BASMAA POST-CONSTRUCTION MANUAL

DESIGN GUIDANCE FOR STORMWATER TREATMENT AND CONTROL FOR PROJECTS IN MARIN, SONOMA, NAPA, AND SOLANO COUNTIES

A Low Impact Development approach
to implementing Provision E.12 of the
Phase II Small MS4 General Permit

Prepared for the Bay Area
Stormwater Management
Agencies Association (BASMAA)
Phase II Committee
with funding from the
North Bay Watershed Association

January 2019

Acknowledgement

The project partners express thanks to the Contra Costa Clean Water Program for allowing use of text and graphics from the Program's *Stormwater C.3 Guidebook, 7th Edition.* These materials include drawings created for CCCWP by Bob Birkeland, ASLA.

Disclaimer

The individuals, cities, towns, counties, districts, and associations listed on page III of this Manual, hereinafter referred to collectively as "Entities," including all commissions, departments, agencies, and other subdivisions of Entities, and including all Entities' elected officials, directors, officers, employees, agents, successors, assigns and persons or entities acting on behalf of Entities accepts no responsibility for any loss, damage, or injury as a result of use of this manual.

Dispute Resolution

Provision H of the Phase II Small MS4 General Permit (Water Quality Order 2013-0001-DWQ) addresses dispute resolution in the event of a disagreement between a Phase II Permittee or other interested party and a California State Regional Water Quality Control Board over the interpretation or implementation of any permit provision.

COLLABORATIVE PROJECT PARTNERS:

Bay Area Stormwater Management Agencies Association Phase II Committee

Marin County Stormwater Pollution Prevention Program

City of Belvedere
Town of Corte Madera
County of Marin
Town of Fairfax
City of Larkspur
City of Mill Valley
City of Novato
Town of Ross
Town of San Anselmo
City of San Rafael
City of Sausalito
Town of Tiburon

Napa Countywide Stormwater Pollution Prevention Program

City of American Canyon
City of Calistoga
County of Napa
City of Napa
City of St. Helena
Town of Yountville

Municipal Stormwater Agencies in Sonoma and Solano Counties

Sonoma County Water Agency
City of Sonoma
City of Petaluma
County of Sonoma

County of Solano
City of Benicia

North Bay Watershed Association Joint Technical Committee

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PREFACE

In 1987, Congress amended the Clean Water Act to mandate controls on discharges from municipal separate storm sewer systems (MS4s). Acting under the Federal mandate and the California Water Code, California Water Boards require cities, towns, and counties to regulate activities which can result in pollutants entering their storm drains. All municipalities prohibit non-stormwater discharges to storm drains and require residents and businesses to use Best Management Practices (BMPs) to minimize the amount of pollutants in runoff. To enforce prohibitions and to promote the use of BMPs, the municipalities inspect businesses and construction sites, conduct public education and outreach, sweep streets, and clean storm drains. In addition, municipalities actively support projects to assess, monitor, and restore local creeks and wetlands.

On February 5, 2013, California's State Water Resources Control Board reissued the Phase II Stormwater National Pollutant Discharge Elimination System (NPDES) Permit for small MS4s. Provision E.12, "Post-Construction Stormwater Management Program," mandates municipalities to require specified features and facilities—to control pollutant sources, control runoff volumes, rates, and durations, and to treat runoff before discharge from the site—be included in development plans as conditions of issuing approvals and permits. The new requirements continue a progression of increasingly stringent requirements since 1989.

Provision E.12 requires all municipal permittees to implement these requirements by **June 30, 2015,** to the extent allowed by applicable law. This includes projects requiring discretionary approvals that have not been deemed complete for processing and discretionary permit projects without vesting tentative maps that have not requested and received an extension of previously granted approvals. Individual municipalities sometimes require implementation on development projects not subject to the requirements to mitigate impacts identified during California Environmental Quality Act (CEQA) review, to address impacts on local drainage systems, or to preserve and enhance local environmental quality.

With funding from the North Bay Watershed Association (NBWA) and support from the NBWA Joint Technical Committee, the Bay Area Stormwater Management Agencies Association (BASMAA), through the BASMAA Phase II Committee, created this Manual to assist applicants for development approvals to prepare submittals that demonstrate their project complies with the NPDES permit requirements. Applicants who seek development approvals for applicable projects within the jurisdictions listed on page III should follow the *Manual* when preparing their submittals.

Links

North Bay Watershed Association http://www.nbwatershed.org/

Bay Area Stormwater Management Agencies Association (BASMAA) www.basmaa.org

San Francisco Bay Regional Water Quality Control Board www.waterboards.ca.gov/sanfranciscobay

State Water Resources Control Board Phase II Stormwater Permit (Water Quality Order 2013-0001-DWQ) http://www.waterboards.ca.gov/water_issues/programs/stormwater/phase_ii_municipal.shtml

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Tables and Checklists

Figures

Additional Resources

Available at the County of Marin's Development Projects/Post-Construction Stormwater Management page https://www.marincounty.org/depts/pw/divisions/creeks-bay-and-flood/mcstoppp/development/new-and-redevelopment-projects

and at the County of Napa's Post-Construction Best Management Practices page https://www.countyofnapa.org/1437/Post-Construction-Best-Management-Practi

- Technical Criteria for Non-LID Facilities
- Example Stormwater Control Plan for a Commercial Project
- Example Stormwater Facilities Operation and Maintenance Plan for a Commercial Project
- Example Stormwater Control Plan for a Residential Subdivision
- Example Stormwater Facilities Operation and Maintenance Plan for a Residential Subdivision
- Operation and Maintenance Plan Agreement Template
- Memo, "Evaluating Hydromodification Performance of Bioretention" (Dubin Environmental Consulting, 2014)

Acronyms

APN	Assessor's Parcel Number
BASMAA	Bay Area Stormwater Management Agencies Association
BGL	Bottom of Gravel Layer
BMP	Best Management Practice
CC&Rs	Covenants, Conditions, and Restrictions
DMA	Drainage Management Area (see Chapter 4)
HOA	Home Owners Association
LID	Low Impact Development
MS4	Municipal Separate Storm Sewer System, as defined in the Clean Water Act
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
SCP	Stormwater Control Plan
TGL	Top of Gravel [Storage] Layer
TSL	Top of Soil Layer

Terms

Self-Treating Areas	Pervious areas that drain directly off-site or to the storm drain system. See page 4-2.
Self-Retaining Areas	Pervious areas that are graded to retain the first inch of rainfall. See page 4-2.
Source Controls	BMPs that control the pollutant sources listed in Appendix A. See pages 3-5 and 3-6.
Hydromodification (HM)	The modification of a stream's hydrograph, caused in general by increases in flows and durations that result when land is developed (e.g., made more impervious). The effects of hydromodification include, but are not limited to, increased bed and bank erosion, loss of habitat, increased sediment transport and deposition, and increased flooding.

CHAPTER 1

ABOUT THE STORMWATER REQUIREMENTS

This BASMAA Post-Construction Manual (Manual) includes standards and requirements applicable to projects in the jurisdictions listed on page III.

These counties, cities, and towns are Permittees under a statewide Phase II municipal stormwater NPDES permit reissued by the California State Water Resources Control Board in 2013. Permit Provision E.12 requires these agencies to regulate development projects to control pollutants in runoff from newly created or replaced impervious surfaces.

This *Manual* is designed to ensure compliance with the requirements, facilitate review of applications, and promote integrated Low Impact Development (LID) design. The *Manual* interprets, clarifies, and adds to permit requirements.

What Projects Must Comply?

Table 1-1 (on the following page) summarizes the minimum requirements for new or redevelopment projects. Your local plan reviewer can advise you regarding exceptions and additional requirements specific to your project, which may supersede this Manual.

Routine maintenance or repair, such as exterior wall surface replacement and pavement resurfacing, and including routine maintenance to maintain original line and grade, hydraulic capacity or original purpose, are not subject to the requirements.

All projects must also conserve natural areas as much as possible consistent with local General Plan requirements, protect slopes and channels against erosion, and comply with local stream setback policies. The stormwater NPDES requirements are separate from and in addition to flood protection requirements.

What is Low Impact Development?

LID design aims to mimic pre-project site hydrology as well as protect water quality. Runoff from roofs and impervious paved areas is dispersed to landscaped areas or routed to bioretention facilities distributed throughout the site. Bioretention facilities infiltrate some runoff and also feature underdrains to convey treated stormwater to storm drains.

Some of the advantages of LID are:

- Provides effective stormwater treatment by filtering pollutants and sequestering them within soils.
- Processes pollutants through biological action in the soil, rendering some pollutants less toxic.
- Bioretention facilities can be an attractive landscape amenity.
- Quick-draining bioretention facilities do not harbor mosquitoes or other vectors.

"Low Impact Development is a stormwater management and land development strategy applied at the parcel and subdivision scale that emphasizes conservation and the use of on-site natural features integrated with engineered, small-scale hydrologic controls to more closely mimic pre-development hydrology."

— Puget Sound Action Team, 2005

- Mimics the natural hydrologic condition, including recharge to groundwater and contribution to stream flows.
- Requires maintenance effort similar to that for landscaped areas; no special equipment is needed.
- Above-ground, visible facilities are easy to monitor and inspect.
- Vegetated areas help reduce the accumulation of heat on roofs and pavement.

Table 1-1. Requirements at a Glance

Type of Project	Project Requirements	Your Submittal
Single-Family Homes*† Projects that create or replace 2,500 square feet (SF) or more of impervious surface.** **Small Projects**† Projects that create or replace between 2,500 and 5,000 SF of impervious surface**	Implement **at least one measure** to reduce runoff, for example by dispersing runoff to landscape or using pervious pavements. Additional Requirements: 1. Limit clearing, grading, and soil compaction. 2. Minimize impervious surfaces. 3. Conserve natural areas of the site as much as possible consistent with local General Plan policies. 4. Comply with stream setback ordinances/requirements. 5. Protect slopes and channels against erosion.	Follow the instructions in the template: "Stormwater Control Plan for a Single-Family Home or Small Development Project" (Appendix C).
Regulated Projects, other than single-family homes,* that create or replace 5,000 SF or more of impervious surface.**	Site Design/Runoff Reduction Measures (above), plus: 1. Route remaining runoff to bioretention or other facilities sized and designed according to the criteria in Chapter 4. †† 2. Identify potential sources of pollutants and implement corresponding source control measures in Appendix A. 3. Provide for ongoing maintenance of bioretention facilities.	Follow the instructions in this manual and use the template: "Stormwater Control Plan for a Regulated Project" (Appendix D)
Roads and Linear Utility Projects (LUPs) Projects that create 5,000 SF or more of newly constructed, contiguous impervious surface.**	Requirements Vary	Contact your local stormwater coordinator regarding compliance options.

Editable forms and templates are available at www.basmaa.org.

* Single-family homes (determined by planning department) that are not part of a larger plan of development.

† Single Family Homes or Small Projects may be required to follow requirements for Regulated Projects where deemed appropriate by the municipality based on the nature and extent of the proposed project.

** When tallying impervious surface created or replaced, pervious pavements designed according to the criteria in Chapter 4, raised decks and solar panels, and surfaces that drain to the sanitary sewer, such as swimming pools, may be excluded.

†† Where a project results in an increase of more than 50% of the impervious area of a previously existing development, runoff from new, replaced, and previously existing impervious surfaces must be included to the extent feasible. Facilities built to these criteria meet the hydromodification management standard in Provision E.12.f. See Dubin Environmental Consulting's 2014 memo, "Evaluating Hydromodification Performance of Bioretention."

CHAPTER 2

THE PATH TO STORMWATER COMPLIANCE

Start Early

Stormwater facilities must be integrated into the planning, design, construction, operation, and maintenance of your development project.

Your strategy for stormwater compliance should be an integral part of the earliest decisions about how the site will be developed. Once subdivision lot lines have been sketched, or buildings and parking have been arranged on a commercial site, the stormwater compliance design may already be constrained—often unnecessarily.

At this earliest stage, also consider who will be responsible for maintaining your bioretention facilities in perpetuity. The NPDES permit requires the local municipality to verify stormwater treatment facilities are being maintained and are operating as designed. The municipality will typically enter into a formal agreement with the property owner. The agreement will typically include provisions to allow access for inspections, require the property owner to retain an approved inspector and/or pay a fee to cover the cost of the inspections, and give the municipality the right to conduct remedial maintenance and recover costs in the event facilities are not properly maintained.

In residential subdivisions, the need to provide for maintenance of stormwater treatment facilities can affect the layout of streets and lots, decisions whether to incorporate a homeowner's association (HOA), liability, insurance, and capital considerations, and the value of the individual built lots. In addition, municipalities may require the builder provide an extended maintenance and warranty period for the facilities before turning them over to an HOA or other entity for maintenance in perpetuity. Again, it's best to start early!

Here are some of the key stormwater compliance milestones as you manage your development project:

1: Pre-application meeting

2: Follow this Manual

3: Stormwater Control Plan (SCP)

4: Draft Stormwater Facilities Operation and Maintenance Plan

5: Detailed Project Design

6: Construction

7: Transfer Maintenance Responsibility

"Plan and design your stormwater controls integrally with the site and landscaping for your project."

1: Pre-Application Meeting

During the early planning stages of your project, set up a pre-application meeting to discuss stormwater requirements with municipal staff responsible for reviewing your project. Their experience with similar projects and with local procedures, requirements, and community preferences can provide invaluable insights.

You might also discuss with staff the right timing for completing your Stormwater Control Plan (SCP). Often, site designs take a few iterative reviews (by staff or by a Design Review Committee) before a satisfactory site layout is achieved. It is important to consider site drainage and locations for bioretention facilities throughout this iterative process. However, it may make sense to delay compilation and formal submittal of the SCP until the site layout is fairly well set.

2: Follow the Manual

During the site planning process, read this *Manual* to understand the principles and design procedures before beginning to design your project. Then, follow the steps in Chapter 3 as you lay out the site.

3: Stormwater Control Plan

Prepare a complete SCP for submittal with your application for planning and zoning approval. The SCP will demonstrate adequately sized bioretention facilities can be accommodated within your site and landscape design.

Be sure the bioretention facilities shown on your SCP Exhibit are also shown, as appropriate, on your preliminary site design, architectural design, and landscape designs.

Your SCP may also be used in supporting a Negative Declaration or may be referenced in an Environmental Impact Report. In general, for most projects, implementing the techniques and criteria in this manual will be considered to mitigate the project's potential impacts on stormwater quality.

If your project receives planning and zoning approval (entitlements), a Condition of Approval will specify the project be designed and constructed consistent with the SCP.

As described in Chapter 3, your SCP will include a Construction Checklist of items to be followed up during the final design phase of your project.

Your SCP must also include a statement accepting responsibility to maintain the stormwater treatment facilities until that responsibility is transferred to the project operator or owner or another responsible party.

4: Draft Stormwater Facilities Operation and Maintenance Plan

During the planning phase of the project, develop a Stormwater Facilities Operation and Maintenance Plan (O&M Plan). As described in Chapter 5, the O&M Plan is a living document used to plan, direct, and record maintenance of bioretention or other treatment facilities. It identifies the individuals responsible for maintenance, who must keep an up-to-date copy and file periodic updates with the municipality. In the case of a residential subdivision, maintenance may be implemented may be a homeowners association, if that arrangement has been approved by your municipality.

The final O&M Plan must include as-built documentation of how the facilities are constructed (this may be required before permit is made final).

Typically, municipalities require an Operation and Maintenance Agreement that "runs with the land." The legally

enforceable agreement obligates current and future property owners to implement the O&M Plan.

5: Detailed project design

After obtaining planning approval, incorporate the site design measures and treatment facilities identified in the SCP into the project construction documents.

The site design and landscape design must integrate the functionality of bioretention facilities and other stormwater features into the aesthetic and functional values of the project.

Typical design issues include edges and transitions to allow runoff to flow from sidewalks and paved areas into bioretention facilities, dissipation of energy gained by runoff flowing down slopes, planting and irrigation of bioretention facilities, and integration of berms, fences, and walls in or near bioretention facilities.

Chapter 4 includes design criteria and tips.

The submitted construction documents should include the Construction Checklist to assist the plan checker to cross-reference the SCP features with the plan sheets that show how the features have been executed.

6: Construct the Project

Careful construction of bioretention facilities, coordinated with the building of the development, will help ensure the facilities function as intended and will also minimize future maintenance problems. Items to check during construction include:

- Avoid compaction of native soils around where bioretention facilities will be constructed.
- Closely follow design elevations.
- Grade parking lots, driveways, and streets to promote evenly distributed sheet flow into bioretention facilities.
- Set overflow inlets at the proper elevation so the surface of the bioretention facility floods as intended.

"Set overflow inlets at the proper elevation so the surface of the bioretention facility floods as intended."

Appendix B is an inspection schedule and checklist for construction of bioretention facilities.

7: Transfer Maintenance Responsibility

Following construction—and a recommended maintenance and warranty period—transfer maintenance responsibility to the owner or operator of the project, who will maintain the facilities in perpetuity. Typically, this responsibility will be formalized in an Operation and Maintenance Agreement between the property owner and the municipality.

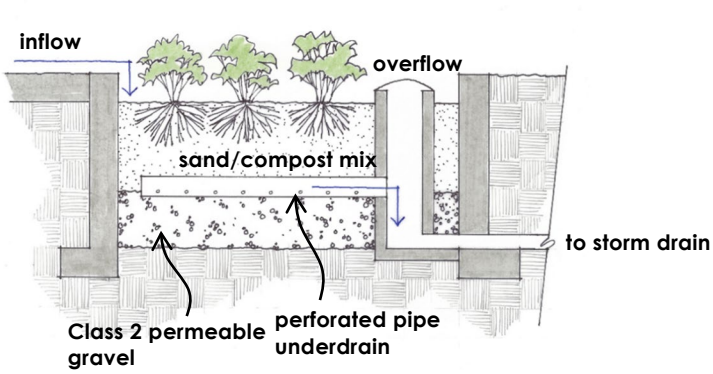


Figure 2.1. Bioretention Facility. The NPDES permit specifies the use of, and design criteria for, bioretention facilities to treat stormwater.

CHAPTER 3

PREPARING A STORMWATER CONTROL PLAN FOR A REGULATED PROJECT

Objectives

Your Stormwater Control Plan (SCP) for a Regulated Project must demonstrate your project incorporates site design measures and treatment facilities (typically bioretention facilities) that will:

- Minimize imperviousness.
- Retain or detain stormwater.
- Slow runoff rates.
- Reduce pollutants in post-development runoff.

In particular, you will need to show all runoff from impervious areas is either dispersed to landscape or routed to a properly designed LID treatment facility.

A complete and thorough SCP will enable municipal development review staff to verify your project complies with these requirements. It is strongly recommended you retain a design professional familiar with the requirements.

Contents

Your SCP will consist of a report and an exhibit. Municipal staff will use the Stormwater Control Plan Checklist (page 3-2) to review your Plan's completeness.

Step by Step

Plan and design your stormwater controls integrally with the site plan and landscaping for your project. This strategy requires you invest in early and ongoing coordination among project architects, landscape architects, and civil engineers. However, it can pay big dividends in a cost-effective, aesthetically pleasing design—and by avoiding design conflicts later.

"Plan and design your stormwater controls integrally with the site and landscaping for your project."

Your initial, conceptual design for the project should include site drainage. This should include identifying areas where runoff can be dispersed and/or the location and approximate size of stormwater treatment and flow-control facilities.

Follow these nine steps to complete your SCP.

Step 1: Project Information

Step 2: Opportunities and Constraints

Step 3: Conceptual Site Design

Step 4: Calculations and Documentation

Step 5: Design Details

Step 6: Source Controls

Step 7: Maintenance

Step 8: Construction Checklist

Step 9: Certification

Appendix D is a template containing an example outline. Example Stormwater Control Plans are available at the Marin County (MCSTOPPP) Post-Construction Stormwater Management webpage.

Stormwater Control Plan Checklist

Contents of Exhibit

- ❒ Existing natural hydrologic features (depressions, watercourses, wetlands, riparian corridors, relatively undisturbed areas) and significant natural resources.
- ❒ Existing and proposed site drainage network and connections to drainage off-site.
- ❒ Proposed design features and surface treatments used to minimize imperviousness and reduce runoff.
- ❒ Entire site divided into separate Drainage Management Areas (DMAs). Each DMA has a unique identifier and is characterized as self-retaining (zero-discharge), self-treating, draining to self-retaining, or draining to a bioretention facility.
- ❒ Proposed locations and footprints of bioretention facilities.
- ❒ Potential pollutant source areas, including loading docks, food service areas, refuse areas, outdoor processes and storage, vehicle cleaning, repair or maintenance, fuel dispensing, equipment washing, etc. listed in Appendix A.

Contents of Report

- ❒ Narrative analysis or description of site features and conditions that constrain, or provide opportunities for, stormwater control.
- ❒ Narrative description of site design characteristics that protect natural resources.
- ❒ Narrative description and/or tabulation of site design characteristics, building features, and pavement selections that reduce imperviousness of the site.
- ❒ Tabulation of proposed pervious and impervious area, showing self-treating areas, self-retaining areas, areas draining to self-retaining areas, and areas tributary to each bioretention facility.
- ❒ Preliminary designs, including calculations, for each bioretention facility. Elevations should show sufficient hydraulic head for each bioretention facility.
- ❒ Tabulation of pollutant sources from the list in Appendix A and for each source, the corresponding source control measure(s).
- ❒ General maintenance requirements for bioretention facilities
- ❒ Means by which facility maintenance will be financed and implemented in perpetuity.
- ❒ Statement accepting responsibility for interim operation & maintenance of facilities.
- ❒ Stormwater Construction Checklist.
- ❒ Certification by professional civil engineer, architect, or landscape architect.

1: Project Information

Enter the following into the Project Data Form in the SCP Template:

- Project Name/Number
- Application Submittal Date
- Project Location
- Applicant Contact Information
- Project Phase
- Project Type and Description
- Project Site Area (square feet)
- Total New or Replaced Impervious Surface Area
- Total Pre-Project Impervious Surface Area
- Total Post-Project Impervious Surface Area

2: Opportunities and Constraints

The following information will help you determine the best stormwater control design for your development site:

- Existing natural hydrologic features, including natural areas, wetlands, marshes, watercourses, seeps, springs, and areas with significant trees.
- Site topography and drainage, including the contours of slopes, the general direction of surface drainage, local high or low points or depressions, and any outcrops or other significant geologic features.
- Zoning, including setbacks and minimum landscaping requirements and open space.
- Soil types, including hydrologic soil groups, and depth to groundwater.

Prepare a brief narrative describing site opportunities and constraints.

Opportunities might include low areas, oddly configured or otherwise unbuildable areas, setbacks, easements, or buffers (which may sometimes accommodate bioretention facilities) and differences in elevation (which can provide hydraulic head).

Constraints might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicle traffic, or safety concerns.

3. Conceptual Site Design

Optimize the site layout. Apply the following design principles:

- Define the development envelope and protected areas, identifying areas that are most suitable for development and areas that should be left undisturbed.
- Limit grading; preserve natural landforms and drainage patterns.
- Set back development from creeks, wetlands, and riparian habitats to the maximum degree possible and at minimum, as required by local ordinances.
- Concentrate development on portions of the site with less permeable soils and preserve areas that can promote infiltration.
- Preserve significant trees (as defined by the local jurisdiction).

"On flat sites, it usually works best to intersperse self-retaining areas and bioretention facilities throughout the site."

Limit paving and roofs. Where possible, design compact, taller structures, narrower and shorter streets and sidewalks, smaller parking lots (fewer stalls, smaller stalls, and more efficient lanes), and indoor or underground parking. Examine the site layout and circulation patterns and identify areas where landscaping or planter boxes can be substituted for pavement.

Use pervious pavements where possible. Inventory paved areas and identify locations where permeable pavements, such as crushed aggregate, turf block, unit pavers, pervious concrete, or pervious asphalt can be substituted for impervious concrete or asphalt paving. Pervious pavements are most applicable where native soils are permeable. On sites with clay soils, it may still be possible to use turf block for emergency access lanes and overflow parking or to use unit pavers or pervious pavement with a sufficiently deep and well-drained base course.

Direct drainage to landscaped areas. There are two options for handling runoff from impervious areas:

The first option is to disperse runoff to lawns or landscaping. **Limit the ratio of impervious to pervious area to 2:1 maximum.** Pervious areas must be relatively flat, and the surface should be graded to a slightly concave surface to create a "self-retaining" area. Sites in densely urbanized areas are often too constrained to implement this option.

The other option is to route runoff to bioretention facilities. The bioretention areas should have a surface area of at least 4% of the tributary impervious area. Bioretention facilities must be flat (no surface slope), and may be configured in free-form fashion as "rain gardens" or in linear fashion to resemble swales. Facilities located on elevated plazas may be configured as planter boxes.

See Chapter 4 for design criteria for self-retaining areas and bioretention facilities.

Tips for Conceptual Drainage Design.

- To make the most efficient use of the site and to maximize aesthetic value, **integrate bioretention facilities with site landscaping**. Many local zoning codes may require landscape setbacks or buffers or may specify that a minimum portion of the site be landscaped. It may be possible to locate some or all of your site's bioretention facilities within this same minimum landscaped area, or within utility easements or other non-buildable areas.
- Put bioretention facilities in **high-visibility, well-trafficked places** and make them a focal point in the landscape.
- Where possible, design site drainage so **only impervious roofs and pavement** drain to bioretention facilities. This yields a simpler, more efficient design and helps protect bioretention facilities from becoming clogged by sediment.
- Avoid walls and steep slopes adjacent to the bioretention soil surface. Place bioretention inlet elevations, and the top of the engineered soil layer, as high as possible (6" below the surrounding ground surface elevation).
- On flat sites, it usually works best to intersperse self-retaining areas and bioretention facilities throughout the site. Keep drainage runs short. Grade streets, parking lots, and driveways to sheet flow

runoff directly into the landscaped areas. Use gutters or trench drains, rather than underground pipes, to convey runoff. It may be necessary, or helpful, to pipe runoff from roof gutters all the way to the facility. Where necessary, bubble-ups can be used to disperse piped runoff.

- On sloped sites, it may work best to collect runoff from roofs and pavement in conventional catch basins and pipe it to downslope bioretention facilities.
- Bioretention facilities must be **level or nearly level** all the way around, so that the entire soil surface is wetted. Linear bioretention facilities (swales) must be designed with their opposite sides at the same elevation. In the linear direction, slopes must be terraced or provided with check dams spaced so that the lip of each dam is at least as high as the toe of the next upstream dam.
- In clay soils, bioretention facilities must be underdrained. A bioretention facility requires two feet of head from inlet to underdrain outlet, which can be connected to an underground storm drain or daylighted.
- Bioretention facilities should be publicly accessible for inspection and maintenance.
- In commercial, mixed-use, and multi-family developments, facilities can be located in parking medians, parking islands, street setbacks, side and rear setbacks, and other landscaped areas.
- In residential subdivisions, the most practical strategy is to drain the lots to the street in the conventional manner, and then drain the street to a bioretention area. It may be most advantageous to create a separate parcel owned in common, which can double as a landscape amenity or a park. (This is one reason why it is important to plan stormwater treatment and flow-control before drawing subdivision lot lines.) Facilities in back or side yards should be avoided. If facilities are located on individual lots, prospective buyers may find undesirable the necessary legal restrictions on what they can do with those facilities.
- Bioretention facilities require excavations three feet deep, which can **conflict with underground utilities**.

Other types of treatment facilities.

Bioretention facilities are generally suitable for the Bay Area's modestly sized developments, clay soils, and setback requirements. Bioretention facilities sized to a minimum 4% of tributary impervious area can typically be fit into parking medians, street setbacks, foundation plantings, and other landscaping features without significantly altering the uses of the site.

Further, bioretention facilities are relatively easy to maintain, provide aesthetic appeal, attenuate peak flows, and are quite effective at removing pollutants, including pollutants associated with very fine particulates in rain and atmospheric dust.

Alternatives to bioretention design.

Proposed alternatives to bioretention facilities (criteria in Chapter 4) must show the ability to achieve:

- Equal or greater amount of runoff infiltrated or evapotranspired

- Equal or lower pollutant concentrations in runoff that is discharged after biotreatment
- Equal or greater protection against shock loadings and spills
- Equal or better accessibility and ease of inspection and maintenance.

Exceptions to bioretention. In some cases, it is very difficult to accommodate bioretention facilities on smaller, densely developed sites. Tree-box-type biofilters or in-vault media filters may be used to meet treatment requirements in the following circumstances:

- Projects that create or replace an acre or less of impervious area and are located in a locally designated pedestrian-oriented commercial district, and have at least 85% of the entire project site covered by permanent structures, or
- Facilities receiving runoff solely from existing (pre-project) impervious areas, or
- Historic sites, structures, or landscapes that cannot alter their original configuration without compromising their historic integrity.

The proposed tree-box-type biofilters or in-vault media filters must meet the "Technical Criteria for Non-LID Treatment Facilities" posted on the BASMAA website.

Local jurisdictions may choose to not accept alternatives to bioretention.

4. Calculations and Documentation

Your SCP must include an Exhibit showing the entire site divided into Drainage Management Areas (DMAs) and the locations and approximate sizes of bioretention facilities. Each should be clearly labeled so the Exhibit can be cross-referenced to the text and tables in the report.

The report will include a brief description of each DMA and each bioretention facility—and tabulated calculations.

Chapter 4 includes a detailed procedure for documenting your design and showing your bioretention facilities meet the minimum sizing requirements.

5. Bioretention Design Criteria

Design criteria in Chapter 4 will assist you to plan for construction of bioretention facilities as part of your project. The criteria that apply to your planned facilities should be summarized in your SCP. Anticipated exceptions to the design criteria should be noted.

6. Source Controls

Your SCP must identify and describe any potential pollutant sources that will be created or expanded as part of the development project.

Review the Pollutant Sources/Source Control Checklist (Appendix A). Begin by identifying which of the listed sources are associated with your project.

Then, create a table in the format shown in Table 3-1 on page 3-7. Enter each identified source in the left-hand column. Then add the corresponding structural source controls from the Pollutant Sources/Source Control Checklist into the center column of your table.

In a narrative, explain any special features, materials, or methods of construction that will be used to implement these permanent, structural source controls.

To complete your table, refer once again to the Pollutant Sources/Source Control Checklist (Appendix A, Column 4). List the operational source controls corresponding to the sources you've identified into the right-hand column of your table. These controls should be implemented as long as the identified activities (sources) continue at the site. These controls may be required as a condition of a use permit or other revocable discretionary approval for uses of the site.

7. Facility Maintenance

In your SCP, specify the means by which maintenance of your bioretention facilities will be financed and implemented in perpetuity.

For commercial, mixed-use or multifamily developments, maintenance responsibility may be assigned to a management entity that will be responsible for keeping up the buildings and grounds. Your O&M Plan, to be submitted later (see Chapter 5), will need to specify how maintenance will be funded and budgeted. Typically, the entity assuming responsibility for maintenance will need to execute a Stormwater Management Facilities Agreement, which runs with the land and provides for periodic inspections and reporting at the facility owner's expense.

For residential subdivisions, consult with municipal staff, then detail the planned arrangements in your Stormwater Control Plan. Include, as available and applicable, information about joint ownership of parcels where bioretention facilities are to be located, about incorporating a homeowners association, about provisions to be incorporated in Covenants, Conditions, and Restrictions, and other relevant information.

Figure 3.1. Roofed and bermed refuse area.

Table 3.1. Format for Tabulating Potential Pollutant Sources and Source Controls

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

Include in your SCP the following statement:

"The applicant accepts responsibility for interim operation and maintenance of stormwater treatment and flow-control facilities until such time as this responsibility is formally transferred to a subsequent owner."

A complete and detailed list of maintenance and inspection requirements, including inspection frequencies, will be required in your O&M Plan. Your O&M plan must also include detailed documentation of how your facilities are constructed.

For this stage, include in your Stormwater Control Plan a summary of the general maintenance requirements for your bioretention facilities. You will find example maintenance requirements in Chapter 5.

8. Construction Checklist

Include in your Stormwater Control Plan a Construction Checklist following the format in Table 3-2 on page 3-8.

Complete the first two columns in the checklist, listing each stormwater source control and treatment measure identified in the plan and identifying the page number where it appears.

Later, cut-and-paste the same table into your construction documents. Complete the rightmost column, listing the sheet number(s) where the same measure is shown on the construction plans.

9. Certification

Include the following statement by a licensed civil engineer, architect, or landscape architect:

"The preliminary design of stormwater treatment facilities and other stormwater pollution control measures in this Stormwater Control Plan are in accordance with the current edition of the BASMAA Post-Construction Manual."

Table 3.2. Format for Stormwater Construction Checklist

Page Number in Stormwater Control Plan	Source Control or Treatment Control Measure	Plan Sheet #

CHAPTER 4

DOCUMENTING YOUR LID DESIGN

NPDES Compliance and LID

The following design and documentation procedure facilitates rapid and thorough evaluation of a LID design for compliance with the NPDES permit requirements for a Regulated Project. Bioretention facilities built to the criteria in this chapter may also qualify as full trash capture devices.

The procedure involves dividing the site into Drainage Management Areas (DMAs), tracking the drainage from each DMA, and ensuring bioretention facilities receiving that drainage are adequately sized to treat the runoff.

Bioretention facilities are sized at 4% of the equivalent tributary impervious area, as specified in the NPDES permit. This ratio, or sizing factor, greatly simplifies making and checking calculations.

Step-by-Step

The procedure requires the following steps:

1. Delineate DMAs.
2. Identify DMA types and runoff factors.
3. Select and lay out bioretention facilities.
4. Calculate the minimum area (footprint) of each bioretention facility.
5. Repeat as necessary until the available area exceeds the minimum area for each bioretention facility.

1: Delineate DMAs

Drainage Management Areas (DMAs) are portions of a project site that drain to a common point. Each DMA must contain only one type of surface (for example, either landscaped or impervious).

In your SCP Exhibit, lines delineating DMAs will generally follow roof ridges and grade breaks. It is advantageous to first prepare a base map using the project grading plan and roof plan, and then delineate the DMAs. This helps ensure your SCP is consistent with the site plan, landscaping plan, and architectural plans.

There are four types of DMAs:

- Self-treating areas
- Self-retaining areas
- Areas draining to self-retaining areas
- Areas draining to a bioretention facility

Self-treating areas are landscaped or turf areas that do not drain to bioretention facilities, but rather drain directly off site or to the storm drain system. Examples include upslope undeveloped areas that are ditched and drained around a development and grassed slopes that drain directly to a street or storm drain. In general, self-treating areas include no

Runoff from impervious areas, such as roofs, can be managed by routing it to self-retaining pervious areas. The maximum ratio is 2 parts impervious area for every 1 part pervious area.

impervious areas, unless the impervious area is very small (5% or less) relative to the receiving pervious area and slopes are gentle enough to ensure runoff will be absorbed into the vegetation and soil. See Figure 4-1.

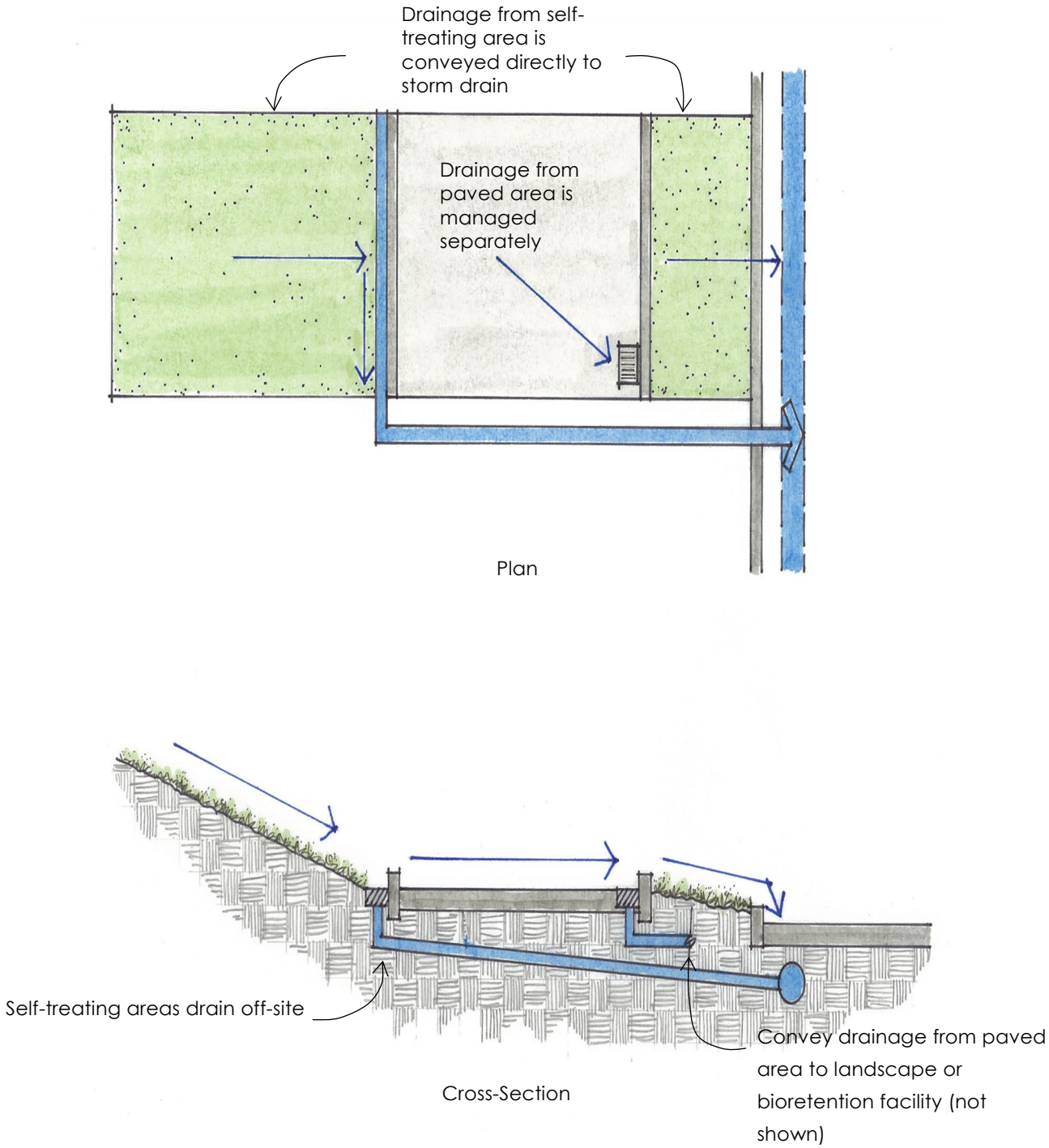


Figure 4-1. Self-Treating Areas are landscaped or turf areas that drain off-site or to the storm drain system.

Self-retaining areas are used where, because of site layout or topography, it is not possible to drain entirely pervious areas off-site separately (as with a self-treating area). The technique works best on flat, heavily landscaped sites. To create self-retaining turf and landscape areas in flat areas or on terraced slopes, berm the area or depress the grade into a concave cross-section so that these areas will retain the first inch of rainfall. Specify slopes, if any, toward the center of the pervious areas. Inlets of area drains, if any, should be set 3 inches or more above the low point to allow ponding. See Figure 4-2.

Pervious pavements may be considered self-retaining areas when designed and constructed according to the following criteria:

No erodible areas should drain on to pervious pavement. A base course of open-graded crushed stone must be deep enough to retain rainfall (3" is adequate) and support design loads (more depth may be required). The subgrade must be uniform and slopes not steep (typically 2% or less). Subgrade compaction must be minimal. If a subdrain is included (not recommended), the outlet elevation must be 3" or more above the bottom of the base course.

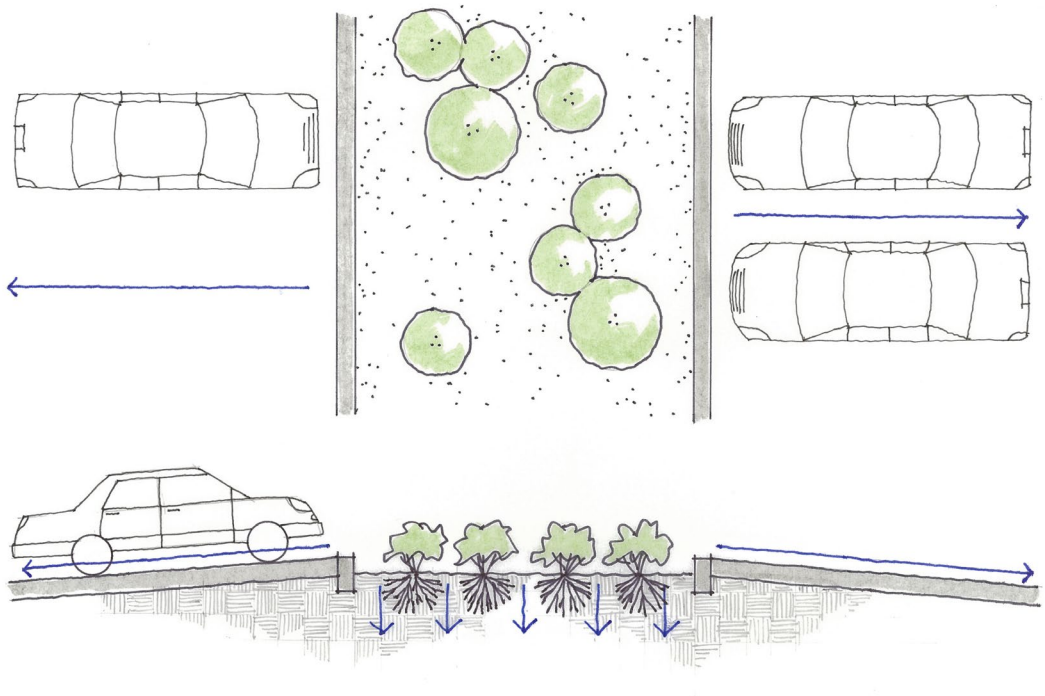


Figure 4-2. Self-retaining areas are depressed pervious areas that produce no runoff.

Granular pavements and unit pavers require a rigid edge to prevent movement.

Solid unit pavers, if used, are set in sand or gravel with minimum 3/8 inch gaps between the pavers, and joints are filled with an open-graded aggregate free of fines.

Permeable concrete or porous asphalt must be installed by industry-certified professionals according to vendor recommendations.

Selection and location of pavements must incorporate Americans with Disabilities Act requirements (if applicable), site aesthetics, and uses.

Areas draining to self-retaining areas. Runoff from impervious areas, such as roofs, can be managed by routing it to self-retaining pervious areas. See Figure 4-3. The maximum ratio is 2 parts impervious area for every 1 part pervious area. The drainage from the impervious area must be directed to and dispersed within the pervious area, and the design, including slopes and soils, must reflect a reasonable expectation that an inch of rainfall will soak into the soil and produce no runoff. For example, if the maximum ratio of 2 parts impervious area into 1 part pervious area is used, then the pervious area must absorb 3 inches of water over its surface before overflowing to an off-site drain.

Prolonged ponding is a potential problem at higher impervious/pervious ratios. In your design, ensure that the pervious areas soils can handle the additional run-on and are sufficiently well-drained.

If pervious pavement is designed and constructed to the criteria on page 4-3, roofs or impervious pavement may drain on to the pervious pavement with the same maximum ratio. Consult with a qualified

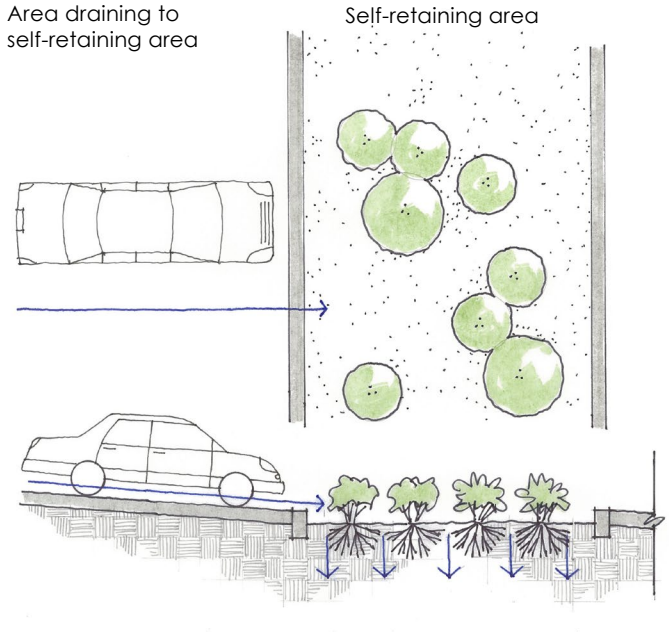


Figure 4-3. Areas Draining to Self-Retaining Areas.

engineer regarding infiltration rates and pavement stability under traffic loads.

Areas draining to a bioretention facility. The square footage of these areas is used to calculate the minimum required size of the bioretention facility. Two or more DMAs can drain to the same bioretention facility. However, a particular DMA can only drain to one bioretention facility.

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

2. Tabulate DMAs

For each DMA, determine whether it will be self-treating, self-retaining, drains to a self-retaining area, or drains to a bioretention facility. Group the DMAs by type. For each DMA, find and tabulate the area, post-project surface, and corresponding runoff factor. Use the runoff factors in Table 4-1.

3. Layout Bioretention Facilities

From your conceptual drainage design (see Chapter 3) identify the locations and footprint of bioretention facilities.

Design criteria for bioretention facilities are at the end of this chapter.

Once you have laid out the bioretention facilities, calculate the square footage you have set aside for each bioretention facility. **Then, recalculate the square footage of your DMAs to omit the square footage now dedicated to bioretention facilities.**

4. Calculate minimum footprints

The minimum area for each bioretention facility is found by summing up the contributions of each tributary DMA—adjusted using the runoff factors in Table 4-1—and multiplying by the sizing factor of 0.04. See Figure 4-4.

Table 4-5 extends the tabulation of DMAs draining to bioretention facilities to a calculation of the required minimum area of the receiving bioretention facility. Complete Table 4-5 for each bioretention facility.

Table 4.1. Runoff Factors for small storms

Roofs and paving	1.0
Landscaped areas	0.1
Bricks or solid pavers—grouted	1.0
Bricks or solid pavers—on sand base—see criteria on p. 4-3	0.2
Pervious concrete or asphalt—see criteria on p. 4-3	0.1
Turfblock or gravel—see criteria on p. 4-3	0.1
Open or porous pavers— see criteria on p. 4-3	0.1

5. Iterate until area is adequate

After computing the minimum bioretention facility size using Steps 1–4, review the site plan to determine if the reserved space for the facility is sufficient. If so, the planned facilities will meet the NPDES permit sizing requirements. If not, revise your plan accordingly. Revisions may include:

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

Bioretention facility design criteria

Layout. Bioretention facilities may be of any shape. However, each layer must designed and built flat and level. The following must have consistent elevations throughout the facility:

- bottom of excavation/gravel layer (BGL)
- top of gravel storage layer (TGL)
- top of soil layer (TSL)
- rim of facility reservoir

See Figures 4-5 and 4-6 and the checklist in Appendix B. **The facility must be designed to "fill up like a bathtub."** This rule ensures all the storage is used during intense rainfall, prevents short-circuiting, and avoids erosion of the soil mix.

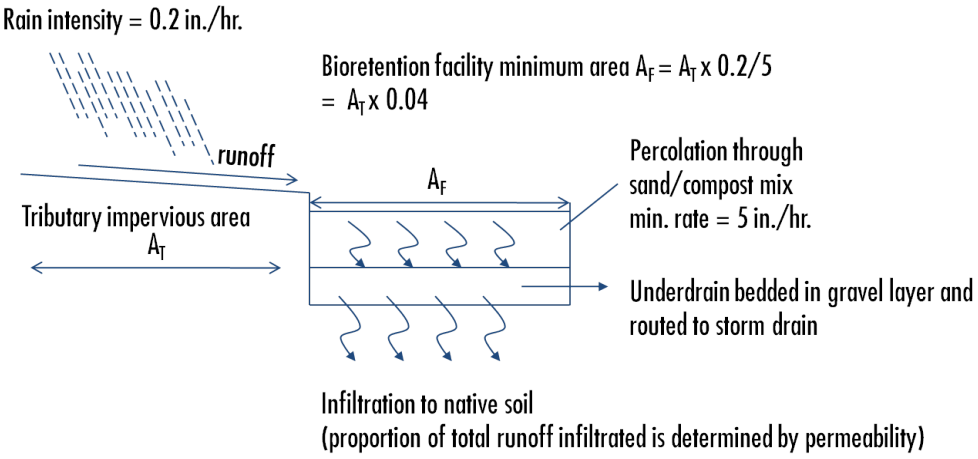


Figure 4-4. Derivation of Minimum Sizing Factor of 0.04 for Bioretention Facilities

As specified in Provision E.12, bioretention facilities are designed to detain and treat runoff produced by a rainfall intensity equal to 0.2 inches per hour. Measured over years, these low-intensity storms produce most of the total volume of runoff (80% or more). The planting medium (sand/compost mix) is designed to filter runoff at a rate of at least 5 inches per hour. If 100% of rainfall ends up as inflow to the bioretention facility (a conservative assumption), then the ratio of tributary impervious area to bioretention surface area needs to be: 0.2 inches/hour ÷ 5 inches/hour = 0.04.

The surface reservoir should be level and circumscribed by a rigid boundary such as a concrete curb, masonry, or landscape timbers. To address concerns about a trip hazard, or to achieve a softer visual effect, soil mix and/or mulch may be gently mounded against the rigid edge. Plantings can be selected and arranged to discourage entry.

Gravel layer. "Class 2 permeable," Caltrans specification 68-2.02F(3), is

Table 4.2. Format for Tabulating Self-Treating Areas

DMA Name	Area (square feet)

Table 4.3. Format for Tabulating Self-Retaining Areas

DMA Name	Area (square feet)

Table 4.4. Format for Tabulating Areas Draining to Self-Retaining Areas

DMA Name	Area (square feet)	Post-project surface type	Runoff factor	Receiving self-retaining DMA	Receiving self-retaining DMA Area (square feet)

Table 4.5. Format for Tabulating Areas Draining to Bioretention Facilities and Calculating Minimum Bioretention Facility Size

DMA Name	DMA Area (square feet)	Post-project surface type	DMA Runoff factor	DMA Area × runoff factor	Facility Name		
					Sizing factor	Minimum Facility Area (SF)	Proposed Facility Area (SF)
Total>					0.04		

recommended. Drain rock or other granular material may be used; however, a membrane layer of pea gravel or other intermediate-sized material should cover the top of the gravel layer to prevent movement of fines from the soil layer into the interstices of the gravel layer. **Do not use filter fabric for this purpose**, as it tends to clog.

Planting Medium. A mixture of sand (60%-70%) and compost (30%-40%) should be used. The specification developed by the Bay Area Stormwater Management Agencies Association (BASMAA) is recommended.

Underdrain. Use minimum 4" dia. PVC SDR 35 or equivalent, perforated pipe, installed with the holes facing down. The underdrain itself may be embedded in the gravel layer; the discharge elevation (typically, where the underdrain is connected to the overflow structure) is critical and must be no lower than the top of the gravel layer. Provide a threaded, capped cleanout in a location accessible for maintenance, connected by a sweep bend.

Plantings and mulch. See Appendix E. Many bioretention facilities incorporate native plants in an attractive garden setting, achieving low maintenance costs, low water demand, and maximum habitat value. However, combined uses, including active uses on turf or mulch, may be appropriate for part or all of a bioretention facility.

Select a plant palette to tolerate fast-draining soils and the microclimate specific to the facility location. The soil surface will be inundated briefly and rarely (for a few hours on possibly up to 5 occasions during a wet winter, but typically less frequently) but otherwise dry unless irrigated. Consider the facility's relationship to existing and proposed buildings and the resulting exposure to sun, heat, shade, and wind.

The following problem conditions should be avoided when developing a planting plan:

- Overly dense plantings that, after growing in, prevent flow into and through the surface reservoir
- Aggressive roots that block inflow or percolation
- Invasive weeds
- Plants that need fertilizer or irrigation—consider site-wide allowances under any water efficient landscape local ordinances.
- Trees and large shrubs installed in bioretention facilities are susceptible to blowing over before roots are established. They should be staked securely. Three stakes per tree are recommended at windy sites.
- Aged mulch (compost) reduces the ability of weeds to establish, keeps the soil mix moist, and replenishes soil nutrients. Compared to bark mulch, aged mulch has somewhat less tendency to float into overflow inlets during intense storms.
- Inert materials, such as rock, gravel, and recycled rubber or glass, may not be used as mulch.

Irrigation. Because the specified soil mix is fast-draining, bioretention facilities may need to be irrigated more than once a day. Irrigation controls should allow separate control of times and durations of irrigation

for bioretention facilities vs. other landscape areas. Smart irrigation controllers are strongly encouraged and may be required by local ordinances or codes. Available controllers may access weather stations, use sensors to measure soil temperature and moisture, and allow input of soil types, plant types, root depth, light conditions, slope, and rainfall.

Drip emitters are strongly recommended over spray irrigation. Use multiple, lower-flow (0.5 to 2 gallons per hour) emitters—two to four emitters for perennials, ground covers, and bunchgrasses; four to six emitters for larger shrubs and trees.

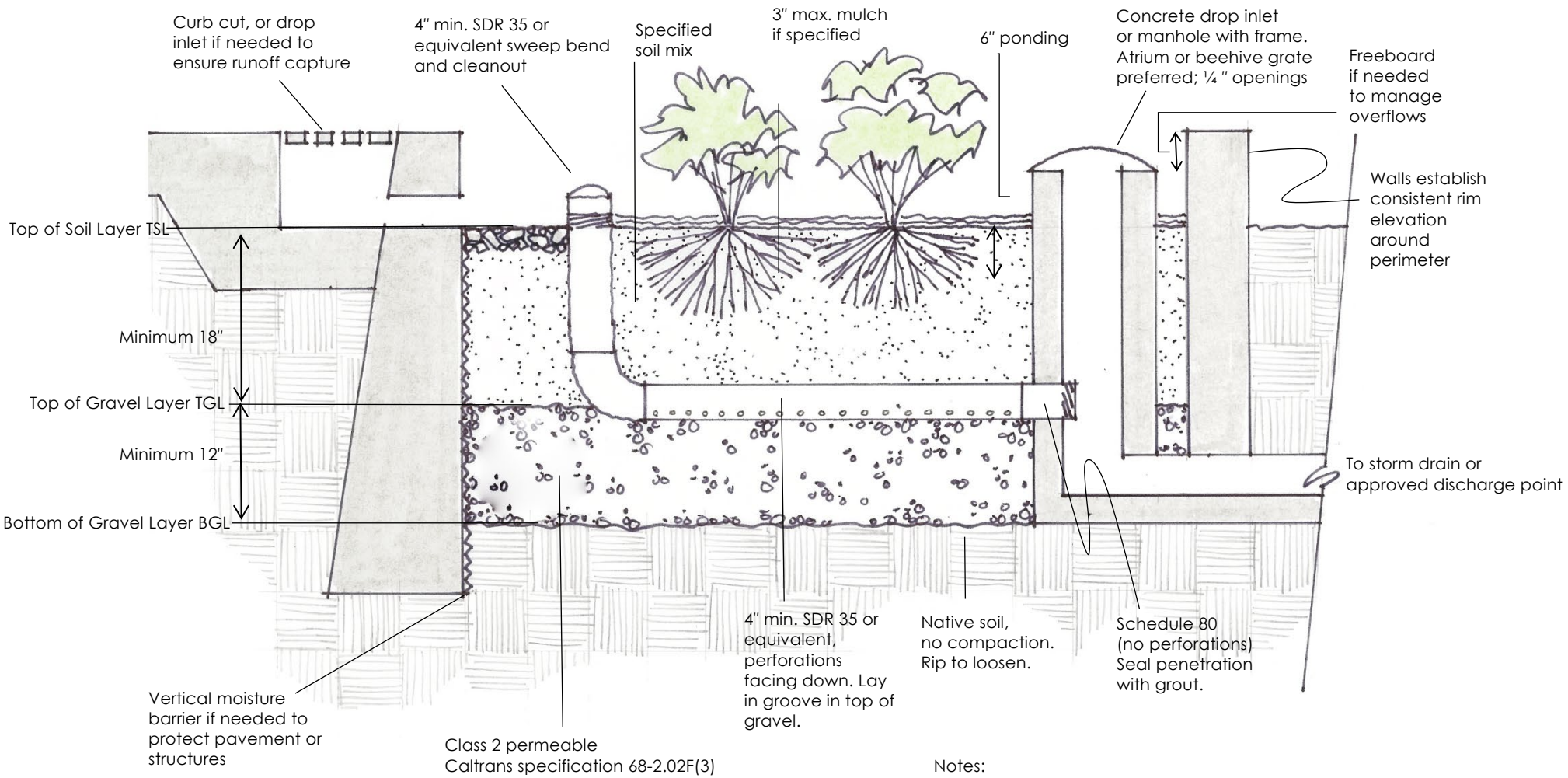
Signage. If required by your local agency, include a sign. Signs should be visible to site users and to maintenance personnel.

Avoid design conflicts. Review your bioretention design for the following:

- Facilities are represented in architectural and landscape drawings and renderings.
- Landscaping plans, including planting plans, show locations of bioretention facilities, and the plant requirements are consistent with the engineered soils and conditions in the bioretention facilities.
- Elevations within and around each facility are consistent with grading, drainage, and paving plans, and with architectural plans. Plans call out elevations of the bioretention top of soil layer, top of gravel layer, bottom of gravel layer, overflow, and rim.
- Facilities do not interfere with circulation or with pedestrian access between parking areas and building entrances.
- Cable vaults, phone vaults, electrical boxes, and other utility boxes are accommodated in designated locations outside the bioretention facilities.

Figure 4-5. Bioretention Facility

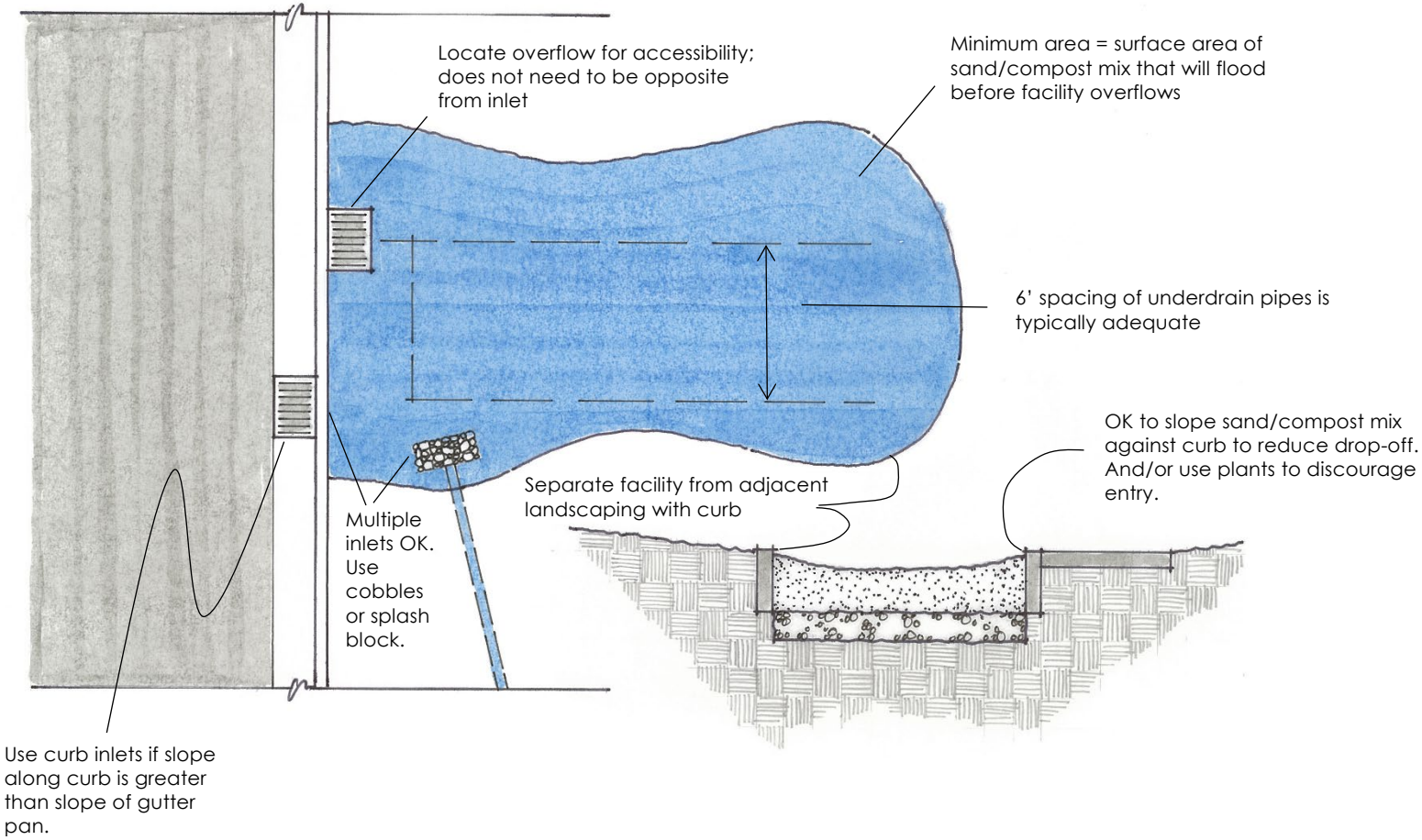
Cross-section
Not to Scale



Notes:
No liner, no filter fabric, no landscape cloth.
Maintain BGL. TGL, TSL throughout facility area at elevations to be specified on drawing.
Elevation of perforated pipe underdrain is atop gravel layer.
See text for soil mix specification, planting and irrigation guidance.

Figure 4-6. Bioretention Facility

Plan
Not to Scale



CHAPTER 5

PREPARING YOUR OPERATION & MAINTENANCE PLAN

Introduction

As required by the statewide Phase II municipal NPDES stormwater permit, Permittees must verify provisions have been made for maintenance of the facilities in perpetuity.

Typically this verification is accomplished by executing and recording an agreement that "runs with the land." The agreement provides the municipality a right of access for inspections and requires the owner to conduct a maintenance inspection at least annually and retain a record of the inspection. If maintenance is not adequate, the municipality may conduct any maintenance or repairs needed and bill the owner to recover costs. The agreement is binding on future owners of the entire property or any subdivided portion of the property. Contact the local agency regarding a template for or model provisions of this agreement.

When bioretention facilities are located in a privately owned common area, such as street or landscaped area within a residential subdivision, the joint responsibilities of the property owners must be spelled out in covenants, conditions, and restrictions (CC&Rs).

The applicant's O&M Plan must address the specific drainage patterns and treatment facilities on the development site. The municipality may require that the O&M Plan be referenced in the agreement or attached as an exhibit. The O&M Plan is used to plan, direct, and record maintenance of the bioretention facilities. The O&M Plan is kept on-site, and a copy maintained at municipal offices.

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

Step by Step

Follow these five steps to prepare your bioretention facilities O&M Plan.

Step 1: Designate Responsible Individuals

Step 2: Describe the Facilities

Step 3: Document the Facilities "As Built"

Step 4: Schedule Maintenance Activities

Step 5: Compile the Plan

1. Responsible Individuals.

Identify the following individuals:

- Person who will have direct responsibility for the maintenance of stormwater controls, maintain self-inspection records, and sign any

correspondence with the municipality regarding the inspections.

- Employees or contractors who will report to the designated contact and are responsible for carrying out maintenance.
- Contact for response to problems, such as clogged drains or broken irrigation mains, that would require immediate response should they occur during off-hours.

Describe the methods and schedule of initial training for staff or contractors regarding the purpose, mode of operation, and maintenance requirements for the facilities on the site.

"Municipalities will typically require a draft Operations and Maintenance Plan be submitted when building permits are applied for — or even before."

2. Facilities to be Maintained

Incorporate the following into the O&M Plan:

- Figures from your Stormwater Control Plan delineating the Drainage Management Areas on the site and showing the locations of the bioretention facilities.
- The tabulation of the Drainage Management Areas from the calculations in your Stormwater Control Plan.

3. Document Facilities "As Built"

Include from the final construction drawings:

- Plans, elevations, and details of the bioretention facilities. If necessary, annotate the drawings with the designations used in the Stormwater Control Plan so it is clear which drawing refers to which facility.
- Construction details and specifications, including depths of sand or soil, compaction, pipe materials, and bedding.
- Location and layouts of inflow piping and piping to off-site discharge.
- Native soils encountered (e.g., sand or clay lenses beneath or near facilities).

Municipalities will typically require a *draft* O&M Plan be submitted when building permits are applied for — or even before.

Changes made in the field during construction must be noted in the *final* Plan to be submitted following construction.

4. Schedule Maintenance Activities

Scheduled the following activities to be completed at least annually. The frequency should be adjusted in response to the needs of each particular facility.

Clean up. Remove any soil or debris blocking planter inlets or overflows. Remove trash that typically collects near inlets or gets caught in vegetation.

Prune or cut back plants for health and to ensure flow into inlets and across the surface of the facility. Remove and replant as necessary. When replanting, maintain the design surface elevation and minimize the introduction of soil.

Control weeds by manual methods and soil amendment. In response to problem areas or threatening invasions, corn gluten, white vinegar, vinegar-based products, or non-selective natural herbicides such as Burnout or Safer's Sharpshooter may be used.

Add mulch. Aged mulch (compost) reduces the ability of weeds to establish,

keeps soil moist, and replenishes soil nutrients. Mulch is added from time to time as necessary to maintain a mulch layer thickness (some agencies require 3"). However, ensure the underlying soil surface beneath the mulch layer is a minimum 6" below the overflow elevation, consistently throughout the surface area of the facility. In particular, ensure that the top of the mulch layer is below the facility overflow, so that as the facility fills during a major storm, the entire surface is become wetted before the overflow elevation is reached.

Check signage. Remove graffiti and replace signs if necessary.

Check irrigation, if any, to confirm it is adequate but not excessive.

Landscape maintenance personnel should be aware of the following:

Do not add fertilizer to bioretention facilities. Compost tea, available from various nurseries and garden supply retailers, may be applied at a recommended rate of 5 gallons mixed with 15 gallons of water per acre, up to two weeks prior to planting and once per year between March and June. Do not apply when temperatures are below 50°F or above 90°F or when rain is forecast in the next 48 hours.

Do not use synthetic pesticides on bioretention facilities. Beneficial nematodes and non-toxic controls may be used. Acceptable natural pesticides include Safer® products and Neem oil.

5. Compile the Plan

Format plans to 8½" x 11" where possible to facilitate duplication, filing, and handling. Include the revision date in the footer of each page.

Consider scanning the graphics and incorporating with the text in electronic files that can be backed up.

The following resources at www.basmaa.org may help you when preparing your plan:

- Sample outline and format for an O&M Plan.
- Form for designating individuals responsible for operation and maintenance.
- Sample facility inspection and maintenance log.
- Sample contents of an inspector's report.

Updates to the O&M Plan

Updates can be made, and a copy transmitted to the municipality, at any time. In particular, contact information should be updated timely.

The O&M Plan should be updated as needed at the time of the annual inspection.

O&M Plans for Other Facility Types

For other types of treatment facilities (see p. 3-5), discuss requirements for O&M plans with municipal staff. O&M plans for tree-box-type biofilters or in-vault media filters should incorporate the manufacturer's recommendations

APPENDIX A

Pollutant Sources/Source Control Checklist

Appendix A. Stormwater Pollutant Sources/Source Controls Checklist

How to use this worksheet (also see instructions on page 3-7 of the *BASMAA Post-Construction Manual*):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding Structural Source Control BMPs in your Stormwater Control Plan drawings.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable Structural Source Control BMPs and Operational Source Control BMPs in a table in your Stormwater Control Plan. Use the format shown in Table 3-1 on page 3-7 of the *BASMAA Post-Construction Manual*. Describe your specific BMPs in an accompanying narrative and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs.

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR STORMWATER CONTROL PLAN (SCP) SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	**2** Structural Source Controls—Show on Stormwater Control Plan Drawings	**3** Structural Source Controls—List in SCP Table and Narrative	**4** Operational Source Control BMPs—Include in SCP Table and Narrative
❑ **A.** On-site storm drain inlets (unauthorized non-stormwater discharges and accidental spills or leaks)	❑ Locations of inlets.	❑ Mark all inlets with the words "No Dumping! Flows to Bay" or similar.	❑ Maintain and periodically repaint or replace inlet markings. ❑ Provide stormwater pollution prevention information to new site owners, lessees, or operators. ❑ See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.casqa.org/resources/bmp-handbooks ❑ Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."
❑ **B.** Interior floor drains and elevator shaft sump pumps	❑ Show drains and pump locations	❑ State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.	❑ Inspect and maintain drains to prevent blockages and overflow.
❑ **C.** Interior parking garages	❑ Show drain locations	❑ State that parking garage floor drains will be plumbed to the sanitary sewer.	❑ Inspect and maintain drains to prevent blockages and overflow.

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR STORMWATER CONTROL PLAN (SCP) SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	**2** Structural Source Controls—Show on Stormwater Control Plan Drawings	**3** Structural Source Controls—List in SCP Table and Narrative	**4** Operational Source Control BMPs—Include in SCP Table and Narrative
❑ **D1.** Need for future indoor & structural pest control		❑ Note building design features that discourage entry of pests.	❑ Provide Integrated Pest Management information to owners, lessees, and operators.
❑ **D2.** Landscape/ Outdoor Pesticide Use/Building and Grounds Maintenance	❑ Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained. ❑ Show self-retaining landscape areas, if any. ❑ Show bioretention facilities. (See instructions in Chapter 4.)	State that final landscape plans will accomplish all of the following. ❑ Preserve existing native trees, shrubs, and ground cover to the maximum extent possible. ❑ Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. ❑ Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. ❑ Consider using pest-resistant plants, especially adjacent to hardscape. ❑ To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	❑ Maintain landscaping using minimum or no pesticides. ❑ See applicable operational BMPs in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.casqa.org/resources/bmp-handbooks ❑ Provide IPM information to new owners, lessees and operators.
❑ **E.** Pools, spas, ponds, decorative fountains, and other water features.	❑ Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet.	❑ If the local municipality requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.	❑ See applicable operational BMPs in Fact Sheet SC-72, "Fountain and Pool Maintenance," in the CASQA Stormwater Quality Handbooks at www.casqa.org/resources/bmp-handbooks ❑ The sanitary sewer operator must be notified and a clean out identified when pools are to be drained to the sanitary sewer.

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR STORMWATER CONTROL PLAN (SCP) SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	**2** Structural Source Controls—Show on Stormwater Control Plan Drawings	**3** Structural Source Controls—List in SCP Table and Narrative	**4** Operational Source Control BMPs—Include in SCP Table and Narrative
❑ **F.** Food service	❑ For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment. ❑ On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.	❑ Describe the location and features of the designated cleaning area. ❑ Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.	❑ State maintenance schedule for grease interceptor
G. Refuse areas	❑ Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas. ❑ If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area. ❑ Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.	❑ State how site refuse will be handled and provide supporting detail to what is shown on plans. ❑ State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.	State how the following will be implemented: ❑ Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.casqa.org/resources/bmp-handbooks
❑ **H.** Industrial processes.	❑ Show process area.	❑ If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."	❑ See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.casqa.org/resources/bmp-handbooks

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR STORMWATER CONTROL PLAN (SCP) SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	**2** Structural Source Controls—Show on Stormwater Control Plan Drawings	**3** Structural Source Controls—List in SCP Table and Narrative	**4** Operational Source Control BMPs—Include in SCP Table and Narrative
❑ **I.** Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)	❑ Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area. ❑ Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults. ❑ Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.	❑ Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains. ❑ Where appropriate, reference documentation of compliance with the requirements of programs for: ▪ Hazardous Waste Generation ▪ Hazardous Materials Release Response and Inventory ▪ California Accidental Release (CalARP) ▪ Aboveground Storage Tank ▪ Uniform Fire Code Article 80 Section 103(b) & (c) 1991 ▪ Underground Storage Tank	❑ See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.casqa.org/resources/bmp-handbooks

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR STORMWATER CONTROL PLAN (SCP) SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
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❑ **J.** Vehicle and Equipment Cleaning	❑ Show on drawings as appropriate: (1) Commercial/industrial facilities having vehicle/ equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses. (2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use). (3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer. (4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.	❑ If a car wash area is not provided, describe measures taken to discourage on-site car washing and explain how these will be enforced.	Describe operational measures to implement the following (if applicable): ❑ Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system. ❑ Car dealerships and similar may rinse cars with water only. ❑ See Fact Sheet SC-21, "Vehicle and Equipment Cleaning," in the CASQA Stormwater Quality Handbooks at www.casqa.org/resources/bmp-handbooks

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR STORMWATER CONTROL PLAN (SCP) SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	**2** Structural Source Controls—Show on Stormwater Control Plan Drawings	**3** Structural Source Controls—List in SCP Table and Narrative	**4** Operational Source Control BMPs—Include in SCP Table and Narrative
❑ **K.** Vehicle/Equipment Repair and Maintenance	❑ Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater. ❑ Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas. ❑ Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.	❑ State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area. ❑ State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements. ❑ State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.	In the Stormwater Control Plan, note that all of the following restrictions apply to use the site: ❑ No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains. ❑ No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately. ❑ No person shall leave unattended parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.
❑ **L.** Fuel Dispensing Areas	❑ Fueling areas shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable. ❑ Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.		❑ The property owner shall dry sweep the fueling area routinely. ❑ See the Business Guide Sheet, "Automotive Service—Service Stations" in the CASQA Stormwater Quality Handbooks at www.casqa.org/resources/bmp-handbooks

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR STORMWATER CONTROL PLAN (SCP) SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	**2** Structural Source Controls—Show on Stormwater Control Plan Drawings	**3** Structural Source Controls—List in SCP Table and Narrative	**4** Operational Source Control BMPs—Include in SCP Table and Narrative
❑ **M.** Loading Docks	❑ Show the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected in a tank for ultimate discharge to the sanitary sewer. ❑ Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation. ❑ Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.		❑ Move loaded and unloaded items indoors as soon as possible. ❑ See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.casqa.org/resources/bmp-handbooks
❑ **N.** Fire Sprinkler Test Water		❑ Provide a means to drain fire sprinkler test water to the sanitary sewer.	❑ See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.casqa.org/resources/bmp-handbooks

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1 Potential Sources of Runoff Pollutants	**2** Structural Source Controls—Show on Stormwater Control Plan Drawings	**3** Structural Source Controls—List in SCP Table and Narrative	**4** Operational Source Control BMPs—Include in SCP Table and Narrative
O. Miscellaneous Drain or Wash Water or Other Sources ❑ Boiler drain lines ❑ Condensate drain lines ❑ Rooftop equipment ❑ Drainage sumps ❑ Roofing, gutters, and trim. ❑ Other sources	❑ Show drain lines and drainage sumps	❑ Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system. ❑ Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. ❑ Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment. ❑ Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water. ❑ Include controls for other sources as specified by local reviewer.	If architectural copper is used, implement the following BMPs for management of rinsewater during installation: ❑ If possible, purchase copper materials that have been pre-patinated at the factory. ❑ If patination is done on-site, prevent rinse water from entering storm drains by discharging to landscaping or by collecting in a tank and hauling off-site. ❑ Consider coating the copper materials with an impervious coating that prevents further corrosion and runoff. Implement the following BMPs during routine maintenance: ❑ Prevent rinse water from entering storm drains by discharging to landscaping or by collecting in a tank and hauling off-site.
❑ **P.** Plazas, sidewalks, and parking lots.	❑ Show extent of permeable paving materials		❑ Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.

APPENDIX B

Bioretention Construction Inspection Checklist

Appendix B. Bioretention Facility Construction Inspection Checklist

Layout (to be confirmed prior to beginning excavation)

- ❒ Square footage of the facility meets or exceeds minimum shown in Stormwater Control Plan
- ❒ Site grading and grade breaks are consistent with the boundaries of the tributary Drainage Management Area(s) (DMAs) shown in the Stormwater Control Plan
- ❒ Inlet elevation of the facility is low enough to receive drainage from the entire tributary DMA
- ❒ Locations and elevations of overland flow or piping, including roof leaders, from impervious areas to the facility have been laid out and any conflicts resolved
- ❒ Rim elevation of the facility is laid out to be level all the way around, or elevations are consistent with a detailed cross-section showing location and height of interior dams
- ❒ Locations for vaults, utility boxes, and light standards have been identified so that they will not conflict with the facility
- ❒ Facility is protected as needed from construction-phase runoff and sediment

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

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

Overflow or Surface Connection to Storm Drainage

(to be confirmed prior to backfilling with any materials)

- ❒ Overflow is at specified elevation
- ❒ No knockouts or side inlets are in overflow riser
- ❒ Overflow location selected to minimize surface flow velocity (near, but offset from, inlet recommended)
- ❒ Grating excludes mulch and litter (beehive or atrium-style grates with ¼" openings recommended)
- ❒ Overflow is connected to storm drain via appropriately sized piping

Underground connection to storm drain/outlet orifice

(to be confirmed prior to backfilling with any materials)

- ❒ Perforated pipe underdrain (PVC SDR 35 or approved equivalent) is installed with holes facing down
- ❒ Perforated pipe is connected to storm drain at specified elevation (typ. bottom of soil elevation)
- ❒ Cleanouts are in accessible locations and connected via sweep bends

Drain Rock/Subdrain (to be confirmed prior to installation of soil mix)

- ❒ Rock is installed as specified, 12" min. depth. Class 2 permeable, Caltrans specification 68-2.02F(3) recommended
- ❒ Rock is smoothed to a consistent top elevation. Depth and top elevation are as shown in plans
- ❒ Slopes or side walls protect from sloughing of native soils into the facility
- ❒ No filter fabric is placed between the subdrain and soil mix layers

Soil Mix

- ❒ Soil mix is as specified.
- ❒ Mix installed in lifts not exceeding 12"
- ❒ Mix is not compacted during installation but may be thoroughly wetted to encourage consolidation
- ❒ Mix is smoothed to a consistent top elevation. Depth of mix (18" min.) and top elevation are as shown in plans, accounting for depth of mulch to follow and required reservoir depth

Irrigation

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

Planting

- ❒ Plants are installed consistent with approved planting plan, consistent with site water allowance
- ❒ Any trees and large shrubs are staked securely
- ❒ No fertilizer is added; compost tea may be used
- ❒ No native soil or clayey material are imported into the facility with plantings
- ❒ 1"-2" mulch may be applied following planting; mulch selected to avoid floating
- ❒ Final elevation of soil mix maintained following planting
- ❒ Curb openings are free of obstructions

Final Engineering Inspection

- ❒ Drainage Management Area(s) are free of construction sediment; landscaped areas are stabilized
- ❒ Inlets are installed to provide smooth entry of runoff from adjoining pavement, have sufficient reveal (drop from the adjoining pavement to the top of the mulch or soil mix, and are not blocked
- ❒ Inflows from roof leaders and pipes are connected and operable
- ❒ Temporary flow diversions are removed
- ❒ Rock or other energy dissipation at piped or surface inlets is adequate
- ❒ Overflow outlets are configured to allow the facility to flood and fill to near rim before overflow
- ❒ Plantings are healthy and becoming established
- ❒ Irrigation is operable
- ❒ Facility drains rapidly; no surface ponding is evident
- ❒ Any accumulated construction debris, trash, or sediment is removed from facility
- ❒ Permanent signage is installed and is visible to site users and maintenance personnel

APPENDIX C

Stormwater Control Plan Template for Small Projects/Single-Family Homes

APPENDIX C

Stormwater Control Plan Template for Small Projects/Single-Family Homes

Introduction

The California State Water Resources Control Board reissued the Phase II NPDES Permit for Small Municipal Storm Sewer Systems (MS4s) in February 2013. As of June 30, 2015, development projects that create or replace between 2,500 square feet and 5,000 square feet of impervious surface (roofs or pavement), including single-family homes, must incorporate **one or more** measures to reduce runoff.*

This requirement is part of municipalities' comprehensive effort to reduce runoff pollution. Some municipalities may choose to implement the requirements earlier, and/or on projects that create or replace less than 2,500 square feet of impervious surface.

It is easy to achieve compliance with the stormwater requirements for small land development projects. Compliance for each project must be carefully documented. Please complete the following form and submit it as directed by municipal staff.

In addition, staff will review your site plan to confirm that the following design strategies have been incorporated into your project:

- Limit disturbance of creeks and natural drainage features
- Minimize compaction of highly permeable soils
- Limit clearing and grading of native vegetation at the site to the minimum area needed to build the project, allow access, and provide fire protection
- Minimize impervious surfaces by concentrating development on the least-sensitive portions of the site, while leaving the remaining land in a natural undisturbed state

*The type and extent of runoff reduction measures required for any specific project will be determined by local staff consistent with a maximum extent practicable standard. Projects that create or replace 5,000 square feet or more of impervious surface, except for detached single-family homes, require a comprehensive Stormwater Control Plan for Regulated Projects.

Step-by-Step Instructions

The steps are:

1. Fill out the Project Data Form (below) and select one or more runoff reduction measures.
2. Prepare a site plan or sketch. Specify and design the runoff reduction measures you will use to meet the stated minimum requirements.

3. Complete your submittal, which will include:
    - Project Data Form
    - Site Plan or Sketch
    - Completed checklist for each Runoff Reduction Measure selected

Step 1: Project Data Form and Runoff Reduction Measure Selection

Complete all fields.

Project Name/Number	
Application Submittal Date [to be verified by municipal staff]	
Project Location [Street Address if available, or intersection and/or APN]	
Name of Owner or Developer	
Project Type and Description [Examples: "Single Family Residence," "Parking Lot Addition," "Retail and Parking"]	
Total Project Site Area (acres)	
Total New or Replaced Impervious Surface Area (square feet) [Sum of impervious area that will be constructed as part of the project]	
Total Pre-Project Impervious Surface Area	
Total Post-Project Impervious Surface Area	
Runoff Reduction Measures Selected (Check one or more)	❑ 1. Disperse runoff to vegetated area ❑ 2. Pervious pavement ❑ 3. Cisterns or Rain Barrels ❑ 4. Bioretention Facility or Planter Box

Step 2: Delineate impervious areas and locations of runoff reduction measures

Delineate the impervious area. On a site plan or sketch, show the impervious area—for example, a roof, or portion of a roof, or a paved area—that will drain to your runoff reduction measure. Typically, these delineations follow roof ridge lines or grade breaks. Alternatively, show the type and extent of pervious paving. An example sketch is attached.

Indicate the location and kind of runoff reduction measure you've selected. At least one option, designed to manage runoff from some amount of impervious area—or to avoid creating runoff—is required.

For each option selected, there is a brief checklist to confirm your design and your submittal meet minimum requirements.

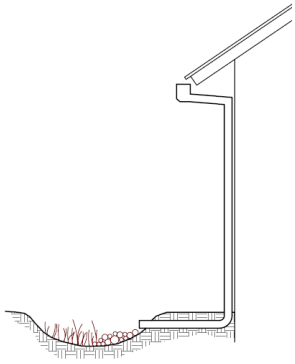
Step 3: Complete and submit your plan

Consult with municipal staff about when and how to submit your Stormwater Control Plan.

Runoff Reduction Options

Option 1: Disperse runoff from roofs or pavement to vegetated areas.

This is the simplest option. Downspouts can be directed to vegetated areas adjacent to buildings, or extended via pipes to reach vegetated areas further away. Paved areas can be designed with curb cuts, or without curbs, to direct flow into surrounding vegetation.



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

On the site plan, show:

- ❑ Each impervious area from which runoff will be directed, and its square footage.
- ❑ The vegetated areas that will receive runoff, and the approximate square footage of each.
- ❑ If necessary, explain in notes on the plan how runoff will be routed from impervious surfaces to vegetated areas.

Confirm the following standard specifications are met:

- ❑ Tributary impervious square footage in no instance exceeds twice the square footage of the receiving pervious area.
- ❑ The design, including slopes and soils, reflects a reasonable expectation that an inch of rainfall will soak into the soil and produce no runoff.
- ❑ Roof areas collect runoff and route it to the receiving pervious area via gutters and downspouts.
- ❑ Paved areas are sloped so drainage is routed to the receiving pervious area.
- ❑ Runoff is dispersed across the vegetated area (for example, with a splash block) to avoid erosion and promote infiltration.
- ❑ Vegetated area has amended soils, vegetation, and irrigation as required to maintain soil stability and permeability.
- ❑ Any drain inlets within the vegetated area are at least 3 inches above surrounding grade.

Option 2: Permeable Pavement

This option can be easy to install and maintain, cost-effective, and can add aesthetic value to your project. Permeable pavements may include pervious concrete, pervious asphalt, porous pavers, crushed aggregate, open pavers with grass or plantings, open pavers with gravel, or solid pavers.

Show on your site plan:

- ❑ Location, extent and types of pervious pavements.

Confirm the following standard specifications are met:

- ❑ No erodible areas drain on to permeable pavement.
- ❑ Subgrade compaction is minimal.
- ❑ Reservoir base course is of open-graded crushed stone. Base depth is adequate to retain rainfall (3 inches is adequate) and support design loads (more depth may be required).
- ❑ No subdrain is included or, if a subdrain is included, outlet elevation is a minimum of 3 inches above bottom of base course.
- ❑ Subgrade is uniform and slopes are not so steep that subgrade is prone to erosion.
- ❑ Rigid edge is provided to retain granular pavements and unit pavers.
- ❑ Solid unit pavers, if used, are set in sand or gravel with minimum 3/8 inch gaps between the pavers. Joints are filled with an open-graded aggregate free of fines.
- ❑ Permeable concrete or porous asphalt, if used, are installed by industry-certified professionals according to the vendor's recommendations.
- ❑ Selection and location of pavements incorporates Americans with Disabilities Act requirements (if applicable), site aesthetics, and uses.

Option 3: Cisterns or Rain Barrels

Use of cisterns or rain barrels to comply with this requirement is subject to municipality approval. Planning and Building Permits may be required for larger systems.

Show on your site plan:

- ❑ Impervious areas tributary to each cistern or rain barrel.
- ❑ Location of each cistern or rain barrel.

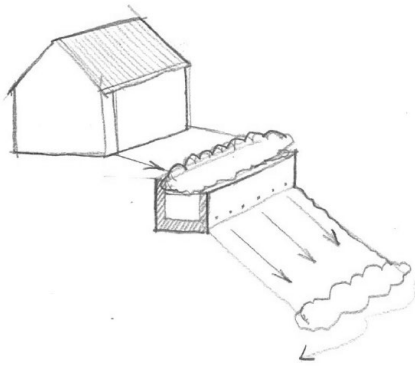
Confirm the following standard specifications are met:

- ❑ Rain barrels are sited at grade on a sound and level surface at or near gutter downspouts.
- ❑ Gutters tributary to rain barrels are screened with a leaf guard or maximum ½-inch to ¼-inch-minimum corrosion-resistant metallic hardware fabric.
- ❑ Water collected will be used for irrigation only.
- ❑ Openings are screened with a corrosion-resistant metallic fine mesh (1/16 inch or smaller) to prevent mosquito harborage.
- ❑ Large openings are secured to prevent entry by children.
- ❑ Rain barrels and gutters are to be cleaned annually.
- ❑ The local mosquito and vector control district is informed of the installation. The district will be provided additional information and/or rights of entry if they request.

Option 4: Bioretention Facility or Planter Box

An above-ground planter box may be appropriate if the development site lacks level landscaped areas for dispersion and pervious pavements are not practical. Planter boxes and bioretention facilities can treat runoff from impervious surfaces 25 times their area (sizing factor of 0.04).

Detailed design guidance for bioretention facilities is in Chapter 4 of the *BASMAA Post-Construction Manual*.



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

Show on your site plan:

- ❑ Impervious areas tributary to the planter box.
- ❑ Location and footprint of planter box.

Confirm the following standard specifications are met:

- ❑ Reservoir depth is 4"-6" minimum.

- ❑ 18" depth soil mix with minimum long-term infiltration rate of 5"/hour. See http://www.cccleanwater.org/c3-guidebook.html for a list of soil mix suppliers.
- ❑ Surface area of soil mix is a minimum 0.04 times the tributary impervious area.
- ❑ "Class 2 perm" drainage layer 12" deep.
- ❑ No filter fabric.
- ❑ Perforated pipe (PVC SDR 35 or approved equivalent) underdrain with outlet located flush or nearly flush with planter bottom.
- ❑ Connection with sufficient head to storm drain or discharge point.
- ❑ Underdrain has a clean-out port consisting of a vertical, rigid, non-perforated PVC pipe, connected to the underdrain via a sweep bend, with a minimum diameter of 4" and a watertight cap.
- ❑ Overflow outlet connected to a downstream storm drain or approved discharge point.
- ❑ Planter is set level.
- ❑ Emergency spillage will be safely conveyed overland.
- ❑ Plantings are suitable to the climate, exposure, and a well-drained soil.
- ❑ Irrigation system with connection to water supply, on a separate zone.

Useful Resources

The following references may be useful for design. Designs must meet the minimum standard specifications herein.

BASMAA Post-Construction Manual.

Start At the Source: Design Guidance Manual for Stormwater Quality.
Bay Area Stormwater Management Agencies Association, 1999.

Concrete Promotion Council of Northern California

California Asphalt Pavement Association

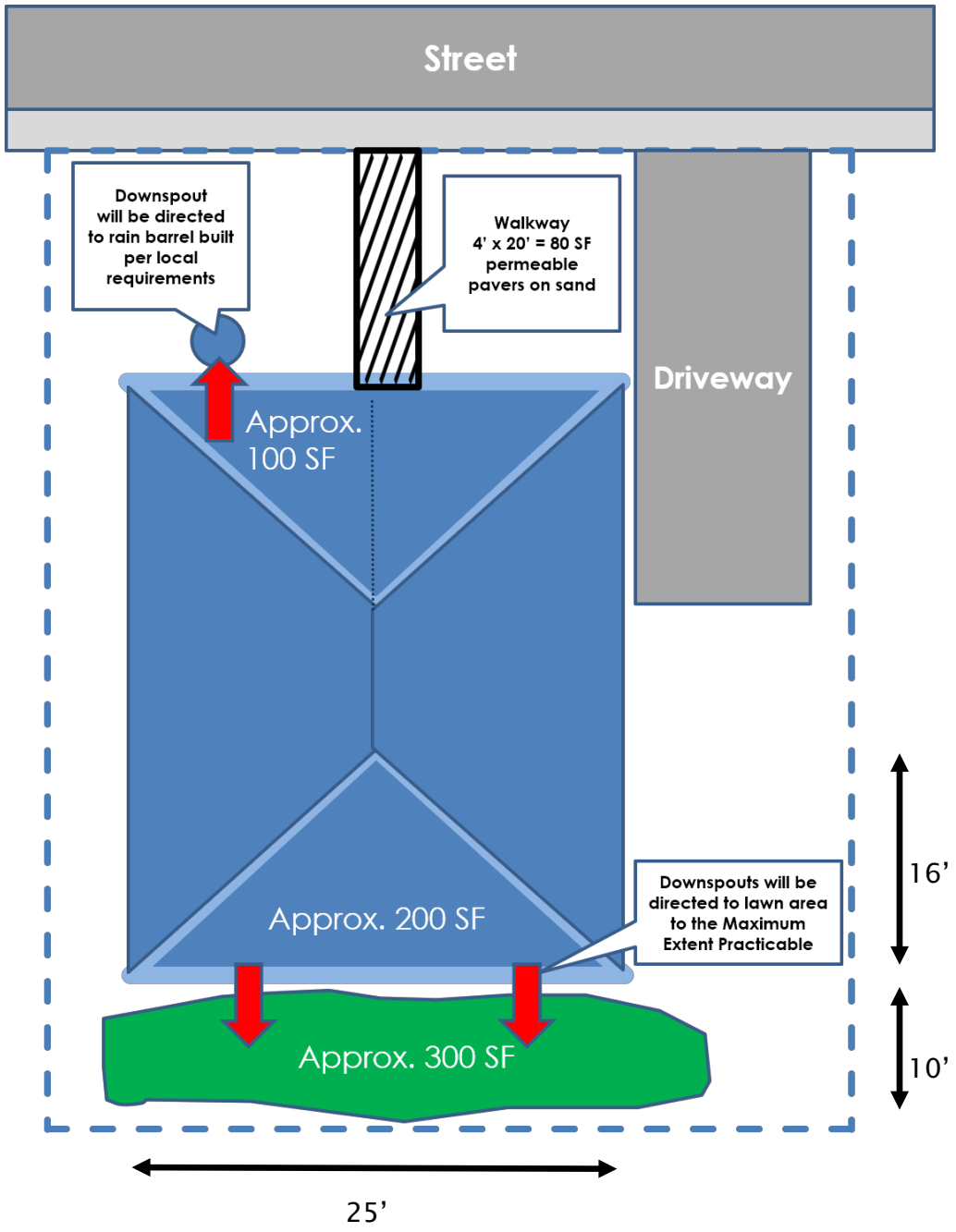
Interlocking Concrete Pavement Institute
http://www.icpi.org/

Porous Pavements, by Bruce K. Ferguson. 2005. ISBN 0-8493-2670-2

Example Sketch

The example below illustrates the level of detail required. Three options are shown; one or more such measures is required.

Not to Scale



APPENDIX D

Stormwater Control Plan Template for Regulated Projects

Stormwater Control Plan
For a Regulated Project
[Name of Project]

[date]

This template is to be used in conjunction with the instructions, criteria, and minimum requirements in the Bay Area Stormwater Management Agencies Association's (BASMAA's) *Post-Construction Manual*.

Check www.basmaa.org for new information and updates to the *Post-Construction Manual* and this template.

[Name of Owner]
[Owner's Representative and Contact Information]

prepared by:

[Preparer's Name]
[Preparer's Contact Information]

Table of Contents

Tables

Figures

Attachments

Stormwater Control Plan Exhibit

Appendices

This Stormwater Control Plan was prepared using the template dated October 2018.

I. Project Data

Table 1. Project Data Form

Project Name/Number	
Application Submittal Date	[to be verified by municipal staff]
Project Location	[Street Address if available, or intersection and/or APN]
Project Phase No.	[If project is being constructed in phases, indicate the phase number. If not, enter "NA"]
Project Type and Description	[Example entries: "Detached single-family residence," "5-story office building," "Residential with 160 single-family homes," "Five 4-story buildings to contain 200 condominiums," "100-unit, 2-story shopping mall," "mixed use retail and residential development (apartments)", "Industrial warehouse."]
Total Project Site Area (acres)	
Total New and Replaced Impervious Surface Area	
Total Pre-Project Impervious Surface Area	
Total Post-Project Impervious Surface Area	

II. Setting

II.A.1. Project Location and Description

[Include site location, division of parcels, planned land uses, zoning, setback and open space requirements, project phasing, number of residential units or square footage of office or retail, parking requirements, neighborhood character, project design objectives (for example LEED certification), other notable project characteristics. A vicinity map may also be useful.]

II.B. Existing Site Features and Conditions

[Include site size, shape, and topography. Hydrologic features, including any contiguous natural areas, wetlands, watercourses, seeps, or springs. Existing land uses. Soil types and hydrologic soil groups, vegetative cover, and impervious areas, if any. Existing drainage for site and nearby areas, including location of municipal storm drains.]

II.C. Opportunities and Constraints for Stormwater Control

[Examples of opportunities: Existing natural areas, low areas, oddly configured or otherwise unbuildable areas, easements and required landscape amenities including open space and buffers that might be used for bioretention facilities, and differences in elevation, which can provide needed hydraulic head.]

[Examples of constraints: impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, density/high-intensity land use, heavy pedestrian or vehicular traffic, utility locations, safety concerns.]

III. Low Impact Development Design Strategies

III.A. Optimization of Site Layout

III.A.1. Limitation of development envelope

III.A.2. Preservation of natural drainage features

III.A.3. Setbacks from creeks, wetlands, and riparian habitats

III.A.4. Minimization of imperviousness

III.A.5. Use of drainage as a design element

III.B. Use of Permeable Pavements

[Permeable pavements include pervious concrete, porous asphalt, porous pavers, crushed aggregate, open pavers, or solid pavers. Show the location, extent, and types of pervious pavement on your SCP Exhibit and describe here how pavements will be constructed according to the appropriate specifications. See page 4-6 of the *BASMAA Post-Construction Manual*.]

III.C. Dispersal of Runoff to Pervious Areas

III.D. Stormwater Control Measures

IV. Documentation of Drainage Design

IV.A. Descriptions of Each Drainage Management Area

IV.A.1. Table of Drainage Management Areas

DMA Name	Surface Type	Area (square feet)

IV.A.2. Drainage Management Area Descriptions

DMA [name], totaling x,xxx square feet, drains [description of area]. DMA [name] drains to [Self-Retaining DMA name or facility name]. [Describe notable or exceptional characteristics or conditions.]

DMA [name], totaling x,xxx square feet, drains [description of area]. DMA [name] drains to [Self-Retaining DMA name or facility name]. [Describe notable or exceptional characteristics or conditions.]

DMA [name], totaling x,xxx square feet, drains [description of area]. DMA [name] drains to [Self-Retaining DMA name or facility name]. [Describe notable or exceptional characteristics or conditions.]

DMA [name], totaling x,xxx square feet, drains [description of area]. DMA [name] drains to [Self-Retaining DMA name or facility name]. [Describe notable or exceptional characteristics or conditions.]

IV.B. Tabulation and Sizing Calculations

IV.B.1. Information Summary for Bioretention Facility Design

Total Project Area (Square Feet)	[should be consistent with Table 1]
[List all DMAs]	[Square footage of each DMA]

IV.B.2. Self-Treating Areas

[Extend table to list additional DMAs.]

DMA Name	Area (square feet)

IV.B.3. Self-Retaining Areas

[Extend table to list additional DMAs. Include areas for which runoff is to harvested and used.]

DMA Name	Area (square feet)

IV.B.4. Areas Draining to Self-Retaining Areas

[Extend table to list additional DMAs.]

DMA Name	Area (square feet)	Post-project surface type	Runoff factor	Product (Area x runoff factor)[A]	Receiving self-retaining DMA	Receiving self-retaining DMA Area (square feet) [B]	Ratio [A]/[B]

IV.B.5. Areas Draining to Bioretention Facilities

[Copy entire table once for each Bioretention Facility.]

DMA Name	DMA Area (square feet)	Post-project surface type	DMA Runoff factor	DMA Area × runoff factor	Facility Name		
					Sizing factor	Minimum Facility Size	Proposed Facility Size
Total>					0.04		

V. Source Control Measures

V.A. Site activities and potential sources of pollutants

V.B. Source Control Table

[See the instructions on page 3-6 of the *Post-Construction Manual* and the checklist in Appendix A.]

Potential source of runoff pollutants	Permanent source control BMPs	Operational source control BMPs

V.C. Features, Materials, and Methods of Construction of Source Control BMPs

x

VI. Stormwater Facility Maintenance

VI.A. Ownership and Responsibility for Maintenance in Perpetuity

[Include (1) a commitment to execute any necessary agreements, and (2) a statement such as the following: "The applicant accepts responsibility for interim operation and maintenance of stormwater treatment and flow-control facilities until such time as this responsibility is formally transferred to a subsequent owner."

VI.B. Summary of Maintenance Requirements for Each Stormwater Facility

[See Chapter 5 of the *Post-Construction Manual*]

VII. Construction Checklist

[See the instructions on page 3-8 of the *Post-Construction Manual*.]

Stormwater Control Plan Page #	Source Control or Treatment Control Measure	See Plan Sheet #s

VIII. Certifications

The preliminary design of stormwater treatment facilities and other stormwater pollution control measures in this plan are in accordance with the current edition of the BASMAA *Post-Construction Manual* [Check with local staff regarding other certification requirements.]

APPENDIX E

Bioretention Facility Plant Matrix

		Plant Categories	Light Preference			Size (feet)		Watering				Tolerances					High Performers			
Scientific name	Common name		Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Wind	Zone 1	Zone 2	Best for irrigated sites	Best for non-irrigated sites	CA Native	Notes
Agrostis exerata	Spike bentgrass	*Grasses and Grass-like Plants*	✓	✓		1	1.25		✓	✓	✓		✓		✓	✓				Moist sand dunes ;adapts to shady woodlands from San Diego to Sonoma County
Bouteloua gracilis	blue grama	*Grasses and Grass-like Plants*	✓			1.5	1	✓				✓		✓		✓				Tolerates no summer water, good for non-irrigated remote sites. AKA= Mosquito Grass
Bromus carinatus	California brome	*Grasses and Grass-like Plants*	✓			2	1	✓			ok	✓		✓		✓			✓	Good for erosion control ; not a good meadow grass
Carex barbarea	Santa Barbara sedge	*Grasses and Grass-like Plants*	✓	✓		3	2	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	Stays green w/ summer H20, moist to drought tolerant, spreading large statured sedge
Carex divulsa	grassland sedge	*Grasses and Grass-like Plants*	✓	✓	✓	1	1		✓		ok		✓	✓	✓	✓	✓			Widely sold in CA as Carex tumulicola (Berkeley sedge). Native to Eurasia. Full sun along coast. Tolerates drought once established. Needs regular water in sun.
Carex nudata	California black sedge	*Grasses and Grass-like Plants*	✓	✓		2	2	✓	✓		✓	✓	✓		✓	✓			✓	Turns orange in frost, showy black flower spikes
Carex obnupta	slough sedge	*Grasses and Grass-like Plants*	✓	✓		2	1		✓	✓	✓		✓	✓	✓				✓	Some salt tolerance, drought tolerant once established. Thick, graceful, bright green stands in wetlands.
Carex pansa	dune sedge	*Grasses and Grass-like Plants*	✓	✓		2	2		✓		✓	✓	✓	✓	✓	✓	✓		✓	Native to Asilomar; Plug not seed planting; mow end of summer if desired.
Carex praegracilis	clustered field sedge	*Grasses and Grass-like Plants*	✓	✓		1.5	1.5		✓	✓	✓	✓	✓	✓	✓	✓			✓	Lawn alternative, tolerates some foot traffic; summer dormant in warmer areas
Chondropetalum tectorum	small cape rush	*Grasses and Grass-like Plants*	✓	✓		4	3			✓	✓	✓	✓		✓	✓				Native to S. Africa, drought tolerant
Danthonia californica	California oat grass	*Grasses and Grass-like Plants*	✓	✓		1.5	1.5		✓		✓		✓		✓	✓			✓	Bunch grass, recommend plugs not seed to start, tolerates some foot traffic
Distichlis spicata	salt grass	*Grasses and Grass-like Plants*	✓			0.3	3		✓	✓	✓	✓	✓	✓	✓	✓			✓	Looks like bermuda grass, withstands foot traffic, for soils with high salt
Festuca californica	California fescue	*Grasses and Grass-like Plants*	✓	✓	✓	2	2	✓			ok	✓	✓	✓					✓	Use only in driest areas of basin
Festuca idahoensis	Idaho fescue	*Grasses and Grass-like Plants*	✓	✓		1	1	✓	✓		ok	✓	✓	✓		✓			✓	Can mow. Needs light summer water at hot sites
Festuca rubra	red fescue	*Grasses and Grass-like Plants*	✓	✓		1	1.5		✓	✓	ok	✓	✓	✓		✓			✓	Can mow. Lawn alternative; Water conservation LDS; Bio Strips; Infiltration basins
Festuca rubra 'molate'	molate fescue	*Grasses and Grass-like Plants*	✓	✓		1	1.5	✓	✓		ok	✓	✓	✓		✓			✓	Can mow. Lawn alternative
Juncus effusus	common rush	*Grasses and Grass-like Plants*	✓	✓		2.5	2.5		✓		ok		✓	✓	✓	✓	✓		✓	Forms dense clumps
Juncus pallidus	giant rush	*Grasses and Grass-like Plants*	✓			4	2	✓			ok	✓	✓	✓	✓	✓	✓			Evergreen, heat and drought tolerant.
Juncus patens	blue rush	*Grasses and Grass-like Plants*	✓			2	1		✓	✓	✓	✓			✓	✓	✓		✓	Plant from plugs; Irrigate occasionally summer
Leymus triticoides	creeping wildrye	*Grasses and Grass-like Plants*	✓	✓		3	1	✓	✓		ok	✓	✓	✓	✓	✓			✓	Can mow 4 x yr.. Sub-surface H20 best. Can be aggressive in moist areas.
Muhlenbergia rigens	deergrass	*Grasses and Grass-like Plants*	✓			3	3	✓	✓		ok	✓				✓			✓	Evergreen, forms mounds.
Sisyrinchium bellum	blue eyed grass	*Grasses and Grass-like Plants*	✓	✓		1	1		✓		ok		✓	✓		✓	✓		✓	Needs occasional summer water, tolerates some foot traffic
Achillea millefolium	common yarrow	*Herbaceous Perennials and Groundcovers*	✓			1.5	1	✓			ok	✓				✓	✓	✓	✓	Good for hot sites. Tolerates mowing, and can be used in a lawn replacement mix.
Artemisia douglasiana	mugwort	*Herbaceous Perennials and Groundcovers*	✓	✓	✓	3	3	✓	✓		ok	✓	✓	✓	✓	✓	✓	✓	✓	Rhizomatous
Artemisia ludoviciana	white sagebrush	*Herbaceous Perennials and Groundcovers*	✓	✓	✓	1.5	2	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	Aromatic. Tolerates foot traffic and wide range of conditions
Asclepias fascicularis	narrowleaf milkweed	*Herbaceous Perennials and Groundcovers*	✓			3	2	✓	✓		ok	✓	✓			✓	✓	✓	✓	Monarch butterfly host plant, deciduous
Darmera peltata	Indian rhubarb	*Herbaceous Perennials and Groundcovers*		✓	✓	3	5			✓	✓					✓			✓	Prefers cool summers. Native to N CA, S OR; found on stream banks and in woodlands.
Epilobium canum	California fuchsia	*Herbaceous Perennials and Groundcovers*	✓	✓		1	4	✓			ok	✓				✓			✓	dormant in winter, best with winter mowing
Epipactis gigantea	stream orchid	*Herbaceous Perennials and Groundcovers*	✓	✓	✓	3	1.5		✓	✓			✓		✓	✓			✓	Goes dormant with drought, salt tolerant
Fragaria chiloensis	beach strawberry	*Herbaceous Perennials and Groundcovers*	✓	✓	✓	0.3	2	✓	✓		ok		✓	✓					✓	Evergreen groundcover, performs well as filler at the upper edges of facility.
Heuchera micrantha	alum root	*Herbaceous Perennials and Groundcovers*		✓	✓	2	1.5	✓	✓		✓			✓		✓			✓	Dainty white flowers
Heuchera pilosissima	hairy alum root	*Herbaceous Perennials and Groundcovers*		✓	✓	1.5	1.5	✓	✓		✓		✓			✓			✓	Tolerates sand, best at basin edges
Iris douglasiana	Douglas iris	*Herbaceous Perennials and Groundcovers*	✓	✓		1.5	2	✓	✓		ok	✓	✓	✓		✓	✓		✓	Also, Iris hybrids
Lilium pardalinum	leopard lily	*Herbaceous Perennials and Groundcovers*	✓	✓		6	4	✓	✓				✓		✓	✓			✓	Native to dry summer areas, deciduous
Lobelia cardinalis	cardinal flower	*Herbaceous Perennials and Groundcovers*		✓	✓	2	2		✓				✓			✓				Not drought tolerant, requires regular water
Lotus scoparius	deerweed	*Herbaceous Perennials and Groundcovers*	✓			4	3	✓				✓				✓			✓	Short-lived, nitrogen fixer
Mimulus aurantiacus	common monkeyflower	*Herbaceous Perennials and Groundcovers*	✓	✓		3	3	✓			ok	✓				✓			✓	Drought tolerant, stress deciduous
Mimulus cardinalis	scarlet monkeyflower	*Herbaceous Perennials and Groundcovers*	✓	✓	✓	3	3		✓	✓	✓	✓				✓			✓	Aggressive seeder, needs summer water
Mimulus guttatus	seep monkeyflower	*Herbaceous Perennials and Groundcovers*	✓	✓		3	3		✓	✓	✓	✓	✓		✓	✓			✓	Attracts Bees, stress deciduous, needs summer water
Mirabilis multiflora	Giant four o'clock	*Herbaceous Perennials and Groundcovers*		✓	✓	2	4	✓			✓	✓				✓			✓	Best for hot sites, native to Southern California
Oenethera hookeri	Hooker's evening primrose	*Herbaceous Perennials and Groundcovers*	✓	✓		3	2	✓			ok	✓			✓	✓	✓	✓	✓	Easy to establish biennial, self seeds
Polypodium californicum	California Polypody fern	*Herbaceous Perennials and Groundcovers*		✓	✓	2	2	✓			✓		✓							Summer dormant except at coast, spreads slowly by rhizomes, frost tender
Prunella vulgaris	self heal	*Herbaceous Perennials and Groundcovers*	✓	✓		0.5	2'	✓	✓		ok		✓	✓		✓			✓	Somewhat drought tolerant, long flowering
Rudebeckia californica	California coneflower	*Herbaceous Perennials and Groundcovers*	✓			3	2	✓	✓		ok	✓			✓	✓			✓	Native to dry summer areas, deciduous
Scaevola 'mauve clusters'	fan flower	*Herbaceous Perennials and Groundcovers*	✓	✓		1	4	✓				✓		✓		✓				Native to Australia, sensitive to frost
Scutellaria austinae	skullcap	*Herbaceous Perennials and Groundcovers*	✓			1	2	✓	✓		✓	✓		✓		✓			✓	Dies back in drought
Sisyrinchium californicum	yellow eyed grass	*Herbaceous Perennials and Groundcovers*	✓	✓		1	1		✓		✓		✓	✓	✓	✓			✓	Can be drought tolerant
Verbena lasiostachys	Western vervain	*Herbaceous Perennials and Groundcovers*	✓	✓		2	2	✓			ok	✓			✓	✓	✓	✓	✓	Attracts butterflies, can be weedy pioneer species
Verbena lilacina	Cedros Island verbena	*Herbaceous Perennials and Groundcovers*	✓	✓		2	4	✓			ok	✓	✓			✓				Drought tolerant, best with minimal irrigation, native to Baja CA
Alyogyne huegelil	blue hibiscus	*Shrubs*	✓			8	7	✓				✓				✓				Very low water after second year, Sunset zones 15-17 & 20-24, prune to encourage flowering
Baccharis pilularis consanguinea	bush baccharis	*Shrubs*	✓			6	6	✓	✓		ok	✓	✓	✓	✓	✓	✓	✓	✓	Fast-growing, somewhat short-lived; deer proof
Calycanthus occidentalis	western spicebush	*Shrubs*	✓	✓		8	8	✓			✓		✓		✓	✓			✓	Deer resistant, deciduous. Bright green leaves, good for hedgerow/screen. Riparian areas.
Carpenteria californica	bush anemone	*Shrubs*	✓	✓		6	4	✓	✓		ü	✓			✓	✓			ü	Interior climate with occasional water otherwise low water needs
Cornus sericera	redtwig dogwood	*Shrubs*	✓	✓		5	4	✓			✓	✓	✓		✓	✓			✓	Deciduous, red stems for winter color, best with afternoon shade. Can cut to ground to maintain small size and red stems.
Erigeron glaucus	seaside daisy	*Shrubs*	✓			1	1.5				ok		✓	✓		✓			✓	Not good for dusty sites
Lonicera hispidula	California honeysuckle	*Shrubs*	✓	✓	✓	4	2		✓	✓	✓		✓			✓			✓	Climbing vine-like. Best in part shade. Attracts birds
Lonicera involucrata	twinberry honeysuckle	*Shrubs*	✓	✓	✓	6	3		✓	✓	✓		✓			✓			✓	Needs good drainage, Best in part shade. Attracts birds
Mahonia pinnata	California holly grape	*Shrubs*	✓	✓	✓	4	4	✓	✓			✓		✓	✓	✓			✓	Slow but easy to grow
Physocarpus capitatus	pacific ninebark	*Shrubs*	✓	✓		8	8	✓	✓	✓	✓	✓	✓		✓	✓			✓	Part shade and summer water required in hot locations

		Plant Categories	Light Preference			Size (feet)		Watering				Tolerances					High Performers			
Scientific name	Common name		Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Wind	Zone 1	Zone 2	Best for irrigated sites	Best for non-irrigated sites	CA Native	Notes
Rhamnus californica	California coffeeberry	*Shrubs*	✓	✓		12	8	✓			✓	✓		✓		✓	✓	✓	✓	'Eve Case' is compact with broad foliage. Syn. *Frangula californica*
Rhamnus crocea	redberry	*Shrubs*	✓	✓	✓	5	5	✓				✓	✓	✓		✓			✓	Pea sized fruits attract birds, stain concrete
Rhododendron occidentale	western azalea	*Shrubs*	✓	✓	✓	8	8		✓	✓	✓		✓		✓	✓			✓	Summer deciduous
Ribes aureum gracillimum	golden current	*Shrubs*	✓	✓		4	3	✓	✓	✓	ok	✓		✓		✓			✓	Easy, fall color, deciduous
Ribes divericatum	coast black gooseberry	*Shrubs*		✓	✓	5	5	✓	✓		ok		✓	✓		✓			✓	Thorny, good for discouraging entry, deciduous
Ribes sanguineum	red flowering currant	*Shrubs*		✓	✓	5	5	✓	✓		✓	✓	✓		✓	✓	✓		✓	Needs good air movement to avoid white fly, more drought tolerant at coast
Ribes speciosum	fuchsia-flowered gooseberry	*Shrubs*	✓	✓	✓	4	4	✓	✓			✓	✓			✓			✓	Prefers only light summer water after 2nd year, stress deciduous
Rosa californica	California wild rose	*Shrubs*	✓	✓		3	6		✓	✓	ok	✓	✓	✓	✓	✓	✓		✓	Hooked thorns, good for discouraging entry. Shade in interior, sun at coast
Rosa gymnocarpa	wood rose	*Shrubs*	✓	✓	✓	2	3		✓		ok	✓	✓			✓	✓		✓	Easy to grow, thorny
Rubus parviflorus	thimbleberry	*Shrubs*	✓	✓		8	5			✓	✓		✓		✓	✓			✓	Spreads readily in wet areas, prefers regular water
Rubus spectabilis	salmonberry	*Shrubs*		✓	✓	8	5		✓	✓	✓		✓	✓	✓	✓			✓	deciduous, soft spiny stems
Rubus ursinus	California blackberry	*Shrubs*		✓	✓	3	5		✓	✓	ok	✓	✓	✓	✓	✓			✓	Thorny, good for discouraging entry. Harbors beneficial insects
Symphoricarpos albus	common snowberry	*Shrubs*	✓	✓	✓	4	4	✓	✓	✓	ok	✓				✓	✓		✓	Adaptable to many conditions, try *Symphoicarpos mollis* at coast
Whipplea modesta	whipplevine	*Shrubs*		✓	✓	0.5	3		✓	✓	✓		✓			✓			✓	Best for moist shady spots near coast
Acer circinatum	vine maple	*Small Trees*		✓	✓	20	10		✓	✓	✓					✓			✓	In wide riparian areas; top of slope. Avoid hot inland climates and coastal conditions/salt spray.
Baccharis viminea	seep-willow	*Small Trees*	✓			8	5	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	Important plant for butterflies and beneficial insects.
Chilopsis linearis	desert-willow	*Small Trees*	✓			15	15		✓		✓	✓			✓	✓	✓		✓	Does best inland
Corylus cornuta v. california	California hazel	*Small Trees*		✓	✓	10	10		✓				✓		✓	✓			✓	Deciduous, edible nut
Fraxinus dipetala	California ash	*Small Trees*	✓	✓		20	20				ok	✓			✓	✓	✓		✓	drought tolerant, slow to establish, then fast
Garrya elliptica	coast silktassel	*Small Trees*	✓	✓		12	12	✓	✓		ok	✓	✓	✓		✓			✓	Winter blooms. 'Evie' is compact variety. Best at coast. Afternoon shade inland, deer resistant
Heteromeles arbutifolia	toyon	*Small Trees*	✓	✓	✓	8	5	✓	✓		✓	✓	✓			✓			✓	Doesn't respond well to pruning low branches, no summer water at coast
Laurus nobilis 'Saratoga'	Grecian bay	*Small Trees*	✓	✓		20	20	✓				✓		✓		✓				Specify 'standard' and prune for tree form, easy
Myrica californica	Pacific wax myrtle	*Small Trees*	✓	✓	✓	25	12	✓	✓				✓	✓		✓			✓	Best at coast
Sambucus mexicana	elderberry	*Small Trees*	✓	✓		20	15	✓	✓						✓	✓	✓		✓	Deciduous, edible fruit, attracts bees and birds, unripe fruits are poisonous but useful and common landscape plant
Acer negundo	box elder	*Trees*	✓	✓	✓	35	35	✓	✓		ok	✓	✓	✓	✓	✓	✓		✓	Tough shade tree, deciduous
Fraxinus latifolia	Oregon ash	*Trees*	✓	✓	✓	70	40			✓	✓		✓		✓	✓			✓	Plant in moist areas with rich soil.
Fraxinus velutina	velvet ash	*Trees*	✓			30	45	✓	✓		ok	✓		✓		✓	✓			Withstands poor drainage and drought
Pittosporum eugenioides	tarata	*Trees*	✓	✓		40	15	✓	✓		✓	✓		✓		✓				Shear to control height
Platanus acerifolia	London plane tree	*Trees*	✓	✓		80	30		✓			✓				✓				Large tree, aggressive roots will lift pavement
Platanus racemosa	California sycamore	*Trees*	✓	✓		80	30		✓	✓	ok	✓				✓			✓	Asymmetrical shape and wide trunk when mature. Give lots of room.
Populus fremontii	cottonwood	*Trees*	✓	✓		80	30		✓			✓				✓			✓	Riparian species with limited drought tolerance. Aggressive roots will lift pavement. Give lots of room.
Quercus agrifolia	coast live oak	*Trees*	✓	✓		60	60	✓				✓	✓	✓		✓			✓	Large evergreen tree, tolerant and widespread, important for wildlife, no summer water
Vitis californica	California grape	*Vine*	✓	✓		10	1-3	✓	✓		✓	✓	✓	✓	✓	✓			✓	Climbing vine. Best in full sun. Can be aggressive in moist area.

Plant Categories	
Grasses and Grass-like Plants	Grass refer to those species that are monocotyledonous plants with slender-leaved herbage.
Herbaceous Perennials and Groundcovers	Herbaceous refers to those species with soft upper growth rather than woody growth. Some species will die back to the roots at the end of the growing season and grow again at the start of the next season. This list only includes those that are perennial, i.e. live for several years.
Shrubs	Shrub is a horticultural distinction that refers to those species of woody plants which are distinguished from trees by their multiple stems and lower height. A large number of plants can be either shrubs or trees, depending on the growing conditions they experience.
Small Tree	Small trees refers to those species of woody plants with one main trunk and a distinct and elevated head with a maximum size of 25' tall and wide.
Tree	Tree refers to those species of woody plants with one main trunk and a rather distinct and elevated head with a size greater than 25' tall or wide.
Water Preference	
Water Preference-Low/Moderate/High	We have provided recommendations for irrigation. All plants should be watered with more frequency during the first two years after planting. After this establishment period, Low water use plants will only need supplemental irrigation at the hottest and driest sites. Plants with Moderate irrigation needs will be best with occasional supplemental water (once per week to once per month) and plants with High irrigation needs will be best with more frequent watering especially during periods of drought in the cooler seasons.
Water Preference-Summer Irrigation	Plants with a check in this column will not withstand a long period of summer drought without irrigation. Plants with an 'ok' in this column are tolerant of, but do not require, frequent summer irrigation. Plants with nothing in this column may not tolerate summer irrigation after establishment.
Stress Tolerance	
Tolerates Heat	A check in the heat column indicates that the plant will tolerate hot sites. It should not be confused with a plants preference for sun. Absence of the check indicates it should only be used in areas close to the Bay or other cool sites.
Tolerates Coast	The coast column indicates plants that perform well within 1,000 feet of the ocean or bay. Most of these plants tolerate some amount of salt air, fog, and wind.
Tolerates Wind	A check in the wind column means that the plant will tolerate winds of ten miles per hour or more.
Zone 1	Plants that tolerate Zone 1 are common riparian, wetland and bog plants capable of surviving in saturated soils for long durations throughout the year. Most of these plants are not drought tolerant and require some water throughout the growing season.
Zone 2	Plants that tolerate Zone 2 are common in riparian/upland transition areas, moist woodlands, and seasonal wetlands. They are capable of surviving in saturated soils for shorter durations especially in the winter or spring. Many of these plants tolerate summer drought but could benefit from some year-round moisture.
High Performers	
Best for irrigated sites	These plants have been used successfully in irrigated bioretention areas in the Bay Area.
Best for non-irrigated sites	These plants have been used successfully in non-irrigated bioretention areas in the Bay Area. Temporary irrigation for establishment is highly recommended.
Origin	
CA Native	Indicates native or cultivar of California native. Cultivars offer habitat benefits to native wildlife and are adapted to the local climate but have reduced genetic diversity.