CITY OF MILPITAS

Stormwater C.3. Guidebook

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C.3. Guidebook Committee

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Table of Contents

GLOSSARY

HOW TO USE THIS GUIDEBOOK 1

CHAPTER 1. OVERVIEW 3

State and Federal Regulatory Perspective 3

Local Development Review Perspective 5
- ► Thresholds 5
- ► Development Review Process 6

Planning and Design Perspective 9

Environmental Benefit Perspective 10

CHAPTER 2. STORMWATER CONCEPTS 13

Maximum Extent Practicable 14

Best Management Practices 15

Imperviousness 16

Design Storm 17

CHAPTER 3. PREPARING YOUR STORMWATER CONTROL PLAN 19
- ► Objectives. 19
- ► Contents. 19

Step by Step 21

Step 1: Assemble Needed Information 21

Step 2: Identify Constraints & Opportunities 23

Step 3: Design to Minimize Imperviousness 23
- ► Cluster Development 23
- ► Optimize the Site Layout 24

► Minimize Directly Connected Impervious Area 24
► Detain and Retain Runoff Throughout the Site 24
► Document your Design 25

Step 4: Locate and Select Treatment BMPs 25

Step 5: Perform Preliminary Design of BMPs 27

Step 6. Specify Source Control BMPs 28
► Identify Pollutant Sources 28
► Identify Permanent Source Control Measures 28
► Identify Operational Source Control BMPs 28

Step 7: Integrate With Other Preliminary Drawings. 29

Step 8: Permitting & Code Compliance Issues. 30

Step 9: Identify BMP Maintenance Needs 31
► Maintenance Needs and Your Stormwater Control Plan 31

Step 10: Stormwater Control Plan & Report 32
► Sample Outline and Contents 32
► Example Stormwater Control Plan 33
► Certification 33

CHAPTER 4. STORMWATER CONTROL & CEQA 35

CEQA and Water Quality Regulations 36

Thresholds of Significance 36

Incorporating Mitigation Measures 37

Stormwater Impacts and the CEQA Process 38

CHAPTER 5. TECHNICAL REQUIREMENTS 39

Stormwater Control Technical Criteria 40
► Limits on the use of infiltration 41
► Numeric Criteria 41
► Volume-based Numeric criteria 41
► Flow-based criteria 43

Documenting Your Design 44
► Selecting and documenting self-retaining areas and BMPs 45
► Sizing Structural BMPs 48
► Using groundwater infiltration 49

Design Help 49

BMP Gallery 50

CHAPTER 6. BMP MAINTENANCE 57

Typical BMP Maintenance Requirements 57
- Vegetated Filters, Swales, and Bioretention Areas 58
- Planter Boxes 58
- Sand Filters 59
- Wet, Extended Wet Detention, and Dry Detention Ponds 60

CHAPTER 7. ALTERNATIVE COMPLIANCE OPTIONS 63

BIBLIOGRAPHY

APPENDIX A: SOILS MAP

APPENDIX B: GROUNDWATER ELEVATION MAP

APPENDIX C: SOURCES AND SOURCE CONTROL BMPs

APPENDIX D: EXAMPLE STORMWATER CONTROL PLANS

APPENDIX E: DETENTION, RETENTION, AND BMP SIZING WORKSHEET

APPENDIX F: CALIFORNIA BMP HANDBOOK SIZING NOMOGRAPHS

APPENDIX G: BUILDING DEPARTMENT REQUIREMENTS FOR TREATMENT BMPs

APPENDIX H: STORMWATER CONTROL OPERATION AND MAINTENANCE PROGRAM

APPENDIX I: EXAMPLE STORMWATER CONTROL OPERATION & MAINTENANCE PLANS

APPENDIX J: PLANT LIST

APPENDIX K: BROCHURES AND FACT SHEETS

APPENDIX L: RECOMMENDED STANDARD SPECIAL CONDITIONS

Tables

TABLE 1-1 A SWPPP AND A STORMWATER CONTROL PLAN ARE TWO SEPARATE DOCUMENTS 7

TABLE 2-1 BMPs CLASSIFIED THREE WAYS 15

TABLE 3-1 FORMAT FOR TABLE OF PERMANENT SOURCE CONTROL MEASURES 28

TABLE 5-1 FORMAT FOR SPREADSHEET TABLE 1 (PERVIOUS AREAS) 44

TABLE 5-2 FORMAT FOR SPREADSHEET TABLE 2 (IMPERVIOUS AREAS) 45

BMP Gallery

LANDSCAPE SWALE 49

VEGETATED FILTER 50

STORMWATER PLANTER 51

SAND FILTER 52

LANDSCAPE INFILTRATION/BIORETENTION 53

BIORETENTION 54

Checklists

STORMWATER CONTROL PLAN CHECKLIST 20

Glossary

Best Management Practice (BMP) Any procedure or device designed to minimize the quantity of pollutants that enter the storm drain system. See Chapter Two for a discussion of the various types of BMPs.

C.3 Provisions, added in November 2001, of the Regional Water Quality Control Board's (see) stormwater NPDES permit (see). Requires Milpitas to change its development review process to control the flow of stormwater and stormwater pollutants from new development sites. RWQCB Order 01-119.

California BMP Method A method for determining the volume of treatment BMPs. Described in Appendix D of the California Stormwater Best Management Practice Manual (Municipal) (SWQTF, 1993).

Compensatory Mitigation Treatment of an equivalent pollutant loading or quantity of stormwater runoff or other equivalent water quality benefit, created where no other requirement for treatment exists, in lieu of on-site treatment BMPs.

Conditions of Approval (COAs) Requirements the City may adopt for a project in connection with a discretionary action (e.g., adoption of an EIR or negative declaration or issuance of a use permit). COAs may include features to be incorporated into the final plans for the project and may also specify uses, activities, and operational measures that must be observed over the life of the project.

Design Storm A synthetic rainstorm defined by rainfall intensities and durations. See Chapter Two.

Detention The practice of holding stormwater runoff in ponds, vaults, within berms, or in depressed areas and letting it discharge slowly to the storm drain system. See **infiltration** and **retention**.

Drawdown time 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.

Exemption Exemption from the requirement to provide **compensatory mitigation** may be allowed for projects that meet certain criteria set by the RWQCB. These projects must, however, show **impracticability** of on-site treatment BMPs and also show that the costs of compensatory mitigation would place an "undue burden" on the project.

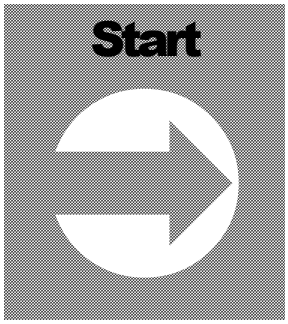
Head In hydraulics, energy represented as a difference in elevation. In slow-flowing open systems, the difference in water surface elevation, e.g., between an inlet and outlet.

Hydromodification Management Plan (HMP)	Required by the C.3 provisions to the stormwater NPDES permit, the HMP must be submitted by January 15, 2004. The HMP, once approved by the RWQCB, will be implemented so that post-project runoff shall not exceed estimated pre-project rates and/or durations, where the exceedance would result in increased potential for erosion or other adverse impacts to beneficial uses.
Impracticable	As applied to on-site treatment BMPs, technically **infeasible** or excessively costly, as demonstrated by set criteria.
Infeasible	As applied to on-site treatment BMPs, impossible to implement because of technical constraints specific to the site.
Infiltration	Seepage of runoff through the soil to mix with groundwater. See **retention.**
Intensity-duration-frequency (IDF)	An adjunct to the rational method (see), IDF allows calculation of the governing rainfall intensity based on the estimated time required for runoff flows from the farthest point of a drainage area to reach the point where peak flows are to be determined.
Low Impact Development	Low Impact Development is an integrated site design methodology that uses small-scale detention and retention to replicate pre-existing site hydrological conditions.
Maximum Extent Practicable (MEP)	Standard, established by the 1987 amendments to the Clean Water Act, for the implementation of municipal stormwater pollution prevention programs. See Chapter Two.
National Pollutant Discharge Elimination System (NPDES)	As part of the 1972 Clean Water Act, Congress established the NPDES permitting system to regulate the discharge of pollutants from municipal sewers and industries. The NPDES was expanded in 1987 to incorporate permits for stormwater discharges as well.
Nomograph	A chart that aids engineering calculations by representing the relationship among three variables. Nomographs in the California BMP Handbooks represent the relationship among percent annual capture, watershed imperviousness, and unit water quality volume.
Numeric Criteria	Sizing requirements for stormwater treatment BMPs established in Provision C.3.d. of the RWQCB's stormwater NPDES permit.
Permeable Pavements	Pavements for roadways, sidewalks, or plazas that are designed to infiltrate runoff, including pervious concrete, pervious asphalt, unit-pavers-on-sand, and crushed gravel.
Percentile Rainfall Intensity	A method of determining design rainfall intensity based on a ranking of storms, over a long period, by rainfall intensity and selection of a percentile.

Planned Unit Development (PUD)	Allows land to be developed in a manner that does not conform to existing zoning requirements. Allows greater flexibility and innovation because the PUD is regulated as one unit instead of each lot being regulated separately.
Rational Method	A method of calculating runoff flows based on the ratio of pervious and impervious areas, rainfall intensity, and tributary area.
Regional (or Watershed) Stormwater Treatment Facility	A facility that treats runoff from more than one project or parcel. Participation in a regional facility may be in lieu of on-site treatment controls, subject to the requirements of NPDES permit provision C.3.g.
Regional Water Quality Control Board (RWQCB)	One of nine California RWQCBs, the RWQCB for the San Francisco Bay Region is responsible for implementing pollution control provisions of the Clean Water Act and California Water Code within the area that drains to San Francisco Bay.
Retention	The practice of holding stormwater in ponds or basins and allowing it to slowly infiltrate to groundwater. See **infiltration** and **detention**.
Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)	SCVURPPP is established by a memorandum of understanding among 13 Santa Clara Valley cities and towns, Santa Clara County, and the Santa Clara Valley Water District, who are listed as Co-permittees in an NPDES stormwater discharge permit issued by the Regional Water Quality Control Board. SCVURPPP implements common tasks and assists the member agencies to implement their local stormwater pollution prevention programs.
Stormwater Control Plan	A plan specifying and documenting permanent site features and BMPs that are designed to control pollutants for the life of the project.
Stormwater Control Operation & Maintenance Plan	A plan detailing operation and maintenance requirements for stormwater treatment BMPs incorporated into a project. An acceptable Stormwater Control Operation and Maintenance Plan must be submitted before the building permit is made final and a Certificate of Occupancy is issued.
Stormwater NPDES Permit	The permit issued to 13 Santa Clara Basin cities and towns, Santa Clara County, and the Santa Clara Valley Water District by the Regional Water Quality Control Board for the San Francisco Bay Region. Order 01-024. Order 01-119 amended Provision C.3 of the permit.
Storm Water Pollution Prevention Plan (SWPPP)	A plan providing for temporary measures to control sediment and other pollutants during construction.
Urban Runoff Pollution Prevention Program	Also Stormwater Pollution Prevention Program. A comprehensive program of activities designed to minimize the quantity of pollutants entering storm drains. See Chapter One.

WEF Method A method for determining the required volume of treatment BMPs, recommended by the Water Environment Federation and American Society of Civil Engineers. Described in *Urban Runoff Quality Management* (WEF/ASCE, 1993).

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



How to Use this Guidebook

Read the Overview to get a general understanding of the requirements. Then follow the step-by-step instructions to prepare your Stormwater Control Plan.

THIS *Guidebook* will help you insure that your project complies with the Regional Water Quality Control Board's C.3. requirements. Because the requirements are complex, and because every project is different, you may want to begin by scheduling a **pre-application meeting** with City staff. At this meeting, you can ask how the C.3. requirements, and other planning and zoning requirements, apply to your project.

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

To use the *Guidebook,* Start by reviewing **Chapter One**, which provides a brief overview and explanation of the new requirements to control runoff from new development projects. The overview covers regulations, the plan review process, design issues, and the environmental benefits the regulations are intended to achieve.

If there are terms and issues you find puzzling, try finding answers in the glossary or in **Chapter Two**. Chapter Two consists of some one-page summaries of key concepts like "maximum extent practicable," infiltration and groundwater protection, and design storm.

Then proceed to **Chapter Three** and follow the step-by-step guidance to prepare a Stormwater Control Plan for your site.

If your project requires CEQA review, **Chapter Four** will tell you how to integrate analysis of stormwater impacts and mitigations into your documentation.

Design requirements are provided in **Chapter Five**, along with references that will aid you in designing the features you've identified in your Stormwater Control Plan. Chapter Five also includes designs, and a simplified design procedure, for stormwater treatment BMPs.

Chapter Six summarizes some of the anticipated maintenance requirements for treatment BMPs.

Chapter Seven outlines the City's plans to create options for alternative (off-site) compliance with the Regional Water Quality Control Board's C.3 requirements.

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

If you are reading this *Guidebook* online – on the City of Milpitas website or using a compact disc available from the City – you can use hyperlinks to access various references. The hyperlinks are throughout the document, as well as in "References and Resources" sections (marked by the 🕮 icon) and in the **bibliography**. Some references are on the CD and City of Milpitas website; others are located at the websites of other organizations. Some of these latter links (URLs) may be outdated. In this case, you might try entering portions of the title or other relevant keywords into an internet search engine.

Chapter 1

Overview

For a broad-based understanding, look at the Stormwater C.3. requirements from four different perspectives: as water-quality regulations, as planning requirements, as a design challenge, and as a way to obtain environmental benefits for the community.

State and Federal Regulatory Perspective

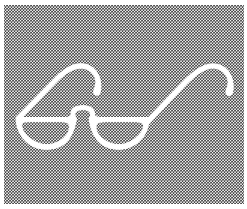
The California Regional Water Quality Control Board for the San Francisco Bay Region (RWQCB) has mandated that the City of Milpitas impose new, more stringent requirements to control runoff from development projects.

The RWQCB amended **Provision C.3.** of the City's stormwater discharge permit in October 2001. The City is phasing in the requirements in from 2002 through 2005.

The RWQCB has determined that the new Provision C.3. requirements are needed to implement Federal Clean Water Act provisions governing discharges from municipal storm drains.

Clean Water Act
Regulations on stormwater discharges have grown progressively more stringent since the Clean Water Act was amended in 1987.

Congress adopted amendments to the Clean Water Act in 1987, and the United States Environmental Protection Agency (USEPA) issued implementing regulations in 1990. That same year, the RWQCB first issued an initial stormwater discharge permit to Milpitas, 12 other South Bay cities and towns, the County of Santa Clara, and the Santa Clara Valley Water District.



Since the early 1990s, Milpitas has required contractors to implement **temporary Best Management Practices (BMPs)** to minimize the amount of sediment and other pollutants that enter site runoff during construction. For several years, Milpitas has also encouraged applicants to design their projects to minimize new impervious area and to incorporate into their plans **permanent treatment BMPs** – features and devices that detain, retain, or treat runoff for the life of the project.

"Maximum Extent Practicable"
For more on this and other stormwater terms, see the Glossary and discussions in Chapter Two.

As before, the standard for these BMPs is **"maximum extent practicable,"** or MEP. However, the new permit requirements define MEP more specifically and include design criteria.

The new development provisions are one part of the City's **comprehensive urban runoff pollution prevention program**. That program also requires:

- Controls on runoff from existing commercial and industrial sites.
- Temporary measures to control sediment and other pollutants in runoff from construction sites.
- Changes in the way the City maintains streets, parks and public infrastructure.
- Prevention of illegal dumping in storm drains.
- Public outreach and education.

Under the RWQCB stormwater discharge permit, South Bay cities and other agencies implement some activities individually. Other activities are done jointly through the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP).

ICON KEY

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

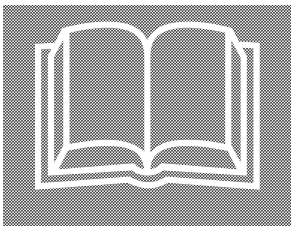
RWQCB staff monitors the City's implementation of permit requirements. The City must report on its development review process, number and type of projects reviewed, and what runoff control measures were included in the projects.

As required by Permit Provision C.3.f., SCVURPPP is working with the Santa Clara Valley Water District on a **Hydromodification Management Plan (HMP)**. The HMP will identify areas where runoff due to development increases the likelihood of erosion and other impacts to streams. In these areas, the RWQCB intends that post-project runoff flow and volume will not exceed pre-project rates or durations. In these areas, projects will need to meet requirements for flow control in addition to requirements for treatment of stormwater.

Once the RWQCB approves the HMP, the City of Milpitas will identify the portions of the City where it applies and will make clear the requirements and documentation for projects in these areas.

In the meantime, while the HMP is being drafted and reviewed, project applicants are encouraged to use "dual-purpose" designs. These designs control pollutants and reduce runoff quantities by minimizing imperviousness and by slowing,

retaining, and detaining runoff flows. The design approach recommended in Chapter Five achieves "dual purpose" by distributing small detention areas throughout the site, increasing the time it takes for runoff to reach storm drains.



References and Resources

- RWQCB Order No. 01-119 (Stormwater NPDES Permit Amendments)
- RWQCB Order 01-024 (Stormwater NPDES Permit)
- RWQCB Fact Sheet on New Development Provisions
- RWQCB Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan)
- Clean Water Act Section 402(p)
- 40 CFR 122.26(d)(2)(iv)(A)(2) – Stormwater Regulations for New Development
- SCVURPPP – Urban Runoff Management Plan (1997)
- City of Milpitas Urban Runoff Management Plan
- Hydromodification Management Plan Literature Review
- Hydromodification Management Plan Workplan

Local Development Review Perspective

The City of Milpitas created this Guidebook to help project applicants implement the stormwater permit provision C.3 requirements. City staff aims to make these complex requirements clear and easy to follow. City staff will work with project applicants to facilitate timely and complete review of their projects.

► THRESHOLDS

The RWQCB's C.3 requirements apply to projects above the **thresholds** stated in the permit. For previously undeveloped sites, the C.3 requirements apply if a project creates more than **one acre of new impervious area**.

For sites over one acre that have been previously developed, the threshold is a bit more complex. If the new project results in an increase of, or replacement of, more than 50% of the previously existing impervious surface, and the existing development was not subject to stormwater treatment measures, then the entire project must be included in the treatment measure design. If less than 50% of the previously impervious surface is to be affected, only that portion must be included in the design. Interior remodels, routine maintenance or repair, roof or exterior surface replacement, and repaving are not subject to C.3 requirements. [1]The threshold changes to 5000 square feet[2] of impervious area for applications deemed complete on April 15, 2005 or later.

Threshold
A Stormwater Control Plan will be required for projects that create more than one acre of new impervious area.

[1] This summary is for information only. For application to a specific project, consult the RWQCB Order and discuss with City staff.

[2] Pending a possible alternative criterion to be proposed by the City and reviewed by the RWQCB. To be consistent with the requirements of more recent NPDES permits issued to cities in neighboring counties, the threshold may be revised to 10,000 square feet of impervious area.

► DEVELOPMENT REVIEW PROCESS

The process for reviewing stormwater controls is integrated with the City's development review procedures. A simplified diagram of the procedures is shown in Figure 1-1.

If the C.3 requirements apply, Planning Division staff will require that a Stormwater Control Plan be submitted along with the Planning and Zoning application. This should be discussed at the pre-application meeting.

CEQA
See Chapter Four for a discussion of how to document stormwater impacts and mitigations in Initial Studies and Environmental Impact Reports.

If the project requires review under the California Environmental Quality Act (CEQA), Planning Staff will require submittal of an **Environmental Information Form**. This submittal should document potential impacts of the project's changes to stormwater runoff. Staff will use an initial study checklist to determine whether the project may still have significant effects on the environment after proposed mitigation measures are included. Stormwater impacts can be mitigated by minimizing site imperviousness, controlling pollutant sources, and incorporating **treatment BMPs** that retain, detain, or treat runoff.

This *C.3 Guidebook* will assist you to prepare a stormwater control plan for your

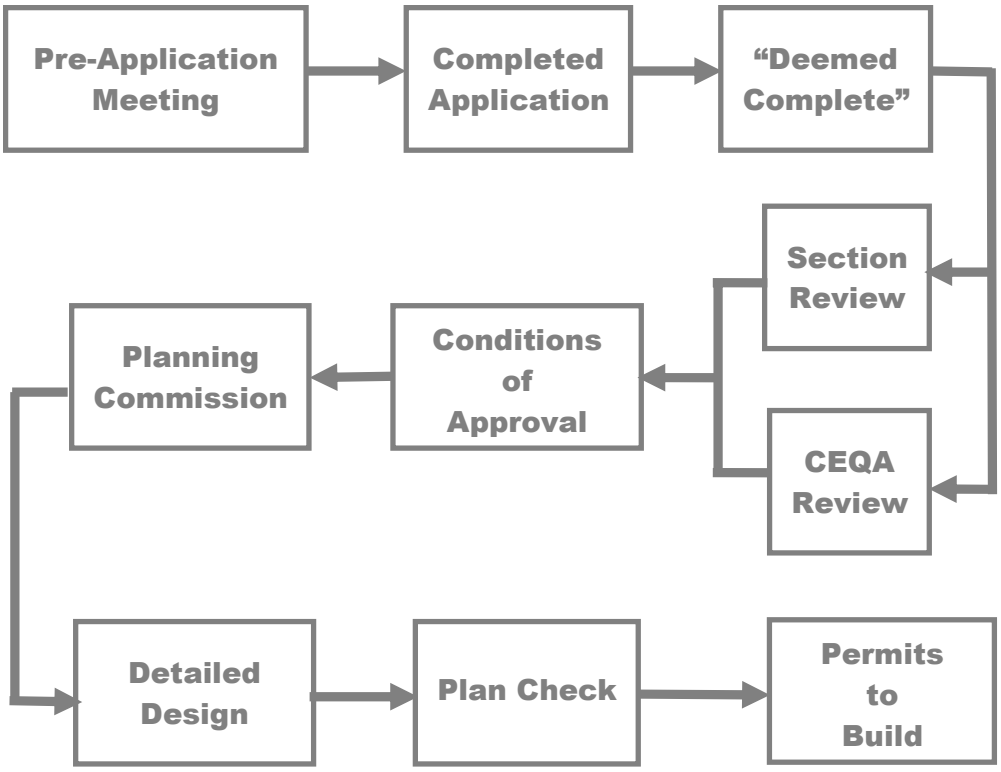
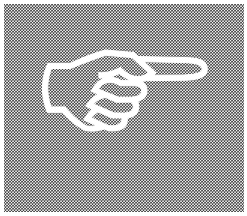


FIGURE 1-1. Review of the Stormwater Control Plan is integrated with the City's development review process.

project. Staff will use the checklist in Chapter 3 to determine if the stormwater control plan portion of your application is complete. Once the application is deemed complete, staff will use the *Guidebook* to determine whether the stormwater control plan complies with the RWQCB's C.3 requirements.

The Planning Department or Planning Commission (or in some cases, the City Council) will approve or deny the application. If the application is approved, the Planning Department, Planning Commission, or City Council will attach conditions of approval, including a requirement that you implement your stormwater control plan. Recommended standard special conditions of approval are in Appendix L.

Following approval of your planning and zoning application, you may submit your application for building permits. City staff will check that the required stormwater controls are incorporated into the plans, that the stormwater controls meet specified design criteria, and that their construction will comply with applicable building codes. A stormwater treatment control operation and maintenance plan (described in Chapter 6) must be submitted and approved before the building permit can be made final and a certificate of occupancy issued.



Architects and engineers should prepare a stormwater control plan simultaneously with the site plan and landscaping plan.

By doing so, they will:

- Maximize multiple benefits of site landscaping.
- Reduce overall project costs.
- Improve site aesthetics and produce a better quality project.
- Be more likely to achieve "maximum extent practicable."
- Speed project review.
- Avoid unnecessary redesign.

A Stormwater Control Plan is a separate document from the Storm Water Pollution Prevention Plan (SWPPP). The SWPPP provides for temporary measures to control sediment and other pollutants during construction. The Stormwater Control Plan specifies permanent controls that should last for the life of the project. In some cases, the two plans need to be coordinated. For example, at the end of the construction phase, a basin used for temporary sediment control could be converted to a permanent swale, basin, or bioretention area. The basin would be shown in the SWPPP and in the Stormwater Control Plan.

TABLE 1-1. A SWPPP and a Stormwater Control Plan are two separate documents.

	Storm Water Pollution Prevention Plan (SWPPP)	*Stormwater Control Plan*
Primary objective	Minimize potential runoff pollution during construction.	Minimize potential runoff pollution for the life of the project.
Pollutants targeted	Sediment from erosion and site disturbance, maintenance of construction equipment, construction activities (e.g. painting).	Pollutants deposited in airborne dust, liquids and dust from automobiles, cleaning solutions (e.g. from food service), litter and trash.
Coordination with review process	Submitted with application for building permit.	Submitted with application for planning and zoning review.
Coordination with project planning	Coordinated with grading plans and construction scheduling and phasing.	Integrated with site plan, drainage plan, and landscaping.

Preparing a Stormwater Control Plan involves the following steps:

1. Assemble needed information.
2. Identify constraints and opportunities.
3. Design to minimize imperviousness.
4. Locate and select treatment BMPs.
5. Perform preliminary design of BMPs.
6. Specify source controls.
7. Integrate with other preliminary drawings.
8. Identify permitting and code compliance issues.
9. Identify BMP maintenance requirements.
10. Complete a Stormwater Control Plan & Report.

Chapter Three helps guide you through each step. **Chapter Four** includes information on how to document stormwater potential impacts and mitigations in CEQA documentation.

References and Resources:

- RWQCB Order No. 01-119 (Stormwater NPDES Permit Amendments) Provisions C.3.(b) and C.3.(j)
- California Planning and Zoning Law
- California Environmental Quality Act
- *CEQA Deskbook 1999 [Second] Edition* (Bass, Herson, and Bodan, Solano Press Books, 2001)
- SCVURPPP – Model Performance Standard for New Development Planning Procedures
- City of Milpitas Development Review Application Form
- City of Milpitas Environmental Information Form
- City of Milpitas Initial Study Checklist
- California Building Code
- *California Stormwater Best Management Practice Handbook (Construction)*
- *Manual of Standards for Erosion and Sediment Control Measures* (Association of Bay Area Governments, 1998)

Planning and Design Perspective

In most cases, stormwater controls will add to the overall cost of a project. Stormwater controls may also constrain use of the site.

However, if executed well, and if integrated with landscaping and site amenities, stormwater controls can **add to your project's quality and value**.

Design Objective
Make the site mimic, as much as possible, the way a natural landscape drains.

From a site design perspective, the aim of stormwater controls is to make site drainage mimic, as much as possible, the way a natural landscape drains.

Much of the rain falling on a natural landscape is held by vegetation, soaks into the soil, or seeps slowly downhill. Pollutants washed out from the atmosphere are absorbed through contact with soils and vegetation.

Roofs and paving prevent rain from reaching the soil. Pollutants wash off the impervious surfaces, and drain pipes transport the runoff rapidly and efficiently. Higher peak flows and runoff volumes promote channel erosion – unless streambanks are hardened.

Because most rainfall comes in small storms – and because small storms have cumulative and profound effects on stream channel stability – it makes sense to **design stormwater controls to detain, retain, and treat runoff from small storms**. In Milpitas, about 85% of average annual rainfall comes in storms of around one inch or less.

An obvious, and effective, way to limit site runoff is to **minimize the amount of pavement and roofs**. Some paved areas can be designed with unit pavers, gravel, or other pervious surfaces. Runoff from small paved areas, like sidewalk or driveway strips, can be sloped to drain to concave lawns or landscaping.

Runoff collected from larger impervious areas, like roofs or parking lots, can be channeled through features located in depressions and integrated into the landscape. These features include swales, infiltration/detention basins, and bioretention areas.

These **treatment BMPs** can help infiltrate runoff into the soil. If soils are impermeable or groundwater is too close to the surface – as in parts of Milpitas – the features can detain and treat runoff before it is allowed to slowly drain away.

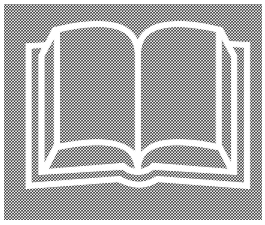
Where space and site layout do not allow swales, basins, or bioretention areas, it is still possible to use vaults for storage and sand filters for treatment. These devices work, but are more expensive, require more maintenance, and generally do not contribute to site aesthetics.

Projects in the Bay Area, throughout the U.S., and in other countries have successfully implemented these techniques. Design manuals are available to guide architects and engineers through the design process, including the selection of options, sizing, and specifications.

Chapter Five provides guidance on design requirements.

References and Resources

- *Start at the Source* (BASMAA, 1999)
- California Best Management Practice Handbooks (CASQA, 2003).
- Urban Runoff Quality Management (WEF/ASCE, 1998)
- Low Impact Development Design Strategies: An Integrated Approach (Maryland, 2001)
- Site Planning for Urban Stream Protection (Scheuler, 1995)
- *Urban Small Sites Best Management Practice Manual* Metropolitan Council of Governments (Minneapolis/St. Paul)



Environmental Benefit Perspective

The unusually diverse natural geography of the Santa Clara Basin – the area that drains to southerly South San Francisco Bay – includes tidal wetlands, alluvial plains, and mountain slopes. Annual rainfall varies from around 60 inches in the Santa Cruz Mountains to 15 inches or less in Milpitas and other parts of the Santa Clara Valley.

Milpitas' climate and location on a broad alluvial plain give its streams a characteristic structure of riffles, pools, terraces, floodplains, and wetlands. In relatively undisturbed stream reaches, this geomorphic structure supports trees and other riparian vegetation. Trees provide shade (cooling stream temperatures), create root wads and undercut banks (refuge for fish) and produce falling leaves and detritus (the bottom of a food web). Fish, frogs, and other animals have evolved to thrive in riparian habitats. Because the habitats are diverse and complex, there are many species that are specialized, have limited ranges, and may be rare.

The landscape of Milpitas, like that of all the San Francisco Bay Area, has been repeatedly transformed since the Spanish arrived in the 1770s. Even before the area was developed, European grasses, weeds, and other plants replaced much of the native vegetation. Creek flows were diverted to irrigate farms; later, pumping lowered the groundwater table. Wetlands were diked to create salt evaporators or were filled for farmland.

Urban development came to Milpitas after the Second World War. To make flood-prone land suitable for development, creeks were channelized or confined within levees. Buildings, streets, and pavement now cover much of the land, and storm drains pipe runoff from urban neighborhoods directly into the creeks. Urbanization has changed the timing and intensity of stream flows and has set off a chain of unanticipated consequences. These consequences include more frequent flooding, destabilized stream banks, bank armoring, loss of streamside trees and vegetation, and the destruction of stream habitat.

The remaining habitat, even where it has been disturbed and reduced to remnants, is an important refuge for various species. The U.S. and California have listed some of these species as endangered, threatened, rare, or having other special status. The riparian habitat along Coyote Creek, including the portion within the City of Milpitas, provides some of the best remaining riparian habitat in Santa Clara County. The area may support burrowing owls and provides potential breeding habitat for various songbirds (including listed yellow warblers) and hunting grounds for raptors, including hawks and owls. Belted kingfishers have been seen flying over Coyote Creek and Berryessa Creek (Milpitas 2001).

In the foothills, riparian areas along creeks support a variety of songbirds and raptors. Insects that thrive in the vegetation provide a food source for bats and lizards, and tall trees may be nesting sites for orioles and hawks. Most of the creeks that wind across Milpitas' alluvial plain remain unburied (although many are channelized). Existing and potential habitat within and along these creeks is not well documented.

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

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

References and Resources

- *Restoring Streams in Cities* (Riley, 1998)
- *Stream Restoration: Principles, Processes, and Practices* (Federal Interagency Stream Restoration Working Group, 1998)
- Santa Clara Basin Watershed Management Initiative *Watershed Characteristics Report* (SCBWMI, 2001) and *Watershed Action Plan* (SCBWMI, 2003).
- *Coyote Creek Trail Public Draft Initial Study* (City of Milpitas, 2001).

Chapter 2

Stormwater Concepts

All about BMPs, MEP, imperviousness, etc.

Like practitioners in any other specialized field, planners and engineers working on stormwater control have created their own lingo. Within the array of acronyms and shorthand, there are several key concepts – some of them based on water-quality regulations, others on evolved design practice – that are indispensable to communication between project proponents, designers, and reviewers.

The glossary at the front of this Guidebook lists words and concepts that can be explained adequately in a sentence or two. Other concepts require elaboration, including explanation of how they apply to designing and permitting development projects in the City of Milpitas.

This chapter explains the following key concepts:

- Maximum Extent Practicable
- Best Management Practices
- Imperviousness
- Design Storm

Maximum Extent Practicable

As required by the Clean Water Act, the RWQCB limits the allowable concentration (and sometimes the allowable load) of pollutants in municipal and industrial wastewaters discharged to State waters.

When it amended the Clean Water Act in 1987, Congress recognized that it was not technically feasible to establish similar limits on pollutants discharged from municipal storm drains. Instead, Clean Water Act Section 402(p)(3)(iii) says that the states

> shall require controls to reduce the discharge of pollutants to the **maximum extent practicable**, including management practices, control techniques and system, design and engineering methods, and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants.

"Maximum extent practicable" is not defined in Federal law or regulation.

SCVURPPP's 1997 Urban Runoff Management Plan (approved by the RWQCB) says that "maximum extent practicable" is subjective (i.e., it requires the exercise of individual judgment), evolving, and flexible. SCVURPPP's plan emphasized that the Co-permittees would implement **continuous improvement** to insure that their programs would consistently achieve "maximum extent practicable."

Under the stormwater discharge permit, SCVURPPP regularly updates (and the RWQCB reviews and approves) model **performance standards** that establish, for various elements of the stormwater pollution prevention program, the level of effort that currently corresponds to "maximum extent practicable."

When reviewing proposed development projects, Milpitas staff uses current performance standards and best professional judgment to determine whether proposed stormwater controls meet the "maximum extent practicable."

As knowledge of stormwater control develops, it is becoming more common for "maximum extent practicable" to be expressed as numeric criteria. For example, the 2001 amendments to the stormwater permit established numeric standards for sizing stormwater treatment BMPs. City staff must apply these standards when reviewing proposed development projects.

For other aspects of site design and treatment BMP design, City staff may consult available design manuals and apply their engineering or other professional judgment.

Best Management Practices

Clean Water Act Section 402(p) and implementing USEPA regulations (40 CFR 122.26) specify a municipal program of "management practices" to control stormwater pollutants. **Best Management Practices (BMP)** refers to any kind of procedure or device designed to minimize the quantity of pollutants that enter the storm drain system.

Since the adoption of the regulations in 1990, a rough taxonomy of BMPs has emerged:

Structural BMPs are built devices or site features (e.g., a constructed wetland), as opposed to **Operational BMPs,** which are practices or procedures (e.g., dumping washwater in an indoor sink rather than the gutter, or sweeping outside work areas daily).

Permanent BMPs are structural BMPs intended to last the life of the project (e.g. a constructed wetland), as opposed to **temporary BMPs** (e.g. silt fences) which are to be removed when construction is finished.

Source control BMPs aim to stop pollutants from entering stormwater. All operational BMPs are for source control, but source control BMPs can also be permanent structural BMPs (e.g., a berm around a dumpster area). **Treatment BMPs,** on the other hand, are features or devices that remove pollutants that have already become suspended or dissolved in stormwater.

TABLE 2-1. BMPs classified three ways.

A. Manifestation	*B. Longevity*	*C. Mode*
Structural	Permanent	Source Control
Operational	Temporary	Treatment

Provision C.3. is concerned with permanent, structural BMPs, including structural source control BMPs, permanent features of landscape and site design, and treatment BMPs.

As described in Chapter Three and Chapter Five, there are two approaches to incorporating treatment BMPs into new development sites. Treatment BMPs can be integrated into the landscape design and distributed throughout the site **(integrated/distributed treatment BMPs)**, or site drainage can be piped to a larger, engineered structural treatment BMP.

Commercial and industrial facilities must implement operational BMPs to the maximum extent practicable, and residents are expected to avoid allowing anything other than stormwater (e.g., soapy water, paint, litter) from entering storm drains. These requirements are implemented and enforced by other parts of the City of Milpitas' comprehensive stormwater pollution prevention program.

Imperviousness

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

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

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

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

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

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

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

Design Storm

No two rainstorms are exactly alike. Hydrologists sort and analyze rain gauge records to find long-term patterns of rainfall **intensity** and **duration**. Then they predict runoff flows and volumes based on these patterns and on the size, slopes, soils, land uses, and drainage patterns of a particular catchment.

Engineers select a **design storm** to calculate the required size of facilities that convey, store, or treat runoff. Because small storms occur many times a year, and larger storms come once in many years, the design storm is selected based on probability (e.g., the allowable likelihood that a channel will overflow in any given year). Often, applicable regulations specify the rainfall intensity and duration that must be used in design.

Different design storms apply to different purposes. Selection of a design storm balances costs and benefits. Roof leaders and flood control channels are typically designed to convey runoff from a storm with a one-in-one-hundred (1%) probability of occurring in any particular year (commonly called the "one-hundred-year storm"). Flood control detention basins may be designed to hold a storm predicted to occur, on average, in 4% or 10% of the coming years (a 25-year or 10-year storm, respectively).

NPDES permit Provision C.3.d includes criteria for designing treatment BMPs. These criteria target treatment of 80% of **cumulative** runoff. (See the discussion of maximum extent practicable on page 14.) Because most runoff is produced by small storms that occur many times a year, treatment BMPs can be designed to bypass larger storms. The 80% criterion means that BMPs will be bypassed, on average, every 1-2 years.

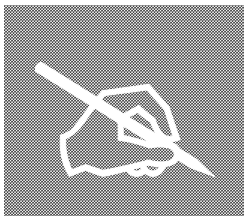
Because treatment BMPs are designed to treat only small storms, they can be considerably smaller than detention basins that are designed to protect property during flood-generating storms that may recur in 10%, 4%, or 1% of coming years. However, treatment BMPs must be designed as part of an overall drainage system that can accommodate larger storms.

Development sites subject to NPDES permit Provision C.3.f will be required to maintain runoff peak flows and durations that existed prior to development. SCVURPPP's **Hydromodification Management Plan** (HMP) will specify locations where C.3.f applies and will also identify the design storm or storms that must be used to compute peak flows and durations.

Chapter 3

Preparing Your Stormwater Control Plan

Step-by-step assistance for site design and BMP selection.



Prepare your Stormwater Control Plan for submittal along with the other items staff has marked on the Planning Division's "Check Sheet for Planning and Zoning Application." Discuss specific requirements that may apply to your project at the pre-application meeting with City staff.

► OBJECTIVES.

Your Stormwater Control Plan should demonstrate that your project will incorporate site design characteristics, landscape features, and treatment BMPs that will minimize imperviousness, retain or detain stormwater, slow runoff rates, and reduce pollutants in post-development runoff to the **maximum extent practicable**. Additional requirements may apply if runoff from your site discharges directly to creeks or wetlands.*

A complete and thorough Stormwater Control Plan will enable Planning staff to verify that your project complies with these requirements. The City requires a Stormwater Control Plan for every applicable project so that City staff can document the City's compliance with its RWQCB permit.

► CONTENTS.

Your Stormwater Control Plan will consist of a plan and a report. Staff will use the following checklist to evaluate the completeness of your Plan.

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* See RWQCB Order 01-119, Provision C.3.(b)(ii).

STORMWATER CONTROL PLAN CHECKLIST

► CONTENTS OF PLAN

As appropriate, show on plans:

- ☑ Existing natural hydrologic features (depressions, watercourses, relatively undisturbed areas) and significant natural resources.
- ☑ Soil types. Soil characteristics must be confirmed by site inspection or boring records if a subsurface infiltration rate is used in design calculations.
- ☑ Depth to groundwater. Must be confirmed if groundwater is generally shallow (<15 feet below ground surface) and a subsurface infiltration rate is used in design calculations.
- ☑ 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.
- ☑ Existing and proposed site drainage network and connections to watercourses or storm drains.
- ☑ Separate drainage areas, depending on complexity of drainage network.
- ☑ For each drainage area, types of impervious area (roof, plaza/sidewalk, and streets/parking) and area of each.
- ☑ Proposed design features and surface treatments used reduce to imperviousness or impervious area.
- ☑ Proposed locations of infiltration or treatment BMPs.

► CONTENTS OF REPORT

A report accompanying the plan should include:

- ☑ A narrative analysis or description of site features and conditions that constrain, or provide opportunities for, stormwater control.
- ☑ A narrative description of site design characteristics that protect natural resources.
- ☑ A narrative description and/or tabulation of site design characteristics, building features, and pavement selections that reduce imperviousness of the site.
- ☑ A table of identified pollutant source areas and for each, the source control measure(s) used to reduce pollutants to the maximum extent practicable.
- ☑ Tabulation of pervious and impervious area, showing self-retaining areas, areas tributary to each infiltration or treatment BMP.
- ☑ Preliminary designs, including calculations, for each infiltration or treatment BMP. BMPs must meet numerical standards set by the Regional Water Quality Control Board. Designs should include elevations showing sufficient hydraulic head for each feature or device.
- ☑ General description of BMP maintenance requirements.
- ☑ A licensed professional engineer's certification that the measures specified in the report meet the requirements of the RWQCB Order.

Step by Step

The City recommends that you plan and design your stormwater controls integrally with the site planning and landscaping for your project. It's best to start with general project requirements and preliminary site design concepts; then prepare the detailed site design, landscape design, and stormwater control plan simultaneously.

Even if a site design has already been prepared, you can still incorporate adequate stormwater controls. However, because you'll be working within the constraints of the design, you may be limited to selecting more expensive, higher-maintenance, and less aesthetically pleasing stormwater treatment options.

Suggested coordination with site and landscape design

The following step-by-step procedure should optimize your design by identifying the best opportunities for stormwater controls **early in the design process.** Regardless of which design procedure you use, you should still review this chapter for explanation of expectations and requirements for your Stormwater Control Plan.

Begin with general project requirements and program.

The recommended steps are:

1. Assemble needed information.
2. Identify site opportunities and constraints.
3. Design to minimize imperviousness.
4. Locate and select treatment BMPs.
5. Perform preliminary design of treatment BMPs.
6. Specify source controls.
7. Integrate the Stormwater Control Plan with site and landscape plans.
8. Identify permitting and code compliance issues.
9. Identify BMP maintenance requirements.
10. Complete the Stormwater Control Plan.

Sketch conceptual site layout, building locations, and circulation.

Complete the landscape design.

Complete the detailed site design.

Submit Site Plan, Landscape Plan, and Stormwater Control Plan

Step 1: Assemble Needed Information

To select types and locations of BMPs, the designer needs to know basic characteristics of the site's surface and subsurface drainage:

- **Existing natural hydrologic features** and natural resources, including any contiguous natural areas, wetlands, watercourses, seeps, or springs.

- **Existing site topography**, including contours of any slopes of 10% or steeper, general direction of surface drainage, local high or low points or depressions, any outcrops or other significant geologic features.

- **Zoning**, including requirements for **setbacks** and **open space**.

- **Soil types.** In general, selection and design of infiltration BMPs is based on the soil types A, B, C, and D cataloged in Appendix A of USDA Technical Release 55, *Urban Hydrology for Small Watersheds.* Preliminary identification of soil types may be made from the soils map in Appendix A of this Guidebook. Where questions may exist regarding soil types or infiltration rates, obtain site-specific information (where available) from site inspection, boring logs, or geotechnical studies associated with previous design or construction.

- **Depth to groundwater.** The City has mapped areas where groundwater is shallow enough to infiltrate the sewer system. See Appendix B. This includes most (but not all) of the City west of Highway 680. Additional sources for groundwater elevations include:

  - Records of the Santa Clara Valley Water District

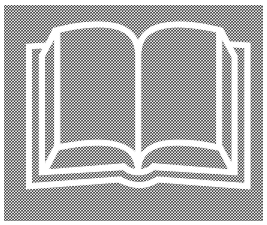
  - Records from the City's domestic wells.

  - Results from geotechnical studies associated with previous design and construction for the site.

- **Existing site drainage.** For undeveloped sites, this should be obtained by inspecting the site and examining topographic maps and survey data. For previously developed sites, site drainage and connection to the City storm drain system should be located from site inspection, City storm drain maps (available from the Land Development Section, Engineering Division), and plans for previous development. It may be possible to locate drainage plans submitted with previous building permit applications.

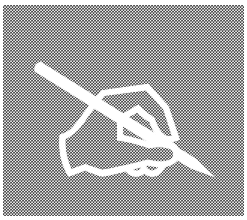
References and Resources

- USDA SCS Technical Release TR55, Appendix A: Soil Types
- City of Milpitas Municipal Code, Title XI, Chapter 10 (Zoning)



Step 2: Identify Constraints & Opportunities

Review the information collected in Step 1. Identify the principal constraints on site design and BMP selection as well as opportunities to reduce imperviousness and incorporate BMPs into the site and landscape design. For example, **constraints** might include impermeable soils, high groundwater, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, or safety concerns. **Opportunities** might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, landscape amenities including open space and buffers (which can double as locations for BMPs), and differences in elevation (which can provide hydraulic head for BMPs).



Prepare a brief **narrative** describing site opportunities and constraints. In the review process, this narrative may help establish the **maximum extent practicable** degree of stormwater control for your site.

Step 3: Design to Minimize Imperviousness

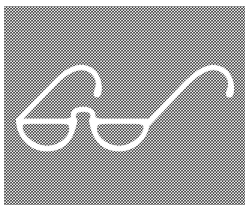
► CLUSTER DEVELOPMENT

Chapter Four of *Start at the Source* (BASMAA, 1999) lists the following design principles which can be applied to the layout of newly developed and redeveloped sites:

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

- Define development envelope and protected areas, identifying areas that are most suitable for development and areas that should be protected.
- Set back development from creeks, wetlands, and riparian habitats.
- Preserve significant trees. (Note: City Ordinance MMCX-2 defines "protected" trees and "heritage and specimen plantings.")
- Avoid erodible soils and steep slopes.

Where possible, conform the site layout along natural landforms, avoid excessive grading and disturbance of vegetation and soils, and replicate the site's natural drainage patterns.



For **new subdivisions**, the Milpitas General Plan encourages the use of **Planned Unit Developments** (PUDs) both on hillsides and the valley floor. Development within PUDs should be clustered to maximize open space, minimize lot sizes,

minimize imperviousness and reduce other environmental impacts. A simple four-step procedure to lay out clustered subdivisions has been used throughout the U.S. (Natural Lands Trust, 2001):

1. Identify land that should be permanently protected.
2. Locate the sites of individual houses within the development area so that their views of the open space are maximized.
3. "Connect the dots" with streets and informal trails.
4. Draw the lot lines.

In residential subdivisions, imperviousness can be further reduced by designing shared driveways and by minimizing the number and size of cul-de-sacs.

► OPTIMIZE THE SITE LAYOUT

For all types of development, **limit overall coverage** of paving and roofs. As is detailed in *Start at the Source,* this can be accomplished by designing compact, taller structures, narrower streets and sidewalks, smaller parking lots (fewer stalls, smaller stalls, and more efficient lanes), and indoor or underground parking. Examine site layout and circulation patterns and identify areas where landscaping or planter boxes can be substituted for pavement.

► MINIMIZE DIRECTLY CONNECTED IMPERVIOUS AREA

With the built and landscaped areas defined on a site drawing, look for opportunities to minimize directly connected impervious area:

- **Direct runoff from impervious areas to adjacent pervious areas** or depressed landscaped areas. A 1:1 ratio of impervious to pervious area is generally acceptable; a 2:1 or higher (impervious/pervious) ratio may be appropriate where soils permit (except in hillside areas). Much higher ratios (over 20:1) can be used with an appropriately designed landscape infiltration/ bioretention BMP, which may require a subsurface liner and drainage.

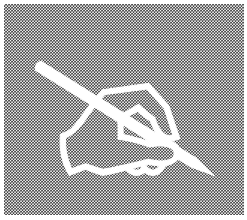
- **Select permeable pavements and surface treatments.** Inventory the site's paved areas and identify locations where permeable pavements, such as crushed aggregate, turf block, or unit pavers can be substituted for impervious concrete or asphalt paving.

► DETAIN AND RETAIN RUNOFF THROUGHOUT THE SITE

- **Use drainage as a design element.** Use above-ground drainage swales, depressed landscape areas, vegetated buffers, and bioretention

areas as amenities and focal points within the site and landscape design. In some cases, swales can be placed within the street right-of-way to convey and treat stormwater runoff from roadways.

- **Minimize peak flow and volume of runoff.** Design landscaped areas and treatment BMPs (Steps 4 and 5) to detain or retain runoff. The "maximum extent practicable" criterion applies now; after October 15, 2004, specific limits on allowable volume and peak discharge from a developed or redeveloped site may be established by the City's forthcoming **Hydromodification Management Plan** (HMP).

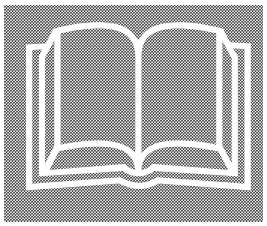


► **DOCUMENT YOUR DESIGN**

Chapter Five describes how to document pervious and impervious areas within your project and how to quantify the benefits achieved by your design decisions to reduce paved and roofed area, to create self-retaining landscaped areas and pervious pavements, and to direct runoff from impervious to pervious areas.

Chapter Five also includes instructions for using the provided spreadsheet to create a table of pervious areas within your site.

To accompany the table, prepare a brief **narrative** that documents the site layout and site design decisions you made that minimize imperviousness, retain or detain stormwater, slow runoff rates, and reduce pollutants in post-development runoff to the maximum extent practicable.



References and Resources

- *Start at the Source* (BASMAA, 1999).
- *Growing Greener* (National Lands Trust, 2001).
- *City of Milpitas General Plan* (Milpitas, 1994).
- *City of Milpitas Municipal Code*, Title XI, Chapter 10 (Zoning)
- City of Milpitas "Planned Unit Development" web page
- *Low Impact Development Manual* (Prince Georges County, 1999).
- *Site Planning for Urban Stream Protection* (Schueler, 1995b).

Step 4: Locate and Select Treatment BMPs

In Step 3, you minimized the total quantity of runoff by reducing impervious area and directing some runoff to pervious areas. You also sketched the site's drainage system, divided the site into drainage areas, and tabulated pervious areas.

In this step, inventory and tabulate impervious areas and identify appropriate locations for **treatment BMPs** that will capture, then retain, detain, or treat the remaining runoff before it flows offsite. Then select the appropriate treatment BMPs. The opportunities and constraints identified earlier (in Step 2) will help guide this process.

There is no hard-and-fast procedure or set of rules for selecting treatment BMPs. Selection is ultimately by the designer's professional judgment and preference, but the suite of BMPs selected must meet the criteria set in the RWQCB permit.

A first consideration in identifying a drainage and treatment strategy is to decide whether **infiltration** is a practical option for the site. In general, the cheapest and most effective treatment BMPs are adequately sized infiltration areas that are designed into site landscaping. In sites with space constraints, infiltration can be promoted by using surface infiltration basins or subsurface trenches or dry wells.[1]

In many sites, however, infiltration BMPs cannot be used because of steep slopes, geotechnical instability, high groundwater, low-permeability soils, or a combination of these factors. BMPs for these sites will use **detention or treatment**, rather than infiltration, to manage runoff.

For sites that use detention and treatment, the primary limiting design factors will be available **space** and available hydraulic **head** (difference in water surface elevation between inflow and outflow). In some cases, a small adjustment of elevations within the site plan can make a treatment option feasible and cost-effective.

A second consideration in developing a drainage and treatment strategy is whether to route most or all drainage through a single detention and treatment BMP or to disperse smaller BMPs throughout the site. Piping runoff to a single treatment area may be simpler and easier to design, but designs that integrate swales, small landscaped areas, and planter boxes throughout the site can be more cost-effective and aesthetically pleasing.

Urban Runoff Quality Management (Water Environment Federation Manual of Practice No. 23; American Society of Civil Engineers Manual and Report on Engineering Practice No. 87) focuses on larger, engineered systems. For areas with less permeable soils (NRCS Soil Types C & D), and where nutrients are not a major concern, this manual recommends extended detention, ponds with permanent pools, constructed wetlands, or media filtration.

Low Impact Development Strategies: An Integrated Design Approach (Prince George's County, Maryland, Department of Environmental Resources, 1999) guides the designer through the **Low Impact Development** (LID) approach to stormwater control, which emphasizes small, cost-effective widely distributed landscape features rather than larger facilities located at the bottom of drainage areas.

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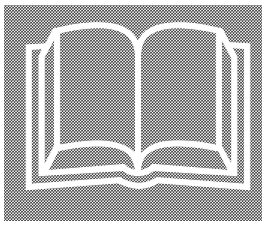
[1] The Santa Clara Valley Water District (SCVWD) restricts the use of dry wells and other subsurface infiltration BMPs. Applicants should obtain an opinion from SCVWD staff before incorporating these BMPs into their Stormwater Control Plan.

Either approach may be best for a particular site, or elements of both approaches may be combined. In addition to the WEF/ASCE Manual and Low Impact Development manual, the City of Portland's *Stormwater Manual* (revised 2002) includes many design details for treatment BMPs.

The City of Milpitas maintains a library of manuals and other design guides for your reference. Staff will provide information on how to obtain paper or electronic copies. These manuals should be used as a starting point for selection and design of treatment BMPs that meet the RWQCB requirements and City of Milpitas codes. Keep in mind that the criteria and recommendations in these manuals may be different, or inapplicable, to projects in the City of Milpitas.

Although the City of Milpitas has no general recommendation for selecting BMPs, the City does require that the overall design for the site meet RWQCB requirements, the City's planning and zoning requirements, and applicable building codes. The designs must also be maintainable. Maintenance requirements for BMPs must be identified in the Stormwater Control Plan. A **Stormwater BMP Maintenance Plan** will be required as a Condition of Approval for the project.

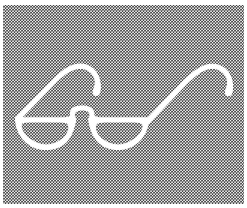


References and Resources

- RWQCB Order 01-119, Provision C.3.d
- *Urban Runoff Quality Management* (WEF/ASCE, 1998).
- *Low Impact Development Manual* (Prince Georges County, 1999).
- *Start at the Source* (BASMAA, 1999).
- *Stormwater Manual* (City of Portland, 2002).
- *California Stormwater BMP Handbooks*
- *Minnesota Urban Small Sites BMP Manual* (Barr Engineering, 2001)

Step 5: Perform Preliminary Design of BMPs

Demonstrate the feasibility and effectiveness of the treatment BMPs you selected by showing that they meet the design criteria in Chapter Five. Detailed construction drawings are not required at this stage, but drawings or sketches should be included as needed to illustrate the proposed design and to support calculations.

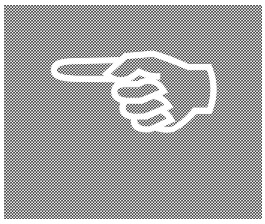


Chapter Five includes a set of widely applicable BMPs that can be integrated into the landscape and distributed throughout the site (**integrated/distributed BMPs**). Chapter Five also provides a method of accounting for pervious and impervious areas and for demonstrating that the suite of BMPs you choose is sufficient to meet the RWQCB permit requirements. See page 44. The City recommends that you use this procedure in preparing your Stormwater Control Plan.

Step 6. Specify Source Control BMPs

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

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



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

► IDENTIFY POLLUTANT SOURCES

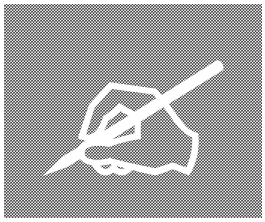
Review your preliminary site plan. Then review the first column in the table of source control measures (Appendix C). Check off the sources of potential pollutants that apply to your site and note the corresponding locations on the site plan.

► IDENTIFY PERMANENT SOURCE CONTROL MEASURES

Use the Source Control Measures table (Appendix C) to prepare a table listing each potential source on your site and the corresponding permanent, structural BMPs used to prevent pollutants from entering runoff. This will provide a guide to Source Control Measures that will be included in your building permit application.

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

Potential source of runoff pollutants	*Permanent source control BMPs*



► IDENTIFY OPERATIONAL SOURCE CONTROL BMPS

Again referring to the Source Control Measures table (Appendix C), prepare a list of operational BMPs that should be implemented continually as long as the anticipated activities uses continue at the site. The City's Urban Runoff ordinance requires that these BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable discretionary approval for use of the site.

References and Resources

- Appendix C, Sources of Runoff Pollutants and Source Control BMPs
- RWQCB Order 01-119, Provision C.3.k
- SCVURPPP Planning Procedures – Model List of Source Control Measures
- SCVURPPP Model Conditions of Approval for Pesticide Reduction in Landscaping Plans
- SCVURPPP Landscape Maintenance Techniques for Pest Reduction
- *Start at the Source*, Section 6.7: Details, Outdoor Work Areas
- *California Stormwater Industrial/Commercial Best Management Practice Handbook*
- *Urban Runoff Quality Management* (WEF/ASCE, 1998) Chapter 4: Source Controls

Step 7: Integrate With Other Preliminary Drawings.

Depending on the complexity of the project, the Stormwater Control Plan drawing may be combined with the site plan, landscape plan, or drainage plan. In any case, the plans should be carefully coordinated with these plans and with site grading and drainage.

Here are some typical considerations that may arise in coordinating stormwater control plans with other construction plans:

Building Drainage. Building codes require that drainage from roofs and impervious areas be drained away from the building. The codes also specify minimum sizes and slopes for roof leaders and drain piping. Detailed designs of BMPs located in or on the building, or within 10 feet of building foundations, must accommodate these codes while also meeting the minimum requirements for detention or flow stated in Provision C.3.

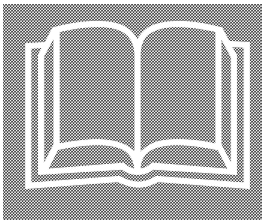
Control of elevations. Distribution of overland flow to landscaped areas may require that grading and landscape plans be executed with greater attention to slopes and elevations.

Drainage Plans. The City may require a drainage plan when the project final design is submitted for plan check. The drainage plan is designed to prevent street flooding during a 10-year storm and successfully route flows from a 100-year storm. To meet the requirements for both the Stormwater Control Plan design storm and the Drainage Plan design storm, BMP designs must incorporate bypasses or overflows to route excess flows to the storm drain system. It may be necessary to complete a preliminary drainage plan at the planning and zoning review stage.

Plant selection. Depressed landscaped areas, bioretention areas, vegetated swales, and many other BMPs require appropriate plant selection to work properly. This plant selection should be coordinated with or incorporated into the landscape plan. The City of Milpitas requires landscaping to be designed for water conservation (City Code, Title VIII, Chapter 5, Water Efficient Landscapes) and also requires that potable water not be used for irrigation where recycled water is available (Title VII, Chapter 6, Water Conservation).

Access for periodic maintenance. All BMPs will require access for periodic inspection in accordance with an approved maintenance plan. Many BMPs (e.g., bioretention basins and swales) require relatively little maintenance, but others (e.g., sand filters or proprietary devices) may require regular replacement of surface sand or replacement of cartridges or inserts. Site plans should provide for the necessary access for personnel and equipment.

Organizing traffic and parking. Your stormwater control plan may call for depressing landscaped areas below paved areas, rather than setting them above paved areas and surrounding them with curbs. Striping or bollards may be needed to guide traffic. Parking lots with crushed aggregate, unit-paver, and other permeable pavements may require bollards, signs, or other indicators to organize parking.

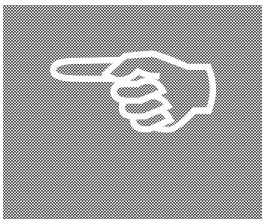


References and Resources

- Milpitas Municipal Code
- City of Milpitas. Engineering Division, Standard Drawings

Step 8: Permitting & Code Compliance Issues.

To meet the RWQCB's "maximum extent practicable" standard, Stormwater Control Plans will typically need to incorporate innovative site design features, pavements, drainage design practices, and BMPs. Because these practices are new, they may be inconsistencies with existing building codes, engineering requirements, and standard conditions of approval.



The City makes no representation that the design practices or recommendations in this guidebook (or in the publications listed as references and in the bibliography) meet existing applicable codes or standards.

Where conflicts occur between recommended stormwater control practices and existing codes and standards, City staff will work with the applicant to identify one or more regulatory or design solutions that can satisfy all applicable requirements.

The City encourages you to identify these potential conflicts in the Planning and Zoning Review phase and to document the potential conflicts in the Stormwater Control Plan. By doing so, it may be possible to resolve the issue prior to final design. This will help avoid the need for redesign and resubmittal of final plans and associated project delays.

Step 9: Identify BMP Maintenance Needs

As required by NPDES Permit Provision C.3.e, the City will periodically verify that treatment BMPs are maintained and continue to operate as designed.

Ongoing maintenance of BMPs will be the responsibility of the property owner.

Before a Certificate of Occupancy is issued, the City will require submittal of a **Stormwater Control Operation and Maintenance Plan** for the site. The plan will list all treatment BMPs on the site along with the required periodic maintenance. The City may require an annual report to verify that this maintenance has been done, and will also refer to the operation and maintenance plan during site inspections.

During the detailed design and construction phases of your project, you should note any additional issues or concerns that may be specific to your site or to a specific BMP installation. For example, it may be necessary to verify that weirs and flow spreaders remain level and that sediment and debris accumulated during constructin does not fill depressions or clog inlets and outlets. These items to be verified post-construction should be included in the Stormwater Control Operation and Maintenance Plan.

Your Stormwater Control Operation and Maintenance Plan must include the project developer's signed statement accepting responsibility for maintenance until the responsibility is legally transferred.

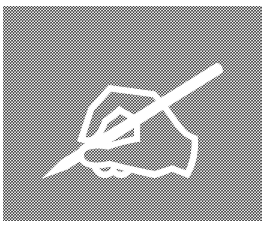
► MAINTENANCE NEEDS AND YOUR STORMWATER CONTROL PLAN

Your Stormwater Control Plan should include a general description of anticipated BMP maintenance requirements. This will help insure that:

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

Chapter Six includes a discussion of **typical maintenance requirements** for some commonly used BMPs.

Step 10: Stormwater Control Plan & Report



Your Stormwater Control Plan Report should document the information gathered and decisions made in Steps 1-9. A clear, complete, well-organized report will make it possible to confirm that the "maximum extent practicable" standard has been applied in each aspect of the project design.

► SAMPLE OUTLINE AND CONTENTS

I. Project Setting

- A. Project Name, Location, Description
- B. Site features and conditions
- C. Opportunities and constraints for stormwater control

II. Measures to Limit Imperviousness

- A. Measures to cluster development and protect natural resources
- B. Measures used to limit directly connected impervious area
  - (1) Site design features
  - (2) Pervious pavements
  - (3) Detention and drainage design
- C. Table summarizing pervious and self-retaining areas .

III. Selection and Preliminary Design of Treatment BMPs

- A. Locations and Elevations
- B. Sizing Calculations
- C. Table summarizing impervious areas and treatment BMPs

IV. Source Control Measures

- A. Description of site activities and potential sources of pollutants
- B. Table showing sources and permanent controls
- C. List of operational source control BMPs

V. Summary of Permitting and Code Compliance Issues

VI. BMP Maintenance Requirements

VII. Certification

► EXAMPLE STORMWATER CONTROL PLAN

Example Stormwater Control Plans are in Appendix D. Your Stormwater Control Plan will reflect the unique character of your own project and should meet the requirements identified in this *Guidebook*. City staff can assist you to determine how specific requirements apply to your project.

► CERTIFICATION

Your Stormwater Control Plan must include the certification of a licensed professional engineer stating as follows: "The selection, sizing, and preliminary design of treatment BMPs and other control measures in this plan meet the requirements of Regional Water Quality Control Board Order 01-119."

Chapter 4

Stormwater Control & CEQA

Incorporating stormwater impacts and control measures into Initial Studies and Environmental Impact Reports

CEQA – the California Environmental Quality Act – requires local jurisdictions to identify and evaluate the environmental impacts of their actions. Municipal actions subject to CEQA include discretionary approvals such as zoning decisions and use permits. The objectives of CEQA include disclosing to decision makers and the public significant environmental effects of proposed activities, identifying ways to avoid or reduce adverse environmental impacts, and preventing environmental damage by requiring implementation of feasible alternatives or mitigation measures.

The City requires that you complete an **Environmental Information Form** as part of your application for planning and zoning review. Depending on the project scope, additional documentation may be required. Your Stormwater Control Plan contains information to be reviewed under CEQA.

The Planning Division will complete an **Environmental Checklist** and **Initial Study** for your project. Depending on the results of the Initial Study, the Planning Division may recommend a Negative Declaration or Mitigated Negative Declaration be issued for the project, or it may recommend that an Environmental Impact Report be prepared.

Further guidance on the CEQA process is available from the Planning Division and from the references and resources 🕮 listed on page 38.

The purpose of this chapter is to clarify how information in your Stormwater Control Plan will be used in the CEQA review process.

CEQA and Water Quality Regulations

NPDES permit provision C.3.m states that when the City conducts environmental review of projects, it must evaluate water quality effects and identify appropriate mitigation measures.

The Governor's Office of Planning and Research (OPR) recommends that CEQA lead agencies should integrate CEQA review with Federal, state, or local laws, regulations, or policies "to the fullest extent possible." (CEQA Guidelines §15124). In 1998, OPR revised the example Environmental Checklist Form (CEQA Guidelines Appendix G) to more closely align with Federal and state laws and requirements, including those of the state's Fish and Game Code, the Federal Clean Water Act, and the California Water Code. The City of Milpitas uses the OPR Environmental Checklist Form.

Specific questions on the Environmental Checklist Form connect the potential significance of project impacts with existing water-quality regulations. For example, Question VIII.a asks: **"Would the project violate any water quality standards or waste discharge requirements?"**

The potential effects of increased runoff peak flows and durations are addressed in question VIII.c: **"Would the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation off-site?**

Potential impacts of runoff pollutants are targeted in Question VIII.e, which asks: **"Would the project create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?"**

Finally, Question VIII.f. asks: **"Would the project otherwise substantially degrade water quality?"**

With the promulgation of the NPDES C.3 provisions, the RWQCB has, in effect, set more specific standards for what constitutes "substantial additional sources" of runoff pollutants.

Thresholds of Significance

A threshold of significance can be defined as "a quantitative or qualitative standard, or set of criteria, pursuant to which the significance of an environmental effect may be determined." (OPR 1994). Thresholds are not rigid or absolute – the significance of an activity depends on its specific location – but they do help Lead Agencies make consistent and well-supported determinations.

In most cases, the City of Milpitas will regard projects that exceed the threshold in NPDES permit provision C.3.c. – defined therein as a "Group 1 project" – to have potentially significant impacts due to increases in runoff pollutants. This threshold is set at 1 acre of new impervious area for projects with applications deemed complete on October 15, 2003 or later, and at 5000 square feet of new impervious area for projects with applications deemed complete on April 15, 2005 or later (subject to RWQCB consideration and possible approval of an alternative standard). The threshold does not apply to projects for which the City has issued a waiver of the requirements for treatment BMPs as provided in NPDES permit Provision C.3.g. The threshold and requirements are intended to address both cumulative and site-specific increases in runoff pollutants due to imperviousness.

A project may also have potentially significant impacts due to increases in runoff pollutants if the facility includes outdoor storage of materials or wastes or if it accommodates outdoor activities such as automotive or equipment repair. Examples include car washes, grocery stores, some restaurants, and corporation yards. The threshold of significance in this case is qualitative and requires project-specific assessment of the potential for pollutants generated on-site to reach storm drains.

Following RWQCB approval of the **Hydromodification Management Plan** (HMP) currently being prepared by SCVURPPP, the City will consider whether to adopt a threshold of significance, based on that plan, for impacts related to increased runoff peak flows and durations that could result in substantial erosion or siltation off-site (as suggested by Environmental Checklist Form Question VIII.c).

Incorporating Mitigation Measures

The RWQCB's C.3 provisions create a *de facto* threshold of significance for stormwater pollutant impacts; they also identify corresponding measures that can mitigate those impacts below the level of significance.

In general, the implementation of treatment BMPs that meet the numeric criteria in Provision C.3.d, as described in Chapter 5, will mitigate the effects of increased imperviousness on water quality to a level that is less than significant. Similarly, implementation of recommended source control BMPs for each identified source of potential pollutants will effectively mitigate the creation of these additional sources.

Following RWQCB approval of the HMP, the City will consider how to define the required level of mitigation necessary to reduce the impacts of increased peak flows or durations to a level of insignificance.

Stormwater Impacts and the CEQA Process

In summary, if the amount of impervious area created by a project is less than the threshold identified in NPDES permit provision C.3.c, and there are no significant new sources of runoff pollutants created by the project, the relevant questions on the Initial Study Checklist can be answered "less than significant impact."

If a project is required to implement treatment BMPs pursuant to NPDES permit C.3.c, the potential for significant stormwater impacts should be noted on the **Environmental Information Form**. This can be done by checking "yes" in response to **Question 26** (Change in ocean, bay, lake, stream, or ground water quality or quantity or alteration of existing drainage patterns) and **referencing the Stormwater Control Plan** for the project.

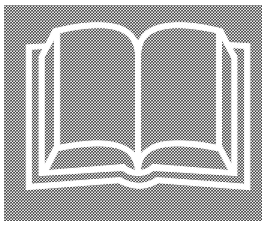
If the Stormwater Control Plan for the project meets the criteria in NPDES permit C.3.d and incorporates recommended source control measures for each potential source of pollutants identified, then the relevant questions regarding stormwater quality in the **Initial Study Checklist** can, in most cases, be answered "less than significant with mitigation incorporation." The City's initial study will note the specific source control and treatment BMPs incorporated and will reference the Stormwater Control Plan.

In some cases, a project may be below the threshold defined in Provision C.3.c but still create a significant new source of potential runoff pollutants. This might occur, for example, with an application for a use permit for a new business (say, a car wash) on an already fully developed (and impervious) site. In these cases, potential impacts can be mitigated through incorporation of appropriate permanent and operational source control BMPs.

Note that source control or treatment BMPs must be maintained for the life of the project to effectively mitigate the potential environmental effect. Similarly, operational BMPs must be implemented thoroughly and consistently to be effective mitigations. Monitoring of permanent BMPs will be accomplished through the City's **BMP verification program** (Chapter Six). The City also inspects industrial and commercial sites to verify consistent use of operational BMPs.

References and Resources

- California Environmental Quality Act Statutes (Public Resources Code §21000 *et seq.*)
- Governor's Office of Planning and Research
- City of Milpitas Environmental Information Form
- City of Milpitas Environmental Impact Assessment Form (Initial Study Checklist)
- CEQA Deskbook (Bass, et. al., 2001)



Chapter 5

Technical Requirements

Technical guidance for designing self-detaining areas and sizing treatment BMPs

This chapter will help you document the technical aspects of your site design and treatment BMPs. Your Stormwater Control Plan (Chapter 3), submitted with your planning and zoning application, must show the locations, sizes, and types of treatment BMPs. During plan check, City staff will conduct a detailed technical review of your construction plans. As part of this review, staff will evaluate your design for compliance with the numeric criteria in the RWQCB's NPDES permit.

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

The chapter has three parts. The first part explains the applicable criteria, interprets the RWQCB's aims in establishing the criteria, and refers to the documents, studies, and rationales on which the criteria are based. This part also provides some recommendations for selecting among the alternative criteria allowed by the RWQCB.

The second part of the chapter provides guidance for designing and documenting **self-retaining areas** and treatment BMPs. The recommended process aims to maximize the use of self-retaining areas and **integrated/distributed BMPs** while providing multiple options and flexibility to the designer. The process involves step-by-step completion of a table that will facilitate plan checking. This table should be submitted as part of your Stormwater Control Plan. See Chapter 3.

The third part of Chapter Five provides some sample specifications and details for treatment BMPs, design recommendations and tips, and references to available design manuals and guidance.

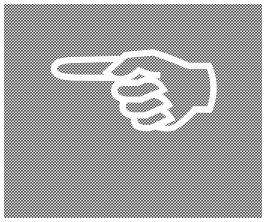
Stormwater Control Technical Criteria

The NPDES C.3. provisions require a complex, multifaceted approach to on-site stormwater control. In effect, project applicants must implement several different, independent measures to control stormwater pollutants, and each of these measures must independently meet a "maximum extent practicable" standard.

Specifically, applicants must control pollutant sources to the maximum extent practicable, limit pesticide use and potential impacts to the maximum extent practicable, and implement site design and landscape features which reduce runoff pollutants to the maximum extent practicable.

Most measures of "maximum extent practicable" are qualitative and are based on professional judgment and current practices. However, the permit includes **numeric criteria** for the design of treatment BMPs. These numeric criteria are intended to insure that the treatment BMPs are adequately designed to remove a significant portion of pollutants in runoff.

The permit also requires limits on peak runoff flow and peak runoff volume. Santa Clara Valley cities and the Santa Clara Valley Water District are working together, through SCVURPPP, to develop a required **Hydromodification Management Plan** (HMP). The HMP, which is still in preparation, will identify areas where peak runoff flow and volume must be controlled. In these areas, post-project runoff must not exceed estimated pre-project rates or durations.



The forthcoming HMP limits on runoff peak flow and volume are independent of the current requirements for treatment to achieve pollutant removal.

The HMP is to be submitted to the RWQCB by January 15, 2004. The RWQCB will set a schedule for its implementation. In the interim, for project applications deemed complete by **October 15, 2003** or later, projects must incorporate BMPs that meet the numeric criteria intended to insure treatment effectiveness.

Typically, BMPs designed for flow control will attempt to detain enough runoff to avoid increases in the peak flows that result from a 2-year, a 5-year, and a 10-year storm.

BMPs for pollutant removal are designed to treat runoff from smaller (1 to 2-year) storm. However, they are also designed to provide longer detention (e.g., 40 hours) to provide plenty of time for pollutants to settle out.

Basins or ponds can achieve detention and retention for flow control and also meet the detention time required to insure effective pollutant removal, but the design may require multiple discharge points at different depths.

► LIMITS ON THE USE OF INFILTRATION

The RWQCB permit requires a 10-foot vertical separation between the bottom of any "treatment BMPs that function primarily as **infiltration** devices" and the "seasonal high groundwater mark." In addition, these BMPs should not serve work areas, including automotive shops, car washes, fleet storage, nurseries, or other areas that may be significant sources of pollutants.

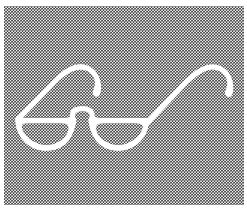
In many areas of Milpitas, high groundwater and impermeable soils preclude the use of infiltration. In some areas east of I-680, steep slopes and geological instability make infiltration inadvisable.

► NUMERIC CRITERIA

The RWQCB permit assumes that treatment BMPs can be classified as relying either on detention and infiltration (e.g. detention basins, dry wells, or constructed wetlands) or on filtration (e.g., sand filters). The permit specifies volume-based criteria for those BMPs relying on infiltration and detention and flow-based criteria for BMPs relying on filtration.

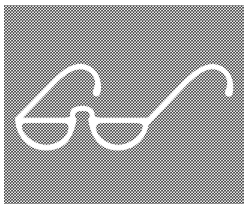
► VOLUME-BASED NUMERIC CRITERIA

The RWQCB permit specifies two alternative methods for calculating **water quality volume**, the volume of water that must be detained for a BMP to meet the "maximum extent practicable" criterion. The first method is stated in the book *Urban Runoff Quality Management* (Water Environment Federation Manual of Practice No. 23; ASCE Manual and Report on Engineering Practice No. 87, 1998) and is referred to as the **WEF Method**. The second method is in Appendix D of the *California Storm Water Best Management Practice Handbook (Municipal)* (SWQTF, 1993) and is referred to as the **California BMP Method.**[1]



The two methods are based on the same rainfall data and hydrological methodology, and they tend to yield similar results. The methods differ in some aspects of their practical application.

Both methods use an analysis of long-term rainfall data to identify a **design storm**. Eighty percent of total annual runoff is produced by storms this size and smaller. In the Milpitas area, the design storm totals about one-half inch of rainfall.



The WEF method requires that the designer specify a **drawdown time** of 12, 24, or 48 hours. Longer drawdown times require larger BMP volumes (because of the potential for back-to-back storms). Although the permit does not specify a

[1] Additional methods for sizing BMPs include those in the 2003 edition of the *California Storm Water Best Management Practices Handbook* (CASQA, 2003, available at www.cabmphandbooks.org) and *Sizing Criteria for Stormwater Treatment* (Geosyntecs Consultants, Draft Report, May 2003, distributed by SCVURPPP). These methods are variations on the methods specified in Provision C.3.d. of the RWQCB permit.

drawdown time, the longer time (48 hours) has been recommended by SCVURPPP consultants. Sediments from the Bay Area's fine-grained soils require a relatively long time to settle out. The California BMP method uses a fixed drawdown time of 40 hours.

The WEF method is based on 80% capture of average annual runoff. The California BMP method allows the designer to select a capture ratio; however, the RWQCB permit specifies that an 80% capture ratio be used.

The WEF method requires estimation of a mean storm precipitation volume. This can be based on local rainfall data. The analysis is conducted by taking periodic (e.g. hourly) rain gauge data, identifying distinct storms, calculating the total rainfall depth of each, and taking an average. Analysis of over 50 years of data at the San Jose Airport gauge resulted in a mean storm size of 0.512 inches. The California BMP method incorporates this analysis into a **nomograph** for the specific locality.

To summarize the comparison so far, the two methods have a similar technical basis, and the input variables are pre-selected in the RWQCB permit requirements.

The remaining difference between the two methods is in the interpretation and calculation of impervious area.

The WEF method requires calculation of a composite (weighted) runoff coefficient for the area that is tributary to the BMP being designed. Neither the permit nor the manual to which it refers specify runoff coefficients. Typical runoff coefficients are provided in various references (e.g. ASCE Manual of Practice No. 77, WEF Manual of Practice FD0-20, *Design and Construction of Urban Stormwater Management Systems*). In general, coefficients are provided as a range applicable to types of development (e.g., multi-unit attached development, 0.60 – 0.75). The choice of a specific coefficient within this range is left to the designer's professional judgment.

The California BMP method requires estimation of "the percentage of impervious area directly connected to the storm drain system. DCIA is defined as the area covered by pavement, building, and other impervious surfaces which drain directly into a storm drain without first flowing across pervious areas (e.g. lawns)." Conceptually, the tributary drainage is divided into areas that are either wholly pervious or wholly impervious. (In fact, the input parameters to the STORM model used to generate the California BMP curves assumed 0.9 for impervious surfaces and 0.15 for pervious surfaces.)

► FLOW-BASED CRITERIA

The RWQCB permit allows three alternatives for calculating the **peak flow rate** that a continuous-flow BMP (e.g., a sand filter without an upstream detention area) must be able to accommodate.

All three use the **rational method** to calculate peak flows:

$$Q = C\,i\,A$$

where

Q = Peak flow rate

C = Runoff coefficient (percent imperviousness)

i = Rainfall intensity

A = Tributary area

The difference between the three methods is in the calculation of the rainfall intensity, *i*.

The three alternatives are **intensity-duration-frequency (IDF)**, **percentile rainfall intensity**, and **0.2 inches/hour**.

The **intensity-duration-frequency** alternative requires that a time of concentration (T_c) be calculated for the tributary area. Calculation of a time of concentration is based on analysis of the time required for a hypothetical drop of water to flow from the furthest point of the watershed, overland and/or through pipes, to the BMP. Once T_c is determined, a corresponding *i* can be found from graphs of rainfall intensity vs. time from start of storm. These graphs can be found in the *Santa Clara County Drainage Manual*. The RWQCB permit specifies use of the rainfall intensity corresponding to a 50-year storm.

The **percentile rainfall intensity** alternative is based on ranking the intensity of rainfall from storms over a relatively long record. The RWQCB permit specifies that the intensity of the 85th percentile storm be multiplied by two. The result for the local area (San Jose) is 0.17 inches per hour.

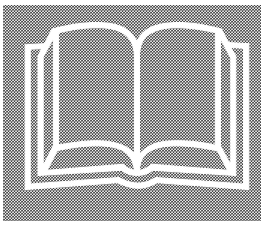
The **0.2 inches/hour** alternative simply specifies the required *i* : 0.2 inches per hour.

In summary, if the designer uses either the percentile rainfall intensity alternative or the 0.2 inches/hour alternative to size a flow-based BMP, he or she need only specify the tributary area and its percent imperviousness.

If the intensity-duration-frequency method is used, the designer must calculate T_c. Because calculation of T_c is complex and uncertain, and because the peak flow rate can be relatively sensitive to T_c, the City discourages applicants from using this method. It is most applicable to larger sites with overland drainage and relatively little impervious cover; however, the use of flow-based BMPs (such as sand filters) is inappropriate in such sites because of the potential for blinding the filter with fine sediments.

References and Resources

- RWQCB Order No. 01-119 (Stormwater NPDES Permit Amendments)
- *California Stormwater Best Management Practice Handbooks* (SWQTF, 1993).
- *California Stormwater Best Management Practice Handbooks* (CASQA, 2003).
- *Urban Runoff Quality Management* (WEF/ASCE, 1998)
- *Hydrology Handbook, Second Edition* (ASCE, 1996)
- *Low Impact Development Design Strategies: An Integrated Approach* (Maryland, 2001)



Documenting Your Design

There are two general approaches to managing site runoff.

The **integrated/distributed BMP** approach emphasizes "disconnection" of impervious areas from the drainage system and detention, infiltration, and treatment of runoff throughout the site. Detention and infiltration areas are sized and shaped to fit the available space. Maintenance requirements may be little more than what is required for normal landscaping. Low Impact Development, pioneered in Prince George's County, Maryland, exemplifies the integrated/distributed approach.

The **structural BMP** approach emphasizes the design of facilities that can retain, detain, and treat stormwater. Facilities are sized by engineering formulas to insure that a targeted proportion of sediment particles either settle or are filtered out of the runoff flow. The WEF/ASCE Manual of Practice, *Urban Runoff Quality Management*, exemplifies the structural BMP approach.

The two approaches are not exclusive and can be combined within one site.

In general, smaller BMPs distributed throughout the site look better and require less area. In addition, integrated/distributed BMPs are less likely to fail and may be less likely to create nuisances or safety hazards.

However, integrated/distributed BMPs are not individually engineered for each application. Therefore, for compliance purposes, it is necessary to account for the impervious area treated by each integrated/distributed BMP and show that the chosen suite of integrated/distributed BMPs will retain and treat the required proportion of total site runoff effectively.

The City of Milpitas has developed the following **recommended procedure** for selecting and documenting self-detaining areas, integrated/distributed BMPs, and structural BMPs.

The procedure maximizes the use of self-retaining areas and integrated/distributed BMPs and anticipates that, in many cases, structural BMPs such as detention basins and media filters may not be necessary to achieve compliance with the C.3 provisions. Where structural BMPs are required, the procedure minimizes their size.[1]

The procedure requires careful delineation of pervious areas and impervious areas (including roofs) throughout the site. The designer must, in effect, account for the runoff produced by each delineated area during the design storm. The procedure uses sizing factors to simplify design and arranges documentation of BMP sizing in a consistent format for presentation and review.

A **spreadsheet template**, in Microsoft Excel format, is provided for making calculations and presenting your submittal.

► SELECTING AND DOCUMENTING SELF-RETAINING AREAS AND BMPS

The required size of structural BMPs is proportionate to the total connected tributary area and the weighted imperviousness of that area. The best way to reduce the number and size of structural BMPs is to **disconnect portions of the tributary area** and remove these disconnected areas from the sizing calculation.

Pervious areas, including turf, landscaped areas, and pervious pavements, may be disconnected by designing them to **retain the design storm**. In effect, this means that they must retain the first ½-inch of rainfall.

Runoff from **impervious areas** (roofs and impervious pavements) can be **effectively disconnected** by routing runoff to planter boxes, bioretention areas, and other BMPs that are integrated into the landscaping. Simple factors may be used to size these **integrated/distributed BMPs**.

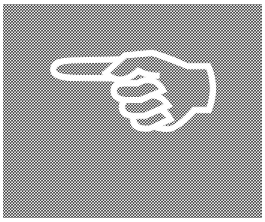
If the entire catchment area can be effectively disconnected, no **structural BMPs** are required. If some of the catchment area still produces runoff, structural BMPs are necessary, but the required size of the BMPs will be minimized.

Documentation requires identifying each self-detaining and non-self-detaining area within the catchment, identifying which non-self-detaining areas drain to

[1] The publication *Using Site Design Techniques to Meet Development Standards for Stormater Quality, A Companion Document to Start at the Source* (BASMAA, May 2003, 14 pp. available at www.scvurppp.org) suggests using self-retaining areas to reduce the size of detention basins and other structural BMPs. The Milpitas *C.3 Guidebook* approach maximizes self retaining areas first, then maximizes the use of integrated/distributed BMPs, and incorporates structural BMPs only as a last resort.

integrated/distributed BMPs, and estimating the imperviousness of each remaining non-self-detaining area. This information is then used to size any required structural BMPs.

These recommendations are intended to facilitate, not substitute for, creative interplay among site design, landscape design, and drainage design. Several iterations may be needed to find the combination of self-retaining areas, integrated/distributed BMPs, and structural BMPs that provides the optimal aesthetics, circulation, and use of available area for your site.



Equivalence
Retaining the first ½ inch of rainfall effectively disconnects an area from the drainage system for the purposes of the water quality design storm.

To create self-retaining turf and landscape areas in flat areas or on terraced slopes, berm the area or depress the grade so that these areas will retain at least ½ inch of rainfall. Specify slopes, if any, toward the center of the area. Or slope toward berms sufficiently high to pond a volume equal to ½ inch times the entire area. (Note: Landscape areas may also be appropriate locations for treatment BMPs.)

Areas covered with pervious pavement (e.g., crushed stone, pervious asphalt, or pervious concrete) can sometimes be handled similarly. Note that care must be taken to insure that sediment from landscaped or undeveloped areas does not wash on to the pervious pavement and cause clogging.

Table 1 in the accompanying spreadsheet (Appendix E) provides for documenting turf, landscape, pervious pavement, and other pervious areas.

Use this table to document all areas within the catchment that are not completely impervious. For non-self-retaining pervious areas only, select the appropriate runoff factor "C" and enter it on the spreadsheet.

To select integrated/distributed BMPs, first determine the impervious surface area that will drain to the BMP. Where possible, distribute drainage from opposite sides of driveways, opposite sides of buildings, and from different sections of parking lots to separate small BMPs located within landscaped areas. Integrated/distributed BMPs are best designed to serve impervious areas 15,000 square feet and smaller.

Then select a BMP type and apply the corresponding sizing factor to determine the required surface are of the BMP. Check that the required surface area can be accommodated within your site design, and redesign if necessary.

TABLE 5-1. ILLUSTRATION OF SPREADSHEET TABLE 1, for documenting pervious areas.

Area ID (as indicated on site drawing)	*Surface*	*Size (in SF) – Self-retaining areas*	*Size (in SF) – Non-self retaining areas*	*If non self-retaining, estimate runoff factor "C"*	*Size × C*
Total					

"C" factors (from BASMAA, 2003)

Turf	0.10	Pervious concrete	0.60
Landscape	0.10	Pervious asphalt	0.55
Crushed aggregate	0.10		

Table 2 in the accompanying spreadsheet (Appendix E) provides a way to document all impervious area within the catchment, document selection of integrated/distributed BMPs, and calculate of the required minimum surface area of each BMP.

TABLE 5-2. ILLUSTRATION OF SPREADSHEET TABLE 2,
for documenting impervious areas and treatment BMPs.

Impervious Area ID (as indicated on site drawing)	*Description (e.g., roof, parking lot, driveway)*	*Size (in SF)*	*BMP ID#*	*Area Served by BMP*	*Sizing Factor*	*Minimum required BMP Surface Area*	*Surface Area as Designed*
Total							

Sizing Factors

Landscape Swale	.034	Bioretention	.034
Vegetated Filter	.034	Sand Filter	.034
Stormwater Planter	.034		

EQUIVALENCE
The 0.034 sizing factor is applicable to BMPs that infiltrate runoff from 100% impervious area at 0.17 inches per hour intensity through soil or sand with a minimum infiltration rate of 5 inches per hour. (0.17/5 = 0.034).

Design requirements and details for some integrated/distributed BMPs are described in the BMP Gallery beginning on page 51.

► SIZING STRUCTURAL BMPS

The runoff from the remaining area in each catchment – pervious areas that are not self-retaining, plus impervious areas that are not served by integrated/distributed BMPs – must be routed to a structural BMP.

As described in the RWQCB permit, structural BMPs are either **volume-based** or **flow-based**.

For some volume-based structural BMPs (e.g., detention basins and constructed wetlands) discharge is controlled by the size of the outlet orifice. Note that suitable outlet orifices cannot be designed for small flows; for this reason, these BMPs should only be used to treat impervious areas larger than 15,000 square feet.

Volume-based BMPs may be sized using either the WEF method or the California BMP method. The two methods are essentially equivalent; the City of Milpitas recommends the California BMP method. The California BMP method is simpler to apply.

To size a structural BMP using the California BMP method, first determine **the percent directly connected impervious area for the remaining area**. The percent directly connected impervious area is simply the remaining impervious area divided by the remaining total area. (Self-retaining areas and areas draining to integrated/distributed BMPs are not included.) If this remaining directly connected impervious area is less than 15,000 square feet, use an integrated/distributed BMP and size factor.

For larger areas, use the nomograph (Appendix F). Follow the horizontal 80% annual percent capture line until it intersects with the appropriate DCIA curve (interpolate if necessary). Then read down to the x-axis and pick off the corresponding unit basin storage volume in feet. Multiply this number times the **remaining area** to be treated. This is the required water quality volume in cubic feet.

The provided spreadsheet calculates the percent directly connected impervious area and total remaining area for you. Only the unit basin storage volume need be read from the nomograph and entered into the spreadsheet. The required water quality volume is calculated automatically.

To determine the design flow for sand filters and other flow-based BMPs, first calculate the **percent imperviousness of the remaining area**. The percent imperviousness of the remaining area must be calculated by multiplying each component area by its respective runoff coefficient (or "C" factor), summing the

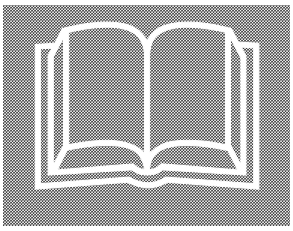
products of that multiplication, and then dividing by the total remaining area. Next, multiply by the appropriate rainfall intensity (0.2 inches/hour). Divide by 43,200 to get the design minimum flow rate in cubic feet per second.

► USING GROUNDWATER INFILTRATION

Where there is sufficient slope, or where the City's storm drain system can be feasibly accessed, it will be possible to design most BMPs with an impermeable liner and underdrain system to limit infiltration to groundwater.

However, where the stormwater NPDES permit criteria can be met, it may be more cost effective – and environmentally beneficial – to allow infiltration. For BMPs that rely on infiltration, the following must be documented:

- Depth from the base of the BMP to groundwater is 10 feet or more.
- Soils are NRCS Type "A" or "B." Infiltration in NRCS Type "C" soils may be allowed if infiltration rates are documented and the design insures drawdown within 24 hours.



References and Resources

- RWQCB Order 01-119, Provisions C.3.d and C.3.i.
- *Hydrology Handbook, Second Edition* (ASCE 1996)
- *Highway Design Manual* (California Department of Transportation, 2001). Chapter 8.
- *Portland Stormwater Management Manual* (City of Portland, 2002).
- Appendix A, Soils Map.
- Appendix B, Groundwater Elevation Map
- *USDA SCS Technical Release TR55*, Appendix A: Soil Types

Design Help

Start at the Source: Design Guidance Manual for Stormwater Quality Protection, published in 1999 by the Bay Area Stormwater Management Agencies Association (BASMAA), is an updated version of a manual first published in 1997. The 1999 edition covers planning and zoning, site design, and drainage systems. The manual also includes some details for site design, pervious pavements and landscaping, and BMPs.

Start at the Source is an excellent general design guide and is best consulted at the **beginning of the site design process**.

State and local governments elsewhere in the U.S. have developed more specific design details for BMPs. Portland, Oregon, developed the "simplified" design, using sizing factors, that is described above for selecting and sizing integrated/distributed BMPs. The City of Milpitas has selected and adapted some

of Portland's design details. These details may be adapted for use with the following integrated/distributed BMPs:

- Landscape Swales
- Vegetative Filters
- Stormwater Planters
- Landscape Infiltration
- Sand Filters

In addition, the City of Milpitas encourages the use of bioretention areas. A typical design (excerpted from Prince Georges County, 1999) is included in the BMP Gallery. Designers should also consult USEPA's *Storm Water Technology Fact Sheet: Bioretention* (EPA 832-F-99-012, 1999).

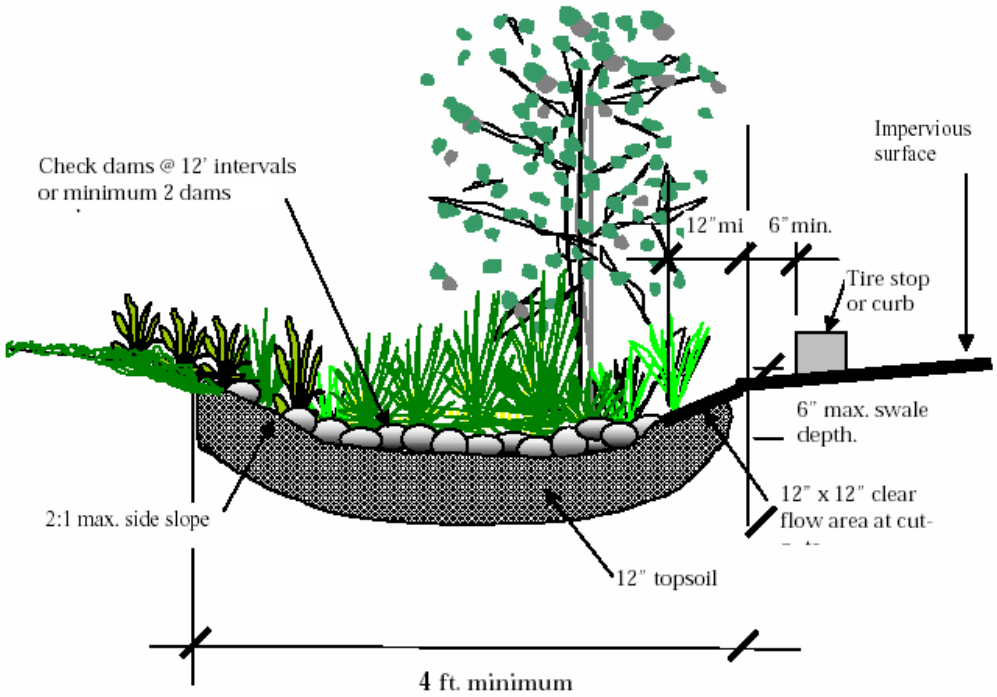
Most of these designs can be adapted to areas with low-permeability soils, shallow groundwater, or steep slopes by incorporating an impermeable liner and an underdrain system composed of drain rock and perforated drain pipe. Because the BMP may require 1' to 4' difference in elevation between the inlet and outlet, it is advisable to consider the requirements for these BMPs when preparing site plans and designing grading and drainage for the site.

For guidance on designing structural BMPs, see *Urban Runoff Quality Management* (WEF/ASCE, 1998) and the *California Stormwater BMP Handbooks* (CASQA, 2003).

BMP Gallery

The BMP designs on the following pages are intended for use with the sizing factors in Table 5-2. The designs are provided to assist you with developing a Stormwater Control Plan. More specific detailed drawings, showing construction materials and methods to be used, plumbing connections, etc., will be required with your application for a building permit. Some of these requirements appear in Appendix G. Check with the City of Milpitas Building Department for requirements that apply to your project.

► **LANDSCAPE SWALE**

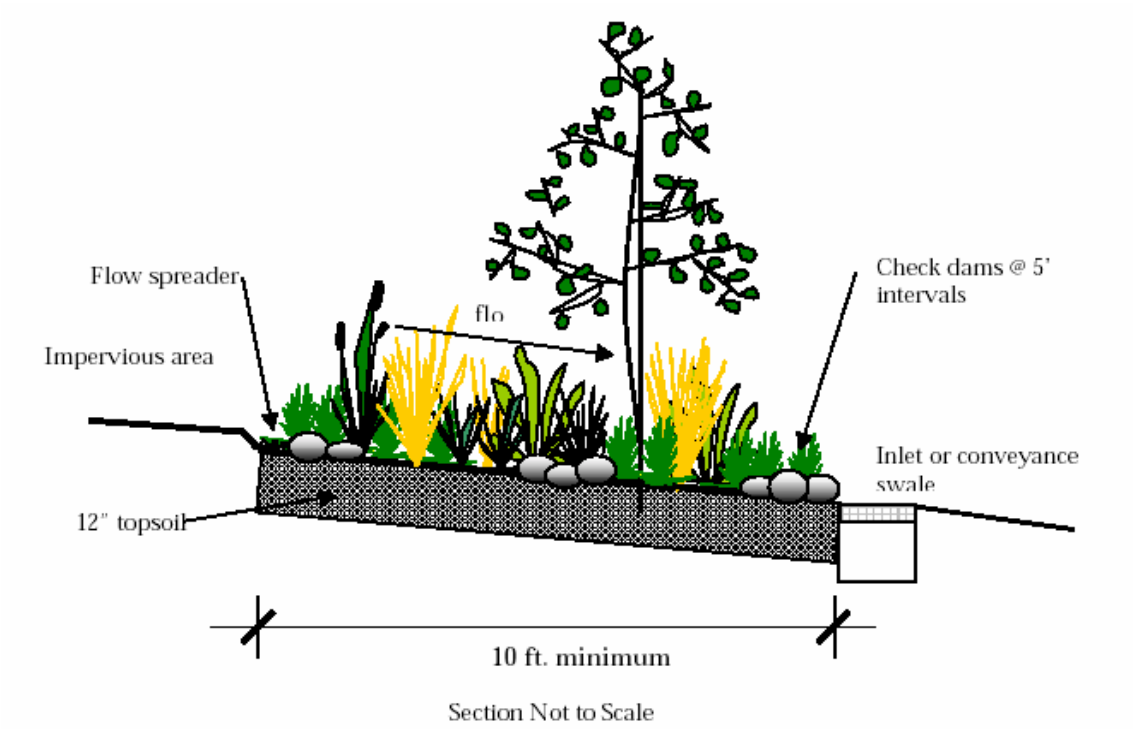


Section Not to Scale

Minimum length: 20 feet.
Maximum slope: 6%.
Soils in the top 12" to be equivalent to a sandy loam with a minimum infiltration rate of 5 inches/hour.
Irrigation required to maintain plant viability.
Check dams should extend the width of the swale, be 12" in length along the swale, 3"-5" high and constructed of rock, old brick, concrete, or similar.
No bypass required for larger storms.
Provide liner where depth to groundwater is less than 10'. Provide underdrain system in "D" soils or where liner is required.

Drawing courtesy City of Portland, OR.

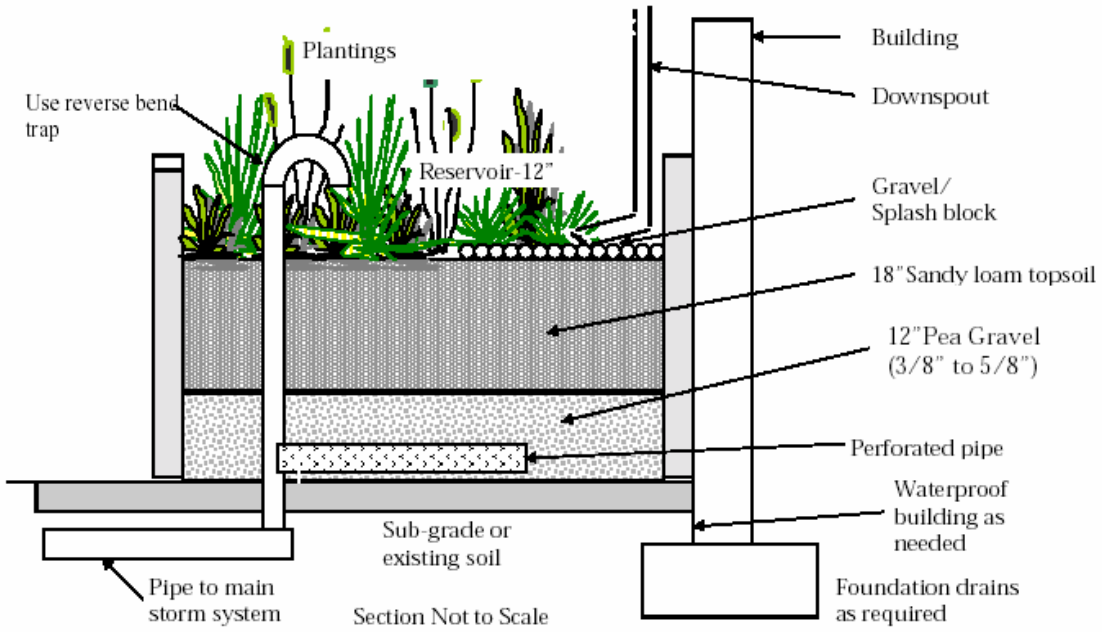
► VEGETATED FILTER



Runoff must enter the filter as sheet flow (e.g. from a parking lot),
or a flow spreader can be used to create sheet flow.
Use with any soil type; no underdrain required.
Soils in the top 12" to be equivalent to a sandy loam with a minimum infiltration rate of 5 inches/hour.
Minimum length: 10 feet.
Minimum width: 20 feet.
Maximum slope: 10%.
Irrigation required to maintain plant viability.
Check dams should extend the width of the swale, be 12" in length along the swale, 3"-5" high, and constructed of rock, old brick, concrete, or similar.

Drawing courtesy City of Portland, OR.

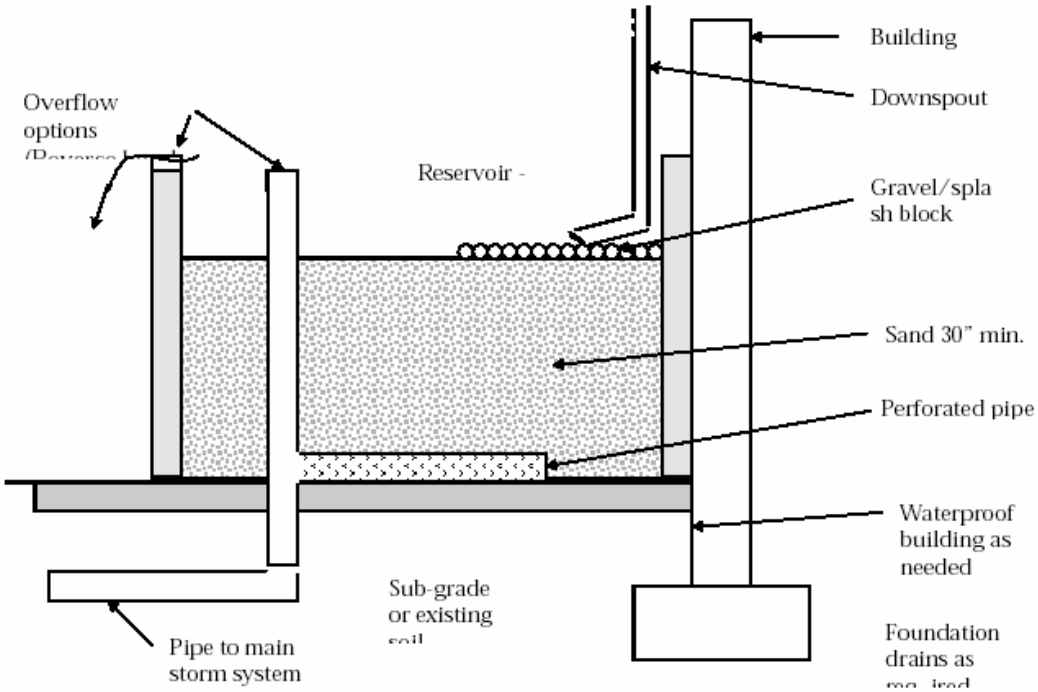
► **STORMWATER PLANTER**



Can be used in any soil type (A,B,C,D). Can be used adjacent to building and within setback area.
Sandy loam topsoil to have a minimum infiltration rate of 5 inches/hour.
Minimum width: 18".
Minimum length: none.
May be constructed of concrete, stone, or other durable material. Monolithic precast concrete recommended.
Irrigation required to maintain plant viability.
Install filter fabric between soil and gravel underdrain and around perforated pipe.
Size overflow trap for building code design storm; set trap below top of box.
Planter wall set against building should be higher to avoid overflow to that side.

Drawing courtesy City of Portland, OR.

► SAND FILTER

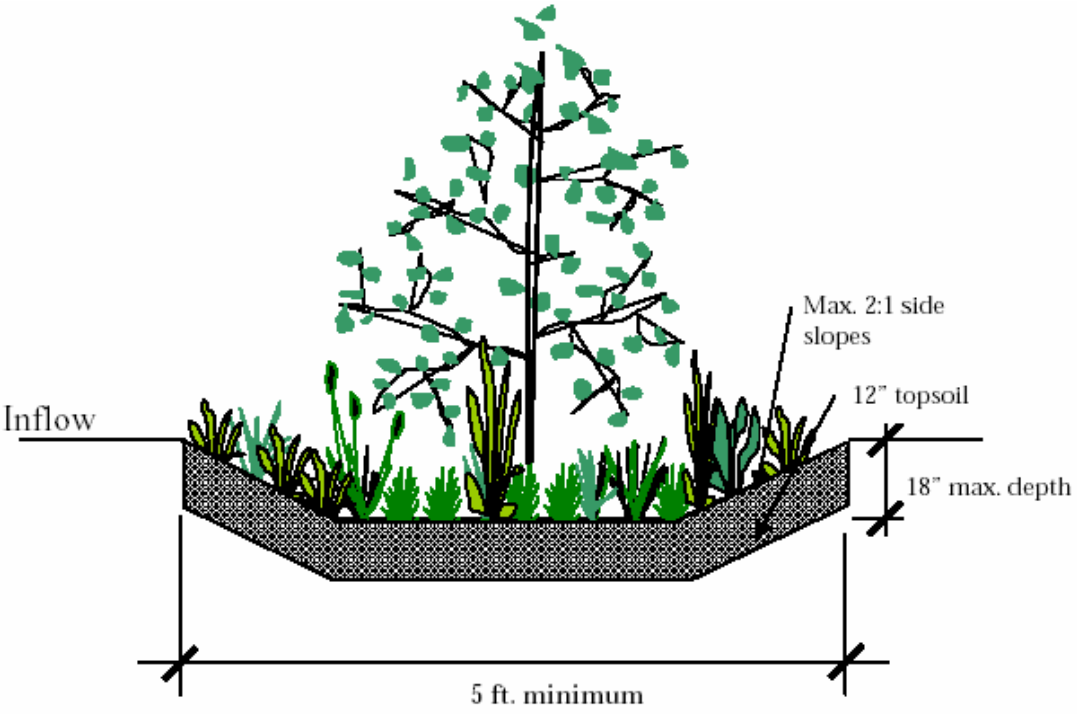


Section Not to Scale

Can be used in any soil type (A,B,C,D). Sand to have a minimum infiltration rate of 5 inches/hour.
Can be used adjacent to building and within setback area.
Can be used above or below grade.
Install filter fabric between soil and gravel underdrain and around perforated pipe.
Size overflow trap for building code design storm; set trap below top of box.
Planter wall set against building should be higher to avoid overflow to that side.

Drawing courtesy City of Portland, OR.

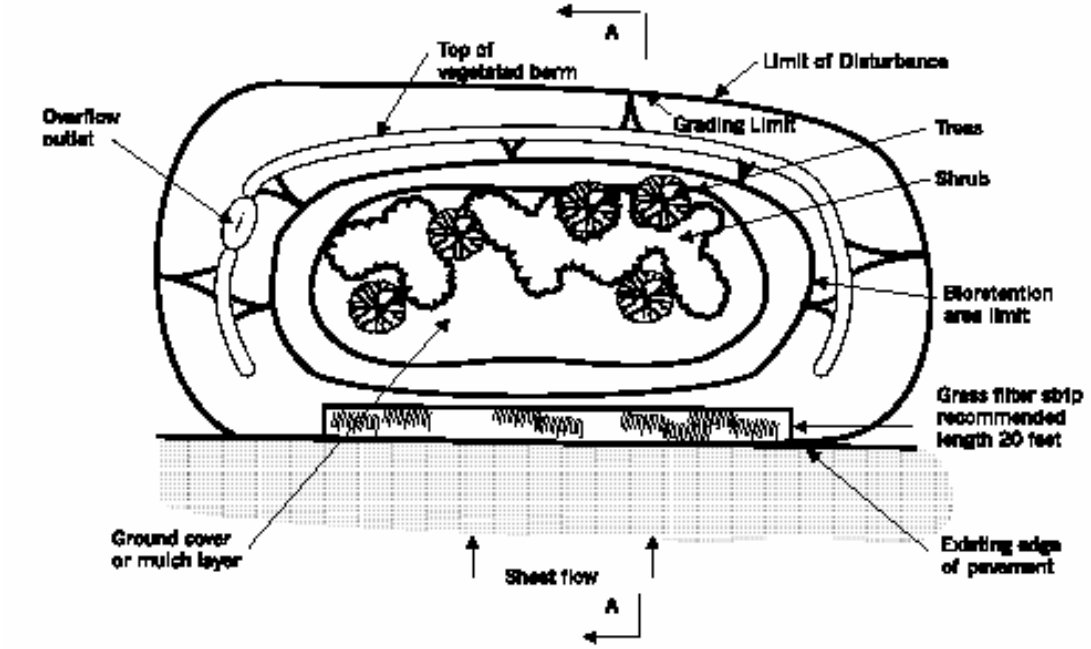
► **LANDSCAPE INFILTRATION/BIORETENTION**



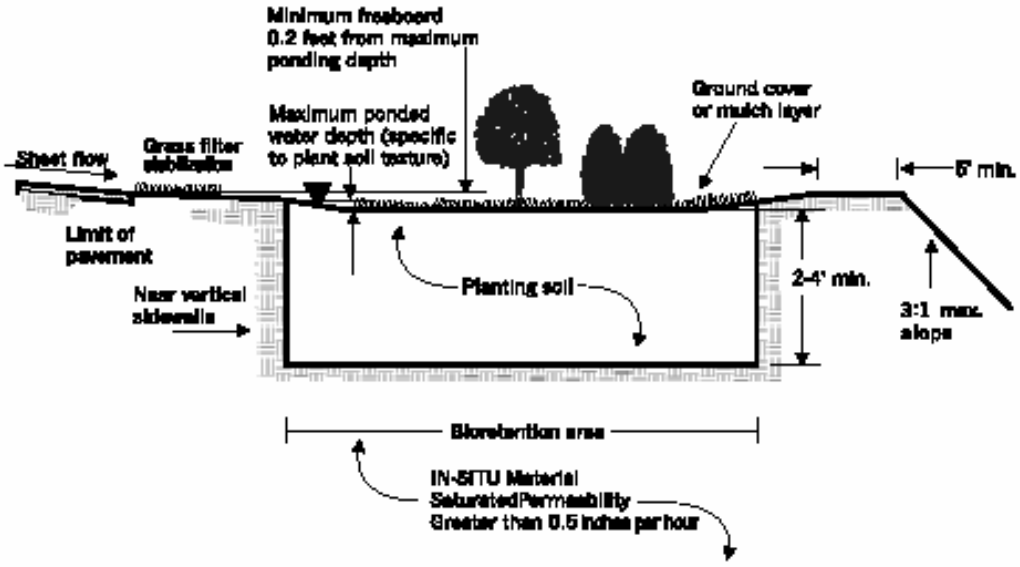
Section Not to Scale

Minimum storage depth: 6"
Maximum storage depth: 18"
Maximum side slope: 2:1.
Minimum bottom width: 3 '
Plantings may include trees, shrubs, grasses or turfgrasses suitable for periodic inundation. Irrigation required to maintain plant viability.
Soils in the top 12" to be equivalent to a sandy loam with a minimum infiltration rate of 5 inches/hour.
Provide liner where depth to groundwater is less than 10'. Provide underdrain system in "D" soils or where liner is required.

► **BIORETENTION**



Plan view (not to scale)



Section A-A (not to scale)

Planting soil to be equivalent to a sandy loam with a minimum infiltration rate of 5 inches/hour. Plantings may include trees, shrubs, grasses or turfgrasses suitable for periodic inundation. Irrigation required to maintain plant viability. Provide liner where depth to groundwater is less than 10'. Provide underdrain system in "D" soils or where liner is required. *Drawing courtesy Prince George's County, MD.*

Chapter 6

BMP Maintenance

Identify the maintenance needs for the treatment BMPs on your site.

Treatment BMPs must be regularly maintained to insure that they continue to be effective and that they do not cause flooding, harbor vectors, or otherwise cause a nuisance. This chapter describes general maintenance requirements for typical BMPs.

BMP maintenance is the responsibility of the property owner. The City will periodically inspect the site to verify maintenance of treatment BMPs.

Create your BMP maintenance plan in two stages. In the first stage, identify typical maintenance requirements for the BMPs you have selected for your site. Include this information in your **Stormwater Control Plan**.

In the second stage, schedule specific maintenance activities for each BMP, including one-time or frequent maintenance and inspections to occur during the first months or years after construction. This **Stormwater Control Operation and Maintenance Plan** – along with the project developer's signed statement accepting responsibility for maintenance until the responsibility is legally transferred to the owner – must be submitted before the building permit is final.

The City will implement a Stormwater Control Operation and Maintenance Verification Program, which will include periodic inspections. The program is described in Appendix H. Example Stormwater Control Operation and Maintenance Plans are in Appendix I.

Typical BMP Maintenance Requirements

Following are typical maintenance requirements for some common treatment BMPs. You can use this information to prepare your Stormwater Control Plan.

► VEGETATED FILTERS, SWALES, AND BIORETENTION AREAS

These BMPs remove pollutants primarily by filtering runoff slowly through an active layer of soil. Routine maintenance is needed to insure that flow is unobstructed, that erosion is prevented, and that soils are held together by plant roots and are biologically active. Typical maintenance consists of the following:

- Inspect **inlets** for channels, exposure of soils, or other evidence of erosion. Clear any obstructions and remove any accumulation of sediment. Examine rock or other material used as a splash pad and replenish if necessary.

- Inspect **outlets** for erosion or plugging.

- Inspect **side slopes** for evidence of instability or erosion and correct as necessary.

- Observe soil at the bottom of the swale or filter for uniform **percolation** throughout. If portions of the swale or filter do not drain within 48 hours after the end of a storm, the soil should be tilled and replanted. Remove any debris or accumulations of sediment.

- Confirm that **check dams** and **flow spreaders** are in place and level and that channelization within the swale or filter is effectively prevented.

- Examine the **vegetation** to insure that it is healthy and dense enough to provide filtering and to protect soils from erosion. Replenish mulch as necessary, remove fallen leaves and debris, prune large shrubs or trees, and mow turf areas. Confirm that irrigation is adequate and not excessive. Replace dead plants and remove invasive vegetation.

- Abate any potential **vectors** by filling holes in the ground in and around the swale and by insuring that there are no areas where water stands longer than 48 hours following a storm. If mosquito larvae are present and persistent, contact the Santa Clara County Vector Control District for information and advice. Mosquito larvicides should be applied only when absolutely necessary and then only by a licensed individual or contractor.

► PLANTER BOXES

Planter boxes capture runoff from downspouts or sheet flow from plazas and paved areas. The runoff briefly floods the surface of the box and then percolates through an active soil layer to drain rock below. Typical maintenance consists of the following:

- Examine **downspouts** from rooftops or sheet flow from paving to insure that flow to the planter is unimpeded. Remove any debris and repair any damaged pipes. Check splash blocks or rocks and repair, replace, or replenish as necessary.

- Examine the **overflow** pipe to make sure that it can safely convey excess flows to a storm drain. Repair or replace any damaged or disconnected piping.

- Check the **underdrain** piping to make sure it is intact and unobstructed.

- Observe the **structure** of the box and fix any holes, cracks, rotting, or failure.

- Check that the **soil** is at the appropriate depth to allow a 12" reservoir above the soil surface and is sufficient to effectively filter stormwater. Remove any accumulations of sediment, litter, and debris. Confirm that soil is not clogging and that the planter will drain within 3-4 hours after a storm event.

- Determine whether the **vegetation** is dense and healthy. Replace dead plants. Prune or remove any overgrown plants or shrubs that may interfere with planter operation. Clean up fallen leaves or debris and replenish mulch. Remove any nuisance or invasive vegetation.

► SAND FILTERS

Sand filters remove pollutants by physical settling and adsorption as runoff flows through the granular media. Unlike the soil in planter boxes and vegetative filters, the sand does not support soil organisms that keep the medium mixed and adsorptive. Sand filters may be more prone to blinding (development of an impermeable surface layer) and clogging (accumulations of clayey sediments deeper in the filter).

Typical maintenance consists of the following:

- Check **inlets**. Remove any accumulated sediment or debris. Examine splash blocks or rock and replace or replenish as needed.

- Insure that the **overflow** pipe or **spill** point is clear and can convey excess flows to storm drains. Look for any evidence of channeling or erosion. Replace or replenish rocks or armoring.

- Observe the **structure** of the filter and fix any holes, cracks, or failure.

- Look at the **sand** to insure that the level allows a 12" reservoir above the surface. Remove any debris or accumulated sediment. Confirm that the surface of the sand is not blinded by fine sediment. If it is, remove and replace the top layer of sand. Check that the filter as a whole is not clogged. If it is, all media may need to be removed and replaced. If no blinding or clogging is apparent, rake the surface of the sand.

- Check the **underdrain** piping to make sure it is intact and unobstructed.

► WET, EXTENDED WET DETENTION, AND DRY DETENTION PONDS

These larger-scale BMPs remove pollutants by detaining runoff in a quiescent pool long enough for some of the particulates to settle to the bottom. They require both routine (preventative) maintenance and non-routine maintenance.

Typical routine maintenance consists of the following:

- Examine **inlets** to insure that piping is intact and not plugged. Remove accumulated sediment or debris near the inlet.

- Examine **outlets** and **overflow structures** and remove any debris or sediment that could plug the outlets. Identify and correct any sources of sediment and debris. Check rocks or other armoring and replace as necessary.

- Inspect **embankments**, dikes, berms, and side slopes for signs of erosion or structural deficiencies.

- Confirm that any **fences** around the facility are secure.

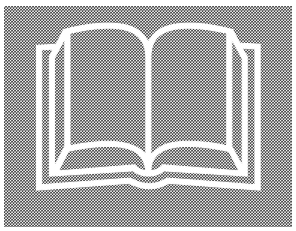
- Control **vectors** by filling any holes in or around the pond and examine the pond for evidence of mosquito larvae.

Typical non-routine maintenance includes the following:

- **Dredge** accumulated sediment. This may be required every five to 15 years, and more frequently if there are excess sources of sediment (as may occur on newly constructed sites where soils are not yet stabilized). Dredging is usually a major project requiring mechanized equipment. The work will include an initial survey of depths and elevations, sediment sampling and testing, removal, transport, and disposal of accumulated sediment, and reestablishment of original design grades and sections.

- Remove **invasive plants**. Depending on the success of the design and the rate of sedimentation, ponds may be subject to excessive growth of

rooted macrophytes, which reduce the effective area of the pond and create quiescent surface water that supports mosquito larvae. Removal may require a level of effort similar to dredging.



References and Resources

- *Start at the Source* (BASMAA, 1999) pp. 139-145.
- *Urban Runoff Quality Management* (WEF/ASCE, 1998). pp 186-189.
- *Stormwater Management Manual* (Portland, 2002). Chapter 6.0.
- *California Storm Water Best Management Practice Handbooks* (CASQA, 2003).
- SCVURPPP Operation & Maintenance Fact Sheets:
  Exfiltration Trench
  Hydrodynamic Separators
  Planter Boxes
  Porous Pavement
  Roof Gardens
  Underground Detention Systems
- *Best Management Practices Guide* (Public Telecommunications Center for Hampton Roads, 2002).

Chapter 7

Alternative Compliance Options

Alternatives for meeting stormwater control requirements for your site by participating in a regional stormwater facility, by implementing compensatory mitigation, or obtaining an exemption.

The RWQCB's permit allows the City to establish a "waiver and compensatory mitigation" program. Under certain conditions, a project applicant may choose to omit runoff treatment BMPs from their project design. Instead, applicants would create an equivalent water-quality benefit at a different site. Where feasible, this site should be in the same drainage basin.

Other C.3 requirements – including site designs to minimize imperviousness and structural source control BMPs – may still apply.

City staff can provide up-to-date information on the City's proposed waiver program and how it might apply to your project.

References and Resources

- RWQCB Order 01-119, Provision C.3.g

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