suited for “disconnection” include roof tops, parking lots and driveways.

Applicability
These procedures are suitable on all development projects including redevelopment.

Directing driveway runoff into a vegetated area by intercepting it with a trench drain is one way to reduce the volume of runoff leaving the site during small storms.

<u>Limitations</u>
Runoff must be discharged at locations that will flow away from structures, have adequate area available to receive the runoff, and are sloped to avoid erosion.

<u>Design Criteria</u>
To the extent possible,

- Roofing downspouts should be redirected to a yard, garden or swale or replaced with drip chains or scuppers.
- Runoff from driveways should not drain directly to a road; instead driveways should:
    - Be constructed from pervious materials, or
    - Be sloped to drain onto stabilized groundcover area, or
    - Be designed to intercept and drain runoff in dispersion trench to adjacent vegetated area.
- Sidewalks and street runoff should drain to stabilized groundcover areas.

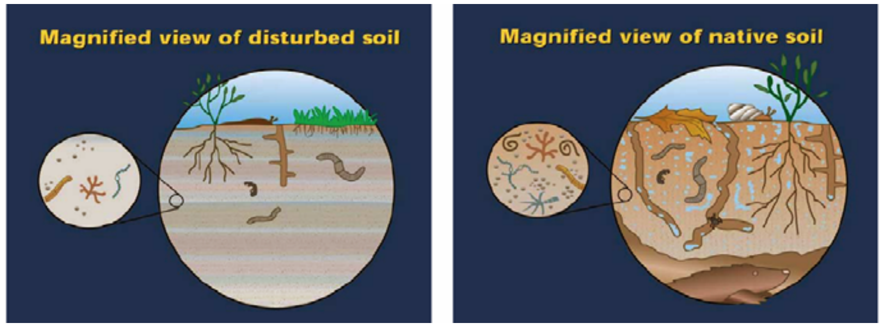
Above, roof scuppers are used to direct runoff through planters. This practice reduces the overall volume of runoff leaving the site during small storms. Source: www.tualatinriverkeepers.org

NE Siskiyou green Street stormwater curb extension: Environmental services, City of Portland
NEMO Nevada

4.4.3 Amend Soils

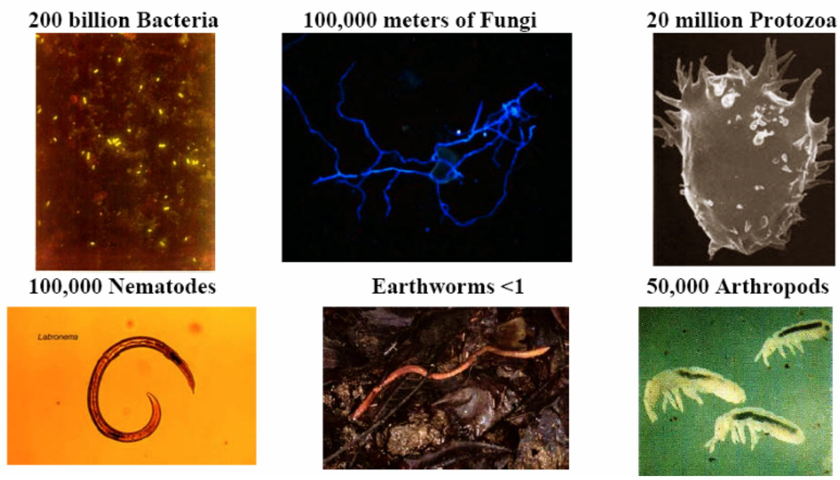
Description

Physical, chemical and/or biological properties of soils can be improved through the addition of soil amendments. The potential hydrologic benefits of compost amended soils include increasing the soil's permeability and water holding capacity, thereby delaying and often reducing the peak stormwater runoff flow rate, and decreasing irrigation water, fertilizer and pesticide requirements.



Disruption of soil can kill most of the beneficial biota and remove the air spaces in the soil that the aerobic biota need to thrive. Surface plantings, fertilizer and other nutrient supplements typically only help the first few inches of soil to develop new biota. Chemical fertilizer addition can actually kill or restrict the development of this biota. The biota is necessary for healthy vegetation.

A cup of undisturbed native topsoil can contain numerous bacteria, fungi, protozoa, nematodes, earthworms and arthropods. These living organisms are essential for maintaining healthy soil.



www.deq.state.or.us/lq/pubs/docs/sw/compost/RestoringSoilHealth.pdf

Where soil impacts cannot be avoided or sterile fill is brought in, the soil organic matter can be restored through numerous materials such as compost, composted yard waste, industrial by-products and wood residuals. It is important that the materials used to improve post-construction soil quality be appropriate and beneficial to the plant cover to be established.

Applicability

These procedures are suitable for soils that have been compacted as a result of construction or previous land use and for soils where the organic quality has been compromised due to overuse of pesticides and fertilizers or an exposure to household/industrial chemicals, concentration of pet waste or extreme and unnatural temperatures.

Limitations

Soil testing should be done to verify that soil amendments will produce a soil with similar chemistry, fertility and biology found in healthy regional soils.

Design Criteria
To the extent possible,

- Ripping, spading or tilling of the soil is recommended to alleviate soil compaction, wherever the subsoil has been compacted by equipment operation. Amending existing soil mitigates sub-soil compaction when compost is incorporated to a 12 inch depth.
- The upper eight inches of existing soils should be amended to restore the soil organic matter to pre-disturbed levels.

References
Idaho Department of Environmental Quality Catalog of Stormwater BMPs.
http://www.deq.state.id.us/water/data_reports/storm_water/catalog/sec_3/bmps/25.pdf
http://www.deq.state.id.us/water/data_reports/storm_water/catalog/sec_3/bmps/26.pdf

City of Seattle Natural Yard Care public handout..
http://www.seattle.gov/util/Services/Yard/Natural_Lawn_&_Garden_Care/Natural_Yard_Care/index.asp

4.4.4 Harvest Rainwater

Description
Rainwater harvesting is the process of intercepting stormwater runoff from a surface and either letting it soak into the ground or storing it for reuse.

There are many types of rainwater harvesting practices including retention grading, rain gardens/bioretention cells, bioswales, pervious pavements, rain cisterns, rain barrels, and infiltration trenches.

Applicability
Rainwater harvesting may be used as on-lot retention facilities in all types of planted soil. Rainwater harvesting is also appropriate in common areas.

Limitations
Infiltration practices must be situated away from structure foundations unless a barrier or waterproofing is incorporated into the building or pavement design. The bottom of the subgrade shall be at least 3 feet above the seasonal high groundwater level.

Design Criteria
While each type of rainwater harvesting practice has its unique design criteria, there are several design criteria that are common to all.

- Managing small volumes of water throughout the watershed is preferred over managing large volumes of stormwater at the bottom of the watershed. Begin at highest elevation of the site and continue to the lowest point of the site, dividing the site into small catchment areas. Flood control detention basin volume credit is allowed if the volume of runoff retained in smaller catchment areas can be quantified using a hydrograph analysis.
- Overland escape capable of handling large rainfall events up to the 100-year storm event is necessary.
- In facilities where standing water cannot be tolerated, an underdrain should be installed beneath the soil amendment layer.

Resources:

Brad Lancaster "Rainwater Harvesting for Drylands and Beyond"
http://www.harvestingrainwater.com/

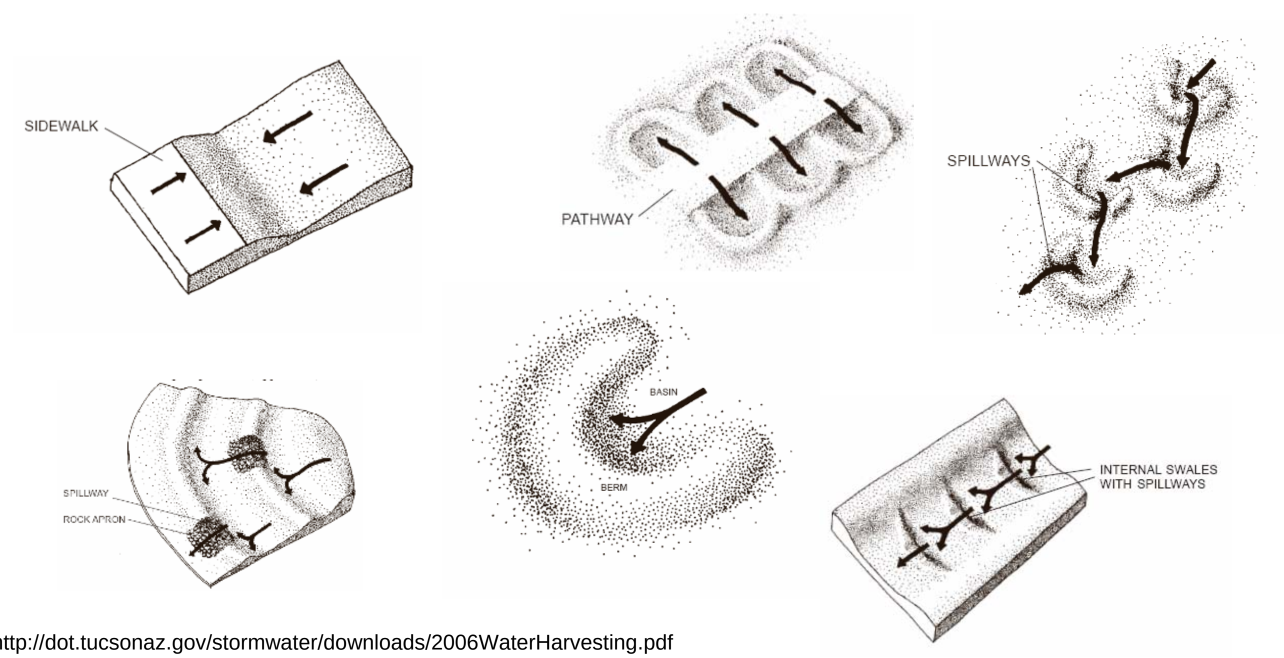
4.4.5a Retention Grading

Description
This practice involves the creation of shallow depressions on gently sloped or nearly flat landscapes. The shallow depressions intercept and infiltrate small volumes of surface water tributary to the depressed area.

Applicability
Retention grading works best in highly permeable soils.

Limitations
Retention grading is not applicable for use on steep banks or in highly erodible soils. Ponded areas should be located 10 ft away from the structure foundation.

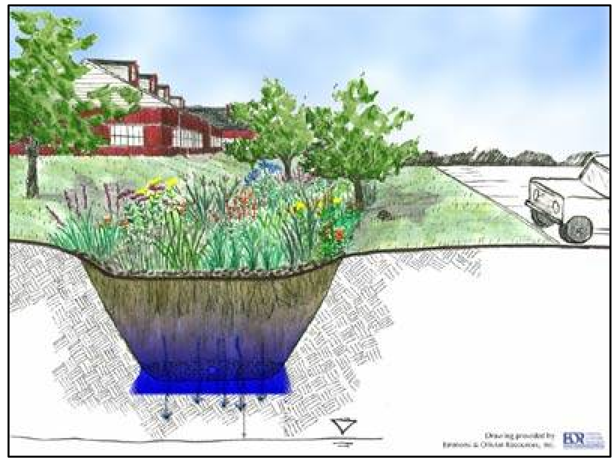
Design Criteria
1. Vegetation is needed to stabilize soil and assist with infiltration and transpiration of runoff. Shrubs and trees should be planted slightly above the ponded water elevation. Grasses are generally used in the ponding area.
2. Catchment areas in new developments should be located and existing low points. In existing developments, grading may be necessary to create a low point.
3. Spillways or channels can be used to link and distribute water throughout the site.
4. Soils in catchment ponding areas should not be compacted.



http://dot.tucsonaz.gov/stormwater/downloads/2006WaterHarvesting.pdf

DRAFT

4.4.5b Rain Gardens and Bioretention Cells



http://ricecreek.org/bmp/rg

Description
Rain gardens (also known as bioretention cells) are made from shallow depressions similar to retention grading. Native soil beneath the sump area is excavated out and backfilled with soil that serves to enhance retention and degradation of contaminants in stormwater runoff. The sump area is heavily planted and mulched. These low spots collect rain water during wet periods. Rain gardens reduce the volume of stormwater runoff delivered to surface water during the more frequent, low runoff events through plant interception and transpiration and by infiltration into the soil. The soil and root system also improves water quality.

Rain gardens are differentiated from detention and retention basins based on their size.

Applicability
Rain gardens can be installed and are effective in most residential, commercial and industrial areas with NRCS type A and B hydrologic group soils. Projects located in NRCS type C and D hydrologic group soils require an underdrain. The NRCS soil web survey is available on-line at http://websoilsurvey.nrcs.usda.gov/

Limitations
Rain gardens are limited to a 5 acre or less tributary area and are not recommended on sites with steep slopes or with high ground water or bedrock elevations. Rain gardens should not be located over septic fields or leach lines, shallow utilities, or within 10 feet of a building foundation.

Design Criteria
- Rain gardens should be located downstream of impervious surfaces and a minimum of 10 feet from structure foundation
- Grass filter strips are excellent at pre-treating sediment laden runoff.
- Ponding depth is dependent on the underlying soils. The rain garden must drain within 72 hours. See Chapter 6 for information on determining infiltration rates.
- Rain garden must be equipped with an overland escape or overflow outlet.
- Rain garden vegetation should consist of diverse, native or drought tolerant species. Species at the bottom of the rain garden must be able to withstand wet conditions. Species planted on the side slopes must be able to withstand occasional inundation.
- Locations of rain gardens should be protected from construction site run-on and compaction.
- Backfill should be rich in aged organic matter with just right percolation rates.

Resources
“Rain garden, Handbook for Western Washington Homeowners”
http://www.pierce.wsu.edu/Water_Quality/LID/Raingarden_handbook.pdf

“Rain gardens, A How-to Manual for Homeowners”
http://clean-water.uwex.edu/pubs/pdf/home.rgmanual.pdf

4.4.5c Bioswales

Costco Bioswale. Source Wallace Group.

Description

Bioswales function similarly to rain gardens except that they are sloped to a destination. They differ from vegetated swales, because in most instances, the bottom of the swale is replaced with soil that is more conducive to infiltration than existing site soils.

A subsurface stone recharge bed can be used to provide stormwater storage.

Applicability

Bioswales can be installed and are effective in all residential and most commercial and industrial in all types of soil conditions.

Limitations

Limited to a 5 acre or less tributary area. Bioswales are not recommended on sites with steep slopes or with high ground water or bedrock elevations. Bioswales should not be located over septic fields or leach lines, shallow utilities or within 10 feet of a building foundation. Bioswales should not be used in locations where there is a high sediment load or soils that are not stabilized.

Design Criteria

- Bioswales are most effective when used in conjunction with a filter strip or forebay.
- Bioswales should be located downstream of impervious surfaces and a minimum of 10 feet from structure foundation (unless structure foundation is protected by waterproof barrier).
- Swale bottom shall be sloped steep enough to drain but not so steep as to cause erosion. Bottom width should be a minimum of 2 feet wide (to uniformly spread stormwater at a slower velocity than a v-ditch would offer) and a maximum of 10 feet wide (to keep runoff from channelizing).
- Swale must be able to handle the storm events delivered to it without re-suspending sediments or scouring slopes.
- Locations of swales should be protected from polluted construction site run-on and compaction.
- Backfill should be rich in aged organic matter with infiltration rates that will allow the swale to drain within 72 hours.
- Swales should not convey stormwater at depths greater than 2 ft and should have gentle side slopes (5H:1V or flatter)
- When bioswales cross driveways (and intersecting roads and alleys), conveyance under the driveway can be provided by culverts or open graded rock veins wrapped in a getoextile.
- When bioswales are specified as a treatment control BMP, stormwater runoff should have a minimum 10 minute hydraulic residence time with a velocity less than 1 feet per second and the water surface elevation at the same height (or less) as the bioswale vegetation is required.

4.4.4d Rain Cisterns and Rain Barrels

http://www.lid-stormwater.net/images/cistern4.jpg

Description

Approximately 40 percent of all urban water use is for irrigation. Capturing and later reusing rainwater in water barrels or cisterns reduces the volume of runoff during rain events and conserves potable water supplies. Roof runoff contains no chlorine or hard minerals. It can easily be used later for landscape irrigation purposes or as collected water conveyed to typical grey water usages (flushing toilets).

In arid areas with heavy rainfall events, large cisterns are necessary if the goal is to capture entire rain events. For instance, a house in the City of San Luis Obispo subject to a 1 inch storm (0.083 ft), with a total roof area of 1000 square feet could yield 620.8 gallons of water for that storm event alone.

Supply in Gallons = Roof Area directed to rain barrel x rain event, depth (ft) x 7.48 gallons/cf

= 1000 sf x 0.083 ft x 7.48 gallons/cf

= 620.8 gallons produced

That's enough water to meet the daily domestic needs of more than seven average Americans. Capturing the average annual runoff would yield over 12,000 gallons of water!

However to completely capture an entire 1 inch rain event, a total of twelve 55 gallon barrels would be needed (assuming that no draw was being taken from the barrel during the rain event and roof rain was lost to evaporation).

Number of 55 gallon barrels needed = 620.8 gallons / 55 gallons per barrel

= 11.3 barrels

= 12 barrels

The equation below can be used to calculate the storm that would fill up a single 55 gallon barrel:

The depth of rain that will fill a barrel $= \dfrac{\text{Capacity of rain barrel (gallons)}}{\text{Contributing roof area (sf) x 7.48 gallons/sf (conversion factor)}}$

$= \dfrac{\text{55 gallons}}{\text{1000 sf/4 x 7.48 gallons/sf}}$

= 0.03 inches of rain

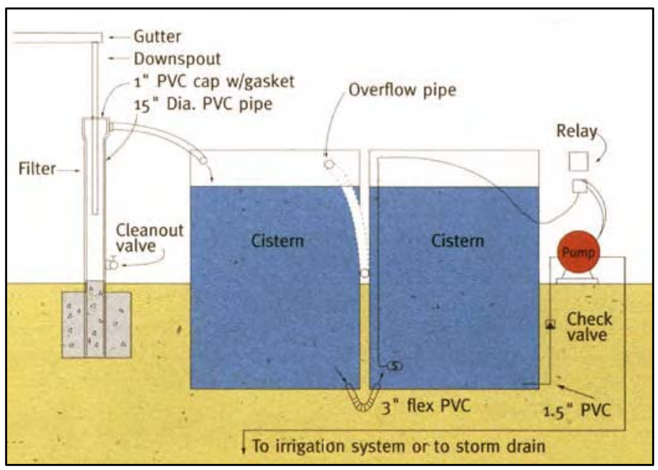
Rain barrels can come in all shapes and sizes. For the committed rainwater harvester, a large underground tank (equipped with pumps) may be more suitable (but more costly) than an above ground tank.

Applicability
The volume of roof runoff to be intercepted is directly proportional to the area of the roof. A larger roof yields more runoff.

Limitations
Roofs constructed with tar, gravel, treated cedar shakes or old asbestos shingle roofs may create too much contamination for rainwater harvesting. Similarly, rainwater should not be harvested if it is conveyed via gutters with lead soldering or lead-based paints. Runoff from roofs exposed to air borne particles originating from cement kilns, gravel quarries, crop dusting, or concentrated automobile emissions could adversely affect the rainwater quality.

Low storage capacities will limit rainwater harvesting so that the system may not be able to provide water in a low rainfall period. Increased storage capacities add to construction and operating costs.

Design Criteria
- Sizing of cisterns and rain barrels should be based on roof area, rainfall patterns, anticipated water usage of connected plumbing facilities or landscape water needs.
- Rainwater collected and intended for flushing toilets will require a parallel plumbing system.
- Rainwater collected and intended for potable uses should include filtration and disinfection to eliminate potential contamination originating from leaves, bird droppings, dust, and other natural causes.
- Tanks should be securely covered with fine-mesh screens on all inlet and outlet pipes to keep mosquitoes from entering tanks. This also protects the tanks from inadvertently trapping and drowning children and wild or domestic animals.
- Rain cisterns and rain barrels should be equipped with overflow devices able to convey spills away from any adjacent structures. Verify that the overflow device is adequately sized to convey the anticipated rain events it will be subject to.
- Consider installing a “first flush” diverter to increase stored water quality and reduce tank maintenance needs. The first flush diverter should allow the first 10 minutes of a storm event after a long dry period to bypass the system.



TreePeople, *Rainwater as a Resource: A Report on Three Sites Demonstrating Sustainable Stormwater Management*, 2007.

References
Rain Barrel Guide
http://www.rainbarrelguide.com/

Aquabarrel Rain Barrel
http://www.aquabarrel.com/

4.4.4e Infiltration Trenches

Infiltration trench in Davis, CA

Description
Infiltration trenches are shallow excavations that are lined with stone to create underground reservoirs. These trenches intercept runoff and store it until it can percolate into the soil through the bottoms and sides of the trench.

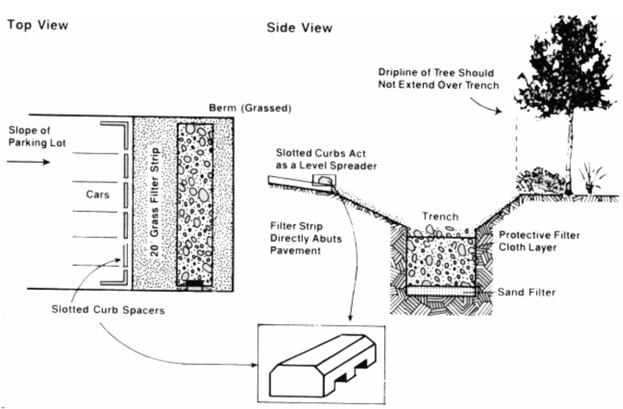
Infiltration trenches receiving polluted stormwater may introduce those contaminates into ground water supplies since they do not have the benefit of soil and roots to filter pollutants out.

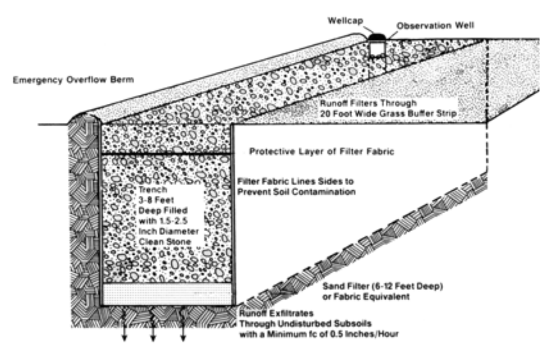
Applicability
Infiltration trenches are recommended in areas with tributary areas less than 2 acres AND where pollutant loads are low and space is not available for bioretention BMPs.

Limitations
Not appropriate for soils without good drainage.

Design Criteria

- Soils percolation rate must allow the structure to drain within 72 hours.
- Stormwater directed towards infiltration trenches must be pretreated to remove suspended solids, nitrates and dissolved metals. Solids can clog the trenches. Nitrates and dissolved metals can be introduced into ground water supply.
- Equip with observation well.
- Infiltration trenches should be located to collect sheet flow from impervious surfaces.
- Infiltration trenches should have a flat bottom slope (or subsurface check dams if use in conjunction with sloped bioswale) and a narrow width to reduce mounding risks.





Souce: Schueler, 1987.

References
http://www.epa.gov/owmitnet/mtb/infltrenc.pdf
http://www.cabmphandbooks.com/Documents/Development/TC-10.pdf

DRAFT

4.4.5 Level Spreaders

Source: NCSU-BAE

Description
Level spreaders disperse concentrated water over a wide enough area so that erosion of the receiving area does not result. It can reduce erosion and the movement of sediment. An additional benefit of a level spreader is to remove other pollutants from runoff by filtration, infiltration, absorption, decomposition and volatilization.

Level spreaders are constructed at zero grade across a slope and used to disperse or "spread" concentrated flow thinly over a receiving area.

Applicability
- Where runoff from an impervious surface is uneven and/or runoff is released as concentrated flow, such as through curb cuts or roof downspouts.
- At the ends of diversions.
- Where the lip of the level spreader can be constructed in undisturbed soil.
- Where there will be no traffic over the spreader.

Limitations
Level spreaders address concentrated flows in small tributary areas (less than 2 acres) and should not be used on steep slopes or highly erodible gentle slopes.

Design Criteria
The spreader lip shall be constructed to a uniform height and zero grade over the length of the spreader. The length of the level spreader lip is based on the volume of water that must be discharged. In general,
- The weir can be constructed of gravel, timber, asphalt, or concrete or of vegetation. Vegetated weirs work best in areas with low flows. However if vegetation is used, it must be inspected frequently to ensure that the vegetated weir will function properly over the range of flows it is subject to.
- Flow volumes and velocities should be verified to ensure that they do not cause channelized flow and erosion in receiving areas.

References
http://www.lrc.usace.army.mil/co-r/level%20spreader.pdf
http://h2o.enr.state.nc.us/ncwetlands/documents/LevelSpreaderGuidancefinal.pdf

4.4.6 Vegetated "Green" Roofs

Description
Standard roof tops accelerate and increase stormwater runoff. Replacing the traditional impervious roof with a vegetated roof can make substantial improvements in stormwater runoff quality and quantity.

Vegetated Rooftop over car wash facility in San Luis Obispo

There are two types of vegetated roofs: eco-roofs and roof gardens. Eco-roofs are lightweight roof systems supporting a few inches of soil and small plants while roof gardens are heavy roofs, usually with a foot or more of soil supporting large plants, shrubs, or trees, either directly on the roof or in planters.

Both types of vegetated roofs slow runoff and increase interception, evaporation, and transpiration of stormwater, in addition to reducing heat island effects associated with roofs. Vegetated roof systems can extend the life of the roof by 2-3 times over conventional roofing systems while reducing the energy required for heating and cooling of the structure.

Applicability
Vegetated roofs are best suited on new construction projects with flat roofs (pitches less than 1.5 percent) and no opportunities to infiltrate or store roof water in other locations on the site.

Limitations
In retrofit applications, load restrictions are usually the main limitation. Follow state and/or local standards with respect to wind and fire resistance of rooftop elements. Extreme sun or wind conditions present a challenge for plant survival. Vegetated roofs may not be appropriate for areas with snow or rooftops with slopes greater than 15 percent and may require irrigation.

Design Criteria
To the extent possible, impervious surface should be replaced with more pervious surfaces. Vegetated roofs are one way to reduce the impact of the project's overall impervious area; however, infiltration techniques are favored over green roofs in areas with groundwater recharge priorities.

Vegetated roofs should be planted with drought tolerant species, but may require supplemental water.

Photo, exterior overview of roofs and distant context · Gap Offices in San Bruno, CA
http://www.greatbuildings.com/buildings/Gap_Offices_in_San_Bruno.html

References
Green Roofs for Healthy Cities, http://www.greenroofs.org

Ch 5: Preventing Stormwater Pollution at the Source – Source Control Measures

5.1 Introduction to Source Control

Source control refers to any schedules of activities, prohibitions of practices, maintenance procedures, managerial practices or operational practices that prevent stormwater pollution by reducing the potential for contamination at the source of pollution.

Source control measures are required for all projects. Source control measures can be categorized as Structural, Procedural or Operational.

> Structural source control measures are physical measures employed to prevent stormwater from contacting work and storage areas to prevent stormwater from picking up pollutants.
>
> Operational source control BMPs are non-structural practices such as employee training, record keeping, good housekeeping, preventative maintenance, spill prevention and cleanup.
>
> Procedural source controls BMPs include implementing process changes such as substituting a less hazardous material for a highly hazardous material in an industrial process.

Implementing operational and procedural source control BMPs are generally considered more cost-effective in minimizing pollution than structural source control measures. Operational and procedural source controls are addressed in Chapter 8 "Operation and Maintenance" of this manual.

While some source control measures can be broadly applied to development, others are site- and pollutant-specific. This chapter describes the purpose, design criteria, maintenance requirements and appropriate use of structural source control measures approved for use in the unincorporated areas of San Luis Obispo County.

5.2 General Structural Source Control Measures

The source control measures included in this section generally apply to all development.

5.2.1 Storm Drain Markers

Description

Storm drain markers are highly visible source controls that are placed adjacent to storm drain inlets. This measure informs the public that runoff drains directly to waterbodies. Storm drain markers raise awareness to help deter littering and illegal dumping.

Applicability

Storm drain marking procedures are suitable for storm drain inlets with concrete curb and gutters.
Design Criteria

- All new storm drain inlets shall be provided with a marker as specified by the County Public Improvement Standards

See CASQA SD-13 for additional design, installation and maintenance considerations.

5.2.2 Alternative Building Materials

Description
Some building materials, such as copper, are prone to leach toxic compounds into stormwater runoff. Some building materials require the routine use of pollutants (i.e. toxic paints and finishes) to maintain their integrity. This BMP employs alternative materials that are not prone to leach toxic compounds or require toxic compounds to maintain their integrity.

Applicability
Alternative building materials are suitable for all developments.

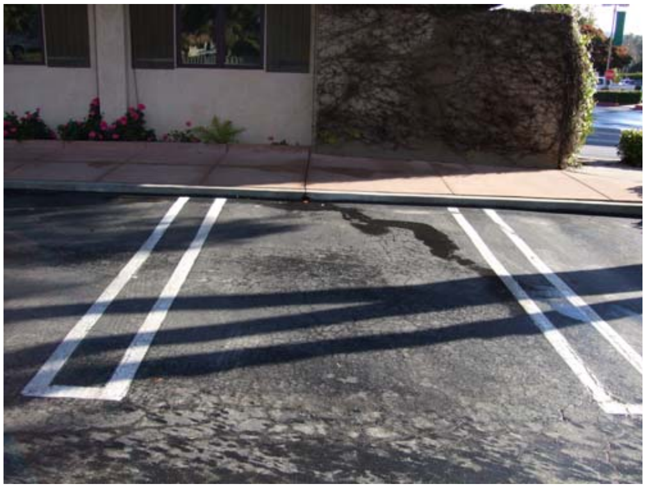
Design Criteria

- Consider using building materials that incorporate green technology, use less toxic materials in their manufacturer, or require minimum maintenance.
- Avoid roofing, gutters, and trim made of copper or other unprotected metals that could leach into runoff.

See CASQA SD-21 for additional design, installation and maintenance considerations.

5.2.3 Clean Water Segregation

Description
Runoff originating from roof and landscaped areas is considered relatively clean. Runoff increases its risk of picking up contaminants if it is allowed to flow over parking lot areas. Adding relatively clean runoff into the treatment train or stormwater treatment process can reduce the overall effectiveness of the treatment train in removing contaminants.



Roof top runoff inappropriately discharged onto pavement (left) will pick up parking lot pollutants. Roof top runoff discharged into stabilized landscaped areas or rain water cisterns is available for infiltration or onsite reuse.

Applicability
Clean water segregation is suitable for all properties with roof drains and/or vegetated areas that produce runoff.

Limitations
Clean water segregation is not appropriate for roof runoff from industrial areas or from runoff traveling over galvanized metal roofs, roofs fabricated with electroplating and metal finishes, including the use of copper chloride etchers, ammonia etchers or that have acid plant bath exhaust vents. Runoff from galvanized roofs should be treated prior to discharge from the site.

Design Criteria
- Relatively clean runoff should be kept isolated from runoff requiring treatment. This can be achieved by:
  - Retaining runoff on site.
  - Directing roof runoff into vegetated areas.
  - Connecting roof and landscape area runoff into a separate storm drain system.
  - Connecting roof and landscape runoff into the site's storm drain system after treatment BMPs to ensure parking lot pollutants have been addressed.
  - Detaining roof and landscape runoff onsite long enough for first flush parking lot runoff to be treated and then sending it from the site in a common storm drain system.
- Consider reuse of roof rain water.

See Fact Sheet SD-11, "Roof Runoff Controls," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

5.2.4 Efficient Irrigation

Description
Efficient irrigation techniques minimize waste and reduce the amount of dry weather runoff discharged to the storm drain system. Efficient irrigation techniques include rain and wind-triggered shutoff devices, automatic line break detection shutoff valves and soil moisture sensors.

Applicability
Efficient irrigation is suitable for all development with irrigated areas.

Limitations
None

Design Criteria
To the extent possible, install
- Native plants that require minimum irrigation.
- Irrigation controllers with evapotranspiration, high wind, and rainfall sensors to prevent over- and under-watering and watering during rainfall events and/or with programmable schedules to set watering time and duration according to plant and seasonal needs.
- "Smart" irrigation controller with master valve connected to flow sensor to detect and shut off water when the sensor indicates an out of expectation flow rate.

A list of "smart" controllers is available at http://www.irrigation.org/SWAT/Industry/ia-tested.asp.

See CASQA SD-12 for additional design, installation and maintenance considerations.

5.3 Site and Pollutant-Specific Structural Source Control Measures

The source control measures included in this section apply to specific types of development or are specified to control specific types of pollutants.

5.3.1 Fueling Areas

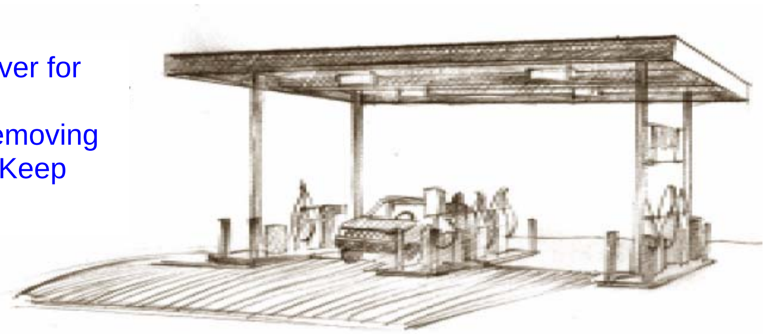
Description
Fueling areas have the potential to contribute oils, grease, solvents, car battery acids, coolants and fuels to stormwater conveyance systems. Spills at vehicle and equipment fueling areas can have a significant impact on the quality of stormwater runoff because fuels contain heavy metals and toxic substances that are not easily removed by stormwater treatment devices. Spill prevention is paramount.

Applicability
The design criteria below (items 1-4) are mandatory for projects with fueling dispensing equipment.

Design Criteria

- The fuel dispensing area must be covered with an overhanging roof structure or canopy. The canopy's minimum dimensions must be equal to or greater than the area within the grade break. The canopy must not drain onto the fuel dispensing area, and the canopy downspouts must be routed to prevent drainage across the fueling area.
- The fuel dispensing area must be paved with Portland Cement Concrete (or equivalent smooth impervious surface). The use of asphalt concrete is prohibited.
- The fuel dispensing area must have a 2% to 4% slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of stormwater to the extent practicable.
- At a minimum, the concrete fuel dispensing area must extend 6.5 feet from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot whichever is less.
- Signs discouraging the topping-off of fuel tanks should be posted.
- Spill response kits, including absorbent materials and disposal containers for accidental spills should be clearly located within the fueling area.

The best fuel island design has a cover for all the dispensers and prevents any stormwater from running over and removing contaminates from the fueling area. Keep spill kits at fuel islands, if possible.



See CASQA SD-30 for additional fueling area design, installation and maintenance considerations.

5.3.2 Maintenance Bays and Loading Docks

Description
Oil and grease, solvents, car battery acid, coolant and gasoline from repair/maintenance bays can negatively impact water quality if allowed to come in contact with stormwater runoff.

Applicability
These procedures are suitable for all commercial and industrial applicable locations.

Design Criteria
- Repair/maintenance bays must be indoors or designed in such a way that does not allow contact with stormwater run-on or runoff.
- Design a repair/maintenance bay drainage system to capture all wash water, leaks and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required, obtain an Industrial Waste Discharge Permit and ensure that drains are equipped with a fail-safe valve that remains closed except during rainfall.
- Cover loading dock areas or design drainage to minimize run-on and runoff of stormwater. If roof is used to shelter locking maintenance bay and loading docks from stormwater, the roof should be surfaced with a non-metallic material to decrease the likelihood of introducing heavy metals into the stormwater system.
- Loading dock area drains connected to the storm drain system must be equipped with a valve or equivalent device that remains closed except during rainfall.
- Loading docks for loading and unloading liquids in containers shall be provided with an inlet with a shutoff value and have the capacity to hold a spill while the value is closed.
- Door skirts between the trailers and the building should be installed to prevent exposure of loading activities to rain.

See CASQA SD-31 for maintenance bay and loading dock design, installation and maintenance considerations.

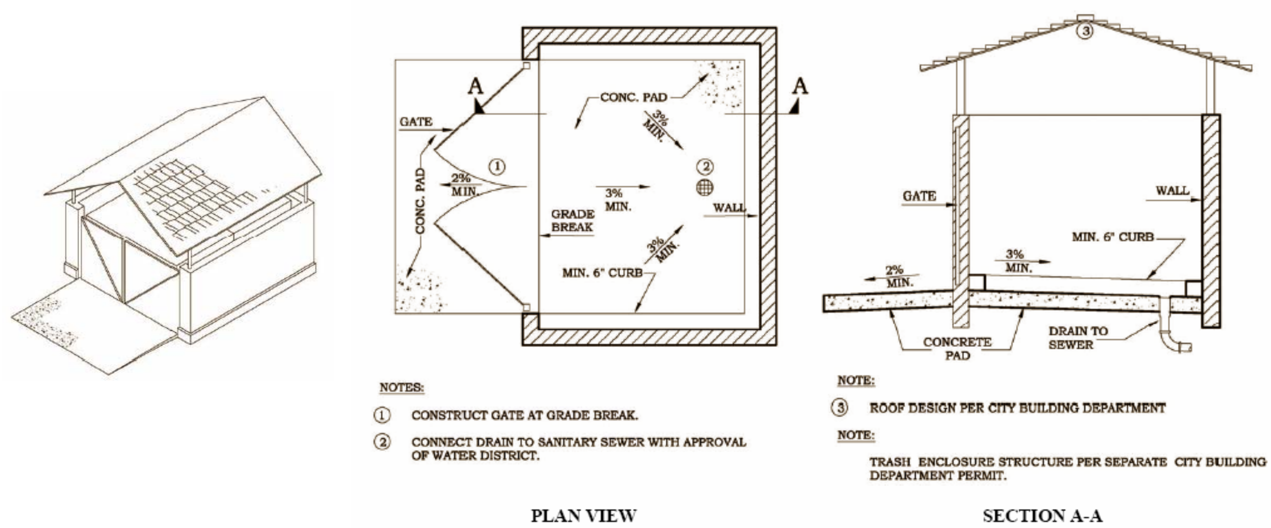
5.3.3 Trash/Recycling Storage Areas

Description
The trash and recycling storage area refers to an area where a trash receptacle or recycling receptacles (dumpsters) are located for use as a repository for solid wastes. Loose trash and debris can easily be transported by the forces of water or wind into nearby storm drain inlets, channel, and/or creeks.

Applicability
These procedures are suitable for all multi-family residential units with four or more units, commercial, and industrial trash areas. Single family residences are exempt from these requirements.

Design Criteria
- Project design should provide an appropriate number of adequately sized receptacles.
- Trash and recycling storage areas must divert drainage from adjoining roofs and pavements around the area(s). Project plans should show how the container area will be graded and paved to prevent run-on to the area and to prevent runoff from leaving the area.

- Trash and recycling storage container areas must be screened or walled to prevent offsite transport of trash.
- Trash and recycling storage within containers should be secured to prevent loose trash and debris from being dispersed by the wind.
- Uncovered bins should be roofed to prevent rainwater from co-mingling with bin contents.
- Trash and recycling storage enclosure pads should be designed to drain to a pervious surface through indirect soil infiltration or to an appropriate treatment control BMP prior to connection to a sanitary sewer.
- The proposed enclosure detail shall be submitted to the County and contracted recycling and garbage hauler for review and approval. Before a building permit can be issued, a form from each hauler accepting the relevant container location and enclosure detail must be submitted.
- No connection to the storm drain system is allowed for new facilities.



See CASQA SD-32 for additional trash storage area design, installation and maintenance considerations.

5.3.4 Vehicle and Equipment Wash Areas

Description
Vehicle and equipment wash waters commonly contain high concentrations of sediments, oils and grease, cleaning chemicals, phosphates, antifreeze and heavy metals. These materials are prohibited from entering the storm drain system through the illicit discharge detection elimination ordinance.

Applicability
These procedures are suitable for all multi-family residential, commercial and industrial areas.

Design Criteria

Describe measures taken to discourage onsite vehicle and equipment washing and explain how these will comply with the appropriate design criteria provided below for commercial/industrial, restaurant, and residential applications:

Commercial/industrial facilities

- 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.
- Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system.
- Wastewater from the commercial vehicle and equipment wash areas shall be equipped with a clarifier, or other pretreatment facility, and properly connected to the sanitary sewer, or other appropriately permitted disposal facility.
- Secondary containment shall be provided 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 area.
- Vehicle wash water should only be discharged to the sanitary sewer and only after obtaining permission from the local wastewater treatment authority. Fueling and maintenance activities shall be isolated from vehicle and equipment wash areas.
- Tanks, containers or sinks used for parts cleaning or rinsing shall not be connected to the storm drain system and may only be connected to the sanitary sewer system. These connections may require additional approvals and permits.

Residential application

- Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited onsite and hoses are provided with an automatic shutoff to discourage such use).
- Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and in large common areas, plumbed to drain to the sanitary sewer.

Restaurant application

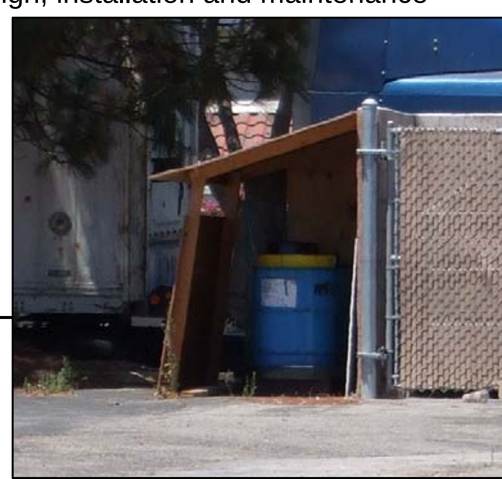
- Restaurant wash areas must be self-contained and equipped with a grease trap and properly connected to a sanitary sewer.
- Food service facilities, including restaurants and grocery stores shall have a sink or other area for cleaning floor mats, containers and equipment. The cleaning area must be located over a paved area and have secondary containment. It must be large enough to clean the largest mat or piece of equipment that needs cleaning. The sink or cleaning area shall be connected to a grease interceptor prior to discharge to the sanitary sewer system.

See CASQA SD-33 for additional vehicle washing area design, installation and maintenance considerations.

5.3.5 Material Storage Areas

<u>Description</u>

Outdoor material storage areas include areas or facilities designated solely for storage of materials. Improper storage of materials outdoors may provide an opportunity for toxic compounds, oil and grease, heavy metals,



nutrients, suspended solids, and other pollutants to enter the storm drain system.

Proper storage is necessary to prevent materials being stored outside from being washed away in stormwater runoff, spilled, or inadvertently discharged to the storm drain system.

Applicability
These procedures are suitable for all projects that include outdoor storage areas for materials. Sites with large quantities or liquids or bulk materials at sites that are connected to the storm drain system are at greatest risk, including:

- Nurseries and garden centers
- Auto recyclers/body shops
- Building supply outlets
- Landfills and recycling centers
- Solid waste and composting facilities
- Maintenance depots
- Power plants

Design Criteria

- Store materials indoors, if feasible.
- Infiltration is discouraged in outdoor material storage areas.
- Protect materials stored outside from rainfall and wind dispersal by keeping them in an enclosure such as a cabinet or shed.
- Protect materials stored outside from run-on by constructing a secondary containment structures (such as berms, dikes or curbs) around the perimeter of the storage area.
- Provide an area to pool spills for collection and disposal or, if allowed, pre-treat and drain the area to the sanitary sewer system. If required, obtain an Industrial Waste Discharge Permit. Secondary containment areas should be sized to hold 110% of the volume of the storage tank or container unless other containment sizing regulations apply (e.g. fire codes).
- Store materials on paved or impervious surfaces.
- Exterior storage areas shall be covered with a roof or awning to minimize collection of stormwater within the secondary containment area.

See CASQA SD-34 for additional outdoor material storage area design, installation and maintenance considerations.

5.3.6 Pools, Spas and Fountains

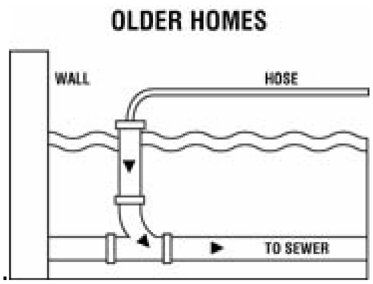
Description
Draining pools, spas and fountains to the street, gutter or storm drain system can pollute waterbodies with copper, chlorine, sediments and other contaminates.

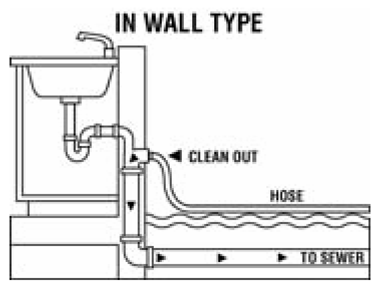
Applicability
These procedures are suitable for all properties with a pool, spa and/or fountain.

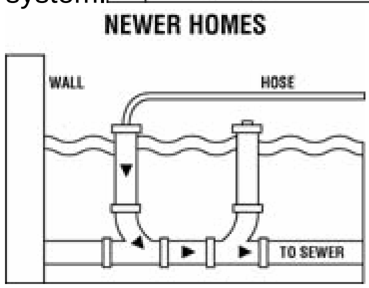
Design Criteria

- The preferred method to discharge decholorinated/debrominated pool, spa and/or foundation algae-free water with pH levels between 6.5 and 8.5 is onto adjacent land surfaces.
- Pool, spa and/or fountain discharges not able to be drained onto adjacent land surfaces should be drained to a sanitary sewer cleanout—never to a street, gutter, or storm drain

system.







Source: www.phoenix.gov

Water from pools, spas and fountains should only be discharged to the sanitary sewer only after obtaining permission from the local wastewater treatment authority. See applicable CASQA Stormwater Quality BMP Fact Sheet SC-72, "Fountain and Pool Maintenance," at www.cabmphandbooks.com or http://phoenix.gov/WATER/pooldrn.html

5.3.7 Outdoor Work and Processing Areas

Description
Outdoor work areas, such as material collection or cleaning points, and outdoor processing areas, such as painting, grinding degreasing areas, have the potential to contribute metals, oil and grease, solvents, phosphates, and suspended solids to the storm drain system.

Applicability
These procedures are suitable for all properties with outdoor work and/or processing area.

Design Criteria
- Infiltration is discouraged.
- Keep runoff from relatively clean areas separate from relatively dirty areas by installing diversion drains or berms.
- When practical, provide a roof over the work area.
- Equipment and accessory washing/steam cleaning facilities should be self-contained and equipped with a grease trap that discharges to the sanitary sewer system.

See CASQA SD-35 and SD-36 for additional Outdoor Work Area and Outdoor Processing Area considerations.

5.3.8 Pet Mitt Stations

Description

Pet waste is a known contributor to stormwater pollution. Providing pet mitt stations at locations that are attractive to dog owners, can encourage owners to pick up pet waste.

Applicability
These procedures are suitable for all properties with large, accessible open areas.

Design Criteria
Pet mitt stations should consist of a dispenser with biodegradable bags for scooping the poop, informational signage and a trash can for convenient disposal.

References
County Parks Mutt Mitt Program

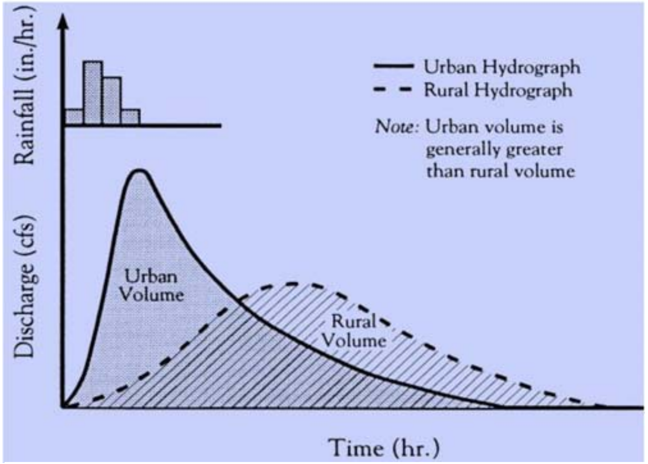
Ch 6: Hydromodification Measures

6.1 Introduction to Hydromodification

Hydromodification is the alteration of hydrologic characteristics (i.e. flow duration, magnitude, recharge and runoff volumes) within a watershed.

Changes to hydrologic characteristics result in increased channel erosion rates, downstream flooding, loss of habitat and, in some cases, property damage.

Hydromodification occurs as a result of land use changes. During development, the conversion of natural vegetated pervious ground cover to impervious surfaces is one of the largest contributors to hydromodification. The second largest contributor is a result of increasing the efficiency at which runoff is removed from a site by shortening the flow path and providing a smoother conveyance method.



www.cleanwaterprogram.org/uploads/FINAL%20HM%20Flyer%20Nov%2007.pdf

Low Impact Development integrated management measures can reduce development-induced hydromodification impacts.

6.2 Hydromodification Design Guidelines

Projects that increase runoff volumes, peak flow rates and/or discharge efficiency rates should reduce the impacts created as a result of the project.

Hydromodification is the term used when a project alters existing rainfall runoff relationships by:

- Increasing the volume of runoff
- Increasing the magnitude of peak discharge
- Increasing the frequency of events that produce runoff

The level of effort required to address hydromodification is based on the project category discussed in Chapter 2. While many of the methods discussed in this chapter are mandatory for Major Category projects, Minor Category projects are urged to voluntarily adopt similar project goals—especially the Low Impact Development practices that can be accomplished with little to no additional cost.

To reduce the effects of hydromodification, projects should:

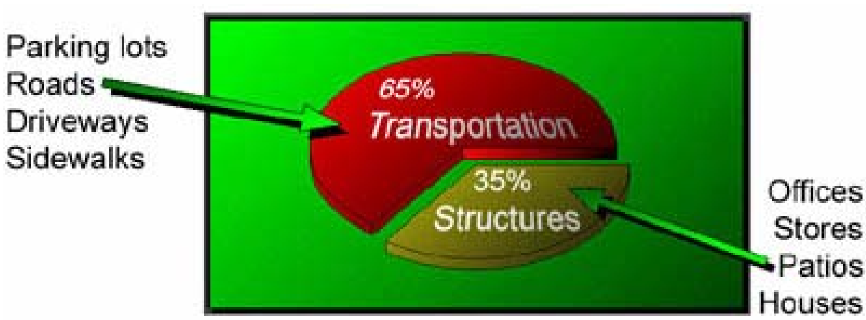
1. Reduce the volume of runoff generated as a result of development
2. Ensure that post-development peak discharges do not exceed pre-development discharges
3. Seek to mimic the pre-development frequency and direction of runoff events.

6.3 Minimize the Volume of Stormwater Runoff

This section presents various approaches to reducing the volume of runoff that leaves the site. It is divided into two categories: (1) Reducing impervious area and (2) Maximizing infiltration.

6.3.1 Reducing Impervious Surfaces

Materials that prevent or substantially reduce infiltration of water into the soil are considered impervious surfaces. Examples of common impervious surfaces associated with development include roof tops, roads, parking lots, sidewalks and driveways. Studies have shown that the majority of impervious surfaces are a result of transportation infrastructure.



Source: Nemo, based on City of Olympia ISRS Final Report

Impervious areas significantly contribute to the amount of contaminates typically found during "first flush" stormwater events.

Strategies employed to reduce impervious surfaces include:

1. Concentrating buildings on soils that are inherently less suitable for infiltration, rather than on site soils characterized with a greater infiltration rate.(See 4.2.1)
2. Clustering structures. (See 4.2.3)
3. Minimizing area dedicated to parking lots and driveways. (See Section 4.2.4)
4. Specifying the narrowest road length and width to meet (but not exceed) the needs of the development (pedestrian, cyclists and motorist safety, traffic volumes). (See Section 4.3.1)
5. Utilizing pervious materials able to fulfill the same function of impervious materials. (See Section 4.3.5)

Understanding the difference between the pre- and post-project impervious area can provide insight into the likely hydromodification effects resulting from the project.

<u>Measuring the Imperviousness of a Site</u>

Rational Coefficients are typically used in the Rational Formula to estimate peak runoff rates. The dimensionless Rational Coefficient can be used as a means to compare the relative absorptive nature that exists between various types of materials.

Runoff Coefficients values range between 0.0 and 1.0 where a value of 0.0 indicates that none of the rain falling on the surface will generate runoff. Conversely, a value of 1.0 indicates that all of the rain falling on the watershed will be carried offsite as runoff.

Typically, one value is selected for the site (i.e. single family residential on 1- acre lots). This approach does not encourage the use of pervious materials nor does it encourage development to take place on the most impervious soils of the site. As some soils (i.e. sand) are better able to absorb runoff than other soils (i.e. clays), purposely constructing new impervious surfaces on less impervious soils will maximize the preservation of remaining soils with higher capacity to infiltrate. The relative advantage of building on one soil type over another is negligible on site with fairly homogenous soil types. For large development tracts with contrasting soil types, however, the advantage of conserving the soils that contribute greatest to groundwater recharge could be significant.

A different method of determining pre- and post-development project rational coefficients is necessary to promote conservation of the most pervious areas and development on the areas already prone to produce runoff. This method calculates composite Rational Coefficients based on an analysis of the site in discrete units (driveways, roads, roofs, lawn and natural vegetation area) instead of larger categories.

Additionally, since some materials are able to absorb surface runoff rather than shed it, replacing impervious materials with materials that are able to serve the same function as intended and reduce the amount of runoff leaving the site. Examples of material substitutions commonly used to replace asphalt and concrete surfaces include porous concrete, vegetated pavers, wood decking or gravel.

Table 6.1 provides relative Runoff Coefficients for several materials commonly used in development projects. Where a reasonable range of runoff coefficient values is given, the actual value of runoff coefficient may vary based on the antecedent moisture condition of the soil, the type of soil, and slope of the project. Where vegetation or pervious materials are specified, an evaluation of the corresponding hydrologic soils group (HSG), as defined by the Natural Resources Conservation Service (NRCS), and the pervious material must be made to determine if the underlying soil or the pervious material is the limiting factor.

Table 6-1. Rational Coefficient Table

Surface Type	Hydrologic Soil Group				Source
	A	B	C	D	
Pools, ponds, creeks and streams	1.00				3
Portland Concrete Cement, Asphalt Concrete & Roof, Conventional	0.95				1, 2
Brick (grouted)	0.85				3
Pervious Concrete/Asphalt (>6”), for < 6-inches, use runoff coefficient of the subgrade	0.05 or design rainfall intensity(in/hr) – 4.0 (in/hr)				3
Vegetated Pavers with established vegetation	0.25			0.40	5
Unit Pavers, use runoff coefficient of the subgrade if pavers are laid over an aggregate base with more than 15% void content	0.10				
Wood Decking	use subgrade runoff coefficient				
Cobbles				0.6	3
Gravel	0.30	0.45	0.50	0.50	4
Roof, Garden Roof (<4 in)	0.50				2
Roof, Garden Roof (4 – 8 in)	0.30				2
Roof, Garden Roof (8.01 - 20 in)	0.20				2
Roof, Garden Roof (> 20 in)	0.10				2
Lawns (0 < slope < 2 %)	0.05	0.10	0.13	0.17	CERM
Lawns (2 < slope < 7 %)	0.10	0.15	0.18	0.22	CERM
Lawns (slope > 7 %)	0.15	0.20	0.25	0.35	CERM
Unimproved	Use SLO County Standard Plan H-3a “Runoff Coefficients for Undeveloped Areas”				

1 Bay Area Stormwater Management Agencies Association
2 State of Minnesota Sustainable Building Guidelines
3 Menlo Park
4. Iowa Stormwater Management Manual
CERM Civil Engineering Reference Manual, Lindberg
5 Smith, D.R., "Evaluations of Concrete Pavements in the United States," in Proceedings of the Second International Conference on Concrete Block Paving, University of Delft, the Netherlands, April 1984, pp. 330-336 and Ferguson, B.K., Porous Pavements, CRC Press Boca Raton, Florida, 2005, p. 126.

Runoff coefficients used in calculations should be taken from Table 6-1. Coefficients that deviate from those above can be used if documented to the satisfaction of the Department of Public Works. A sample calculation for determining weighted Rational Coefficients is provided below.

Source: studio0202.files.wordpress.com

Table 6-2. Revised Rational Coefficient Example Calculation

SCENARIO	RUNOFF COEFFICIENT	SURFACE TYPE DESCRIPTION
Pre-developed	0.31	Using SLO County Standard Plan H-3a with low relief, normal soil infiltration, excellent vegetal cover, normal surface storage.
Traditional	0.40	Residential lots 10,000 sf to 19,999 sf, 2-10%, Sand soil (per SLO County Standard Plan H-3)
Revised (Initial)	0.55	All impervious and paved areas (roof, asphalt, concrete, decking and pool) have a 0.95 rational coefficient, all vegetated areas have a 0.15 rational coefficient for lawns greater than 2% but less than 10% on Hydrologic Soil Group B.
Revised (Improved, run 1)	0.37	Replaced sidewalk with pervious concrete, uses unit pavers for driveway and pool deck area. Wood decking used underlying soil rational coefficient.
Revised (Improved, run 2)	0.27	Same scenario as Improved, run 1 but with the addition of a 4-inch green roof.

The traditional and revised approach (initial) should be comparable with each other, but in the above example, the current approach (single rational coefficient) is less than the revised approach (weighted rational coefficient). The weighted rational coefficient was reduced through the replacement of highly impervious surfaces with more pervious surfaces. All other things being equal, a lower rational coefficient will result in lower peak flows. Note that final revised run (run 2) has a runoff coefficient that is less than the runoff coefficient associated with pre-developed condition. This scenario indicates that the proposed site in run 2 is able to absorb more runoff than the site was historically able to absorb.

If the soils on the site were classified as two (or more) hydrologic soil group types, impermeable surfaces constructed on the less pervious soils would yield a lower Rational Coefficient than if the impermeable surfaces were constructed on the more pervious of the soil types.

6.3.2 Maximizing Interception

Increasing the site's ability to intercept rainfall and runoff also helps reduce the overall volume of runoff generated by the site. Strategies used to intercept runoff include:

1. Planting cul-de-sacs, medians and roof tops and incorporating interceptor trees into the site landscaping.
2. Preserving the soils that are not intended as subgrade for roads or foundations for buildings by delineating on the plans, and staking in the field,.
3. Amending site soils.
4. Capturing roof area rainwater.

See Chapter 4 for additional information on the benefits of maximizing site landscaping, conserving site soils and rainwater harvesting.

6.3.3 Maximizing Infiltration

The volume of runoff can be reduced by directing runoff towards infiltration BMPs. This approach should not be considered for industrial sites or locations where hazardous wastes are present or spills may occur.

Two categories are used to differentiate the two types of infiltration BMPs:

1. Direct infiltration. Direct infiltration BMPs consist of infiltration trenches, infiltration basins and dry wells. These BMPs allow surface water to be directly conveyed to subsurface soils without allowing the water to benefit from the filtering capabilities of soil. The runoff directed to these types of devices requires pretreatment to limit the potential for groundwater contamination.

2. Indirect infiltration. Indirect infiltration BMPs consist of bioretention areas and vegetated swales. Contaminates carried by runoff directed at these types of BMPs will be treated by the physical, biological, and chemical mechanisms of the soil as the runoff infiltrates into the system.

Due to the soil's ability to improve the quality of the runoff, indirect infiltration BMPs are preferred over direct infiltration BMPs. Not every site is well suited for ground water recharge, however; some sites may require an underdrain to assure that accumulated runoff does not stagnate and encourage mosquito breeding.

Infiltration rates are dependent on rainfall intensity, receiving ground slope and permeability of soils and subsoil(s), soil structure, surface vegetation, soil moisture and soil biota. To determine if a site is well suited for infiltration BMPs, the following four step process is provided.

Step 1. Initial Screening.

Eliminate areas within the site with:
- Existing topography and slopes greater than 20%
- Groundwater and bedrock depths shallower than 10 feet

Eliminate areas located within:
- 500-ft of an area of known groundwater contamination or underground fuel tank
- FEMA defined 100-year flood plain
- 250 feet of public wells
- 100 feet of private wells and riparian corridors (Schueler,1987)
- 50 ft of septic system or leach field
- 100 ft of roadways with average daily traffic of 25,000 trips or greater for main road
- 100 ft of intersecting roadway with average daily traffic of 15,000 trips or greater

Highlight remaining areas with NRCS hydrologic soil group type A or B

To complete Step 1, a to-scale site plan/map, including the topography of the entire development site plus 500-feet beyond site boundary is prepared. This map is intended to aid the development team in determining the areas most suitable for infiltration BMPs. The map should also incorporate the constraints information (i.e. tree conservation and environmentally sensitive areas, etc) identified when the constraints map was developed (See Section 4.2.1).

Note that infiltration BMPs must be at a lower elevation than the adjacent areas from which they will receive runoff.

Projects located in NRCS hydrologic soil group type C and D soils are less suitable for infiltration BMPs because these soils do not allow significant volumes of runoff to infiltrate them. Projects with these slow draining soils must use a permeable backfill in conjunction with an underdrain or alternative BMPs such as vegetated swales and strips. As a result, these projects can skip Step 2 and proceed to field testing of the proposed BMP location as specified in Step 3.

Step 2. Characterize soil

Characterize soil structure, USDA texture, gradation, percent fines, and soil horizons at the proposed bottom and 4-ft below the bottom of the proposed BMP. One sample must be evaluated by a licensed geotechnical engineer for each considered location, regardless of type or size.

The soil horizon information is used to identify the relative infiltration rates based on each horizon (see Table 6.3).

Table 6.3: Design Infiltration Rates for Soil Textures Receiving Stormwater

SOIL TEXTURE	INITIAL INFILTRATION RATE (IN/HR)
Coarse sand or coarser, loamy coarse sand, sand	3.600
Loamy sand	1.630
Sandy loam, fine sand, loamy fine sand, very fine sand and loamy fine sand	0.500
Loam	0.240
Silt loam	0.130
Sandy clay loam	0.110
Clay loam	0.030
Silty Clay loam	0.043
Sandy clay	0.040
Silty clay, clay	0.070

The infiltration rate of the soil texture with the least permeable soil can be used an as initial indicator of the sites infiltration rate. Infiltration rates less than 0.5-inches per hour (indirect infiltration) and 1.0-inches per hour (direct infiltration) do not drain quickly enough for use as an infiltration system without the addition of an underdrain. Infiltration rates that exceed 3-in/hr (indirect or direct) are considered at risk of introducing contaminants into groundwater supplies and should only be used where it can be demonstrated that pre-treatment of the runoff will confidently eliminate that risk. These sites will also require significant irrigation to sustain surface landscaping.

The number of potential infiltration testing locations can be reduced by the elimination of all evaluated areas that have percent fines greater than 10 percent. Sites with excessive percent fines tend to clog the pore spaces in the soil, thereby reducing its ability to function as designed.

Distributing small infiltration areas throughout the site is preferred over the use of large retention basins. Depending on the site, using a combination of small, natural stormwater retention areas can reduce the overall size of a flood control detention and piping system.

Step 3. Determine the types of suitable infiltration BMPs for the location

Remaining potential infiltration sites can be preliminarily sized based on the estimated infiltration rate for the textural class identified in the samples evaluated. There are many types of infiltrating BMPs including bioretention systems, swales, retention basins, dry wells, infiltration trenches, modular pavements and rain gardens. Often site conditions point toward one BMP being more appropriate than another.

Infiltration BMPs should not be installed on fill areas without a geotechnical evaluation.

Table 6.4 provides a list of the more common characteristics to help select the most appropriate BMP.

Table 6-4. Infiltration BMP Selection Criteria

CRITERIA	VALUE	
Tributary Area	Bioretention Systems	< 2 ac or 4% of tributary area
	Dry wells:	< 10 ac
	Infiltration trenches:	< 10 ac (Young et al, 1996)
	Swales:	< 10 ac
	Retention Basins:	5 to 50 ac (Young et al, 1996)
	Rain gardens	5% of tributary area
	Porous Concrete	10% of impervious site tributary area
Site Slope	Infiltration BMPs should not be placed on slopes greater than 6% without a geotechnical recommendation.	
Need for Treatment	Sites intending to use infiltration BMPs as a treatment BMP must also verify that the: 1. Cation exchange capacity (CEC) of the soil is greater than or equal to 5 milliequivalents CEC/100g of dry soil (USEPA Method 9081). 2. Organic content of the soil is greater than 20%	

Infiltration BMPs must be designed to completely drain within 72 hours after a storm to prevent low oxygen conditions and odor and mosquito problems. If the infiltration rates of the underlying soils are slow, the depth and footprint of the infiltration BMP must be adjusted to achieve this standard.

Upon completion of Step 3, the anticipated footprint and its location relative to proposed structures should be included on the infiltration feasibility map. Most infiltration BMPs will require a 10-ft setback downslope of a structure, unless the structure is protected with a water/vapor barrier (Stego wrap, Mirafi 570, etc). The liner should be uv-stabilized to assure long lasting protection. A hundred (100 ft) setback should be maintained upslope from building foundations.

Each infiltration area requires an overland escape path. Having a series of smaller infiltration areas can reduce the risk of failure that is typically associated with a single site solution and has been found to reduce the water quality treatment needed at "end of pipe" locations.

Step 4. Establish Design Criteria for Infiltration BMPs

The evaluation requirements are specific to the infiltration device being proposed. Table 6.4 provides a list of testing requirements for each type of infiltration BMP currently accepted by the County.

a. The vertical separation distance should be based on the highest anticipated seasonal groundwater elevation with consideration of the potential increase in the maximum height of the water table due to the infiltration device. Groundwater mounding calculations by a geotechnical engineer shall be conducted in areas where slope stability is a concern and/or at locations with a high water table.

b. Specific infiltration rates used in design shall be in accordance with **one** of the following:

i. The last field measured percolation rate, as adjusted by standard correction factors, for a 12x12x12 or a 4, 6 or 8-inch bore hole extending five feet below the bottom of the proposed elevation of the infiltration system and based on an average of two **falling head percolation tests** with a minimum four hour soaking period. (A constant head percolation test can be used for test holes that can't maintain a pre-soak condition).

Testing frequency should be consistent with the testing frequency provided in Table 6.5. The design infiltration rate is the average of the individual test holes of each infiltration facility.

Table 6.5: Design Infiltration Rates Test frequency Requirements

<table>
<tr><th>INFILTRATION BMP</th><th>TEST REQUIRED</th><th>MIN. NO. OF TESTS REQUIRED*</th></tr>
<tr><td>Rain Gardens</td><td rowspan="5">Pits or borings (5-feet or depth to limiting layer, whichever is less).</td><td>N/A</td></tr>
<tr><td>Infiltration Trench (≤ 2000 sf of contributing drainage area)</td><td>1 test/100 linear feet of trench with a minimum of 2, and sufficient to determine variability.</td></tr>
<tr><td>Infiltration Trench (> 2000 sf of contributing drainage area)</td><td rowspan="2">1 test/50 linear feet of trench with a minimum of 2, and sufficient to determine variability.</td></tr>
<tr><td>Bioretention systems</td></tr>
<tr><td>Infiltration Grassed Swales</td><td>1 test/1000 linear feet of trench with a minimum of 2, and sufficient to determine variability.</td></tr>
<tr><td>Retention Basins</td><td rowspan="2">Pits to 10-feet or depth to limiting layer. Borings to 20 feet or depth to limiting layer. Include mounding potential.</td><td rowspan="2">2 pits required per infiltration area with an additional 1 pit or boring for every 10,000 sf of infiltration area and sufficient to determine variability</td></tr>
<tr><td>Dry Wells</td></tr>
</table>

**The depth and number of test holes, pits and samples should be increased if, in the judgment of a licensed geotechnical engineer, the conditions are highly variable and such increases are necessary to accurately estimate the performance of the system.*

ii. One third of the field measured infiltration rate for soils five feet below the bottom of the proposed elevation of the infiltration system based on **double-ring infiltrometer** requirement of ASTM D3385.

iii. Single family residences may use an adjusted infiltration rate based on a ratio of the initial infiltration rate associated with the samples **soil texture** and a factor of safety of 0.8. The initial design infiltration rate value is based on the soil texture of the least permeable soil below the bottom elevation of the infiltration device (see Table 6.3).

The adjusted infiltration rate used in subsequent design calculations requires the initial infiltration rate be multiplied by 0.8. The 0.8 represents a safety factor to account for potential clogging, bio-buildup and site variability.

Example.
Sand (3.6 initial infiltration rate) x 0.8 (safety factor) = 2.88 (adjusted infiltration rate)

Step 5 and 6. Test material proposed for back fill, verify system performance

Material proposed for back fill may consist of excavated material, imported material or a combination of the two and shall be subject to a textural analysis to verify it conforms to current bioretention media properties.

The last steps are included in this section for continuity and are not associated with determining if a particular site is well suited for infiltration BMPs. Step 5 is intended to verify that the material used as backfill meets the design criteria. This step should be included prior to construction. Areas designated for infiltration BMPs should be protected from construction equipment and from receiving sediment-laden construction site runoff.

Step 6 verifies that the system is performing as designed. It is required at the option of the county and uses the percolation rate procedures identified in step 4.

6.4 Maintaining Peak Runoff Rates

The use of detention to maintain post-development peak runoff rates to pre-development levels may also be required at locations where other, more passive methods are unable to adequately mitigate for the post-developed conditions.

In all cases, post-construction peak runoff flow rates and velocities from the project site shall be maintained at levels that will not cause a significant increase in downstream erosion.

Measures to control flow rates and velocities shall not disrupt flows and flow patterns that are necessary to support downstream wetlands or riparian habitats. Diversion of runoff to regional facilities shall not be allowed to deprive immediate downstream habitats of minimum flows and/or overbank flow events.

6.5 Mimic Pre-Development Frequency and Duration of Events

Small storms are responsible for most annual urban runoff and groundwater recharge. LID techniques seek to intercept rainfall, reduce the extent of directly connected impervious surfaces, and slow down the rate of runoff. These techniques best mimic the pre-development frequency and duration of small storm events and are preferred.

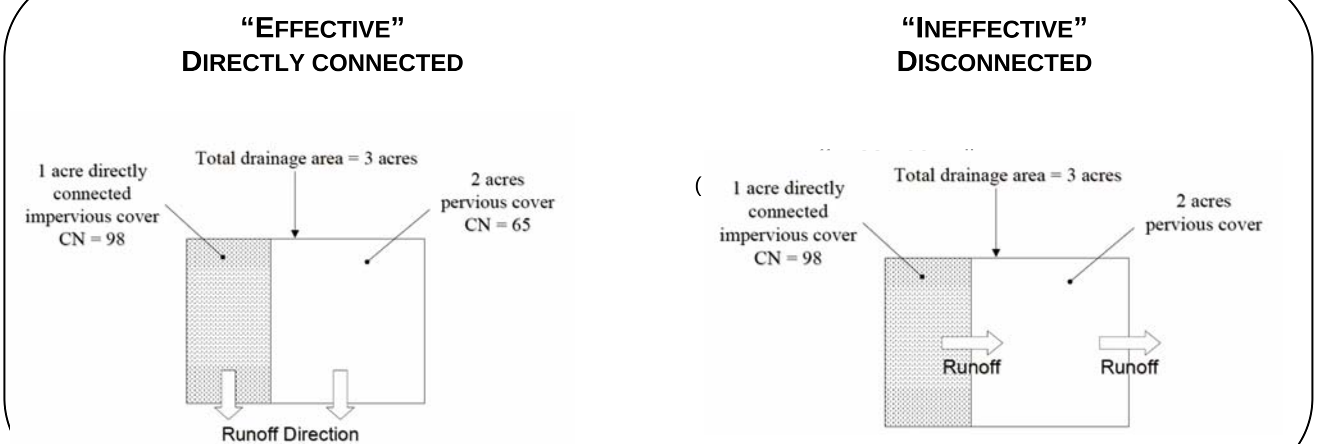
Section 6.3.2 discussed rainfall interception techniques and is not repeated here. This section includes recommendations to reduce the extent of effective impervious surface area and increase the time of concentration.

6.5.1 Reduce Directly Connected Impervious Areas (DCIA)

Studies have shown adverse biological impacts to surface waters in watersheds with effective impervious area (EIA) greater than 2-3% (Horner, 2007).

Effective impervious areas are areas such as rooftops, streets, sidewalks, and parking lots that drain directly to a stream or wetland system via pipes or by sheet flow. They are considered “effective” because the effectively drain the landscape.

Impervious areas that drain to landscapes, swales, parks and other impervious areas are considered “ineffective” because the water is allowed to infiltrate through the soil and into groundwater, without a direct connection to the stream of wetland. As show in the figure below, this decreases both the runoff volume and the time of concentration.



(Obropta, Rutgers Cook College)

Reducing effective impervious area means to disconnect impervious surfaces from the drainage system so that runoff does not flow directly to streams. Disconnecting the stormwater system allows the watersheds’ hydrologic cycle to respond in a manner that more closely reflects pre-disturbed conditions (though it does not restore such condition). DCIA reduction can occur as part of new development, redevelopment, or be part of a retrofit design. The level of benefit is determined by how well the practices minimize runoff in small to mid size storm events.

6.5.2 Maintain or Increase the Time of Concentration

Practices that increase the time it takes for runoff to travel across a site include:

- Roughening the travel path surface (vegetation vs pavement or pipes)
- Incorporating check dams and grade changes to allow interim ponding
- Lengthening the flow path
- Converting concentrated flow back into sheet flow
- Disconnecting impervious areas

Maintaining or exceeding the existing time of concentration using the techniques discussed above will reduce peak flows during small storm events.

6.6 Mitigating Hydromodification Impacts

The preferences for managing hydromodification impacts on a site are as follows (in order of preference):

1. Minimize the amount of runoff to be managed by minimizing the extent of impervious surfaces.
2. Infiltrate runoff where Type A and B soils exists. Multiple distributed surface infiltration systems are preferred over single infiltration systems due to the redundancy that multiple systems provide against failure in minor events and the larger surface area for transpiration, evaporation and infiltration of runoff. Surface systems are preferred over subsurface systems to avoid the "out of site, out of mind" problems typical of subsurface systems.
3. Bioretention or vegetated channels designed with detention.
4. Dispersion techniques for roof and road runoff
5. Pervious pavements and driveways, particularly if they drain to a vegetated area.
6. When none of the above is feasible, more conventional collection, conveyance and detention systems can be considered. When utilizing conventional systems, effort should be made to promote groundwater recharge and reduction of runoff volumes by constructing conveyance in vegetated open channels and maintaining the size of drainage area serviced by the detention facility.

6.7 Calculating Site Runoff Volume, Duration and Peak Discharge

A hydrograph analysis allows an evaluation of the relationship between runoff and rainfall over an isolated storm event. There are several commercial software packages available for analyzing hydrographs. Regardless of which package is used, the software should be set up as follows:

Hydrograph Method:	SBUH or custom localized curve, if available*
Storm Returns:	See Chapter 2 for storm return requirement
Time Interval:	1 minute
Storm Distribution:	Type I
Storm Duration:	24-hours
Rainfall Depths:	Corresponding NOAA Isopluvial Precipitation chart
Antecedent Moisture Condition:	AMC II
Time of Concentration:	Per TR-55 Manual

The greatest difference between the post-project volume and the pre-project volume for the storm event specified represents the increase runoff volume generated as a result of the project. Modifications to the site design should be made until there is an acceptable difference between the pre- and post-development scenarios except for projects that meet the exemption criteria provided in Section 6.7.

The pre-and post-development SCS Curve Numbers are determined in a similar manner as described in the Section 6.3.1 "Measuring the Imperviousness of a Site". Rainfall depths for the 2, 5, 10, 25, 50 and 100-year storm events as well as the water quality event are provided in Chapter 2. Time of concentration calculations should adhere to TR-55 methodology. Since areas with high equipment traffic will infiltrate less volume than undisturbed soils, post-development curve numbers will need to reflect changes in soil characteristics expected after construction has been completed unless the plans call to restore the soil structure (i.e. deep tilling, chisel plowing or amending the upper soil surface).

A third hydrograph may be required to evaluate the peak flow rate, time to peak and storage requirements associated with each storm event originating from only the directly connected impervious areas.

The comparison of pre-development against the larger of the post-development and directly connected area hydrographs provides insight into the project's hydrologic impacts and should be reviewed against the requirements provided in Chapter 2.

6.8 Hydromodification Exemptions

A project conditioned to adhere to hydromodification requirements, can request an exemption if it can be demonstrated that the project:

1. Will not create an increase in directly connected impervious surfaces over pre-project conditions.
2. Discharge to an existing well armored channel with little likelihood of future removal and with demonstrated limited benefit to meeting hydromodification control (HC) requirements.
3. Discharge to sandy beaches, tidal flats or marshes which are depositional in nature and are at low risk of erosion from increased flows.
4. Is an infill project within a highly developed watershed.
5. Demonstrates through sediment transport modeling across the range of geomorphically-signficant flows to the permitting agencies satisfaction that the project flows and sediment reductions will not detrimentally affect the receiving water.
6. Demonstrate impracticality of meeting HC requirements by showing that the combined construction cost of both required stormwater treatment and hydromodification control BMPs exceeds two percent of the project construction cost, excluding land costs, soil disposal fees, hauling, contaminated soil testing, mitigation, disposal, or other normal site enhancement costs such as landscaping or grading that are required for other development purposes. If a developer demonstrates that the total cost to fully comply with the HC and other stormwater treatment requirements will exceed this cost threshold, a determination may be made by the Director of Public Works, Director of Planning & Building or designee that the project shall comply with the HC requirements by either (1) implementing hydromodification controls onsite to the maximum extent practicable, or (2) by contributing to an in-stream or offsite solution, if available, up to a maximum cost for all controls of two percent of the project cost.

Ch 7: Treatment Control Measures

7.1 Introduction to Treatment Control

Stormwater leaving a site must meet the treatment goals established in Chapter 2.

Preference for treatment control implementation:

- Prevent and eliminate the need for treatment control.
  - See source controls.
  - Increase public awareness and employee training.
- Use LID practices to eliminate runoff for treatment storms.
- Use LID practices to capture pollutants from stormwater streams. Treatment control BMPs should be placed as close to the source of pollutant as possible.
- Use conventional “end of pipe” treatments as a least favored option.

Chapter 5 provides information on source controls appropriate for varying types of development. Chapter 6 provides information on ways to reduce the volume of runoff leaving the site. This chapter describes treatment controls including LID practices that can be used to capture pollutants from runoff as well as conventional “end of pipe” treatments. This chapter also contains ancillary devices that can be incorporated into designs to provide enhanced treatment.

Projects discharging to Clean Water Act 303(d) listed water bodies must address all constituents that will contribute to the impairment of the waterbody.

Structural treatment control stormwater BMPs should be implemented close to pollutant sources to maximize pollutant removal. Such BMPs may be located onsite or offsite, used singly or in combination, or shared by multiple new developments.

7.2 Treatment Control BMPs

Each project has unique features that make it particularly well suited for a specific BMP or which can eliminate specific BMPs from consideration. Characteristics that may influence the selection of a treatment control BMP include tributary area to the BMP, land use, site slopes, soils, cost, etc. This section discusses some of the physical constraints that might influence the selection of a treatment control BMP. To create a list of viable treatment controls for a particular site, begin the initial review with the list of acceptable treatment control BMPs below.

Infiltration Trench (TC-10)	Constructed Wetland (TC-21)
Retention Basin (TC-11)	Detention Basins (TC-22)
Vegetated Swale (TC-30)	Vegetated Filter Strip (TC-31)
Bioretention (TC-32)	Surface Sand Filters
Media Filters (TC-40)	Oil & Water Separators (TC-50)
Catch Basin Inserts	Manufactured Systems

Treatment control BMPs are not meant to be isolated components, rather they should be part of an integrated stormwater management treatment train.

Infiltration Trenches (TC-10)
An infiltration trench is an excavated trench, backfilled with a stone aggregate, and lined with filter fabric. Pollutants are filtered out of the runoff as it infiltrates the surrounding soils. Infiltration trenches are highly effective at removing sediment, nutrients, trash, metals, bacteria, oil and grease, organics and oxygen demanding constituents. See http://www.cabmphandbooks.com/Documents/Municipal/TC-10.pdf or http://www.epa.gov/owmitnet/mtb/infltrenc.pdf for additional information regarding infiltration trenches.

Constructed Wetlands (TC-21)
Constructed wetlands are excavated basins with an undulating bottom into which wetland vegetation is purposely placed to enhance pollutant removal from stormwater runoff. Constructed wetland remove solids and course organic material, soluble nutrients and some dissolved nutrients. See http://www.deq.state.mi.us/documents/deq-swq-nps-conw.pdf or http://www.cabmphandbooks.com/Documents/Municipal/TC-21.pdf for additional information regarding constructed wetlands.

Retention Basins (TC-11)
Infiltration facilities store runoff until it gradually infiltrates into the soil. Retention basins are highly effective at removing sediment, nutrients, trash, metals, bacteria, oil and grease, organics and oxygen demanding constituents. See http://www.cabmphandbooks.com/Documents/Municipal/TC-11.pdf for additional information regarding retention basins.

Detention Basins (TC-22)
Detention basins are basins where outlets have been designed to detain stormwater runoff from a water quality design storm for some minimum time (e.g., 72 hours) to allow particles and associated pollutants to settle out. Detention basis are less effective than retention basins at removing sediment, metals, bacteria, oil and grease, organics and oxygen demanding constituents. The efficiency removal rate corresponds to detention time, with higher removal efficiency rates with longer detention times. See http://www.cabmphandbooks.com/Documents/Municipal/TC-22.pdf for additional information regarding detention basins.

Vegetated Swales (TC-30)
Vegetated swales are shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales are moderately effective at trapping particulate pollutants (suspended solids and trace metals). Swales can contribute to increased nutrient loads if over-fertilized. See http://www.cabmphandbooks.com/Documents/Municipal/TC-30.pdf for additional information regarding vegetated swales.

Vegetated Filter Strip (TC-31)
Vegetated filter strips are vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and allowing sediment and other pollutants to settle out. They are highly effective at removing sediment, metals and oil and grease. They are not very efficient at removing nutrients and bacteria. See http://www.cabmphandbooks.com/Documents/Municipal/TC-31.pdf for additional information regarding vegetated filter strips.

Bioretention (TC-32)
Bioretention facilities remove pollutants through a variety of physical, biological, and chemical treatment processes that are soil and plant-based. Bioretention facilities are highly effective at removing sediment, trash, metals, bacteria, oil and grease, organics and oxygen demanding constituents. Nutrients can be effectively removed by properly maintained bioretention facilities; however, over fertilized bioretention facilities can introduce nutrients into the system. See http://www.cabmphandbooks.com/Documents/Municipal/TC-32.pdf for additional information regarding bioretention facilities.

Surface Sand Filters
Sand filter systems consist of two or three chambers or basins. The first is the sedimentation chamber, which removes floatables and heavy sediments. The second is the filtration chamber which removes additional pollutants by filtering the runoff through a sand bed. The third is the discharge chamber. Sand filters are able to achieve high removal efficiencies for sediment, biochemical oxygen demand (BOD), and fecal coliform bacteria; however, removal efficiencies for metal, is moderate, and nutrient removal is often low. See http://www.epa.gov/owmitnet/mtb/sandfltr.pdf for additional information regarding surface sand filters.

Media Filters (TC-40)
Media filters are usually two-chambered filtering structures consisting of a pretreatment settling basin and a filter bed filled with sand or other absorptive filtering media. Media filters are highly efficient at removing sediment, trash, metals, oil and grease and organic constituents; however, removal efficiencies are moderate for bacteria and low for nutrients. They are often used where the site precludes the use of surface BMPs. See http://www.cabmphandbooks.com/Documents/Municipal/TC-40.pdf and.http://www.deq.state.id.us/water/data_reports/storm_water/catalog/sec_4/bmps/7.pdf for additional information regarding media filters.

Oil/Water Separators (TC-50)
Regional Water Quality Control Board Region 2 (August 5, 2004 Letter entitled “Use of storm drain inlet filters and oil/water separators to meet the requirements of NPDES Municipal Stormwater Permits”), indicates that vault based oil-water separators are generally ineffective at removing pollutants at concentrations seen in urban runoff. While their removal rates are low, the pollutants captured in one storm are likely to be flushed out in a subsequent storm. The Region 2 Board recommends that oil/water separators only be used as part of a treatment train and on projects where oil and grease concentrations are expected to be very high. Oil and water separators are also commonly called water quality inlets or oil and grit separators. See http://www.cabmphandbooks.com/Documents/Municipal/TC-50.pdf for additional information oil/water separators.

Catch Basin Inserts
According to Regional Water Quality Control Board Region 2 (August 5, 2004 Letter) storm drain filters (also known as catch basin inserts) are discouraged because they are subject to clogging and binding, are rarely maintained, have rapidly decaying effectiveness rates over a time frame that is significantly shorter that the typically recommended replacement or maintenance intervals, are ineffective at removing dissolved pollutants, and are easily bypassed if fouled to prevent flooding.

Manufactured Systems
Manufactured systems are generally all “end of pipe” treatment systems and are highly discouraged. Applicants are encouraged to research the BMP effectiveness based on independent

studies. See http://www.bmpdatabase.org/index.htm for scientifically sound information to improve the design, selection and performance of BMPs.

7.3 Stormwater Pollutants

It is important that stormwater treatment control BMPs address the pollutants generated by the project. Review the tables in this section to eliminate unsuitable or incompatible treatment control measures from the list. As a treatment control BMP is eliminated, note the criteria that justified its removal on the checklist provided in Appendix B. Use this checklist during the development review process.

Table 7.1 provides a matrix of the categories of pollutants corresponding to various land uses.

Table 7-1: Pollutant Categories Associated with Various Types of Development

General Pollutant Categories	Project Category							
	Single Family Residential	Multi-Family Residential	Commercial/ Industrial	Auto Repair Shops	Restaurant	Hillside Developments	Parking Lots	Streets/Roads
Pathogens	X	P	P(3)		X			
Metals				X			X	X
Nutrients	X	X	P(1)			X	P(1)	P(1)
Pesticides	X	X	P(1)			X	P(2)	
Organic Compounds			P(2)	X(4)(5)				X(4)
Sediments	X	X	X			X	P(1)	X
Trash & Debris	X	X	X	X	X	X	X	X
Oxygen Demanding Substances	X	P(1)	P(1)		X	X	P(5)	P(5)
Hydrocarbons	X	P(2)	X	X	X	X	X	X

Source: CASQA, 2003

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.

Understanding the sources of pollutants associated with development is useful in selecting appropriate site, source and treatment control measures. The sources of pollutants commonly found in urban runoff are provided in Table 7-2.

DRAFT

Table 7-2: Sources of Pollutants Commonly Found in Urban Runoff

POLLUTANT	MAJOR SOURCES	POTENTIAL EFFECTS
Nutrients • **Nitrogen** • **Phosphorus**	• Fertilizers • Animal Waste • Detergents • Atmospheric deposition • Leaking sewage pipes	• Lowers oxygen levels • Destroys habitat • Promotes algal blooms • Limits recreation • Interferes with navigation
Pathogens • **Bacteria** • **Viruses**	• Animal waste • Illicit connections between storm sewers and sewage lines • Leaking sewage pipes	• Poses human health risks • Closes beaches • Closes shellfish harvesting areas
Hydrocarbons • **Oil** • **Grease** • **Petroleum-based products** • **Polycyclic aromatic hydrocarbons (PAHs)**	• Parking Lots • Roads • Automobile emissions • Improper disposal of used motor oil • Illicit connections to drain systems	• Lowers levels of dissolved oxygen in receiving waters • Causes toxic impacts • Damages habitat
Toxic Organics • **Pesticides** • **Polychlorinated biphenyls (PCBs)**	• Lawn care • Agricultural lands • Industrial uses • Illicit connections to drain systems	• Causes toxic impacts • May lead to human and animal reproductive abnormalities • Increases animal mortality rates
Sediments	• Construction sites • Agricultural lands • Logged forest lands • Eroded stream banks	• Increases water turbidity • Alters water flows • Destroys benthic habitat • Blocks sunlight • Attracts particulate forms of metals and nutrients
Metals • **Lead** • **Copper** • **Cadmium** • **Zinc** • **Mercury** • **Chromium** • **Selenium** • **Nickel**	• Illicit connections to drain systems • Automobile emissions, Brake pad residues • Atmospheric deposition • Industrial activities • Commercial activities	• Increases toxicity of sediment and water column • Adds toxins to food chain • Causes genetic defects, reproductive abnormalities and increased mortality rates among fish and wildlife • Increases risks of cancer, neurological disorders and birth defects among humans
Trash & Debris	• Human activities	• Aesthetic impacts • Impairs recreational uses • Threatens aquatic life
Elevated Temperatures	• Industrial sources • Removal of trees next to streams and rivers • Impervious surfaces and conveyances	• Threat to insects, fish and other temperature sensitive aquatic species

Sources: Terrene Institute, 1996; U.S. EPA, 1995

7.4 Treatment Control BMP Considerations

Site and land use categories can be used to further refine the list of suitable treatment controls.

Effectiveness

This category addresses how well the treatment control BMP is able to reduce the pollutants of concern in the stormwater. Eliminate treatment control BMPs that have a low effective removal rate for the pollutant of concern(s) associated with the project.

Treatment Control BMPs	Pollutant Category						
	Metals	Nutrients	Sediment	Trash and Debris	Oil and Grease	Organics	Pathogens
Infiltration Trench (TC-10)	H	H	H	H	H	H	H
Constructed Wetland (TC-21)	H	M	H	H	H	H	H
Retention Basin (TC-11)	H	H	H	H	H	H	H
Detention Basin (TC-22)	M	L	M	H	M	M	M
Vegetated Swale (TC-30)	M	L	M	M	M	M	L
Vegetated Filter Strips (TC-31)	H	L	H	M	H	M	L
Bioretention (TC-32)	H	M	H	H	H	H	H
Surface Sand Filters	L	M	H	L	H	M	L
Media Filter (TC-40)	H	L	H	H	H	H	M
Oil Water Separators (TC-50)	L	L	L	M	M	L	L
Catch Basin Inserts	L	L	L	M	L	L	L

Source: xxxxxx

L=Low, M=Medium, H=High

Probability of Failure

Infiltration systems without adequate pre-treatment to remove sediment from runoff are at risk of premature failure due to clogging.

Proximity to Hot Spots

Hot spots are areas that have higher concentrations of pollutants than is typically found in urban runoff. Treatment control facilities that discharge to groundwater should not be used at hot spot locations. Therefore, projects that generate hot spot type pollutants should not use infiltration trenches, retention basins, dry wells, permeable pavements with underground recharge beds.

Receiving Waters

Projects discharging to Clean Water Act 303(d) listed waterbodies must address all constituents that will contribute to the impairment of the waterbody.

Tributary Area

Some practices require a minimum area to ensure sufficient flows to the BMP, while others are limited to the maximum runoff they can handle. When considering the removal of a potential treatment control BMP based on tributary area, be sure to remember that large areas can be subdivided into smaller catchment areas to facilitate treatment or flow splitters that can be installed to capture and treat the first flush while by-passing larger storm events.

Additional information regarding flow splitters is available at the Minnesota Urban Small Sites BMP Manual http://www.metrocouncil.org/environment/Watershed/BMP/CH3_STFlowSplitters.pdf

Table 7-3 provides a list of treatment practices where effectiveness is based on the size of the tributary area draining to it.

Table 7-3. Applicability of treatment practices relative to BMP Tributary area

PRACTICE	FEASIBLE (ACRE)	MARGINAL (ACRE)
Infiltration Trench (TC-10)	0-5	5
Constructed Wetlands (TC-21)	25-100	10-25
Retention Basin (TC-11)	5 acre and/or base flow	5-10
Detention Basin (TC-22)	5-25	<5
Vegetated swales (TC-30)	0-5	5-50
Vegetated Filter Strips (TC-31)	0-5	5-10
Bioretention facilities (TC-32)	4-20	0.5-4 and 20-50
Surface Sand Filters	1-10	10-25
Media Filters (TC-40)	0-2	>2
Oil water separators (TC-50)	0-5	5-7.5

Slopes

The slope of a BMP is a consideration in the Treatment Control BMP selection process. Larger BMPs, such as detention and retention basins, may require impractically large embankment heights if they were to be situated on a steep slope. Steep slopes may cause erosion or provide inadequate hydraulic residence times for vegetated strips and swales. When an entire site has steep slopes, it may be best to provide a number of smaller BMPs that can fit into the existing contours of the site.

Water Tables and Bedrock

Treatment control BMPs that rely on the chemical, biological and physical properties of soil to achieve treatment goals may be limited due to high groundwater or shallow bedrock elevations.

Land Available

Densely developed sites may have inadequate space to incorporate some treatment control BMPs. Some treatment control BMPs require a significant amount of land for installation.

Poorly Drained Soils
Some treatment control BMPs, such as wetlands, thrive with poorly drained soils, while others treatment control BMPs are precluded for use unless under drains are incorporated into the treatment area.

Grade Differences
Most infiltration BMPs must be at a lower elevation than the adjacent areas from which they will receive runoff. Some filtering systems have modest head requirements that might preclude their use in some areas.

Table 7-4 provides a list of treatment practices that are influenced by the conditions listed above and that are typical of development sites.

Table 7-4 Treatment Practices Site Condition Considerations

PRACTICE	HOT SPOT RUNOFF	STEEP SLOPES	HIGH WATER TABLE	SHALLOW BEDROCK	PROXIMITY TO FOUNDATION	POORLY DRAINED SOILS
Infiltration Trench (TC-10)	No	No	No	No	D	No
Constructed Wetland (TC-21)	Ok	Ok	Ok	D	Ok	No
Retention Basin (TC-11)	No	No	No	No	D	No
Detention Basin (TC-22)	D	No	No	No	D	Ok
Vegetated Swale/(TC-30)	D	D	No	Ok	D	D
Vegetated Filter Strips (TC-31)	No	No	No	No	No	Ok
Bioretention (TC-32)	D	Ok	No	No	D	Ok
Surface Sand Filter	Ok	No	No	No	No	No
Media Filter (TC-40)	Ok	Ok	Ok	Ok	Ok	Ok
Oil Water Separators (TC-50)	Ok	Ok	Ok	D	D	D
Catch Basin Inserts	Ok	Ok	Ok	Ok	Ok	Ok

Ok – compatible site conditions
No – Site condition that precludes treatment control BMP use
D – Site condition will require additional engineering to use treatment control BMP

Additional Considerations
There are additional considerations beyond the site considerations and targeted pollutant criteria described above, including cost, difficulty to maintain, community acceptance, habitat value and public safety.

Costs
The costs associated with initial construction and ongoing operation and maintenance (O&M) may influence the selection of one treatment control BMP over another.

Difficulty to Maintain
BMPs not maintained are ineffective.

Community Acceptance
Public understanding of a BMP's function is helpful in alleviating BMP concerns. BMPs that blend well into the existing landscape are generally favored over more structurally based BMPs.

Habitat Value
Treatment control BMPs that improve habitat for aquatic, terrestrial and recreational uses, as well as address stormwater pollutants of concern are encouraged. Treatment control facilities may encourage adoption by endangered or threatened species—thereby eliminating the ability to perform routing operation and maintenance activities without benefit of environmental permits unless a "Safe Harbor Agreement" can be formalized in advance. See http://www.mde.state.md.us/assets/document/wetlandswaterways/safeharbor.pdf for additional information on safe harbor agreements.

Safety
BMP installations in areas frequented by community members, particularly children, such as parks, schools, or other recreation areas, should be selected with safety concerns in mind. For areas where there is potential for the BMP to be disturbed or vandalized, consideration should be given to selecting a BMP that is less obvious and less likely damaged.

Table 7-5 provides a list of treatment practices ranked by the considerations mentioned in this section.

Table 7-5 Other Considerations.

PRACTICE	COST		EASE OF MAINTENANCE	COMMUNITY ACCEPTANCE	HABITAT VALUE	SAFETY
	INITIAL	O&M				
Infiltration Trench (TC-10)	H	H	H	M	L	H
Constructed Wetland (TC-21)	H	M	M	H	H	M
Retention Basin (TC-11)	M	M	M	M	M	L
Detention Basin (TC-22)	L	L	L	L	L	M
Vegetated Swale (TC-30)	M	M	L	H	H	H
Vegetated Filter Strips (TC-31)	L	L	L	M	L	H
Bioretention (TC-32)	M	L	L	H	M	H
Surface Sand Filters	H	M	M	M	L	H
Media Filter (TC-40)	H	M	L	L	L	H
Oil Grit Separators (TC-50)	L	M	H	M	L	H
Catch Basin Inserts	L	M	M	M	L	H

L – Low
M – Medium
H - High

Appendix C - Treatment Control Feasibility Checklist

TREATMENT CONTROL BMP	CONSIDERED FOR USE	REJECTED BASED ON
Infiltration Trench (TC-10)		
Constructed Wetland (TC-21)		
Retention Basin (TC-11)		
Detention Basin (TC-22)		
Vegetated Swale (TC-30)		
Vegetated Filter Strip (TC-31)		
Bioretention (TC-32)		
Surface Sand Filter		
Media Filter (TC-40)		
Oil & Water Separator (TC-50)		
Catch Basin Insert		
Proprietary System		

Ch 8: Maintenance

8.1 Introduction to Stormwater Facility Maintenance

Stormwater facilities typically consist of a series of collection and conveyance systems, stormwater quantity control (detention/retention), and treatment facilities. A maintenance program is essential to ensure that the facilities continue to function as designed to maintain water quality and prevent possible flooding and property damage. To help understand stormwater facility maintenance requirements, it is useful to have a general knowledge of how they function.

Collection and conveyance systems
Collection and conveyance systems intercept and transport stormwater. They typically consist of curb cuts or inlets that collect water and swales or pipes that move water. Stormwater conveyance systems are designed to accept a specific maximum flow rate, as determined by the runoff generated during the design storm and the tributary area to the facility.

Typical failures include reduced capacity due to clogged surface grates and pipes. Plugging commonly occurs due to sediment and large debris washed from adjacent surfaces. Reduced conveyance system capacity results in localized flooding and possible property damage.

Quantity Control (detention/retention)
The intent of stormwater quantity control facilities is to reduce the peak flow and/or volume discharged from developed sites.

Detention facilities mitigate the site's increased runoff rate by providing temporary storage and controlling the release rate from the site through the use of orifice plates. The intent of the detention basin is to match the pre-developed runoff rates for several specific storm events in the developed condition (i.e. store the volume associated with the 50-year storm under developed conditions and release it at the 2-year pre-developed discharge rate). The runoff leaving the basin is metered from the basin to reduce potential stormwater impacts to surface waters or pipe networks located downstream of the development. While some detention facilities are able to reduce the volume of runoff released, they mainly serve to control the release rate of storms.

Retention facilities do not discharge to pipes or surface water bodies, rather they provide temporary storage until the collected runoff is able to soak into the ground.

Detention and retention facilities may be designed as basins or as underground facilities.

When infiltration devices fail, it is usually as a result of:

1. An inaccurate estimation of the Design Infiltration Rate;
2. An inaccurate estimation of the seasonal high water table;
3. Excessive compacting or sediment loading during construction;
4. No pretreatment for post-development and lack of maintenance.

Treatment facilities
Treatment facilities seek to remove oils, chemicals, metals, and sediment from stormwater runoff prior to being discharged from the property. They achieve this goal through a combination of filtration, sediment settling, plant nutrient uptake and physical separation and may consist of landscape and structural components.

Typical failures are dependent on the type of treatment facility specified. Facilities that are underground or difficult to access are at greater risk of neglect due to the "out of site, out of mind" factor. Passive, surface types of treatment facilities are generally considered easier to identify and address small problems before they become big problems.

Each of these types of facilities requires ongoing operational and maintenance activities to be done to ensure they continue to meet the purpose for which they were installed.

This chapter provides insight into the maintenance requirements for each types of facility, although multiple types of facilities may be present at each site. Some maintenance needs are common to all types of facilities, while others depend on the specific facility.

Example maintenance checklists are provided for the common types of stormwater facilities used in San Luis Obispo County shown in the table below.

Infiltration Trench (TC-10)	Wetlands (TC-21)
Retention Basin (TC-11)	Detention Basin (TC-22)
Vegetated Swale (TC-30)	Vegetated Filter Strip (TC-31)
Bioretention (TC-32)	Surface Sand Filter
Media Filter (TC-40)	Oil & Water Separator (TC-50)
Catch Basin Insert	Proprietary System

Facility owners should incorporate the use of maintenance procedures and checklists that apply to their facilities into their Operation and Maintenance Plans. Structural or treatment control BMPs located within a public area proposed for transfer will be the responsibility of the developer until they are accepted for transfer by the County or other appropriate public agency.

8.2 Operation and Maintenance Plans

Private stormwater facility owners are responsible for ensuring that the facilities are maintained and continue to function as designed. As part of the project application, the property owner shall complete an O&M maintenance agreement. The private stormwater facility owner will draft an O&M Plan and will provide a self-certification statement ensuring compliance with the Plan.

The Operation and Maintenance (O&M) plan must:

- Identify who is responsible for maintenance and how the maintenance will be funded. A copy of the maintenance agreement must be included with the O&M Plan.
- Include an overview of site drainage patterns, including all discharge points and the location of each treatment BMP.
- Document design parameters, features, methods and materials of construction, intended mode of operation and other key characteristics of stormwater treatment BMPs on the site.
- Include BMP manufacture data and manuals for proprietary BMP systems.
- Identify the maintenance program and schedule to ensure treatment BMPs continue to operate as intended. Maintenance is required at least once per year.
- A checklist to be used during verification inspections.

The O&M Plan and self-certification must be filed as a covenant to the recorded deeds for all lots to enforce the imposition of any special tax assessment that may be necessary to maintain stormwater treatment facilities if the responsibility party fails or is unable to perform any of the obligations in the Maintenance Agreement.

8.3 Transferring O&M Responsibility for Stormwater Facilities

There are two ways to transfer O&M responsibilities:

- Structural or treatment control BMPs located within a public area proposed for transfer will be the responsibility of the developer until they are accepted for transfer by the County or other appropriate public agency.

- The responsibility of private ownership of stormwater facilities can also be transferred to another private entity when the property is sold, transferred, or leased to another person or entity by including O&M responsibility as a condition in the sales, transfer or lease agreement. The first deed transfer or any lease agreements shall include the details of these requirements and information about the BMP such as the following:
  - BMP location;
  - How and when to perform the necessary inspections and maintenance; and
  - How long to keep all inspection and maintenance records.

The transfer of this information is required with any subsequent sale of the property.

8.4 Example Stormwater BMP Maintenance and Inspection Checklists

Example Maintenance Checklist for Infiltration Trench BMP (TC-10)

ROUTINE MAINTENANCE ACTIVITIES FOR INFILTRATION TRENCHES		
No.	**MAINTENANCE TASK**	**FREQUENCY OF TASK**
1	Remove obstructions, debris and trash from infiltration trench and dispose of properly.	Monthly, or as needed after storm events
2	Inspect trench to ensure that it drains between storms, and within 5 days after rainfall. Check observation well 2-3 days after storm to confirm drainage.	Monthly during wet season, or as needed after storm events
3	Inspect filter fabric for sediment deposits by removing a small section of the top layer.	Annually
4	Monitor observation well to confirm that trench has drained during dry season.	Annually, during dry season
5	Mow and trim vegetation around the trench to maintain a neat and orderly appearance.	As needed
6	Remove any trash, grass clippings and other debris from the trench perimeter and dispose of properly.	As needed
7	Check for erosion at inflow or overflow structures.	As needed
8	Confirm that cap of observation well is sealed.	At every inspection
9	Inspect infiltration trench using the Trench inspection checklist.	Monthly, or after large storm events, and after removal of accumulated debris or material

Prohibitions

Trees and other large vegetation should be prevented from growing adjacent to the trench to prevent damage. Standing water shall not remain in the trench for more than three days, to prevent mosquito generation. Should any mosquito issues arise, consult the County Health Department for proper vector control measures.

Example Maintenance Checklist for Detention Basin BMP (TC-22)

Routine Maintenance Activities for Extended Detention Basins		
No.	**Maintenance Task**	**Frequency of Task**
1	Conduct annual vegetation management during the summer, removing weeds and harvesting vegetation. Remove all grass cuttings and other green waste.	Once a year
2	Trim vegetation at beginning and end of wet season to prevent establishment of woody vegetation, and for aesthetics and mosquito control.	Twice a year (spring and fall)
3	Evaluate health of vegetation and remove and replace any dead or dying plants. Remove all green waste and dispose of properly.	Twice a year
4	If turf grass is included in basin design, conduct regular mowing and remove all grass cuttings. Avoid producing ruts when mowing.	As needed
5	Remove sediment from forebay when the sediment level reaches the level shown on the fixed vertical sediment marker and dispose of sediment properly.	As needed
6	Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of basin volume and dispose of sediment properly.	Every 10 years, or as needed
7	Remove accumulated trash and debris from the extended detention basin at the middle and end of the wet season and dispose of trash and debris properly.	Twice a year (Before and after the rainy season)
8	Inspect extended detention basin using the attached inspection checklist.	Quarterly, or as needed

Prohibitions

The use of pesticides and quick release fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed.

Example Wetland and Basin BMP Inspection Checklist

Inspection Items	Satisfactory (S) or Unsatisfactory (U)	Comments/Corrective Action
General		
Dead, diseased, or dying vegetation present?		
Poisonous vegetation, noxious weeds or excessive weeds present?		
Does tree growth interfere with required maintenance activities?		
Any evidence of oil, gasoline, contaminants or other pollutants?		
Is vegetation sparse or are there bare or eroded patches occurring in more than 10% of the swale bottom or 30% of swale side slopes?		
Embankment and Emergency Spillway		
Any evidence of rodent holes if facility is acting as a dam or berm?		
Is erosion damage within basin over 2 inches deep with the cause of damage or potential for continued erosion still present?		
Is erosion present in/around emergency spillway?		
Cracking, sliding, bulging of embankment or spillway? Any part of berm settled 4 or more inches lower than the design elevation?		
Any discernable water flow through embankments?		
Any obstructions of spillway(s)?		
Inlet/Outlet Structures and Channels		
Clear of debris and functional?		
Accumulated sedimentation in forebay or inlet structure?		
For concrete structures, any cracks wider than 1/2-inch and longer than 1-foot with evidence of soil particles entering the structure through the cracks?		
Pipes, plates in good condition?		
Outfall channels functional and not eroding?		
Basin Bottom		
Accumulated sedimentation?		
Hazards		
Have there been complaints from residents or public hazards notes?		

Example Maintenance Checklist for Vegetated Swale BMP (TC-30)

Routine Maintenance Activities for Vegetated Swales		
No.	**Maintenance Task**	**Frequency of Task**
1	Mow turf grass	As needed
2	Remove obstructions and trash from vegetated swale.	Monthly, or as needed
3	Inspect swale to check for erosion and sediment and debris accumulation and dispose of sediment and debris properly.	Twice a year: 1) one inspection should occur at the end of the wet season in order to plan and schedule summer maintenance, 2) the other inspection should occur after periods of heavy runoff
4	Remove sediment accumulating near culverts and in channels and dispose of sediment properly.	As needed.
5	Inspect swale using the inspection checklist.	As needed

Prohibitions
The use of pesticides and quick release fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed.

Example Maintenance Checklist for Vegetated Filter Strip BMP (TC-31)

Routine Maintenance Activities for Vegetated Buffer Strips		
No.	**Maintenance Task**	**Frequency of Task**
1	Mow turf grass Remove grass cuttings.	As needed
2	Remove obstructions and trash from vegetated buffer strip and dispose of properly.	Monthly, or as needed
3	Inspect buffer strip to check for erosion and sediment and debris accumulation. Dispose of sediment and debris properly.	Twice a year: 1) one inspection at the end of the wet season in order to plan and schedule summer maintenance, 2) the other inspection after periods of heavy runoff
4	Remove sediment accumulating near culverts and if it covers vegetation. Dispose of sediment properly.	As needed
5	Inspect buffer strip using the inspection checklist.	As needed

Prohibitions
The use of pesticides and quick release fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed.

Example Maintenance Checklist for Bioretention BMP (TC-32)

Routine Maintenance Activities for Bioretention Areas		
No.	**Maintenance Task**	**Frequency of Task**
1	Remove obstructions, debris and trash from bioretention area and dispose of properly.	Monthly, or as needed after storm events
2	Inspect bioretention area to ensure that it drains between storms and within five days after rainfall.	Monthly, or as needed after storm events
3	Inspect inlets for channels, soil exposure or other evidence of erosion. Clear obstructions and remove sediment.	Monthly, or as needed after storm events
4	Remove and replace all dead and diseased vegetation.	Twice a year
5	Maintain vegetation and the irrigation system. Prune and weed to keep bioretention area neat and orderly in appearance.	Before wet season begins, or as needed
6	Check that mulch is at appropriate depth (3 inches per soil specifications) and replenish as necessary before wet season begins.	Monthly
7	Inspect bioretention area using the attached inspection checklist.	Monthly, or after large storm events, and after removal of accumulated debris or material

Prohibitions

The use of pesticides and quick release fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed.

Example Maintenance Inspection Checklist for Bioretention BMP Facilities

Inspection Activities	**Suggested Schedule**
Inspect for: trash and debris; yard waste, excessive erosion; sediment accumulation in the basin,; tree growth on overflow structure; the presence of burrowing animals; standing water where there should be none; vigor and density of the grass turf. Note signs of pollution, such as oil sheens, discolored water, or unpleasant odors.	Annually
Maintenance Activities	**Suggested Schedule**
Clean and remove debris from bioretention area and contributing areas Mow Prune and weed planted areas.	Monthly or as needed

Proprietary Treatment Systems

Manufactured Stormwater Treatment Measures are proprietary treatment devices that tend to be installed below ground and operate using some type of proprietary filter media, hydrodynamic separation, or sedimentation and screening. Common examples of manufactured treatment measures include manufactured media filters, inlet filters or drain inserts, oil/water separators and hydrodynamic separators.

Routine Maintenance Activities

The principal maintenance objective is to prevent sediment buildup and clogging, which reduces pollutant removal efficiency and may lead to failure of the manufactured treatment measure.

Example Maintenance Checklist for Proprietary System BMPs

Routine Maintenance Activities for Manufactured Treatment Measures		
No.	**Maintenance Task**	**Frequency of Task**
1	Inspect for standing water, sediment, trash and debris.	Monthly during rainy season
2	Remove sediment, trash and debris from sedimentation basin, riser pipe and filter bed, using vactor truck method. Dispose of sediment, trash, filters and debris properly.	As needed
3	Ensure that manufactured treatment measure drains completely within three days.	After major storm events and as needed.
4	Inspect outlets to ensure proper drainage.	Monthly during rainy season, or as needed after storm events
5	Follow manufacturer's guidelines for maintenance and cartridge replacement.	As per manufacturer's specifications.
6	Inspect manufactured treatment measure, using the attached inspection checklist.	Monthly, or after large storm events, and after removal of accumulated debris or material

Prohibitions

Trees and other large vegetation shall be prevented from growing adjacent to the manufactured treatment measure to prevent damage. Standing water shall not remain in the treatment measures for more than three days, to prevent mosquito generation.

Glossary, Terms and Acronyms

The following are the terms and acronyms used frequently in this manual.

ADT— Average daily traffic

Base flow — Streamflow which results from precipitation that infiltrates into the soil and eventually moves through the soil to the stream channel. This is also referred to as groundwater flow, or dry-weather flow.

Biofilter— Any of a number of devices used to control pollution using living materials to filter or chemically process pollutants.

Bioretention— A technique that uses parking lot islands, planting strips, or swales to collect and filter urban stormwater, that includes grass and sand filters, loamy soils, mulch, shallow ponding and native trees and shrubs.

Best Management Practices (BMPs) —Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of "waters of the United States." BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw materials storage. BMPs include structural and nonstructural controls, and operation and maintenance procedures, which can be applied before, during, and/or after pollution producing activities.

Buffer— A zone created or sustained adjacent to a shoreline, wetland or stream where development is restricted or prohibited to minimize the negative effects of land development on animals and plants and their habitats.

CCRWQCB— Central Coast Regional Water Quality Control Board

Cluster Development — The principle of cluster development incorporates grouping new homes onto part of a development parcel so that the remaining land can be preserved as open space.

Commercial Development — Any development on private land that is not heavy industrial or residential. The category includes, but is not limited to hospitals, laboratories and other medical facilities, educational institutions, recreational facilities, plant nurseries, car wash facilities, mini-malls, business complexes, shopping malls, hotels, office buildings, public warehouses, and light industrial complexes.

Commercial/Industrial Facility — Any facility involved and/or used in the production, manufacture, storage, transportation, distribution, exchange or sale of goods and/or commodities, and any facility involved and/or used in providing professional and non-professional services. This category of facilities includes, but is not limited to, any facility defined by the SIC Code. Facility ownership (federal, state, municipal, private) and profit motive of the facility are not factors in this definition.

Connected Impervious Area — An impervious area is considered connected if runoff from it flows directly into the drainage system. It is also considered connected if runoff from it occurs as concentrated shallow flow that runs over a pervious area and then into a drainage system.

Construction — Clearing, grading, excavating, building and related activities that result in soil disturbance. Construction includes structure teardown. It does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of facility; emergency construction activities required to immediately protect public health and safety; interior remodeling with no outside exposure of construction material or construction waste to stormwater; mechanical permit work; or sign permit work.

Control — To minimize, reduce, eliminate, or prohibit by technological, legal, contractual or other means, the discharge of pollutants from an activity or activities.

Control Structure — A device used to hold back or direct a calculated amount of stormwater to or from a stormwater management facility. Typical control structures include vaults or manholes fitted with baffles, weirs, or orifices.

Conveyance — The transport of stormwater from one point to another.

Design Storm — Rainfall runoff data or where rainfall runoff data is not available, data based on a synthetic rainstorm, as defined by rainfall intensities and durations.

Detention — The collection of runoff in a ponding area, depression, or storage chamber followed by its gradual release through an outlet into a receiving water body. Detention is one way to reduce a site's peak runoff rate to its pre-development peak rate for the storm event of a given magnitude, but is not an effective way to reduce the runoff volume. The detention process allows sediment and associated pollutants to settle out of the runoff.

Development — Any construction, rehabilitation, redevelopment or reconstruction of any public or private residential project (whether single-family, multi-unit or planned unit development); industrial, commercial, retail and other non-residential projects, including public agency projects; or mass grading for future construction. It does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of facility, nor does it include emergency construction activities required to immediately protect public health and safety.

Development Standards — Standards that the County has developed for new development and significant redevelopment projects to control the discharge of stormwater pollutants in post-construction stormwater.

Directly Adjacent — Situated within 200 feet.

Directly Connected Impervious Area or Surface — The area of impervious surface which drains directly into the storm drain system without first allowing flow across a pervious area (e.g. lawn).

Discharging directly to — An outflow from a drainage conveyance system that is composed entirely of flow from the subject development or redevelopment site and not commingled with flows from adjacent land.

Disconnected impervious area or surface — An impervious area or surface that drains across a pervious area prior to discharge to a storm drain system.

Drawdown — The time required for a stormwater detention or infiltration BMP to drain and return to the dry weather condition. For detention BMPs, drawdown time is a function of basin volume and outlet orifice size. For infiltration BMPs, drawdown time is a function of basin volume and infiltration rate.

Drywell — A structural subsurface facility with perforated sides or bottom, used to infiltrate stormwater into the ground.

Effective Imperiousness Area— Impervious area not directly connected to a stream or drainage system during the specified design storm.

Environmentally Sensitive areas (ESA) — Areas that include but are not limited to all Clean Water Act Section 303(d) impaired water bodies; areas designated as special biological significance by the State Water Resource Control Board, water bodies designated with the habitat-related uses EST, WET, MAR, WILD, BIO, RARE, SPWN by the State Water Resource Control Board, areas designated as preserves within the County of San Luis Obispo.

Evapotranspiration — The combined loss of water from a given area, occurring during a specified period of time, by evaporation from the soil surface and transpiration from plants into the atmosphere.

Erosion — (1) The loosening and transportation of rock and soil debris by wind, rain, or running water. (2) The gradual wearing away of the upper layers of earth.

Feasible— Capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental and technological factors. Infeasibility must be supported by substantial evidence developed through good faith efforts to investigate alternatives that would result in less adverse impacts. A substantial modification to the configuration of a development, or reduction in density or intensity, would not be considered infeasible unless support by the above factors.

Flow-Based Treatment Control Measures — Stormwater quality treatment measures that rely on flow capacity to treat stormwater. These measures remove pollutants from a moving stream of water through filtration, infiltration, adsorption, and/or biological processes. Examples: vegetated swales and filter strips.

General Construction Activities Stormwater Permit (Construction General Permit) — The general NPDES permit adopted by the State Regional Water Quality Control Board, which authorizes the discharge of stormwater from construction activities under certain conditions.

General Industrial Activities Stormwater Permit (Industrial General Permit) — The general NPDES permit adopted by the State Board which authorizes the discharge of stormwater from certain industrial activities under certain conditions.

Habitat-Related Uses — Several habitat-related beneficial uses defined by the Regional Water Quality Control Board that include warm and cold freshwater habitats; estuarine, wetland and marine habitats; wildlife habitat; biological habitats (including Areas of Special Biological Significance); habitats that support rare, threatened, or endangered species; habitats that support migration of aquatic organisms; and habitats that support spawning, reproduction, and/or early development of fish.

Head (hydraulic head) — 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.

Heat Island Effect — The increase in ambient temperatures generated by heat radiating from paved surfaces exposed to sunlight.

Hillside — Lands that have a natural gradient of 10 percent or greater.

Hot Spots — A land use or activity that produces higher concentrations of trace metals, hydrocarbons or priority pollutants than normally found in urban runoff. Hot spots are typically associated with auto recyclers, vehicle service, maintenance and washing facilities, industrial facilities with outdoor storage or loading docs.

Hydrograph — Runoff flow rate plotted as a function of time.

Hydromodification — Hydromodification is the alteration of hydrologic characteristics (i.e. flow duration, magnitude, recharge rates and runoff volumes) within a watershed.

Hydraulic Residence Time — The average time required to completely renew a waterbody's water volume.

Hydrologic Soil Group — A group of soils having similar runoff potential under similar storm and cover conditions. Natural Resource Conservation Service (NRCS) HSG information for a given site can be used to identify the likelihood that native soils can be used for infiltration BMPs (http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx). There are four types of HSG's.

A. (Low runoff potential). The soils have a high infiltration rate even when thoroughly wetted. They chiefly consist of deep, well drained to excessively drained sands or gravels. They have a high rate of water transmission (1 to 8.3 inches per hour).

B. The soils have a moderate infiltration rate when thoroughly wetted. They chiefly are moderately deep to deep, moderately well drained to well drained soils that have moderately fine to moderately coarse textures. They have a moderate rate of water transmission (0.5 to 1 inch per hour).

C. The soils have a slow infiltration rate when thoroughly wetted. They chiefly have a layer that impedes downward movement of water or have moderately fine to fine texture. They have a slow rate of water transmission (0.17 to 0.27 inches per hour).

D. (High runoff potential). The soils have a very slow infiltration rate when thoroughly wetted. They chiefly consist of clay soils that have a high swelling potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. They have a very slow rate of water transmission (0.02 to 0.1 inches per hour).

Typically those designated as Type A and Type B are more readily available for use with infiltration BMPs

Illicit Connection — Any man-made conveyance that is connected to the storm drain system without a permit, excluding roof drains and other similar type connections. Examples include channels, pipelines, conduits, inlets, or outlets that are connected directly to the storm drain system.

Illicit Discharge — Any discharge to the storm drain system that is prohibited under local, state, or federal statutes, ordinances, codes, or regulations. The term illicit discharge includes all non storm-water discharges except discharges pursuant to an NPDES permit, discharges that are identified as "allowable" in NPDES Municipal Stormwater Permits, and discharges authorized by the Regional Board.

Impervious Surface — Any material that prevents or substantially reduces infiltration of water into the soil.

Impervious Surface Area — The ground area covered or sheltered by an impervious surface, measured in plan view, i.e., the impervious surface of a pitched roof is equal to the ground ware it shelters, rather than the surface area of the roof itself.

Infiltration — The downward entry of water into the surface of the soil. Infiltration rate (or infiltration capacity) is the maximum rate at which a soil in a given condition will absorb water.

Inspection — Entry and the conduct of an on-site review of a facility and its operations, at reasonable times, to determine compliance with specific municipal or other legal requirements.

Integrated Management Practices (IMPs) — A LID practice or combination of practices that are the most effective and practicable (including technological, economic, and institutional considerations) means of controlling the predevelopment site hydrology, point or non-point source pollutants at levels compatible with environmental quality goals. They are small-scale structural stormwater practices distributed through out a site or drainage area for the purpose of managing or influencing the site hydrology.

Low Impact Development (LID) — An approach to site design and stormwater management that seeks to maintain the site's pre-development rates and volumes of runoff. LID accomplishes this through the minimization of impervious cover, strategic placement of buildings, pavement and landscaping, and the use of small-scale distributed runoff management features that are collectively called "Integrated Management Practices" (IMPs). LID emphasizes conservation and use of existing natural site features.

Maximum Extent Practicable (MEP) — Section 402(p)(3)(B) of the Clean Water Act (CWA) directs the Regional Board to issue NPDES Municipal Stormwater Permits which require the dischargers to develop and implement programs with the goal of reducing the discharge of pollutants in stormwater runoff to the maximum extent practicable (MEP). The SWRCB through a State Board's Office of Chief Counsel (OCC) issued memorandum (dated 11 February 1993) defined MEP to include *technical feasibility, cost, and benefit derived with the burden being on the municipality to demonstrate compliance with MEP by showing that a BMP is not technically feasible in the locality or that BMP costs would exceed any benefit to be derived* (dated 11 February 1993).

Municipal Separate Storm Sewer System (MS4) — A conveyance or system of conveyances (including roads with drainage systems, municipal streets, alleys, catch basins, curbs, gutters, ditches, manmade channels, or storm drains) owned by a State, city, county, town or other public body, that is designed or used for collecting or conveying stormwater, which is not a combined sewer, and which is not part of a publicly owned treatment works, and which discharges to Waters of the United States.

National Pollutant Discharge Elimination System (NPDES) — The national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits under Clean Water Act §307, 402, 318, and 405.

Natural Drainage System — An unlined or unimproved (not engineered) creek, stream, river or similar waterway.

New Development — Land disturbing activities; structural development, including construction or installation of a building or structure, creation of impervious surfaces; and land subdivision.

Nonpoint Source Pollution— Pollution that enters water from dispersed and uncontrolled sources, such as rainfall, moving over and through the ground rather than a single, identifiable source.

Non-Stormwater Discharge — Any discharge to a storm drain that is not composed entirely of stormwater. Certain non-stormwater discharges are authorized per the NPDES Municipal Stormwater Permits.

Non-Structural Practices — Natural features or directed activities specifically utilized for the purpose of managing or influencing the site hydrology and/or improving water quality. Non-structural practices can include pollution prevention, preservation of open space and natural flow paths, street sweeping, etc.

Not Directly Connected Pavement — See Disconnected Pavement.

NPDES Municipal Stormwater Permit — A permit issued by a Regional Water Quality Control Board to local government agencies (Dischargers) placing provisions on allowable discharges of municipal stormwater to waters of the state.

Peak Runoff — The maximum stormwater runoff rate (cfs) determined for the design storm, or design rainfall intensity

Performance Standard — A narrative or measurable number specifying the minimum acceptable outcome for a pollution control practice.

Permeable — A type of material that allows passage of water.

Permitting Agency — The entity responsible for issuing grading, building and encroachment permits for new and redevelopment projects.

Pervious Pavement — See Porous Pavement.

Pollutants — Any introduced gas, liquid, or solid that makes a resource unfit for its normal or usual purpose and substances defined in CWA §502(6) (33.U.S.C.§1362(6)), and incorporated by reference into California Water Code §13373.

Pollutants of Concern — Biochemical oxygen demand (BOD), sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation), pathogens, oil and grease, and any pollutant that has been identified as a cause of impairment in any water body to which the MS4 discharges.

Point Source Pollution — A source of pollutants from a single point of conveyance, such as a pipe. Fore example, the discharge from a sewage treatment plant or a factory is a point source pollutant.

Porous Pavements (Pervious pavements) — Pavements for roadways, sidewalks, parking lots or plazas that are designed to infiltrate runoff, such as: pervious concrete, pervious asphalt, unit pavers- on-sand, and crushed gravel.

Post-Construction Stormwater Quality Plan — A plan specifying and documenting permanent site features and control measures that are designed to control pollutants for the life of the project. The plan should include sufficient design detail and calculations to demonstrate the adequacy of the stormwater quality control measures to control pollution from the developed site. This plan may be required prior to issuance of certain development permits; check with your local permitting agency.

Pre-Developed Condition — Native vegetation and soils that existed at a site prior to any development. The pre-developed condition may be assumed to be an area with the typical vegetation, soil, and stormwater runoff characteristics of open space areas typical of California's central coast unless reasonable historic information is provided that the area was atypical.

Priority Development Project — Any development project that falls within any of the following categories:

Single-family hillside residence

Commercial development where the land area for development is ≥ 100,000 sf

Automotive repair shop defined in any of the following standard industrial classification codes: 5013, 5014, 5541, 7532-7534, or 7536-7539.

Retail Gasoline Outlet

Restaurant where the land area for development or redevelopment ≥or 5,000 sf. (SIC Code 5812)

Detached residential development of 10 or more units

Attached residential development of 10 or more units

Parking lots ≥ 5,000 sf or with at least 25 parking spaces AND potentially exposed to stormwater runoff

Discharging to receiving waters within defined ***Environmentally Sensitive Areas.*** All development and redevelopment located within or directly adjacent to or discharging directly to an environmentally sensitive areas.

Rain Event or Storm Event — Any rain event greater than 0.1 inch in 24 hours except where specifically stated otherwise.

Rainy Season — For San Luis Obispo County, the calendar period beginning October 15 and ending April 15.

Rational Method — A method of calculating runoff flows based on rainfall intensity, and tributary area, and a factor representing the proportion of rainfall that runs off.

Receiving Waters — All surface water bodies identified in the Basin Plan (http://www.swrcb.ca.gov/rwqcb3/BasinPlan/Index.htm) prepared by the Central Coast Regional Water Quality Control Board.

Recharge— Infiltration of surface water to groundwater.

Redevelopment — Land-disturbing activity that results in the creation, addition, or replacement of 5,000 square feet or more of impervious surface area on an already developed site. Redevelopment includes, but is not limited to: the expansion of a building footprint; addition or replacement of a structure; replacement of impervious surface area that is not part of a routine maintenance activity; and land disturbing activities related to structural or impervious surfaces. Where redevelopment results in an increase of less that 50% of the impervious surface of a previously existing development, and the existing development was not subject to the Design Standards, the Design Standards apply only to the addition, and not to the entire development. It does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of facility, nor does it include emergency construction activities required to immediately protect public health and safety.

Regional Stormwater Quality Treatment Facility (Regional Facility) — A facility that treats runoff from more than one project or parcel. A regional facility may be in lieu of on-site treatment controls to treat urban runoff prior to discharge to Waters of the State, subject to the approval of the applicable permitting agency.

Regional Water Quality Control Board (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 Luis Obispo County is within the Central Coast Regional Water Quality Control Board (Region 3).

Restaurant — A 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).

Retail Gasoline Outlet — Any facility engaged in selling gasoline and lubricating oils.

Retention — The practice of holding stormwater in ponds or basins and allowing it to slowly infiltrate to groundwater. Some portion will evaporate. Also see infiltration. Retention reduces the volume of runoff from a site and can also be effective in reducing the peak runoff rate if the retention volume is sufficiently large.

Runoff — See Urban Runoff

Runoff Coefficient — A measure of the permeability that is used to estimate the portion of the rainfall that will run off the watershed.

SIC Code — Standard Industrial Classification Codes as defined by the U.S. Department of Labor (see http://www.osha.gov/pls/imis/sic_manual.html)

Setback— The required distance between a structure and a lot line.

Sheet flow — A flow condition during a storm where the depth of stormwater runoff is shallow and informally spread over the land surface.

Significant Redevelopment — Includes, but is not limited to: expansion of a building footprint; replacement of a structure; replacement of impervious surface that is not part of routine maintenance activity; and land-disturbing activities related to structural or impervious surfaces. For redevelopment projects subject to this manual, the applicable design standards apply only to the redeveloped area, and not to the entire site, except in cases where untreated drainage from the existing developed portion is allowed to enter/flow through the redeveloped portion. In such cases, any new required treatment control measures must be designed for the entire contributing drainage area. Redevelopment and infill project applicants should check with the local permitting agency at the start of project design to verify whether or not the manual requirements apply.

Significant Tree— Any tree which is more than 12-inches in diameter measured four and one-half feet above the root crown; or any (list specific tree and size).

Source Control Measure — Any schedules of activities, prohibitions of practices, maintenance procedures, managerial practices or operational practices that aim to prevent stormwater pollution by reducing the potential for contamination at the source of pollution.

Steep Slope — An area of land that has a slope angle of 10% or greater.

Stormwater — Stormwater runoff, snowmelt runoff, and surface runoff and drainage.

Stormwater Quality Plan — See Post-Construction Stormwater Quality Plan

Storm Runoff — Surplus surface water generated by rainfall that does not seep into the earth and flows overland to flowing or stagnant bodies of water.

Structural Control Measure — Any structural facility designed and constructed to mitigate the adverse impacts of stormwater and urban runoff pollution (e.g. canopy, structural enclosure). The category may include both source and treatment control measures.

Structural Practices — Any man made stormwater practice or feature that requires maintenance in order to function or provide the hydrologic benefit as designed. Structural practices include, but are not limited to, rain gardens, stormwater bioretention basins, stormwater infiltration facilities, stormwater retention and detention facilities, engineered vegetated filter strips, and any other features that are designed, constructed and maintained in order to managing or influencing the site hydrology and/or improve runoff water quality.

Target Pollutants — Pollutants identified by the County or RWQCB as most likely to impair local receiving waters, based on evaluation of available monitoring data and other information.

Time of Concentration (Tc) – The time for runoff to travel from the hydraulically most distant point of the development site to the watershed outlet or study point.

Treatment — The application of engineered systems that use physical, chemical, or biological processes to remove pollutants. Such processes include, but are not limited to, filtration, gravity settling, media absorption, biodegradation, biological uptake, chemical oxidation, and UV radiation.

Treatment train — A stormwater technique in which several treatment types (filtration, infiltration, retention, evaporation) are used in conjunction with one another and are integrated into a comprehensive runoff management system.

Treatment Control Measure — Any engineered system designed to remove pollutants by simple gravity settling of particulate pollutants, filtration, biological uptake, media absorption or any other physical, biological, or chemical process.

Urban Runoff — Any runoff from urbanized areas including stormwater and dry weather flows from a drainage area that reaches a receiving water body or subsurface. During dry weather, urban runoff may be comprised of groundwater base flow and/or nuisance flows, such as excess irrigation water.

Vector— Any insect or organism that is capable of harboring or transmitting a causative agent of human disease.

Volume-Based Treatment Control Measures — Stormwater quality treatment measures that rely on volume capacity to treat stormwater. These measures detain or retain runoff and treat it primarily through settling or infiltration. Examples: detention and infiltration basins, porous pavement and stormwater planters (bioretention).

Water Board(s) — Generic reference to the State Water Resources Control Board (SWRCB) and/or the nine Regional Water Quality Control Boards (RWQCBs).

Water Table— The upper surface of groundwater or the level below which the soil is saturate with water. The water table indicates the uppermost extent of groundwater.

Water Quality Volume (WQV) — For stormwater treatment BMPs that depend on detention to work, the volume of water that must be detained to achieve maximum extent practicable pollutant removal. This volume of water must be detained for a specified drawdown time.

STORMWATER PROJECT DESIGNATION CHECKLIST

Post-construction stormwater management is required for all projects. The required documentation and level of processing varies based on the project designation: “Priority”, “Standard” or “Exempt”. The checklist below is provided to assist you in determining the designation of your project.

ITEM	DEVELOPMENT AND REDEVELOPMENT CATEGORY	YES	NO
1.	Single-family hillside residence > 10%		
2.	Commercial development where the land area for development is ≥ 100,000 sf		
3.	Automotive repair shop		
4.	Retail Gasoline Outlet		
5.	Restaurant where the land area for development or redevelopment ≥or 5,000 sf		
6.	Detached residential development of 10 or more units		
7.	Attached residential development of 10 or more units		
8.	Parking lots ≥ 5,000 sf or with at least 25 parking spaces AND potentially exposed to storm water runoff		
9.	Discharging to 303(d) receiving waters, Sensitive Resource Area (SRA), Sensitive Riparian Vegetation (SRV) or Wetlands (WET) Overlays?		

If you answered **YES** to any of the above questions, then your project is considered a **PRIORITY PROJECT** and will be required to submit a Stormwater Quality Plan and Stormwater Quality Priority Project Application.

If you answered **NO** to all of the above, and your project disturbs greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, are required to develop and implement strategies that include a combination of structural and/or non-structural BMPs, then your project is considered a **STANDARD PROJECT**. Standard projects must submit a completed Stormwater Quality Standard Project Application.

If you project does not meet any of the above criteria, then your project is potentially considered an **EXEMPT PROJECT**. Please consult with the Planning and Building Department staff to verify if your project meets the criteria to be considered “Exempt.” Exempt projects are encouraged to implement practices that will reduce stormwater impacts associated with development. A list of potential practices appropriate for homeowners is included on the back of this sheet.

Specific information regarding these requirements is provided in the Counties LID Design Standard Manual.

Measures Homeowners Can Take to Reduce Stormwater Impacts

Everyone is strongly encouraged to reduce the stormwater impacts associated with development by taking these actions:

- ☐ Protect soils from compaction that will ultimately be used in planted areas
- ☐ Amend soils designated to be used as planted areas
- ☐ Sumped planted areas are preferred over mounded planting areas to better retain irrigation and rain water.
- ☐ Direct driveway runoff and runoff from roof downspouts at least 10-feet away from foundations and towards planting beds and lawns where water can safely soak into the ground (rain garden)
- ☐ Protect existing trees from construction impacts by placing safety fence around the root zone of the tree (minimally the shadow of the tree canopy at high noon) and/or plant new trees
- ☐ Use permeable pavers for walkways, driveway and patios instead of concrete
- ☐ Through minor grading, encourage water retention on site (but away from foundations)
- ☐ Install rain cisterns to capture and re-use roof rain water

Stormwater Quality Plan Application for Priority Projects

Applicant Information Check box for contact person assigned to this project

□	Landowner Name Mailing Address Email Address Phone
□	Applicant Name Mailing Address Email Address Phone
□	Agent Name Mailing Address Email Address Phone

Since the SWQP is a living document, revisions may be necessary during various stages of approval by the County. Please provide the approval information requested below.

Project Review Stage	Does the SWQP need revisions?		If YES, provide revision date
	Yes	No	

Attachments

Attachment		Completed	N/A
A	Project Location Map (scale 1” = 250’)		
B	Site Map (scale 1” = 40’) with easements and rights-of-way depicted.		
C	Stormwater Quality Plan		
D	Treatment BMP Location Map		
E	Operation and Maintenance Plan for Treatment BMPs		

Stormwater Quality Plan Checklist

The submittal requirements checklist is intended to aid the design engineer in preparing a stormwater quality plan.

Exhibits

- ☐ Existing natural hydrologic features (depressions, watercourses, relatively undisturbed areas) and significant natural resources with drain areas and sub-areas (if applicable) delineated and with arrows showing flow direction of stormwater. If applicable, show 100-year flood elevations.
- ☐ Soil types and depth to groundwater. If applicable, show monitoring well locations, soil boring locations.
- ☐ Existing and proposed site drainage network and connections to drainage offsite.
- ☐ Proposed design features and surface treatments used to minimize imperviousness.
- ☐ Entire site divided into separate drainage areas, with each area identified as self-retaining (zero discharge), self-treating, or draining to a treatment/flow control facility.
- ☐ For each drainage area, types of impervious surface area proposed (roof, plaza/sidewalk, and streets/parking) and area for each.
- ☐ Proposed locations and sizes of infiltration, treatment, or flow-control facilities. Include tributary area and basis for sizing (rational C, NRCS CN value, Tc, etc)
- ☐ Potential pollutant source areas, including loading docks, food service areas, refuse areas, outdoor processes and storage, vehicle cleaning, repair or maintenance, fuel dispensing, equipment washing, etc. listed in Table 3-7.

Report

- ☐ Table of Contents
- ☐ Project and applicant name, location (address and APN No.), and description (type of project)
- ☐ List of permits requested and other permits required (401, 404, Caltrans Encroachment, etc)
- ☐ List of waterbodies that will receive runoff from the site. (Step 1)
- ☐ Table of minimum requirements that apply to the project (Step 1)
- ☐ 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 2)
- ☐ Narrative description and/or tabulation of site design characteristics, building features, and pavement selections that reduce imperviousness of the site. (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. (Step 4).
- ☐ Applicable flowcharts for determining minimum requirements with decision path clearly marked. (Step 4, 5 and 6)
- ☐ Identification of any conflicts with codes or requirements or other anticipated obstacles to implementing the Stormwater Quality Plan. (Step 7)
- ☐ Tabulation of proposed pervious and impervious area, showing self-treating areas, self-retaining areas, and areas tributary to each infiltration, treatment, or flow-control facility. (Step 7)
- ☐ Preliminary designs, including calculations, for each infiltration, treatment, or flow-control facility. Elevations should show sufficient hydraulic head for each. (Step 8)
- ☐ General maintenance requirements for infiltration, treatment, and flow-control facilities. (Step 9)
- ☐ Means by which facility maintenance will be financed and implemented. (Step 9)
- ☐ Statement accepting responsibility for operation & maintenance of facilities (Step 9)
- ☐ Certification by a civil engineer, architect, and landscape architect

DRAFT

Checklist for Source Controls

Please complete the following checklist for Source Control BMPs. If the BMP is not applicable for this project, then check N/A only at the main category.

BMP			Yes	No	N/A
1.	**Provide Storm Drain System Marking**				
	a.	All storm drain inlets and catch basins within the project area shall have prohibitive language (such as: “NO DUMPING – DRAINS TO WATERBODY”) and graphical icons to discourage illegal dumping.			
2.	**Design Outdoors Material Storage Areas to Reduce Pollution Introduction**				
	a.	This is a detached single-family residential project. Therefore, personal storage areas are exempt from this requirement.			
	b.	Outdoor equipment and materials storages areas are either: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the stormwater conveyance system; or (2) protected by secondary containment structures such as berms, dikes, or curbs.			
	c.	Non hazardous storage areas are paved and sufficiently impervious to contain leaks and spills.			
	d.	The storage areas have a roof or awning to minimize direct precipitation within the secondary containment area.			
3.	**Design Trash Storage Areas to Reduce Pollution Introduction**				
	a.	Paved with an impervious surface, designed not to allow run-on from adjoining areas, screened or walled to prevent off-site transport of trash; or,			
	b.	Provide attached lids on all trash containers that exclude rain, or roof or awning to minimize direct precipitation.			
4.	**Use Efficient Irrigation Systems & Landscape Design**				
	a.	Irrigation system has a rain shutoff device to prevent irrigation after precipitation.			
	b.	Irrigation system is programmed for each landscape area’s specific water requirements.			
	c.	Irrigation system utilizes flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.			
	d.	Plant material selected shall be appropriate to site specific characteristics such as soil type, topography, climate, amount and timing of sunlight, prevailing winds, rainfall, air movement, patterns of land use, ecological consistency and plan iterations.			
	e.	Existing native trees, shrubs and ground cover retained and incorporated in the landscape plan.			
	f.	Proper maintenance and landscaping is the responsibility of the owner.			
5.	**Private Roads**				
	a.	Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings.			
	b.	Urban curb/swale system: street slopes to curb, periodic swale inlets drain to vegetated swale/biofilter.			
	c.	Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to stormwater conveyance system.			

Checklist for Source Controls, Page 2 of 3

6.	**Residential Driveways & Guest Parking**				
	a.	Design driveways with shared access, flared (single lane at street) or wheelstrips (paving only under tires); or, drain into landscaping prior to discharging to the stormwater conveyance system.			
	b.	Uncovered temporary or guest parking on private residential lots paved with a permeable surface; or, designed to drain into landscaping prior to discharging to the stormwater conveyance system.			
7.	**Dock Areas**				
	a.	Loading dock areas are covered and/or graded to minimize run-on and runoff from the loading area.			
	b.	Loading docks use for the loading and unloading of liquids in containers shall be provided with an inlet with a shutoff valve and have enough capacity to hold a spill while the valve is closed.			
		Direct connections to storm drains from depressed loading docks (truck wells) are prohibited.			
8.	**Maintenance Bays**				
	a.	Repair/maintenance bays shall be indoors; or, designed to preclude urban run-on and runoff.			
	b.	Design a repair/maintenance bay drainage system to capture all wash water, leaks and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited.			
9.	**Vehicle Wash Areas**				
	a.	Wastewater from vehicle washing operations is not discharged to a storm drain system (without a permit).			
	b.	Commercial/industrial facilities wash areas are self-contained; or covered with a roof or overhang, be equipped with a clarifier, grease trap or other pretreatment facility, as appropriate and properly connected to a sanitary sewer (with a permit)			
10.	**Outdoor Processing Areas**				
	a.	Cover or enclose areas that would be the most significant source of pollutants; or, slope the area toward a dead-end sump; or, discharge to the sanitary sewer system following appropriate treatment in accordance with conditions established by the applicable sewer agency.			
	b.	Grade or berm area to prevent run-on from surrounding areas.			
	c.	Installation of storm drains in areas of equipment repair is prohibited.			
11.	**Equipment Wash Areas**				
	a.	Be self-contained; or covered with a roof or overhang.			
	b.	Sink and cleanings area are equipped with a clarifier, grease trap or other pretreatment facility, prior to discharge to the sanitary sewer.			
	c.	Interior floor drains shall be properly connected to a sanitary sewer.			
	d.	Food service facilities, including restaurants and grocery stores, have a sink or other area for cleaning floor mats, containers, and equipment. The cleaning area is located on a paved surface and has secondary containment, and is large enough to clean the largest mat or piece of equipment that needs cleaning.			
12.	**Parking Areas**				
	a.	Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design.			
	b.	Overflow parking (parking stalls provided in excess of the minimum parking requirement) are constructed with permeable paving materials.			
	c.	Interior level parking garage floor drains shall be connected to a water treatment device approved by the County prior to discharging to the sanitary sewer system.			
	d.	Parking lots are swept regularly to prevent the accumulation of litter and debris.			

Checklist for Source Controls, Page 3 of 3

13.	**Fueling Area**				
	a.	Fuel dispensing areas have an overhanging roof structure or canopy that extends a minimum of ten feet in each direction from each pump. The cover's minimum dimensions are equal to or greater than the area within the grade break. The cover does not drain onto the fuel dispensing area and the downspouts are routed to prevent drainage across the fueling area. The fueling area drain to the project's treatment control BMP(s) prior to discharging to the stormwater conveyance system.			
	b.	Fuel dispensing areas are paved with Portland cement concrete (or equivalent smooth impervious surface) and graded at the minimum slope to prevent ponding. Fueling areas are separated from the rest of the site by a grade break that prevents run-on of stormwater.			
	c.	Have an appropriate slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of urban runoff.			
	d.	At a minimum, the concrete fuel dispensing area must extend 6.5 feet from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot, whichever is less.			
14.	**Pool / Spa / Fountain Discharge**				
	a.	Swimming pool, hot tub, spa and fountain discharge drains…			
15.	**Miscellaneous Drain/Wash water**				
	a.	Building roof drains discharge away from the building to an unpaved or vegetated area.			

Checklist for Site Design Controls

Table 3-5: Commonly Needed Site Information

Item	Site Design Options		Yes	No	N/A
1.	Can the project be relocated or realigned to avoid/reduce impacts to receiving waters or to increase the preservation of critical (or problematic) areas such as floodplains, steep slopes, wetlands, and areas with erosive or unstable soil conditions?				
2.	Can the project be designed to minimize impervious footprint?				
3.	Are natural areas conserved where feasible?				
4.	Where landscape is proposed, can rooftops, impervious sidewalks, walkways, trails and patios be drained into adjacent landscaping?				
5.	For roadway projects, can structures and bridges be designed or located to reduce work in live streams and minimized construction impacts?				
6.	Can any of the following methods be utilized to minimize erosion from slopes?				
	a.	Minimize slope disturbance?			
	b.	Shorten slope length or steepness with retaining walls?			
	c.	Provide benches or terraces on high cut and fill slopes to reduce concentration of flows?			
	d.	Can the slopes be rounded to reduce concentration of flows?			
	e.	Can concentrated flows be collected and conveyed in stabilized drains and channels?			
7.	Are stormwater facilities located outside of streams and wetlands?				

For projects that include work in channels, consider site design measures.

Table 3-6: Channel Site Design Impact Table

Item	Criteria	Yes	No	N/A	Comments
1.	Will the project increase velocity or volume of downstream flow?				If YES, go to 5.
2.	Will the project discharge to unlined channels?				If YES, go to 5.
3.	Will the project increase potential sediment load or downstream flow?				If YES, go to 5.
4.	Will the project encroach, cross, realign, or cause other hydraulic changes to a stream or affect upstream and/or downstream stability?				If YES, go to 7.
5.	Review channel lining materials and design for streambank erosion.				Continue to 6.
6.	Consider channel erosion control measures within the project limits as well as downstream. Consider scour velocity.				Continue to 7.
7.	Include, where appropriate, energy dissipation devices at culverts.				Continue to 8.
8.	Ensure all transitions between culvert outlets/headwalls/wingwalls and channels area smooth to reduce turbulence and scour.				Continue to 9.
9.	Include, if appropriate, detention facilities to reduce peak discharges.				
10.	“Hardening” natural downstream areas to prevent erosion is not an acceptable technique for protecting channel slopes, unless pre-development conditions are determined to be such				Continue to 11.

	that that hardening would be required even in the absence of the proposed development.				
11	Provide other design principles that are comparable and equally effective.				

DRAFT

Stormwater Quality Plan Application for Standard Projects

Applicant Information Check box for contact person assigned to this project

☐	Landowner Name Mailing Address Email Address Phone
☐	Applicant Name Mailing Address Email Address Phone
☐	Agent Name Mailing Address Email Address Phone

Since the SWQP is a living document, revisions may be necessary during various stages of approval by the County. Please provide the approval information requested below.

Project Review Stage	Does the SWQP need revisions?		If YES, provide revision date
	Yes	No	

Item A. Post-Construction Phase

☐	My project is **not** defined as a Priority Project (Refer to Step 1)

Indicate the post-construction BMPs that will be used:

- ☐ There will be permanent landscaping as part of this project. The property owner will maintain the landscaping.
- ☐ Outlet protection/ velocity dissipation devices will be placed at storm drain outfalls to reduce the velocity of the flow.

- ☐ Other

- ☐ Other

Attachments

Attachment		Completed	N/A
A	Project Location Map		
B	Site Map		

DRAFT

Appendix B - Treatment Control Feasibility Checklist

Treatment Control BMP	Considered for Use	Rejected Based On
Infiltration Trench (TC-10)		
Constructed Wetland (TC-21)		
Retention Basin (TC-11)		
Detention Basin (TC-22)		
Vegetated Swale (TC-30)		
Vegetated Filter Strip (TC-31)		
Bioretention (TC-32)		
Surface Sand Filter		
Media Filter (TC-40)		
Oil & Water Separator (TC-50)		
Catch Basin Insert		
Proprietary System		

Plant List & Guidelines for Landscape-Based Stormwater Measures

Introduction

Of the list of Best Management Practices published by the EPA, the following depend on plant material for their success:

- Infiltration Basin;
- Grassed Channel;
- Infiltration Trench;
- Vegetated Filter Strip;
- Dry Swale;
- Bioretention;
- Dry Detention Pond;
- Wet Swale;
- Wet Pond;
- Storm Water Wetland.

Therefore, the careful selection of plant species is a critical step in successful LID design and implementation. Plants facilitate natural infiltration of surface runoff, increase evapotranspiration, reduce the 'heat island' effect of urbanized areas, and reduce the rate, volume, and pollutant loading of urban runoff that ultimately ends up in local waterways or in local aquifers.

For the drainage features to function optimally, several plant characteristics need to be considered to determine their appropriateness for that particular BMP, and more specifically, the zone at which they are located within it. Most of these characteristics are included in the LID Plant List table, but basically for each plant selection, the following need to be looked at: water requirements; tolerance for inundation; root and leaf structure; and the ability to filter pollutants.

California native plants make up the entire LID Plant List, and this is the case for several reasons: they are perfectly adapted to local environmental conditions; they generally require less water and fertilization; and they limit the impact to native habitats. Native plants are also less susceptible to pests and diseases. There are a vast number of plants native to San Luis Obispo County that should provide designers with enough choices for virtually every scenario likely to be encountered. While the list does not include every suitable plant species for use within the County, it provides a good basis point for developing project specific plant palettes. Non-native species are inappropriate because they can become invasive, and water can quickly spread their occurrence and alter downstream habitats. Turf grass is also discouraged for LID drainage features due to its tendency to require large amounts of supplemental water, fertilizers, and regular maintenance.

The Planting Zones

Low Zone

The area at the bottom of the drainage feature where water temporarily ponds during either a rain event, or an upstream activity such as washing or irrigation. The low zone should not be designed to hold water, but should completely drain within 72 hours. However, during rainy seasons, this zone may be inundated for extended periods of time. Species planted in this zone should have the following characteristics:

- Water tolerant;
- Dense root structure and vegetative cover to discourage erosion, slow runoff velocities, and provide maximum pollutant filtration.
- Native grasses and groundcovers are excellent choices for this zone.

Mid Zone

The mid zone is the side slopes of the drainage feature, whose primary function is to slow down runoff velocity. While water passes through this area and saturates the soil, it does not stand for any period of time during typical storm events. Species planted in this zone should have the following characteristics:

- Tolerant of periodic inundation;
- Tolerant of periods without water;
- Dense root structure to provide erosion protection of side slopes.

High Zone

The top of the drainage feature will not see any standing water.
Species planted in this zone should have the following characteristics:

- Deep roots to provide structural stability to

the drainage feature;
- Tolerant of extended periods without water;
- Tolerant of occasional inundation.

Planting Design Criteria

There are numerous conditions to consider when choosing plant species for LID drainage features. Not surprisingly, many of the species on the LID Plant List have native habitats that mimic the various and (sometimes) disparate conditions that these features employ.

The purpose of the LID Plant List is to provide a cross section of suitable plant species as a base point for the development of project specific plant palettes. Designers and property owners are encouraged to propose other species that meet the spirit of these guidelines; the County will have the discretionary right to permit or deny their use. The following characteristics should be considered when proposing new plants:
- The planting zone(s) where the plant will be located (see Planting Zones Diagram);
- The size of the planting area and the size of the plant species at maturity;
- Native to California, preferably to San Luis Obispo County (non-native plants are inappropriate);
- Tolerant of San Luis Obispo County's climatic patterns (such as prolonged dry periods);
- Tolerant of seasonal flooding/inundation;
- Low maintenance requirements;
- Adaptability.

Plant species should aim to control erosion and wick water from soils. Some of the best choices for the low zone are groundcovers and grasses that quickly cover exposed soil. Low shrubs, grasses and groundcovers are suitable for the mid zone, depending on the area, gradient, soil type, and drainage patterns (sheet flow vs. concentrated flow, or flooding). Trees and larger shrubs are best planted in the high zone where their deeper roots can provide reinforcement to the drainage feature, and absorb the infiltration.

Energy dispersion devices may be required to be installed or constructed in certain situations to protect the integrity of the drainage feature, and the vegetation itself. These situations occur where features receive a concentrated flow, and may include such elements as gabions, weirs, or cobblestones. Where conditions absolutely demand, small areas of hardscape may be used.

Plant Layout

Some rules of thumb for planting layout of LID drainage features are:
- The smallest practical area of land should be exposed at any one time during development to minimize erosion. Erosion control measures should be integrated into planting designs, such as biodegradable erosion control mats. Plant mixes applied though a hydroseeding process should include erosion control specifications, which may be via a mulching process, or an integral part of the seed mix;
- Vegetation should be installed as soon as possible after soil is exposed;
- Plants should be laid out in staggered rows, and spaced so 100% coverage is attained at two-thirds of the species mature size.

Other Requirements

Soils Test

Prior to planting, but after grading operations are substantially complete, a soils test shall be undertaken by a qualified soil laboratory. The test results shall become a part of the design review submittal. Surface soils in San Luis Obispo County vary from almost pure sand at the coast, to heavy clay for much of the inland areas. Since the soils percolation rate, ability to allow the infiltration of water, and the depth to groundwater, is critical to the design of LID drainage features, this test will help to determine which BMP(s) are appropriate for that site. The soil report should contain, at a minimum:
- Native soil composition;
- Infiltration rates;
- Texture test;
- Depth at which groundwater was encountered (if at all);
- Cation exchange capacity;
- Agricultural suitability analysis;
- Recommended amendments for plant species to survive;
- Date of test.

Prior to planting, and on the advice of the soils report, the soil shall be amended to provide premium growing conditions for the plants specified.

Mulch

Immediately after planting, all exposed soil shall be covered with mulch to minimize erosion, and aid soil moisture retention. Mulch material may be either mineral (e.g. cobble or uncompacted decomposed granite) or biodegradable (e.g. bark or wood-chips). Biodegradable erosion control mats may also be used either on their own, or in conjunction with another mulch material. Mulch materials must not inhibit infiltration, and must be stable enough to withstand occasional high velocity runoff. Bark chips that have a tendency to float are not recommended. Acceptable mulching materials are:

- Nitrogen fortified bark (1” to 2” diameter);
- Redwood bark (1” to 2” diameter);
- Chipped gravel, crushed stone, or cobbles (1/2” to 2-1/2” diameter);
- 50/50 blend of top soil and aged compost.

Shredded bark (sometimes called ‘Gorilla Hair’) is not acceptable due to its tendency to form a tightly woven mat that can become almost impervious, and can also encourage mould growth.

Maintenance

Good design and planning can minimize the amount of maintenance required for a drainage feature. Weeds can be suppressed by a good coverage of vegetation, native plants require little, if any fertilizing, and the avoidance of over-planting will reduce the amount of pruning needed. The most critical time for the vegetation is in the period immediately following construction, when plant species are not fully established; weed control, and supplemental irrigation may be required to ensure a healthy, vigorous vegetative cover.

It is worth noting the County policy of not using any herbicides or pesticides on any of their rights-of-way. Native plants are less susceptible to pests and diseases, and are therefore often more durable choices.

Given the nature of the LID drainage features, they will likely capture trash and debris (particularly after a significant rain event) and will need to be periodically cleaned out. Depending on the adjacent land uses, there may also be a build-up of silt that should be removed as necessary to allow optimum functionality of the feature. In the event that cleaning and maintenance operations damage the vegetation, it should be replaced as soon as possible.

Nursery Sources

Enviromental Seed Producers, Inc.
P.O. Box 2709
Lompoc, CA 93438
(805) 735-8888
www.espseeds.com

Las Pilitas Nursery
3232 Las Pilitas Road
Santa Margarita, CA 93453
(805) 438-5992
www.laspilitas.com

Native Sons, Inc.
379 West El Campo Road
Arroyo Grande, CA 93420
(805) 481-5996
www.nativeson.com

S&S Seeds
P.O. Box 1275
Carpinteria, CA 93014
(805) 684-0436
www.ssseeds.com

San Marcos Growers
125 South San Marcos Road
Santa Barbara, CA 93111
(805) 683-1561
www.smgrowers.com

slo starts
1858 Los Osos Valley Road
Los Osos, CA 93402
(805) 528-7533

References

Brenzel Norris, Kathleen. Sunset Western Garden Book. Menlo Park: Sunset Publishing Corporation, 2001.

Joni L. Janecki & Associates, Inc. City of Salinas Development Standards Plan - LID Development Practices for Urban Storm Drainage Management, 2007.

Bornstein, Fross & O'Brien. California Native Plants for the Garden. Cachuma Press, Los Olivos, California, 2005

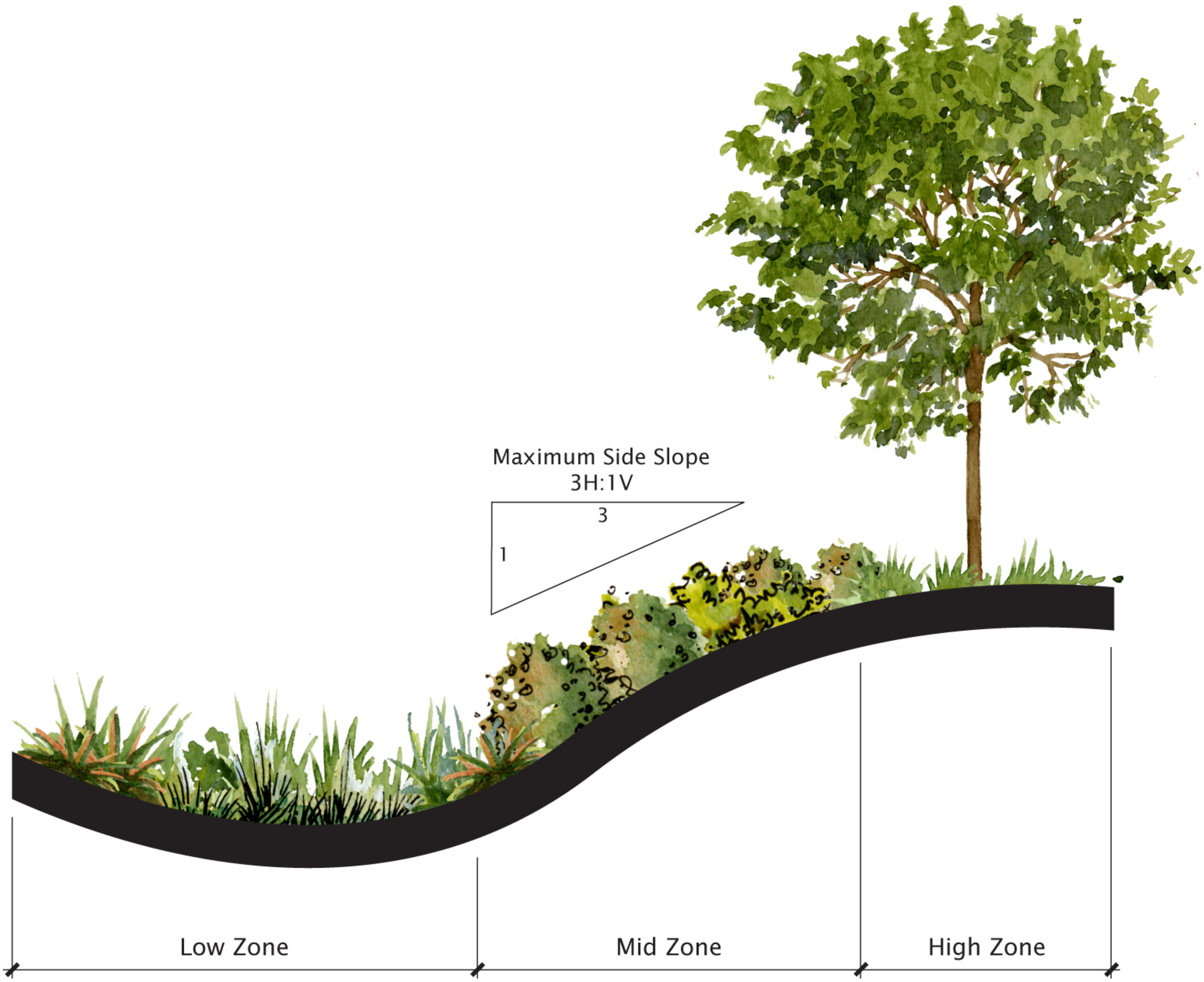
Greenlee, John. The Encyclopedia of Ornamental Grasses. Rodale Press, Pennsylvania, 1992

Las Pilitas Nursery. Online native plants information resource. Available at www.laspilitas.com.

Native Sons Nursery. Online native plants information resource. Available at www.nativeson.com.

USDA Natural Resources Conservation Service Plants Database. Online plant information resource. Available at http://plants.usda.gov/

US Environment Protection Agency. Online storm water BMP resource. Available at www.epa.gov.



Planting Zones Diagram

This diagram illustrates the three basic planting zones for landscape-based strormwater measures. Used in conjunction with the LID Plant List, it shows the general zones that are recommended for each species. Site specific conditions should also be considered, such as solar orientation and micro-climate.

Appendix C - Plant List for Landscape-Based Stormwater Measures

Botanical Name	Common Name	Planting Zone[1]			LID Design Considerations[2]									Notes
		Low Zone	Mid Zone	High Zone	Small Planting Strips (< 5' Wide)	Large Planting Areas (> 5' Wide)	Tolerates Prolonged Saturation	Tolerates Periodic Flooding	Tolerates Prolonged Dry Periods	Requires Good Drainage	Tolerates Mowing	Phytoremediation Capabilities	Tolerates Clay Soils	
GRASSES, GROUNDCOVERS, FERNS & BULBS														
Achillea millefolium	Yarrow		✓	✓	✓	✓				✓	✓		✓	Good erosion control
Aquilegia formosa	Western Columbine	✓			✓	✓	✓	✓	✓					
Arctostaphylos spp.	Manzanita		✓	✓	✓	✓			✓	✓				
Bothriochloa barbinodis	Cane Bluestem		✓	✓	✓	✓		✓	✓	✓				Good erosion control
Bromus carinatus	California Brome		✓	✓	✓				✓					
Calamagrostis nutkaensis	Pacific Reedgrass		✓		✓	✓		✓	✓					
Calochortus albus	White Fairy Lantern		✓		✓	✓		✓	✓					
Carex pansa	California Meadow Sedge	✓	✓		✓	✓		✓		✓				Good erosion control
Carex praegracilis	Dune Sedge	✓	✓		✓	✓		✓	✓	✓	✓			Good erosion control
Carex tumulicola	Foothill Sedge	✓	✓	✓	✓	✓	✓	✓	✓		✓			Good erosion control
Castilleja miniata	Indian Paintbrush		✓	✓	✓	✓			✓	✓				
Deschampsia caespitosa	Tufted Hair Grass		✓		✓	✓		✓	✓	✓				Needs irrigation
Deschampsia holciformis	Pacific Hairgrass	✓	✓		✓	✓	✓	✓						
Dudleya pulverulenta	Chalk Dudleya		✓	✓	✓	✓			✓	✓				Not in North County/California Valley
Eleocharis macrostachya	Common Spike Rush	✓	✓		✓	✓	✓	✓						
Eschscholzia californica	California Poppy		✓	✓	✓	✓			✓	✓				
Festuca californica	California Fescue		✓	✓	✓	✓		✓	✓					Good erosion control
Festuca idahoensis	Western Fescue	✓	✓	✓	✓	✓		✓	✓					Good erosion control
Fragaria chiloensis	Beach Strawberry		✓		✓			✓	✓	✓				
Heuchera micrantha	Crevice Alum Root		✓	✓	✓	✓		✓	✓	✓				
Hordeum californicum	California Barley		✓	✓	✓	✓		✓	✓	✓			✓	
Hordeum intercedens	Bobtail Barley		✓	✓	✓	✓		✓	✓	✓			✓	
Iris douglasiana	Douglas Iris		✓	✓	✓	✓		✓		✓				Good erosion control
Juncus acutus	Spiny Rush	✓	✓		✓	✓	✓	✓	✓					Good erosion control
Juncus bufonius	Toad Rush	✓	✓		✓	✓	✓	✓	✓					Good erosion control
Juncus effusus	Soft Rush	✓	✓		✓	✓	✓	✓	✓					Good erosion control
Juncus mexicanus	Mexican Rush	✓	✓		✓	✓	✓	✓	✓					Good erosion control
Juncus patens	Wire Grass	✓	✓		✓	✓	✓	✓	✓					Good erosion control
Lasthenia californica	California Goldfields	✓	✓		✓	✓	✓	✓	✓				✓	
Lasthenia glabrata	Yellowray Goldfields	✓	✓		✓	✓	✓	✓	✓				✓	
Layia platyglossa	Tidy Tips		✓	✓	✓	✓			✓					
Leymus condensatus 'Canyon Prince'	Canyon Prince Wild Rye		✓	✓					✓					
Leymus triticoides	Creeping Wild Rye	✓	✓		✓	✓		✓	✓		✓		✓	Fast spreading
Lilium pardalinum	Leopard Lily		✓			✓		✓	✓	✓				
Linanthus parviflorus	Stardust		✓	✓	✓	✓			✓	✓				Annual
Lupinus microcarpus var. densiflorus	Whorled Lupine		✓	✓	✓	✓			✓	✓				Annual
Melica imperfecta	Coast Melic Grass		✓	✓	✓			✓						Not directly on coast
Muhlenbergia rigens	Deer Grass		✓	✓	✓	✓		✓	✓				✓	Good erosion control; Fast growing
Nassella pulchra	Purple Needlegrass		✓	✓		✓			✓		✓			State grass of California
Polystichum munitum	Sword Fern		✓		✓	✓		✓						
Salvia spp.	Sage		✓	✓	✓	✓		✓	✓					Not directly on coast; Fast growing
Satureja douglasii	Yerba Buena	✓	✓		✓			✓					✓	
Scirpus californicus	California Bulrush	✓				✓	✓	✓						
Scirpus maritimus	Saltmarsh Bulrush	✓				✓	✓	✓						
Sisyrinchium bellum	Blue-Eyed Grass		✓	✓	✓	✓			✓		✓			
Symphoricarpus mollis	Creeping Snowberry		✓	✓		✓			✓					Good erosion control
Triteleia laxa	Ithuriel's Spear		✓	✓	✓	✓		✓	✓					
VINES														
Clematis lasiantha	Chaparral Clematis		✓	✓		✓			✓	✓				
Vitis californica	California Wild Grape	✓	✓	✓	✓	✓		✓	✓	✓				
SHRUBS														
Arctostaphylos spp.	Manzanita		✓	✓	✓	✓			✓	✓				Good erosion control
Baccharis pilularis	Coyote Brush			✓	✓	✓		✓	✓					Good erosion control; Fast growing
Baccharis salicifolia	Mulefat		✓	✓		✓	✓	✓	✓					
Berberis aquifolium	Oregon Grape			✓	✓	✓			✓					
Ceanothus spp.	Wild Lilac			✓		✓				✓				Good erosion control; Fast growing
Cornus sericea	Creek Dogwood	✓	✓	✓	✓	✓	✓	✓					✓	Good erosion control; Allergenic
Fremontodendron californica	Flannel Bush			✓		✓				✓				Fast growing
Garrya elliptica	Coast Silk-Tassel			✓	✓	✓			✓	✓			✓	
Heteromeles arbutifolia	Toyon			✓		✓			✓	✓				Good erosion control
Lupinus albifrons	Silver Bush Lupine		✓	✓		✓			✓	✓				Fast growing
Myrica californica	Pacific Wax Myrtle		✓	✓		✓		✓						Fast growing
Rhamnus californica	Coffeeberry		✓	✓		✓			✓	✓				Good erosion control
Ribes sanguineum	Pink-Flowering Currant		✓	✓	✓	✓	✓	✓	✓				✓	Good erosion control
Ribes speciosum	Fuchsia-Flowering Gooseberry		✓		✓		✓	✓					✓	Good erosion control
Ribes viburnifolium	Catalina Perfume		✓	✓	✓	✓	✓	✓	✓				✓	Good erosion control
Rosa californica	California Wild Rose		✓	✓		✓	✓	✓	✓					Good erosion control; Potentially invasive
Rubus ursinus	California Blackberry		✓			✓		✓	✓				✓	
Sambucus mexicana	Elderberry		✓	✓	✓	✓	✓	✓	✓				✓	Good erosion control; Fast growing
TREES														
Acer macrophyllum	Big-Leaf Maple		✓	✓		✓	✓	✓						Fast growing
Aesculus californica	Buckeye			✓		✓	✓	✓	✓				✓	Good erosion control
Alnus rhombifolia	White Alder		✓	✓		✓	✓	✓						Fast growing
Cercis occidentalis	Western Redbud		✓	✓	✓	✓		✓	✓	✓				Good erosion control
Platanus racemosa	California Sycamore		✓	✓		✓		✓						Fast growing
Populus fremontii	Western Cottonwood		✓	✓		✓	✓					✓		Good erosion control; Fast growing
Prunus ilicifolia ssp. Lyonii	Catalina Cherry			✓	✓	✓	✓	✓	✓				✓	
Salix laevigata	Red Willow	✓	✓	✓	✓	✓	✓	✓				✓		
Salix lasiolepis	Arroyo Willow	✓	✓	✓	✓	✓	✓	✓				✓		
Umbellularia californica	California Bay Laurel			✓		✓	✓	✓						

Footnotes:

[1] See 'Planting Zone Section' for illustration of zones as they relate to stormwater BMP's.

[2] Lid design considerations are specific factors that relate to landscape-based stormwater measures. Designers should also consider usual environmental factors such as sun/shade requirements, coastal exposure, wind tolerance, etc., when developing site specific plant lists.

[3] All plant species are considered native to California to limit impact to native habitats, and take advantage of their natural suitability to San Luis Obispo County's climate. All are considered appropriate for use throughout the entire county unless noted otherwise.