



CONTRA COSTA
CLEAN WATER
P R O G R A M

STORMWATER C.3 GUIDEBOOK

Stormwater Quality Requirements for Development Applications

9th Edition

April 12, 2024

Visit www.cccleanwater.org for updates.

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Stormwater C.3 Guidebook

Contra Costa Clean Water Program

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This Guidebook is referenced in stormwater ordinances adopted by

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Walnut Creek
Contra Costa County
Contra Costa County Flood Control and Water Conservation District

9TH EDITION

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Stormwater Glossary

Bay Area Hydrology Model (BAHM)	A software tool for design of flow control structures to meet hydromodification management requirements for new development or redevelopment projects.
Bay Area Municipal Stormwater Collaborative (BAMSC) --successor to the Bay Area Stormwater Management Agencies Association (BASMAA)	Informal collaborative of Bay Area municipal stormwater programs, including the Contra Costa Clean Water Program. BAMSC implements various regional activities mandated by the Municipal Regional Permit, provides a forum for promoting regional consistency among stormwater programs, and coordinates negotiations with the Regional Water Board on behalf of the permittees.
Best Management Practice (BMP)	Any procedure or device designed to minimize the quantity of pollutants that enter the storm drain system or to control stormwater flow.
Bioretenention	The practice of capturing runoff within a matrix of soil and plant roots. Following capture, the runoff is evapotranspirated or infiltrated to surrounding and underlying soils. During frequent or intense runoff events, the soil-and-plant-root matrix may become saturated, in which case excess runoff may be discharged to an underdrain (biotreatment).
Biotreatment	The practice of filtering runoff through a matrix of soil and plant roots prior to discharge to a receiving water or municipal storm drain.
C.3	Provision in the Municipal Regional Permit. Requires the Permittees to use their planning authorities to include appropriate source control, site design, and stormwater treatment measures in new development and redevelopment projects to address pollutant discharges and prevent increases in runoff flows.
C.3 Web Page	https://www.cccleanwater.org/development-infrastructure/development
California Environmental Quality Act (CEQA)	California law that requires public agencies to evaluate the environmental impacts of development projects.
California Stormwater Quality Association (CASQA)	Publisher of the California Stormwater Best Management Practices Handbooks. www.casqa.org

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Condition of Approval (COA)	Requirements a municipality may adopt for a project in connection with a discretionary action (e.g., adoption of a negative declaration or issuance of a use permit). COAs may specify features required to be incorporated into the final plans for the project and may also specify uses, activities, and operational measures that must be observed over the life of the project.
Contra Costa Clean Water Program (CCCWP)	<u>CCCWP</u> was established by an agreement among 19 Contra Costa cities and towns, Contra Costa County, and the Contra Costa County Flood and Water Conservation District. CCCWP implements common tasks and assists the member agencies to implement their local stormwater pollution prevention programs.
Design Storm	A hypothetical rainstorm defined by rainfall intensities and durations.
Detention	The practice of holding stormwater runoff in ponds, vaults, within berms, or in depressed areas and letting it discharge slowly to the storm drain system. See definitions of Infiltration and Retention.
Directly Connected Impervious Area	Any impervious surface which drains into a catch basin, area drain, or other conveyance structure without first flowing across pervious areas.
Direct Infiltration	Infiltration via methods or devices, such as dry wells or infiltration trenches, designed to bypass unsaturated surface soils and transmit runoff directly to groundwater.
Drainage Management Area (DMA)	Site areas subdivided by surface types for the purposes of a Stormwater Control Plan with each DMA identified as self-treating, self-retaining (zero-discharge), draining to a self-retaining area, or draining to an integrated management practice (IMP).
Drawdown time	The time required for a stormwater detention or infiltration facility to drain and return to the dry-weather condition. For detention facilities, drawdown time is a function of basin volume and outlet orifice size. For infiltration facilities, drawdown time is a function of basin volume and infiltration rate.
Harvesting and Reuse	The practice of capturing runoff and storing it for later use. Typical non-potable uses include toilet flushing, landscape irrigation, and industrial uses such as concrete production or washing.
Head	In hydraulics, energy represented as a difference in elevation. In slow-flowing open systems, the difference in water surface elevation, e.g., between an inlet and outlet.
Hydrograph	Runoff flow rate plotted as a function of time.

Hydromodification Management (HM)	Control of runoff intensities and durations to reduce the potential for downstream erosion.
Hydrologic Soil Group	Classification of soils by the Natural Resources Conservation Service (NRCS) into A, B, C, and D groups according to infiltration capacity.
IMP Sizing Calculator	A stand-alone application created by the CCCWP to facilitate the iterative calculations needed to size integrated management practices (IMPs) for Municipal Regional Stormwater Permit compliance. The calculator is available, along with instructions for its use, on the CCCWP's C.3 web page .
Impervious surface	Any material that prevents or substantially reduces infiltration of water into the underlying soil. See discussion of imperviousness in Chapter 2.
Indirect Infiltration	Infiltration via facilities, such as bioretention areas, expressly designed to treat runoff and then allow infiltration to surface soils.
Infiltration	Seepage of runoff through soil to underlying groundwater. See Retention.
Infiltration Device	Any structure that is designed to infiltrate stormwater into the subsurface and, as designed, bypasses the natural groundwater protection afforded by surface or near-surface soil. See Direct Infiltration.
Infiltration Rate	Rate at which water can be added to a soil without creating runoff. See Percolation Rate.
Integrated Management Practice (IMP)	A facility Best Management Practice (BMP) that provides small-scale treatment, retention, and/or detention and is integrated into site layout, landscaping, and drainage design. See Low Impact Development.
Lead Agency	The public agency that has the principal responsibility for carrying out or approving a project. (California Environmental Quality Act Guidelines [CEQA §15367]).
Low Impact Development (LID)	A stormwater management strategy aimed at maintaining or restoring the natural hydrologic functions of a site. LID design detains, treats, and infiltrates runoff by minimizing impervious area, using pervious pavements and green roofs, dispersing runoff to landscaped areas, and routing runoff to rain gardens, cisterns, swales, and other small-scale facilities distributed throughout a site.

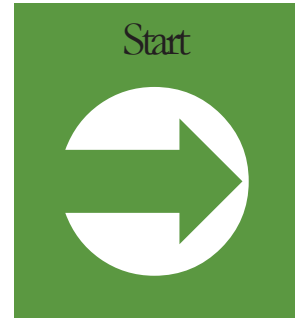
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Maximum Extent Practicable (MEP)	Standard, established by the 1987 amendments to the Clean Water Act, for the reduction of pollutant discharges from municipal storm drains.
Municipal Regional Stormwater Permit (MRP)	A stormwater National Pollutant Discharge Elimination System (NPDES) permit and Waste Discharge Requirements issued by the San Francisco Bay Regional Water Quality Control Board in 2009 (MRP 1.0) to cities, towns, and Flood Control Districts in five Bay Area counties. Reissued in 2015 (MRP 2.0) and in May 2022 (MRP 3.0).
National Pollutant Discharge Elimination System (NPDES)	As part of the 1972 Clean Water Act, Congress established the NPDES permitting system to regulate the discharge of pollutants from municipal sanitary sewers and industries. NPDES was expanded in 1987 to incorporate permits for stormwater discharges.
National Resources Conservation Services (NRCS)	Federal government organization that classifies soils into hydrologic soil groups A, B, C, and D groups according to infiltration capacity.
Numeric Criteria	Sizing requirements for stormwater treatment facilities established in Provision C.3.d. of the Municipal Regional Permit.
Operation and Maintenance (O&M)	Refers to requirements in the Municipal Regional Permit to inspect treatment BMPs and implement preventative and corrective maintenance in perpetuity. See Chapter 5.
Percolation Rate	The rate at which water flows through a soil.
Permeable or Pervious or Porous Pavements	Pavements for roadways, sidewalks, or plazas that are designed to infiltrate runoff, including pervious concrete, pervious asphalt, porous pavers, and granular materials. See the Design Sheet for Pervious Pavements.
Permeability	The rate at which water flows through a saturated soil under steady state conditions.
Pervious surface	Any material that allows infiltration of runoff into underlying soil.
Pre-Project	Conditions that exist on a development site immediately before the project, to which municipal approvals apply.
Project	The whole of an action which has the potential for adding or replacing or resulting in the addition or replacement of roofs, pavement, or other impervious surfaces. This definition is consistent with the CEQA definition of a project.

Proprietary Stormwater Treatment Facilities	Products designed and marketed by private businesses for treatment of stormwater. Many of these products do not meet requirements of the Municipal Regional Permit.
Rational Method	A method of calculating runoff flows based on rainfall intensity, tributary area, and a runoff coefficient representing the proportion of rainfall that runs off based on the type of ground cover.
Regional Water Quality Control Board (Regional Water Board or RWQCB)	California RWQCBs are responsible for implementing pollution control provisions of the Clean Water Act and California Water Code within their jurisdiction. There are nine California RWQCBs. Contra Costa County municipalities are under the jurisdiction of the RWQCB for the San Francisco Bay Region for stormwater discharges.
Regulated Project	A land development project that meets the definition of Regulated Project in Municipal Regional Permit Provision C.3.b. See Table 1-1 on page 7.
Replaced Impervious Area	In redeveloped projects, replaced impervious area refers to the square footage of existing impervious area that will be replaced with new impervious surfaces after redevelopment. See Illustration 2-1 on p. 18.
Retention	Practices such as infiltration, harvest and use, and evapotranspiration that reduce the amount of runoff discharged from a site.
Runs with the land	A legal expression with particular meaning that whoever owns the land has the obligation
Self-retaining area	An area designed to retain runoff. Self-retaining areas may include graded depressions with landscaping or pervious pavements. See Figure 3-2 on page 37.
Self-treating area	Natural, landscaped, or turf areas that do not drain to IMPs, but rather drain overland off site or to the storm drain system. See Figure 3-1 on page 36.
Source Control	A facility or procedure to prevent pollutants from entering runoff.
Stormwater Control Plan	A plan specifying and documenting permanent features and facilities to control pollutants and stormwater flows for the life of the project.
Stormwater Control Operation & Maintenance Plan	A plan detailing operation and maintenance requirements for stormwater treatment and flow-control facilities incorporated into a project.

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Storm Water Pollution Prevention Plan (SWPPP)	A plan documenting temporary measures to control sediment and other pollutants during construction.
Stormwater Treatment Facility	Stormwater facility that is intended to remove pollutants from stormwater. Facilities can include LID treatment and HM treatment, as well as non-LID treatment
Surface Loading Rate	The flow applied to a filter divided by the filter surface area. Stormwater facility that is intended to remove pollutants from stormwater. Facilities can include LID treatment and HM treatment, as well as non-LID treatment
Treatment	Removal of pollutants from runoff, typically by filtration or settling.
WEF Method	A method developed by the Water Environment Federation (WEF) for determining the minimum design volume of stormwater treatment facilities, described in <i>Urban Runoff Quality Management</i> (WEF/ASCE, 1998).
Water Board	See Regional Water Quality Control Board.
Water Quality Volume (WQV)	For stormwater treatment facilities that depend on detention to work, the volume of water that must be detained for a minimum specified drawdown time to achieve pollutant removal.



Do These Things First

Start out on the right track.

THIS Stormwater C.3 Guidebook (*Guidebook*) will help you design your project to meet local requirements for Low Impact Development (LID) drainage design—and ensure that your project complies with the C.3 requirements in the third reissuance of the San Francisco Bay Regional Water Quality Control Board (Water Board)’s Municipal Regional Stormwater Permit (MRP 3.0). MRP 3.0 can be accessed online at [the Water Board’s website](#).

First, **confirm which requirements apply to your project**. See Table 1-1, page 7.

Then, **engage your whole project team**. LID drainage design disperses, infiltrates, detains, and treats runoff using landscape features and engineered bioretention facilities (“rain gardens”) dispersed throughout the site. LID features and facilities are integrated into the project’s landscaping and, when properly designed, can be used for active or passive retention. Your site designer, architect, landscape architect, and drainage engineer need to work together on the LID drainage design from concept to completion.

Your team should prepare and refine the LID drainage design concurrently with sketching building footprints, internal roadways and circulation, parking, and landscape features. For subdivisions, LID drainage design should be initiated before sketching parcel lines and before the first stages of producing a tentative map. Use the guidance and tools in Chapter 3.

Consider, at the outset, who will own the LID features and facilities, who will be responsible for their maintenance, and how they will be maintained. See Chapter 5.

In a **pre-application** meeting with municipal planning staff, discuss the basic elements of, or ideas for, your LID design along with other project objectives and features.

Integrate the materials you prepare for discretionary review so that the visual and aesthetic characteristics of your LID features and facilities—including valley gutters, conveyance swales, dispersal areas, and bioretention facilities—are accurately represented in the preliminary site plan, landscaping plan, and renderings.

Use the design criteria in Chapters 3 and 4, and the IMP Sizing Calculator available on the Contra Costa Clean Water Program (CCCWP) website (<https://www.cccleanwater.org/development-infrastructure/development/stormwater-c-3-guidebook>), to evaluate your LID drainage design for compliance with the runoff-treatment and flow-control requirements that apply to your project. Then, adjust your design and iterate your entries into the IMP Sizing Calculator until you have an aesthetic and functional LID design that meets the numeric criteria outlined in Provision C.3.d of the MRP 3.0.

Construction-Phase Controls
Your Stormwater Control Plan is a separate document from the Storm Water Pollution Prevention Plan (SWPPP). A SWPPP provides for temporary measures to control sediment and other pollutants during construction. See the CCCWP website for information on requirements for construction-phase controls.

Follow the step-by-step guidance in Chapter 2, and use the template provided, to prepare a **Stormwater Control Plan** submittal that will accompany your application for entitlements and development approvals.

Plan ahead to ensure the required **elevations, details, cross-sections, and notes** appear in your construction plan set. See “What to Show on Construction Plans” on page 92, “Items to Be Inspected During Construction” on page 95, and the model construction inspection checklist on pages 96 through 97.

Draft a separate, required **Stormwater Facilities Operation and Maintenance Plan** (O&M Plan) using the instructions in Chapter 5 and the template provided. The O&M Plan is to be referenced in a typically required Operation and Maintenance Agreement that “runs with the land.”

The most recent version of this *Guidebook*, updates and errata, templates, and example submittals are on the [CCCWP website](#). The *Guidebook* is formatted for 2-sided printing or, when viewed as a.pdf, allows the use of hyperlinks for internal navigation and to access external references and resources.

Flood Controls:
Implementation of the LID and Hydromodification (HM) requirements in this *Guidebook* is separate from, and in addition to, flood control requirements that may apply to your project.

The CCCWP 9th edition was updated from the 8th edition to incorporate changes to compliance requirements stemming from MRP 3.0. In MRP 3.0, Provision C.3.g.v.(2) directs CCCWP Permittees to require development projects subject to HM to use the methods and criteria in the *Guidebook*. For projects requiring HM, permittees are now required to use the Bay Area Hydrology Model (BAHM) instead of the Integrated Management Practices (IMP) Calculator; updates in the 9th Edition *Guidebook* reflect this change and provide related guidance.

Guidance & tools should be used for projects subject to MRP 2.0 vs. MRP 3.0. For projects subject to MRP 2.0 refer to the legacy document 7th Edition Stormwater C.3 Guidebook and Template on the CCCWP website. For projects subject to MRP 3.0 (published May 11, 2022), and for Regulated Projects (C.3.b.) approved July 1, 2023 or later, please refer to the 9th Edition Guidebook and Template.

The *Guidebook* is the collective work product of the Contra Costa Clean Water Program's Development Committee. The *Guidebook's* purpose is to facilitate the review and approval process for Provision C.3, while also obtaining excellence in the quality and community benefit of built projects. Development Committee members pool the expertise they have gained from working with applicants for development approvals, and the Committee directs updates and refinements to the *Guidebook* with each new edition. Some background for various policy and technical decisions, including submittal requirements and technical criteria for facility design, is in **Appendix E**.

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Policies and Procedures

Determine if your development project must comply with the Municipal Regional Permit Provision C.3 requirements. Review the steps to compliance.

Thresholds, Effective Dates, and Requirements

Table 1-1 (on page 7) summarizes requirements for parcel-based development projects. Thresholds are based on the sum of **impervious area created or replaced** in connection with a project.

The following are included in that sum:

- Removing and replacing pavement to the top of the base course or lower—or repairing pavement base.
- Laying gravel over dirt or installing pavement over existing gravel.

The following may be excluded:

- Interior remodels and routine maintenance or repair such as replacement of a roof or exterior wall surface.
- Pavement overlay of pavement, or adding gravel to a gravel road, within the existing footprint.
- Pervious pavements constructed to the criteria in this *Guidebook*.
- Swimming pools and other features that overflow and drain to the sanitary sewer.

► **THE “50% RULE” FOR PROJECTS ON PREVIOUSLY DEVELOPED SITES**

Projects on previously developed sites may also need to retrofit drainage to provide **treatment** of runoff from all impervious areas of the entire site. For sites creating

or replacing a total area of impervious surface greater than the applicable threshold (Table 1-1):

- If the new project results in an alteration of **more than 50%** of the impervious surface of a previously existing development, and the existing development was not subject to stormwater treatment measures, then the entire project must be included in the treatment measure design.
- If the new project results in an alteration of **less than 50%** of the impervious surface of a previously existing development, and the existing development was not subject to stormwater treatment measures, then only the new and replaced impervious surface must be included in the treatment system design.

Municipal staff will determine case-by-case when and how the “50% rule” applies. Staff may use the original entitlement (discretionary approval) or approved building plans as a guide when calculating the impervious area of the previously existing development.

TABLE 1-1. THRESHOLDS AND REQUIREMENTS FOR PARCEL-BASED PROJECTS

	Impervious Area Threshold	Requirement
Non-Regulated Projects	All projects requiring municipal approvals or permits (including single-family residences)	As encouraged or directed by local staff, preserve or restore open space, riparian areas, and wetlands as project amenities; minimize land disturbance and impervious surfaces (especially parking lots); cluster structures and pavements; include micro-detention in landscaped and other areas; and direct runoff to vegetated areas. Use Bay-friendly landscaping features and techniques. Include Source Controls specified in Appendix D.
	Projects creating or replacing more than 2,500 to 5,000 square feet of impervious surface that are not Regulated Projects	Using the template in Appendix C, prepare and submit a Stormwater Control Plan for a Small Land Development Project. Implement one or more of the following measures: (1) Direct roof runoff into cisterns or rain barrels for reuse if allowed by your municipality; (2) direct roof runoff onto vegetated areas; (3) Direct runoff from sidewalks, walkways, and/or patios onto vegetated areas; (4) direct runoff from driveways and/or uncovered parking lots onto vegetated areas; (5) Construct sidewalks, walkways and/or patios with permeable surfaces or; (6) construct bike lanes, driveways, and/or uncovered parking lots with permeable surfaces.
Regulated Projects	One single-family home, not part of a larger plan of development, creating or replacing 10,000 square feet of impervious surface	Prepare and submit a Stormwater Control Plan as described in Chapter 2, including features and facilities to ensure runoff is treated before leaving the site. Use the Low Impact Development (LID) Design Guide in Chapter 3 and the design criteria in Chapter 4, including sizing factors and criteria for “treatment only.”
	All other projects creating or replacing between 5,000 square feet and one acre of impervious surface (10,000 square feet for projects approved before 7/1/2023)	
	Projects creating or replacing an acre or more of impervious surface, unless exempted. See text.	Design LID features and facilities for hydromodification management (HM) as well as stormwater treatment. Prepare and submit a Stormwater Control Plan as described in Chapter 2 and use the LID Design Guide in Chapter 3, including the sizing factors and criteria for “treatment and HM.” See Appendix E for additional information.

¹Summary only. Requirements for your project are determined by your municipality.

²Thresholds in **bold** apply to projects approved beginning 7/1/2023.

C.3 Applicability and Entitlements

Provision C.3 compliance must be demonstrated at the time of application for a development project, including rezoning, tentative map, parcel map, conditional use permit, variance, site development review, design review, development agreement, or building permit.

All Regulated Projects require a Stormwater Control Plan showing the location and footprint of proposed impervious surfaces and of proposed stormwater facilities, and a description of how runoff will flow from impervious surfaces to the facilities. Instructions for preparing a Stormwater Control Plan are in Chapter 2.

► **DEFINITION OF A “PROJECT”**

When determining which Provision C.3 requirements apply, a “project” should be defined consistent with California Environmental Quality Act (CEQA) definitions of “project.” Specifically, the “project” is the **whole of an action** that has the potential for adding or replacing, or resulting in the addition or replacement, of roofs, pavement, or other impervious surfaces and thereby resulting in increased flows and runoff pollutants. “Whole of an action” means the project may not be segmented or piecemealed into smaller parts if the effect is to reduce the quantity of impervious area for any part to below the C.3 threshold.

The C.3 project scope includes any impervious surfaces **added or replaced within the public right-of-way** in connection with the project.

► **GRANDFATHERING**

Regulated Projects approved prior to July 1, 2023 which have approved Stormwater Control Plans may be issued building permits and allowed to proceed. Regulated Projects with vesting tentative maps, regardless of the date of map approval, may be issued building permits to proceed with development in substantial compliance with the ordinance, policies, and standards in effect at the time the vesting tentative map was approved or conditionally approved, in accordance with California law.

This “grandfathering” applies only to the specific discretionary approval that was the subject of the original application. Subsequent applications for further approvals constitute a project for the purposes of C.3. If those subsequent approvals or entitlements cover specific locations, modes, or designs for addition or replacement of roofs, pavement, or other impervious surfaces, and if the impervious area created or replaced is in excess of the applicable thresholds, then the C.3 requirements will apply to those areas of the project covered by the subsequent approval or entitlement.

For example, an application for a subdivision tentative map which received final discretionary approval prior to the C.3 start dates may be exempt from Provision C.3. However, if the project proponent later applies for discretionary approval, then C.3 requirements would apply to those improvements.

► **PROVISION C.3 COMPLIANCE REQUIREMENTS FOR SUBDIVISION MAPS**

Your drainage design will determine where stormwater treatment facilities will be constructed. Note that **stormwater treatment facilities should not be located on individual single-family residential lots**. This is especially important when the

facilities will manage runoff from other lots, from streets, or from common areas. Facility landowners will be responsible for facility maintenance. **See Chapter 5.**

For typical subdivisions, it works best to drain individual lots to the common street, and then drain the street to treatment facilities located within the private street right-of-way or on one or more separate, jointly owned parcels.

Your team should complete a preliminary drainage design before making final the right-of-way of internal streets and before sketching parcel lines. **Each stormwater treatment facility footprint must have a corresponding easement** to restrict future building of structures at the facility location.

Applications for tentative maps may be required to include the following:

- Delineation of separate parcels upon which stormwater facilities will be located.
- Dedication of easements and inclusion of provisions related to provision C.3 compliance.
- Execution of, or commitment to execute later, a covenant running with the land and agreement for residents of the subdivision to operate and maintain stormwater facilities.
- Conditions, Covenants, and Restrictions (CC&Rs) recorded against the subdivision to establish reciprocal obligations of the lot owners to maintain stormwater facilities.

If a tentative map approval would potentially entitle future owners of individual parcels to construct new or replaced impervious area which, in aggregate, could exceed the thresholds in Table 1-1, then the applicant must take steps to ensure C.3 requirements can and will be implemented as the subdivision is built out.

If the tentative map application does not include plans for site improvements, the applicant should nevertheless identify the type, size, location, and final ownership of stormwater treatment and flow-control facilities adequate to serve new roadways and any common areas, and to also manage runoff from an expected reasonable estimate of the square footage of future roofs, driveways, and other impervious surfaces on each individual lot. The municipality may condition approval of the map on implementation of stormwater treatment measures in compliance with Provision C.3 when construction occurs on the individual lots. This condition may be enforced by a grant deed of development rights or by a development agreement.

If a municipality deems it necessary, the future impervious area of one or more lots may be limited by a deed restriction. This might be necessary when a project is exempt from one or all C.3 provisions because the total impervious area is below a threshold, or to ensure runoff from impervious areas added after the project is approved does not overload a stormwater treatment and flow-control facility.

Local Requirements:

Cities, towns, or the County may have requirements that differ from, or are in addition to, this countywide *Guidebook*. See Appendix A for local requirements.

See the *Policy for C.3 Compliance for Subdivisions* on the CCCWP's [C.3 web page](#). After consulting with local planning staff, applicants for subdivision approvals will propose one of the following four options, depending on project characteristics and local policies:

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

For the option selected, municipal staff will determine the appropriate conditions of approval, easements, deed restrictions, or other legal instruments necessary to ensure future compliance. When new streets and common areas are constructed, facilities to treat runoff from those new impervious areas must be constructed concurrently, and agreements for the operation and maintenance of those facilities must be executed timely.

► **PHASED PROJECTS**

As part of an application for approval of a phased development project, a conceptual or master Stormwater Control Plan which describes and illustrates, in broad outline, how the drainage for the project will comply with the Provision C.3 requirements should be provided. The level of detail in the conceptual or master Stormwater Control Plan shall be consistent with the scope and level of detail of

the development approval being considered. The conceptual or master Stormwater Control Plan should specify that a more detailed Stormwater Control Plan for each later phase or portion of the project will be submitted with subsequent applications for discretionary approvals.

Projects in Public Roads or Right-of-Way

Work within the public right-of-way that is part of a parcel-based project is included in the sum of impervious area created or replaced. For example, the following frontage improvements are included in the sum of impervious area:

- Removal or replacement of curb or sidewalk,
- Removal or replacement of roadway pavement to the top of the base course or lower,
- Construction of a new public street, or
- Paving of an existing dirt or gravel roadway.

For projects entirely within the public right-of-way, Regulated Project thresholds are shown in Table 1-2.

TABLE 1-2. THRESHOLDS FOR PUBLIC ROAD AND TRAIL PROJECTS

Impervious Area Threshold	Project Types
5,000 square feet contiguous¹	<ul style="list-style-type: none"> ▪ New roads, including sidewalks and bike lanes ▪ Adding traffic lanes to an existing road ▪ New stand-alone trail projects 10 feet wide or wider ▪ Sidewalk gap closures, sidewalk replacement, Americans with Disabilities Act (ADA) curb ramps
One acre contiguous²	<ul style="list-style-type: none"> ▪ Removing/replacing asphalt or concrete to top of base course or lower ▪ Repair of pavement base ▪ Extending pavement edge (e.g., safety improvement, paving gravel shoulder) ▪ Utility trenching projects 8 feet wide or wider

¹For projects approved prior to 7/1/2023, the threshold is 10,000 square feet contiguous.

²Projects approved prior to 7/1/2023 are exempt.

Hydromodification Management Requirements

As shown in Table 1-1 on page 7, in addition to incorporating treatment controls, projects creating or replacing 1 acre or more of impervious area—unless exempted—must ensure post-project runoff does not exceed estimated pre-project

rates and durations in a way that could potentially accelerate stream erosion. Additional information on hydromodification management (HM) is in Appendix E.

► **EXEMPTIONS**

Per MRP 3.0 Provision C.3.g.i, projects may be exempted from HM requirements if any of the following apply:

- The project is not located in an area of HM applicability on the HM Applicability Map located on [CCCWP's website](#).
- The post-project impervious area is less than, or the same as, the pre-project impervious area. (At the discretion of municipal staff, on HM projects applicants may provide treatment-only controls for an impervious square footage that is less than or equal to the pre-project impervious square footage. See Appendix E).

► **SITES THAT ARE ALREADY PARTIALLY DEVELOPED**

At the discretion of municipal staff, applicants with HM projects may provide treatment-only controls for an impervious square footage that is less than or equal to the pre-project impervious square footage. Treatment and HM controls must be provided for the remaining impervious square footage.

► **COMPLIANCE WITH HM REQUIREMENTS**

Projects subject to the HM requirements must use the LID Design Guide in Chapter 3 and the criteria in Chapter 4 **to develop a design that meets both treatment and HM requirements.**

For a compliant and/or efficient LID design for HM:

- Drain only impervious areas to bioretention or other treatment/HM facilities.
- Use self-treating areas and self-retaining areas to manage runoff from landscaped areas.
- Wherever possible, disperse runoff from impervious areas to landscaped areas.
- If the required footprint for a bioretention facility seems too large, consider using the cistern and bioretention or bioretention and vault options.

See the Design Guide in Chapter 3.

► **HM REQUIREMENTS - RECENT UPDATE**

CCCWP recently went through the process of identifying, analyzing, and comparing options for HM implementation in compliance with Provision C.3.g. Applicants for development projects subject to HM requirements are now required to use BAHM to demonstrate HM compliance. Detailed direction on this new HM compliance methodology and pathway are discussed in Chapter 3.

Offsite Compliance Options for Runoff Treatment

Experience has shown that LID features and facilities, distributed throughout the site and designed using the guidance in Chapter 3, are feasible on nearly all development sites. However, in lieu of incorporating facilities to treat runoff from impervious areas at the development project site, an applicant may propose a secondary project that will **treat runoff from an equivalent amount of existing impervious surface area** with LID (i.e., retrofit with LID) at another location within the same watershed.

To be considered, the secondary project must include construction, operation, and maintenance of facilities that meet the criteria in Chapter 3. Those facilities must treat runoff from an amount of impervious surface equivalent to, or greater than, the impervious surface that would be subject to requirements at the project location.

An applicant may propose to combine onsite and offsite facilities to add up to the equivalent amount of impervious area as would be required for only onsite treatment. **Drainage from equivalent existing impervious square footage not subject to C.3 requirements, including existing impervious square footage on the same parcel*** or on an adjacent parcel or public or private street **within the same watershed, may be retrofitted with LID and the retrofit drainage square footage used to offset new or replaced impervious square footage that would be difficult or expensive to route to treatment.**

An applicant may also propose to share in a larger project and be credited for a proportional amount of the impervious area for which runoff is treated by that project.

Consideration or acceptance of such proposals is at the discretion of the local municipality.

* Excluding existing impervious square footage subject to the 50% rule.

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Preparing A Stormwater Control Plan

Step-by-step documentation of compliance for Regulated Projects

Your Stormwater Control Plan for a Regulated Project will demonstrate your project complies with all applicable requirements in MRP 3.0 to:

- minimize imperviousness and reduce runoff,
- slow runoff rates and retain or detain stormwater,
- incorporate required source controls,
- treat stormwater prior to discharge from the site,
- control runoff rates and durations if required, and
- provide for operation and maintenance of stormwater facilities.

The Stormwater Control Plan must be submitted with your application for discretionary approval and must have sufficient detail to ensure the stormwater design, site plan, and landscaping plan are congruent.

A complete and thorough Stormwater Control Plan will facilitate quicker review and fewer cycles of review. Every Contra Costa municipality requires a Stormwater Control Plan for every applicable project.

Your Stormwater Control Plan will consist of a report and an exhibit.

Municipal staff may use the checklist on the following page to evaluate your Stormwater Control Plan.

STORMWATER CONTROL PLAN CHECKLIST

CONTENTS OF EXHIBIT

Show the following on drawings:

Existing natural hydrologic features (depressions, watercourses, relatively undisturbed areas) and significant natural resources.

Existing and proposed site drainage network and connections to drainage off site.

Layout of buildings, pavement, and landscaped areas.

Impervious areas proposed (including roofs, plazas, sidewalks, and streets/parking) and area of each.

Entire site divided into separate Drainage Management Areas (DMA), with each DMA identified as self-treating, self-retaining (zero-discharge), draining to a self-retaining area, or draining to an Integrated Management Practice (IMP). Each DMA has one surface type (roof, paving, or landscape), is labeled, and square footage noted.

Locations, footprints, square footage, and top of soil elevation of proposed treatment and flow-control facilities.

Potential pollutant source areas, including refuse areas, outdoor work and storage areas, etc. and corresponding required source controls listed in Appendix D.

CONTENTS OF REPORT

Include the following in a report:

Narrative analysis or description of site features and conditions that constrain or provide opportunities for stormwater control. Include soil types (including Hydrologic Soil Group as defined by the Natural Resources Conservation Service (NRCS), slopes, and depth to groundwater.

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 minimize imperviousness of the site.

Tabulation of DMAs, including self-treating areas, self-retaining areas, areas draining to self-retaining areas, and areas draining to IMPs, in the format shown in Chapter 4. Output from the IMP Sizing Calculator may be used.

Sketches and/or descriptions showing there is sufficient hydraulic head to route runoff into, through, and from each IMP to an approved discharge point.

A table of identified pollutant sources and for each source, the source control measure(s) used to reduce pollutants to the maximum extent practicable. See Appendix D.

General maintenance requirements for infiltration, treatment, and flow-control facilities.

Means by which facility maintenance will be financed and implemented in perpetuity.

Statement accepting responsibility for interim operation and maintenance of facilities.

Identification of any conflicts with codes or requirements or other anticipated obstacles to implementing the Stormwater Control Plan.

Construction Plan C.3 Checklist.

Certification by a civil engineer, architect, and landscape architect.

Appendix: Compliance with flow-control requirements
(if using an HM compliance option other than the design guidance in Chapter 3).

A template for a Stormwater Control Plan in Microsoft Word format can be found on at the Contra Costa Clean Water Program’s [C.3 web page](#). Follow the instructions in this *Guidebook* while using the template. A Design Review Checklist is included in Appendix G as an additional resource to the process of completing a Stormwater Control Plan.

Project Data

The table in the Stormwater Control Plan template is shown below for reference. The table is formatted to facilitate compilation of the municipalities’ annual reports.

TABLE 2-1. FORMAT FOR REPORTING PROJECT DATA

Project Name/Number	
Application Submittal Date	[to be verified by municipal staff]
Project Location	[Street Address if available, or intersection and/or Assessor’s Parcel Number]
Name of Developer	
Project Phase No.	[If project is being constructed in phases, indicate the phase number. If not, enter “NA”]
Project Type and Description	[Example entries: “5-story office building,” “Residential with 160 single-family homes with five 4-story buildings to contain 200 condominiums,” “100-unit, 2-story shopping mall,” “mixed use retail and residential development (apartments),” “Industrial warehouse.”]
Project Watershed	[Request from municipal staff]
Total Project Site Area (acres)	
Total Area of Land Disturbed (acres)	
Total New Impervious Surface Area (square feet [ft ²])	
Total Replaced Impervious Surface Area (ft ²)	
Total Pre-Project Impervious Surface Area (ft ²)	
Total Post-Project Impervious Surface Area (ft ²)	
50% Rule[*]	[Applies or Doesn’t Apply]
Project Density	[State dwelling units per acre and/or Floor Area Ratio]
Applicable Special Project Categories [Complete even if all treatment is Low Impact Development (LID)]	[State A, B, C, or none. If “C”, state basis for affordable housing, location, density, and parking credits.]
Percent LID and non-LID treatment	[State totals for project and provide details under “Documentation of Drainage Design.”]
Hydromodification Management (HM) Compliance [†]	State “applies” or explain reason for exemption.

* 50% rule applies if: Total Replaced Impervious Surface Area > 0.5 × Pre-Project Impervious Surface Area

† HM applies if: (Total New Impervious Surface Area + Total Replaced Impervious Surface Area) ≥ 1 acre unless exempt. See page 5.

To determine the replaced impervious surface area, it is necessary to overlay a drawing of the existing, pre-project impervious areas with the proposed site plan and evaluate the square footage of existing impervious areas that will be covered with new impervious surfaces. See the example in Figure 2-1.

Setting

Prepare a brief narrative placing the project in context. Discuss, as appropriate, the 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, Leadership in Energy and Environmental Design [LEED] certification), and other notable project characteristics.

Include a vicinity map.

Existing Features and Site Conditions

In a well-organized narrative, describe:

- Project site size, shape, and existing topography, including the general direction of surface drainage, local high or low points or depressions, any outcrops or other significant geologic features, and any contiguous natural areas, wetlands, watercourses, seeps, or springs.
- Existing land use and current or proposed zoning, including requirements for setbacks and open space.
- Soil types (including hydrologic soil groups as defined by Natural Resources Conservation Service [NRCS]) and depth to groundwater.
- Existing and proposed site drainage, including connections to the municipal storm drain system. Describe any drainage from adjacent areas that runs on to the project area.
- Existing vegetative cover and impervious areas, if any.

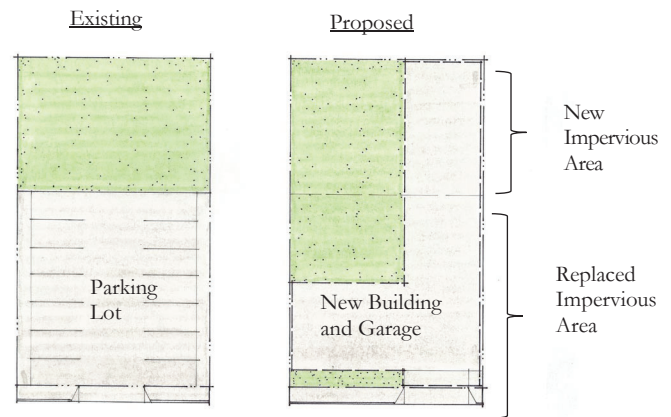


FIGURE 2-1. ILLUSTRATION OF REPLACED IMPERVIOUS AREA. The proposed building replaces impervious area on the existing parking lot. It also creates new impervious area. To complete the Project Data Table, measure, calculate, and enter the total new impervious area, total replaced impervious area, the pre-project impervious area, and the post-project impervious area.

Identify Constraints & Opportunities

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

In your narrative, describe site opportunities and constraints. This narrative will help you as you proceed with LID design and explain your design decisions to others.

Low Impact Development Design Strategies

Use the Low Impact Development Design Guide (Chapter 3) to analyze your project for LID, design and document drainage, and specify preliminary design details for integrated management practices.

After analyzing your project for LID (see page 28), prepare a narrative overview of your design and how your design decisions:

- Optimize the site layout,
- Use pervious surfaces where appropriate,
- Disperse runoff to pervious (self-retaining) areas, and
- Drain impervious surfaces to bioretention facilities or other integrated management practices (IMPs).

Documentation of Drainage Design

Chapter 3 includes calculation procedures and instructions for using the IMP Sizing Calculator to organize and present your calculations.

As shown in the checklist (page 16), your **Exhibit** must show the entire site divided into separate Drainage Management Areas (DMAs), with each area identified as one of the following:

1. SELF-TREATING AREA
2. SELF-RETAINING AREA

3. AREA DRAINING TO A SELF-RETAINING AREA, OR
4. AREA DRAINING TO AN IMP.

Each Drainage Management Area must be clearly marked with a unique identifier along with the types and square footage of any impervious surfaces.

Proposed location, size, and approximate top of soil elevation (TSL) of each treatment and flow-control facility must also be indicated on the exhibit. Each facility should be clearly marked with a unique identifier.

It is best to use the grading plan (screened) as background for the Exhibit. It may also be appropriate to show portions of the roofing plan (also screened) wherever roof ridges define DMAs.

Your Stormwater Control Plan **report** must include:

- Tabulation of proposed self-treating areas, self-retaining areas, areas draining to self-retaining areas, and areas draining to IMPs, with the corresponding IMPs identified on the Exhibit.
- Complete output from the IMP Sizing Calculator, showing the minimum square footage required and proposed square footage for each IMP.
- If flow-control requirements apply, the required storage volume or volumes, and the diameters of each underdrain orifice, must also be shown (sized using BAHM – see Chapter 3).

Your Stormwater Control Plan must also include preliminary design information for each bioretention facility or other IMP. Depending on the complexity of the project and the stage of the design, reviewers may expect to see renderings or details, in plan and/or cross-section, showing how the IMPs will be integrated into the site. This may include transitions between the flat, planted surface of bioretention facilities and the adjacent buildings, roadways, sidewalks, or landscapes, and planting plans consistent with the active or inactive uses of the planted bioretention area.

For submittals that include preliminary or final construction drawings, plan views, cross-sections, and other details must be consistent with the design criteria in this *Guidebook*. See Chapter 4 for “What to Show on Construction Plans” and for design guidance and design criteria.

Also include in your Stormwater Control Plan report:

- A narrative briefly describing each DMA, its drainage, and where drainage will be directed.

- A narrative briefly describing each IMP. Include any special characteristics or features distinct from the design sheets in Chapter 3.

Group and consolidate descriptions, or provide additional detail, as necessary to help the reviewer understand your drainage design.

Source Control Measures

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

Source control BMPs include permanent, structural features that may be required in your project plans—such as roofs over and berms around trash and recycling areas—and operational BMPs, such as regular sweeping and “housekeeping,” that must be implemented by the site’s occupant or user.

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

1. **Identify Pollutant Sources:** Review the first column in the Pollutant Sources/Source Control Checklist (Appendix D). Check off the potential sources of pollutants that apply to your site.
2. **Note Locations on Stormwater Control Plan Exhibit:** Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist (Appendix D). Show the location of each pollutant source and each permanent source control BMP in your Stormwater Control Plan Exhibit.
3. **Prepare a Table and Narrative:** Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist (Appendix D). Create a table using the format in Table 2-2 on the following page. In the left column, list each potential source on your site (from Appendix D, Column 1). In the middle column, list the corresponding permanent, structural BMPs (from Columns 2 and 3, Appendix D) used to prevent pollutants from entering runoff. Accompany this table with a narrative that explains any special features, materials, or methods of construction that will be used to implement these permanent, structural BMPs.

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

TABLE 2-2. FORMAT FOR TABLE OF PERMANENT AND OPERATIONAL SOURCE CONTROL MEASURES

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

► REFERENCES AND RESOURCES:

- [Appendix D](#), Stormwater Pollutant Sources/Source Control Checklist
- Municipal Regional Permit Provision C.3.c.
- [Bay-Friendly Landscape Guidelines](#) (Stopwaste.org, 2008)
- https://basmaa.org/wp-content/uploads/2021/04/basmaa_start-at-the-source-site-design-guidance-manual_1999.pdf Section 6.7: Details, Outdoor Work Areas

Stormwater Facility Maintenance

As required by MRP 3.0 Provision C.3.h, your local municipality will periodically verify that treatment and flow-control facilities on your site are maintained and continue to operate as designed.

To make this possible, your municipality will require that you include in your Stormwater Control Plan:

1. A means to finance and implement facility maintenance in perpetuity.
2. Acceptance of responsibility for maintenance from the time the facilities are constructed until responsibility for operation and maintenance is legally transferred. A warranty covering a period following construction may also be required. Check with your local municipality for warranty requirements.
3. An outline of general maintenance requirements for the treatment and flow-control facilities you have selected.

Your local municipality will also require that you prepare and submit a detailed Stormwater Facilities Operation and Maintenance Plan that sets forth a maintenance schedule for each of the treatment and flow-control facilities built on your site. An agreement assigning responsibility for maintenance and providing for inspections and certification may also be required.

Details of these requirements, and instructions for preparing a Stormwater Facilities Operation and Maintenance Plan, are in Chapter 5.

► **REFERENCES AND RESOURCES:**

- *Chapter 5*
- [*Model Stormwater Ordinance \(CCCWP, 2013\)*](#)
- [*Model Operation and Maintenance Agreements*](#)

Construction Plan C.3 Checklist

When you submit construction plans for City review and approval, the plan checker will compare that submittal with your Stormwater Control Plan. By creating a Construction Plan C.3 Checklist for your project, you will facilitate the plan checker’s comparison and speed review of your project by completing the following steps:

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

TABLE 2-3. FORMAT FOR CONSTRUCTION PLAN C.3 CHECKLIST

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

Note that the updated table—or Construction Plan C.3 Checklist—is **only a reference tool** to facilitate comparison of the construction plans to your Stormwater Control Plan. Local municipal staff can advise you regarding the process required to propose changes to the approved Stormwater Control Plan.

See Chapter 3 for details of IMP construction to be included in construction plans.

Certification

Your local municipality may require that your Stormwater Control Plan be certified by an architect, landscape architect, or civil engineer. See Appendix A.

Your certification should state: “The selection, sizing, and preliminary design of stormwater treatment and other control measures in this plan meet the requirements of Regional Water Quality Control Board Order R2-2022-0018.”

Stormwater Control Plan Report Sample Outline

- I. Project Data (table)
- II. Setting
 - A. Project Name, Location, Description
 - B. Existing Site Features and Conditions
 - C. Opportunities and Constraints for Stormwater Control
- III. Low Impact Development Design Strategies
 - A. Optimization of site layout
 - (1) Limitation of development envelope
 - (2) Preservation of natural drainage features
 - (3) Setbacks from creeks, wetlands, and riparian habitats
 - (4) Minimization of imperviousness
 - (5) Use of drainage as a design element
 - B. Use of Permeable Pavements
 - C. Dispersal of Runoff to Pervious (Self-Retaining) Areas
 - D. Integrated Management Practices
- IV. Documentation of Drainage Design
 - A. Description of each Drainage Management Area
 - B. Tabulation and Sizing Calculations

- V. Source Control Measures
 - A. Description of site activities and potential sources of pollutants
 - B. Table showing sources, permanent source controls, and operational source controls
 - C. Features, Materials, and Construction of Source Control BMPs
- VI. Stormwater Facility Maintenance
 - A. Ownership and responsibility for maintenance in perpetuity
 - (1) Commitment to execute any necessary agreements and/or annex into a fee mechanism, per local requirements
 - (2) Statement accepting responsibility for operation and maintenance of facilities until that responsibility is formally transferred
 - B. Summary of maintenance requirements for each stormwater facility
- VII. Construction Plan C.3 Checklist
- VIII. Certifications

Attachment: Stormwater Control Plan Exhibit

Appendix: Compliance with Flow-Control (Hydrograph Modification) requirements

Stormwater Control Plan Template

A template with the above format and headings is available on the CCCWP website.

Example Stormwater Control Plans

Example Stormwater Control Plans are available on the CCCWP website.

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Low Impact Development Site Design Guide

Guidance for designing your site to include LID site drainage, stormwater treatment facilities, and HM facilities, and for documenting your site's compliance

Low Impact Development aims to mimic pre-development hydrology by directing runoff to natural landscape features throughout the development site that detain, disperse, infiltrate, and filter runoff.

Contra Costa municipalities require—as a condition of development approval for Regulated Projects—installation of LID measures to treat the amount of runoff specified in MRP 3.0.

Your Stormwater Control Plan must include an exhibit and calculations showing site drainage and proposed LID features and facilities to meet the criteria in this *Guidebook*. This will require that you delineate the entire site into DMAs, and for each DMA, characterize the square footage, surface type, and routing of the drainage. You will also need to show the locations, sizes, and types of proposed stormwater treatment and HM facilities.

This may be accomplished in two steps:

1. **Analyze your project** and identify and select options for meeting LID requirements and runoff treatment requirements as well as HM requirements, if they apply. See Development Review Checklist in Appendix E for direction on how to document stormwater controls for development practices.
2. **Design and document drainage** for the whole site and document how that design meets this *Guidebook's* stormwater treatment and HM criteria. HM applicability maps are available on [CCCWP's website](#).

For most projects, you will need to iterate these two steps to converge on a workable design that complements site conditions and project objectives.

Before beginning your LID design, first determine which requirements apply to your site. See Chapter 1. Determine whether the 50% rule applies, and whether you will need to incorporate HM. The guidance in this chapter will enable you to size stormwater facilities (IMPs) for treatment-only or for treatment plus HM.

Analyze Your Project for LID

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

1. **Optimize the site layout** by preserving natural drainage features and designing buildings and circulation to minimize the amount of impervious surface.
2. **Use pervious surfaces** such as turf, gravel, or pervious pavement, or use surfaces that retain rainfall, such as green roofs.
3. **Disperse runoff** from impervious surfaces onto adjacent pervious surfaces (e.g., direct a roof downspout to disperse runoff onto a lawn).
4. Drain impervious surfaces to engineered IMPs, which are typically bioretention facilities, sometimes augmented with additional storage. Other IMPs include flow-through planters and dry wells, which may be used in specific situations for hydromodification management. IMPs capture stormwater runoff and reduce downstream flows through a combination of evaporation and transpiration, percolation through engineered soils followed by attenuated release and/or infiltration to surrounding soils.

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

A combination of two or more strategies may work best for your project. Table 3-1 on the following page includes ideas for applying LID strategies to site conditions and types of development. It may be useful as a starting point for thinking through application of the four strategies.

TABLE 3-1. IDEAS FOR RUNOFF MANAGEMENT

<i>Site Features/Issues</i>	<i>Optimize Site Layout</i>	<i>Pervious Pavement</i>	<i>Green Roof</i>	<i>Disperse Runoff to Landscape</i>	<i>Bioretention Facility</i>	<i>Flow-through Planter</i>	<i>Cistern + bioretention</i>	<i>Bioretention + Vault</i>	<i>Dry Well</i>
Clayey native soils	✓		✓	✓	✓	✓	✓	✓	
Permeable native soils	✓	✓	✓	✓	✓	✓			✓
Very steep slopes	✓		✓			✓			
Shallow depth to groundwater	✓		✓			✓			
Roof drainage	✓			✓	✓	✓	✓		✓
Parking lots	✓	✓		✓	✓			✓	✓
Extensive landscaping	✓			✓	✓				
Densely developed sites with limited space/landscape		✓	✓		✓	✓	✓	✓	✓

► **REFERENCES AND RESOURCES**

- [*Green Roofs for Stormwater Runoff Control*](#) (USEPA, 2009a)
- [*Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act*](#) (USEPA, 2009b)
- [*Porous Pavements*](#) (Ferguson, 2005)
- [*Green Roof Minimum Specifications*](#) (BASMAA, 2011b)

The four strategies for LID design are described in more detail below.

► **OPTIMIZE THE SITE LAYOUT**

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

- Define the development envelope and protected areas, identifying areas that are most suitable for development and areas that should be left undisturbed.
- Set back development from creeks, wetlands, and riparian habitats.
- Preserve significant trees.
- Where possible, conform the site layout along natural landforms, avoid excessive grading and disturbance of vegetation and soils, and replicate the site's natural drainage patterns.
- Concentrate development on portions of the site with less permeable soils and preserve areas that can promote infiltration.
- For all types of development, limit overall coverage of paving and roofs. This can be accomplished by designing compact, taller structures, narrower and shorter streets and sidewalks, smaller parking lots (fewer stalls, smaller stalls, and more efficient lanes), and indoor or underground parking. Examine site layout and circulation patterns and identify areas where landscaping can be substituted for pavement.
- Use drainage as a design element. Use depressed landscape areas, vegetated buffers, and bioretention facilities as amenities and focal points within the site and landscape design. Bioretention facilities can be almost any shape.
- Detain and retain runoff throughout the site. On flatter sites, it typically works best to intersperse landscaped areas and IMPs among the buildings and paving. On hillside sites, drainage from upper areas may be collected in conventional catch basins and piped to landscaped areas and IMPs in lower areas. Or use low retaining walls to create terraces that can accommodate IMPs. Wherever possible, direct drainage from landscaped areas off site and not to IMPs.

► **USE PERVIOUS SURFACES**

Green roofs are one potential strategy for using pervious surfaces in LID design. Green roofs are growing in popularity and many have been built in the Bay Area in the last few years. Benefits include longer roof life, lower heating and cooling costs, and better sound insulation, in addition to air-quality and water-quality benefits. However, initial costs are higher than for conventional roofs, and green roofs may add to the complexity of permitting, financing, and insuring new buildings. For C.3 compliance purposes, green roofs are considered not to produce increased runoff or runoff pollutants (that is, any runoff from a green roof requires no further treatment or detention) if the media is sufficiently deep to store an inch of rainfall (typically, a 3-inch media depth is sufficient) and also supports long-term health of vegetation. Green roofs must be shown on site plans but may be excluded from hydromodification and water quality sizing calculations described later in this chapter.

Other options for using pervious surfaces in LID design are permeable, or pervious, pavements and surface treatments. Inventory paved areas on your preliminary site plan and identify where permeable pavements, such as crushed aggregate, turf block, unit pavers, pervious concrete, or pervious asphalt could be substituted for impervious concrete or asphalt paving. In clay soils, pervious pavements require a deep base course for structural stability and may not be cost-effective when compared to conventional pavement with drainage to bioretention facilities. Installation of pervious pavement on slopes requires special design features. Depending on the site, the additional costs may be partially offset by reduced needs for drainage structures and for stormwater treatment and HM.

► **DISPERSE RUNOFF TO ADJACENT PERVIOUS AREAS**

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

For sites subject to stormwater treatment requirements only a 2:1 maximum ratio of impervious to self-retaining area is acceptable. Dispersal is a particularly cost-effective strategy where HM requirements apply, but the impervious-to-pervious ratio must be limited to 1:1. Be sure soils will drain adequately. See the criteria for runoff reduction measures in Chapter 4. See the description of self-retaining areas later in this chapter.

► **DIRECT RUNOFF TO BIORETENTION OR OTHER IMPs**

The CCCWP has developed design criteria (see Chapter 4) for the following IMPs:

- **Bioretention facilities**, which can be configured to integrate with your landscape design.
- **Flow-through planters**, which can be used on elevated plazas or other circumstances where infiltration to native soils is not possible.
- **Cistern + bioretention** facilities, which use an upstream storage volume and metered flow to reduce the required square footage of a bioretention facility or flow-through planter.
- **Bioretention + vault** facilities, which capture a volume downstream of bioretention and meter outflows.
- **Dry wells** and other infiltration facilities, which can be used only where soils are permeable. See other restrictions in Appendix E.

Table 3-4 on page 41 shows the conditions under which each IMP may be used.

Finding the right location for bioretention or other facilities on your site involves a careful and creative integration of several factors:

- Put bioretention facilities in **high-visibility, well-trafficked areas** and make them a focal point in the landscape.
- If the property is being subdivided now or in the future, the facility should be in a **common, accessible area**. In subdivisions, it often works best to drain roofs and driveways to the street gutter and direct the gutter to one or more IMPs located within the common right-of-way. **Avoid locating shared facilities on private residential lots.**
- Even if the facility will serve only one site owner or operator, make sure the facility is located for ready access by inspectors from the local municipality and the Contra Costa Mosquito and Vector Control District.
- To make the most efficient use of the site and to maximize aesthetic value, **integrate IMPs with site landscaping**. Many local zoning codes require landscape setbacks or buffers or may specify that a minimum portion of the site be landscaped. It may be possible to locate some or all of your site’s treatment and HM facilities within

this same area, or within utility easements or other non-buildable areas.

- The facility must be accessible to equipment needed for its maintenance. Bioretention facilities will typically need access for the same types of equipment used for landscape maintenance.
- Where possible, **design site drainage so only impervious roofs and pavement drain to IMPs.** This yields a simpler, more efficient drainage design with smaller IMPs, which is especially important on projects where HM is required, and also helps protect IMPs from becoming clogged by sediment.
- Place bioretention inlet elevations and the top of the engineered soil layer as high as possible (typically 6 to 12 inches below the surrounding ground surface elevation). Avoid walls and steep slopes adjacent to the bioretention soil surface. On flatter sites, **keep drainage runs short and use surface drainage** (sheet flow, valley gutters, or trench drains) to convey runoff from paved areas to the bioretention facility.
- For effective, low-maintenance operation, **locate facilities so drainage into and out of the device is by gravity flow.** Because pumped systems require more energy, more maintenance, are risk untimely failure. Facilities with standing water can cause mosquito control problems and municipal reviewers may decline to approve them.
- **Bioretention facilities must be level** all the way around, so that the entire soil surface is wetted. Linear bioretention facilities (swales) must be designed with their transverse sides at the same elevation. In the linear direction, slopes must be terraced or provided with check dams.
- Bioretention facilities and other IMPs require excavations 3 or more feet deep, which can **conflict with underground utilities.**

Bioretention facilities may not be combined with, located within, or integrated with facilities for detention of flood flows. **Keep bioretention facilities and detention basins separate.** See below for methods for evaluating the peak-flow-mitigation benefit of LID features and facilities. To complete your analysis, include in your Stormwater Control Plan a brief **narrative** documenting the site layout and site design decisions you made. This will provide background and context for how your design meets the quantitative LID criteria.

► REFERENCES AND RESOURCES

- [*Central Coast Low Impact Development Center*](#)
- [*Start at the Source*](#) (BASMAA, 1999)
- [*Urban Street Stormwater Guide*](#) (National Association of City Transportation Officials, 2017)
- [*San Mateo Green Streets Guide*](#) (2009)

Develop and Document Your LID Drainage Design

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

This procedure is intended to facilitate, not substitute for, creative interplay among site design, landscape design, and drainage design. Several iterations may be needed to optimize your drainage design as well as aesthetics, circulation, and use of available area for your site.

The CCCWP uses two tools for appropriately sizing IMPs:

1. For projects requiring HM, use the BAHM which is an HSPF-based, continuous simulation program that models stormwater runoff and the movement of water through IMPs using historical, local rainfall data, and hydraulic equations that mimic the function of different LID facilities. Please note, BAHM contains many proprietary and non-LID stormwater management approaches that are not consistent with CCCWP requirements. This chapter includes a crosswalk table that summarizes the BAHM model elements that can be used to evaluate CCCWP IMPs.
2. For projects requiring only water quality treatment, use the IMP Sizing Calculator, which is software produced by the CCCWP to quickly and easily facilitate the iterative calculations needed to create an optimal site design. In addition to performing calculations, the IMP Sizing Calculator formats the results into a summary report that can be included with your project review submittal.

The BAHM software and user manual is available from Clear Creek Solutions: <https://www.clearcreeksolutions.info/bahm-download-page>. If you are unfamiliar with BAHM’s usage as a design aid for HM projects, please consider attending training sessions in your area or online.

The **IMP Sizing Calculator** is available, along with instructions for its use, on the CCCWP’s [C.3 web page](#). Mean annual precipitation estimates can be found

on Public Works Figure B-166, which is accessible from the CCCWP’s [C.3 web page](#).

The IMP calculator can be used to demonstrate compliance with requirements for:

- Stormwater treatment, using:
 - Standard sizing (applies to most development projects),
 - Reduced sizing (may be used, with justification, for road reconstruction projects that follow requirements outlined in MRP 3.0 Provision C.3.b.ii (5)(c), or that are non-regulated projects under C.3.b),
 - Non-LID treatment (may be used only for qualifying projects, with demonstration of infeasibility of LID treatment).

When using the calculator, **be sure to read through the following instructions**, as they include key information you will need for design. These procedures and formulas can be used to **investigate, check, and verify** calculations made with the IMP Sizing Calculator.

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

► **STEP 1: DELINEATE DMAS**

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

► **STEP 2: CLASSIFY DMAS AND DETERMINE RUNOFF FACTORS**

Next, determine how drainage from each DMA will be handled. Each DMA will be one of the following four types—based on the DMA’s drainage characteristics.

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

For HM projects, runoff from self-treating areas and self-retaining areas does not require any further treatment or HM. Areas that drain to self-retaining areas or IMPs can be modeled directly in BAHM using the procedures described in the BAHM user manual. For water quality treatment projects, the IMP Sizing Calculator user guide describes how to model the four DMA types listed above.

Except for pervious pavement installations greater than 3,000 ft² in area, there is no requirement for operation and maintenance inspections. Additional information about each type of DMA drainage characteristic is included on the following pages.

#1. Self-treating areas are landscaped or turf areas that do not drain to IMPs, but rather drain directly off site or to the storm drain system. Examples include upslope undeveloped areas that are ditched and drained around a development and grassed slopes that drain off site to an existing public street or storm drain. See Figure 3-1. Self-treating areas include no impervious areas, unless the impervious area is very small (5% or less) in relationship to the receiving pervious area, and slopes are gentle enough to ensure runoff from impervious areas will be absorbed into the vegetation and soil.

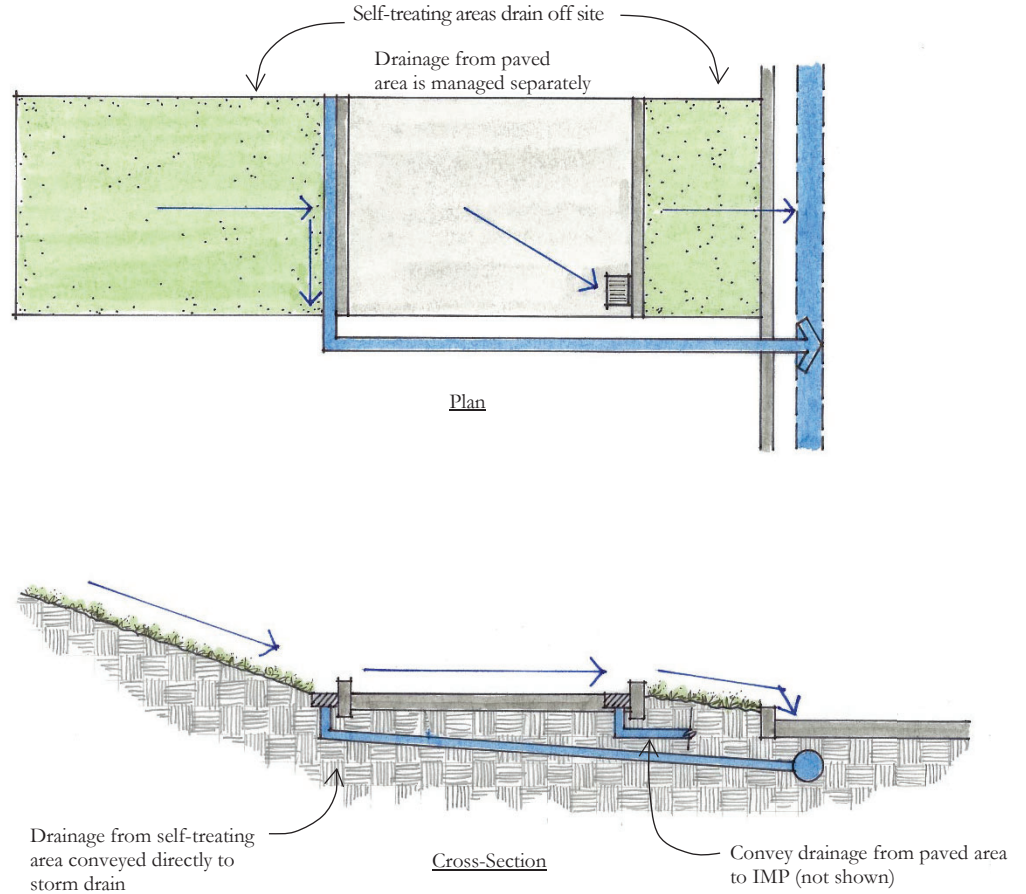


FIGURE 3-1. SELF-TREATING AREAS are landscaped or turf areas that drain directly off site or to the storm drain system.

#2. Self-retaining areas are designed to retain the first one inch of rainfall without producing any runoff. The technique works best on flat, heavily landscaped sites. It may be used on mild slopes if there is a reasonable expectation that a one-inch rainfall event would produce no runoff. See Figure 3-2.

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. Grade slopes, if any, toward the center of the pervious area. Inlets of area drains, if any, should be set 3 inches above the low point to allow ponding.

Green roofs are considered self-retaining areas.

Pervious pavement (e.g., crushed stone, pervious asphalt, or pervious concrete) is self-retaining if designed and constructed according to the criteria in Chapter 4.

#3. Areas draining to self-retaining areas. Runoff from impervious or partially pervious areas can be managed by routing it to self-retaining pervious areas. See Figure 3-3. For example, roof downspouts can be directed to lawns, and driveways can be sloped toward landscaped areas. The drainage from the impervious area must be directed to and dispersed within the pervious area. If HM requirements also apply, the self-retaining area and its tributary should be modeled using BAHM. For water quality treatment projects, the ratio of tributary area to self-retaining area cannot exceed 2 to 1.

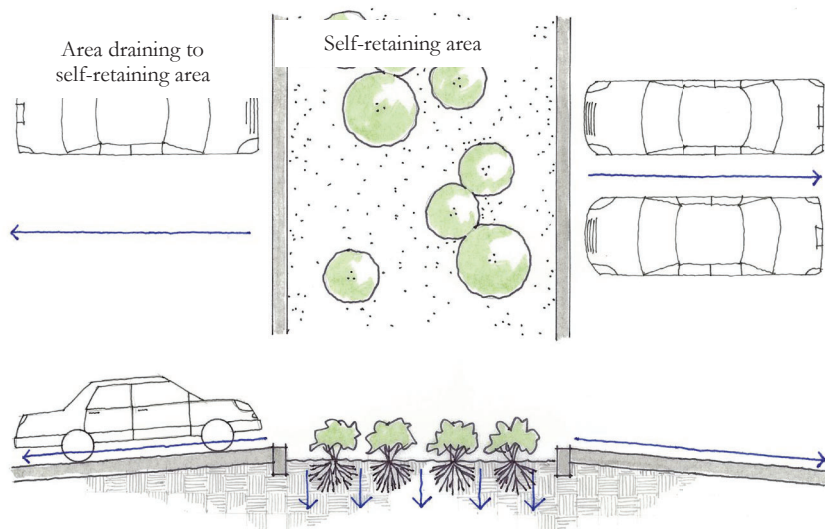


FIGURE 3-2. SELF-RETAINING AREAS are depressed pervious areas that produce no runoff.

Designs with a larger impervious to self-retaining area ratio would be flagged with a warning in the IMP Sizing Calculator.

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

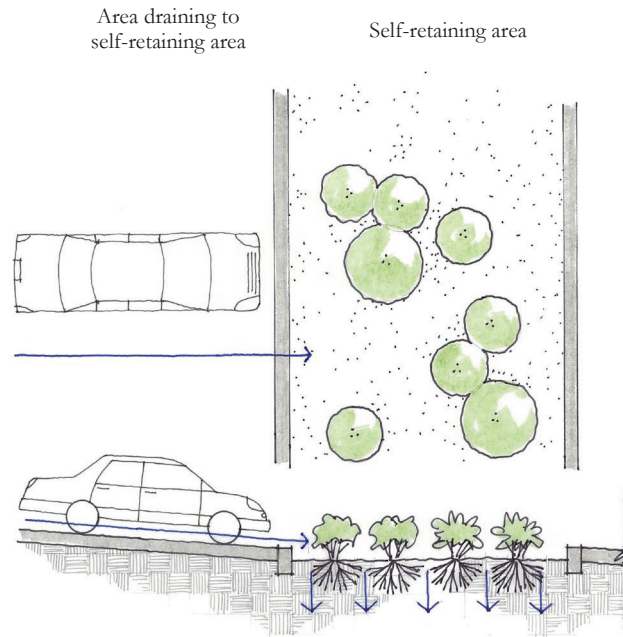


FIGURE 3-3. AREAS DRAINING TO SELF-RETAINING AREAS.
The maximum ratio is two parts impervious to one part pervious, or one-to-one if HM requirements apply.

If pervious pavement is designed and constructed to be self-retaining—that is, according to the criteria in Chapter 4—adjacent roofs or impervious pavement may drain onto the pervious pavement with the same maximum ratios. For HM projects, the tributary and permeable pavement should be modeled in BAHM using the permeable pavement material void spaces, gravel base, etc. Consult with a qualified engineer regarding infiltration rates, pavement stability, and suitability for the intended traffic, especially when considering draining impervious areas on to pervious pavement.

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

Equation 3-1

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

HM sites are to be modeled using BAHM.

TABLE 3-2. RUNOFF FACTORS FOR EVALUATING DRAINAGE TO SELF-RETAINING AREAS FOR WATER QUALITY TREATMENT ONLY PROJECTS

Surface	Treatment only
Conventional Roof	1.0
Concrete or Asphalt	1.0
Pervious Concrete	0.1
Porous Asphalt	0.1
Grouted Unit Pavers	1.0
Solid Unit Pavers	0.2
Crushed Aggregate	0.1
Decomposed Granite*	0.1
Turfblock	0.1
Landscape	0.1
Green Roof	0.1

* with no binder, uncompacted

#4. Areas draining to IMPs are used to calculate the required size of the bioretention facility or other IMP. On densely developed sites—such as commercial and mixed-use developments and small-lot residential subdivisions—most DMAs will drain to IMPs.

For HM projects, IMP dimensions will be computed in BAHM. For water quality treatment projects, the IMP Sizing Calculator computes IMP dimensions using established sizing factors (ratios of IMP area to impervious DMA area). Treatment-only IMPs are smaller and simpler in design.

More than one drainage management area can drain to the same IMP. However, because the minimum IMP sizes are determined by ratio to drainage area size, one drainage area may not drain to more than one IMP. See Figure 3-4.

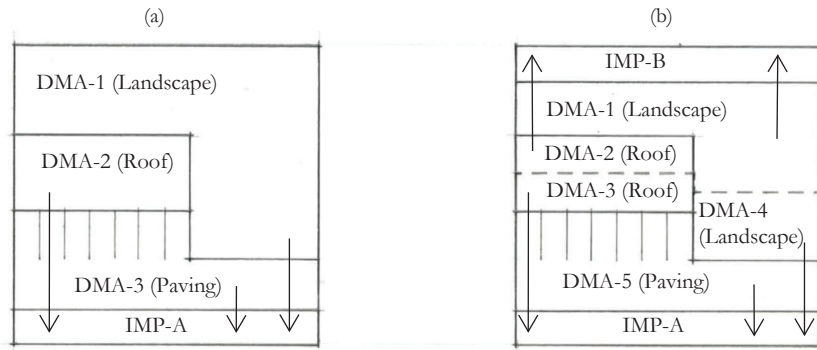


FIGURE 3-4. DELINEATE EACH SURFACE AS A SEPARATE DMA.

(a) More than one DMA can drain to an IMP. (b) If another IMP is added, divide the DMAs as necessary so that each DMA drains to only one IMP.

► STEP 3: TABULATE DRAINAGE MANAGEMENT AREAS

Prepare a table of DMAs, using the format in Table 3-3, and include it in your Stormwater Control Plan. Proceed to Step 4 to check that the IMPs can be sized to fit your preliminary site plan.

TABLE 3-3. FORMAT FOR TABULATION OF DRAINAGE MANAGEMENT AREAS

<i>DMA Name</i>	<i>DMA Type</i>	<i>Description</i>	<i>Area (square feet)</i>

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

Select from the IMPs in Table 3-4. Note that flow-through planters may be used only on elevated plazas, adjacent to building foundations, and other locations where it is not feasible to allow the facility to infiltrate to underlying soil.

TABLE 3-4. IMP SELECTION

	Treatment Only			Treatment + Flow Control		
	A	B	C/D	A	B	C/D
Hydrologic Soil Group						
Bioretention	✓	✓	✓	✓	✓	✓
Flow-through Planter	✓	✓	✓			✓
Dry Well	✓	✓		✓	✓	
Cistern + Bioretention				✓	✓	✓
Bioretention + Vault				✓	✓	✓

Descriptions, illustrations, designs, and design criteria for the IMPs are in Chapter 4. Once you have laid out the IMPs, calculate the square footage you have set aside on your site plan for each IMP.

► **STEP 5: CALCULATE MINIMUM IMP AREA AND VOLUMES**

Most projects are for **treatment only**, and standard sizing criteria apply. The minimum IMP areas and volumes are determined by summing up the contributions of each tributary DMA and multiplying times the factors shown in Table 3-5.

Note that the minimum areas are the wetted area and **do not include side slopes**.

TABLE 3-5. MINIMUM IMP AREAS AND VOLUMES FOR TREATMENT ONLY

Hydrologic Soil Group	A	B	C	D
Bioretention Facility Area	0.04	0.04	0.04	0.04
Flow-through Planter Area	0.04	0.04	0.04	0.04
Dry Well (treatment only) Area	0.02	0.04	N/A	N/A
Volume	0.068	0.136	N/A	N/A
Area = ft ² of IMP footprint per ft ² of impervious tributary area (unitless)				
Volume = ft ³ per ft ² of tributary area (ft.)				
Apply runoff factors from Table 3-2 for landscape or other pervious surfaces.				

Tree-box-type high-flowrate biofilters and vault-based high-flowrate media filters may be used on portions of a project only for projects that meet the criteria on Non-LID Special Projects, as described later in this chapter, including a demonstration that it is infeasible to use LID to treat 100% of runoff.

For **treatment-and-HM**, the minimum area and minimum storage volumes are to be calculated using the BAHM software. Please see the BAHM user manual for detailed modeling instructions. A worked example for a project requiring HM, using BAHM is provided in Appendix H.

IMPs installed in C/D soils will require a flow control orifice to meet HM flow duration control performance criteria. The designer/modeler should size the flow control orifice so that its hydraulic capacity approximates one-tenth of the two-year pre-project flow rate (0.1Q₂). This approach results in more efficient IMP sizing.

The 0.1Q₂ flow rate can be estimated from the BAHM summary report for pre-project conditions as part of the iterative design process. The orifice equation (Eqs. 3-18, 3-19) should then be used to determine an initial orifice diameter when conducting iterative BAHM simulations to optimize IMP sizing and achieve flow duration control.

Equation 3-18

$$\text{Orifice Area (in ft}^2\text{)} \approx \frac{0.1Q_{2\text{pre-project}}}{C_d \sqrt{64.4 \times H}}$$

Where:

C_d is the orifice coefficient of 0.6

H is the maximum saturated water level above the orifice in feet

0.1Q₂ is the pre-project flow rate determined in BAHM

Equation 3-19

$$\text{Orifice Diameter (in inches)} = 12 \times \sqrt{\frac{4 \times \text{Orifice Area}}{\pi}}$$

Where the orifice area is expressed in feet.

► **STEP 6: DETERMINE IF IMP AREA AND VOLUME ARE ADEQUATE**

Sizing and configuring IMPs may be an iterative process. After computing the minimum IMP area using Steps 1 through 5, review the site plan to determine if the reserved IMP area is sufficient.

If so, the planned IMPs will meet the Provision C.3 sizing requirements. If not, revise the plan accordingly. Revisions may include:

- Reducing the overall imperviousness of the project site.
- Changing the grading and drainage to redirect some runoff toward other IMPs which may have excess capacity.
- Making tributary landscaped DMAs self-treating or self-retaining (may require changes to grading).
- Expanding IMP surface area.
- Using a different IMP. The cistern + bioretention and bioretention + vault options were created to achieve HM **in a smaller footprint** than bioretention alone. Note these options are more costly and complex to build and operate.

Revisions to square footage of an IMP typically require a corresponding revision to the square footage of the surrounding or adjacent DMA.

► **STEP 7: PRESENT IMP SIZING CALCULATIONS**

Review the output from the IMP Sizing Calculator. Coordinate and cross-check your presentation of DMAs and calculation of minimum IMP sizes with the Stormwater Control Plan Exhibit (labeled to show delineation of DMAs and locations of IMPs) and with your Stormwater Control Plan report, which should incorporate a brief description of each DMA and each IMP.

Tabulate and sum the total area of all DMAs and IMPs listed and show it is equal to the total project area. This step will include adjusting the square footage of some DMAs to account for area used for IMPs. **Note the minimum square footage for IMPs does not include the area of transitions or slopes adjacent to the IMP.**

Integrating Your LID Design into Your Project

Before completing your Stormwater Control Plan exhibit and report, perform another check to ensure your stormwater control design is fully coordinated with the site plan, grading plan, and landscaping plan being proposed for the site.

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

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

Review Chapter 4 to anticipate additional requirements for design and construction of IMPs.

Reduced Bioretention Sizing

Bioretention facilities for **treatment only** must be sized so that the area of engineered soil mix that is flooded at the point of overflow is a minimum 4% of tributary equivalent impervious area. See Tables 3-2 and 3-5 and the accompanying instructions.

Reduced sizing (less than 4% of tributary equivalent impervious area) can only be used for road reconstruction projects that follow requirements outlined in MRP 3.0 Provision C.3.b.ii (5)(c), or that are non-regulated projects under C.3.b. For further detail on applicability of reduced bioretention sizing, visit <https://www.cccleanwater.org/development-infrastructure/green-infrastructure/resources>. All facilities must be at least as large as the minimum sizes determined by the following equation:

$$\text{Sizing Factor} = 0.00060 \times \text{MAP} + 0.0086$$

where MAP = Mean Annual Precipitation in inches, per Contra Costa County Public Works Figure B-166, which can be found on the [CCCWP web page](#).

It should be noted, however, the reduced sizing factor calculation for bioretention facilities may not satisfy full trash capture.

Bioretention Facility Characteristics. The facility must conform to all *Guidebook* design and construction criteria, including the following:

- Each layer of the facility must be level throughout, and construction drawings must show elevations for facility rim, overflow grate, top of soil layer (TSL), top of gravel layer (TGL), and bottom of gravel layer (BGL).
- Facilities must be inspected at each stage of construction.

See details in Appendix F for further designer guidance.

Non-LID Treatment

LID has been found to be feasible for nearly all development sites. If you believe LID design may be infeasible for part of or your entire development site, you should consult with municipal staff and seek additional technical assistance for incorporating LID into your site before considering non-LID options.

► SPECIAL PROJECTS

“Special Projects” that meet the criteria in Provision C.3.e.ii may be subject to local staff review and approval and subject to a demonstration that it is

4% or Smaller?
Appendix E includes technical background and a policy rationale for Contra Costa municipalities’ treatment-only sizing criteria.

infeasible to use LID to treat 100% of runoff, use the following non-LID treatment systems for up to the specified proportion of the total impervious area on the site:

- Tree-box-type high-flowrate biofilters.
- Vault-based high-flowrate media filters.

Special projects fall into three categories. Category A special projects must:

- create or replace one half acre or less of impervious surface area;
- be built as part of a stated objective to preserve or enhance pedestrian oriented urban design;
- be located in the central business district, downtown core, neighborhood business district or historic preservation site or district;
- include no surface parking except incidental surface parking for emergency vehicles, Americans with Disabilities Act (ADA) access, and loading areas;
- and have at least 85% coverage for the project site by permanent structures.

Category B special projects must:

- create or replace between one half acre and 2 acres of impervious surface area
- be built as part of a stated objective to preserve or enhance pedestrian oriented urban design;
- be located in the central business district, downtown core, neighborhood business district or historic preservation site or district;
- include no surface parking except incidental surface parking for emergency vehicles, ADA access, and loading areas;
- and have at least 85% coverage for the project site by permanent structures.

Category C affordable housing projects must:

- be primarily a residential development project
- achieve at least a gross density of 40 dwelling units per acre
- be preserved housing with deed restrictions running at least 55 years with rent/mortgage rates (including utilities) no greater than 30% of the area median household income (AMI) limits adjusted for household size based on the maximum percentage of AMI for each income category as defined by the Federal Department of Housing and Urban Development for affordable housing in metropolitan areas as follows:
 - Acutely low household income is 0-15% of AMI
 - Extremely low household income is 16-30% AMI
 - Very low household income is 31-50% AMI
 - Low household income is 51-80% AMI
 - Moderate household income is 80-120% AMI

A calculation worksheet to aid in Special Projects calculations is provided as part of the Development Review checklist (Appendix G).

► **ALTERNATIVE TREATMENT SYSTEMS**

Alternative treatment is an option provided in the Amendment of Order No. R2-2022-0018 to NPDES Permit No. CAS61200. However, a regional guidance document needs to be prepared before alternative treatment can be used. This document effort will likely be led by the Bay Area Municipal Stormwater Collaborative.

The Regional Guidance Document to facilitate compliance with Demonstration of Technical Infeasibility and Demonstration of Commensurate Benefit, once finalized, is to be submitted to the Water Board for Executive Officer approval. The Regional Guidance Document must be submitted on or before the deadline described in Provision C.3.c.i.(2)(c)(iii)f.2. If the Executive Officer determines that Regional Guidance Document is sufficiently detailed to enable review of demonstrations of technical infeasibility and commensurate benefits, the Executive Officer may approve demonstration of technical infeasibility and commensurate benefit through the Regional Guidance Document in lieu of approving both separately. Once the guidance document is developed and approved, further guidance for the use of

alternative treatment to comply with C.3.d will be provided in a future update to this guidebook.

► **TECHNICAL CRITERIA FOR NON-LID FACILITIES**

General:

- Water quality treatment IMPs must have a treatment throughput rate that is sufficient to fully treat stormwater runoff generated by a continuous rainfall intensity of 0.2 inches per hour.
- Landscape and non-impervious surfaces should be self-treating or self-retaining and should not drain to treatment facilities, if feasible.
- Use the runoff factors in Table 3-2.
- The applicant's Stormwater Control Plan must include as an attachment a letter from the manufacturer stating the manufacturer has reviewed the Stormwater Control Plan, and the proposed device meets these technical criteria. Check with your local municipality for warranty requirements.
- If the project will include non-LID treatment measures, select a treatment measure certified for "Basic" General Use Level Designation (GULD) by the Washington State Department of Ecology's TAPE.

High-Flowrate Tree-Box-Type Biofilters:

- Maximum design surface loading rate of 50 inches per hour.
- Precast concrete construction.
- Inlet design to capture flows at least up to the maximum design surface loading rate and to bypass high flows.
- Minimum media depth of 1.8 feet (may be reduced, but maintaining the same media volume, if required because of inadequate head to discharge point).
- Media and facility configuration supports a healthy tree or other vegetation.

Vault-Based High-Flowrate Media Filters:

- Replaceable cartridge filters.

- Maximum design filter surface loading rate of 1 gallon per minute per square foot (gpm/ft²)
- Storage volume detains runoff and allows settling of coarse solids prior to filtration.
- Flow through the cartridge filters is controlled by an orifice or other device so that the design surface loading rate is not exceeded.

► **EXAMPLE CALCULATIONS:**

Given a project with the following DMAs draining to a non-LID facility:

DMA 1: 2,050 ft² roof, runoff factor 1.0

DMA 2: 3,035 ft² asphalt, runoff factor 1.0

DMA 3: 250 ft² solid unit pavers set in sand, runoff factor 0.2 (per Table 3-2)

Equivalent Impervious Area

$$= (2,050 \text{ ft}^2 + 3,035 \text{ ft}^2) \times 1.0 + (250 \text{ ft}^2 \times 0.2) = 5,135 \text{ ft}^2$$

High-Flowrate Tree-Box-Type Biofilter:

Sizing factor

$$\begin{aligned} &= [\text{rainfall rate (in/hr)}] / [\text{media infiltration rate (in/hr)}] \\ &= [0.2 \text{ in/hr}] / [50 \text{ in/hr}] \\ &= 0.004 \end{aligned}$$

Minimum biofilter surface area

$$\begin{aligned} &= [\text{equivalent impervious area (ft}^2\text{)}] \times [\text{sizing factor}] \\ &= [5,135 \text{ ft}^2] \times [0.004] \\ &= 21 \text{ ft}^2 \end{aligned}$$

Vault-Based High-Flowrate Media Filter:

Design flowrate (in gallons per minute)

$$\begin{aligned} &= [\text{equivalent impervious area (ft}^2\text{)}] \times [\text{rainfall rate (in/hr)}] \\ &= [5,135 \text{ ft}^2] \times [0.2 \text{ in/hr}] \times [1 \text{ ft}/12 \text{ in}] \times [1 \text{ hr}/60 \text{ min}] \times [7.48 \text{ gal}/\text{ft}^3] \\ &= 10.7 \text{ gallons per minute (gpm)} \end{aligned}$$

Obtain the cartridge capacity directly from the manufacturer. For this example, assume:

$$\text{Cartridge capacity} = 4 \text{ gpm per cartridge}$$

Number of cartridges required (round up to whole number)

$$\begin{aligned} &= [\text{design flow rate (gpm)}] / [\text{cartridge capacity (gpm per cartridge)}] \\ &= [10.7 \text{ gpm}] / [4 \text{ gpm/cartridge}] \\ &= 3 \text{ cartridges} \end{aligned}$$

If flow-control (HM) requirements apply, also review the options for compliance in Chapter 1. Then consult with municipal staff before preparing an alternative design for stormwater treatment and HM.

► **DEMONSTRATION OF INFEASIBILITY IS REQUIRED**

To obtain approval to use any non-LID treatment systems, the applicant must demonstrate, to the satisfaction of the municipal reviewer, that it is infeasible to treat runoff from the same area using bioretention facilities, either sized to 4% of tributary equivalent impervious area, or as may be justifiable for the site and for specific DMAs, reduced bioretention sizing (see preceding section).

For all non-LID designs, the applicant must submit a complete Stormwater Control Plan, including an exhibit showing the entire site divided into discrete Drainage Management Areas, and text and tables showing how drainage is routed from each DMA to a treatment facility.

In addition, to establish the **infeasibility of implementing LID on the entire site**, include in the Stormwater Control Plan an explanation of how routing of drainage has been optimized so that as much runoff as possible goes to LID features and facilities (if any). For DMAs draining to tree-box-type high-flow-rate biofilters and/or high-flow-rate media filters, briefly describe all project areas not covered by buildings. Note the uses of all impervious paved areas and why LID treatment is precluded for these areas.

For any landscaped areas, note and briefly describe the following technical constraints as applicable:

- Inadequate size to accommodate bioretention facilities that meet sizing requirements for the tributary area.
- Slopes too steep to terrace.
- Environmental constraints (for example, landscaped area is within a riparian corridor and applicable regulations prohibit bioretention facilities within that corridor).
- High groundwater (within 2 feet of ground surface) or shallow bedrock.
- Conflict with subsurface utilities.
- Cap over polluted soil or groundwater.
- Lack of head or routing path to route runoff to the landscaped area or from a bioretention underdrain to the municipal storm drain.

- Other conflicts, including required uses that preclude use for stormwater treatment (describe in detail).

Also include in your Stormwater Control Plan a narrative discussion of

infeasibility of offsite treatment:

- Describe whether the project proponent owns or otherwise controls land within the same watershed of the project that can accommodate in perpetuity offsite bioretention facilities adequately sized to treat the runoff volume of the primary project.
- Identify any regional LID stormwater mitigation programs available to the project for in-lieu C.3 compliance.

A worked example for a project requiring HM, using BAHM is provided in Appendix H.

► **REFERENCES AND RESOURCES**

- [Municipal Regional Permit](#) Provision C.3.e.
- [Special Projects Proposal](#) (BASMAA, 2010)

Crosswalk Summary of CCCWP IMPs and BAHM Model Elements

TABLE 3-6. BAHM TERMINOLOGY AND CROSS REFERENCE TABLE

BAHM Term	Definition	Countywide Program Guidance Term	Additional Countywide Program Guidance
Basin	The project drainage area or the area that drains to a treatment measure or hydromodification management (HM) facility	Drainage Management Area (DMA)	
Pond	Surface storage facility (either with a trapezoidal or irregularly shaped top edge) with an outlet structure to control outflow to meet HM standards; can allow infiltration	<ul style="list-style-type: none"> • Detention basin • Self-retaining area (represented by shallow pond) 	<ul style="list-style-type: none"> • Detention Basin is not an LID treatment option (except when used to represent a self-retaining area) • Detention Basin is not an HM option allowed by CCCWP

BAHM Term	Definition	Countywide Program Guidance Term	Additional Countywide Program Guidance
Vault	Below-ground, rectangular storage facility with an outlet structure to control outflow to meet HM standards; can allow infiltration	Storage vault	
Tank	Below-ground storage facility, represented by a cylinder placed on its side (either circular or an arched half-cylinder with open bottom) with an outlet structure to control outflow to meet HM standards; can allow infiltration	<ul style="list-style-type: none"> • Large diameter pipe (circular tank) • Subsurface infiltration system (arched half-cylinder) 	
BMP	Best management practice for treatment and/or HM control	<ul style="list-style-type: none"> • IMP (CCCWP) • Stormwater Treatment or HM Control Measure (SCVURPPP) 	
Bioretention	Landscaped treatment system with sloped sides using biotreatment soil underlain by gravel, with optional underdrain, allowing infiltration	Bioretention	Select “BAHM5” as the top layer to represent approved Bay Area bio-treatment soil mix
In-Ground Infiltration Planter	Bioretention facility with vertical sides and an open bottom allowing infiltration to native soil and optional underdrain	<ul style="list-style-type: none"> • Bioretention (CCCWP) • Bioinfiltration • Flow-through planter 	Select “BAHM5” as the top layer to represent approved Bay Area bio-treatment soil mix
Flow-Through Planter	Bioretention facility with vertical sides, solid bottom, and underdrain; no infiltration allowed	<ul style="list-style-type: none"> • Biotreatment • Flow-through planter (CCCWP) 	Select “BAHM5” as the top layer to represent approved Bay Area bio-treatment soil mix

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BAHM Term	Definition	Countywide Program Guidance Term	Additional Countywide Program Guidance
Permeable Pavement	Surface layer of porous asphalt, porous concrete, concrete pavers, or grid pavement underlain by one or two subgrade layers of gravel or sand	Permeable, pervious, or porous pavement	
Gravel Trench	Gravel-filled trench allowing infiltration into native soil (may include underdrain)	Infiltration trench with underdrain	
Infiltration Trench	A gravel-filled trench with no underdrain (all water must infiltrate into native soil)	Infiltration trench with no underdrain	Underdrain generally recommended (i.e., use gravel trench)
Dry well	In-ground Infiltration Planter, Infiltration Trench or Gravel Trench with no underdrain (all water must infiltrate into native soil)	Dry well	
Infiltration Basin	Trapezoidal “pond” that can infiltrate stored water into native soil at a specified rate	Infiltration basin	Not an HM option allowed by CCCWP
Dispersion	Method of allowing an impervious “lateral” basin to flow onto a pervious “lateral” basin which infiltrates some of the runoff before routing the rest to an HM control facility	One way of representing a self-retaining area	
Green Roof	Roof area covered with vegetation and soil media (drainage through media is represented as “groundwater” that contributes to the total runoff)	Green roof	

Runoff Reduction Measures

1. **Self-Treating Areas**
2. **Self-Retaining Areas**
3. **Areas Draining to Self-Retaining Areas**

Runoff-reduction site-design measures are the most effective and least expensive way to implement LID.

- Manage drainage from pervious landscaped areas separately, so that it doesn't run on to adjacent pavement.
- Further reduce runoff by dispersing runoff from impervious roofs and pavement to landscaped areas.

To incorporate these features into your project, **delineate and classify the Drainage Management Areas (DMAs)** appropriately on your Stormwater Control Plan Exhibit. See page 35.

Follow the criteria below in your Exhibit and grading and drainage plan.

Note: Runoff from drainage management areas that do not meet the criteria for self-treating areas, self-retaining areas, or areas draining to self-retaining areas must be directed to bioretention facilities or other IMPs.

1. Self-Treating Areas

Self-treating drainage management areas are natural, landscaped, or turf areas that drain directly off site or to the storm drain system. Examples include upslope undeveloped areas from which runoff is piped or ditched and drained around a development and grassed slopes that drain offsite to a street gutter. Self-treating areas must not drain on to adjacent paved areas within the project.

Drainage from self-treating areas must flow to off-site streets or storm drains without flowing on to paved areas within the project. Lawn or landscaped areas adjacent to streets can be considered self-treating areas. Pavement within a self-treating area must not exceed 5% of the total area.

► Best Uses

- Sites with extensive landscaping

► Advantages

- Low cost
- No maintenance verification requirement
- Complements site landscaping

► Limitations

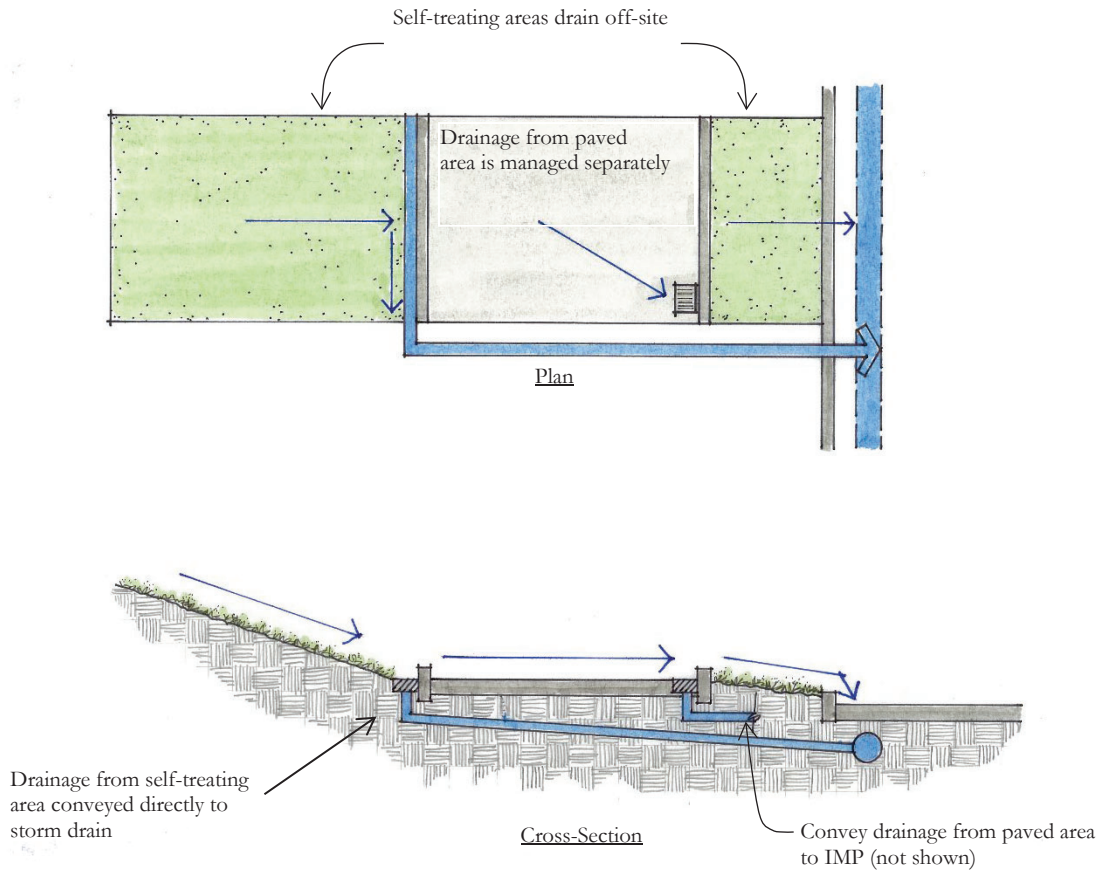
- Requires substantial square footage
- Grading requirements must be coordinated with landscape design



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Criteria for Self-Treating Areas

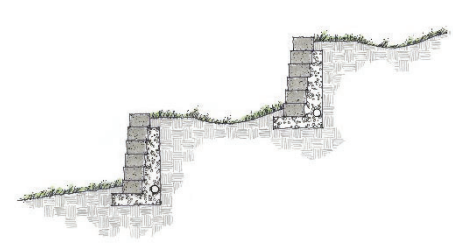
- Runoff from the self-treating area does not enter an IMP or another drainage management area, but goes directly offsite or to the storm drain system.
- The self-treating area is at least 95% lawn or landscaping (not more than 5% impervious).
- Re-graded or re-landscaped areas have amended soils, vegetation,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

2. Self-Retaining Areas

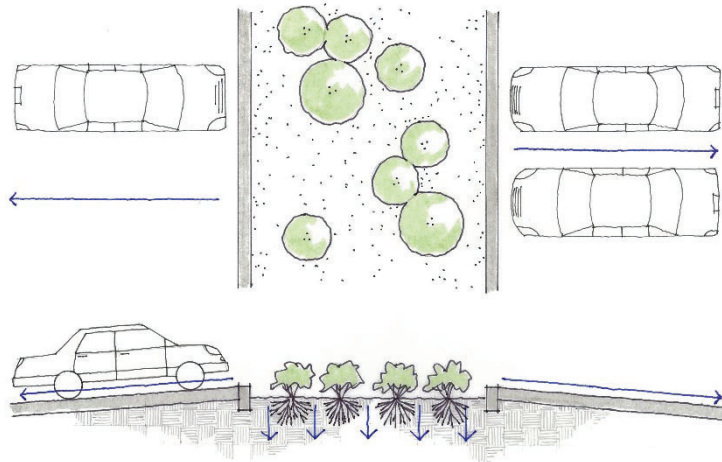
Where a landscaped area is upslope from or surrounded by paved areas, a self-retaining drainage management area (also called a zero-discharge area) may be created. Self-retaining areas are designed to retain the first one inch of rainfall without producing any runoff. The technique works best on flat,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

To create self-retaining turf and landscape areas in flat areas or on terraced slopes, berm the area or depress the grade into a concave cross-section so that these areas will retain the first inch of rainfall.

Self-retaining areas can also be created by depressing lawn and landscape below surrounding sidewalks and plazas. Leave enough reveal (elevation difference) to accommodate buildup of turf or mulch.

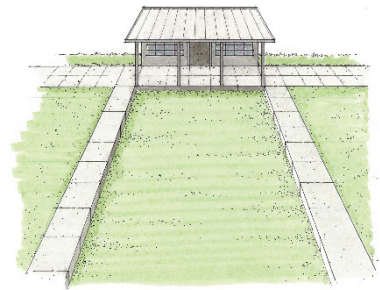


Slope terraced to create a self-retaining area



► **Criteria for Self-Retaining Areas**

- Area is bermed all the way around or graded concave.
- Slopes do not exceed 4%.
- Entire area is lawn, landscaping, or pervious pavement (see criteria for pervious pavement).
- Area has amended soils, vegetation, and irrigation as may be required to maintain soil stability and permeability.
- Any area drain inlets are at least 3 inches above surrounding grade.
- Overflow (which may occur during high-intensity events) is conveyed safely.

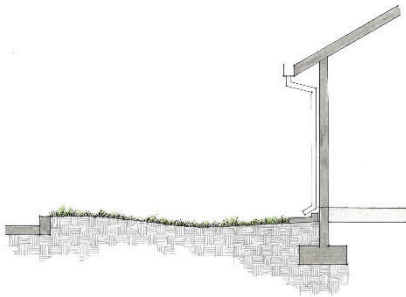


Lawn depressed to create a self-retaining area

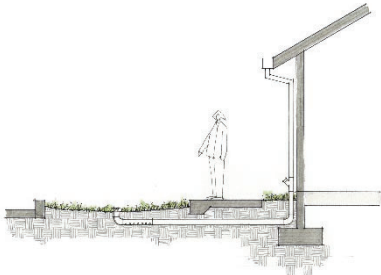
3. Areas draining to self-retaining areas

Drainage from roofs and paving can be directed to self-retaining drainage management areas and allowed to infiltrate into the soil. The maximum ratios are:

The self-	Site requirement	Maximum allowable ratio
	Treatment only	2 parts impervious: 1 pervious
	Treatment and flow-control	1 part impervious: 1 pervious



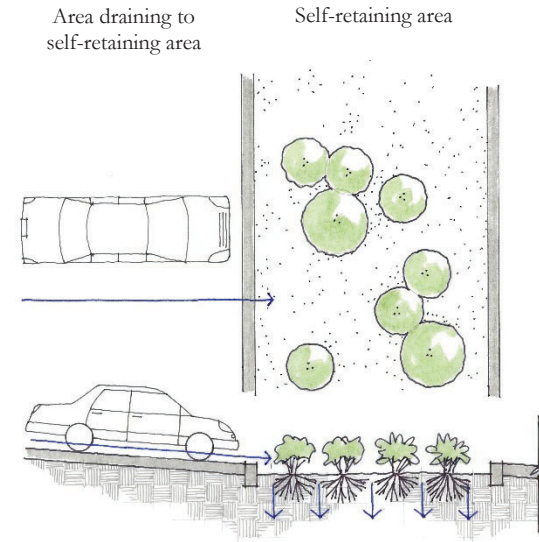
Roof runoff is directed to an adjacent self-retaining landscaped area.



A roof leader extends to a bubble-up to convey roof runoff to a self-retaining area.

retaining area must be bermed or depressed to retain an inch of rainfall including the flow from the tributary impervious area. Inlets of area drains, if any, should be set 3 inches above the low point to allow ponding. Self-retaining areas should be designed to promote even distribution of ponded runoff over the area.

Runoff from walkways or driveways in parks and park-like areas can sheet-flow to self-retaining areas. Roof leaders can be connected to self-retaining areas by piping beneath plazas and walkways. If necessary, a “bubble-up” can be used.



► CRITERIA FOR AREAS DRAINING TO SELF-RETAINING AREAS

- Ratio of tributary impervious area to self-retaining area is not greater than 2:1 (1:1 if flow-control requirements apply).
- Roof leaders collect runoff and route it to the self-retaining area.
- Paved areas are sloped so drainage is routed to the self-retaining area.
- If runoff is concentrated where it enters the self-retaining area, there are appropriate measures to protect against erosion and promote flow across the self-retaining area.

Pervious Pavements



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

Pervious pavements are often costly to build and maintain when compared to conventional pavement draining to bioretention facilities. However, in some applications the aesthetic or practical benefits of a flat surface unbroken by drainage structures may be worth the additional cost.



► Best Uses

- Flat areas (< 2% slope)
- Areas with competent, permeable native soils
- Low-traffic areas
- Where aesthetic quality can justify higher cost

► Advantages

- No maintenance verification requirement for installations < 3000 square feet
- Surface treatments can complement landscape design

► Limitations

- Initial cost
- Placement requires specially trained crews
- Geotechnical concerns, especially in clay soils
- Concerns about pavement strength and surface integrity



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Pervious pavements are not treatment facilities. However, they may be configured as self-retaining areas. In specific, limited circumstances, pervious pavements configured as self-retaining areas may receive some runoff from roofs or conventional pavement—if it can be shown that the required amount of runoff, as well as rain falling on the pervious pavement, will infiltrate into the underlying soil.

Solid unit pavers—such as bricks, stone blocks, or precast concrete shapes—are considered to reduce runoff compared to impervious pavement, when the unit pavers are set in sand or gravel with 3/8-inch gaps between the pavers. Joints must be filled with an open-graded aggregate free of fines.

If pervious pavement areas drain to Integrated Management Practices (IMPs), use the runoff factors in Table 3-2 when sizing the IMPs.

► **DETAILS**

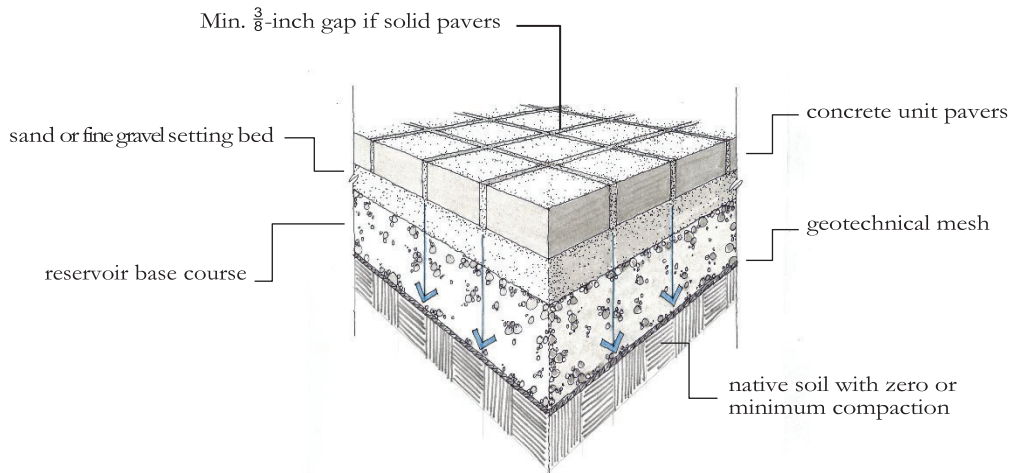
Permeable pavements can be used in clay soils; however, special design considerations, including an increased depth of base course, typically apply and will increase the cost of this option. Geotechnical fabric between the base course and underlying clay soil is recommended.

Permeable pavements are best used on grades from flat to approximately 2%. Installations on steeper grades, particularly on clay soils, require cut-off trenches lateral to the slope—to intercept, store, and infiltrate drainage from the base course.

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

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

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



TYPICAL CONFIGURATION for a pervious pavement. The base course is a minimum 3-inch depth for runoff retention. A deeper base course is typically required for pavement stability.

► **CRITERIA FOR PERVIOUS PAVEMENTS**

- Installation is flat or < 2% grade.
- No erodible areas drain on to pavement.
- Subgrade is uniform and slopes are not so steep that subgrade is prone to erosion. Compaction is minimal.
- Reservoir base course is of open-graded crushed stone. Base depth is adequate to retain rainfall and support design loads.
- If a subdrain is provided, outlet elevation is a minimum of 3 inches above highest point of bottom of base course.
- 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 and porous asphalt, if used, are installed by qualified professionals according to vendor's recommendations.
- Selection and location of pavements incorporates Americans with Disabilities Act requirements, site aesthetics, and uses.
- Pavement design and/or grading design incorporates management of design flows to avoid local flooding (typically a 10-year storm).

► **RESOURCES**

National Ready Mix Concrete Association
<http://www.perviouspavement.org/>.

National Asphalt Pavement Association
www.asphaltpavement.org.

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

Start at the Source Design Manual for Water Quality Protection, pp. 47-53. <http://www.ccleanwater.org/c3-resources.html>.

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

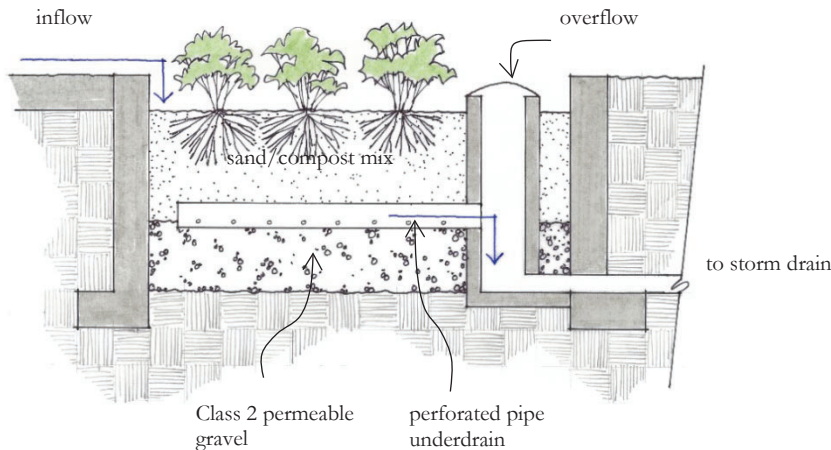
Caltrans. 2013. *Pervious Pavement Design Guidance*.
http://www.dot.ca.gov/hq/oppd/stormwtr/bmp/DG-Pervious-Pvm_082114.pdf.

Bioretention Facilities



Bioretention facilities can be rectangular, linear, or nearly any shape.
Photo by Scott Wikstrom

Bioretention facilities capture runoff in a shallow reservoir on the soil surface, then filter the runoff through plant roots and a biologically active soil mix. The treated runoff then trickles into a subsurface gravel layer. Runoff is held in the gravel layer until it infiltrates it into the ground. If the entire gravel layer becomes saturated, an underdrain conveys excess treated runoff to a storm drain or to surface drainage.



- ▶ **Best Uses**
 - Commercial areas
 - Residential subdivisions
 - Industrial facilities
 - Roadways
 - Parking lots
 - Fit in setbacks, medians, and other landscaped areas
- ▶ **Advantages**
 - Can be any shape
 - Low maintenance
- ▶ **Limitations**
 - Require 4%-15% of tributary impervious square footage
 - Typically require 3-4 feet of head
 - Irrigation may be required



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LAYOUT AND SITE DRAINAGE

See the guidance on page 32-33 regarding how to incorporate bioretention facilities into your site. Also see “Integrating Your LID Design into Your Project” on page 49, and ideas on applications and ancillary uses on page 73. Place bioretention facilities in visible, well-trafficked areas and make them a focal point in the landscape.

- On flatter sites, use surface drainage, rather than underground pipes, to convey runoff to the bioretention facility inlets. The top of soil elevation should be as high as possible—typically 6 to 12 inches below surrounding grade.
- Where possible, design site drainage so only impervious roofs and pavement drain to the bioretention facility. Avoid high walls or steep slopes adjacent to bioretention facilities. Avoid side slopes within bioretention areas as much as possible. The bioretention soil mix will tend to rill even on very mild slopes (>8:1).
- Integrate bioretention facilities with the landscape design.
- Make the bioretention facilities level around their perimeter.
- Where possible, grade tributary paved areas to sheet flow runoff and disperse it among curb cuts, rather than concentrating flow at one inlet location.
- Place each facility in a common, accessible area. Avoid locating facilities on private residential lots.

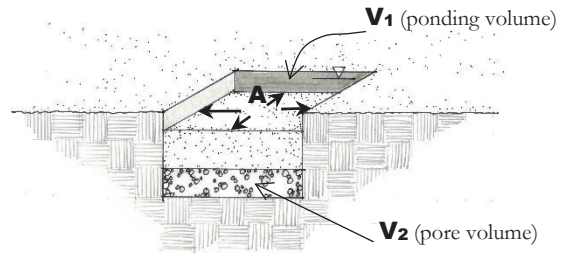
► **DIMENSIONS**

For development projects subject only to **runoff treatment requirements**, the following minimum dimensions apply.

Parameter	Criterion
Surface reservoir mean depth	6-inch minimum
Soil mix surface area	0.04 × equivalent tributary impervious area (or per reduced sizing if applicable, see p. 50).
Soil mix depth	18-inch minimum
Gravel layer	12-inch minimum Class 2 permeable
Underdrain discharge	At top of gravel layer

Where **flow-control requirements** also apply, the bioretention facility must be designed to meet the minimum surface area (A), surface volume (V_1), and subsurface volume (V_2) using Equation 3-3 and the sizing factors and equations in Tables 3-6 and 3-7.

Use the IMP Sizing Calculator for sizing and to show calculations.



Surface storage and overflow. In treatment-and-flow-control facilities, the overflow elevation must be set to achieve the minimum surface storage volume calculated using Equation 3-3 and the V_1 sizing factor. The V_1 volume is based on the required area times a 12-inch depth, but the designer can also meet V_1 volume by a larger than required area and reducing depth.

Minimum subsurface volume. For treatment-and-flow-control facilities the minimum subsurface volume V_2 specified in Table 3-6 is the void space, not the entire volume of gravel. Where the native soils are Hydrologic Soil Group C or D, V_2 may be achieved by a 30-inch deep layer of gravel **of 40% porosity**, extending under the minimum footprint “A”. Note that if the facility area is increased, the required depth to achieve the same volume is correspondingly decreased.

If desired, voids created by buried structures such as pipes or arches, may be substituted, as long as the voids are hydraulically interconnected and the minimum subsurface volume calculated by Equation 3-3 is achieved.

► **FACILITY DETAILS**

Prepare details and include notes on construction drawings as appropriate to your design.

Inlets. Curb cuts should be wide (12 inches is recommended) to avoid clogging with leaves or debris. Allow for a minimum reveal of 6 inches between the inlet and soil mix elevations to ensure turf or mulch buildup does not block the inlet. In addition, place an apron of stone or concrete, a foot square or larger, inside each inlet to prevent vegetation from growing up and blocking the inlet.

If the linear slope along the curb is greater than the orthogonal slope of the gutter pan, runoff flows will not enter the inlet efficiently. Use a drop inlet with a grate instead.

Where runoff is concentrated and conveyed to the facility via pipes or swales, protect the plants and soil mix from high-velocity flows with energy-dissipating cobble of appropriate size. In larger installations, provide cobble-lined channels to better distribute flows throughout the facility.

“Bubble ups” can be used to dissipate energy when runoff is piped from roofs and up-gradient paved areas.

Overflow structure. A precast concrete catch basin or manhole is required except in small and protected facilities. The overflow elevation is critical and must be designed to achieve the surface reservoir requirements. The outlet should be designed to exclude floating mulch and debris. An atrium-style or beehive grate is recommended and may be required.

Underdrains. Underdrains must have their discharge elevation set at the top of gravel layer elevation. Perforated pipe can be laid in a shallow groove dug across the top of the gravel layer, holes facing down, and connected to the overflow structure. Underdrains must be constructed of rigid pipe (SDR 35 or equivalent) and provided with a cleanout.

Flow-control orifice. For treatment-and-flow-control facilities, the underdrain must be routed through a device designed to limit flows to that specified in Equation 3-10 or 3-11 (page 46). Typically, a section of solid pipe is designed to protrude slightly into the overflow structure. The pipe is threaded and fitted with a standard cap; a hole of the specified diameter is drilled into the cap. The cap can then be easily removed for cleaning or adjustment and reinstalled.

Vaults, utility boxes, backflow preventers, and light standards. Utility features and structures must be located outside the bioretention facility.

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

► **SOIL, PLANTING, AND IRRIGATION**

Gravel underlayer. Use “Class 2 permeable,” Caltrans specification 68-2.02(F)(3). Open-graded crushed rock, washed, may be used as an alternative, but requires 4- to 6-inch washed pea gravel be substituted at the top of the crushed rock layer. **Do not use filter fabric** to separate the soil mix from the gravel drainage layer or the gravel drainage layer from the native soil.

Planting Soil Mix. The required mix of sand and compost is specified in BASMAA’s April 2016 “Specification of Soils for Biotreatment or Bioretention Facilities.” The mix is similar to a loamy sand and must maintain a minimum percolation rate of 5 inches per hour throughout the life of the facility. It is suitable for maintaining plant life with no (or very little) fertilizer use. Use of the specified (rather than “alternative”) soil mix is strongly encouraged.

At their sole discretion, municipal construction inspectors may accept test results and certification for a “brand-name” mix from a soil supplier. Batch-specific testing is required for installations of over 100 cubic yards.

Submittals for the soil mix must include and follow the CCCWP “Soil Mix for Bioretention Specification Verification Checklist.” The checklist, soil mix specification, and a list of suppliers are available on the [CCCWP C.3 web page](#).

Ensure the soil mix is installed level and at the specified elevation, and that the elevation does not change when plants are installed. Place the bioretention soil in 8- to 12-inch lifts. Lifts are **not to be compacted** but are placed to reduce the possibility of excessive settlement. Allow time for natural compaction and settlement prior to planting. Bioretention soil may be watered to encourage compaction.

Planting. Species in Appendix B were selected for:

- Adaptation to Contra Costa’s climate
- Drought tolerance
- Adaptation to well-drained soils
- Adaptation to low soil fertility
- Allow infiltration
- Not invasive weeds
- Do not have aggressive roots

Characteristics noted in the table, including irrigation preferences and ability to tolerate heat, coastal conditions, flooding, and wind should be considered when selecting plants.

This list is not comprehensive, nor will all these species succeed at every site. Selection for a particular site should be done by experienced professionals familiar with the plants and site conditions. Avoid planting species on the California Invasive Plant Council's invasive plant inventory list.

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. Straps should be inspected once or twice a year and removed once trees are established to prevent girdling.

Mulch is not required but is recommended for the purpose of retaining moisture, preventing erosion and minimizing weed growth. Compost meeting the specification for use in the planting soil mix is recommended for use as mulch. This "aged mulch" has less tendency to float compared to bark mulch.

Irrigation. Bioretention soils have a high infiltration rate and require a different irrigation system design than the designs typically used for heavy clay soils in Contra Costa County. Irrigation systems must be designed to minimize water use, avoid overwatering, and prevent underdrain discharges during dry weather.

Bioretention facilities and planter boxes may need to be irrigated more than once a day, for shorter periods. Irrigation controls should allow separate control of times and durations of irrigation for bioretention facilities and planter boxes vs. other landscape areas.

Smart irrigation controllers are strongly encouraged. 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 usable rainfall.

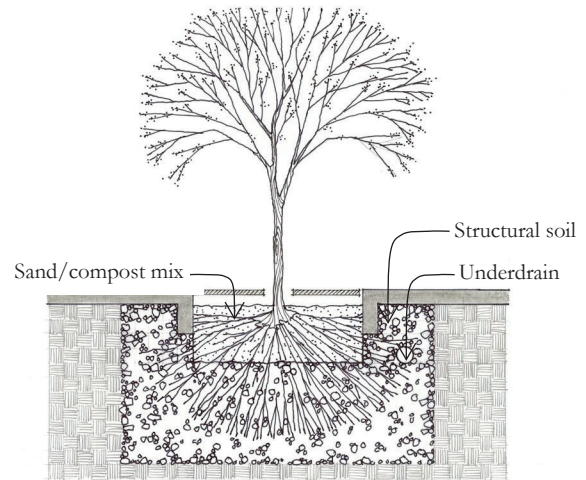
Drip emitters are strongly recommended over spray irrigation. Use multiple, lower-flow (1/2 to 2 gallons per hour) emitters in fast-draining bioretention soils. Use two or more emitters for perennials, ground covers, and bunchgrasses. Four to six emitters may be needed for larger shrubs and trees. Some types of emitters encourage horizontal distribution of water.

Spray heads must be positioned to avoid direct spray into bioretention facility or planter box outlet structures.

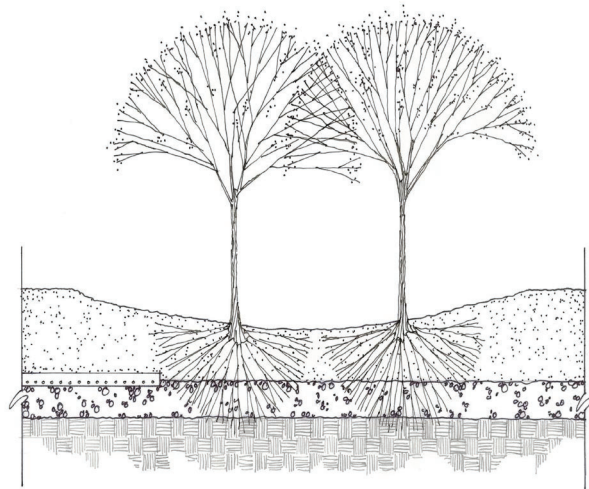
Trees. Bioretention areas can accommodate small or large trees within the minimum areas and volumes calculated by Equation 3-3. Tree canopies intercept rain, and tree roots maintain soil permeability and help retain runoff. Normal maintenance of a bioretention facility should not affect tree lifespan.

Consider the following when designing bioretention facilities to accommodate trees, especially large trees:

- The bioretention facility requires 18 inches of soil mix over the minimum surface area. Trees can be planted in this soil mix; the area occupied by the tree counts toward the minimum area requirement.
- Trees require sufficient rooting volume to thrive. [Structural soils](#) can be used below or around the soil mix.
- Most tree roots extend horizontally near the soil surface.
- The bioretention soil mix has low moisture-holding capacity. Consider planning for tree roots to access native clay soils through the side walls as the tree grows. However, where needed, adjacent paving or structures can be protected with a root barrier.
- A podium of native soil is sometimes constructed so that the root ball can be installed at the correct elevation (so that bioretention soil mix and mulch do not cover the tree's root collar).
- Large trees should be spaced appropriately for their size at maturity.
- Trees may need to be staked for longer because the bioretention soil mix provides little structural support against trees being toppled by wind.



Bioretention facility configured as a tree well.



Larger bioretention facility with trees.

► **APPLICATIONS AND ANCILLARY USES**

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

Residential subdivisions. In the design of many subdivisions, it has proven easiest and most effective to drain roofs and driveways to the streets (in the conventional manner) and then drain the streets to bioretention areas, with one bioretention area for each 1 to 10 lots, depending on subdivision layout and topography.

Bioretention areas should be placed in common areas or on one or more separate, dedicated parcels with joint ownership.

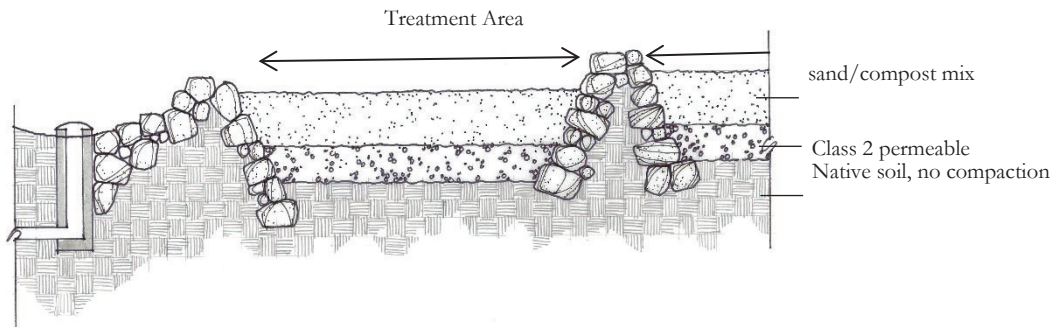
Sloped sites. Bioretention facilities must be constructed as a basin or as a series of basins, with the circumference of each basin level.

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

Swales can be used on mild slopes. Check dams should be placed every 4 to 6 inches of elevation change and so that the lip of each dam is at least as high as the toe of the next upstream dam.

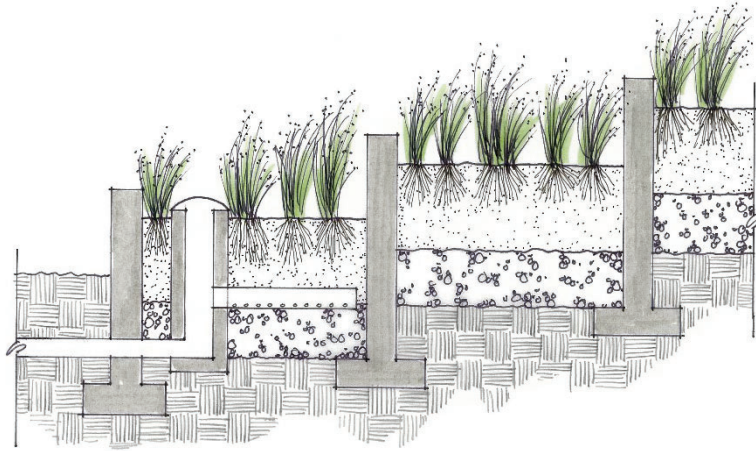


Bioretention facility in El Cerrito with active and passive recreational uses.



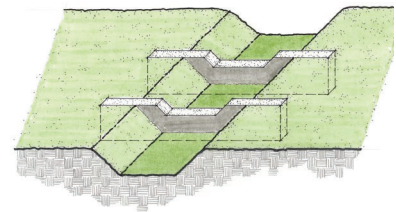
Swale with check dams. Not suitable for steeper slopes. Movement of soil can be a problem even at mild slopes. Design must ensure ponding behind each check dam.

A series of planters is a more robust solution and is required for steeper slopes.



Concrete check dams are a better solution on steeper slopes.

Solutions for surface storage. Placing a steep-sided depression in an urban landscape poses aesthetic challenges as well as practical challenges. First, use sheet flow, valley gutters, and trench drains, instead of pipes, to move runoff to the bioretention facility, so that inlets can be at or near ground level.



Key check dams into bottom and side slopes.

To further avoid the effects of high and steep drop offs, consider:

- Increasing the facility area and reducing the surface depth accordingly.
- Incorporating steps down into the facility.
- Specifying taller, woody plants to block or discourage entry.

Mulch can be mounded a few inches deeper at walkway edges to transition to the top of soil elevation.

References and Resources

- [Model Biotreatment Soil Media Specifications—MRP 2.0 Provision C.3.c.i.\(2\)\(c\)\(ii\)](#)
- *Recommendations for Soils Specification, Planting, and Irrigation of Bioretention Facilities*, WRA Environmental Consultants, November 5, 2008.
- [US Composting Council](#)
- [ASTM International](#)
- *Plant List and Planting Guidance for Landscape-Based Stormwater Measures*. Appendix B in the *Alameda County Clean Water Program C.3 Technical Guidance* (2016).
- *Plants and Landscapes for Summer Dry Climates*. Nora Harlow, Ed. East Bay Municipal Utility District, Oakland.
- *California Native Plants for Your Garden and Wildlife*, Las Pilitas Nursery, 2008.
- *Native Treasures: Gardening with the Plants of California*. M. Nevin Smith, 2016. University of California Press.
- [The Calflora Database, 2008](#).
- [California Invasive Plant Council](#)
- *A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California*, University of California Cooperative Extension and California Department of Water Resources.
- [Our Water Our World](#), website developed to assist consumers in managing home and garden pests in a way that helps protect water.
- [Bay-Friendly Best Practices for Landscape Professionals](#), a whole systems approach to the design, construction, and maintenance of the landscape to support the integrity of the San Francisco Bay watershed.
- [University of California Statewide Integrated Pest Management \(IPM\) Program](#)

► **Criteria for Bioretention**

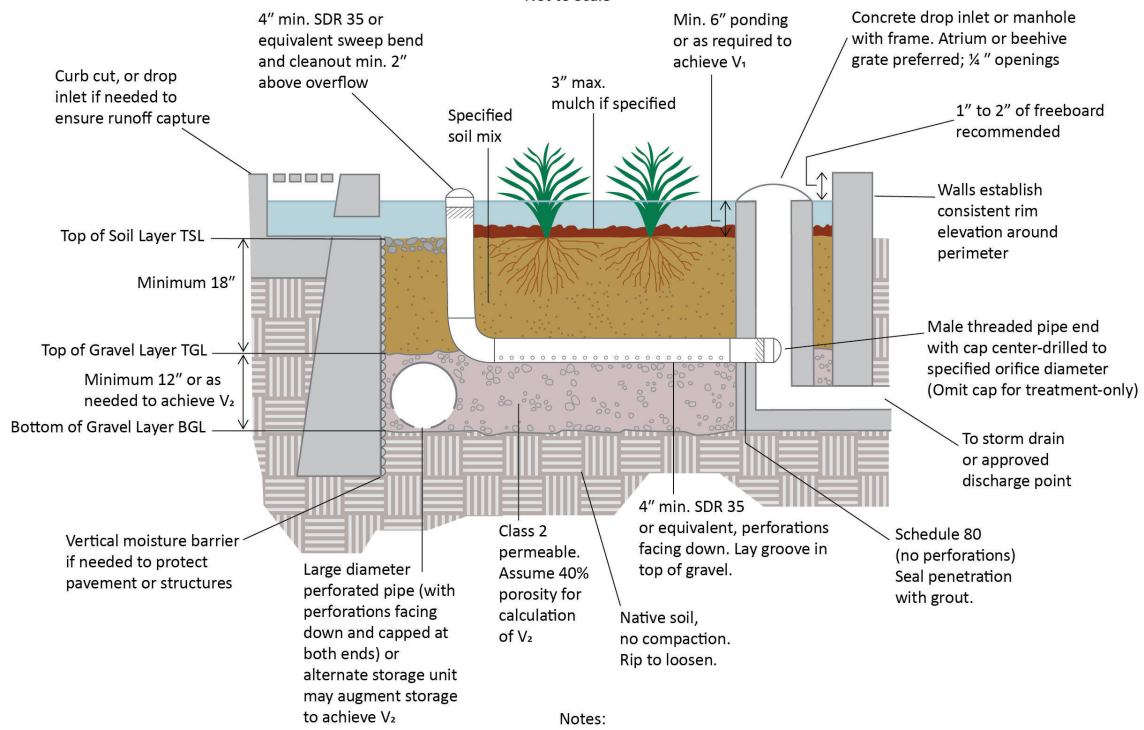
- Bioretention facilities are located in a visible, well-trafficked area.
- Top of soil elevation is as high as possible. High walls and steep slopes adjacent to the facility are avoided.
- Location and footprint of facility are congruent on the site plan, landscaping plan, and grading plan.
- Bioretention area is designed as a basin (level edges) or a series of basins, and grading plan is consistent with these elevations. Check dams, if any, are set so the lip or weir of each dam is at least as high as the toe of the next upstream dam.
- Volume or depth of surface reservoir meets or exceeds minimum. Freeboard above overflow (1 to 2 inches recommended) is not included in surface reservoir volume.
- 18-inch depth specified soil mix.
- Area of soil mix meets or exceeds minimum.

CHAPTER 3: DESIGN SHEETS

- *Perforated pipe (PVC SDR 35 or approved equivalent) underdrain with discharge elevation at the top of the “Class 2 perm” layer. Holes facing downward. Connection and sufficient head to storm drain or approved discharge point.*
- No filter fabric.
- Underdrain has a clean-out port consisting of a vertical, rigid, non-perforated PVC pipe, with a minimum diameter of 4 inches and a watertight cap.
- Curb inlets are 12-inch wide, have 4 to 6-inch reveal and an apron or other provision to prevent blockage when vegetation grows in, and energy dissipation as needed.
- Overflow catch basin or manhole connected to a downstream storm drain or approved discharge point.
- Emergency spillage will be safely conveyed overland.
- Plantings are suitable to the climate, exposure, and a well-drained soil, and occasional inundation during large storm events.
- Irrigation system with connection to water supply, on a separate zone.
- Vaults, utility boxes, backflow preventers, and light standards are located outside the minimum soil mix surface area.
- **For treatment-and-flow-control facilities only**
- Volume of surface storage meets or exceeds minimum (V_1).
- Volume of subsurface storage meets or exceeds minimum (V_2).
- In “C” and “D” native soils, underdrain is connected to discharge through an appropriately sized orifice or other flow-limiting device.

Bioretention Facility

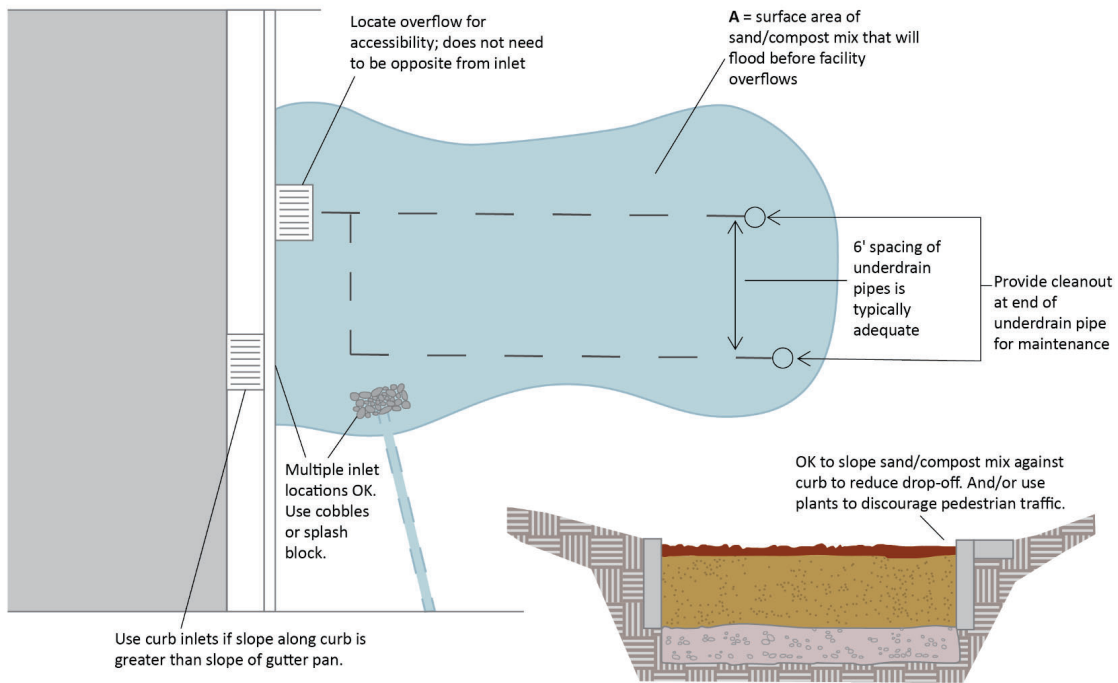
Cross-section
Not to Scale



- Notes:
- No liner, no filter fabric, no landscape cloth.
 - Maintain BGL, TGL, TSL throughout facility area at elevations to be specified on drawing.
 - Class 2 perm layer may extend below and underneath drop inlet.
 - Invert elevation of perforated pipe underdrain discharge is at TGL.
 - See Chapter 3 for factors and equations used to calculate V_1 , V_2 and orifice diameter.

Bioretention Facility

Plan
Not to Scale



► **Best Uses**

- Management of roof runoff
- Podium-style developments
- On building plazas

► **Advantages**

- Versatile
- Can be any shape
- Low maintenance

► **Limitations**

- Can only be used where infiltration is not possible
- May not be used for flow control (HM) where underlying soils are Hydrologic Soil Group “A” or “B”
- Requires underdrain
- Requires 3 to 4 feet of head

Flow-through Planter

Unlike bioretention facilities, flow-through planters are designed to discharge all influent runoff following treatment, rather than infiltrating some treated runoff into the underlying soil.

Flow-through planters are contained within a concrete box, or plastic liners may be used on the sides and bottom. An underdrain is constructed with the discharge elevation near the bottom of the gravel layer (that is, there is no “dead” storage).”

Flow-through planters may be used as an alternative to bioretention under certain conditions:

- Upper-story plazas
- Where bioretention facilities could cause mobilization of pollutants in soil or groundwater.
- Other situations where infiltration is a concern, such as locations with potential geotechnical hazards that cannot be mitigated except by preventing infiltration.



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► **DIMENSIONS AND MATERIALS**

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

Parameter	Criterion
Surface reservoir depth	6-inch minimum
Soil mix surface area	$0.04 \times$ tributary impervious area
Soil mix depth	18-inch minimum
Gravel layer	12-inch minimum Class 2 permeable
Underdrain	At bottom of gravel layer

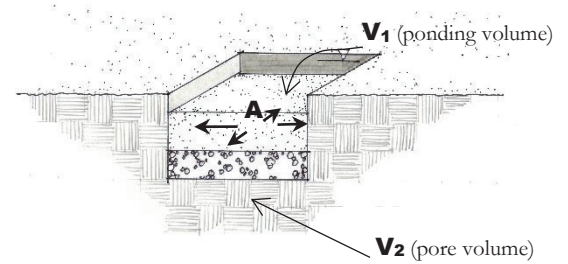
Where **flow-control requirements** also apply, the flow-through planter must be designed to meet the minimum surface area (A), surface volume (V_1), and subsurface volume (V_2) using Equation 3-3 and the sizing factors and equations in Tables 3-6 and 3-7. The IMP Sizing Calculator should be used.

Minimum surface and subsurface volume. In a vertical-sided box-like planter for treatment-and-flow-control with the minimum surface area A, the minimum surface volume V_1 can be achieved with an overflow height of 10 inches (12-inch total height of walls with 2 inches of freeboard).

For treatment-and-flow-control facilities the minimum subsurface volume V_2 specified in Table 3-8 is the void space, not the entire volume of gravel. The minimum subsurface volume V_2 can be achieved with a gravel (Class 2 permeable) depth of 30 inches. This combination results in a planter approximately 5' high. The planter height can be reduced by incorporating void-creating underdrain pipes, other pipes, or arches, or by increasing the planter area so that the minimum V_2 is achieved.

Gravel. “Class 2 permeable,” Caltrans specification 68-2.02(F)(3), is preferred. Open-graded crushed rock, washed, may be used, but requires 4- to 6-inch washed pea gravel be substituted at the top of the crushed rock layer. **Do not use filter fabric** to separate the soil mix from the gravel drainage layer or the gravel drainage layer from the native soil.

If desired, voids created by buried structures such as pipes or arches may be substituted, as long as the voids are hydraulically interconnected and the minimum subsurface volume calculated by Equation 3-3 is achieved.



Soil mix. Criteria for the required mix of sand and compost are in Appendix B. It is similar to a loamy sand and must maintain a minimum percolation rate of 5 inches per hour throughout the life of the facility, and it must be suitable for maintaining plant life with a minimum of fertilizer use. A list of suppliers is on the C.3 web pages.

Underdrains. Underdrains must have their discharge elevation set as flush with the planter bottom as possible. Underdrains must be constructed of rigid pipe (SDR 35 or equivalent) and provided with a cleanout.

Flow-control orifice. For treatment-and-flow-control facilities, the underdrain must be routed through a device designed to limit flows to that specified in Equation 3-10 or 3-11 (page 46). Typically, a section of solid pipe is designed to protrude slightly into the overflow structure. The pipe is threaded and fitted with a standard cap; a hole of the specified diameter is drilled into the cap. The cap can then be easily removed for cleaning or adjustment and reinstalled.

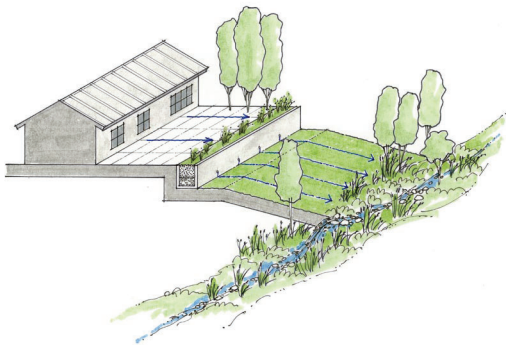
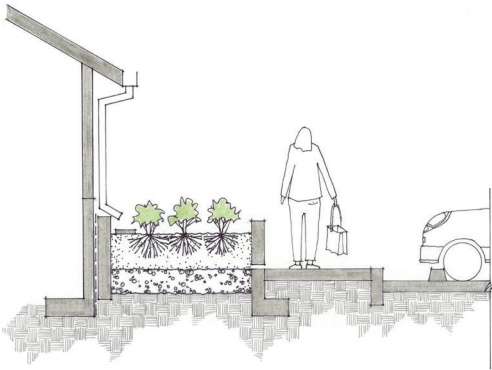
► **APPLICATIONS**

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

Adjacent to buildings. Designers should aim to use bioretention facilities (that is, facilities open at the bottom to allow infiltration) adjacent to buildings. An impermeable vertical cutoff wall between the facility and the building may be incorporated. Where it is not feasible to adjust the building and foundation design, flow-through planters may be used. Planter vegetation can soften the visual effect of the building wall. A setback with a raised planter box may be appropriate even in some neo-traditional pedestrian-oriented urban streetscapes.

Steep slopes. Flow-through planters provide a means to detain and treat runoff on very steep slopes that cannot accept infiltration from a bioretention facility. The planter can be built into the slope similar to a retaining wall. The design should consider the need to access the planter for maintenance. Flows from the planter underdrain and overflow must be directed in accordance with local

Bioretention facility adjacent to building. An impermeable cutoff wall between the facility and the building may be incorporated.



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

requirements. It is sometimes possible to disperse these flows to the downgradient hillside.

► **Design Checklist for Flow-through Planter**

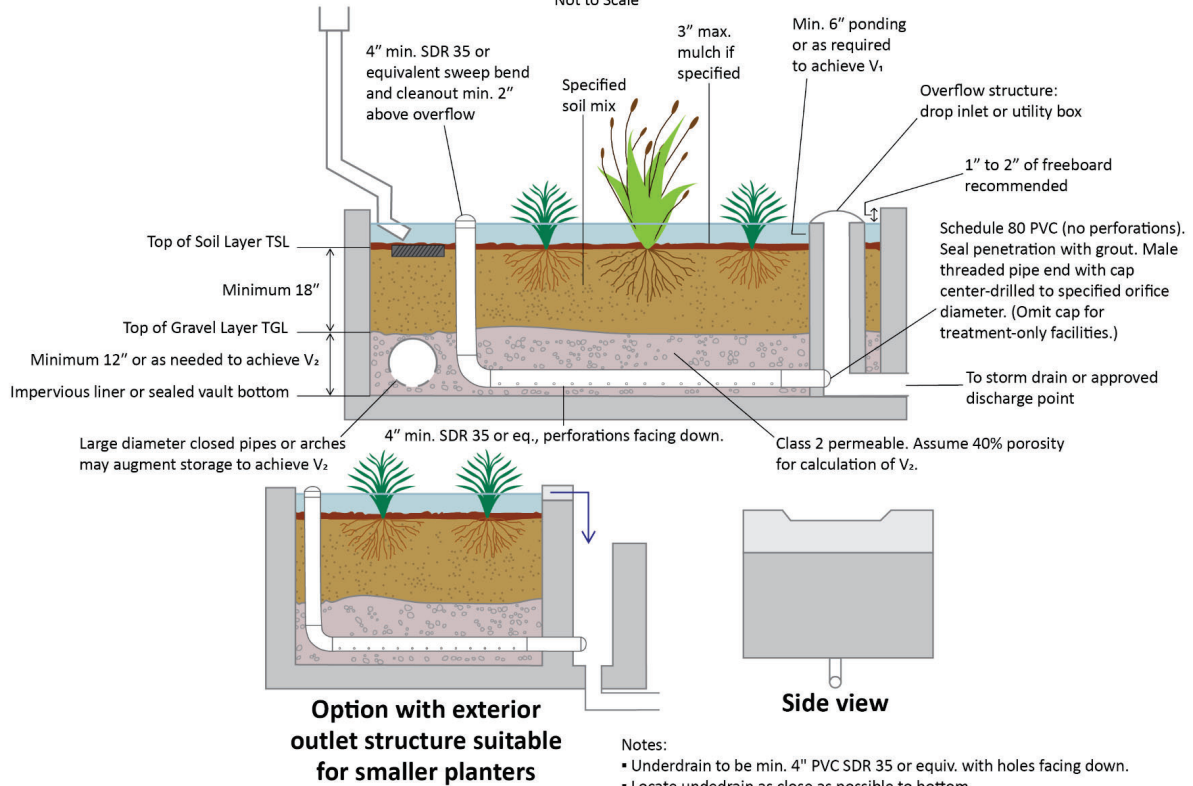
- Location and footprint of facility are shown on site plan and landscaping plan.
- Planter is set level.
- Location is on an upper-story plaza, adjacent to a building foundation, where mobilization of pollutants in soil or groundwater is a concern, or where potential geotechnical hazards are associated with infiltration.
- Volume or depth of surface reservoir meets or exceeds minimum.
- 18-inch depth specified soil mix (reference *Guidebook* Appendix B).
- Area of soil mix meets or exceeds minimum.
- “Class 2 perm” drainage layer.
- 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, with a minimum diameter of 4 inches and a watertight cap.
- Overflow outlet connected to a downstream storm drain or approved discharge point.
- 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. See Appendix B.

For treatment-and-flow-control flow-through planters only

- Volume of surface storage meets or exceeds minimum.
- Volume of subsurface storage meets or exceeds minimum.
- Underdrain is connected via an appropriately sized orifice or other flow-limiting device.

Flow-through Planter

Not to Scale



- Notes:
- Underdrain to be min. 4" PVC SDR 35 or equiv. with holes facing down.
 - Locate underdrain as close as possible to bottom.
 - No filter fabric, no landscape cloth.
 - See Appendix B for soil mix specification, planting and irrigation guidance.
 - See Chapter 3 for factors and equations used to calculate V_1 , V_2 and orifice diameter.

Dry Wells and Infiltration Basins

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

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

► Criteria

Dry wells and infiltration basins must be designed with the minimum volume and infiltrative area calculated by Equation 3-3 using the sizing factors in Table 3-6.

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

► Details

Dry wells should be sited to facilitate maintenance and allow for the potential future need for removal and replacement.

In locations where native soils are coarser than a medium sand, the area directly beneath the facility should be over-excavated by 2 feet and backfilled with sand as a groundwater protection measure.

► Best Uses

- Projects on sites with permeable soils

► Advantages

- Compact footprint
- Can be installed in paved areas

► Limitations

- Can be used only on sites with Group “A” or Group “B” soils
- Requires minimum of 10 feet from bottom of facility to seasonal high groundwater
- Not suitable for drainage from some industrial areas or arterial roads
- Must be maintained to prevent clogging
- Typically, not as aesthetically pleasing as bioretention facilities



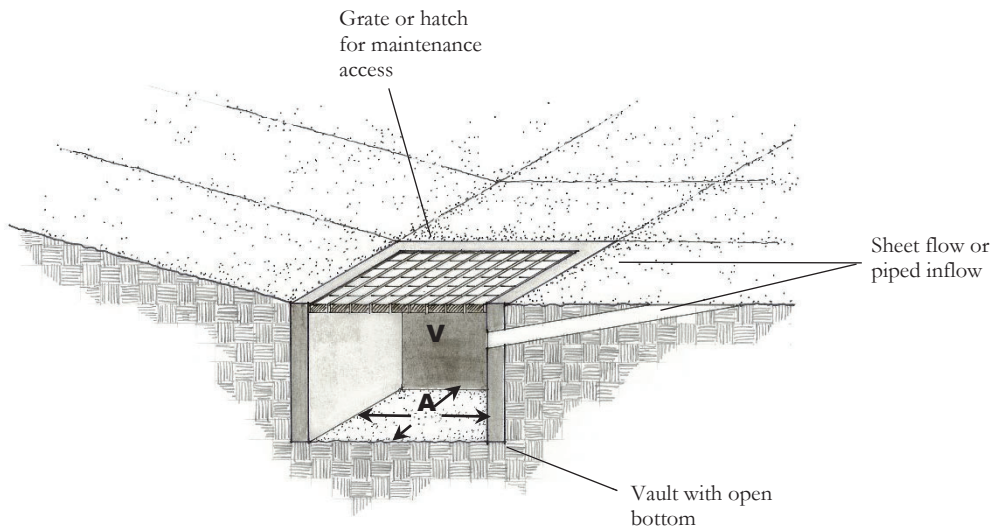
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Criteria for Dry Wells and Infiltration Basins

- Volume (V) and infiltrative area (A) meet or exceed minimum.
- Emergency spillage will be safely conveyed overland.
- Depth from bottom of the facility to seasonally high groundwater elevation is ≥ 10 feet.
- Areas tributary to the facility do not include automotive repair shops; areas subject to high vehicular traffic (25,000 or greater average daily traffic on main roadway or 15,000 or more average daily traffic on intersecting roadway), car washes; fleet storage areas (bus, truck, etc.); nurseries, or other uses that may present an exceptional threat to groundwater quality.
- Underlying soils are in Hydrologic Soil Group A or B. Infiltration rate is sufficient to ensure a full basin will drain completely within 72 hours. Soil infiltration rate has been confirmed.
- 10-foot setback from structures or as recommended by structural or geotechnical engineer.



Cistern + Bioretention Facility

A cistern in series with a bioretention facility or flow-through planter can meet treatment and flow-control requirements where space is limited. The cistern includes an orifice for flow control. The downstream bioretention facility or flow-through planter is sized to accommodate the maximum flow from the cistern orifice.

► CRITERIA

Cistern. Size the cistern using Equation 3-3 (page 45) and the factors and rainfall adjustment equations in Tables 3-6 and 3-7. The cistern must also include an orifice or other device to limit outflow to the calculated maximum release rate.

Bioretention facility. Size the bioretention facility or flow-through planter based on the cistern maximum release rate and a maximum surface loading rate of 5 inches per hour.

► DETAILS

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

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

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

► APPLICATIONS

Shallow ponding on a flat roof. The “cistern” storage volume can be designed in any configuration, including simply storing rainfall on the roof where it falls and draining it away slowly. In sites with Group “D” soils, the required average depth amounts to about 3/4 inch.

► Best Uses

- To meet flow-control requirements in limited space
- Management of roof runoff
- Dense urban areas

► Advantages

- Storage volume can be in any configuration
- Small footprint

► Limitations

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



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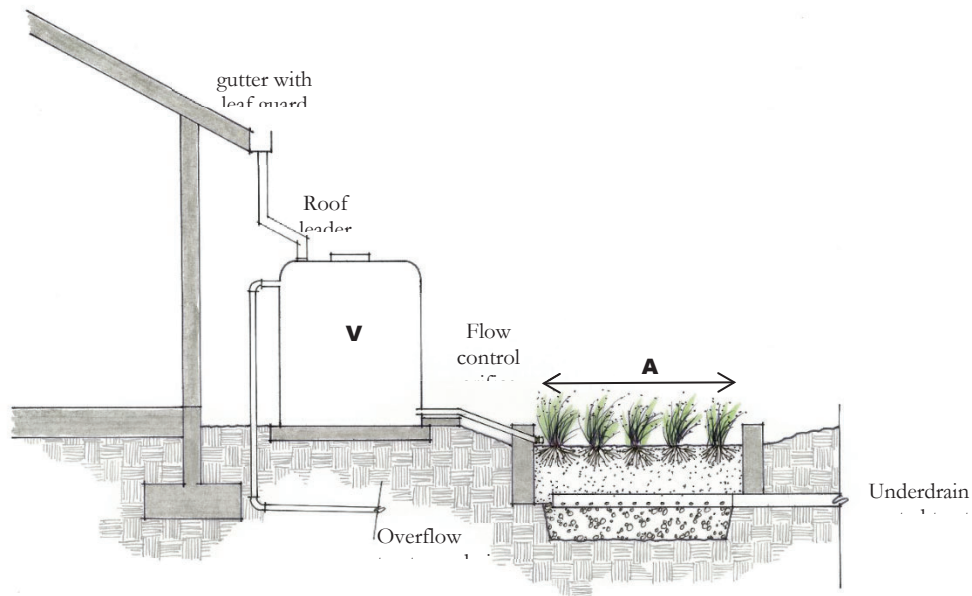
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Cistern attached to a building and draining to a planter.

This system for treatment-and-flow-control can be constructed with a flow-through planter at a height as low as 30 inches.

Criteria for Cistern + Bioretention

- Cistern volume meets or exceeds calculated minimum V (Eq. 3-3).
- Cistern outlet with orifice or other flow-control device restricts flow to calculated maximum. A drilled, threaded cap is suggested for easy maintenance.
- Cistern outlet is piped to bioretention area or flow-through planter.
- Bioretention surface area meets or exceeds the calculated minimum.
- Except for surface area, bioretention facility is designed to the criteria for “treatment only” in the “Bioretention Facility” design sheet (p. 66) or “Flow-through Planter” design sheet (p. 79).
- Cistern is designed to drain completely and/or sealed to prevent mosquito harborage.
- Design provides for exclusion of debris and accessibility for maintenance.
- Overflow connected to a downstream storm drain or approved discharge point.
- Emergency spillage will be safely conveyed overland.



Bioretention + Vault

A bioretention facility in series with a vault can meet treatment and flow-control requirements where space is limited. In this configuration, the bioretention facility is sized to a minimum of 4% of the tributary impervious area. The underdrain and overflow from the bioretention facility are routed to a storage vault, which can be located beneath a plaza, sidewalk, or parking area. An orifice limits the rate of discharge from the vault to the storm drain system.

► CRITERIA

Bioretention facility. Size and design the bioretention facility to the treatment-only criteria (see Bioretention Facility design sheet, p. 66.)

Vault. Size the vault using Equation 3-3 (page 45) and the factors and rainfall adjustment equations in Tables 3-6 and 3-7. The vault must include an orifice or other device to limit outflow.

Dead storage in the bioretention facility (volume of the gravel pore space or other free volume below the elevation of the underdrain discharge) may be credited toward the required V_2 .

► DETAILS

Preventing mosquito harborage. Vaults must be designed to drain completely, leaving no standing water, and have an open bottom to allow infiltration into the native soil.

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

► APPLICATIONS

Parking lot. Because the required landscaped bioretention facilities is only 4% of the tributary impervious area, the bioretention component can in many cases be integrated into parking lot medians and islands. The vault component can be located beneath aisles or driveways.

► Best Uses

- To meet flow-control requirements in limited space
- Parking lots
- Dense urban areas

► Advantages

- Smaller footprint than bioretention facility sized for flow control

► Limitations

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



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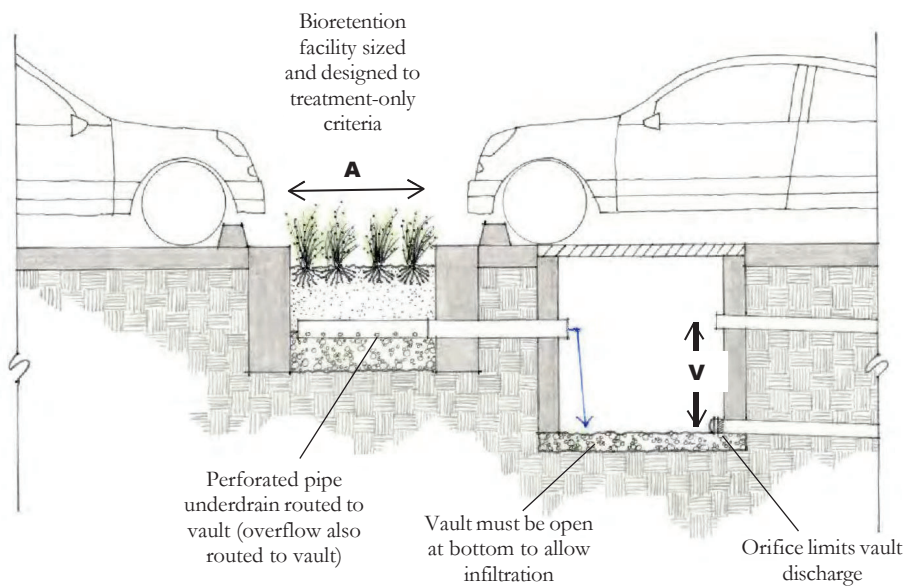
Multiple bioretention facilities draining to a single vault.

Two or more bioretention areas can be connected to a single vault. The vault minimum volume and outlet maximum flow rate are the sum of those calculated for each individual bioretention facility.

Vault with pumped discharge. Where insufficient head exists, vaults may be equipped with pumps to discharge (at a rate no greater than the calculated maximum) to a storm drain or approved discharge point.

Design Checklist for Bioretention + Vault

- Bioretention facility is designed to the treatment-only criteria in the “Bioretention Facility” design sheet (pp. 66-78).
- Vault retention volume meets or exceeds calculated minimum.
- Vault outlet with orifice or other flow-control device restricts flow to calculated maximum.
- Bioretention facility underdrain is routed to the vault.
- Bioretention facility overflow is routed to the vault.
- Sufficient head exists to convey flow from the underdrain to the vault and from the vault to the discharge point.
- Bottom of vault is open to allow infiltration.
- Vault design provides for exclusion of debris and accessibility for maintenance.
- Vault outlet and overflow are connected to a downstream storm drain or approved discharge point.
- Emergency spillage will be safely conveyed overland.



Design and Construction of Bioretention Facilities and Other Integrated Management Practices

*Guidance for preparing construction documents
and overseeing construction of IMPs*

Details of construction are critical to ensuring stormwater facilities work properly. A misplaced inlet, an overflow at the wrong elevation, or the wrong soil mix can make a bioretention facility useless or ineffective even before it comes on-line and could result in delays to project approvals and additional expense.

Your Stormwater Control Plan is intended for the planning phase and must contain, at minimum, enough detail to demonstrate your planned LID features and that facilities are feasible and are coordinated with the project site plan, architectural renderings, landscape design, grading and drainage plan, and other information submitted with your application for development approvals.

At plan check, reviewers will examine the construction documents to ensure the site design features and the construction of bioretention facilities and other IMPs will meet the criteria in this chapter and throughout the *Guidebook*.

Following are design sheets for:

- Self-treating and self-retaining areas,
- Pervious pavements,
- Bioretention facilities,
- Flow-through planters,
- Dry wells,

- Cisterns + bioretention, and
- Bioretention + vaults.

These design sheets include recommended configurations and conceptual details, and example applications, for these features and facilities. Additional designer notes and construction-level details for various site conditions are provided in the Typical Green Infrastructure Details within Appendix F. **The information in these design sheets and within the Typical GI Details must be adapted and applied to the conditions specific to the development project.** It is not acceptable to simply copy the information onto construction drawings. Local planning, building, and public works officials have final review and approval authority over the project design.

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

What to Show on Construction Plans

With few exceptions, the plan set should include separate sheets specifically incorporating the features and facilities described in the Stormwater Control Plan. The information on these sheets must be carefully coordinated and made consistent with grading plans, utility plans, landscaping plans, and (in many cases) architectural plans.

On the grading and drainage plan, or on a separate stormwater control plan sheet showing the grading and drainage plan (and possibly the roof plan) screened as background, show how DMAs follow grade breaks and are consistent with the grading plan and the Stormwater Control Plan.

► SHOW KEY ELEVATIONS

On the grading and drainage plan, or in a detailed plan view, call out the following elevations:

- Bottom of gravel layer (BGL, or the bottom of the excavation), top of gravel layer (TGL), and top of soil layer (TSL). Note that each of these is consistent (flat) throughout the facility.
- The top of curbs or walls surrounding the facility, and spot elevations of adjacent pavement.
- At curb cut inlets, show the top of paving, top of curb, and bioretention TSL.

- At overflow grates, show the grate elevation and the adjacent TSL.
- Call out elevations of piped inlets.

For treatment-and-flow-control IMPs, demonstrate how the minimum surface volume is attained by the design.

► **SHOW HOW RUNOFF FLOWS**

As needed for clarity, show the direction of runoff flow across roofs and pavement and into IMPs. For runoff conveyed via pipes or channels, show locations, slopes, and elevations at the beginning and end of each run.

For roof drainage, show the routing of roof leaders. Use drawings or notes to make clear how drainage from leaders is routed under walkways, across pavement, through drainage pipes, or by other means to reach the IMP.

Show pipes or channels connecting the IMP underdrain and overflow to the site drainage system, municipal storm drain system, or other approved discharge point. Call out slopes and key elevations.

► **SHOW IMPS IN CROSS-SECTION**

For many installations, a not-to-scale cross-section view can be used to illustrate the dimensions and placement of the soil and gravel layers, surrounding walls, and overflow structures. Where needed, use detailed, specific cross-section drawings to show edge treatments, inlet elevations, overflow grates, rock for energy dissipation, moisture barriers, and other information. The design of the edge treatments needs to consider pedestrian and vehicular loading on the wall and adjacent pavement surfaces, lateral support of the wall, impact of wall footings on the infiltrative footprint, lateral movement of subsurface water, and connections to adjacent infrastructure. Refer to the Typical GI Details provided in Appendix F for example facility sections and component details. The Typical GI Details provide a Designer Checklist at the beginning of each section that is helpful in ensuring that the construction plans include all of the key information needed for plan review and successful construction of the facility.

The design sheets shall be used as a general guide and the detail drawings and corresponding construction notes within the Typical GI Details can be used as a starting point for project-specific details. Do not just copy and paste any of the detail drawings and/or notes there on to your construction drawings.

► **ADD NOTES TO IMP DETAILS**

On cross-section drawings, incorporate the following notes (see pages 62 through 74).

- Gravel drainage layer shall be “Class 2 permeable,” Caltrans specification 68-2.02(F)(3).
- Soil mix shall meet “Specification of Soils for Biotreatment or Bioretention Facilities,” dated April 18, 2016.
- Mulch shall meet “Composted Wood Mulch Specification for Stormwater Biotreatment Areas,” dated August 1, 2021. ([Biotreatment Area Wood Mulch Specification](#))
- Underdrain shall be [4 inch minimum] Standard Dimensional Ratio (SDR) 35 or equivalent, perforations facing down. Lay in groove at top of gravel layer. A minimum of one cleanout shall be installed on the end of the underdrain to facilitate cleaning of the underdrain.
- Underlying soil is to be uncompacted and ripped to loosen to a minimum depth of 3 inches immediately prior to placement of the gravel drainage layer.
- If impermeable liner is required, the subgrade shall be prepared and contoured as necessary to provide a smooth surface, void of sharp rock/debris. No void spaces shall be present between the liner and the subgrade. Geotextile fabric may be installed between the subgrade and the liner to protect the liner from sharp aggregate present in the subgrade. Engineer shall inspect/approve the prepared subgrade prior to the installation of any overlying geotextile material.
- Final grades of bioretention soil shall include considerations for soil settlement and the maximum allowable drop down from the adjacent walking surfaces to the bottom of the planter.

What to Show on Landscaping Plans

Show the footprints of the IMPs precisely on the landscaping plan, consistent with the grading plan and other plans in the submittal.

Include a planting plan and an irrigation plan suitable for the soils and other special conditions of bioretention facilities. See page 93 for guidance on plantings and irrigation and the plant list in Appendix B for ideas on a plant palette.

Review and revise your landscaping general notes to ensure the notes are consistent with the special requirements of bioretention facilities.

Include the following notes on the landscaping plan sheets:

- No soil amendments, fertilizers, or synthetic pesticides are to be used within bioretention facilities. Use only approved bioretention soil mix and aged compost mulch.
- Maintain top of soil elevation following planting.

► **REFERENCES AND RESOURCES**

- San Francisco [*Stormwater Management Requirements and Design Guidelines*](#)
- Central Coast Low Impact Development Center [*Bioretention Standard Details and Specifications*](#)

Items to Be Inspected During Construction

Successful construction of IMPs requires attention to detail during **every stage** of the construction process, from initial layout to rough grading, installation of utilities, construction of buildings, paving, landscaping, and final cleanup and inspection.

Construction project managers need to understand the purpose and function of IMPs and know how to avoid common missteps that can occur during construction. For bioretention facilities, the following operating principles should be noted at a pre-construction meeting.

- Runoff flow from the intended tributary DMA must flow into the facility.
- The surface reservoir must fill to its intended volume during high inflows.
- Runoff must filter rapidly through the layer of imported soil mix.
- Filtered runoff must infiltrate into the native soil to the extent possible (or allowable).
- Remaining runoff must be captured and drained to a storm drain or other approved location.

See the model construction inspection checklist on the following pages.

IMP CONSTRUCTION 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 elevations of the facility are low enough and inlets 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 and are outside of the facility footprint
- 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 (typically no lower than two inches below facility rim)
- 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 inch openings recommended)
- Overflow is connected to storm drain via appropriately-sized piping
- Bottom of overflow structure has positive drainage into storm drain (no ponding)

UNDERGROUND CONNECTION TO STORM DRAIN/OUTLET ORIFICE
(to be confirmed prior to backfilling IMP 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 (treatment only) or orifice (treatment-and-flow-control)
- Underdrain pipe discharge invert elevation is at top of gravel layer elevation. Pipe is set holes facing down in a groove dug in the top of the gravel layer (In approved flow-through planters, underdrain elevation is as near bottom as possible)
- Cleanouts are in accessible locations and connected via sweeps
- Structures (arches or large diameter pipes) for additional surface storage are installed as shown in plans and specifications and have the specified volume

(continued on next page)

IMP CONSTRUCTION CHECKLIST (CONTINUED)

DRAIN ROCK/SUBDRAIN (to be confirmed prior to installation of soil mix)

Class 2 permeable, Caltrans specification 68-2.02(F)(3). 4-inch to 6-inch depth of pea gravel atop drain rock may be substituted with inspectors' approval
 Rock is smoothed to a consistent top elevation and depth and top elevation (TGL) are as shown in plans
 Perimeter curb is installed to prevent 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. Submittal is complete and quality of delivered mix is verified by visual and tactile examination and comparison to submitted sample
 Mix installed in 8-inch to 12-inch lifts
 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 inches minimum) and top elevation are as shown in plans, accounting for depth of mulch to follow and required reservoir depth (allow time for natural compaction and settlement prior to planting)

IRRIGATION

Irrigation system is installed so it can be controlled separately from other landscaped areas (smart irrigation controllers and drip emitters are recommended)
 Spray heads, if any, are positioned to avoid direct spray into outlet structures

PLANTING

Plants are installed consistent with approved planting plan
 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 to 2 inches of 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

DMAs are free of construction sediment and 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

Bioretention Soil Submittals

Bioretention soils must meet the region-wide “[Specification of Soils for Biotreatment or Bioretention Facilities](#)” (2016).

At their sole discretion, municipal construction inspectors may choose to accept test results and certification for a “brand name” mix from a soil supplier. Tests must be conducted within 120 days prior to the date soil is delivered to the project site. Batch-specific test results are required for projects that install more than 100 cubic yards of soil mix.

Submittals, whether for the “brand name” mix or batch-specific, must include a minimum 1-gallon sample and the completed CCCWP Bioretention Soil Mix Specification Submittal Verification Checklist.

The inspector should examine by look and feel each delivery of the soil mix prior to installation and verify the following:

- The delivered mix closely resembles the submitted mix.
- The mix has a grainy, gritty texture and does not clump when dry.
- If formed in the hand when damp, the mix may be slightly spongy but breaks apart easily.
- After manipulating the mix, there is no smearing or discoloration on the hand.

Operation & Maintenance of Stormwater Facilities

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

Stormwater NPDES Permit Provision C.3.e requires each municipality verify stormwater treatment and flow-control facilities, and impervious pavement installations 3,000 ft² and greater in area, are adequately maintained. Municipalities must report the results of inspections to the Water Board annually.

Facilities you install as part of your project will be incorporated into the local municipality's verification program. This is a six-stage process:

1. Determine **who will own** the facility and be responsible for its maintenance in perpetuity and document this in your Stormwater Control Plan. The Stormwater Control Plan must also identify the means by which ongoing maintenance will be assured (for example, a maintenance agreement that runs with the land).
2. Identify typical maintenance requirements, allow for these requirements in your project planning and preliminary design, and document the typical maintenance requirements in your Stormwater Control Plan.
3. Prepare an **Operations and Maintenance Plan** (O&M Plan) for the site incorporating detailed requirements for **each treatment and flow-control facility**. Typically, a draft O&M Plan must be submitted with the building permit application, and a final O&M Plan must be submitted for review and approved by the municipality prior to building permit final and issuance of a certificate of occupancy. Local requirements vary as to schedule. Check with municipal staff.
4. **Maintain** the facilities from the time they are constructed until ownership and maintenance responsibility is formally transferred.

5. **Formally transfer** operation and maintenance **responsibility** to the site owner or occupant. A warranty, secured by a bond, or other financial instrument, may be required to secure against lack of performance due to flaws in design or construction. A typical warranty period should be consistent with local municipality requirements.
6. Maintain the facilities in perpetuity and comply with your municipality’s self-inspection, reporting, and verification requirements.

See the schedule for these stages in Table 5-1. **Again, local requirements will vary.**

TABLE 5-1. SCHEDULE FOR PLANNING OPERATION AND MAINTENANCE OF STORMWATER TREATMENT AND FLOW-CONTROL FACILITIES

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

Stage 1: Ownership and Responsibility

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

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

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

Ownership and maintenance responsibility for treatment and flow-control facilities should be discussed at the **beginning of project planning**, typically at the pre-application meeting for planning and zoning review. Experience has shown provisions to finance and implement maintenance of treatment and flow-control facilities can be a major stumbling block to project approval, particularly for **small residential subdivisions**. (See “Applying C.3 to New Subdivisions” in Chapter 1.)

► **PRIVATE OWNERSHIP AND MAINTENANCE**

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

The CCCWP has prepared the following model agreements:

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

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

The model agreements provide the municipality may collect a management and/or inspection fee established by the standard fee schedule. In addition, the agreements provide that, if the property owner fails to maintain the stormwater facility, the municipality may enter the property, restore the stormwater facility to good working order, and obtain reimbursement, including administrative costs, from the property owner.

To augment and enforce maintenance requirements, the County established a two-tiered Community Facilities District (Mello-Roos) throughout the unincorporated area to cover the costs of inspections, reporting to the Water Board and, if necessary, code enforcement and maintenance and repair of individual facilities. Some cities and towns may have similar districts.

► **TRANSFER TO PUBLIC OWNERSHIP**

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

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

Local Requirements
Cities, towns, or the County may have requirements that differ from, or are in addition to, this countywide Guidebook. See Appendix A and check with local planning and community development staff.

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

Stage 2: General Maintenance Requirements

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

- Ongoing costs of maintenance have been considered in your facility selection and design.
- Site and landscaping plans provide for access for inspections and by maintenance equipment.

- Landscaping plans incorporate irrigation requirements for facility plantings.
- Initial maintenance and replacement of facility plantings is incorporated into landscaping contracts and guarantees.

A fact sheet available on the CCCWP C.3 web page describes general maintenance requirements for bioretention facilities.

Stage 3: Stormwater Facilities O&M Plan

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

Your O&M Plan must be submitted to and approved by your municipality before your building permit can be made final and a certificate of occupancy issued.

Your O&M Plan must be kept onsite for use by maintenance personnel and during site inspections. It is also recommended that a copy of the Stormwater Control Plan be kept onsite as a reference.

MRP 3.0 Provision C.3.h requires Contra Costa municipalities periodically verify operations and maintenance (O&M) of facilities installed in their jurisdiction. Each year, they must report to the Water Board the facilities inspected that year and the status of each.

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

► TOOLS AND ASSISTANCE

The following step-by-step instructions—and forms available on the [CCCWP website](#)—will help you prepare your O&M Plan. You may use, adapt, and assemble these documents to prepare your own O&M Plan, which will be customized to the specific needs of your site.

The available tools and assistance includes:

- A form for stating or updating key contact information for responsible individuals.
- A format for an Inspection and Maintenance Log.

- Sample contents of an inspector’s report.
- A Fact Sheet incorporating a suitable maintenance plan for bioretention facilities and flow-through planters.

Additional useful references, including links to additional documents, are available in “References and Resources” at the end of this chapter.

► **YOUR O&M PLAN: STEP BY STEP**

The following step-by-step guidance will help you prepare each required section of your O&M Plan.

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

► **STEP 1: DESIGNATE RESPONSIBLE INDIVIDUALS**

To begin creating your O&M Plan, your organization must designate and identify:

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

It is recommended to use the form available on the [CCCWP website](#) to list this information. **Updated contact information must be provided to the municipality immediately whenever a property is sold and whenever designated individuals or contractors change.** Complete a new form—and send a copy to the municipality—whenever this occurs.

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

Describe how **funding for** O&M will be assured, including sources of funds, budget category for expenditures, process for establishing the annual maintenance budget, and the process for obtaining authority should unexpected expenditures for major corrective maintenance be required.

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

► **STEP 2: SUMMARIZE DRAINAGE AND BMPS**

Incorporate the following information from your Stormwater Control Plan into your O&M Plan:

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

Review the Stormwater Control Plan narrative that describes each facility and its tributary drainage area and update the text to incorporate any changes that may have occurred during planning and zoning review, building permit review, or construction. Incorporate the updated text into your O&M Plan.

► **STEP 3: DOCUMENT FACILITIES “AS BUILT”**

Include the following information from final construction drawings:

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

In the final O&M Plan, incorporate field changes to design drawings, including changes to any of the following:

- Location and layouts of inflow piping, flow splitter boxes, and piping to offsite discharge.
- Depths and layering of soil, sand, or gravel.

- Placement of filter fabric or geotextiles (not recommended between soil and gravel layers of bioretention facilities).
- Changes or substitutions in soil or other materials.
- Natural soils encountered (e.g. sand or clay lenses).

► **STEP 4: PREPARE CUSTOMIZED MAINTENANCE PLANS**

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

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

- Specific information noted in Steps 2 and 3, above.
- Other input from the facility designer, municipal staff, or other sources.
- Operation and Maintenance Fact Sheet for Bioretention Facilities and Flow-through Planters (available on the [C.3 Web Page](#))

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

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

- Pumps or other mechanical equipment.
- Proprietary devices used as or in conjunction with BMPs.

Manufacturers' publications should be referenced in the text (including models and serial numbers where available). Copies of the manufacturers' publications should be included as an attachment in the back of your O&M Plan or as a separate document.

► **STEP 5: COMPILE O&M PLAN**

Your O&M Plan should follow this general outline:

- I. Inspection and Maintenance Log
- II. Updates, Revisions and Errata

III. Introduction

- A. Narrative overview describing the site; drainage areas, routing, and discharge points; and treatment and flow control facilities

IV. Responsibility for Maintenance

A. General

- (1) Name and contact information for responsible individual(s)
- (2) Organization chart or charts showing organization of the maintenance function and location within the overall organization
- (3) Reference to Operation and Maintenance Agreement (if any). A copy of the agreement should be attached
- (4) Maintenance Funding
 - (a) Sources of funds for maintenance
 - (b) Budget category or line item
 - (c) Description of procedure and process for ensuring adequate funding for maintenance

B. Staff Training Program

C. Records

D. Safety

V. Summary of Drainage Areas and Stormwater Facilities

A. Drainage Areas

- (1) Drawings showing pervious and impervious areas (copied or adapted from Stormwater Control Plan)
- (2) Designation and description of each drainage area and how flow is routed to the corresponding facility

B. Treatment and Flow Control Facilities

- (1) Drawings showing location and type of each facility
- (2) General description of each facility (Consider a table if more than two facilities)
 - (a) Area drained and routing of discharge
 - (b) Facility type and size

VI. BMP Design Documentation

- A. “As-built” drawings of each facility (design drawings in the draft O&M Plan)
- B. Manufacturers’ data, manuals, and maintenance requirements for pumps, mechanical or electrical equipment, and proprietary facilities (include a “placeholder” in the draft plan for information not yet available)
- C. Specific operation and maintenance concerns and troubleshooting

VII. Maintenance Schedule or Matrix

- A. Maintenance Schedule for each facility with specific requirements for:
 - (1) Routine inspection and maintenance
 - (2) Annual inspection and maintenance
 - (3) Inspection and maintenance after major storms
- B. Service Agreement Information

Assemble and make copies of your O&M Plan. One or more copies must be submitted to the municipality, and at least one copy kept on site. Here are some suggestions for formatting the O&M Plan:

- Format plans to 8½ by 11 inches to facilitate duplication, filing, and handling.
- Include the revision date in the footer on each page.
- Scan graphics and incorporate with text into a single electronic file. Keep the electronic file backed-up so that copies of the O&M Plan can be made if the hard copy is lost or damaged.

► **STEP 6: UPDATES**

Your O&M Plan will be a living document.

O&M personnel may change; mechanical equipment may be replaced, and additional maintenance procedures may be needed. Throughout these changes, the O&M Plan must be kept updated.

Updates may be transmitted to your municipality at any time. However, at a minimum, updates to the O&M Plan must accompany the annual inspection report. These updates should reference the sections of the O&M Plan being changed and should be placed in reverse chronological order (most recent at the top) in Section II of the binder. If the entire O&M Plan is updated, as it should be from time to time, these updates should be removed from the first section, but may be filed (perhaps in the back of the binder) for possible future reference.

Stage 4: Interim Operation & Maintenance

In accordance with MRP 3.0 Provision C.3.e.ii, include the following statement in your Stormwater Control Plan:

The property owner 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.

Applicants will typically be required to warranty stormwater facilities against lack of performance due to flaws in design or construction following completion of construction. The warranty may need to be secured by a bond or other financial instrument. The warranty should be consistent with local municipality requirements.

Stage 5: Transfer Responsibility

As part of the final O&M Plan, note the expected date when responsibility for operation and maintenance will be transferred. Notify your municipality when this transfer of responsibility takes place.

Stage 6: Operation & Maintenance Verification

Each Contra Costa municipality implements a Stormwater Treatment Measures Operation and Maintenance Verification Program, including periodic site inspections.

Local stormwater ordinances state municipalities may require an annual certificate of compliance certifying operations and maintenance of treatment and flow-control

facilities. To obtain a certificate of compliance, the responsible party must request and pay for an inspection from the municipality each year. Alternatively, owners or lessees may arrange for inspection by a private company authorized by the municipality. Based on the results of the inspection, the municipality may issue a certificate, issue a conditional certificate requiring correction of noted deficiencies by a specific date, or deny the certificate.

Some municipalities have established alternative procedures. Check with local staff for requirements.

Design to Minimize Long-Term Maintenance

The design criteria on page 111 have been developed and refined, based on accumulated experience, to ensure constructed bioretention facilities are robust and resilient. When properly designed and constructed, bioretention facilities require little intervention beyond cleanup, pruning, and occasional replanting, at a level of effort similar to that required for any vegetated area.

Table 5-2 on the following page identifies how certain design criteria optimize operation and minimize long-term maintenance needs.

► TYPICAL MAINTENANCE PROGRAM

The Stormwater Facility Operation and Maintenance Fact Sheet: Bioretention Facilities and Flow-through Planters is available on CCCWP's Stormwater C.3 Guidebook web page. The fact sheet provides a typical maintenance program for bioretention facilities. The same typical maintenance program is incorporated into the template, also available on CCCWP's Stormwater C.3 Guidebook web page, for a Stormwater Facility O&M Plan.

The typical maintenance program includes:

- General maintenance rules, including a prohibition on using synthetic fertilizers, pesticides, or any soil amendments other than aged compost mulch or the approved sand/compost mix.
- Routine trash removal and weeding.
- Observations and corrections following significant rain events.
- Annual vegetation and other maintenance during winter.
- Inspection prior to the start of the rainy season

TABLE 5-2. SUMMARY OF DESIGN CRITERIA adopted to ensure facility longevity and reduce required maintenance.

<i>Feature</i>	<i>Page #</i>	<i>Operation and Maintenance-Related Benefit</i>
Facility is in a high-visibility, well-trafficked location		Facility is valued for aesthetic and other ancillary benefits and is more likely to be maintained consistently
In subdivisions, facility is in an accessible common area and not on an individual lot		Avoids potential alterations to facility after construction and resulting conflicts with individual homeowners over need to restore the facility to original condition.
Consistent cross-section, configuration, and specifications for all bioretention facilities throughout County		Facilitates inspection, evaluation, and repairs if needed.
Soil mix specification		Avoids infiltration failure and ensures minimum infiltration rate (facility treatment capacity) is achieved over the long term.
Underdrain pipe specifications		Discharge elevation at top of gravel layer maximizes amount of treated runoff that is stored and infiltrated. Holes facing down prevents accumulation of soil within the underdrain pipe. Specified pipe can be rooted if needed.
Plants are required		Plant roots and associated biological activity keep soil pores open, facilitating percolation and preventing blinding/clogging of the surface and resulting loss of infiltration capacity. Aesthetic qualities of planted areas help ensure owners' attention to and engagement with the facility. Biological activity helps break down and/or immobilize pollutants.
Gravel (Class 2 permeable) specification		Resists migration of fines from overlying soil mix, eliminates need for filter fabric (which tends to clog) or additional layer atop gravel.
Top of soil elevation is flat		Maximizes surface reservoir, avoids rills in mulch and in bioretention soil mix that result from flow.
Overflow is precast concrete with frame and grate		Helps ensure overflow is at proper elevation, which ensures ponding, rather than flow, across the entire facility surface. Resistant to accidental damage (compared to an upturned plastic pipe).
Concrete curb or other hardscaped rim delineates edge of facility		Clearly shows facility boundary to guide landscape maintenance crews. Helps prevent fine sediments from adjacent slopes from entering the bioretention soil mix.

► **REFERENCES AND RESOURCES**

- *Model Stormwater Ordinance* (CCCWP, 2005)
- *Start at the Source* (BASMAA, 1999) pp. 139-145.
- *Urban Runoff Quality Management* (WEF/ASCE, 1998). pp 186-189.
- Contra Costa Clean Water Program *Vector Control Plan*

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Retrofitting with Green Infrastructure

*How to identify and evaluate opportunities to integrate
LID features and facilities into existing drainage systems*

Retrofitting streets and paved areas with LID is difficult. Elevations and grades are fixed constraints—unlike a new development or fully redeveloped site, where the layout and grades of future buildings, pavement, and landscape can be adjusted during the design.

Some built locations present striking opportunities for retrofit. For many other locations, retrofitting with LID is a practical impossibility.

In a retrofit, options for LID are mostly the same as in a land development project:

- Convert impervious areas to landscape.
- Replace impervious pavement with pervious pavement.
- Disperse runoff from impervious areas to landscaped areas.
- Intercept flow in an existing swale, gutter, or pipe, direct it to a bioretention facility, and direct the underdrain and overflow from the bioretention facility to a downstream storm drain, culvert, or swale.

Design guidance and criteria for these features and facilities are in Chapter 4. Further design guidance can be found in references cited at the end of this chapter.

This chapter will help guide the process of identifying and evaluating LID opportunities in the built landscape.

Project Identification

The most cost-effective projects involve dispersing runoff from paved areas to **self-retaining areas** via sheet flow, gutters, swales, or pipes. The receiving self-retaining area needs to be large enough—the 2:1 impervious-to-pervious ratio applies—and lower than the low point of the tributary impervious area. In an urban setting, such potential opportunities are rare. When found, as they sometimes are along landscaped medians or shoulders of suburban arterial roadways, or in plazas, parks, and golf courses, the opportunity should be investigated.

More typically, runoff from an existing catchment is diverted from the street or gutter to a **bioretention facility** built at or near an existing storm drain inlet.

Follow these Steps

To identify and evaluate Green Infrastructure retrofit opportunities, follow these steps:

1. Locate the low points (usually existing storm drain inlets).
2. Review existing and potential landscape use adjacent to low points.
3. Evaluate the tributary catchment.
4. Calculate minimum sizes of the planned LID feature or facility.
5. Sketch and evaluate a preliminary footprint of the feature or facility.
6. Check facility inlet and outlet elevations.

► STEP 1: LOCATE LOW POINTS

Existing conventional drainage systems typically convey runoff via sheet flow and gutters to storm drain inlets, which connect to underground pipes. These storm drain inlets are candidate locations for LID features and facilities. Sometimes the storm drain inlet itself can be repurposed as a bioretention facility overflow with the same grate elevation.

Many municipal utility maps and geographic information system (GIS) maps include the location and size of storm drain pipes, but unfortunately do not typically include storm drain inlets. This makes the maps of little use for green infrastructure planning. Fortunately, inlet locations can often be found using satellite and street view imagery available online. A site visit may be needed to confirm inlet locations, particularly if street curbs and parking lots are parked up in the images.

► STEP 2: REVIEW AREAS ADJACENT TO LOW POINTS

Most low points (typically storm drain inlets) are in locations where it isn't practical to retrofit the surrounding area for bioretention.

- Many storm drain inlets are near street intersections—where sidewalks, pedestrian crossings, utilities, and other uses converge, and space is at a premium.
- In parking lots, inlets are typically centered in the drive aisle.

Traffic medians and islands are often, but not always, located at high points within the right-of-way and are rarely adjacent to storm drain inlets.

Some situations where inlet locations may create retrofit opportunities:

- Excessive street width.
- Wide parkway strip.
- Abandoned turn lane or other lane.
- Unused right-of-way at oddly configured intersection.
- Triangular area within a roadway gore (nose).
- Street narrowed (or to be narrowed) for pedestrian crossing (bulb-out).
- Adjacent to a park or green space.
- Adjacent to a utility easement
- Unused/abandoned right-of-way, for example, from a realigned roadway or former streetcar line.

Existing drainage swales or ditches, including short runs between culverts, are typically ineligible to be converted for bioretention treatment because of restrictions in Clean Water Act Sections 401 and 404.

► STEP 3: EVALUATE THE TRIBUTARY CATCHMENT

Once a potential location for a bioretention facility has been identified, the next step is to determine whether the facility can be sized adequately to receive the amount of runoff draining to that location.

Storm drain inlets are seldom shown on municipal utility maps, and the areas tributary to each inlet are generally not mapped. Typically, it is necessary to survey and evaluate each catchment in the field.

Catchment boundaries may be easy or difficult to discern. A field visit is typically required, especially in areas with older infrastructure. On a street with a gradient, an upgradient storm drain inlet may mark a boundary. Street crowns are usually catchment boundaries, and are mostly, but not always, at the street centerline. In flatter terrain, it may be helpful to use a rotating laser level to find high points along a gutter line or to locate an off-center crown.

In neighborhoods built before about 1980, especially on alluvial slopes (common in the San Francisco Bay Area), one storm drain inlet may receive runoff from an entire block in a street grid. Or there may be additional inlets which were apparently added later to solve nuisance flooding at low points. Also, look for concrete swales connecting the drainage from the low corner of one block to the next block downgradient.

The catchment typically extends to a grade break at the back of sidewalk. However, in low-density residential neighborhoods, and in older commercial/industrial neighborhoods, parcels may be configured to drain to the gutter via curb outlets or via sheet flow over driveways. Look for these features to ascertain whether to include the parcels in the tributary area. Estimate the relative imperviousness of the parcel (typically 85-100% for commercial/industrial and 35-50% for low-density residential).

To quickly estimate the catchment area, trace catchment boundaries in Google Earth or other GIS.

► STEP 4: CALCULATE MINIMUM FACILITY SIZES

For potential self-retaining areas, size at one-half the tributary equivalent impervious area.

For bioretention facilities, multiply the tributary equivalent impervious area by 0.04. This size is generally workable in parking lots, where stalls can be reconfigured or eliminated to accommodate the facility.

Reduced sizing (less than 4% of tributary equivalent impervious area) can only be used for road reconstruction projects that follow requirements outlined in MRP 3.0 Provision C.3.b.ii (5)(c), or that are non-regulated projects under C.3.b. For projects that meet these requirement, bioretention sizing can be calculated using the following sizing factor:

$$\text{Sizing Factor} = 0.00060 \times \text{MAP} + 0.0086$$

Where MAP=Mean Annual Precipitation in inches, per Contra Costa County Public Works Figure B-166.

This will provide a reasonable range for trial-sizing bioretention facilities to treat impervious area drainage. Larger facilities will overflow less frequently and will

provide more robust performance over time. However, the reduced sizing factor calculation for bioretention facilities does not satisfy full trash capture requirements.

► **STEP 5: SKETCH AND EVALUATE A PRELIMINARY FACILITY FOOTPRINT**

Edges—transitions between the bioretention soil surface and the surrounding pavement—are often challenging design problems. Each facility requires its own solutions. Here are some problems and considerations that are often encountered:

- Slopes. The standard street section descends from crown to curb and rises again to back of sidewalk. The street may slope in the longitudinal direction as well. A bioretention facility typically requires that the top-of-soil be flat and six inches below the elevation of the existing storm drain inlet. As a result, the transition to the surrounding street and/or sidewalk requires a perimeter curb or wall. Depending on the drop to the top of soil, perimeter curbs or fences may be required to prevent vehicles or pedestrians from falling into the facility. It is useful to estimate the required wall heights when first envisioning how the bioretention facility might fit into the existing topography. This can be done in the field by checking existing elevations around the perimeter with a rotating laser level and rod.
- Traffic control. For bioretention facilities built as sidewalk extensions or bulb-outs, the shape of the transition within the lane may be specified by municipal standards.
- Compatibility with plans for multi-modal transportation. Planned upgrades to the street configuration—for traffic calming, road diet, bike lanes, or “complete streets”—may conflict with the ideal bioretention facility footprint. Bioretention facilities typically need to be at the gutter, either extending into a parking lane or straddling the existing curb and also replacing some parkway strip. Many bike lane configurations use this same alignment along the gutter.
- Property ownership or control. Whether to pursue a green infrastructure retrofit at the location may depend on the quality of working relationships with private parties, utilities, or other agencies having jurisdiction. Sometimes the area near a storm drain (or even at the storm drain) seems within the public right-of-way but is on a privately owned parcel—or the area is under the jurisdiction of a municipal department other than transportation, such as a parks department or surplus lands. And sometimes the opportunity may exist to divert runoff to landscaped area within an existing utility easement, or to extend a bioretention facility into the easement.

- Access for maintenance. Routine maintenance of bioretention facilities requires the same tools and access as for other landscaping. Maintenance access can be an issue for facilities on arterial streets, especially if a temporary lane closure is required.
- Water for irrigation. While not a requirement, an available connection to water expands the choices of plant palette.
- Utility conflicts. Existing subsurface utility lines can sometimes be moved. Sometimes, utilities can be left in place and a bioretention facility built around the line. However, large-diameter pipes or ducts can make building at an otherwise promising location impracticable. And any occurrence of utilities within the potential facility’s footprint will add to project costs and potential delays.

Design, Construction, and Maintenance

Detailed design, construction, and maintenance of retrofit bioretention facilities—including street retrofits—are generally the same as for facilities in newly developed or redeveloped sites. For criteria and requirements, see Chapters 4 and 5 in this *Guidebook*.

For additional design resources, including example details useful for integration into streets and streetscapes, see the references and resources below and on the [CCCWP Green Infrastructure Planning Resources webpage](#).

► REFERENCES AND RESOURCES

- Chapter 4, Design and Construction of Bioretention Facilities and Other Integrated Management Practices
- Chapter 5, Operation and Maintenance of Stormwater Management Facilities
- San Francisco Public Utilities Public Utilities Commission [Stormwater Management Requirements and Design Guidelines Appendix B: Typical Details](#)
- CASQA/Central Coast Low Impact Development Institute [Standard LID Design Plans and Specifications](#)
- City of San Jose [Green Stormwater Infrastructure Maintenance Field Guide](#)

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Local Exceptions and Additional Requirements

*Municipality-specific procedures, policies, and submittal requirements.
Obtain from your municipal planning and community development department.*

The [Contra Costa Clean Water Program C.3 web page](#) includes links to each Contra Costa municipality's C.3 information.



Plant Recommendations for Bioretention Facilities and Planter Boxes

Appendix B — Plant Recommendations for Bioretention Facilities and Planter Boxes

Grasses and Grass-like Plants															
Scientific name Common name	Light Preference			Size (feet)		Watering				Tolerates				CA Native	Other Notes
	Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Flood	Wind		
<i>Bromus carinatus</i> California brome	✓			2	1	✓			ok	✓		✓	✓	✓	
<i>Bouteloua gracilis</i> blue grama	✓			1.5	1	✓				✓		✓	✓		Tolerates no summer water, good for non-irrigated remote sites
<i>Carex densa</i> dense sedge	✓			1	1		✓	✓	✓	✓		✓		✓	
<i>Carex obnupta</i> slough sedge	✓			2	1		✓	✓	✓	✓	✓	✓	✓	✓	
<i>Carex praegracilis</i> clustered field sedge	✓	✓		1.5	1.5		✓	✓	✓	✓	✓	✓	✓	✓	
<i>Carex subfusca</i> rusty sedge	✓	✓		1	1		✓		ok	✓	✓	✓	✓	✓	Great for swales
<i>Carex divulsa</i> Berkeley sedge		✓	✓	1	1		✓		ok		✓	✓	✓	✓	AKA <i>Carex tumulicola</i> , Full sun along coast.
<i>Deschampsia cespitosa</i> tufted hairgrass	✓			2	1		✓		ok			✓	✓	✓	Can look weedy
<i>Distichlis spicata</i> salt grass	✓			0.3	3		✓	✓	✓	✓	✓	✓	✓	✓	Looks like bermuda grass, withstands foot traffic, for soils with high salt
<i>Eleocharis palustris</i> creeping spikerush	✓			1	1		✓	✓	ok	✓	✓	✓	✓	✓	
<i>Elymus glaucus</i> blue wildrye	✓			1.5	2		✓	✓	ok	✓	✓	✓	✓	✓	good for grazing, difficult to mow, messy looking lawn
<i>Festuca californica</i> California fescue	✓	✓	✓	2	2	✓			ok	✓	✓		✓	✓	
<i>Festuca idahoensis</i> Idaho fescue	✓	✓		1	1	✓	✓		ok	✓	✓		✓	✓	Can mow. Needs light summer water at hot sites
<i>Festuca rubra</i> red fescue	✓	✓		1	1.5	✓	✓		ok	✓	✓	✓	✓	✓	Can mow. Lawn alternative
<i>Festuca rubra</i> 'molate' molate fescue	✓	✓		1	1.5	✓	✓		ok	✓	✓		✓	c	Can mow. Lawn alternative

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Scientific name Common name	Light Preference			Size (feet)		Watering				Tolerates				CA Native	Other Notes
	Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Flood	Wind		
<i>Hordeum brachyantherum</i> meadow barley	✓	✓		1.5	1		✓	✓	ok	✓	✓		✓	✓	
<i>Juncus patens</i> blue rush	✓			2	1		✓	✓	✓	✓		✓		✓	
<i>Leymus triticoides</i> creeping wildrye	✓	✓		3	1	✓	✓		ok	✓	✓	✓	✓	✓	Can mow. Recommended for swales.
<i>Melica californica</i> California melica	✓	✓		1	1	✓				✓			✓	✓	
<i>Melica imperfecta</i> melic	✓	✓		1	1	✓			ok		✓	✓		✓	Part shade inland, light water in Summer to keep green or goes dormant
<i>Muhlenbergia rigens</i> deergrass	✓			3	3	✓	✓		ok	✓		✓		✓	
<i>Nasella pulchra</i> purple needlegrass	✓	✓		2	1	✓	✓		ok	✓		✓	✓	✓	
<i>Nassella lepida</i> foothill needlegrass	✓	✓	✓	1.5	1	✓	✓		ok	✓	✓		✓	✓	
<i>Phalaris californica</i> California canarygrass		✓	✓	1.5	1		✓	✓	ok		✓	✓	✓	✓	Can be aggressive spreader

Appendix B — Plant Recommendations for Bioretention Facilities and Planter Boxes

Herbaceous Perennials and Groundcovers															
Scientific name Common name	Light Preference			Size (feet)		Watering				Tolerates				CA Native	Other Notes
	Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Flood	Wind		
<i>Achillea filipendulina</i> fernleaf yarrow	✓			3	3	✓			✓	✓					
<i>Achillea millefolium</i> common yarrow	✓			1.5	1	✓			ok	✓				✓	Good for hot sites
<i>Achillea tomentosa</i> woolly yarrow	✓	✓		1	1.5	✓	✓		ok	✓			✓		
<i>Aloe striata</i> coral aloe	✓	✓		2	2	✓			ok						Sun along coast, afternoon shade inland
<i>Arctostaphylos hookeri</i> Monterey manzanita	✓	✓		1	4	✓	✓		ok		✓		✓	✓	Better in part shade in hot sites
<i>Arctostaphylos uva-ursi</i> kinnick-kinnick	✓	✓		1	15	✓	✓		ok		✓		✓	✓	Full sun at coast, part shade inland. Cultivars to try include 'emerald carpet,' 'Point Reyes,' 'San Bruno Mountain' depending on site
<i>Ceratostigma plumbaginoides</i> dwarf plumbago		✓		0.75	5	✓	✓		✓	✓					
<i>Epilobium canum</i> California fuchsia	✓	✓		1	4	✓			ok					✓	
<i>Eriogonum fasciculatum</i> flattop buckwheat	✓			3	4	✓				✓				✓	
<i>Eschscholzia californica</i> California poppy	✓			1	1	✓			ok	✓	✓	✓	✓	✓	
<i>Fragaria chiloensis</i> beach strawberries	✓	✓	✓	0.3	2	✓			ok		✓			✓	
<i>Gazania spp.</i> treasure flower	✓			0.5	2	✓	✓		✓	✓			✓		
<i>Iris douglasiana</i> Douglas iris	✓	✓		1.5	2	✓	✓		ok	✓			✓	✓	Also, Iris hybrids

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<i>Scientific name</i>	Light Preference			Size (feet)		Watering				Tolerates				CA Native	Other Notes
	Common name	Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Flood		
<i>Lotus scoparius</i> deerweed	✓				4	3	✓				✓		✓		✓
<i>Lupinus bicolor</i> miniature lupine	✓				1	1	✓					✓	✓		✓ Adds nitrogen
<i>Mimulus aurantiacus</i> common monkeyflower	✓	✓			3	3	✓			ok			✓		✓
<i>Mimulus cardinalis</i> scarlet monkeyflower	✓	✓	✓		3	3		✓	✓	✓			✓		✓ Aggressive seeder
<i>Polygonum capitatum</i> pink knotweed	✓	✓			0.5	4	✓			✓	✓	✓		✓	
<i>Prunella vulgaris</i> self heal	✓	✓					✓	✓		ok		✓	✓	✓	✓
<i>Rudebeckia californica</i> California coneflower	✓				3	2	✓	✓		ok	✓		✓		✓
<i>Salvia clevelandii</i> Cleveland sage							✓								
<i>Scaevola 'mauve clusters'</i> fan flower	✓	✓			1	4	✓				✓			✓	
<i>Sedum spathulifolium</i> stone crop	✓						✓			ok	✓			✓	varies For above the high water line
<i>Sisyrinchium bellum</i> blue eyed grass					1	1	✓			ok	✓	✓	✓	✓	✓
<i>Sisyrinchium californicum</i> yellow eyed grass	✓	✓			1	1		✓		✓	✓	✓	✓	✓	✓
<i>Solidago californica</i> California goldenrod		✓			3	2	✓	✓		ok	✓		✓		✓
<i>Stachys byzantine</i> lamb's ears	✓	✓			1	3	✓			ok	✓	✓		✓	
<i>Verbena tenuisecta</i> moss verbena	✓				0.5	5	✓			ok	✓	✓		✓	

Appendix B — Plant Recommendations for Bioretention Facilities and Planter Boxes

Small Shrubs															
Scientific name Common name	Light Preference			Size (feet)		Watering				Tolerates				CA Native	Other Notes
	Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Flood	Wind		
<i>Artemisia californica</i> California sagebrush	✓			2-5	4-5	✓				✓	✓		✓	✓	Will not tolerate sprinklers
<i>Baccharis pilularis</i> 'Twin Peaks' or 'Pigeon Point' dwarf coyote brush	✓			2	6	✓	✓		ok	✓	✓	✓	✓	c	
<i>Cistus skanbergii</i> hybrid rockrose	✓			3	5	✓	✓		✓	✓	✓	✓	✓		Best with annual shearing
<i>Correa</i> 'Carmine Bells' or 'ivory bells' Australian fuchsia	✓	✓		3	6	✓	✓		✓	✓			✓		Ivory bells does not tolerate wind. Attracts hummingbirds. Sunset Zones 16-17 (not recommended for E. Contra Costa)
<i>Erigeron glaucus</i> seaside daisy	✓			1	1.5				ok		✓			✓	
<i>Eriogonum crocatum</i> saffron buckwheat	✓			1.5	1.5	✓				✓	✓		✓	✓	
<i>Eriogonum umbellatum</i> sulfur buckwheat	✓			0.7	3	✓			ok	✓			✓	✓	
<i>Grevillea lanigera</i> woolly grevillea	✓			4	6	✓				✓			✓		Sunset Zones 15-24 (not recommended for E. Contra Costa)
<i>Lavendula</i> spp. lavender	✓			1.5	1.5	✓			ok	✓	✓				
<i>Mahonia pinnata</i> California holly grape	✓	✓	✓	4	4	✓	✓			✓		✓	✓	✓	
<i>Mahonia repens</i> creeping Oregon grape	✓	✓		2	3	✓	✓		ok		✓	✓		✓	
<i>Rosmarinus officinalis</i> rosemary	✓			2.5	5	✓			✓	✓	✓		✓		
<i>Rubus ursinus</i> California blackberry		✓	✓	3	5		✓	✓	ok	✓	✓	✓	✓	✓	Thorns. Harbors beneficial insects

Appendix B — Plant Recommendations for Bioretention Facilities and Planter Boxes

Small Shrubs															
Scientific name Common name	Light Preference			Size (feet)		Watering				Tolerates				CA Native	Other Notes
	Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Flood	Wind		
<i>Symphoricarpos albus</i> common snowberry	✓	✓	✓	4	4	✓	✓	✓	ok	✓				✓	Adaptable to many conditions
<i>Westringia fruticosa</i> coast rosemary	✓			4	8	✓				✓	✓		✓		
<i>Whipplea modesta</i> whipplevine		✓	✓	0.5	3		✓	✓	✓		✓	✓		✓	Sunset zones 16-17, 19-24 only (not recommended E. Contra Costa), best for moist shady spots
Large Shrubs															
Scientific name Common name	Light Preference			Size (feet)		Watering				Tolerates				CA Native	Other Notes
	Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Flood	Wind		
<i>Alyogyne huegelii</i> blue hibiscus	✓			6	5	✓				✓					Very low water after second year, Sunset zones 15-17 & 20-24 (not recommended E. Contra Costa)
<i>Arctostaphylos densiflora</i> 'Howard McMinn' McMinn manzanita	✓	✓		3	7	✓				✓			✓	c	
<i>Baccharis pilularis</i> coyote brush	✓			6	7	✓	✓		ok	✓	✓	✓	✓		Fast-growing, short-lived
<i>Berberis darwinii</i> Darwin's barberry	✓	✓		6	6	✓				✓		✓	✓		Sprinklers will kill foliage
<i>Carpenteria californica</i> Bush anemone	✓	✓		6	4	✓	✓		✓	✓				✓	Interior climate with occasional water otherwise low water needs
<i>Ceanothus</i> spp. Various ceanothus	✓	✓		varies	varies	✓			□	✓			✓	✓	fast-growing but short-lived
<i>Cercis occidentalis</i> western redbud	✓			12	8	✓			□	✓		✓	✓	✓	Prune low branches for small tree form, susceptible to disease if overwatered
<i>Cotinus coggygia</i> smoke bush	✓			15	15	✓			□			✓	✓		No water after second year

Appendix B — Plant Recommendations for Bioretention Facilities and Planter Boxes

Large Shrubs															
Scientific name Common name	Light Preference			Size (feet)		Watering				Tolerates				CA Native	Other Notes
	Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Flood	Wind		
<i>Eriogonum arborescens</i> Santa Cruz Island buckwheat	✓			3	5	✓			✓	✓	✓	✓	✓	✓	Low water after second year
<i>Eriogonum giganteum</i> St. Catherines lace	✓			5	6	✓			□		✓	✓	✓	✓	best at coast, tolerant of unwatered inland garden
<i>Fremontodendron californicum</i> flannel bush	✓			20	14	✓			□	✓		✓		✓	Fast-growing, short-lived
<i>Garrya elliptica</i> Coast silktassel	✓	✓		8	8	✓	✓		✓	✓		✓	✓	✓	'Evie' is compact variety
<i>Heteromeles arbutifolia</i> toyon	✓	✓	✓	7	5	✓	✓		✓	✓		✓		✓	Doesn't respond well to pruning low branches
<i>Juniperus chinensis</i> "Mint Julep" mint julep juniper	✓	✓		3	6	✓	✓		✓	✓		✓			
<i>Lonicera hispidula</i> California honeysuckle	✓	✓	✓	4	2		✓	✓	✓		✓	✓		✓	Climbing vine-like. Best in part shade. Attracts birds
<i>Lonicera involucrate</i> twinberry honeysuckle	✓	✓	✓	6	3		✓	✓	✓		✓	✓		✓	Best in part shade. Attracts birds
<i>Nandina domestica</i> heavenly bamboo	✓	✓		4	3	✓	✓		✓	✓		✓			
<i>Philadelphus coronaries</i> sweet mock orange	✓	✓		10	10		✓		✓				✓		Best with annual pruning
<i>Physocarpus capitatus</i> Pacific ninebark	✓	✓		5	5	✓	✓	✓	ok		✓	✓		✓	Part shade and summer water required in hot locations
<i>Pittosporum eugeniodes</i> Pittosporum	✓	✓		40	15	✓	✓		✓	✓		✓			shear to control height
<i>Pittosporum tenuifolium</i> Pittosporum	✓	✓		40	15	✓	✓		✓	✓		✓			shear to control height

Appendix B — Plant Recommendations for Bioretention Facilities and Planter Boxes

Large Shrubs															
Scientific name Common name	Light Preference			Size (feet)		Watering				Tolerates				CA Native	Other Notes
	Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Flood	Wind		
<i>Prunus illicifolia</i> holly leaf cherry	✓	✓		15	15	✓	✓			✓	✓	✓	✓	✓	
<i>Prunus lyonii</i> Catalina cherry	✓	✓		15	15	✓	✓			✓	✓	✓	✓	✓	
<i>Rhamnus californica</i> California coffeeberry	✓	✓		3-15	6	✓			✓	✓		✓	✓	✓	'Eve Case' is compact with broad foliage
<i>Rhus integrifolia</i> lemonade berry	✓	✓		8	6	✓			✓	✓			✓	✓	Shear to hedge if desired
<i>Ribes malvaceum</i> chaparral currant	✓	✓		5	5	✓	✓		ok	✓				✓	
<i>Ribes sanguineum</i> flowering currant		✓	✓	5-12	5-12	✓	✓		✓	✓	✓			✓	Needs good air movement to avoid white fly
<i>Ribes speciosum</i> fuchsia-flowered gooseberry	✓	✓	✓	3-6	3-6	✓	✓		✓	✓	✓			✓	
<i>Rosa californica</i> California wild rose	✓	✓		3	3-6		✓	✓	ok	✓	✓	✓	✓	✓	hooked thorns not compatible with foot traffic
<i>Rosa gymnocarpa</i> wood rose	✓	✓		2	3		✓		ok	✓	✓	✓		✓	
<i>Vitis californica</i> California grape	✓	✓		10	2-10	✓	✓		✓	✓	✓	✓	✓	✓	Climbing vine. Best in full sun. Can be aggressive in moist area.
<i>Vitis girdiana</i> desert grape	✓			8	2-11	✓	✓		✓	✓	✓	✓	✓	✓	Climbing vine. May be more suited to biofilter soils than californica.
Small Trees															
Scientific name Common name	Light Preference			Size (feet)		Watering				Tolerates				CA Native	Other Notes
	Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Flood	Wind		
<i>Acer Negundo</i> box elder	✓	✓	✓	30	30	✓	✓		ok	✓	✓	✓	✓	✓	Tough shade tree, deciduous
<i>Arbutus unedo</i> strawberry tree	✓	✓				✓	✓		✓	✓	✓				'Elfin King' is dwarf from 6' tall

Appendix B — Plant Recommendations for Bioretention Facilities and Planter Boxes

Small Trees															
Scientific name Common name	Light Preference			Size (feet)		Watering				Tolerates				CA Native	Other Notes
	Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Flood	Wind		
<i>Arctostaphylos manzanita</i> common manzanita	✓			6-15	8-12	✓				✓			✓	✓	Prune to be small tree. "Dr. Hurd" is more tolerant of summer water.
<i>Cercis occidentalis</i> western redbud	✓	✓		12	8	✓				✓			✓	✓	Prune low branches for small tree form; susceptible to disease if overwatered.
<i>Eriobotrya deflexa</i> bronze loquat	✓	✓		18	25	✓	✓		✓	✓		✓			Monthly deep watering
<i>Eriobotrya japonica</i> Japanese loquat	✓	✓		25	20	✓	✓		✓	✓		✓			Susceptible to blight under stress
<i>Fraxinus angustifolia</i> Raywood ash	✓			30	30		✓		✓	✓					Fall color
<i>Fraxinus dipetala</i> California ash	✓	✓		20	20				ok	✓		✓		✓	
<i>Fraxinus latifolia</i> Oregon ash	✓	✓	✓	30	25	✓			✓	✓	✓	✓		✓	
<i>Fraxinus velutina</i> velvet ash	✓			25	15	✓	✓		ok	✓		✓	✓		
<i>Garrya elleptica</i> coast silk tassel	✓	✓		20	20	✓	✓		ok		✓				Afternoon shade inland, responds well to pruning
<i>Laurus 'Saratoga'</i> hybrid laurel	✓	✓		12-40	12-40	✓				✓		✓	✓		prune for tree form
<i>Myrica californica</i> Pacific wax myrtle	✓	✓	✓	10-30	10-30	✓	✓				✓				best at coast
<i>Pinus thumbergiana</i> Japanese black pine	✓	✓		25	20	✓			✓	✓	✓			✓	Asymmetrical, often leaning habit
<i>Pittosporum undulatum</i> victorian box	✓	✓		15	15	✓	✓		✓	✓					Sunset zones 16-17, 21-24 only (not recommended E. Contra Costa. Prune low branches for tree form.
<i>Prunus ilicifolia</i> holly leaf cherry	✓	✓		15	15	✓	✓			✓	✓		✓	✓	
<i>Prunus lyonii</i> Catalina cherry	✓	✓		15	15	✓	✓			✓	✓		✓	✓	

Appendix B — Plant Recommendations for Bioretention Facilities and Planter Boxes

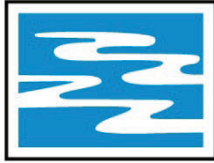
Small Trees															
Scientific name Common name	Light Preference			Size (feet)		Watering				Tolerates				CA Native	Other Notes
	Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Flood	Wind		
<i>Prunus serrulata</i> "shirofugen" cherry	✓			25	25		✓				✓	✓	✓		Additional cultivars
Key															
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.														
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 Flooding															
Tolerates Wind	A check in the wind column means that the plant will tolerate winds of ten miles per hour or more.														
CA Native - c	Cultivar of California native. Cultivars offer habitat benefits to native wildlife and are adapted to the local climate but have reduced genetic diversity.														
Other Notes - Sunset Climate Zones	Under the Other Notes category, we have indicated appropriate Sunset Climate Zones only for plants that will not do well across all of Contra Costa County. Please refer to the <i>Sunset Western Garden Book</i> which defines climate zones in the Bay Area based on elevation, influence of the Pacific Ocean, presence of hills and other factors.														



Preparing a Stormwater Control Plan for a Small Land Development Project

Instructions and template for preparing a submittal for a project creating or replacing more than 2,500 square feet but less Than 5,000 square feet of impervious area (10,000 square feet for one single-family residence that is not a part of a larger plan of development)

The template is available in Word format on the Contra Costa Clean Water Program website.



Preparing a Stormwater Control Plan for a Small Land Development Project

► INTRODUCTION

Development projects that create or replace 2,500 square feet or more of impervious surface (roofs or pavement) must incorporate one or more specified measures to reduce runoff. 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 (the threshold is 10,000 square feet or more for one single-family home that is not part of a larger plan of development) of impervious surface are “Regulated Projects,” and require a more comprehensive Stormwater Control Plan. See the Contra Costa Clean Water Program (CCCWP) *Stormwater C.3 Guidebook*.

These requirements are part of municipalities’ comprehensive effort to reduce runoff pollution. The “Small Projects” requirement is mandated by Provision C.3.i. in the California Regional Water Quality Control Board for the San Francisco Bay Region’s [Municipal Regional Stormwater Permit](#).

It is fairly 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.

► STEP-BY-STEP INSTRUCTIONS

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 Impervious Surface Area (square feet) [Sum of currently pervious areas that will be covered with new impervious surfaces]	
Total Replaced Impervious Surface Area [Sum of currently impervious areas that will be covered with new impervious surfaces.]	
Total Pre-Project Impervious Surface Area	
Total Post-Project Impervious Surface Area	
Runoff Reduction Measures Selected (Check one or more)	<input type="checkbox"/> 1. Disperse runoff to vegetated area <input type="checkbox"/> 2. Pervious pavement <input type="checkbox"/> 3. Cisterns or Rain Barrels <input type="checkbox"/> 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 have 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 for Small Projects.

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.

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.



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.

Confirm the following standard specifications are met:

- Tributary impervious square footage in no instance exceeds twice the square footage of the receiving pervious area.
- 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 1/2-inch to 1/4-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 Contra Costa Mosquito and Vector Control District (District) is informed of the installation. The District will be provided additional information and/or rights of entry if requested.

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).

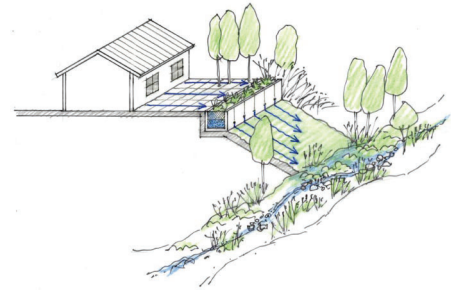
Detailed design guidance for planter boxes and bioretention areas is in the *CCCWP Stormwater C.3 Guidebook*.

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 to 6-inch minimum.
- 18-inch depth soil mix with minimum long-term infiltration rate of 5 inches per hour. See [Stormwater C.3 Guidebook - Contra Costa Clean Water Program \(cccwater.org\)](http://cccwater.org) 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 inches 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 inches 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.



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

Useful Resources

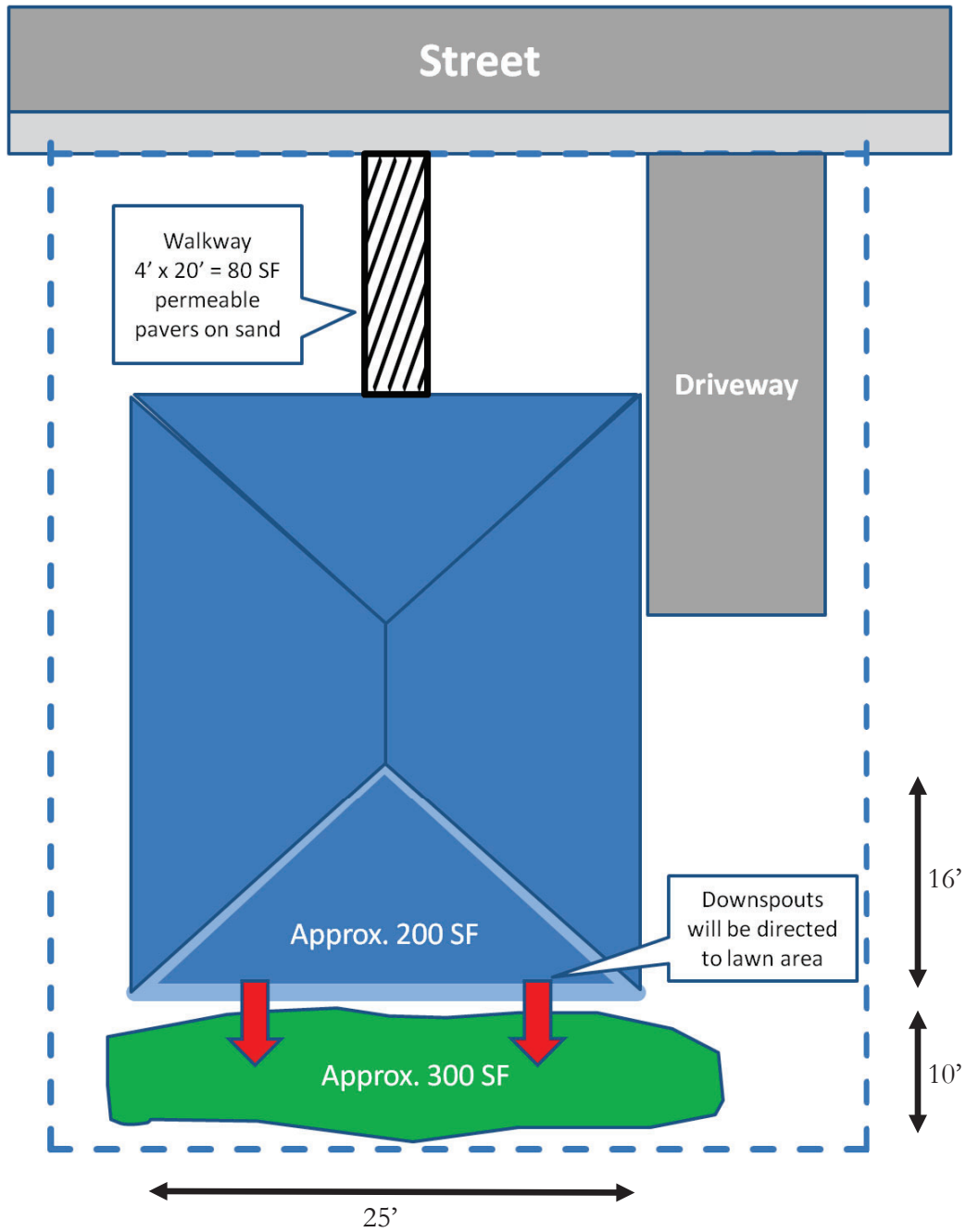
The following references may be useful for design. Designs must meet the minimum standard specifications in this supplement to the *Stormwater C.3 Guidebook*.

- *Contra Costa Clean Water Program Stormwater C.3 Guidebook*. Available at [Stormwater C.3 Guidebook - Contra Costa Clean Water Program \(cccleanwater.org\)](https://www.cccleanwater.org/Stormwater-C.3-Guidebook-Contra-Costa-Clean-Water-Program)
- *Start At the Source: Design Guidance Manual for Stormwater Quality*. Bay Area Stormwater Management Agencies Association, 1999. Available at [Foreword \(cccleanwater.org\)](https://www.cccleanwater.org/Foreword)
- *Slow It, Spread It, Sink It: A Homeowner's Guide to Turning Runoff into a Resource*. Resource Conservation District of Santa Cruz County. 2nd Ed., 2015. <https://www.rcdsantacruz.org/images/brochures/pdf/HomeDrainageGuide.v25.pdf>
- National Ready Mix Concrete Association
<http://www.perviouspavement.org/>
- 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.

Not to Scale





Pollutant Sources/ Source Control Checklist

APPENDIX D — STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions on page 16 of the *Stormwater C.3 Guidebook*):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your Stormwater Control Plan drawings.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in a table in your Stormwater Control Plan. Use the format shown in Table 2-2 on page 22 of the *Guidebook*. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

IF THESE SOURCES WILL BE ON THE PROJECT SITE THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on Stormwater Control Plan Drawings	3 Permanent Controls—List in Stormwater Control Plan Table and Narrative	4 Operational BMPs—Include in Stormwater Control Plan Table and Narrative
<input type="checkbox"/> A. On-site storm drain inlets A well-executed LID design will not have any storm drain inlets except that on some hillside sites inlets may capture runoff to be conveyed to a bioretention facility or other IMP at a lower elevation. On previously developed sites, in areas that are not being rebuilt or retrofit with LID (see the “50% rule”), markings must be installed on existing storm drain inlets.	<input type="checkbox"/> Locations of inlets.	<input type="checkbox"/> Mark all inlets with the words “No Dumping! Flows to Bay” or similar.	<input type="checkbox"/> Maintain and periodically repaint or replace inlet markings. <input type="checkbox"/> Provide stormwater pollution prevention information to new site owners, lessees, or operators. <input type="checkbox"/> Include the following in lease agreements: “Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains.”

APPENDIX D — STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

APPENDIX D — STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on Stormwater Control Plan Drawings	3 Permanent Controls—List in Stormwater Control Plan Table and Narrative	4 Operational BMPs—Include in Stormwater Control Plan Table and Narrative
<input type="checkbox"/> D2. Landscape/ Outdoor Pesticide Use	<input type="checkbox"/> Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained. <input type="checkbox"/> Show self-retaining landscape areas, if any. <input type="checkbox"/> Show stormwater treatment and hydrograph modification management IMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)	State that final landscape plans will accomplish all of the following. <input type="checkbox"/> Preserve existing native trees, shrubs, and ground cover to the maximum extent possible. <input type="checkbox"/> Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. <input type="checkbox"/> Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. <input type="checkbox"/> Consider using pest-resistant plants, especially adjacent to hardscape. <input type="checkbox"/> To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	<input type="checkbox"/> Maintain landscaping using minimum or no pesticides. <input type="checkbox"/> Provide IPM information to new owners, lessees and operators.
<input type="checkbox"/> E. Pools, spas, ponds, decorative fountains, and other water features.	<input type="checkbox"/> Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines .)	If the local municipality requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.	<input type="checkbox"/> See applicable operational BMPs in Fact Sheet SC-72 , “Fountain and Pool Maintenance,” in the CASQA Stormwater Quality Handbooks

APPENDIX D — STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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<input type="checkbox"/> F. Food service	<input type="checkbox"/> For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment. <input type="checkbox"/> On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.	<input type="checkbox"/> Describe the location and features of the designated cleaning area. <input type="checkbox"/> Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.	<input type="checkbox"/> See the brochure, " Water Pollution Prevention Tips to Protect Water Quality and Keep Your Food Service Facility Clean. " Provide this brochure to new site owners, lessees, and operators.
<input type="checkbox"/> G. Refuse areas	<input type="checkbox"/> Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas. <input type="checkbox"/> If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent runoff and show locations of berms to prevent runoff from the area. <input type="checkbox"/> Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.	<input type="checkbox"/> State how site refuse will be handled and provide supporting detail to what is shown on plans. <input type="checkbox"/> State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.	<input type="checkbox"/> State how the following will be implemented: Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See BMP Municipal Complete.pdf "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks

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<input type="checkbox"/> H. Industrial processes.	<input type="checkbox"/> Show process area.	<input type="checkbox"/> If industrial processes are to be located on site, state: “All process activities to be performed indoors. No processes to drain to exterior or to storm drain system.”	<input type="checkbox"/> See Fact Sheet SC-10, “ Non-Stormwater Discharges ” in the CASQA Stormwater Quality Handbooks
<input type="checkbox"/> I. Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)	<input type="checkbox"/> Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area. <input type="checkbox"/> Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults. <input type="checkbox"/> Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.	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 Contra Costa Hazardous Materials Programs for: <ul style="list-style-type: none"> ▪ Hazardous Waste Generation ▪ Hazardous Materials Release Response and Inventory ▪ California Accidental Release (CalARP) ▪ Aboveground Storage Tank ▪ Uniform Fire Code Article 80 Section 103(b) & (c) 1991 ▪ Underground Storage Tank www.cchealth.org/groups/hazmat/	<input type="checkbox"/> See the Fact Sheets SC-31 , “Outdoor Liquid Container Storage” and SC-33 , “Outdoor Storage of Raw Materials ” in the CASQA Stormwater Quality Handbooks

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<input type="checkbox"/> J. Vehicle and Equipment Cleaning	<input type="checkbox"/> 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.	<input type="checkbox"/> If a car wash area is not provided, describe measures taken to discourage on-site car washing and explain how these will be enforced.	Describe operational measures to implement the following (if applicable): <ul style="list-style-type: none"> <input type="checkbox"/> Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system. <input type="checkbox"/> 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

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<p><input type="checkbox"/> K. Vehicle/Equipment Repair and Maintenance</p>	<p><input type="checkbox"/> Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.</p> <p><input type="checkbox"/> Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.</p> <p><input type="checkbox"/> Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.</p>	<p><input type="checkbox"/> State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.</p> <p><input type="checkbox"/> State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.</p> <p><input type="checkbox"/> State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.</p>	<p>In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:</p> <p><input type="checkbox"/> No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.</p> <p><input type="checkbox"/> No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.</p> <p><input type="checkbox"/> No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.</p>

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<input type="checkbox"/> L. Fuel Dispensing Areas	<input type="checkbox"/> Fueling areas ¹ 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. <input type="checkbox"/> Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area ¹ .] The canopy [or cover] shall not drain onto the fueling area.		<input type="checkbox"/> The property owner shall dry sweep the fueling area routinely.

¹ The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.

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

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<ul style="list-style-type: none"> <input type="checkbox"/> O. Miscellaneous Drain or Wash Water or Other Sources <input type="checkbox"/> Boiler drain lines <input type="checkbox"/> Condensate drain lines <input type="checkbox"/> Rooftop equipment <input type="checkbox"/> Drainage sumps <input type="checkbox"/> Roofing, gutters, and trim. <input type="checkbox"/> Other sources 		<ul style="list-style-type: none"> <input type="checkbox"/> Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system. <input type="checkbox"/> Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. <input type="checkbox"/> Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment. <input type="checkbox"/> Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water. <input type="checkbox"/> Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff. <input type="checkbox"/> Include controls for other sources as specified by local reviewer. 	
<ul style="list-style-type: none"> <input type="checkbox"/> P. Plazas, sidewalks, and parking lots. 			<ul style="list-style-type: none"> <input type="checkbox"/> 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.



Regulatory and Technical Background



Regulatory and Technical Background

Some background, including updates, on selected policies and criteria in the Guidebook 9th Edition

LAND development is a complex undertaking, and no two projects are the same. Municipal staff can and should exercise latitude and discretion, within the boundaries of permit compliance, when interpreting the C.3 requirements as they apply to a specific project. This appendix provides information and explanations of technical and regulatory issues which may help with decision-making.

Introduction: Stormwater NPDES Permit History

In 1993, the Regional Water Board first issued a municipal stormwater NPDES permit to Contra Costa County, the 19 cities and towns within the County, and the Contra Costa Flood Control and Water Conservation District. The permit mandated a comprehensive program to prevent stormwater pollution. The comprehensive program includes measures to prevent pollution from municipal facilities and operations, identification and elimination of illicit discharges to storm drains, business inspections, public outreach, construction site inspections, monitoring and studies of stream health, and control of runoff pollutants from new developments and redevelopments.

In 2003, the Regional Water Board added Provision C.3, tightening requirements for new developments and redevelopments. The permittees began implementing the provision in 2005. The Regional

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Water Board added hydrograph modification management (flow control) requirements in 2006.

In October 2009, the Regional Water Board included Contra Costa municipalities in its first Municipal Regional Permit (MRP). The MRP applies to all municipalities in Alameda, Contra Costa, San Mateo, and Santa Clara counties, and some municipalities in Solano County, and supersedes the earlier countywide stormwater NPDES permits. The MRP mandates a Low Impact Development (LID) approach similar to that developed by the CCCWP from 2003 through 2009. The Regional Water Board amended the MRP on November 28, 2011, detailing some exceptions for when LID treatment is required. The LID requirements went into effect December 1, 2011.

The MRP was reissued on November 19, 2015 (MRP 2.0) and again on May 11, 2022 (MRP 3.0).

Regulatory Context and Roles

MRP Provision C.3 requires municipalities to condition development approvals with incorporation of specified stormwater controls. The municipalities' annual report to the Regional Water Board includes a list of development projects approved during the year and the specific stormwater controls that were required for each project. In the annual report, the municipalities also document their program to verify stormwater treatment and flow-control facilities are being adequately maintained. **The municipalities—not the Regional Board or its staff—are charged with ensuring development projects comply with the C.3 requirements.** (Regional Water Board staff sometimes reviews stormwater controls in connection with applications for Clean Water Act Section 401 water-quality certification, which is required for projects that involve work in streams, including dredging and filling.)

Municipal staff review the project proponent's Stormwater Control Plan for compliance with the requirements of Provision C.3. At the same time, they consider how the design of LID features and facilities integrates with the site design, landscape design, and building architecture to support municipal objectives such as design quality, consistency with neighborhood character and values, and contribution to natural qualities achievable within the urban context.

As discussed in Chapter 5, municipalities are responsible for inspecting and verifying the proper operation and maintenance of stormwater treatment facilities, and some pervious pavement installations, in perpetuity. Project proponents and municipalities share the aim of designing and building facilities that are low-maintenance and long-lasting.

Municipal reviewers have latitude and discretion to reject proposed C.3 compliance designs that, while meeting the specific requirements and numeric criteria in this *Guidebook* and the NPDES permit, don't reflect best practices or local values for urban design and architectural design, or are not sustainable.

Imperviousness

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

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

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

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

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

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

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

Low Impact Development (LID)

MRP Provision C.3.c mandates the use of LID for stormwater treatment, with narrow exceptions. Techniques for implementing LID are detailed in Chapter 3 of this *Guidebook*.

LID aims to mimic a site’s pre-development hydrology by minimizing imperviousness and then by detaining, infiltrating, and filtering runoff in landscape-based features—principally bioretention facilities.

To mitigate the effects of imperviousness on a watershed scale, LID must be implemented widely and consistently throughout the watershed. Effective LID design requires that facilities be integrated into the urban landscape so that they are seen and valued by people living and working there. This helps ensure the LID facilities are preserved and maintained over the life of the development. The design procedures and requirements in Chapter 3, Low Impact Development Site Design Guide, sets out a design procedure and requirements intended to ensure LID features and facilities are integrated into the project site design and landscape design.

Further, LID facilities must be designed and constructed to be robust, resilient, and low-maintenance. Chapter 4, Design and Construction of Bioretention Facilities and Other Integrated Management Practices, sets forth design criteria intended to achieve quality and consistency in facilities constructed throughout Contra Costa. Under MRP Provision C.3.h., Permittees bear responsibility for periodic inspection and verification of LID facilities on public and private properties. In Chapter 5, Table 5-2 lists key required features and design criteria and the corresponding benefit to long-term facility operation.

► **CCCWP, LID, AND PROVISION C.3 COMPLIANCE**

In 1999, a manual, “Low Impact Development Design Strategies: An Integrated Design Approach,” was published by the Prince George’s County, Maryland Department of Environmental Resources. The manual describes the key goals, strategies, and practices of LID as understood today.

Also in the 1990s, CCCWP staff participated in meetings of the Bay Area Stormwater Management Agencies Association’s Development Committee. With participation by RWQCB staff, the Committee reached consensus to promote landscape-based methods of reducing runoff and treating runoff on new development sites. The Committee provided input to an RWQCB “Staff Recommendations for New and Redevelopment Controls for Stormwater Programs” (April 1994). The Committee then solicited proposals for, and directed the preparation of, a design manual, “Start at the Source” (1997). An updated and expanded version of “Start at the Source” was published in 1999. “Start at the Source” does not use the terms “Low Impact Development” or “LID,” but includes the same concepts.

Throughout the 1990s, decisions regarding whether to require implementation of runoff reduction and stormwater treatment on a new development site, and how much, were at the discretion of individual municipal governments—decisions typically following the recommendation of municipal planning staff. This level of implementation was described at the time as “Do what you can, where you can.”

In 2000, Water Board staff drafted amendments to the countywide stormwater permits for municipalities in Santa Clara County. The Water Board adopted the amendments in the Santa Clara, Alameda, San Mateo, and Contra Costa Counties during 2001-2003. The new “Provision C.3” requirements were based, in large part, on requirements adopted earlier by the Regional Water Quality Control Board for the Los Angeles Region. At the heart of those requirements were numerical criteria

specifying the amount of runoff that must be treated prior to discharge—in effect, specifications for the size or capacity of treatment facilities. See “Stormwater Facility Sizing Criteria,” below.

In 2000 the State Water Resources Control Board, in a response to petition from the City of Bellflower and other parties, found that the Los Angeles RWQCB based its decision on a “maximum extent practicable” standard. The SWRCB Order WQ 2000-11 provided a basis for similar numeric standards in subsequent permits issued by the RWQCBs, including the Bay Area MRP in past and current iterations. See “Stormwater Treatment Facility Sizing Criteria” below.

In 2003, BASMAA published a companion document to “Start at the Source,” titled “Using Site Design Techniques to Meet Development Standards for Stormwater Quality.” The document shows how “self-treating areas” and “runoff reduction areas” (self-retaining areas) can be used to reduce the tributary drainage, and therefore the minimum required size, of stormwater treatment facilities for a development site. This document was among the first efforts to codify how to use LID techniques to meet permit standards for stormwater treatment.

The first edition (2005) of CCCWP’s *Stormwater C.3 Guidebook* built on an earlier work by the City of Milpitas (2003) that applied the permit numeric sizing criteria to the design of bioretention facilities and other LID facilities.

With these two elements in place—(1) codified methods for implementing runoff reduction and (2) criteria for sizing LID treatment facilities—it was possible to develop and promulgate a design methodology that uses LID to comply with the RWQCB’s permit requirements.

The methodology was incorporated into the *Stormwater C.3 Guidebook* and has been refined in subsequent editions. With the 3rd Edition (2006), CCCWP developed and released an IMP Sizing Calculator. The calculator facilitates the arithmetic required to size treatment facilities—that is, summing tributary areas and multiplying times sizing factors. More significantly, the calculator tracks tributary areas (Drainage Management Areas, or DMAs) and treatment facilities (Integrated Management Practices, or IMPs). This facilitates creating, documenting, and evaluating a land development project design that uses a full suite of LID features and facilities (self-treating areas, self-retaining areas, and a menu of IMPs) to achieve compliance. The *Guidebook*’s step-by-step procedure, combined with the calculator, facilitates a design that distributes, manages, and treats runoff throughout the site rather than one facility or a few facilities.

During 2004-2005, Contra Costa municipalities updated their stormwater ordinances to reference the “Provision C.3” requirements and to require that applications for development project approvals include “a stormwater control plan that meets the criteria in the most recent version of the Contra Costa Clean Water Program *Stormwater C.3 Guidebook*.” This launched LID as the standard acceptable means of compliance with the C.3 requirements throughout the County, although there was continued, but declining, use of non-LID site designs and facilities over the following few years.

► **LID IN THE MRP**

The Municipal Regional Stormwater Permit (MRP) consolidated and superseded the earlier countywide permits. Adopted October 14, 2009, MRP 1.0 included Provision C.3.c., which required treatment of the amount of runoff specified in the numeric criteria using “LID treatment measures.” These measures were defined as “harvesting and re-use, infiltration, evapotranspiration, and biotreatment.”

Among these four treatment measures, Provision C.3.c. in MRP 1.0 allowed the use of bioretention only if the first three measures were infeasible on the project site.

The effective date of Provision C.3.c. was set to be December 1, 2011. In the interim, the Permittees were directed to prepare the following reports:

- Feasibility/Infeasibility Criteria Report (due May 1, 2011), with “discussion of proposed feasibility and infeasibility criteria and procedures the Permittees shall employ to make a determination of when biotreatment will be allowed...
- Status Report on Application of Feasibility/Infeasibility Criteria (due December 1, 2013)
- Model Biotreatment Soil Media Specifications (due December 1, 2010—see “Bioretention Soils,” below)
- Green Roof Minimum Specifications (due May 1, 2011)

These reports were prepared under the auspices of BASMAA. CCCWP participated actively in preparation of the reports.

The RWQCB amended MRP 1.0 on November 28, 2011, requiring full implementation of the LID requirements on private development projects immediately on December 1, 2011 (December 1, 2012 for public projects).

By this time, Contra Costa municipalities had been requiring LID for compliance with the Provision C.3.d. treatment requirements for nearly seven years. CCCWP participated actively in the preparation of the required reports, and because CCCWP negotiated permit terms that aligned with the *Stormwater C.3 Guidebook*, the mandated transition to LID required only minor changes to the *Guidebook* and to the development review practices of Contra Costa municipalities. However, it was necessary to incorporate instructions for analyzing the feasibility of harvesting and reuse—and the feasibility of infiltration—in the 6th Edition, which was published February 15, 2012.

The Status Report on Application of Feasibility/Infeasibility Criteria (December 1, 2013) found:

- Infiltration of some runoff is feasible on most projects, but in the clay soils typical in the Bay Area, the amount of runoff that can be infiltrated is highly variable. On most sites, it is not practical or feasible to design

facilities that can reliably and dependably infiltrate the amount of runoff specified in Provision C.3.d. Bioretention facilities can infiltrate between 40% and 80% of total runoff depending on rainfall patterns and facility size.

- Very few development projects create the quantity and timing of non-potable water demand required to feasibly harvest and use the amount of runoff specified in Provision C.3.d.
- Bioretention is, on balance, equal in water-quality effectiveness to harvesting/use or infiltration.

A BASMAA “White Paper” on Provision C.3 in MRP 2.0 (February 2015) proposed a “Bay Area Approach” to implementing new development requirements based on by-then-substantial experience with implementing LID. The “White Paper” recommended omitting the feasibility test and allowing bioretention as an equivalent “first tier” option for LID treatment.

To support the recommendation, BASMAA’s consultants conducted modeling of bioretention performance. The modeling, presented in the Status Report on Application of Feasibility/Infeasibility Criteria, used a bioretention facility with the underdrain discharge elevation set at the top of the gravel underdrain layer. It is assumed that underlying soils are not compacted.

Setting the underdrain discharge elevation at the top of a bioretention facility’s gravel layer, and specifying that underlying soils be uncompacted, maximizes the amount of runoff that is captured and made to infiltrate into native soils rather than being discharged through the underdrain. This, in turn, minimizes the amount of pollutants discharged from the facility, particularly for soluble pollutants.

MRP 2.0 implemented the “White Paper” recommendation but did not include any design requirement regarding the underdrain discharge elevation. Nevertheless, CCCWP Permittees have required that bioretention facilities include the “raised underdrain” design and that underlying soils be uncompacted and be loosened or ripped prior to installation of the gravel layer. See Chapter 4.

Where bioretention facilities are to be built close to foundations or pavement, or on steep slopes, the design of curbs, walls, footings, and other elements may need to incorporate consideration of additional soil moisture introduced by the facilities. In many cases, an impermeable cutoff wall is constructed between the bioretention facility and an adjacent foundation or pavement section, as recommended by the project geotechnical engineer.

Flow-through planters may be used as an alternative to bioretention only on upper-story plazas, where infiltration could cause mobilization of pollutants in soil or groundwater, and other situations where infiltration is a concern, such as locations with potential geotechnical hazards that cannot be mitigated except by preventing infiltration.

Bioretention Soil Mix Specification and Verification

► BACKGROUND

The original C.3 requirements (for Contra Costa municipalities, these were in a 2003 permit amendment) did not require LID be used for treatment and had no specific criteria for bioretention facilities. CCCWP took the lead, regionally, to refine guidance and criteria for LID features and facilities that would treat the stormwater flows identified in the new Provision C.3.d.

CCCWP's initial design guidance for bioretention facility soils (Guidebook 2nd Ed., 2005) called for a "sandy loam with a minimum infiltration rate of 5 in./hr." In at least one significant instance, native "sandy loam" material passed initial review, was installed in a constructed facility, and then exhibited a sudden loss of infiltration capacity after three to four rain events. In the Guidebook 3rd Ed. (Oct. 2006), the specification was revised to "... 'sandy loam' soil mix with no more than 5% clay content. Mix should be 50-60% sand, 20-30% compost, and 20-30% topsoil..." This was the beginning of a move away from a performance specification and toward a design specification for bioretention soils. However, as late as 2007, CCCWP trainings included the use of a falling-head "bucket test" to measure the infiltration rate of bioretention soil delivered to the site. Staff from Contra Costa County, San Pablo, and Walnut Creek later developed a more portable version of the "bucket test" that uses a plexiglass tube.

Experience revealed the "bucket test" has poor repeatability. This could be due, in part, to variation among samples, test equipment, and test procedures. Many users found that initial test runs on a sample show an adequate infiltration rate (sometimes much faster than 5 inches per hour) which diminishes unpredictably on repeated wettings. In addition, there is no data available with which to evaluate the hypothesized correlation between the "bucket test" measurement and performance of the installed soil material.

In early 2008, CCCWP issued an RFP seeking a technical consultant to prepare specifications for "an appropriate soil mix to ensure a long-term minimum infiltration rate of 5 inches per hour while supporting plants and recommended procedures for verification at the construction site and/or in a laboratory." WRA, Inc., was selected and their consultant Megan Stromberg worked with CCCWP's Development Committee to develop detailed specifications for two soil mix options (Mix "A" and Mix "B"). The two mixes were included in an update to the Guidebook 4th Ed. in January 2009. The specifications required submittal of grain size analyses for the sand component and quality analyses for the compost component, but purposefully omitted any requirement for infiltration testing of the final mix. In addition, the specifications explicitly allowed municipal inspectors to accept test results and certification for a "brand name" mix from a soil supplier.

The first version of the San Francisco Bay Area Municipal Regional Stormwater Permit (MRP 1.0), which took effect December 1, 2009, required the Permittees to propose, within a year, soil media specifications for bioretention soil media. Through the Bay Area Stormwater Management Agencies Association (BASMAA),

the Permittees retained WRA, Inc., and Megan Stromberg assisted a regional process to develop consensus on the proposed specifications. The process included an April 2010 roundtable of soil scientists, soils engineers, consultants, municipal staff, building industry representatives, and Water Board staff. Based on the outcomes of the process, BASMAA recommended the Contra Costa specifications be used as a starting point for the required proposal. With minor changes from the Contra Costa specifications, as recommended by WRA, the proposed regional specifications were submitted to the Water Board. The specifications were incorporated into a permit amendment effective December 1, 2011. With a few minor updates, these are the same specifications that are in effect now.

► **SUBMITTAL AND VERIFICATION REQUIREMENTS**

In addition to ensuring that bioretention facility operation is in compliance with permit requirements, inspection of the delivered bioretention soil protects the facility owner and future owners. Infiltration rates vary logarithmically, and when an installed soil fails to infiltrate runoff, it tends to fail noticeably. In a properly operating facility, any runoff ponded on the surface should infiltrate within an hour or two following the end of rainfall. In a facility that is failing, ponding on the surface of the facility may be apparent several hours or even days after a rain event. Corrective maintenance would typically require the current owner to remove and replace the plantings and soil media.

The specifications call out the information that applicants must submit to show the soil in their under-construction bioretention facilities meets the minimum performance requirements. The submittal requirements omit any infiltration test if the recommended mix is used. If an alternative mix is used, as allowed, the submittal must include: “Certification from an accredited geotechnical testing laboratory that the Bioretention soil has an infiltration rate between 5 and 12 inches per hour...” when compacted to 85-90% of maximum dry density. This is substantially different from the “bucket test.” There is no readily available means to correlate the one test to the other, or to performance of a facility after installation. Further, the need to convey a sample to an accredited geotechnical testing laboratory and await results means that it is not practical to test the material following its delivery to the construction site. Therefore, the test results may or may not be applicable to the material that is delivered and installed.

In summary, CCCWP’s early decision to rely on a design specification (that is, the physical properties of the mix components) rather than on infiltration-rate testing was based on the experience of Permittee staff overseeing the construction and operation of bioretention facilities. With BASMAA, CCCWP negotiated the current permit requirements, which do not include infiltration-rate testing if the recommended mix is used. If an alternative mix is used, infiltration testing is required, but must be done in a laboratory.

Based on this experience, this 8th Edition of the Guidebook strongly encourages use of the recommended mix and includes submittal procedures for verifying the mix prior to installation.

A sample must be submitted along with a multi-page form completed by the suppliers of the compost, the sand, and the completed mix, and by laboratories testing and certifying the sand and compost components. At the job site, at the time of delivery, the inspector should compare the sample to the delivered material. If there is indication that it might not be the same material, it should be rejected.

As discussed among municipal staff during CCCWP's annual trainings, the most effective way for inspectors to ensure the quality of the delivered material, after reviewing the laboratory test results for the sand and compost components, is to inspect it by look and feel.

A mix meeting the design specification will have a grainy, gritty texture and will not clump when dry. If formed in the hand when damp, the material may be slightly spongy but should break apart easily. Smearing or discoloration on the hand likely indicates the presence of excessive clay. Each delivery should be inspected, and each batch inspected visually for homogeneity.

Note that a slower infiltration rate is not always necessary for plant health. In some cases this misconception has led to problems in executing the mix design. What's needed for plant health is moisture retention, and the specified amount of compost is intended to provide that regardless of a high infiltration rate. Excessive water use can be avoided by selecting an appropriate plant palette and by using drip irrigation with smart controllers (if water is available at the location).

Limits on the Use of Infiltration Devices

MRP Provision C.3.d.iv. restricts the design and location of “infiltration devices” that, as designed, may bypass filtration through surface soils before reaching groundwater.

Infiltration devices include:

- Dry wells
- Infiltration basins
- Infiltration trenches

Infiltration devices do not include:

- Bioretention facilities
- Self-retaining or self-treating areas
- Pervious pavements

Infiltration devices may not be used in areas of industrial or light industrial activity; areas subject to high vehicular traffic (25,000 or greater average daily traffic on main roadway or 15,000 or more average daily traffic on any intersecting roadway); automotive repair shops; car washes; fleet storage areas (bus, truck, etc.); nurseries, or other areas with pollutant sources that could pose a high threat to water quality, as determined by municipal staff.

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

In addition, infiltration devices are not recommended where:

- The infiltration device would receive drainage from areas where chemicals are used or stored, where vehicles or equipment are washed, or where refuse or wastes are handled.
- Surface soils or groundwater are polluted.
- The facility could receive sediment-laden runoff from disturbed areas or unstable slopes.
- Increased soil moisture could affect the stability of slopes of foundations.
- Soils are insufficiently permeable to allow the device to drain within 72 hours.

Stormwater Treatment Facility Sizing Criteria

Criteria for sizing stormwater treatment facilities are in MRP Provision C.3.d.

► TECHNICAL BACKGROUND

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

$Q = CiA$, where

Q = flow

C = weighted runoff factor between 0 and 1

i = rainfall intensity

A = area

The permit identifies three alternatives for calculating rainfall intensity:

1. the intensity-duration-frequency method, with a hydrograph corresponding to a 50-year storm,

2. the 85th percentile rainfall intensity times two, and
3. 0.2 inches per hour.

An [analysis](#) conducted for the CCCWP determined all three methods yielded similar results.

The 0.2 inches per hour criterion is the basis for a consistent countywide sizing factor for bioretention facilities when used for stormwater treatment only (i.e., not for flow control). The factor is based on a design maximum surface loading rate of 5 inches per hour (mandated by MRP Provision C.3.c.i.(2)(c)(ii)). The sizing factor is the ratio of the design intensity of rainfall on tributary impervious surfaces (0.2 inches/hour) to the design surface loading rate in the facility (5 inches/hour), or **0.04** (dimensionless).

The City of Milpitas (2003) was the first Bay Area municipality to publish guidance incorporating the 4% sizing factor for bioretention facilities, followed by the first edition (2005) of this *Guidebook*. Other countywide programs' guidance soon followed. By the time the MRP was adopted in 2009, the 4% sizing criterion for bioretention was in common use by most municipalities.

For **volume-based** treatment facilities, MRP Provision C.3.d. references two methods, the **WEF method** and the **CASQA BMP Handbook method**. Both the WEF and California BMP methods are based on continuous simulation of runoff from a hypothetical one-acre area entering a basin designed to draw down in 48 hours. The CASQA BMP Handbook method is based on continuous simulation of runoff from a hypothetical unit tributary area entering a basin designed to draw down in 24 or 48 hours. The WEF method is a simplified procedure involving a regression equation for a runoff coefficient developed using rainfall/runoff relationships for 60 urban U.S. watersheds, and regression constants for determining the design runoff volume, for a 12-, 24-, or 48-hour drawdown time, based on analysis of long term rainfall records from seven U.S. cities, including San Francisco.¹

Local rainfall data and the CASQA BMP Handbook method were formerly used for sizing detention basins in Contra Costa County. The simulation was iterated to find the unit basin size that detains about 80% of the total runoff during the simulation period. The unit basin storage size is expressed as a depth which varies from about 0.45 to 0.85 inches in Contra Costa County. The results of the method are presented in a [nomograph](#). The technical background is available in a 2005 [technical memo](#).

Since the LID requirements in the MRP 2011 amendments took effect, **detention basins may not be used to meet stormwater treatment requirements for Regulated Projects**. The WEF method and CASQA BMP Handbook method were included in the 2011 amendments and in the subsequent MRP 2.0, but are **obsolete**

¹ WEF Manual of Practice No. 23/ASCE Manual and Report on Engineering Practice No. 87, "Urban Runoff Quality Management", 1998

as design standards, but are sometimes used to calculate the volume associated with capture of 80% of annual runoff.

In the 2009 MRP, a third option for sizing stormwater treatment facilities was added to Provision C.3.d. This option states that “treatment systems that use a **combination of flow and volume capacity** shall be sized to treat at least 80 percent of the total runoff over the life of the project, using local rainfall data.”

This option can also be used to develop sizing factors for facilities with a standard cross-section (i.e., where the volume available to detain runoff is proportional to facility surface area). To calculate sizing factors, inflows, storage, infiltration to groundwater, underdrain discharge, and overflows are tracked for each time-step during a long-term simulation. The simulation is repeated, with variations in the treatment surface area, to determine the minimum area required for the facility to capture and treat 80% of the inflow during the simulation. Such an analysis was conducted for BASMAA by Dubin Environmental Consulting and is described in a Technical Report (Dubin, 2017).

► **APPLICABILITY OF REDUCED BIORETENTION SIZING**

The criteria in Chapter 3 requires that a minimum 4% sizing factor be used unless justification is provided and documented. Reduced sizing can only be used for road reconstruction projects that follow requirements outlined in MRP 3.0 Provision C.3.b.ii (5)(c), or that are non-regulated projects under C.3.b. For further detail on applicability of reduced bioretention sizing, visit <https://www.cccleanwater.org/development-infrastructure/green-infrastructure/resources>. In addition, all facilities must be at least as large as the minimum sized determined from the equation in the Technical Report (Dubin, 2017). The rationale for this policy follows.

Generally, in projects with surface parking and/or substantial landscaping, bioretention facilities designed to the 4% sizing factor can be incorporated into the project at reasonable cost and in a way that complements other elements of the site and landscape design. Hundreds of development projects have been built to this LID standard in Contra Costa municipalities since 2005.

Use of the 4% sizing factor is practicable on most sites. Requiring that facilities be built to this minimum addresses the following uncertainties inherent in LID design and construction.

Uncertainties in Hydrologic Analysis. Variation in actual runoff from predicted runoff could result from any or all of the following factors:

- Geographic variability might not be fully captured by the rainfall analysis.
- Rainfall is simulated in hourly increments, but drainage management areas typically have a time of concentration less than one hour.
- Rain gauge records may not fully represent the range and timing of all runoff events, especially rare large events.

- Climate change is causing increased frequency of intense storms.
- The model is based on a 1-acre impervious tributary area. Actual tributary areas are more complex, with various slopes and surfaces, and sometimes complicated routing of runoff.

Uncertainties in Facility Design and Construction. The Permittees' experience is that this ideal configuration—the configuration simulated by the modeling in the Technical Report—is not always attained in built facilities. Despite best efforts to ensure project quality, the Permittees have somewhat limited authority, and limited resources, to enforce design and construction standards on private projects. Even on public projects, where the Permittee is both implementer and overseer, it is often necessary to make compromises in design and construction, because of unforeseen field conditions, or to accommodate other project purposes. Typical deviations from the ideal configuration include the following:

- Side slopes were counted when representing the facility area, but some or all of the side slope area is not actually inundated prior to overflow (i.e., is actually higher in elevation than the facility overflow).
- The facility is not built flat, reducing the amount of effective surface storage or subsurface storage.
- The overflow grate is placed too low, reducing the amount of surface storage.
- The surface reservoir is made shallow by an excess of sand/compost mix.
- The excavation for the gravel layer does not extend beneath the entire treatment area of the facility.
- The underdrain discharge elevation is lower than the top of the gravel layer.
- Subsurface utilities or footings intrude into the gravel layer.
- Soil media is not to specification, or clayey sediment drains into the facility, causing the percolation rate to be less than 5 inches per hour.

Projects where reduced sizing may be justified. Based on Contra Costa municipalities' experience reviewing applications for development project approvals, in projects where structures cover all or nearly all the site square footage, designers are more likely to encounter some or all of the following constraints:

- Tributary drainage areas (Drainage Management Areas, or DMAs) are smaller and the routing of runoff from the DMAs to the facilities becomes more complex.

- There is a greater variation in the ratio between DMA area and the available area for a bioretention facility. It is more difficult to adjust DMA boundaries to distribute runoff among facilities.
- There is insufficient room for side slopes between the facilities and surrounding grade. Perimeter curbs and walls may be required, and protective fences may sometimes be installed atop the walls. High walls around facilities can yield a well-like appearance and the soil surface may be shaded. The walls may need to be buttressed or engineered to avoid tipping, sliding, or other modes of failure.
- Facilities may be located adjacent to buildings or roadways, requiring the addition of moisture barriers or beefed-up foundations.
- Potential facility locations conflict with above-ground or below-ground utilities.
- Facilities are more visible to site users and maintaining a pleasing appearance is of greater concern.

To facilitate maximum effectiveness of LID stormwater treatment in situations with these constraints, the criteria in Chapter 3 include a project-wide requirement that the project include no surface parking or only incidental surface parking. The criteria also require a demonstration—for each facility proposed to be smaller than the 4% criterion—that facility size has been maximized given the specific constraints.

Flow-Control (Hydromodification Management)

MRP Provision C.3.g. specifies:

Stormwater discharges from HM projects shall not cause an increase in the erosion potential of the receiving stream over the pre-project (existing) condition. Increases in runoff flow and volume shall be managed so that post-project runoff shall not exceed pre-project rates and durations, where such increased flow and/or volume is likely to cause increased potential for erosion of creek beds and banks, silt pollutant generation, or other adverse impacts on beneficial uses due to increased erosive force.

Comparison of post-project to pre-project flows is based on continuous simulation of runoff over a period of 30 years or more, using local hourly rainfall data, and statistical analysis of the cumulative duration of flows.

As required by the 2003 amendment adding “Provision C.3” requirements to the countywide NPDES permit, the CCCWP submitted a **Hydrograph Modification Management Plan (HMP)** in July 2005. CCCWP’s HMP included design criteria for Low Impact Development **Integrated Management Practices (IMPs)**. Applicants

for development approvals can comply with both treatment and HM requirements by incorporating IMPs into the project drainage design. The RWQCB approved² Contra Costa's proposed HM standard in July 2006. The HM standard was incorporated into the *Guidebook* Third Edition, which was published in October 2006. The IMPs and IMP design criteria were updated in the Fourth Edition, published in September 2008. A supplement to the Fourth Edition, adding two new IMP configurations (Cistern + Bioretention, Bioretention + Vault) was published in October 2009.

Fulfilling a requirement in the RWQCB's 2006 Order, CCCWP implemented an IMP Model Calibration and Validation Plan during 2011-2013. The objective of that plan was to evaluate the flow-control effectiveness of the IMPs. IMPs at sites in Walnut Creek and in Pittsburg were monitored during the 2011 and 2012 water years. The results were submitted to the Water Board in a September 2013 IMP Monitoring Report. Results showed that the IMPs provide considerably greater flow-control effectiveness than predicted by the continuous simulation modeling presented in the 2005 HMP. The primary reason is that the 2005 model inputs underestimated the amount of runoff that would be infiltrated by the IMPs. Bioretention facilities built to *Guidebook* criteria controlled runoff flows between one-tenth of the 2-year pre-project peak flow (0.1Q₂) and the 10-year pre-project peak flow (Q₁₀). These are the thresholds specified in MRP 1.0, 2.0, and 3.0.

Fulfilling a requirement in MRP 2.0, CCCWP worked closely with RWQCB staff to prepare a Hydromodification Technical Report, completed in September 2017. The report describes field work conducted on Contra Costa streams during 2017, which supplemented field work conducted in 2004-2005. The report also documents implementation of Direct Simulation of Erosion Potential a modeling methodology used in other parts of California that more precisely predicts the risk of accelerated stream erosion. The September 2017 report concluded that risk could be controlled using LID design criteria—including IMP sizing factors—similar to those in effect since 2008.

CCCWP received Water Board staff comments on the 2017 report in 2020; however, there was not a successful resolution to the comments.

In MRP 3.0 (2022), Provision C.3.g.vi.(2) requires CCCWP Permittees to submit a new Technical Report, subject to the Executive Officer's approval, describing how the CCCWP Permittees will implement the new standard. Provision C.3.g.v. directs CCCWP Permittees to require development projects subject to HM to use the methods and criteria in the current edition of the Stormwater C.3 Guidebook until the Executive Officer approves the Technical Report. Alternatively, CCCWP Permittees may implement the HM Standard in Provision C.3.g.ii., which references BAHM.

In 2023, Haley & Aldrich conducted a MRP 3.0 Hydromodification Management Compliance Options study that examined the benefits, challenges, and feasibility of

² Order R2-2006-0050

four possible approaches for Contra Costa Permittees to complying with the requirements of MRP 3.0 Provision C.3.g. Option 3, directing applicants for development projects subject to HM requirements to use BAHM to demonstrate HM compliance, scored the highest in the option criteria analysis, with a distinguishing feature of being the only option that would have the greatest regional consistency, easiest pathway to compliance and lowest implementation cost.

Thus, the 9th Edition *Guidebook* explains the updated HM compliance methodology using BAHM and provides related guidance and examples.

Applicability: Maps and Exemptions. The flow-control standard applies to projects which create or replace one acre or more of impervious area and for which applications for development approvals were deemed complete after 14 October 2006. See Chapter 1, including Table 1-1.

Projects may be exempted from HM requirements if any of the following apply:

- The post-project impervious area is less than, or the same as, the pre-project impervious area.

In previous editions (prior to the 9th Edition), CCCWP adopted, and incorporated into the *Guidebook*, requirements that each applicant for approval of an HM project would need to determine if any exemptions applied, and document any claimed exemptions with evidence (for example, show that each reach of drainage from the project site to the Bay or Delta was pipe or hardened channel).

The Tentative Order for MRP 2.0 (2015) unexpectedly included a requirement that Permittees without applicability maps produce maps. CCCWP elected not to contest this requirement, because some Permittees felt that having a map would streamline the review process for their applicants. The development of GIS technology since 2005 meant that maps could be prepared and updated more quickly and accurately than 10 years previous.

CCCWP prepared a draft map, with a few areas “to be determined” and submitted it to the Water Board in September 2017. Updates were made to the draft map were made in 2023 and submitted to the Water Board. Approval was received in February 2024.

Sites that Are Already Partially Developed. At the discretion of municipal staff, on HM projects applicants may provide treatment-only controls for an impervious square footage that is less than or equal to the pre-project impervious square footage. Treatment + HM controls must be provided for the remaining impervious square footage.

The rationale for this guidance is that the combination of treatment-only and treatment + HM controls will meet the Permit requirement that runoff flow and volume be managed so that post-project runoff doesn’t exceed estimated pre-project rates and durations. The rationale is detailed in a 10 March 2009 memo,

“Guidance on Flow Control for Development Projects on Sites that are Already Partially Developed,” available on the CCCWP website.

Selection and Design of HM Controls. The LID design procedure and criteria in Chapter 3 have been developed and refined, progressively for over a decade, to meet the needs of Contra Costa development projects. In addition to meeting the HM standard, projects designed using Chapter 3 will also meet the LID goals and principles in MRP Provision C.3.c.

Most projects use a combination of site design measures (self-treating and self-retaining areas) and bioretention facilities to meet runoff treatment and flow-control requirements. Design guidance and criteria for more complex options with smaller surface footprints—“cistern + bioretention” and “bioretention + vault”—are in Chapters 3 and 4 and may be used if space on the site is constrained.



Green Infrastructure Details

Introduction on the Development and Use of the CCCWP Typical GI Details

Over the past decade, municipalities across the Bay Area have been developing comprehensive Typical Green Infrastructure Details to assist engineers and landscape architects in the design of green infrastructure. Rather than recreate details developed by other agencies and/or start from scratch, CCCWP has reviewed the best available green infrastructure details and has decided to adopt the County of San Mateo Department of Public Works Green Infrastructure Typical Details (SMC GI Details), Version 2.0, dated June 2022, as its primary resource. The County of San Mateo used the San Francisco Public Utilities Commission's GI Typical Details as the base model and modified the entire set of details to align with their separate storm sewer system requirements, standard road sections and other requirements. Additionally, the SMC GI Details includes new details that are not within the SFPUC details.

CCCWP has modified a select subset of bioretention detail sheets to better align with C.3 Guidebook and other County-specific requirements and best practices. These modified details sheets (GEN 0.1, BP 3.1, BP 3.2, BP 4.1 and BP 4.5) are identified with an asterisk following the sheet numbers in the sheet index as well as the sheets themselves. No other detail sheets from the SMC GI Details have been modified at this time. Designers using unmodified details will need to revise them as necessary to comply with CCCWP and local agency requirements in addition to modifying them to accommodate project-specific conditions. Please note that the modified details refer to other bioretention details that have not been modified to align with CCCWP C.3 requirements so Designers will need to carefully review those referenced details and modify them accordingly when incorporating them into Design Drawings.

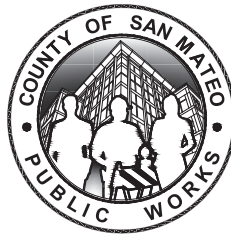
All details included in this set are available in AutoCAD drawing format for use by CCCWP member agencies.



COUNTY OF SAN MATEO
DEPARTMENT OF PUBLIC WORKS

GREEN INFRASTRUCTURE TYPICAL DETAILS

(JUNE 2022, VERSION 2.0-DRAFT)



THE FOLLOWING DETAILS USE THE SAN FRANCISCO PUBLIC UTILITIES COMMISSION'S (SFPUC'S) GREEN INFRASTRUCTURE TYPICAL DETAILS AS THE BASE MODEL AND INCLUDE MODIFICATIONS AND/OR ADDITIONS TO ALIGN WITH COUNTY OF SAN MATEO CODES, REQUIREMENTS, STANDARD ROAD SECTIONS AND BEST PRACTICES. THE COUNTY OF SAN MATEO WISHES TO THANK THE SFPUC FOR THE GENEROUS USE OF THEIR MATERIALS.

Details have been updated for CCCWP

Unmodified details referenced within the CCCWP modified details

SHEET NO.	SHEET TITLE	SHEET NO.	SHEET TITLE	SHEET NO.	SHEET TITLE	
GENERAL INFORMATION		BP 5.2	PARCEL PLANTER - DESIGNER NOTES (2 OF 2)	BC 2.5	INLETS - TRASH CAPTURE, CURB CUT WITHIN TRENCH DRAIN	
GEN 0.1	USER GUIDE	BP 5.3	PARCEL PLANTER PLAN - ALTERNATIVE 1	BC 2.6	INLETS - EMBEDDED ROCK ENERGY DISSIPATOR	
PERVIOUS PAVEMENT (PP)		BP 5.4	PARCEL PLANTER PLAN - ALTERNATIVE 2	BC 3.1	OUTLETS - DESIGNER NOTES	
PP 1.1	DESIGNER NOTES (1 OF 2)	BP 5.5	PARCEL PLANTER - RAISED PLANTER SECTION	BC 3.2	OUTLETS - CURB CUT	
PP 1.2	DESIGNER NOTES (2 OF 2)	BP 5.6	PARCEL PLANTER - AT GRADE PLANTER SECTION	BC 3.3	OUTLETS - CURB CUT WITH TRENCH DRAIN	
PP 1.3	KEY MAP	BP 5.7	PARCEL PLANTER - PLANTER ON STRUCTURE SECTION	BC 3.3.1	OUTLETS - CURB CUT WITH TRENCH DRAIN - MODIFICATION AND METAL PLATE TOP OUTLET	
PP 2.1	MATERIAL SECTIONS - PERMEABLE PAVERS	BIORETENTION BASIN (BB)			BC 3.4	OUTLETS - OVERFLOW STRUCTURES
PP 3.1	MATERIAL SECTIONS - PERVIOUS CONCRETE	BB 1.1	DESIGNER NOTES	BC 4.1	SOIL AND AGGREGATE LAYERS	
PP 4.1	MATERIAL SECTIONS - POROUS ASPHALT	BB 2.1	ROADSIDE SECTION TYPE 1	BC 5.1	UNDERDRAINS - DESIGNER NOTES	
PAVEMENT COMPONENTS (PC)		BB 2.1.1	ROADSIDE SECTION TYPE 2	BC 5.2	UNDERDRAINS	
PC 1.1	EDGE TREATMENTS - DESIGNER NOTES	BB 2.2	PARCEL SECTION	BC 6.1	CHECK DAMS - DESIGNER NOTES	
PC 1.2	EDGE TREATMENTS - KEY MAP	BB 2.3	ROADSIDE LAYOUT TYPE 3, STREET WITH VALLEY GUTTER	BC 6.2	CHECK DAMS	
PC 1.3	EDGE TREATMENTS - VEHICULAR APPLICATIONS	BB 2.4	ROADSIDE SECTION TYPE 3	SUBSURFACE INFILTRATION (SI)		
PC 1.4	EDGE TREATMENTS - PEDESTRIAN APPLICATIONS (1 OF 2)	BIORETENTION COMPONENTS (BC)			SI 1.1	DESIGNER NOTES (1 OF 2)
PC 1.5	EDGE TREATMENTS - PEDESTRIAN APPLICATIONS (2 OF 2)	BC 1.1	EDGE TREATMENTS - DESIGNER NOTES	SI 1.2	DESIGNER NOTES (2 OF 2)	
PC 1.6	EDGE TREATMENTS - PAVER AT STRUCTURES	BC 1.2	EDGE TREATMENTS - VEHICULAR APPLICATIONS (1 OF 3)	SI 2.1	INFILTRATION SYSTEM - LARGE SYSTEM - PLAN	
PC 2.1	SUBSURFACE CHECK DAMS - DESIGNER NOTES	BC 1.2.1	EDGE TREATMENTS - VEHICULAR APPLICATIONS MODIFICATIONS (2 OF 3)	SI 2.2	INFILTRATION SYSTEM - LARGE SYSTEM - SECTION	
PC 2.2	SUBSURFACE CHECK DAMS	BC 1.3	EDGE TREATMENTS - VEHICULAR APPLICATIONS (3 OF 3)	SI 3.1	SHALLOW DRY WELL - SMALL SYSTEM - PLAN	
PC 3.1	SUBSURFACE OVERFLOWS - DESIGNER NOTES	BC 1.4	EDGE TREATMENTS - PEDESTRIAN APPLICATIONS (1 OF 4)	SI 3.2	SHALLOW DRY WELL - SMALL SYSTEM - SECTION - ALTERNATIVE	
PC 3.2	SUBSURFACE OVERFLOW	BC 1.5	EDGE TREATMENTS - PEDESTRIAN APPLICATIONS (2 OF 4)	SI 4.1	DEEP DRY WELL - SMALL SYSTEM - PLAN & SECTION	
PC 3.3	SUBSURFACE UNDERDRAIN	BC 1.5.1	EDGE TREATMENTS - PEDESTRIAN APPLICATIONS (3 OF 4)	GENERAL COMPONENTS (GC)		
PC 3.4	UNDERDRAIN PIPE	BC1.5.2	EDGE TREATMENTS - PEDESTRIAN APPLICATIONS (4 OF 4)	GC 1.1	LINERS - DESIGNER NOTES	
BIORETENTION PLANTER (BP)		BC 1.6	EDGE TREATMENTS - LATERAL BRACING (1 OF 2)	GC 1.2	LINERS - LINERS AND ATTACHMENTS	
BP 1.1	DESIGNER NOTES (1 OF 2)	BC 1.7	EDGE TREATMENTS - LATERAL BRACING (2 OF 2)	GC 2.1	UTILITY CROSSINGS - DESIGNER NOTES (1 OF 2)	
BP 1.2	DESIGNER NOTES (2 OF 2)	BC 1.8	EDGE TREATMENTS - METAL FENCING	GC 2.2	UTILITY CROSSINGS - DESIGNER NOTES (2 OF 2)	
BP 2.1	STORMWATER PLANTER WITH PARKING - PLAN	BC 1.9	EDGE TREATMENTS - WOOD FENCING	GC 2.3	UTILITY CROSSINGS - BIORETENTION	
BP 2.2	STORMWATER PLANTER WITH PARKING - SECTIONS	BC 1.10	EDGE TREATMENTS - SEAT WALL	GC 2.4	UTILITY CROSSINGS - BIORETENTION SECTIONS (1 OF 2)	
BP 3.1*	STORMWATER PLANTER WITHOUT PARKING - PLAN	BC 1.11	EDGE TREATMENTS - TIMBER FOOT BRIDGE LAYOUT	GC 2.5	UTILITY CROSSINGS - BIORETENTION SECTIONS (2 OF 2)	
BP 3.2*	STORMWATER PLANTER WITHOUT PARKING - SECTIONS	BC 1.12	EDGE TREATMENTS - TIMBER FOOT BRIDGE SECTION (1 OF 2)	GC 2.6	UTILITY CROSSINGS - PERVIOUS PAVEMENT	
BP 3.3	STORMWATER BARRIER PLANTER - CL. 4 BIKEWAY - PLAN	BC 1.13	EDGE TREATMENTS - TIMBER FOOT BRIDGE SECTION (2 OF 2)	GC 2.7	UTILITY CROSSINGS - PERVIOUS PAVEMENT SECTIONS (1 OF 2)	
BP 3.4	STORMWATER BARRIER PLANTER - CL. 4 BIKEWAY - SECTION	BC 2.1	INLETS - DESIGNER NOTES	GC 2.8	UTILITY CROSSINGS - PERVIOUS PAVEMENT SECTIONS (2 OF 2)	
BP 4.1*	STORMWATER CURB EXTENSION - ALTERNATIVE 1	BC 2.2	INLETS - CURB CUT WITH GUTTER MODIFICATION	GC 2.9	UTILITY CROSSINGS - LINER PENETRATIONS	
BP 4.2	STORMWATER CURB EXTENSION - ALTERNATIVE 2	BC 2.2.1	INLETS - CURB CUT WITH METAL PLATE TOP	GC 2.10	UTILITY CROSSINGS - WALL PENETRATIONS (1 OF 2)	
BP 4.3	STORMWATER CURB EXTENSION - ALTERNATIVE 3	BC 2.3	INLETS - CURB CUT AT BULB OUT	GC 2.11	UTILITY CROSSINGS - WALL PENETRATIONS (2 OF 2)	
BP 4.4	STORMWATER CURB EXTENSION - ALTERNATIVE 4	BC 2.3.1	INLETS - CURB CUT AT BULB OUT - MODIFICATION WITH METAL PLATE TOP	GC 2.12	UTILITY CROSSINGS - UTILITY TRENCH DAM	
BP 4.5*	STORMWATER CURB EXTENSION - ALTERNATIVE 5	BC 2.4	INLETS - CURB CUT WITH TRENCH DRAIN	GC 3.1	UTILITY CONFLICTS - DESIGNER NOTES	
BP 4.6	STORMWATER CURB EXTENSION - ALTERNATIVE 6	BC 2.4.1	INLETS - CURB CUT WITH TRENCH DRAINS MODIFICATIONS			
BP 5.1	PARCEL PLANTER - DESIGNER NOTES (1 OF 2)					

NOT FOR CONSTRUCTION - REFER TO USER GUIDE



ANN M. STILLMAN
INTERIM DIRECTOR
OF PUBLIC WORKS


**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

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GC 3.3	UTILITY CONFLICTS - PARKING METERS
GC 4.1	OBSERVATION PORT - DESIGNER NOTES
GC 4.2	OBSERVATION PORT - BIORETENTION
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TW 1.1	TREE WELL FILTER - DESIGNER NOTES
TW 1.2	TREE WELL FILTER - CONNECTED TREE WELLS WITH PARKING - PLAN
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USER GUIDE: HOW TO USE THESE GI TYPICAL DETAILS

THE DETAILS PROVIDED ARE THE COUNTY OF SAN MATEO DEPARTMENT OF PUBLIC WORKS GREEN INFRASTRUCTURE TYPICAL DETAILS, DATED JUNE 2022, WHICH WERE BASED UPON THE SAN FRANCISCO PUBLIC UTILITIES COMMISSION'S GREEN INFRASTRUCTURE (GI) TYPICAL DETAILS, VERSION 2.0, DATED SEPTEMBER 2016. A SELECT SUBSET OF DETAILS (IDENTIFIED WITH AN ASTERISK IN THE SHEET NUMBER) HAVE BEEN MODIFIED BY CCCWP TO PROVIDE REFERENCE DETAILS THAT BETTER ALIGN WITH THE STORMWATER C.3 GUIDEBOOK, COUNTY-SPECIFIC REQUIREMENTS AND BEST PRACTICES.

THESE TYPICAL DETAILS (MODIFIED AND UNMODIFIED) WERE DEVELOPED TO BE REVISED AND CUSTOMIZED FOR EACH INDIVIDUAL PROJECT BY DESIGN PROFESSIONALS. THEY SHOW **TYPICAL** CONFIGURATIONS, RATHER THAN A REQUIRED COUNTY **STANDARD** CONFIGURATION. THIS DISTINCTION IS DELIBERATE. WE RECOGNIZE THAT TO CREATE GI PROJECTS THAT ARE FUNCTIONAL, CONTEXTUAL, AND AESTHETIC, DESIGN PROFESSIONALS MUST USE THEIR PROFESSIONAL JUDGMENT AND CREATIVE THINKING TO BE RESPONSIVE TO EACH SITE-SPECIFIC CONDITION, E.G., IN-SITU SOILS, VEHICULAR LOADS, DRAINAGE PATTERNS, ETC.

AUTOCAD (ACAD) DRAWINGS OF THESE TYPICAL DETAILS ARE PROVIDED SUCH THAT THE DESIGN PROFESSIONALS MUST MODIFY THE PLAN, SECTIONS, CALL-OUTS, AND/OR CONSTRUCTION NOTES TO ADDRESS THE PROJECTS SITE-SPECIFIC CONDITIONS AND LOCAL PERMITTING AGENCY REQUIREMENTS.

CONTENT

THESE TYPICAL DETAILS ARE FORMATTED, ORGANIZED, AND DEVELOPED WITH THE NECESSARY INFORMATIONAL TOOLS TO GUIDE THE DESIGN PROFESSIONAL THROUGH THE PROPER SELECTION, LAYOUT, AND DESIGN OF **GI STORMWATER CONTROL MEASURE** AND THE SELECTION OF APPROPRIATE SITE-SPECIFIC **STORMWATER CONTROL MEASURE COMPONENT DETAILS** (I.E. INLETS, OUTLETS, AND EDGE TREATMENTS, ETC.). THESE TYPICAL DETAILS PROVIDE THE FOLLOWING ORGANIZATION:

PURPOSE: SUMMARY OF EACH FACILITY'S INTENDED PERFORMANCE AND FUNCTION.

DESIGNER NOTES & GUIDELINES: TECHNICAL DESIGN REQUIREMENTS AND/OR SIZING CRITERIA GUIDELINES ARE PROVIDED SUCH THAT EACH FACILITY IS DESIGNED AND APPROPRIATELY CUSTOMIZED BY THE DESIGN PROFESSIONAL.

LAYOUT REQUIREMENTS: TECHNICAL INFORMATION, DESIGN REQUIREMENTS, AND REFERENCE TO RELATED COUNTY REQUIREMENTS.

DESIGNER CHECKLIST: TECHNICAL DESIGN INFORMATION THAT **MUST** BE DETERMINED AND SHOWN IN THE CONSTRUCTION DOCUMENTS (CDs) TO ENSURE PROPER DESIGN AND CONSTRUCTABILITY.

STORMWATER CONTROL MEASURE PLANS: TYPICAL PLAN VIEW WITH GENERAL CONFIGURATION FOR PROPER FUNCTION. DIMENSIONAL LAYOUT AND EDGING MATERIALS SHOULD BE ADJUSTED BASED ON PROPOSED SITE DESIGN AND PROGRAMING. **[ADJUST ACAD DETAIL CALL-OUTS AND REFERENCES FOR USE IN CDs]**

STORMWATER CONTROL MEASURE SECTIONS AND PROFILES: A TYPICAL SECTION AND/OR PROFILE WITH GENERAL CONFIGURATION FOR PROPER FUNCTION. DIMENSIONAL LAYOUT AND EDGING MATERIALS SHOULD BE ADJUSTED BASED ON PROPOSED SITE DESIGN AND PROGRAMING. **[ADJUST ACAD DETAILS CALL-OUTS AND REFERENCES FOR USE IN CDs]**

CONSTRUCTION NOTES: CONSTRUCTION RELATED NOTES FOR USE BY THE CONTRACTOR. **[ADJUST ACAD NOTES FOR USE IN CDs]**

NAVIGATION


THE TYPICAL DETAILS HAVE BEEN DEVELOPED WITH A NAVIGATION SYSTEM AND KEY BAR TO ASSIST THE DESIGN PROFESSIONALS WITH LINKING THE SPECIFIC STORMWATER CONTROL MEASURE TO RELEVANT DESIGN NOTES AND POSSIBLE DETAIL COMPONENTS. EXAMPLE KEY BAR:

EDGE TREATMENTS						SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS			
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS		
PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC
1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	3.1	3.2	3.3	3.4

USE ON CONSTRUCTION DOCUMENTS

DESIGN PROFESSIONALS USING THE AUTOCAD DRAWINGS **MUST REVIEW AND ADJUST THE DETAILS AND CONSTRUCTION NOTES TO ADDRESS THEIR SITE-SPECIFIC CONDITIONS**. TO ALLOW FOR SITE-SPECIFIC DESIGN ADJUSTMENTS THE TYPICAL DETAILS ARE DEVELOPED AS **"NOT FOR CONSTRUCTION"** DRAWINGS. TITLE BLOCKS ARE PROVIDED FOR DOCUMENT ORGANIZATION AND REFERENCE ONLY.

- **DO NOT** INCLUDE THE NON-ADJUSTED DETAIL WITH TITLE BLOCK WITHIN THE CONSTRUCTION DOCUMENTS.
- **DO NOT** INCLUDE NON-ADJUSTED DETAIL PLANS, SECTIONS, OR CONSTRUCTION NOTES WITHIN THE CONSTRUCTION DOCUMENTS.
- **DO NOT** REFERENCE THE GI TYPICAL DETAIL SHEET NAME AND/OR NUMBER (I.E. **BP 2.1**) AS A STANDARD DETAIL CALL-OUT WITHIN THE CONSTRUCTION DOCUMENTS.
- **DO NOT** EXPECT CONTRACTORS TO CONDUCT CALCULATIONS OR BE RESPONSIBLE FOR MISSING DESIGN INFORMATION.

	GREEN INFRASTRUCTURE TYPICAL DETAILS COUNTY OF CONTRA COSTA	DATE 01.2024	USER GUIDE	FILE NO.
		VERSION 02		GEN 0.1*
		REVISED N/A		

*THIS DETAIL HAS BEEN MODIFIED FOR CCCWP

PURPOSE:

PERVIOUS PAVEMENT (PAVEMENT) CONTROLS PEAK FLOWS AND VOLUMES OF STORMWATER RUNOFF VIA INFILTRATION THROUGH THE PAVEMENT SURFACE, STORAGE IN THE PAVEMENT SECTION, INFILTRATION INTO NATIVE SOIL, AND OVERFLOW THROUGH OPTIONAL SUBSURFACE OUTLETS. RUNOFF IS TREATED AS IT INFILTRATES INTO UNDERLYING NATIVE SOIL.

DESIGNER NOTES & GUIDELINES:

- THE DESIGNER MUST ADAPT PLAN, SECTION DRAWINGS, AND CALCULATE DEPTH TO ADDRESS SITE-SPECIFIC CONDITIONS.
- ALL PAVEMENT SYSTEMS MUST BE DESIGNED BY A LICENSED ENGINEER IN ACCORDANCE WITH THE AASHTO GUIDE, INTERLOCKING CONCRETE PAVER INSTITUTE DESIGN MANUAL, OR CALTRANS DESIGN MANUAL FOR DESIGN OF PAVEMENT STRUCTURES BASED ON SITE-SPECIFIC CONDITIONS INCLUDING TRAFFIC LOADS AND SUBGRADE CONDITIONS. PAVEMENT SECTIONS SET FORTH IN THESE TYPICAL DETAILS ARE PROVIDED TO REPRESENT THE ANTICIPATED RANGE OF DESIGN REQUIREMENTS, BASED ON "GOOD" AND "POOR" SOIL CHARACTERIZATIONS NORMALLY ENCOUNTERED IN SAN MATEO COUNTY. **ACTUAL SECTION DEPTHS MUST BE DETERMINED AS DESCRIBED IN GUIDELINE #3, BELOW.** SEE TABLES BELOW FOR TRAFFIC LOADING AND EFFECTIVE ROADBED SOIL RESILIENT MODULUS ASSUMPTIONS USED IN DEVELOPING THESE TYPICAL SECTIONS.
- TRAFFIC LOADING ASSUMPTIONS:

DESIGN ASSUMPTION	MODERATE VEHICULAR	LIGHT VEHICULAR	PEDESTRIAN
EQUIVALENT SINGLE AXLE LOADS*	2,000,000	40,000	800
TRAFFIC INDEX (TI)**	10	6.5	4
* SEE AASHTO GUIDE FOR DESIGN OF PAVEMENT STRUCTURES FOR DEFINITIONS			
** SEE CALTRANS HIGHWAY DESIGN MANUAL FOR DEFINITIONS			

SUBGRADE ASSUMPTIONS:

DESIGN ASSUMPTION	GOOD SOILS	POOR SOILS
EFFECTIVE ROADBED SOIL RESILIENT MODULUS, M_R (PSI)*	6,800	3,700
CALIFORNIA R-VALUE **	33.3	15.6
DRAINAGE COEFFICIENT, m_1 *	1.15	0.75
LAYER COEFFICIENT, a_1 * FOR OPEN GRADED AGGREGATE BASE	0.08	
* SEE AASHTO GUIDE FOR DESIGN OF PAVEMENT STRUCTURES FOR DEFINITIONS		
** SEE CALTRANS HIGHWAY DESIGN MANUAL FOR DEFINITIONS		
- GEOTECHNICAL EVALUATION OF SUBGRADE SOILS TO VERIFY THEIR STRUCTURAL SUITABILITY FOR PERVIOUS PAVEMENT INSTALLATIONS IS REQUIRED.
- THE PERVIOUS PAVEMENT FACILITY MUST BE DESIGNED TO PROVIDE SUFFICIENT SUBSURFACE STORAGE IN THE PAVEMENT SECTION TO MEET PROJECT HYDROLOGIC PERFORMANCE GOALS. THE SECTION THICKNESS WILL BE A FUNCTION OF THE SUBGRADE INFILTRATION RATE (DRAINAGE COEFFICIENT), SUBGRADE SLOPE, AND THE HEIGHT AND SPACING OF SUBSURFACE CHECK DAMS. SEE **PC 2.1** AND **PC 2.2**.
- ENTIRE PAVEMENT BASE SECTION MAY BE USED TO MEET SUBSURFACE STORAGE REQUIREMENTS.
- SUBSURFACE STORAGE DRAWDOWN TIME (I.E. TIME FOR MAXIMUM SUBSURFACE STORAGE VOLUME TO INFILTRATE INTO SUBGRADE AFTER THE END OF A STORM) SHOULD NOT EXCEED 48 HOURS. DRAWDOWN TIME IS CALCULATED AS THE MAXIMUM SUBSURFACE PONDING DEPTH DIVIDED BY THE NATIVE SOIL INFILTRATION RATE.
- THE DESIGNER MUST ENSURE THAT THE PAVEMENT EDGES ARE RESTRAINED AND THAT WATER IS CONTAINED IN THE PAVEMENT SECTION AS NEEDED TO PROTECT ADJACENT PAVEMENT SECTIONS OR STRUCTURES. SEE EDGE TREATMENTS (**PC 1.1** THROUGH **PC 1.6**) FOR GUIDANCE ON DESIGN OF THESE COMPONENTS.
- THE DESIGNER MUST EVALUATE UTILITY SURVEYS FOR POTENTIAL UTILITY CROSSINGS OR CONFLICTS. REFER TO **GC 2.1 - GC 2.12** FOR UTILITY CROSSING DETAILS AND **GC 3.1 - GC 3.3** FOR UTILITY CROSSING CONFLICT DETAILS.
- GEOTECHNICAL EVALUATION OF SEASONAL HIGH GROUNDWATER LEVEL IS REQUIRED TO VERIFY MINIMUM 5 FEET SEPARATION BETWEEN BASE OR RESERVOIR COURSE AND GROUNDWATER.
- ALL PERVIOUS PAVEMENT DESIGN MUST COMPLY WITH MUNICIPAL STANDARD ACCESSIBILITY/ADA REQUIREMENTS.

RELATED COMPONENTS

EDGE TREATMENTS:	PC 1.1	PC 1.6
CHECK DAMS:	PC 2.1	PC 2.2
OVERFLOWS:	PC 3.1	PC 3.3
LINERS:	GC 1.1	GC 1.2
UTILITY CROSSINGS:	GC 2.1	GC 2.12
UTILITY CONFLICTS:	GC 3.1	GC 3.3
OBSERVATION PORTS:	GC 4.1	GC 4.3
CLEANOUTS:	GC 5.1	

RELATED SPECIFICATIONS

	CSI NO.
PERMEABLE/PERVIOUS PAVERS: - PERMEABLE/PERVIOUS PAVERS - JOINT FILLER AGGREGATE - PAVEMENT BASE - EDGE RESTRAINTS - GEOTEXTILE FOR SOIL SEPARATION	32 14 43
PERVIOUS CONCRETE PAVEMENT: - PERVIOUS CONCRETE - PAVEMENT BASE - GEOTEXTILE FOR SOIL SEPARATION	32 13 43
POROUS ASPHALT PAVEMENT: - POROUS ASPHALT - PAVEMENT BASE - GEOTEXTILE FOR SOIL SEPARATION	32 12 43

NOTES		KEY MAP	SECTIONS		
PP 1.1	PP 1.2	PP 1.3	PP 2.1	PP 3.1	PP 4.1



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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
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PERVIOUS PAVEMENT
DESIGNER NOTES (1 OF 2)

FILE NO.
**PP
1.1**

LAYOUT REQUIREMENTS:

1. ALL PERVIOUS PAVEMENT APPLICATIONS SHALL CONFORM TO THE CURRENT SMC PUBLIC WORKS POLICIES REGARDING PERVIOUS PAVEMENT. THE DESIGN MUST COMPLY WITH SMC PUBLIC WORKS STANDARD ACCESSIBILITY REQUIREMENTS.
2. THE ALLOWABLE CATCHMENT AREA CONTRIBUTING RUN-ON TO A PERVIOUS PAVEMENT FACILITY IS A MAXIMUM OF 2:1 RATIO OF AREA CONTRIBUTING RUN-ON TO PERVIOUS PAVEMENT AREA UNLESS A LOWER RATIO IS RECOMMENDED BY THE MANUFACTURER. THE DESIGNER SHOULD CONSIDER THE INCREASED MAINTENANCE REQUIREMENTS ASSOCIATED WITH HIGHER RUN-ON RATIOS WHEN DESIGNING THE FACILITY.
3. "PERVIOUS PAVERS" REFER TO PAVERS THAT ALLOW WATER TO FLOW THROUGH ACTUAL UNIT PAVER WHILE "PERMEABLE PAVERS" REFER TO PAVER SYSTEMS THAT ONLY ALLOW WATER TO PASS THROUGH JOINTS.
4. WHEN DESIGNED TO ACCEPT RUN-ON FROM OTHER CATCHMENT AREAS, PERVIOUS PAVEMENT AREAS MUST BE PROTECTED FROM SEDIMENTATION WHICH CAN CAUSE CLOGGING AND DIMINISHED FACILITY PERFORMANCE. THE FOLLOWING REQUIREMENTS APPLY FOR RUN-ON CONTRIBUTIONS:
 - RUN-ON FROM LAWN, LANDSCAPE OR OTHER ERODIBLE SURFACES IS DISCOURAGED. IF MINOR RUN-ON FROM LAWN OR LANDSCAPE AREAS IS UNAVOIDABLE, THOSE ERODIBLE AREAS MUST BE FULLY STABILIZED.
 - CONCENTRATED RUN-ON SHOULD BE DISPERSED PRIOR TO DISCHARGE TO A PERVIOUS PAVEMENT FACILITY.
5. WEARING COURSE SHALL BE SET FLUSH (\pm 3/16 INCH) WITH ADJACENT WALKING SURFACES.
6. WEARING COURSE SHALL HAVE A MINIMUM SURFACE SLOPE OF 0.5% TO ALLOW FOR SURFACE OVERFLOW AND A MAXIMUM SURFACE SLOPE AS LISTED BELOW:
 - a. POROUS ASPHALT SURFACE: = 5 PERCENT SLOPE
 - b. PERVIOUS CONCRETE SURFACE: = 10 PERCENT SLOPE
 - c. PERMEABLE UNIT PAVERS: = 12 PERCENT SLOPE (PER MANUFACTURER'S RECOMMENDATION) SLOPES EXCEEDING 2% MAY REQUIRE SUBSURFACE CHECK DAMS (REFER TO PC2.1).
7. WHILE THERE IS NO MAXIMUM SLOPE FOR THE SUBGRADE UNDER THE PERVIOUS PAVEMENT COURSES, THERE MAY BE ENGINEERING CHALLENGES ASSOCIATED WITH SUBSURFACE CHECK DAM REQUIREMENTS ON SUBGRADE SLOPES EXCEEDING 5%. SEE SUBSURFACE CHECK DAMS (PC 2.1 AND PC 2.2).
8. PERMEABLE GEOTEXTILES MAY BE USED ALONG BASE AND SIDES. IMPERMEABLE LINERS MAY BE USED ALONG THE SIDES BUT MAY NOT BE USED ALONG BASE.

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- PERVIOUS PAVEMENT SPECIFICATIONS AND/OR PAVER TYPE AND GAP WIDTH
- PERVIOUS PAVEMENT WIDTH AND LENGTH
- ELEVATIONS AND CONTROL POINTS AT EVERY CORNER OR POINT OF TANGENCY
- THICKNESS OF EACH LAYER IN THE PAVEMENT SECTION
- JOINT SPACING AND TYPE
- SUBGRADE SLOPE
- SUBSURFACE CHECK DAM SPACING, HEIGHT, AND TYPE
- ELEVATIONS OF EACH PIPE INLET AND OUTLET INVERT
- TYPE AND DESIGN OF PERVIOUS PAVEMENT COMPONENTS (E.G., EDGE TREATMENTS, OUTLETS, UNDERDRAINS, etc.)

NOTES		KEY MAP	SECTIONS		
PP 1.1	PP 1.2	PP 1.3	PP 2.1	PP 3.1	PP 4.1



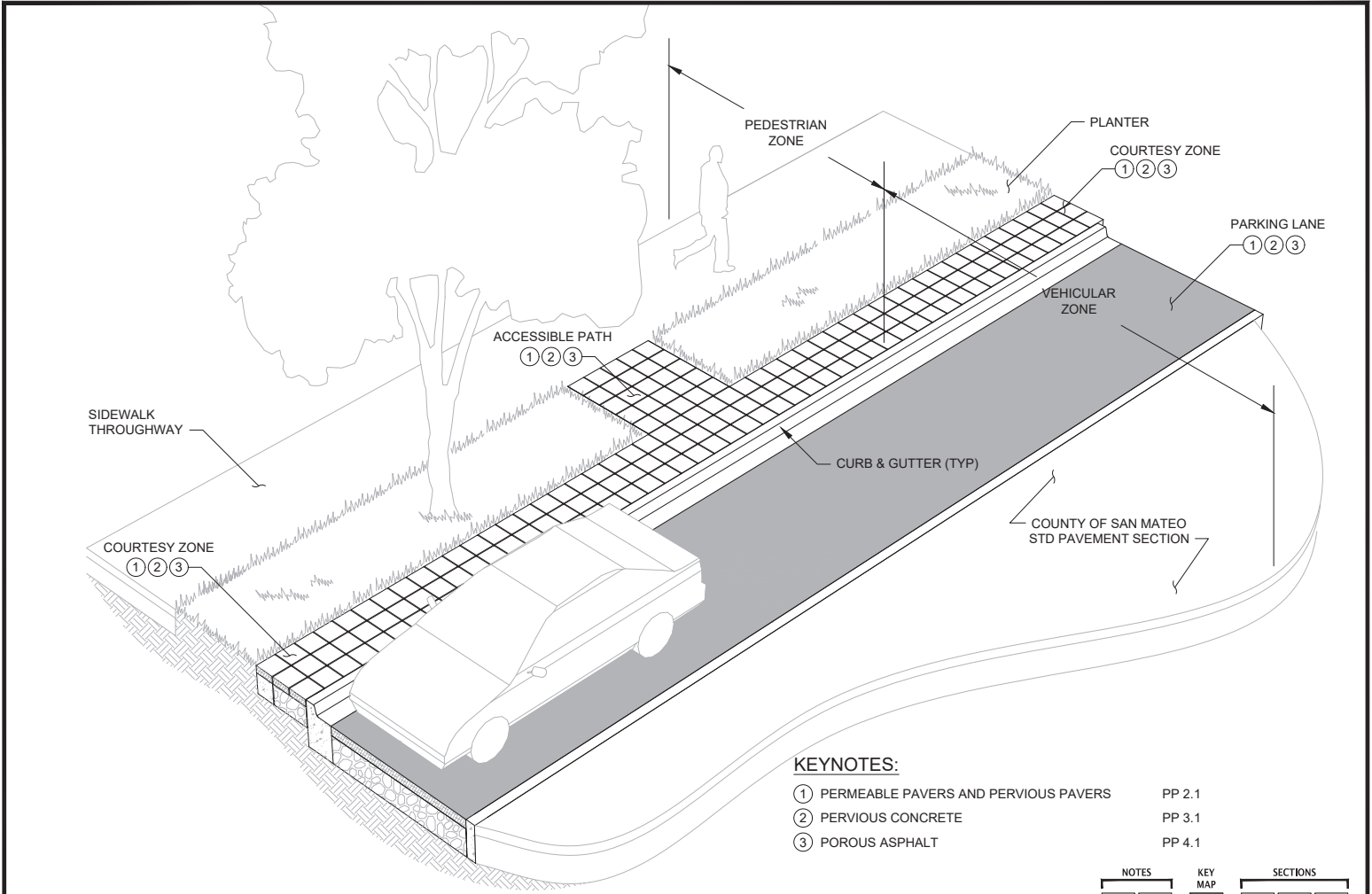
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PERVIOUS PAVEMENT
DESIGNER NOTES (2 OF 2)

FILE NO.
**PP
1.2**



- KEYNOTES:**
- ① PERMEABLE PAVERS AND PERVIOUS PAVERS PP 2.1
 - ② PERVIOUS CONCRETE PP 3.1
 - ③ POROUS ASPHALT PP 4.1

NOTES		KEY MAP	SECTIONS		
PP 1.1	PP 1.2	PP 1.3	PP 2.1	PP 3.1	PP 4.1

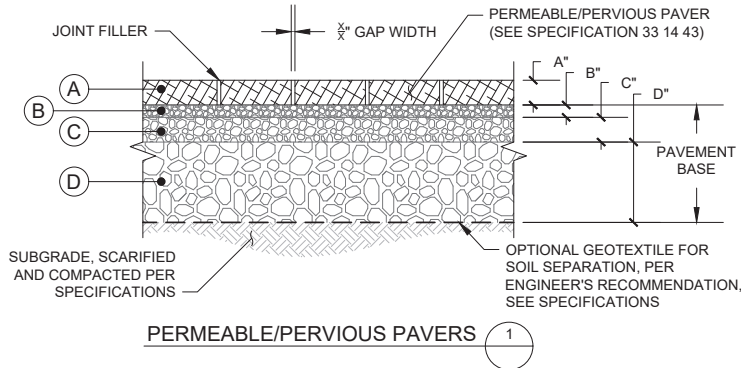

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PERVIOUS PAVEMENT
 KEY MAP

FILE NO.
PP
 1.3



MINIMUM MATERIAL THICKNESS (IN):

LAYER	MATERIAL TYPE*	MODERATE VEHICULAR		LIGHT VEHICULAR		PEDESTRIAN	
		GOOD SOILS**	POOR SOILS**	GOOD SOILS**	POOR SOILS**	GOOD SOILS**	POOR SOILS**
(A)	PERMEABLE/PERVIOUS PAVERS	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8
(B)	LEVELING COURSE ASTM NO. 8	2	2	2	2	2	2
(C)	BASE COURSE ASTM NO. 57 OR CALTRANS CLASS 1 TYPE PERMEABLE	6	6	6	4	4	4
(D)	RESERVOIR COURSE ASTM NO. 2, 3, OR 57	22	28	-	10	-	-

* MATERIAL FINER THAN NO. 100 SIEVE SHALL NOT EXCEED 2 PERCENT FOR ANY AGGREGATE LAYER (LICENSED PROFESSIONAL TO SELECT AGGREGATE).
 ** "GOOD" AND "POOR" SOIL CLASSIFICATIONS BASED ON AASHTO GUIDE FOR DESIGN OF PAVEMENT STRUCTURES. SEE DESIGNER NOTES FOR SUBGRADE ASSUMPTIONS. (LICENSED PROFESSIONAL MUST CALCULATE REQUIRED DEPTH BASED ON SITE CONDITIONS).

TYPICAL JOINT FILLER AGGREGATE SIZE:

GAP WIDTH (IN)	JOINT FILLER AGGREGATE*
3/8 OR 1/2	ASTM NO. 8
1/4	ASTM NO. 9 OR 89
1/8	ASTM NO. 10 **

* PROVIDED FOR REFERENCE ONLY, FOLLOW MANUFACTURER'S RECOMMENDATIONS
 ** FOR PERVIOUS PAVERS ONLY, ASTM NO. 20 SAND NOT ALLOWED PER MANUFACTURERS RECOMMENDATIONS.

CONSTRUCTION NOTES:

- SEE PERMEABLE/PERVIOUS PAVES SPECIFICATIONS FOR WEARING COURSE, PAVEMENT BASE, SUBGRADE, AND OTHER REQUIREMENTS FOR PERMEABLE PERVIOUS PAVES FACILITIES.
- MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT SMC ASSET PROTECTION STANDARDS, AND/OR CHAPTER 3 OF SMCWPPP GI DESIGN GUIDE AND OTHER UTILITY PROVIDER REQUIREMENTS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSINGS AND UTILITY CONFLICTS.

NOTES		KEY MAP	SECTIONS		
PP 1.1	PP 1.2	PP 1.3	PP 2.1	PP 3.1	PP 4.1



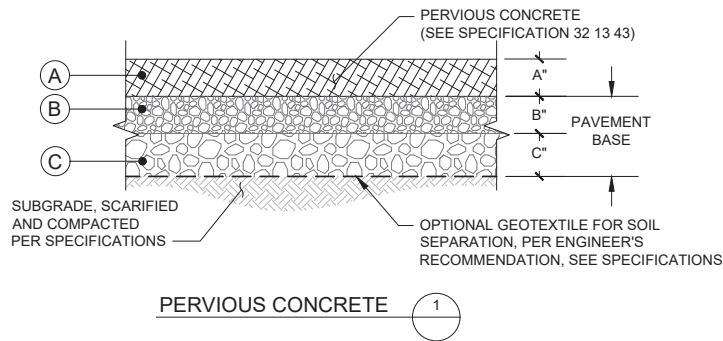
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**PERVIOUS PAVEMENT
 MATERIAL SECTIONS
 PERMEABLE PAVERS**

FILE NO.
**PP
 2.1**



MINIMUM MATERIAL THICKNESS (IN):

LAYER	MATERIAL TYPE*	MODERATE VEHICULAR		LIGHT VEHICULAR		PEDESTRIAN	
		GOOD SOILS**	POOR SOILS**	GOOD SOILS**	POOR SOILS**	GOOD SOILS**	POOR SOILS**
(A)	PERVIOUS CONCRETE	9	9.5	6.5	7	4.5	5
(B)	BASE COURSE ASTM NO. 3 OR 57 OR CALTRANS CLASS 1 TYPE PERMEABLE	6	6	6	6	6	6
(C)	OPTIONAL RESERVOIR COURSE ASTM NO. 2, 3, OR 57	-	-	-	-	-	-

* MATERIAL FINER THAN NO. 100 SIEVE SHALL NOT EXCEED 2 PERCENT FOR ANY AGGREGATE LAYER (LICENSED PROFESSIONAL TO SELECT AGGREGATE).

** "GOOD" AND "POOR" SOIL CLASSIFICATIONS BASED ON AASHTO GUIDE FOR DESIGN OF PAVEMENT STRUCTURES. SEE DESIGNER NOTES FOR SUBGRADE ASSUMPTIONS. (LICENSED PROFESSIONAL MUST CALCULATE REQUIRED DEPTH BASED ON SITE CONDITIONS).

CONSTRUCTION NOTES:

- SEE PERVIOUS CONCRETE SPECIFICATIONS FOR WEARING COURSE, PAVEMENT BASE, SUBGRADE, AND OTHER REQUIREMENTS FOR PERVIOUS CONCRETE FACILITIES.
- MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT SMC ASSET PROTECTION STANDARDS, AND/OR CHAPTER 3 OF SMCWPPP GI DESIGN GUIDE AND OTHER UTILITY PROVIDER REQUIREMENTS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSINGS AND UTILITY CONFLICTS.
- OPTIONAL RESERVOIR COURSE MAY BE NEEDED DEPENDING ON CALCULATED WATER QUALITY DESIGN VOLUME STORAGE REQUIREMENTS.

NOTES		KEY MAP	SECTIONS		
PP 1.1	PP 1.2	PP 1.3	PP 2.1	PP 3.1	PP 4.1



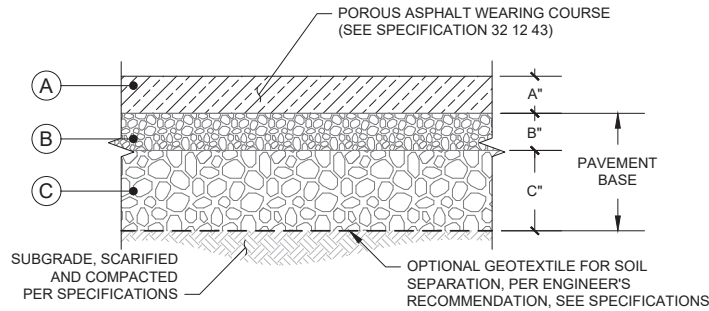
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**PERVIOUS PAVEMENT
MATERIAL SECTIONS
PERVIOUS CONCRETE**

FILE NO.
**PP
3.1**



POROUS ASPHALT (1)

MINIMUM MATERIAL THICKNESS (IN):

LAYER	MATERIAL TYPE*	MODERATE VEHICULAR		LIGHT VEHICULAR		PEDESTRIAN	
		GOOD SOILS**	POOR SOILS**	GOOD SOILS**	POOR SOILS**	GOOD SOILS**	POOR SOILS**
(A)	POROUS ASPHALT	6	8	4	4	3	4
(B)	BASE COURSE ASTM NO. 57 OR CALTRANS CLASS 1 TYPE PERMEABLE	6	6	5	4	6	4
(C)	RESERVOIR COURSE ASTM NO. 2, 3, OR 57	10	19	-	11	-	8

* MATERIAL FINER THAN NO. 100 SIEVE SHALL NOT EXCEED 2 PERCENT FOR ANY AGGREGATE LAYER (LICENSED PROFESSIONAL TO SELECT AGGREGATE).

** "GOOD" AND "POOR" SOIL CLASSIFICATIONS BASED ON AASHTO GUIDE FOR DESIGN OF PAVEMENT STRUCTURES. SEE DESIGNER NOTES FOR SUBGRADE ASSUMPTIONS. (LICENSED PROFESSIONAL MUST CALCULATE REQUIRED DEPTH BASED ON SITE CONDITIONS).

CONSTRUCTION NOTES:

- SEE POROUS ASPHALT SPECIFICATIONS FOR WEARING COURSE, PAVEMENT BASE, SUBGRADE, AND OTHER REQUIREMENTS FOR POROUS ASPHALT FACILITIES.
- MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT SMC ASSET PROTECTION STANDARDS, AND/OR CHAPTER 3 OF SMCWPPP GI DESIGN GUIDE AND OTHER UTILITY PROVIDER REQUIREMENTS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSINGS AND UTILITY CONFLICTS.

NOTES		KEY MAP	SECTIONS		
PP 1.1	PP 1.2	PP 1.3	PP 2.1	PP 3.1	PP 4.1



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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

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PERVIOUS PAVEMENT
MATERIAL SECTIONS
POROUS ASPHALT

FILE NO.
PP
4.1

PURPOSE:

EDGE TREATMENTS ARE USED TO STABILIZE THE EDGE OF THE PERVIOUS PAVEMENT AND CONTAIN WATER WITHIN THE PERVIOUS PAVEMENT SECTION.

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT PLAN AND SECTION DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
2. ALL EDGE TREATMENT SYSTEMS MUST BE DESIGNED BY A LICENSED ENGINEER BASED ON SITE SPECIFIC CONDITIONS.
3. MINIMUM EDGE TREATMENT EMBEDMENT KEY DEPTHS ARE SPECIFIED TO PREVENT LATERAL SEEPAGE UNDER THE EDGE TREATMENT AND INTO ADJACENT PAVEMENT SECTIONS. DEEPER EMBEDMENT MAY BE REQUIRED UNDER SOME CONDITIONS.
4. FOR DEEP PAVEMENT SECTIONS, EDGE TREATMENT NOT REQUIRED TO EXTEND MORE THAN 12 INCHES BELOW WEARING COURSE PROVIDED REQUIREMENTS AT INTERFACE WITH IMPERMEABLE PAVEMENTS ARE SATISFIED.
5. USE THE EDGE TREATMENT KEY MAP ON **PC 1.2** TO IDENTIFY WHERE EACH TYPE OF EDGE TREATMENT IS REQUIRED OR ALLOWED.

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- EDGE TREATMENT TYPE AND MATERIAL
- EDGE TREATMENT WIDTH AND HEIGHT
- EMBEDMENT KEY DEPTH IF DIFFERENT THAN THE PROVIDED MINIMUMS

EDGE TREATMENTS						SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS			
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS		
PC 1.1	PC 1.2	PC 1.3	PC 1.4	PC 1.5	PC 1.6	PC 2.1	PC 2.2	PC 3.1	PC 3.2	PC 3.3	PC 3.4



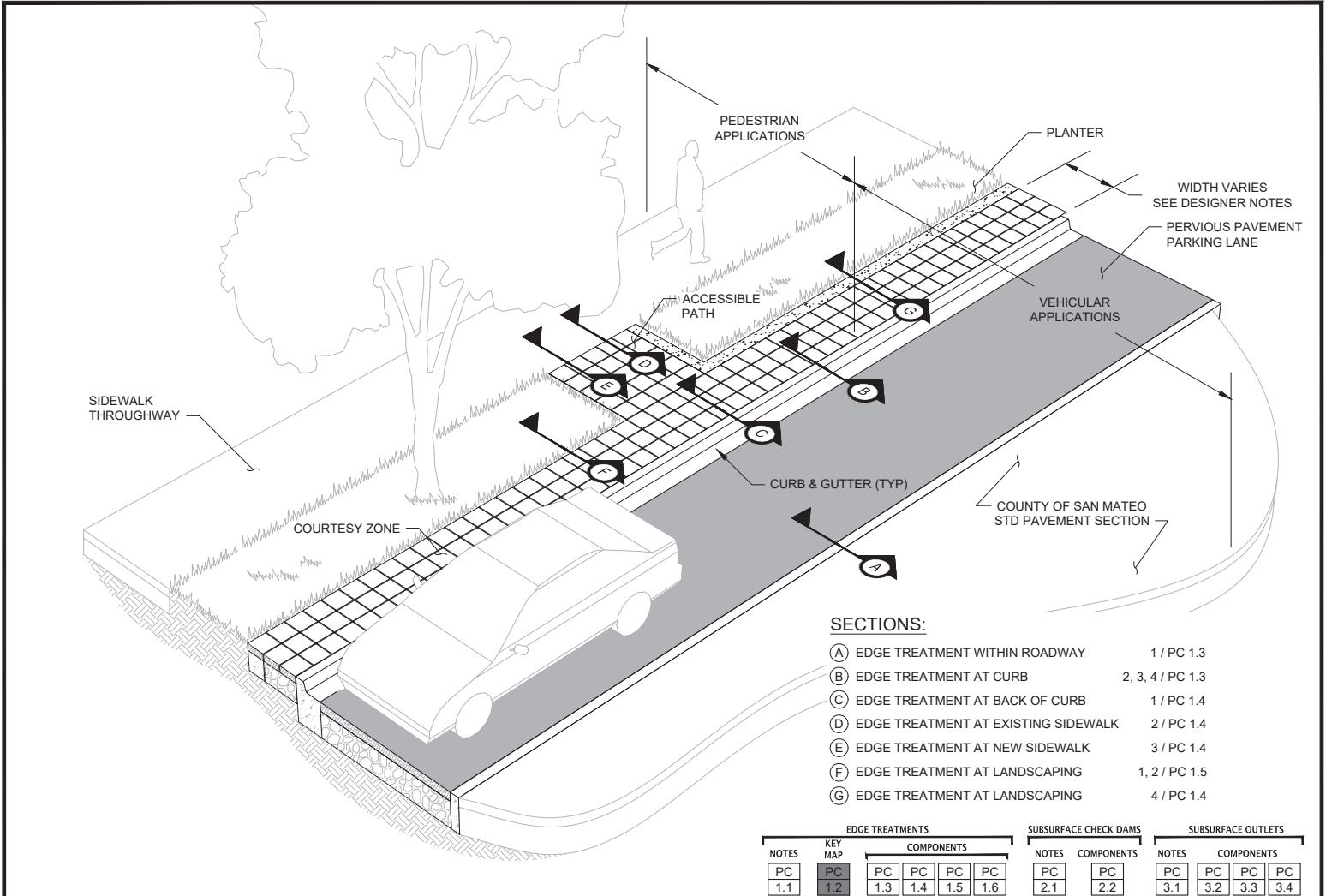
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE	06.2022
VERSION	02
REVISED	N/A

PAVEMENT COMPONENTS
EDGE TREATMENTS
DESIGNER NOTES


FILE NO.
PC
1.1



SECTIONS:

- (A) EDGE TREATMENT WITHIN ROADWAY 1 / PC 1.3
- (B) EDGE TREATMENT AT CURB 2, 3, 4 / PC 1.3
- (C) EDGE TREATMENT AT BACK OF CURB 1 / PC 1.4
- (D) EDGE TREATMENT AT EXISTING SIDEWALK 2 / PC 1.4
- (E) EDGE TREATMENT AT NEW SIDEWALK 3 / PC 1.4
- (F) EDGE TREATMENT AT LANDSCAPING 1, 2 / PC 1.5
- (G) EDGE TREATMENT AT LANDSCAPING 4 / PC 1.4

EDGE TREATMENTS					SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS				
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS		
PC 1.1	PC 1.2	PC 1.3	PC 1.4	PC 1.5	PC 1.6	PC 2.1	PC 2.2	PC 3.1	PC 3.2	PC 3.3	PC 3.4

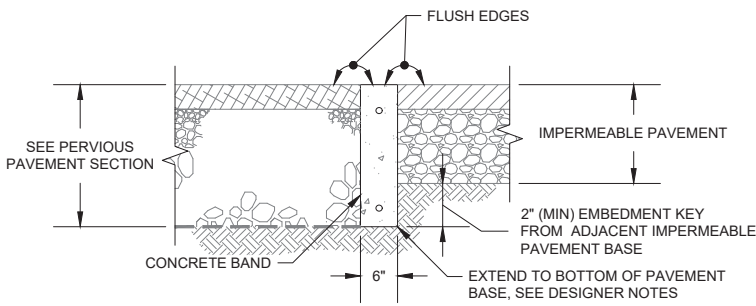

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GREEN INFRASTRUCTURE
TYPICAL DETAILS
 COUNTY OF SAN MATEO

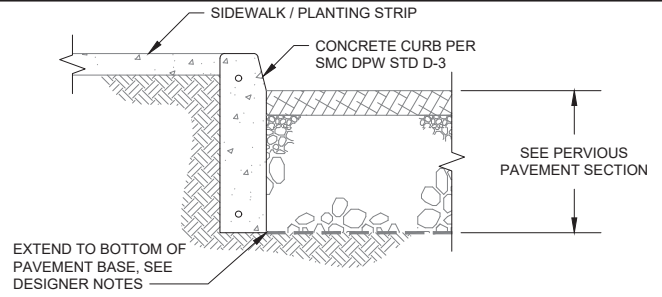
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PAVEMENT COMPONENTS
 EDGE TREATMENTS
 KEY MAP

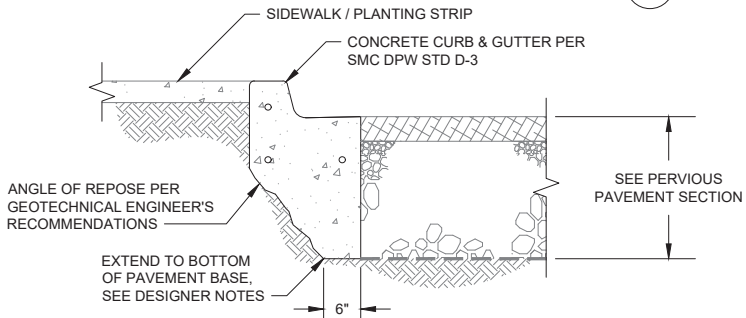
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PC 1.2



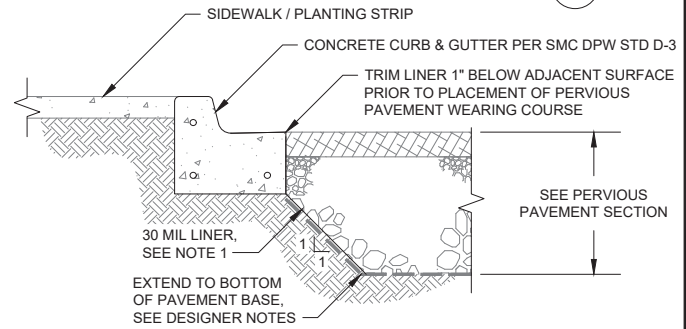
CONCRETE BAND WITHIN PAVED AREA (1)



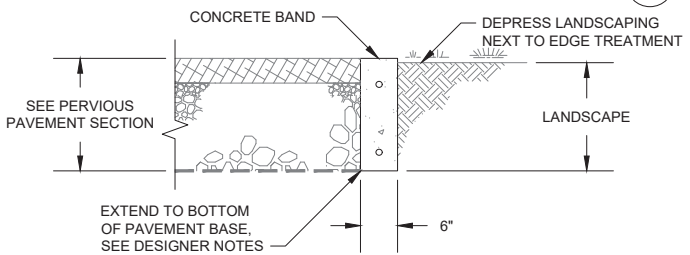
DEEPEMED STANDARD CURB (2)



DEEPEMED STANDARD CURB AND GUTTER (3)



IMPERMEABLE LINER AT STANDARD CURB AND GUTTER (4)



CONCRETE BAND AT LANDSCAPE (5)

CONSTRUCTION NOTES:

- LINER SHALL BE HDPE CONFORMING TO GEOSYNTHETIC RESEARCH INSTITUTE (GRI) GM13 OR LLDPE CONFORMING TO GRI GM 17.

EDGE TREATMENTS				SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS					
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS		
PC 1.1	PC 1.2	PC 1.3	PC 1.4	PC 1.5	PC 1.6	PC 2.1	PC 2.2	PC 3.1	PC 3.2	PC 3.3	PC 3.4



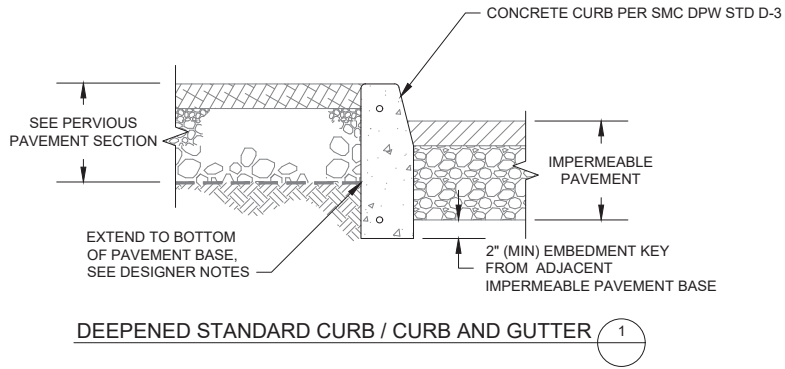
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TYPICAL DETAILS**
COUNTY OF SAN MATEO

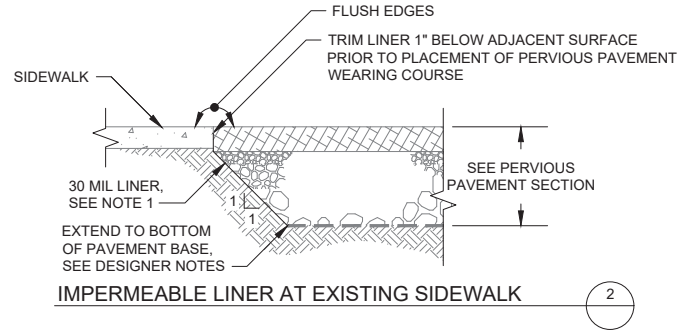
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PAVEMENT COMPONENTS
EDGE TREATMENTS
VEHICULAR APPLICATIONS

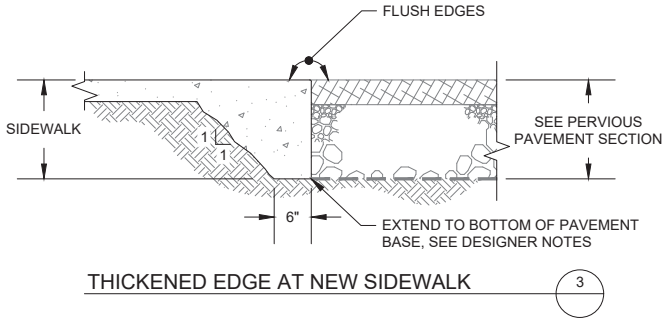
FILE NO:
PC 1.3



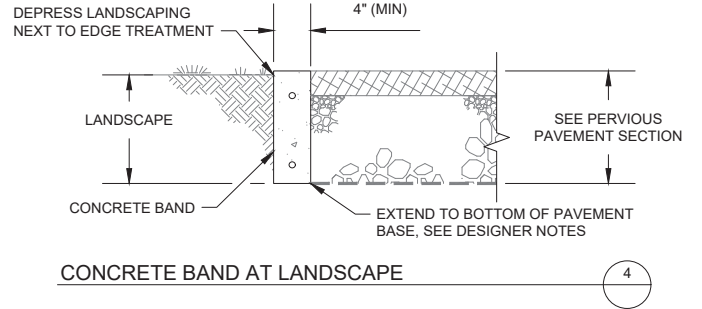
DEEPENED STANDARD CURB / CURB AND GUTTER (1)



IMPERMEABLE LINER AT EXISTING SIDEWALK (2)



THICKENED EDGE AT NEW SIDEWALK (3)




CONCRETE BAND AT LANDSCAPE (4)

CONSTRUCTION NOTES:

- 1. LINER SHALL BE HDPE CONFORMING TO GEOSYNTHETIC RESEARCH INSTITUTE (GRI) GM13 OR LLDPE CONFORMING TO GRI GM 17.

EDGE TREATMENTS						SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS				
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS			
PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC
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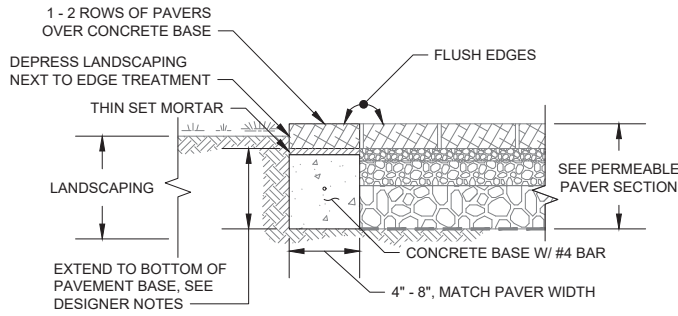
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

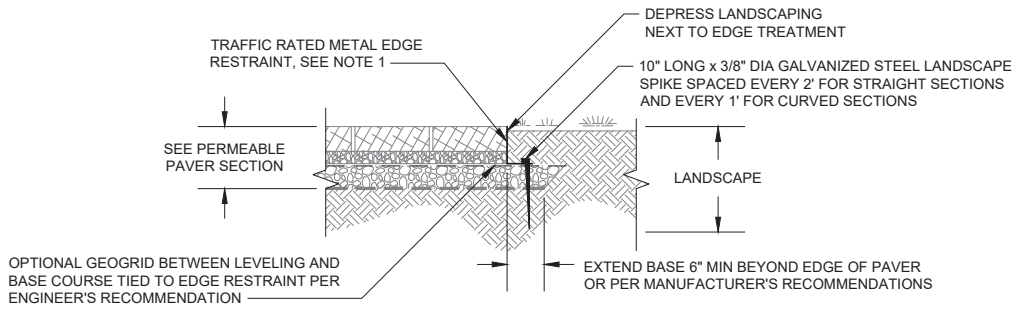
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VERSION	02
REVISED	N/A

PAVEMENT COMPONENTS
EDGE TREATMENTS
PEDESTRIAN APPLICATIONS (1 OF 2)

FILE NO.
PC
1.4



MORTARED PAVER AT LANDSCAPING 1



METAL PAVER EDGE AT LANDSCAPING 2

CONSTRUCTION NOTES:

- COORDINATE WITH SAN MATEO COUNTY DEPARTMENT OF PUBLIC WORKS IF STEEL IS REQUIRED IN RIGHT OF WAY.

EDGE TREATMENTS						SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS			
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS		
PC 1.1	PC 1.2	PC 1.3	PC 1.4	PC 1.5	PC 1.6	PC 2.1	PC 2.2	PC 3.1	PC 3.2	PC 3.3	PC 3.4



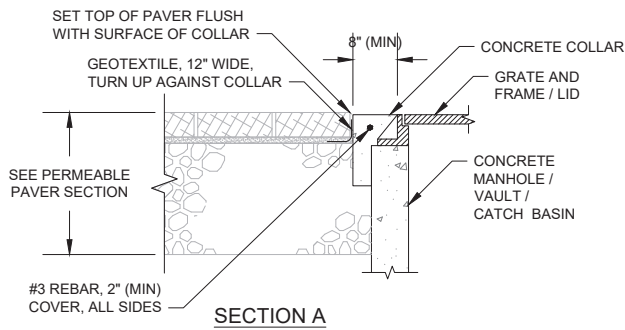
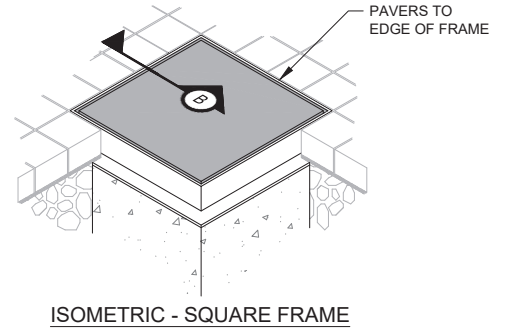
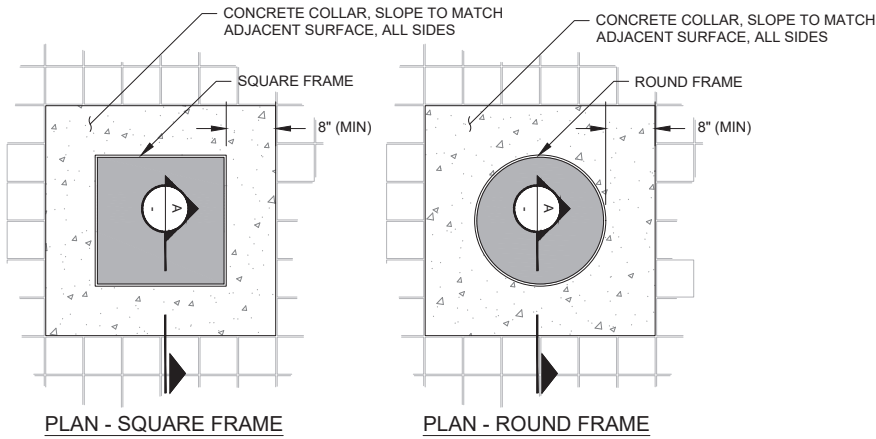
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TYPICAL DETAILS**
COUNTY OF SAN MATEO

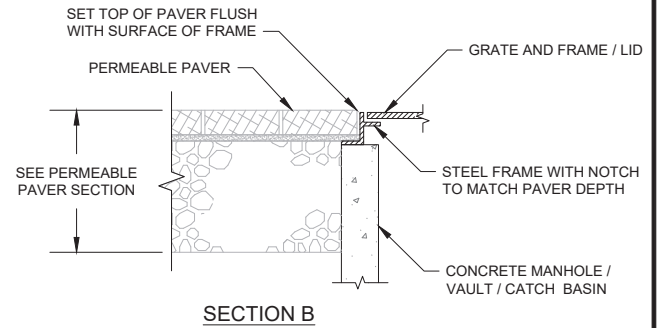
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PAVEMENT COMPONENTS
EDGE TREATMENTS
PEDESTRIAN APPLICATIONS (2 OF 2)

FILE NO.
**PC
1.5**



PERMEABLE PAVER EDGE AT STRUCTURE - VEHICULAR APPLICATIONS



PERMEABLE PAVER EDGE AT STRUCTURE - PEDESTRIAN APPLICATIONS



EDGE TREATMENTS						SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS			
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS		
PC 1.1	PC 1.2	PC 1.3	PC 1.4	PC 1.5	PC 1.6	PC 2.1	PC 2.2	PC 3.1	PC 3.2	PC 3.3	PC 3.4



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PAVEMENT COMPONENTS
EDGE TREATMENTS
PAVER AT STRUCTURES

FILE NO.
PC
1.6

PURPOSE:

PERVIOUS PAVEMENT FACILITIES MUST BE DESIGNED TO PROVIDE SUBSURFACE STORAGE OF STORMWATER TO ALLOW TIME FOR THE WATER TO INFILTRATE INTO THE UNDERLYING SOIL. SLOPED FACILITIES ON POOR SOILS HAVE AN INCREASED POTENTIAL FOR LATERAL FLOWS THROUGH THE STORAGE RESERVOIR COURSE ALONG THE TOP OF THE RELATIVELY IMPERMEABLE SUBGRADE SOIL. THIS REDUCES THE STORAGE AND INFILTRATION CAPACITY OF THE PAVEMENT SYSTEM. SUBSURFACE DETENTION STRUCTURES, OR CHECK DAMS, CAN BE INCORPORATED INTO THE SUBGRADE AND ALIGNED PERPENDICULAR TO THE LONGITUDINAL SUBGRADE SLOPE TO CREATE PONDING IN THE AGGREGATE STORAGE RESERVOIR COURSE TO DETAIN SUBSURFACE FLOW, INCREASE INFILTRATION, AND REDUCE STRUCTURAL PROBLEMS ASSOCIATED WITH SUBGRADE EROSION ON SLOPES.

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT SECTION DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
2. WHILE THE DESIGNER MUST DETERMINE IF CHECK DAMS ARE NECESSARY BASED ON SITE-SPECIFIC CONDITIONS, SOME GENERAL GUIDELINES ARE PROVIDED BELOW:

SUBGRADE SOILS	SUBGRADE SLOPE	RUNON FROM OTHER AREAS	CHECK DAM REQUIRED
TYPE A/B	ANY	ALLOWED	NO
TYPE C/D	≤ 2%	NOT ALLOWED	NO
	≤ 2%	ALLOWED	NO*
	> 2%	ALLOWED	YES

* RECOMMENDED FOR SUBSURFACE FLOW PATHS OVER 50 FEET

3. THE DESIGNER MUST ESTABLISH THE HEIGHT AND SPACING OF THE CHECK DAMS BASED ON THE SUBGRADE SLOPE AND THE STORAGE DEPTH REQUIRED TO MEET PROJECT HYDROLOGIC PERFORMANCE GOALS. THE AVERAGE DEPTH OF SUBSURFACE STORAGE ACROSS THE FACILITY AREA MUST MEET THE REQUIRED STORAGE DEPTH. REFER TO CHECK DAM SPACING GUIDANCE ON THIS DRAWING FOR CHECK DAM SPACING CALCULATIONS.
4. MAXIMUM CHECK DAM HEIGHT IS GOVERNED BY 48 HOUR DRAWDOWN REQUIREMENT AND NATIVE SOIL INFILTRATION RATE. SEE **PP 1.1** FOR ADDITIONAL GUIDANCE.
5. THE AREA OF SUBBASE COVERED BY IMPERMEABLE CHECK DAM MATERIAL SHOULD BE EXCLUDED FROM HYDROLOGIC PERFORMANCE CALCULATIONS WHEN THE AREA IS SIGNIFICANT (GREATER THAN 10 PERCENT) RELATIVE TO THE PAVEMENT AREA.
6. THE DESIGNER MUST ENSURE THAT THE RESERVOIR COURSE DEPTH IS SUFFICIENT TO ACCOMMODATE THE HEIGHT OF THE CHECK DAMS WITH THE REQUIRED MINIMUM CLEARANCE.
7. CONVEYANCE CALCULATIONS ARE REQUIRED TO EVALUATE THE NEED FOR SUBSURFACE OUTLETS (E.G., PERFORATED UNDERDRAIN PIPES SET AT THE DESIGN SUBSURFACE PONDING DEPTH) AND DOWNSLOPE OVERTFLOW SYSTEM. REFER TO **PC 3.1**.
8. LOCATE CHECK DAMS TO MINIMIZE IMPACT TO UTILITY ACCESS.
9. LOCATE PERVIOUS CONCRETE CONTROL JOINTS AT CHECK DAM LOCATIONS WHEN CHECK DAM EXTENDS INTO THE STRUCTURAL PAVEMENT SECTION.

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- CHECK DAM TYPE AND MATERIAL
- CHECK DAM ELEVATION, HEIGHT, AND WIDTH
- CHECK DAM SPACING
- CHECK DAM CLEARANCE (MEASURED FROM BOTTOM OF WEARING COURSE)

CHECK DAM SPACING GUIDANCE:

TYPICAL MAXIMUM SPACING, $L_{SPACING, MAX}$ (FEET) :

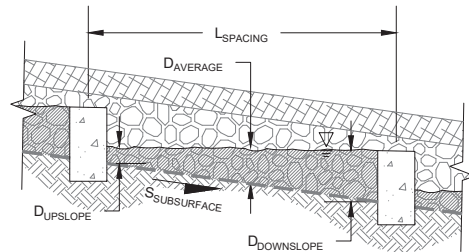
$$L_{SPACING, MAX} = D_{DOWNSLOPE} \div S_{SUBSURFACE}$$

$D_{DOWNSLOPE}$ = DOWNSLOPE STORAGE DEPTH (I.E. CHECK DAM HEIGHT) (FEET)
 $S_{SUBSURFACE}$ = SUBSURFACE SLOPE (FT/FT)

SPACING, $L_{SPACING}$ (WHEN $L_{SPACING} \leq L_{SPACING, MAX}$) :

$$L_{SPACING} = \frac{2 (D_{AVERAGE} - D_{DOWNSLOPE})}{S_{SUBSURFACE}}$$

$D_{AVERAGE}$ = AVERAGE STORAGE DEPTH (FEET)



EDGE TREATMENTS						SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS			
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS		
PC 1.1	PC 1.2	PC 1.3	PC 1.4	PC 1.5	PC 1.6	PC 2.1	PC 2.2	PC 3.1	PC 3.2	PC 3.3	PC 3.4



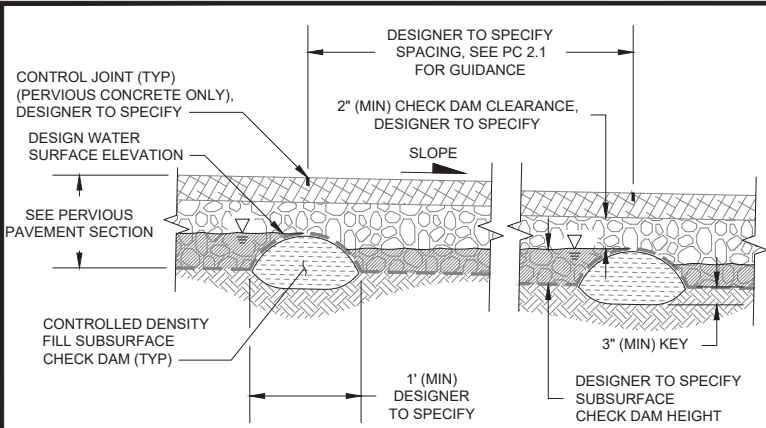
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**GREEN INFRASTRUCTURE
 TYPICAL DETAILS**
 COUNTY OF SAN MATEO

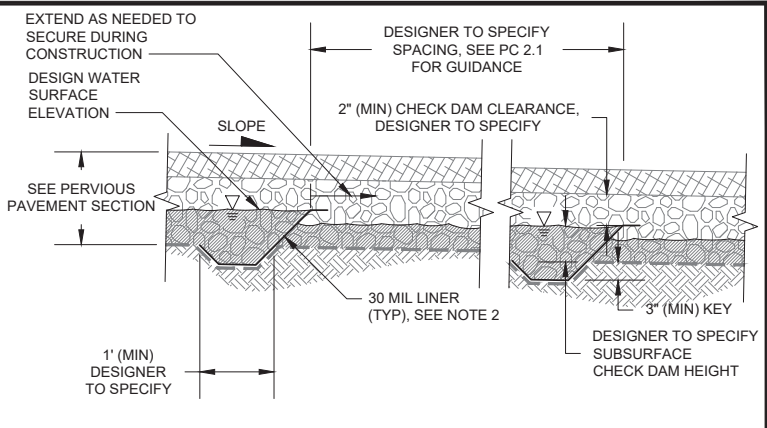
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PAVEMENT COMPONENTS
 SUBSURFACE CHECK DAMS
 DESIGNER NOTES

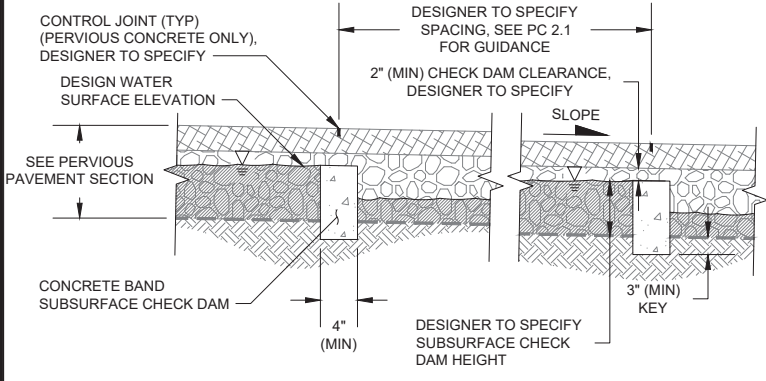
FILE NO.
PC 2.1



CONTROLLED DENSITY FILL SUBSURFACE CHECK DAM ①



IMPERMEABLE LINER SUBSURFACE CHECK DAM ②



CONCRETE BAND SUBSURFACE CHECK DAM ③

- CONSTRUCTION NOTES:**
1. ALL MATERIAL AND WORKMANSHIP FOR CHECK DAMS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
 2. LINER SHALL BE HDPE CONFORMING TO GEOSYNTHETIC RESEARCH INSTITUTE (GRI) GM13 OR LLDPE CONFORMING TO GRI GM 17.

EDGE TREATMENTS						SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS			
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS		
PC 1.1	PC 1.2	PC 1.3	PC 1.4	PC 1.5	PC 1.6	PC 2.1	PC 2.2	PC 3.1	PC 3.2	PC 3.3	PC 3.4



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**GREEN INFRASTRUCTURE
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COUNTY OF SAN MATEO

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PAVEMENT COMPONENTS
SUBSURFACE CHECK DAMS

FILE NO.
PC 2.2

PURPOSE:

PERVIOUS PAVEMENT SUBSURFACE OVERFLOWS AND/OR UNDERDRAINS ARE DESIGNED TO CONVEY EXCESS FLOW TO AN APPROVED DISCHARGE POINT. FOR **SUBSURFACE OVERFLOW** CONFIGURATIONS, THE OVERFLOW RISER ELEVATION IS SET AT THE MAXIMUM DESIGN PONDING DEPTH IN THE PAVEMENT BASE. FOR **SUBSURFACE UNDERDRAIN** CONFIGURATIONS, THE CHECK DAM IS SET AT THE MAXIMUM DESIGN PONDING DEPTH IN THE PAVEMENT BASE, AND THE UNDERDRAIN IS LOCATED IN AN UNDERDRAIN TRENCH. WATER BELOW THE OVERFLOW RISER OR CHECK DAM ELEVATION IS TEMPORARILY STORED AND INFILTRATED INTO THE UNDERLYING SUBGRADE. UNDERDRAINS ARE ONLY RECOMMENDED WHEN AN AVAILABLE DAYLIGHT CONDITION EXISTS.

DESIGNER NOTES & GUIDELINES:

1. DESIGNERS MUST ADAPT DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
2. OVERFLOW / UNDERDRAIN PIPES MUST BE LOCATED AT AN ELEVATION HIGHER THAN THE STORM DRAIN MAIN HYDRAULIC GRADE LINE TO PREVENT BACK FLOW INTO THE PAVEMENT SECTION.
3. OVERFLOW IS TYPICALLY PROVIDED BY A SUBSURFACE SLOTTED OVERFLOW PIPE(S) WITH DOWNSTREAM OUTLET CONTROL OR UPSTREAM CHECK DAMS SET AT THE DESIGN PONDING ELEVATION.
4. EMERGENCY OVERFLOW FOR LARGE STORM EVENTS CAN BE PROVIDED BY SURFACE SHEET FLOW UPON INUNDATION OF THE PAVEMENT SECTION (REQUIRES SURFACE CONVEYANCE SYSTEM OR OTHER RUNOFF COLLECTION METHOD).
5. THE DESIGNER MUST CONSIDER THE FLOW PATH OF WATER WHEN THE PERVIOUS PAVEMENT SECTION IS FULLY SATURATED TO THE MAXIMUM DESIGN DEPTH TO CONFIRM THERE ARE NO UNANTICIPATED DISCHARGE LOCATIONS (E.G., INTERSECTING UTILITY TRENCHES) AND TO ENSURE THE DESIGN PROVIDES EMERGENCY OVERFLOW CONVEYANCE TO AN APPROVED DISCHARGE POINT.
6. CONVEYANCE CALCULATIONS ARE REQUIRED TO DESIGN THE OVERFLOW / UNDERDRAIN PIPE DIAMETER AND PIPE SPACING TO SATISFY SMC HYDRAULIC REQUIREMENTS.
7. IF SITE CONSTRAINTS NECESSITATE USE OF OVERFLOW PIPE IN AN AREA SUBJECT TO VEHICULAR TRAFFIC OR OTHER LOADING, APPROPRIATE COVER DEPTH AND PIPE MATERIAL MUST BE DESIGNED.
8. WEARING COURSE MAY BE USED TO FULFILL MINIMUM COVER REQUIREMENTS PROVIDED WEARING COURSE IS RIGID PAVEMENT.
9. OPTIONAL OBSERVATION PORTS CAN BE USED TO DETERMINE WHETHER AN OVERFLOW / UNDERDRAIN IS DEWATERING PROPERLY. REFER TO **GC 4.1- GC 4.3**.
10. OVERFLOW / UNDERDRAIN PIPES MUST BE EQUIPPED WITH CLEANOUTS. REFER TO **GC 5.1**.
11. INSTALL OVERFLOW PIPES AT DOWNGRADIENT END OF PAVEMENT. OVERFLOWS NOT REQUIRED AT EACH CHECK DAM LOCATION.
12. PIPE MATERIAL SHALL BE DESIGNED PER SAN MATEO COUNTY CODE (CHAPTER X, SECTION X).
13. AN OUTLET ORIFICE CONTROL DEVICE MAY BE INSTALLED TO FURTHER DETAIN OUTFLOW AND MAXIMIZE INFILTRATION. ENGINEER SHALL DESIGN, DETAIL, SPECIFY, AND CONDUCT SUPPLEMENTAL PERFORMANCE CALCULATIONS AS NEEDED.

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- OVERFLOW / UNDERDRAIN PIPE MATERIAL, DIAMETER, AND COVER DEPTH
- OVERFLOW / UNDERDRAIN PIPE INVERT ELEVATION AND SLOPE
- OVERFLOW / UNDERDRAIN PIPE ALIGNMENT AND DISCHARGE LOCATION

EDGE TREATMENTS						SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS				
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS			
PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC
1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	3.1	3.2	3.3	3.4	



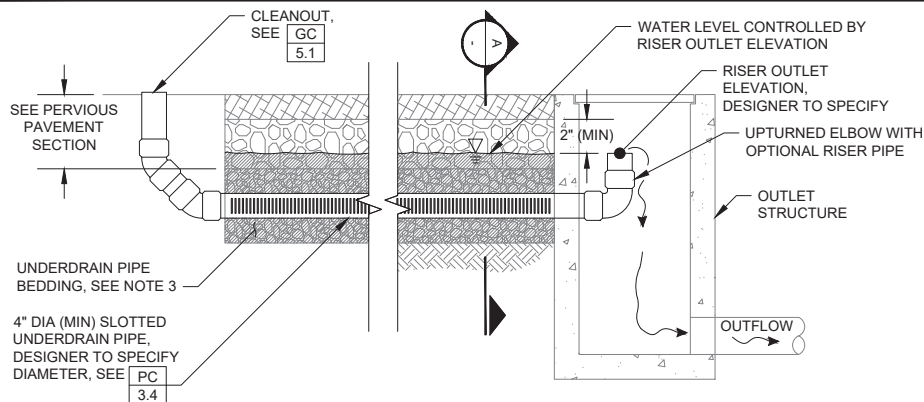
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

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PAVEMENT COMPONENTS
SUBSURFACE OVERFLOWS
DESIGNER NOTES

FILE NO.
PC
3.1

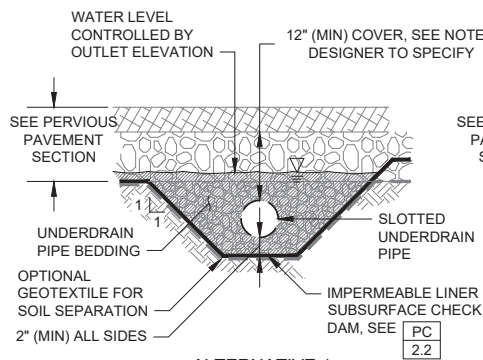


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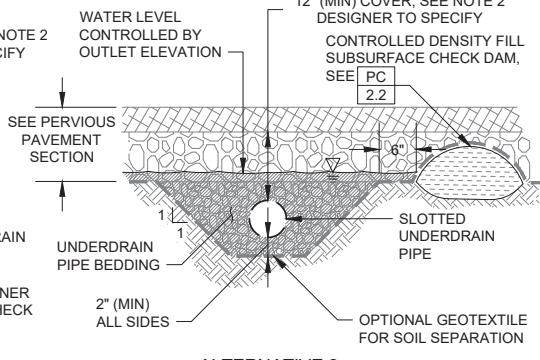
OVERFLOW CONTROL STRUCTURE WITH RISER 1

CONSTRUCTION NOTES:

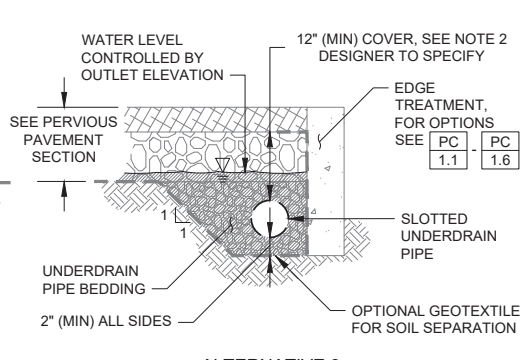
1. ALL MATERIAL AND WORKMANSHIP FOR UNDERDRAIN STRUCTURES SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. LOCATE UNDERDRAIN PIPE BELOW STRUCTURAL PAVEMENT BASE DEPTH.
3. UNDERDRAIN PIPE BEDDING SHALL BE ASTM NO. 57 CONFORMING TO THE REQUIREMENTS OF GRAVEL BASE MATERIAL FOR PAVEMENTS, UNLESS OTHERWISE SPECIFIED.



ALTERNATIVE 1



ALTERNATIVE 2



ALTERNATIVE 3

UNDERDRAIN PIPE TRENCH SECTION A

EDGE TREATMENTS						SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS			
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS		
PC 1.1	PC 1.2	PC 1.3	PC 1.4	PC 1.5	PC 1.6	PC 2.1	PC 2.2	PC 3.1	PC 3.2	PC 3.3	PC 3.4



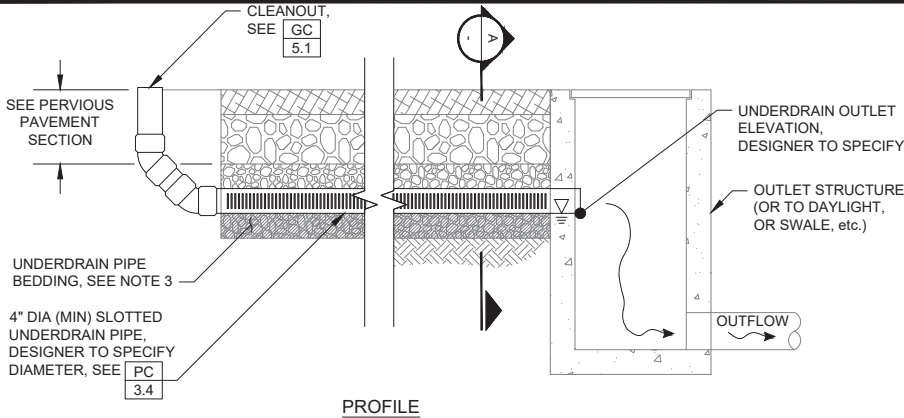
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TYPICAL DETAILS**
COUNTY OF SAN MATEO

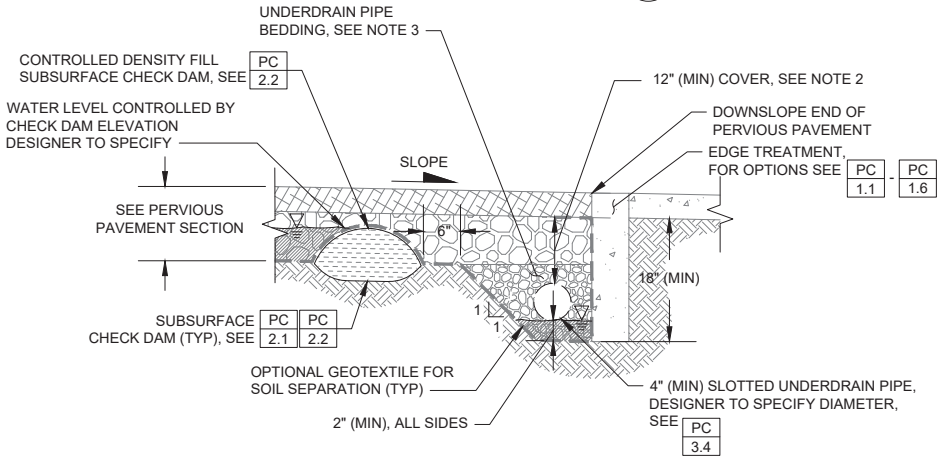
DATE: 06.2022
VERSION: 02
REVISED: N/A

PAVEMENT COMPONENTS
SUBSURFACE OVERFLOW

FILE NO.
PC 3.2



PROFILE
UNDERDRAIN TO DAYLIGHT 1



CHECK DAM-CONTROLLED WITH UNDERDRAIN A

CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR OVERFLOW STRUCTURES SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. LOCATE UNDERDRAIN PIPE BELOW STRUCTURAL PAVEMENT BASE DEPTH.
3. UNDERDRAIN PIPE BEDDING SHALL BE ASTM NO. 57 CONFORMING TO THE REQUIREMENTS OF GRAVEL BASE MATERIAL FOR PAVEMENTS, UNLESS OTHERWISE SPECIFIED.

EDGE TREATMENTS						SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS			
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS		
PC 1.1	PC 1.2	PC 1.3	PC 1.4	PC 1.5	PC 1.6	PC 2.1	PC 2.2	PC 3.1	PC 3.2	PC 3.3	PC 3.4



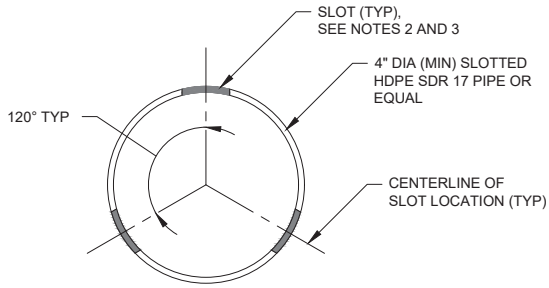
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**GREEN INFRASTRUCTURE
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PAVEMENT COMPONENTS
SUBSURFACE UNDERDRAIN

FILE NO.
PC 3.3



SLOTTED UNDERDRAIN PIPE 1

CONSTRUCTION NOTES:

1. UNDERDRAIN PIPE SHALL BE SLOTTED HDPE SDR 17 (PREFERRED), PERFORATED PIPE HDPE SDR 17, OR ACCEPTABLE SUBSTITUTE MATERIAL PER ENGINEERS SPECIFICATION. SINGLE WALL AND DUAL WALL CORRUGATED HDPE PIPE (AASHTO M252 AND M294 TYPES C, S, AND D) ARE NOT ACCEPTABLE.
2. ALL PERFORATIONS SHALL BE SLOTTED TYPE, MEASURING 0.032 INCH WIDE (MAX), SPACED AT 0.25 INCH (MIN), AND PROVIDING A MINIMUM INLET AREA OF 5.0 SQUARE INCH PER LINEAR FOOT OF PIPE.
3. PERFORATIONS SHALL BE ORIENTED PERPENDICULAR TO LONG AXIS OF PIPE, AND EVENLY SPACED AROUND CIRCUMFERENCE AND LENGTH OF PIPE.

EDGE TREATMENTS						SUBSURFACE CHECK DAMS		SUBSURFACE OUTLETS			
NOTES	KEY MAP	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS		
PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC
1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	3.1	3.2	3.3	3.4



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PAVEMENT COMPONENTS
UNDERDRAIN PIPE

FILE NO.
PC
3.4

PURPOSE:

BIORETENTION PLANTERS CAPTURE AND TREAT STORMWATER RUNOFF VIA SURFACE AND SUBSURFACE STORAGE, FILTRATION THROUGH BIOTREATMENT SOIL, AND INFILTRATION INTO NATIVE SOIL WHERE FEASIBLE. BIORETENTION PLANTERS MAY ALSO BE REFERRED TO AS STORMWATER PLANTERS OR STORMWATER CURB EXTENSIONS AND INCLUDE 3 TYPES OF PLANTERS: BIOINFILTRATION (UNLINED, NO UNDERDRAIN), BIORETENTION (UNDER-DRAINED) AND FLOW-THROUGH (LINED WITH UNDERDRAIN). ALL TYPES TYPICALLY HAVE VERTICAL SIDE WALLS IN ORDER TO MAXIMIZE WATER STORAGE VOLUME IN CONSTRAINED SITES.

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT PLAN AND SECTION DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
2. PLANTER AREA, PONDING DEPTH, BIOTREATMENT SOIL DEPTH, AND AGGREGATE STORAGE DEPTH MUST BE SIZED TO MEET PROJECT HYDROLOGIC PERFORMANCE GOALS.
3. FACILITY DRAWDOWN TIME (i.e., TIME FOR SURFACE PONDING TO DRAIN THROUGH THE ENTIRE SECTION INCLUDING AGGREGATE STORAGE AFTER THE END OF A STORM) REQUIREMENTS:
 - 48 HOUR (PREFERRED), 72 HOUR MAXIMUM FACILITY DRAWDOWN (i.e. ORIFICE CONTROLLED SYSTEM OR EXTENDED STORAGE DEPTH WITHIN INFILTRATION SYSTEM)
4. AN AGGREGATE COURSE IS REQUIRED UNDER THE BIOTREATMENT SOIL FOR BIORETENTION IN SEPARATE SEWER SYSTEM AREAS TO PROVIDE ADDITIONAL TREATMENT. SEE GUIDANCE ON **BC 4.1**.
5. THE PLANTER WALL SLOPE IS TYPICALLY DESIGNED TO MATCH THE LONGITUDINAL SLOPE OF THE ADJACENT ROADWAY/SIDEWALK. THE FACILITY SUBGRADE, HOWEVER, SHOULD BE FLAT. CHECK DAMS MAY BE USED TO TERRACE FACILITIES TO PROVIDE SUFFICIENT PONDING FOR HIGHER-SLOPED INSTALLATIONS. DESIGNER MUST SPECIFY CHECK DAM HEIGHT AND SPACING. REFER TO **BC 6.1** AND **BC 6.2** FOR GUIDANCE ON CHECK DAM DESIGN.
6. DEPENDING ON THE HEIGHT OF THE PROPOSED PLANTER WALL, ADDITIONAL STRUCTURAL CONSIDERATIONS MAY BE REQUIRED TO ADDRESS WALL LOADING. REFER TO **BC 1.1** THROUGH **BC 1.12** FOR GUIDANCE ON EDGE TREATMENTS.
7. WHEN FACILITY CONSTRUCTION IMPACTS EXISTING SIDEWALK, ALL SAW CUTS MUST ADHERE TO SMC DPW REQUIREMENTS. SAW CUTS SHOULD BE ALONG SCORE LINES AND ANY DISTURBED SIDEWALK FLAGS SHOULD BE REPLACED IN THEIR ENTIRETY.
8. PLANTERS IN PUBLIC RIGHT OF WAY SHALL BE DESIGNED WITH EMERGENCY OVERFLOW TO THE STREET IN THE EVENT THE PLANTER OUTLET IS OBSTRUCTED OR CLOGGED.
9. UP TO TWO PLANTERS MAY BE CONNECTED IN SERIES, IN LIEU OF MULTIPLE INLETS, PROVIDED THE CONNECTION IS A TRENCH DRAIN OR EQUAL SURFACE CONVEYANCE AND IS ADEQUATELY SIZED TO CONVEY FLOWS.
10. PLANTER VEGETATION MUST BE SPECIFIED BY DESIGN PROFESSIONAL PER C.3 TECHNICAL GUIDANCE MANUAL, APPENDIX A PLANT LIST, AND SMCWPPP GI DESIGN GUIDE CHAPTER 4.
11. THE DESIGNER MUST EVALUATE UTILITY SURVEYS FOR POTENTIAL UTILITY CROSSINGS OR CONFLICTS. REFER TO **GC 2.1 - GC 2.12** FOR UTILITY CROSSING DETAILS AND **GC 3.1 - GC 3.3** FOR UTILITY CROSSING CONFLICT DETAILS.
12. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT JURISDICTIONAL ASSET PROTECTION STANDARDS. IN THE ABSENCE OF THESE STANDARDS, THE DESIGNER SHALL REFER TO CHAPTER 3 OF SMCWPPP GI DESIGN GUIDE FOR BEST PRACTICES AND COORDINATE DIRECTLY WITH RELEVANT UTILITY PROVIDERS FOR REQUIREMENTS.
13. FREEBOARD REQUIREMENTS SHOWN SHOULD BE USED AS GUIDELINES BUT THE DESIGNER SHALL REFER TO THE C.3 TECHNICAL GUIDANCE MANUAL FOR ADDITIONAL FREEBOARD REQUIREMENTS, ESPECIALLY WHERE THE BIORETENTION PLANTER IS LOCATED IN A SUMP AND DEPENDS ON OUTFLOW THROUGH AN OVERFLOW STRUCTURE/CATCH BASIN.

RELATED COMPONENTS		
EDGE TREATMENTS:	BC 1.1	BC 1.12
INLETS:	BC 2.1	BC 2.6
OUTLETS:	BC 3.1	BC 3.4
SOIL & AGGREGATE LAYERS:	BC 4.1	
UNDERDRAINS:	BC 5.1	BC 5.2
CHECK DAMS:	BC 6.1	BC 6.2
LINERS:	GC 1.1	GC 1.2
UTILITY CROSSINGS:	GC 2.1	GC 2.12
UTILITY CONFLICTS:	GC 3.1	GC 3.3
OBSERVATION PORTS:	GC 4.1	GC 4.2
CLEANOUTS:	GC 5.1	

RELATED SPECIFICATIONS
BIORETENTION: BIOTREATMENT SOIL MIX PER BASMAA SPECIFICATIONS (SEE SMCWPPP C.3 REGULATED PROJECTS GUIDE APPENDIX K)

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						PARCEL APPLICATIONS						
PLAN SECTIONS	PLAN SECTIONS	PLAN SECTIONS	PLAN SECTIONS	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	NOTES	PLAN	SECTIONS								
BP 1.1	BP 1.2	BP 2.1	BP 2.2	BP 3.1	BP 3.2	BP 3.3	BP 3.4	BP 4.1	BP 4.2	BP 4.3	BP 4.4	BP 4.5	BP 4.6	BP 5.1	BP 5.2	BP 5.3	BP 5.4	BP 5.5	BP 5.6	BP 5.7



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COUNTY OF SAN MATEO

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BIORETENTION PLANTER
DESIGNER NOTES (1 OF 2)

FILE NO:
**BP
1.1**

NOT FOR CONSTRUCTION - REFER TO USER GUIDE

LAYOUT REQUIREMENTS:

- REFER TO THE SMC STANDARD DRAWINGS, ROAD SECTIONS, AND CODES FOR COURTESY STRIP, THROUGHWAY, PARKING SPACE AND ACCESSIBLE PATH REQUIREMENTS.
- LOCATE CURB CUTS AND GUTTER MODIFICATIONS TO AVOID CONFLICTS WITH ACCESSIBILITY REQUIREMENTS (E.G., LOCATE OUTSIDE OF CROSSWALKS).

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- PLANTER WIDTH AND LENGTH
- DEPTH OF PONDING
- DEPTH OF FREEBOARD
- DEPTH OF BIOTREATMENT SOIL
- DEPTH AND TYPE OF AGGREGATE STORAGE, IF ANY
- PLANTER SURFACE ELEVATION (TOP OF BIOTREATMENT SOIL) AT UPSLOPE AND DOWNSLOPE ENDS OF FACILITY
- CONTROL POINTS AT EVERY PLANTER WALL CORNER AND POINT OF TANGENCY
- DIMENSIONS AND DISTANCE TO EVERY INLET, OUTLET, CHECK DAM, SIDEWALK NOTCH, ETC.
- ELEVATIONS OF EVERY INLET, OUTLET, STRUCTURE RIM AND INVERT, CHECK DAM, PLANTER WALL CORNER, AND SIDEWALK NOTCH
- TYPE AND DESIGN OF PLANTER COMPONENTS (E.G., EDGE TREATMENTS, INLETS/GUTTER MODIFICATIONS, UTILITY CROSSINGS, LINER, AND PLANTING DETAILS)

SOIL TYPE GUIDANCE:

HYDROLOGIC SOIL GROUP	SOIL TYPE	CORRESPONDING UNIFIED SOIL CLASSIFICATION	DESCRIPTION
A	SAND, LOAMY SAND, OR SANDY LOAM	GW - WELL-GRADED GRAVELS, SANDY GRAVELS GP - GAP-GRADED OR UNIFORM GRAVELS, SANDY GRAVELS GM - SILTY GRAVELS, SILTY SANDY GRAVELS SW - WELL-GRADED, GRAVELLY SANDS SP - GAP-GRADED OR UNIFORM SANDS, GRAVELLY SANDS	LOW RUNOFF POTENTIAL. SOILS HAVING HIGH INFILTRATION RATES EVEN WHEN THOROUGHLY WETTED AND CONSISTING CHIEFLY OF DEEP, WELL TO EXCESSIVELY DRAINED SANDS OR GRAVELS.
B	SILT LOAM OR LOAM	SM - SILTY SANDS, SILTY GRAVELLY SANDS MH - MICACEOUS SILTS, DIATOMACEOUS SILTS, VOLCANIC ASH	SOILS HAVING MODERATE INFILTRATION RATES WHEN THOROUGHLY WETTED AND CONSISTING CHIEFLY OF MODERATELY DEEP TO DEEP, MODERATELY WELL TO WELL-DRAINED SOILS WITH MODERATELY FINE TO MODERATELY COARSE TEXTURES.
C	SANDY CLAY LOAM	ML - SILTS, VERY FINE SANDS, SILTY AND CLAYEY FINE SANDS	SOILS HAVING SLOW INFILTRATION RATES WHEN THOROUGHLY WETTED AND CONSISTING CHIEFLY OF SOILS WITH A LAYER THAT IMPEDES DOWNWARD MOVEMENT OF WATER, OR SOILS WITH MODERATELY FINE TO FINE TEXTURES.
D	CLAY LOAM, SANDY CLAY, SILTY CLAY, OR CLAY	GC - CLAYEY GRAVELS, CLAYEY SANDY GRAVELS SC - CLAYEY SANDS, CLAYEY GRAVELLY SANDS CL - LOW PLASTICITY CLAYS, SANDY OR SILTY CLAYS OL - ORGANIC SILTS AND CLAYS OF LOW PLASTICITY CH - HIGHLY PLASTIC LAYS AND SANDY CLAYS OH - ORGANIC SILTS AND CLAYS OF HIGH PLASTICITY	HIGH RUNOFF POTENTIAL. SOILS HAVING VERY SLOW INFILTRATION RATES WHEN THOROUGHLY WETTED AND CONSISTING CHIEFLY OF CLAY SOILS WITH A HIGH SWELLING POTENTIAL, SOILS WITH A PERMANENT HIGH WATER TABLE, AND SHALLOW SOILS OVER NEARLY IMPERVIOUS MATERIAL.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						PARCEL APPLICATIONS		SECTIONS				
BP	BP	BP	BP	BP	BP	BP	BP	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	BP	BP	BP	BP	BP	BP	
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7



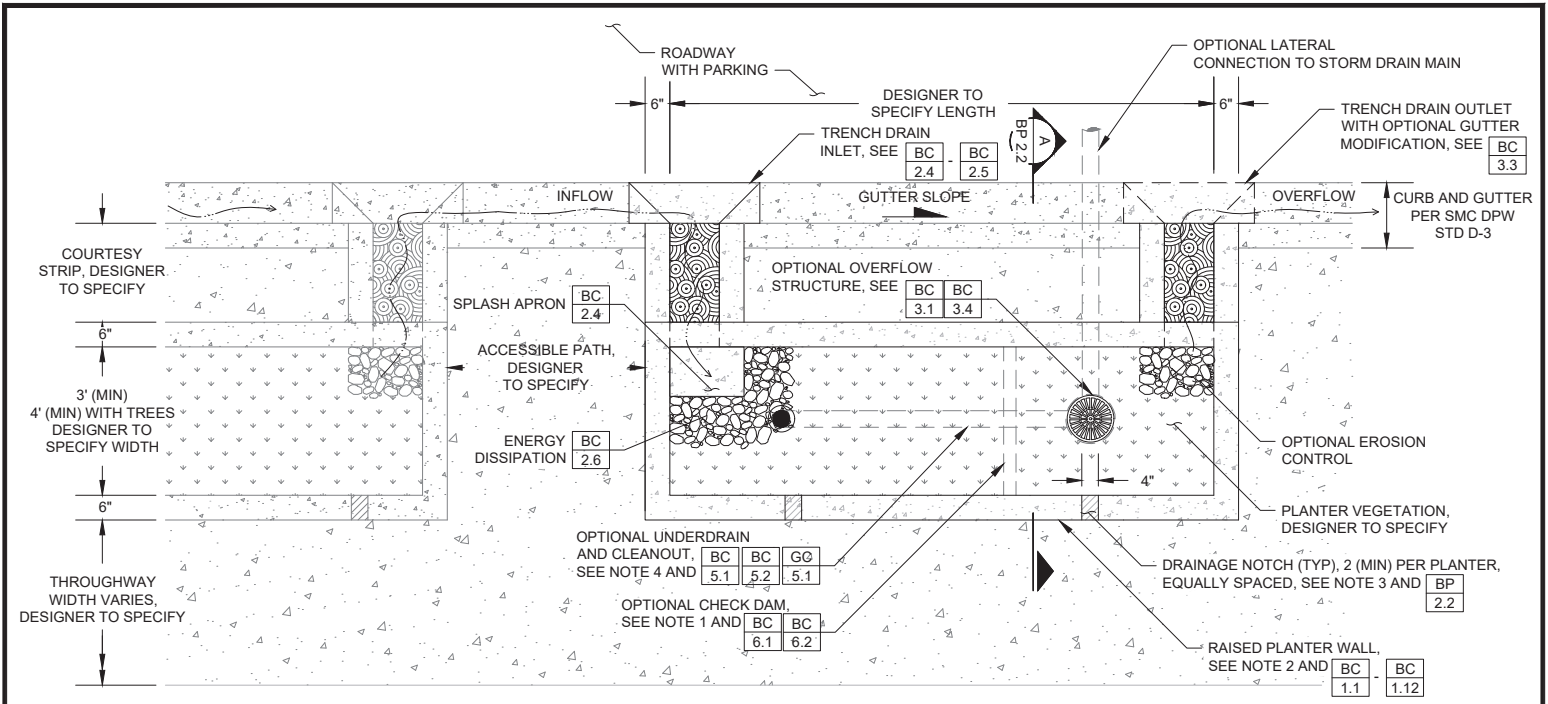
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE: 06.2022
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BIORETENTION PLANTER
DESIGNER NOTES (2 OF 2)


FILE NO.
**BP
1.2**



CONSTRUCTION NOTES:

1. CHECK DAMS SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN.
2. SLOPE TOP OF PLANTER WALL TO MATCH LONGITUDINAL SLOPE OF ADJACENT SURFACE.
3. LAY OUT DRAINAGE NOTCHES TO PREVENT PONDING BEHIND PLANTER WALL WITH 5' MAXIMUM SPACING BETWEEN NOTCHES.
4. PROVIDE ONE CLEANOUT PER PLANTER (MIN) FOR FACILITIES WITH UNDERDRAINS.
5. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT SMC ASSET PROTECTION STANDARDS AND OTHER UTILITY PROVIDER REQUIREMENTS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						NOTES		PLAN		SECTIONS			
BP	BP	BP	BP	BP	BP	BP	BP	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	BP	BP	BP	BP	BP	BP	BP	BP
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7	

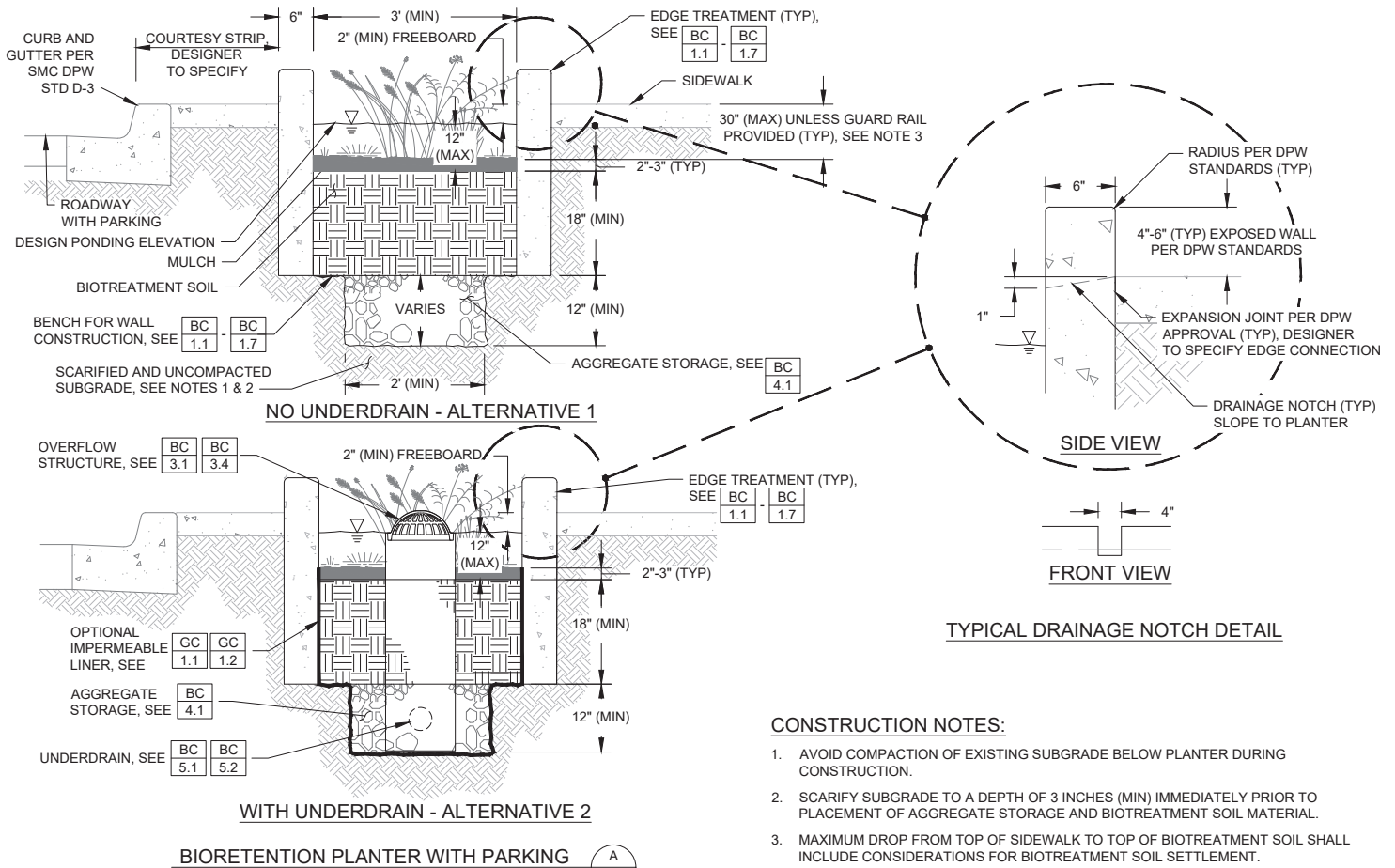

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GREEN INFRASTRUCTURE
TYPICAL DETAILS
 COUNTY OF SAN MATEO

DATE: 06.2022
 VERSION: 02
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BIORETENTION PLANTER
 STORMWATER PLANTER WITH PARKING
 PLAN

FILE NO:
BP
 2.1



CONSTRUCTION NOTES:

1. AVOID COMPACTION OF EXISTING SUBGRADE BELOW PLANTER DURING CONSTRUCTION.
2. SCARIFY SUBGRADE TO A DEPTH OF 3 INCHES (MIN) IMMEDIATELY PRIOR TO PLACEMENT OF AGGREGATE STORAGE AND BIOTREATMENT SOIL MATERIAL.
3. MAXIMUM DROP FROM TOP OF SIDEWALK TO TOP OF BIOTREATMENT SOIL SHALL INCLUDE CONSIDERATIONS FOR BIOTREATMENT SOIL SETTLEMENT.

NOTES	W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						PARCEL APPLICATIONS		
	PLAN SECTIONS	PLAN SECTIONS	PLAN SECTIONS	PLAN SECTIONS	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	NOTES	PLAN	SECTIONS		
BP 1.1, BP 1.2	BP 2.1, BP 2.2	BP 3.1, BP 3.2	BP 3.3, BP 3.4	BP 4.1, BP 4.2	BP 4.3	BP 4.4	BP 4.5	BP 4.6	BP 5.1, BP 5.2	BP 5.3, BP 5.4	BP 5.5	BP 5.6	BP 5.7		



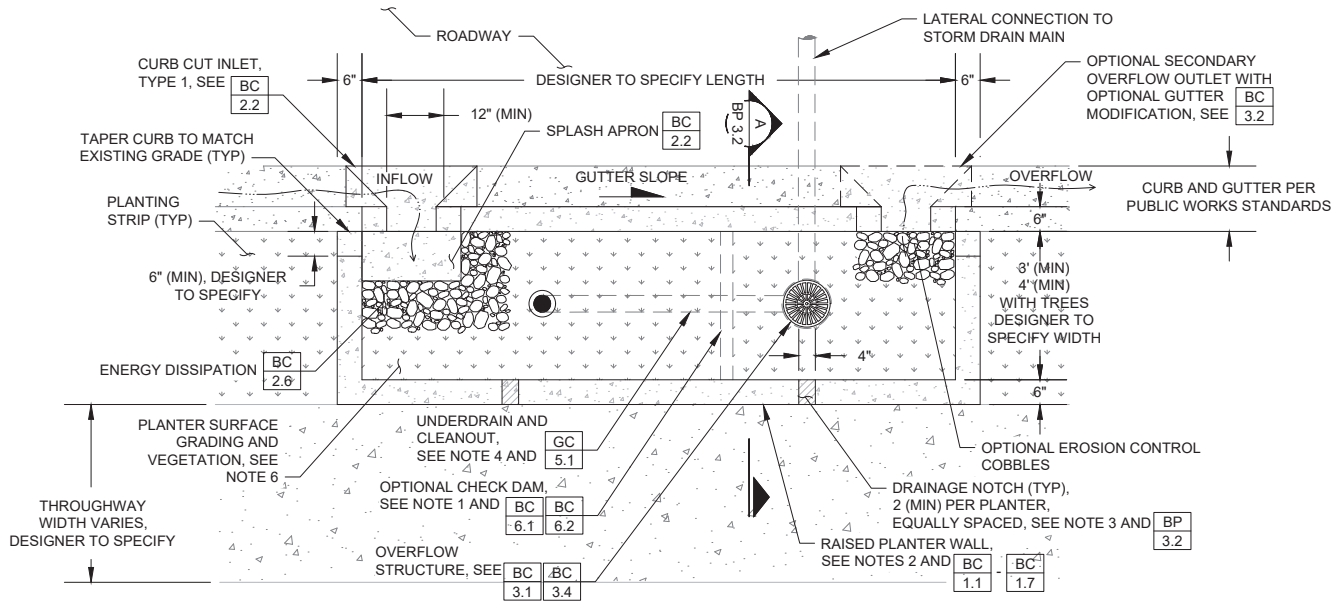
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BIORETENTION PLANTER
STORMWATER PLANTER WITH PARKING
SECTIONS

FILE NO:
BP 2.2



CONSTRUCTION NOTES:

- CHECK DAMS (IF NEEDED) SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN.
- SLOPE TOP OF PLANTER WALL TO MATCH LONGITUDINAL SLOPE OF ADJACENT SURFACE.
- LAY OUT DRAINAGE NOTCHES TO PREVENT PONDING BEHIND PLANTER WALL WITH 5' MAXIMUM SPACING BETWEEN NOTCHES.
- PROVIDE ONE CLEANOUT PER PLANTER (MIN) AT UPSTREAM END OF UNDERDRAIN.
- MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT PUBLIC WORKS AND OTHER UTILITY PROVIDER REQUIREMENTS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
- DESIGNER TO SPECIFY FINISH SURFACE GRADING AND PLANTING. UNLESS OTHERWISE NOTED IN THE GRADING PLAN, THE FINISH SURFACE SHALL BE FLAT TO PROVIDE THE MAXIMUM WATER STORAGE.

NOTE ABOUT REFERENCED DETAILS:

THIS DETAIL REFERENCES BIORETENTION COMPONENT AND SECTION DETAILS THAT ARE THE ORIGINAL COUNTY OF SAN MATEO TYPICAL GI DETAILS AND HAVE NOT BEEN MODIFIED TO ALIGN WITH CCC REQUIREMENTS. IF USED, THE DESIGNER WILL NEED TO MODIFY THESE DETAILS TO CONFORM TO CCC REQUIREMENTS AND SITE-SPECIFIC CONDITIONS.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						PARCEL APPLICATIONS						
PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	NOTES		PLAN		SECTIONS		
BP 1.1	BP 1.2	BP 2.1	BP 2.2	BP 3.1	BP 3.2	BP 3.3	BP 3.4	BP 4.1	BP 4.2	BP 4.3	BP 4.4	BP 4.5	BP 4.6	BP 5.1	BP 5.2	BP 5.3	BP 5.4	BP 5.5	BP 5.6	BP 5.7



**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF CONTRA COSTA

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BIORETENTION PLANTER*
STORMWATER PLANTER WITHOUT PARKING
PLAN

FILE NO:
BP 3.1*

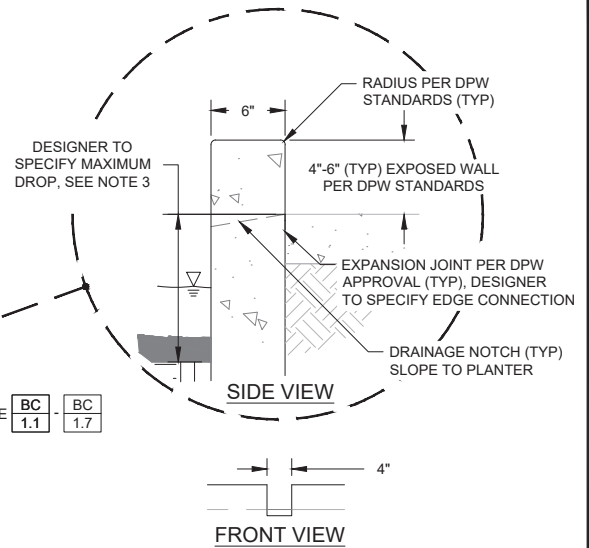
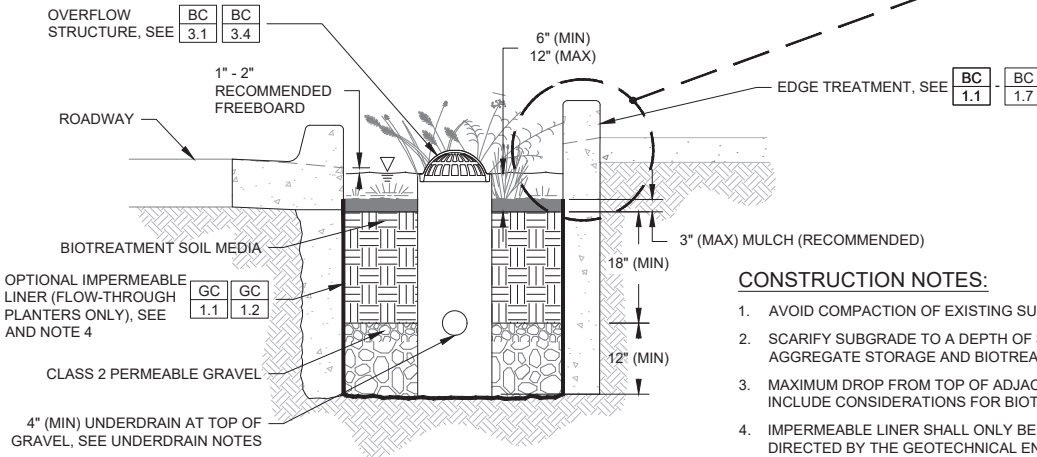
*THIS DETAIL HAS BEEN MODIFIED FOR CCCWP

NOTE ABOUT REFERENCED DETAILS:

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UNDERDRAIN NOTES:

1. IF PLANTER IS COMPLETELY LINED, E.G., FLOW-THROUGH PLANTER, THE UNDERDRAIN SHALL BE SET AT THE BOTTOM OF THE LINED PLANTER (2" MAX ABOVE LINER IF BEDDING UNDER PIPE IS NEEDED). OTHERWISE, THE UNDERDRAIN SHALL BE SET IN A GROOVE AT TOP OF GRAVEL WITH PERFORATIONS FACING DOWN AS SHOWN.
2. PERFORATED UNDERDRAIN PIPE SHALL BE 4-INCH SDR 35 OR EQUIVALENT.
3. USE A SHORT SECTION OF SOLID SCHEDULE 80 PVC (OR EQUIVALENT) AT THE CONNECTION TO THE OVERFLOW STRUCTURE AND SEAL PENETRATION WITH NON-SHRINK GROUT.
4. NO GEOTEXTILE FABRICS ARE ALLOWED TO BE INSTALLED AROUND THE UNDERDRAIN OR UNDER UNLINED BIORETENTION PLANTERS.



TYPICAL DRAINAGE NOTCH DETAIL

CONSTRUCTION NOTES:

1. AVOID COMPACTION OF EXISTING SUBGRADE BELOW PLANTER DURING CONSTRUCTION.
2. SCARIFY SUBGRADE TO A DEPTH OF 3 INCHES (MIN) IMMEDIATELY PRIOR TO PLACEMENT OF AGGREGATE STORAGE AND BIOTREATMENT SOIL MATERIAL.
3. MAXIMUM DROP FROM TOP OF ADJACENT PEDESTRIAN AREA TO TOP OF BIOTREATMENT SOIL SHALL INCLUDE CONSIDERATIONS FOR BIOTREATMENT SOIL SETTLEMENT.
4. IMPERMEABLE LINER SHALL ONLY BE USED WHEN SITE CONDITIONS REQUIRE USE, UNLESS DIRECTED BY THE GEOTECHNICAL ENGINEER.
5. INSTALL BIOTREATMENT SOIL MEDIA (BSM) IN EITHER TWO 8" - 12" LIFTS AND THEN WETTED TO ACCOMMODATE AN EXPECTED 2" OF SETTLING OR THREE 6" LIFTS THEN WETTED WITH ADDITIONAL BSM ADDED TO THE SURFACE AS NEEDED TO ACHIEVE A FINAL DEPTH OF 18".

BIORETENTION PLANTER WITHOUT PARKING

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						PARCEL APPLICATIONS		SECTIONS				
PLAN	SECTIONS	PLAN	SECTIONS	PLAN	SECTIONS	PLAN	SECTIONS	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	NOTES	PLAN	SECTIONS	PLAN	SECTIONS		
BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7



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COUNTY OF CONTRA COSTA

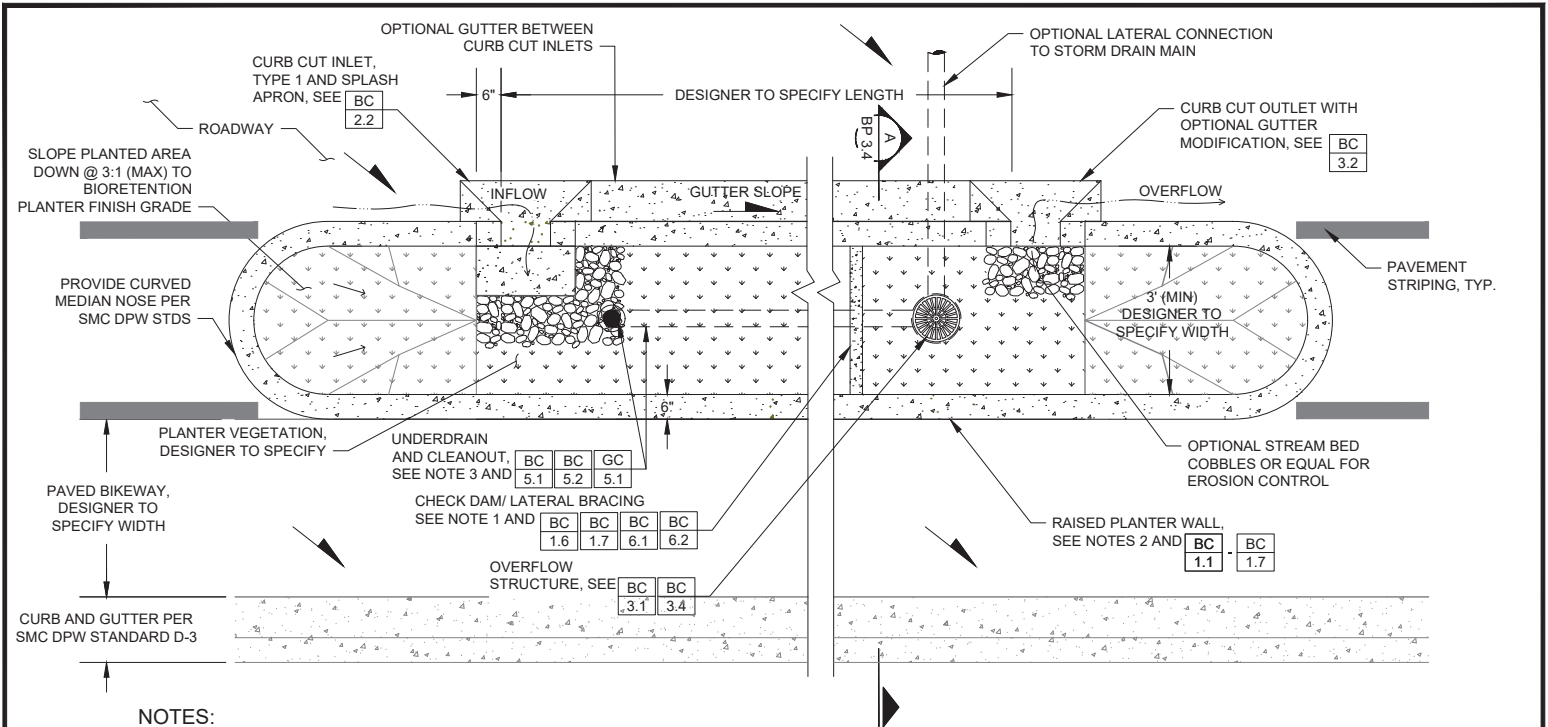
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BIORETENTION PLANTER*
STORMWATER PLANTER WITHOUT PARKING
SECTIONS

FILE NO:
**BP
3.2***

*THIS DETAIL HAS BEEN MODIFIED FOR CCCWP

NOT FOR CONSTRUCTION - REFER TO USER GUIDE



NOTES:

1. CHECK DAMS SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN.
2. SLOPE TOP OF PLANTER WALL TO MATCH LONGITUDINAL SLOPE OF ADJACENT SURFACE.
3. PROVIDE ONE CLEANOUT PER PLANTER (MIN) AND NO LESS THAN ONE CLEANOUT FOR EVERY 100 LINEAR FEET OF PIPE FOR FACILITIES WITH UNDERDRAINS.
4. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT JURISDICTIONAL UTILITY PROTECTION STANDARDS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		BULBOUT						PARCEL APPLICATIONS						
PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	NOTES		PLAN		SECTIONS		
[BP] 1.1	[BP] 1.2	[BP] 2.1	[BP] 2.2	[BP] 3.1	[BP] 3.2	[BP] 3.3	[BP] 3.4	[BP] 4.1	[BP] 4.2	[BP] 4.3	[BP] 4.4	[BP] 4.5	[BP] 4.6	[BP] 5.1	[BP] 5.2	[BP] 5.3	[BP] 5.4	[BP] 5.5	[BP] 5.6	[BP] 5.7



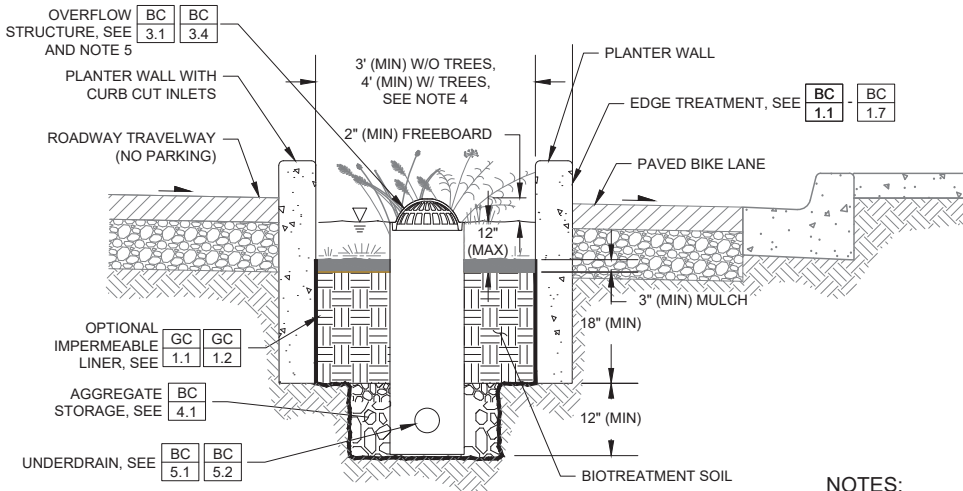
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BIORETENTION PLANTER
STORMWATER BARRIER PLANTER
CLASS 4 BIKEWAY – PLAN

FILE NO:
**BP
3.3**



STORMWATER BARRIER PLANTER FOR CLASS 4 BIKEWAY (A)

NOTES:

1. AVOID COMPACTION OF EXISTING SUBGRADE BELOW PLANTER DURING CONSTRUCTION.
2. SCARIFY SUBGRADE TO A DEPTH OF 3 INCHES (MIN) IMMEDIATELY PRIOR TO PLACEMENT OF AGGREGATE STORAGE AND BIOTREATMENT SOIL MATERIAL.
3. MAXIMUM DROP FROM TOP OF CURB TO TOP OF BIOTREATMENT SOIL SHALL INCLUDE CONSIDERATIONS FOR BIOTREATMENT SOIL SETTLEMENT.
4. DESIGNER TO SPECIFY PLANTER WIDTH AND IF TREES ARE DESIRED, PROVIDE ADDITIONAL TREE ROOT VOLUME USING STRUCTURAL SOIL OR SILVA CELLS UNDER ADJACENT BIKEWAY PAVEMENT.
5. OVERFLOW STRUCTURE TO HAVE SQUARE OR ATRIUM GRATE PER PROJECT DESIGN AND THE DISCRETION OF THE PUBLIC WORKS DEPARTMENT.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		BULBOUT						PARCEL APPLICATIONS					
PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	NOTES		PLAN		SECTIONS	
BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6



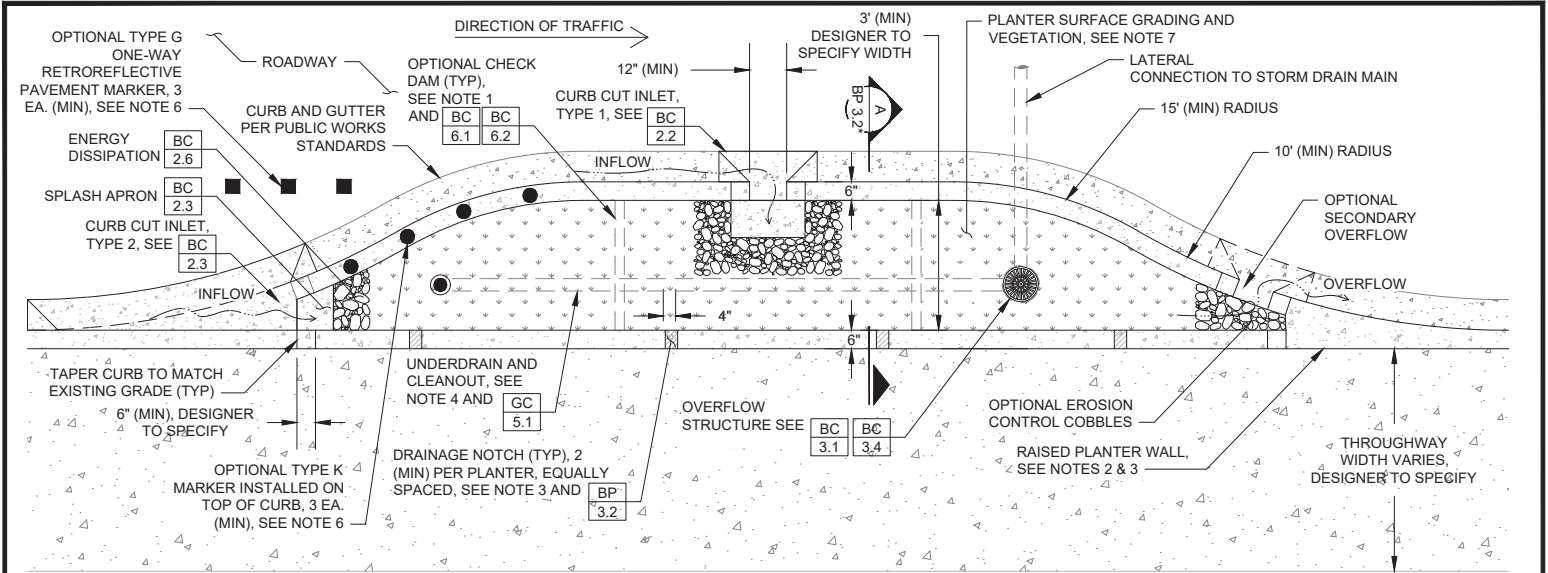
ANN M. STILLMAN
INTERIM DIRECTOR
OF PUBLIC WORKS

**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE: 06.2021
VERSION: 01
REVISED: N/A

BIORETENTION PLANTER
STORMWATER BARRIER PLANTER
CLASS 4 BIKEWAY – SECTION

FILE NO:
BP
3.4



CONSTRUCTION NOTES:

- CHECK DAMS (IF NEEDED) SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN.
- SLOPE TOP OF PLANTER WALL TO MATCH LONGITUDINAL SLOPE OF ADJACENT SURFACE.
- LAY OUT DRAINAGE NOTCHES TO PREVENT PONDING BEHIND PLANTER WALL WITH 5' MAXIMUM SPACING BETWEEN NOTCHES.
- PROVIDE ONE CLEANOUT PER PLANTER (MIN) AT UPSTREAM END OF UNDERDRAIN.
- MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO PUBLIC WORKS AND OTHER UTILITY PROVIDER REQUIREMENTS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
- THE TYPE AND LOCATION OF ALL PROPOSED TRAFFIC SAFETY MARKERS AND DELINEATORS MUST BE APPROVED BY THE TRANSPORTATION AGENCY HAVING JURISDICTION PRIOR TO INSTALLATION.
- DESIGNER TO SPECIFY FINISH SURFACE GRADING AND PLANTING. UNLESS OTHERWISE NOTED IN THE GRADING PLAN, THE FINISH SURFACE SHALL BE FLAT TO PROVIDE THE MAXIMUM WATER STORAGE.

NOTE ABOUT REFERENCED DETAILS:

THIS DETAIL REFERENCES BIORETENTION COMPONENT AND SECTION DETAILS THAT ARE THE ORIGINAL COUNTY OF SAN MATEO TYPICAL GI DETAILS AND HAVE NOT BEEN MODIFIED TO ALIGN WITH CCC REQUIREMENTS. IF USED, THE DESIGNER WILL NEED TO MODIFY THESE DETAILS TO CONFORM TO CCC REQUIREMENTS AND SITE-SPECIFIC CONDITIONS.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						NOTES		PLAN		SECTIONS		
BP	BP	BP	BP	BP	BP	BP	BP	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	BP	BP	BP	BP	BP	BP	BP
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7



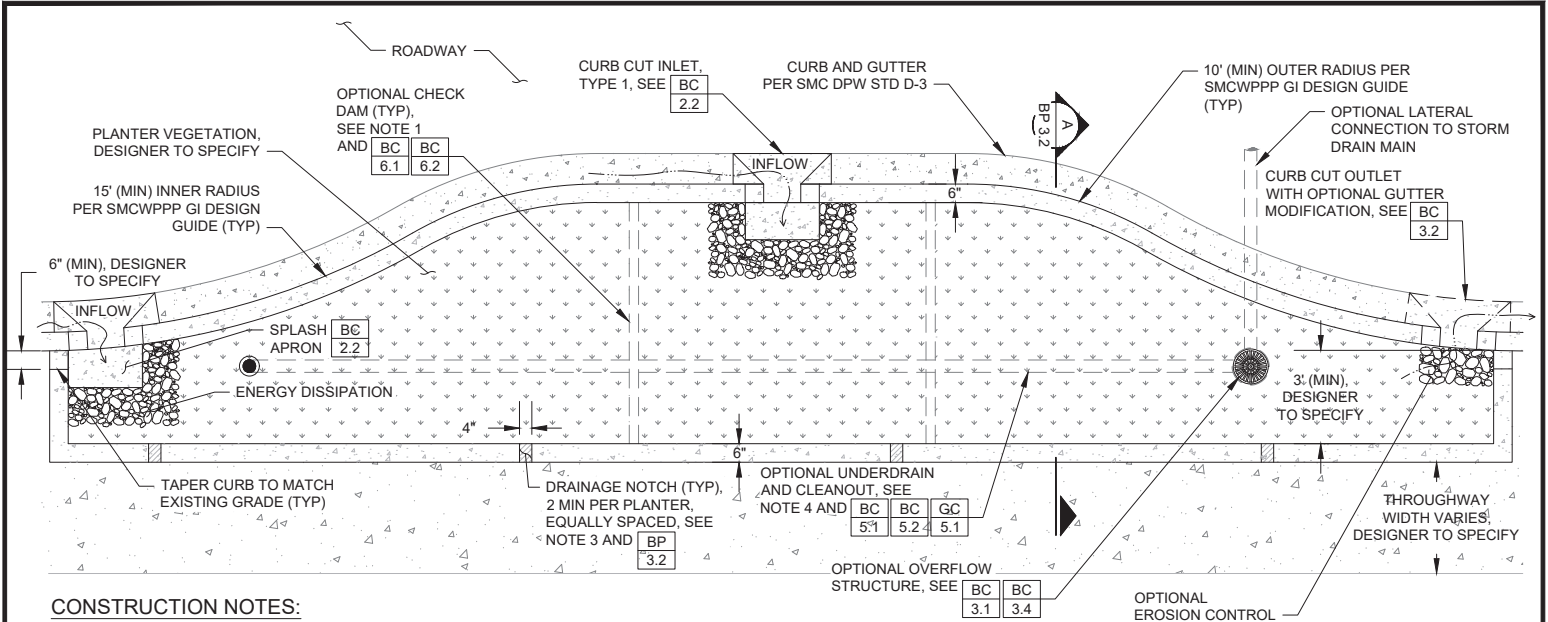
**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF CONTRA COSTA

DATE: 01.2024
VERSION: 01
REVISED: N/A

BIORETENTION PLANTER*
STORMWATER CURB EXTENSION
ALTERNATIVE 1

FILE NO:
**BP
4.1***

*THIS DETAIL HAS BEEN MODIFIED FOR CCCWP



CONSTRUCTION NOTES:

1. CHECK DAMS (IF NEEDED) SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN.
2. SLOPE TOP OF PLANTER WALL TO MATCH LONGITUDINAL SLOPE OF ADJACENT SURFACE.
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5. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT SMC ASSET PROTECTION STANDARDS AND OTHER UTILITY PROVIDER REQUIREMENTS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						NOTES		PLAN		SECTIONS			
BP	BP	BP	BP	BP	BP	BP	BP	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	BP	BP	BP	BP	BP	BP	BP	BP
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7	

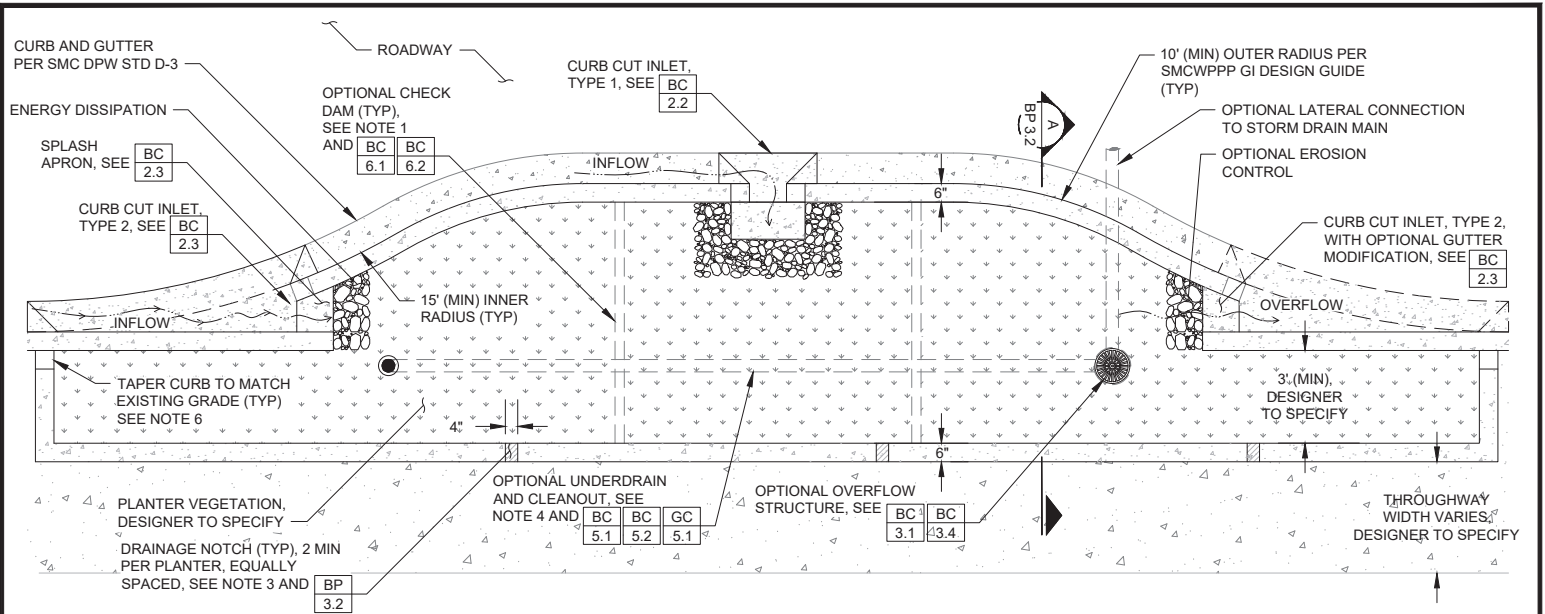
ANN M. STILLMAN
INTERIM DIRECTOR
OF PUBLIC WORKS

GREEN INFRASTRUCTURE
TYPICAL DETAILS
COUNTY OF SAN MATEO

DATE: 06.2022
VERSION: 02
REVISED: N/A

BIORETENTION PLANTER
STORMWATER CURB EXTENSION
ALTERNATIVE 2


FILE NO:
BP 4.2



CONSTRUCTION NOTES:

- CHECK DAMS (IF NEEDED) SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN.
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- IF STREET PARKING IS ALLOWED IMMEDIATELY ADJACENT TO THE CURB CUT INLET/OUTLET, THE PLANTER WALL TAPER SHOULD BE LOCATED 18" BEHIND THE FACE OF CURB. COORDINATE WITH SMC DPW.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						PARCEL APPLICATIONS						
PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	NOTES		PLAN		SECTIONS		
BP 1.1	BP 1.2	BP 2.1	BP 2.2	BP 3.1	BP 3.2	BP 3.3	BP 3.4	BP 4.1	BP 4.2	BP 4.3	BP 4.4	BP 4.5	BP 4.6	BP 5.1	BP 5.2	BP 5.3	BP 5.4	BP 5.5	BP 5.6	BP 5.7


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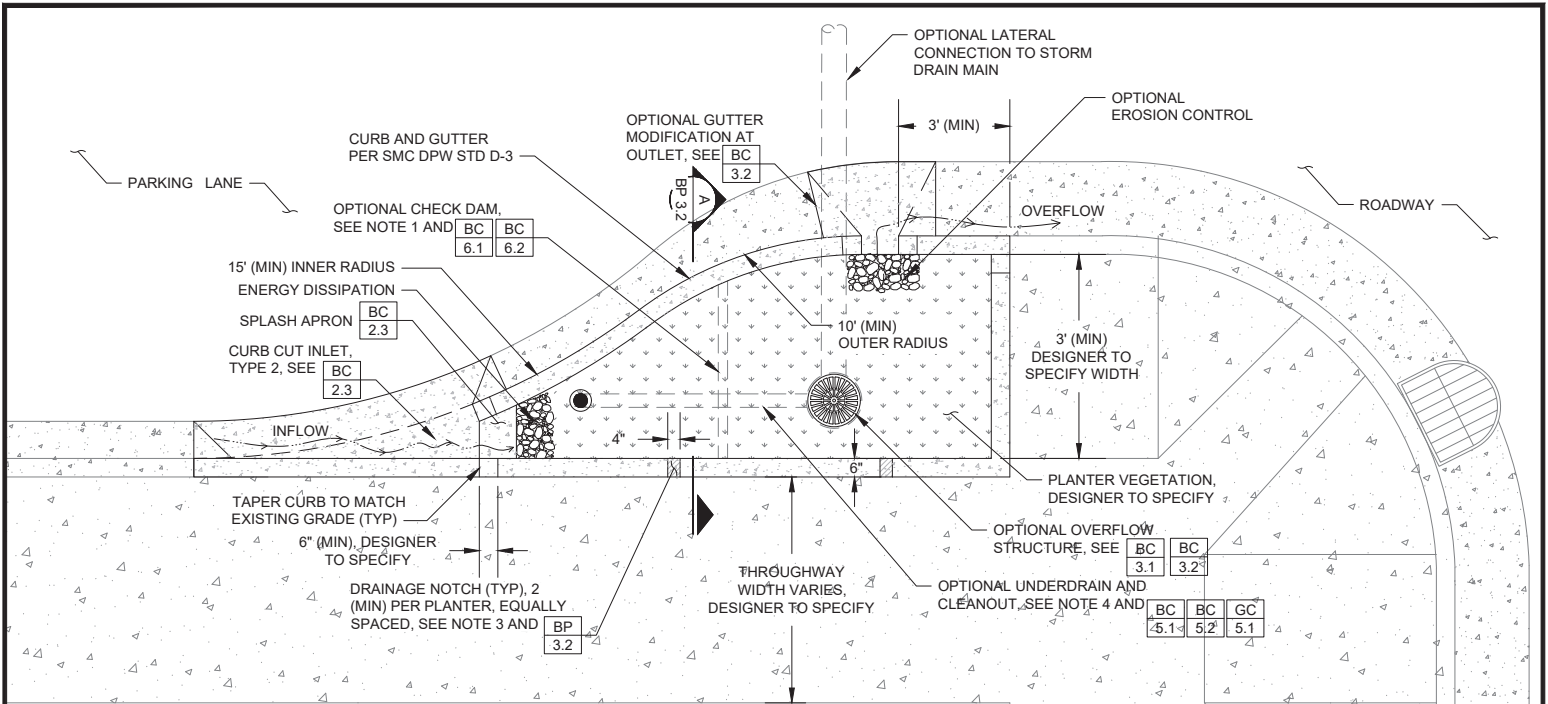
GREEN INFRASTRUCTURE
TYPICAL DETAILS
 COUNTY OF SAN MATEO

DATE: 06.2022
 VERSION: 02
 REVISED: N/A

BIORETENTION PLANTER
 STORMWATER CURB EXTENSION
 ALTERNATIVE 3

FILE NO:
BP 4.3

NOT FOR CONSTRUCTION - REFER TO USER GUIDE



CONSTRUCTION NOTES:

- CHECK DAMS (IF NEEDED) SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN.
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NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						PARCEL APPLICATIONS						
PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	NOTES		PLAN		SECTIONS		
[BP 1.1]	[BP 1.2]	[BP 2.1]	[BP 2.2]	[BP 3.1]	[BP 3.2]	[BP 3.3]	[BP 3.4]	[BP 4.1]	[BP 4.2]	[BP 4.3]	[BP 4.4]	[BP 4.5]	[BP 4.6]	[BP 5.1]	[BP 5.2]	[BP 5.3]	[BP 5.4]	[BP 5.5]	[BP 5.6]	[BP 5.7]



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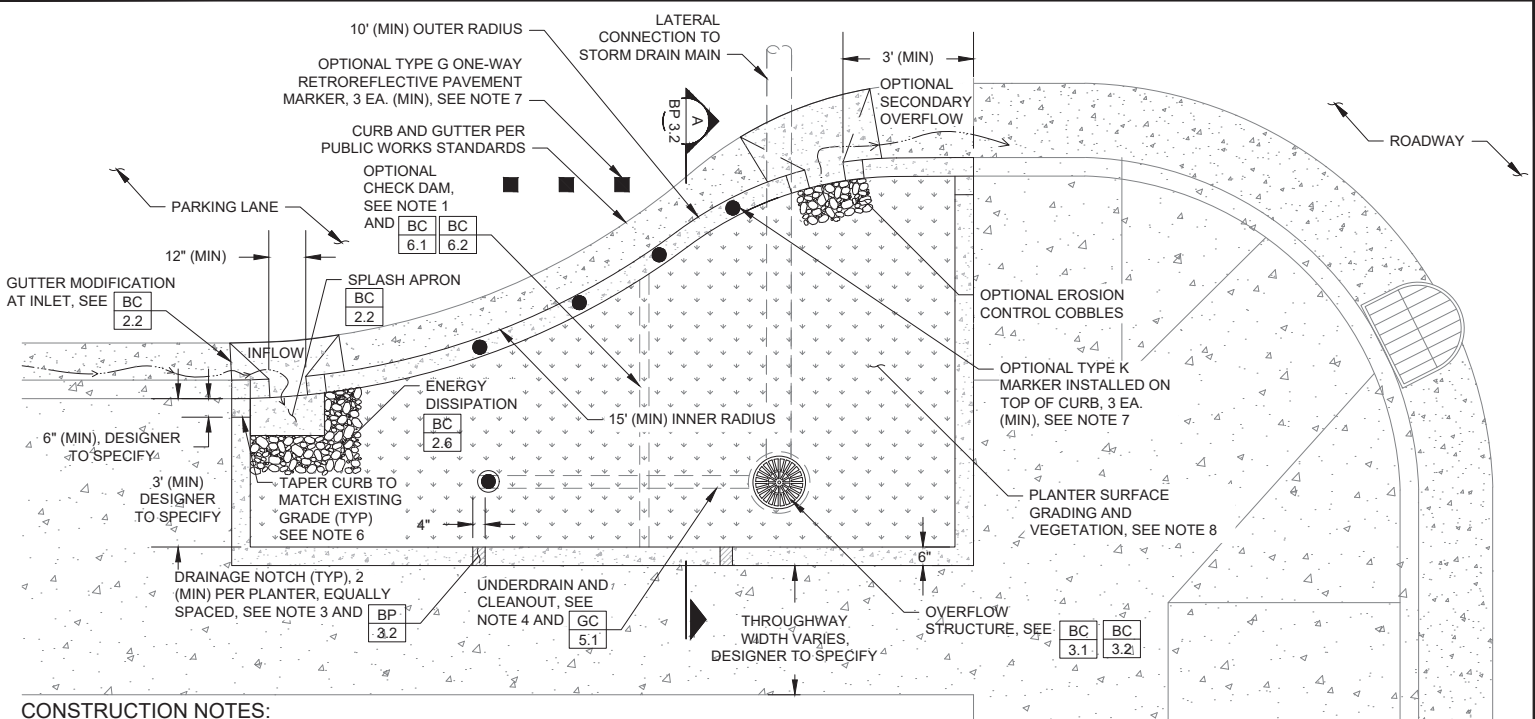
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TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE: 06.2022
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REVISED: N/A

BIORETENTION PLANTER
STORMWATER CURB EXTENSION
ALTERNATIVE 4

FILE NO:
BP 4.4

NOT FOR CONSTRUCTION - REFER TO USER GUIDE



CONSTRUCTION NOTES:

- CHECK DAMS (IF NEEDED) SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN.
- SLOPE TOP OF PLANTER WALL TO MATCH LONGITUDINAL SLOPE OF ADJACENT SURFACE.
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- IF STREET PARKING IS ALLOWED IMMEDIATELY ADJACENT TO THE CURB CUT INLET/OUTLET, THE PLANTER WALL TAPER SHOULD BE LOCATED 18" BEHIND THE FACE OF CURB. COORDINATE WITH DPW.
- THE TYPE AND LOCATION OF ALL PROPOSED TRAFFIC SAFETY MARKERS AND DELINEATORS MUST BE APPROVED BY THE TRANSPORTATION AGENCY HAVING JURISDICTION PRIOR TO INSTALLATION.
- DESIGNER TO SPECIFY FINISH SURFACE GRADING AND PLANTING. UNLESS OTHERWISE NOTED IN THE GRADING PLAN, THE FINISH SURFACE SHALL BE FLAT TO PROVIDE THE MAXIMUM WATER STORAGE.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						PARCEL APPLICATIONS						
PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	NOTES		PLAN		SECTIONS		
[BP 1.1]	[BP 1.2]	[BP 2.1]	[BP 2.2]	[BP 3.1]	[BP 3.2]	[BP 3.3]	[BP 3.4]	[BP 4.1]	[BP 4.2]	[BP 4.3]	[BP 4.4]	[BP 4.5]	[BP 4.6]	[BP 5.1]	[BP 5.2]	[BP 5.3]	[BP 5.4]	[BP 5.5]	[BP 5.6]	[BP 5.7]



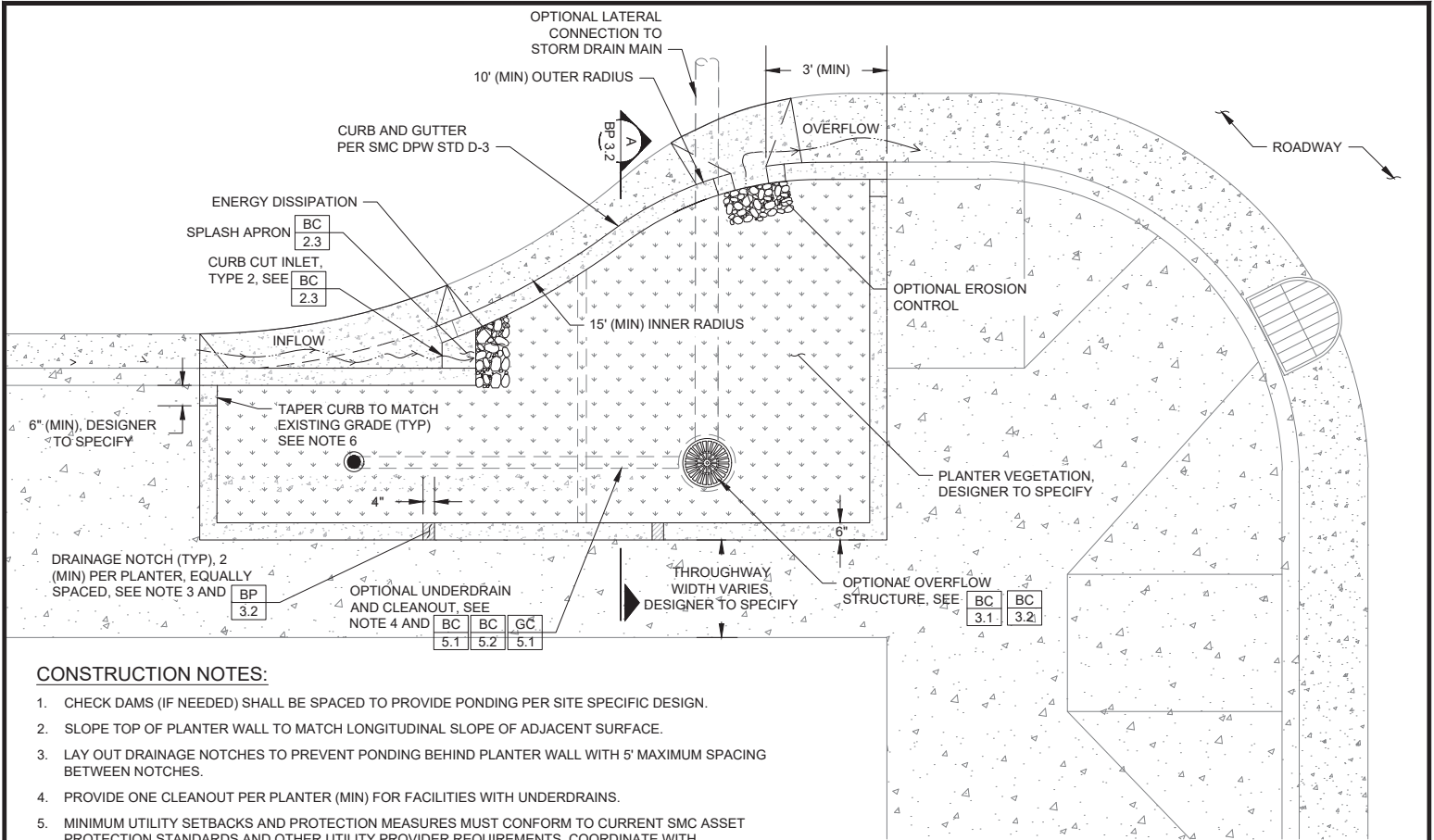
**GREEN INFRASTRUCTURE
 TYPICAL DETAILS**
 COUNTY OF CONTRA COSTA

DATE: 01.2024
 VERSION: 01
 REVISED: N/A

BIORETENTION PLANTER*
 STORMWATER CURB EXTENSION
 ALTERNATIVE 5

FILE NO:
BP 4.5*


*THIS DETAIL HAS BEEN MODIFIED FOR CCCWP



CONSTRUCTION NOTES:

- CHECK DAMS (IF NEEDED) SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN.
- SLOPE TOP OF PLANTER WALL TO MATCH LONGITUDINAL SLOPE OF ADJACENT SURFACE.
- LAY OUT DRAINAGE NOTCHES TO PREVENT PONDING BEHIND PLANTER WALL WITH 5' MAXIMUM SPACING BETWEEN NOTCHES.
- PROVIDE ONE CLEANOUT PER PLANTER (MIN) FOR FACILITIES WITH UNDERDRAINS.
- MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT SMC ASSET PROTECTION STANDARDS AND OTHER UTILITY PROVIDER REQUIREMENTS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
- IF STREET PARKING IS ALLOWED IMMEDIATELY ADJACENT TO THE CURB CUT INLET/OUTLET, THE PLANTER WALL TAPER SHOULD BE LOCATED 18" BEHIND THE FACE OF CURB. COORDINATE WITH SMC DPW.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						PARCEL APPLICATIONS						
PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	NOTES		PLAN		SECTIONS		
BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7



ANN M. STILLMAN
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE	06.2022
VERSION	02
REVISED	N/A

BIORETENTION PLANTER
STORMWATER CURB EXTENSION
ALTERNATIVE 6

FILE NO.
BP
4.6

PURPOSE:

PARCEL BIORETENTION PLANTERS CONTROL PEAK FLOWS AND VOLUMES OF STORMWATER RUNOFF BY PROVIDING SURFACE, SUBSURFACE STORAGE AND INFILTRATION INTO NATIVE SOIL. WATER IS TREATED AS IT FILTERS THROUGH THE BIOTREATMENT SOIL. BIORETENTION PLANTERS MAY ALSO BE REFERRED TO AS STORMWATER PLANTERS AND INCLUDE 3 TYPES OF PLANTERS: BIOINFILTRATION (UNLINED, NO UNDERDRAIN), BIORETENTION (UNDER-DRAINED) AND FLOW-THROUGH (LINED WITH UNDERDRAIN). ALL TYPES TYPICALLY HAVE VERTICAL SIDE WALLS IN ORDER TO MAXIMIZE WATER STORAGE VOLUME IN CONSTRAINED SITES.

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT PLAN AND SECTION DRAWINGS TO ADDRESS BUILDING- AND SITE-SPECIFIC CONDITIONS.
2. THE DESIGNER MUST COMPLY WITH ALL APPLICABLE SITE AND BUILDING CODE REQUIREMENTS FOR ON-SITE ACCESSIBILITY AND SAFETY INCLUDING, BUT NOT LIMITED TO, CURBS, PEDESTRIAN SURFACING, AND GUARDRAILS/FALL HEIGHTS.
3. PLANTER AREA, PONDING DEPTH, BIOTREATMENT SOIL DEPTH, AND AGGREGATE STORAGE DEPTH MUST BE SIZED TO MEET PROJECT-SPECIFIC PERFORMANCE GOALS.
4. FACILITY DRAWDOWN TIME (I.E., TIME FOR SURFACE PONDING TO DRAIN THROUGH THE ENTIRE SECTION INCLUDING AGGREGATE STORAGE AFTER THE END OF A STORM) REQUIREMENTS:
 - 48 HOUR (PREFERRED), 72 HOUR MAXIMUM FACILITY DRAWDOWN (I.E. ORIFICE CONTROLLED SYSTEM OR EXTENDED STORAGE DEPTH WITHIN INFILTRATION SYSTEM)
5. CHECK DAMS MAY BE USED TO TERRACE FACILITIES TO PROVIDE SUFFICIENT PONDING FOR HIGHER-SLOPED INSTALLATIONS. DESIGNER MUST SPECIFY CHECK DAM HEIGHT AND SPACING. REFER TO **BC 6.1** AND **BC 6.2** FOR GUIDANCE ON CHECK DAM DESIGN.
6. PLANTER OVERFLOW STRUCTURES SHALL BE DESIGNED TO CONVEY THE ANTICIPATED DESIGN FLOWS PER SMC REQUIREMENTS.
7. PLANTERS SHALL BE DESIGNED TO OVERFLOW TO THE STREET IN THE EVENT THE PLANTER OUTLET IS OBSTRUCTED OR CLOGGED.
8. MATERIALS FOR PLANTERS MAY VARY TO WORK WITH SITE AND ARCHITECTURAL PALETTE.
9. FACILITIES ADJACENT TO A BUILDING (WITHIN 10 FEET) SHOULD BE LINED TO AVOID NEGATIVE IMPACTS OF WATER AT FOUNDATION. LINER CAN BE OMITTED WITH LETTER FROM LICENSED DESIGN PROFESSIONAL(S) STATING THAT BUILDING WATERPROOFING, STRUCTURAL INTEGRITY, AND STORMWATER FUNCTION IS NOT IMPACTED.
10. FACILITIES MAY BE EXTENDED ABOVE GRADE FOR SEATWALL OR RAISED PLANTER CONFIGURATIONS, IF APPROPRIATE CONVEYANCE MEASURES ARE PROVIDED TO MEET DESIGN REQUIREMENTS.
11. CONVEYANCE CONNECTIONS MAY BE CONFIGURED TO ACCEPT RUNOFF VIA OVERHEAD CONVEYANCE (DOWNSPOUTS, OVERHEAD RUNNELS), SURFACE FLOW (CHANNELS), OR SUBSURFACE CONVEYANCE (PIPES, TRENCH DRAINS). REFER TO APPLICABLE SMC PLANNING AND BUILDING CODES FOR CONVEYANCE CONNECTION REQUIREMENTS.
12. CONVEYANCE CONNECTIONS (E.G. SCUPPER, CHANNEL, PIPE) SHALL BE SIZED TO ACCOMMODATE DRAINAGE FROM ROOF AREA WITH ADEQUATE FREEBOARD TO AVOID OVERFLOWING. REFER TO APPLICABLE SMC PLANNING AND BUILDING CODES FOR CONVEYANCE CONNECTION REQUIREMENTS.
13. UNDERDRAINS REQUIRED ON STRUCTURE TO DRAIN PLANTER AND AVOID ACCUMULATION OF WATER ON STRUCTURE WATERPROOFING SYSTEM.
14. OVERFLOW STRUCTURE (MATERIAL AND WORKMANSHIP) SHALL CONFORM TO APPLICABLE SMC PLANNING, BUILDING AND PUBLIC WORKS CODES AND REQUIREMENTS. SIZE AND MODEL OF ATRIUM GRATE AT OVERFLOW TO BE DETERMINED BY ENGINEER TO ENSURE CONVEYANCE OF PEAK FLOW.
15. THE DESIGNER MUST EVALUATE UTILITY SURVEYS FOR POTENTIAL UTILITY CROSSINGS OR CONFLICTS. REFER TO **GC 2.1 - GC 2.12** FOR UTILITY CROSSING DETAILS AND **GC 1.4 - GC 4.4** FOR UTILITY CROSSING CONFLICT DETAILS.
18. REFER TO SMC PLANNING AND BUILDING CODES FOR CURB AND/OR RAILING REQUIREMENTS.

19. FREEBOARD REQUIREMENTS SHOWN SHOULD BE USED AS GUIDELINES BUT THE DESIGNER SHALL REFER TO THE SMCWPPP C.3 TECHNICAL GUIDANCE MANUAL FOR ADDITIONAL FREEBOARD REQUIREMENTS, ESPECIALLY WHERE THE BIORETENTION PLANTER IS LOCATED IN A SUMP AND DEPENDS ON OUTFLOW THROUGH AN OVERFLOW STRUCTURE/CATCH BASIN.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						NOTES		PLAN		SECTIONS		
BP	BP	BP	BP	BP	BP	BP	BP	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	BP	BP	BP	BP	BP	BP	BP
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7



ANN M. STILLMAN
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GREEN INFRASTRUCTURE
TYPICAL DETAILS
COUNTY OF SAN MATEO

DATE: 06.2022
VERSION: 02
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BIORETENTION PLANTER
PARCEL PLANTER
DESIGNER NOTES (1 OF 2)

FILE NO.
BP
5.1

LAYOUT REQUIREMENTS:

THE DESIGNER MUST COMPLY WITH ALL STORMWATER, LAND USE, AND BUILDING CODE REQUIREMENTS:

1. ADHERE TO ALL CODES FOR ACCESSIBILITY REQUIRED FOR PARCEL LEVEL DEVELOPMENT
2. PARCEL PLANTERS SHOULD NOT INTERFERE WITH OTHER LAND USE REQUIREMENTS SUCH AS BUFFERING AND SCREENING, SETBACKS, SIGHT DISTANCE, AND MINIMUM SITE COVERAGE.
3. DESIGNER MUST COMPLY WITH ALL CURRENT LOCAL CODES, INCLUDING BUT NOT LIMITED TO:
 - COUNTY OF SAN MATEO STORMWATER AND DRAINAGE ORDINANCE
 - COUNTY OF SAN MATEO PLANNING ORDINANCE
 - CALIFORNIA BUILDING CODE
 - COUNTY OF SAN MATEO BUILDING CODE AMENDMENTS
 - ADA STANDARDS FOR ACCESSIBLE DESIGN

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- PLANTER WIDTH AND LENGTH
- DEPTH OF PONDING
- DEPTH OF FREEBOARD
- DEPTH OF BIOTREATMENT SOIL
- DEPTH AND TYPE OF GRAVEL STORAGE
- PLANTER SURFACE ELEVATION (TOP OF BIOTREATMENT SOIL) AT UPSLOPE AND DOWNSLOPE ENDS OF FACILITY
- CONTROL POINTS AT EVERY PLANTER WALL CORNER OR POINT OF TANGENCY
- DIMENSIONS AND DISTANCE TO EVERY INLET, OUTLET, CHECK DAM, SIDEWALK NOTCH, ETC.
- ELEVATIONS OF EVERY INLET, OUTLET, STRUCTURE RIM AND INVERT, CLEAN OUT, PLANTER WALL CORNER, AND SIDEWALK NOTCH
- TYPE AND DESIGN OF PLANTER COMPONENTS (E.G., EDGE TREATMENTS, INLETS/GUTTER MODIFICATIONS, UTILITY CROSSINGS, LINER, AND PLANTING DETAILS).
- OVERFLOW STRUCTURE AND ATRIUM GRATE SIZE AND MODEL NUMBER

RELATED COMPONENTS					
EDGE TREATMENTS:	<table border="1"> <tr> <td>BC</td> <td>BC</td> </tr> <tr> <td>1.1</td> <td>1.12</td> </tr> </table>	BC	BC	1.1	1.12
BC	BC				
1.1	1.12				
INLETS:	<table border="1"> <tr> <td>BC</td> <td>BC</td> </tr> <tr> <td>2.1</td> <td>2.6</td> </tr> </table>	BC	BC	2.1	2.6
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2.1	2.6				
OUTLETS:	<table border="1"> <tr> <td>BC</td> <td>BC</td> </tr> <tr> <td>3.1</td> <td>3.4</td> </tr> </table>	BC	BC	3.1	3.4
BC	BC				
3.1	3.4				
SOIL & AGGREGATE LAYERS:	<table border="1"> <tr> <td>BC</td> </tr> <tr> <td>4.1</td> </tr> </table>	BC	4.1		
BC					
4.1					
UNDERDRAINS:	<table border="1"> <tr> <td>GC</td> <td>GC</td> </tr> <tr> <td>5.1</td> <td>5.2</td> </tr> </table>	GC	GC	5.1	5.2
GC	GC				
5.1	5.2				
CHECK DAMS:	<table border="1"> <tr> <td>GC</td> <td>GC</td> </tr> <tr> <td>6.1</td> <td>6.2</td> </tr> </table>	GC	GC	6.1	6.2
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6.1	6.2				
LINERS:	<table border="1"> <tr> <td>GC</td> <td>GC</td> </tr> <tr> <td>1.1</td> <td>1.2</td> </tr> </table>	GC	GC	1.1	1.2
GC	GC				
1.1	1.2				
UTILITY CROSSINGS:	<table border="1"> <tr> <td>GC</td> <td>GC</td> </tr> <tr> <td>2.1</td> <td>2.12</td> </tr> </table>	GC	GC	2.1	2.12
GC	GC				
2.1	2.12				
UTILITY CONFLICTS:	<table border="1"> <tr> <td>GC</td> <td>GC</td> </tr> <tr> <td>3.1</td> <td>3.3</td> </tr> </table>	GC	GC	3.1	3.3
GC	GC				
3.1	3.3				
OBSERVATION PORTS:	<table border="1"> <tr> <td>GC</td> <td>GC</td> </tr> <tr> <td>4.1</td> <td>4.3</td> </tr> </table>	GC	GC	4.1	4.3
GC	GC				
4.1	4.3				
CLEANOUTS:	<table border="1"> <tr> <td>GC</td> </tr> <tr> <td>5.1</td> </tr> </table>	GC	5.1		
GC					
5.1					

RELATED SPECIFICATIONS
BIORETENTION: BIOTREATMENT SOIL MIX PER BASMAA SPECIFICATIONS (SEE SMCWPPP C.3 REGULATED PROJECTS GUIDE APPENDIX K)

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						PARCEL APPLICATIONS						
PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS		ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	NOTES		PLAN		SECTIONS		
BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7



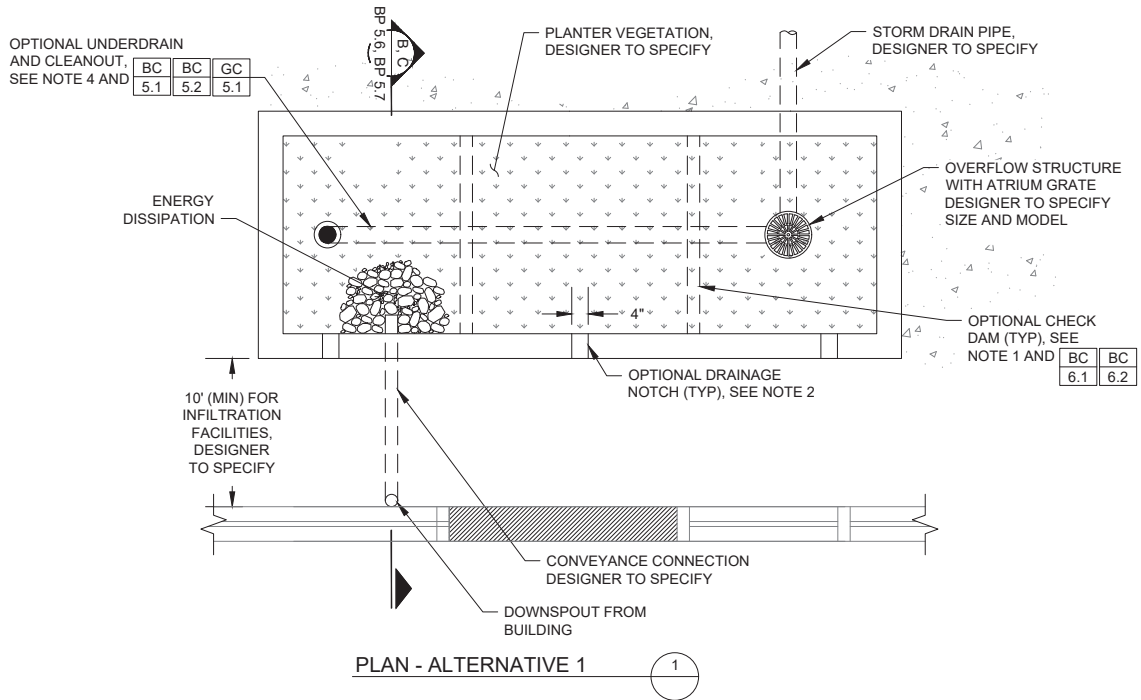
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**GREEN INFRASTRUCTURE
 TYPICAL DETAILS**
 COUNTY OF SAN MATEO

DATE	06.2022
VERSION	02
REVISED	N/A

BIORETENTION PLANTER
 PARCEL PLANTER
 DESIGNER NOTES (2 OF 2)

FILE NO.	BP 5.2
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CONSTRUCTION NOTES:

1. CHECK DAMS SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN.
2. LAY OUT DRAINAGE NOTCHES TO PREVENT PONDING BEHIND PLANTER WALL WITH 5' MAXIMUM SPACING BETWEEN NOTCHES .
3. COORDINATE WATERPROOFING AT BUILDINGS WITH ARCHITECT AND ENGINEER.
4. PROVIDE ONE CLEANOUT PER PLANTER (MIN) FOR FACILITIES WITH UNDERDRAINS.
5. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT SMC ASSET PROTECTION STANDARDS AND OTHER UTILITY PROVIDER REQUIREMENTS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						NOTES		PLAN		SECTIONS		
BP	BP	BP	BP	BP	BP	BP	BP	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	BP	BP	BP	BP	BP	BP	BP
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7



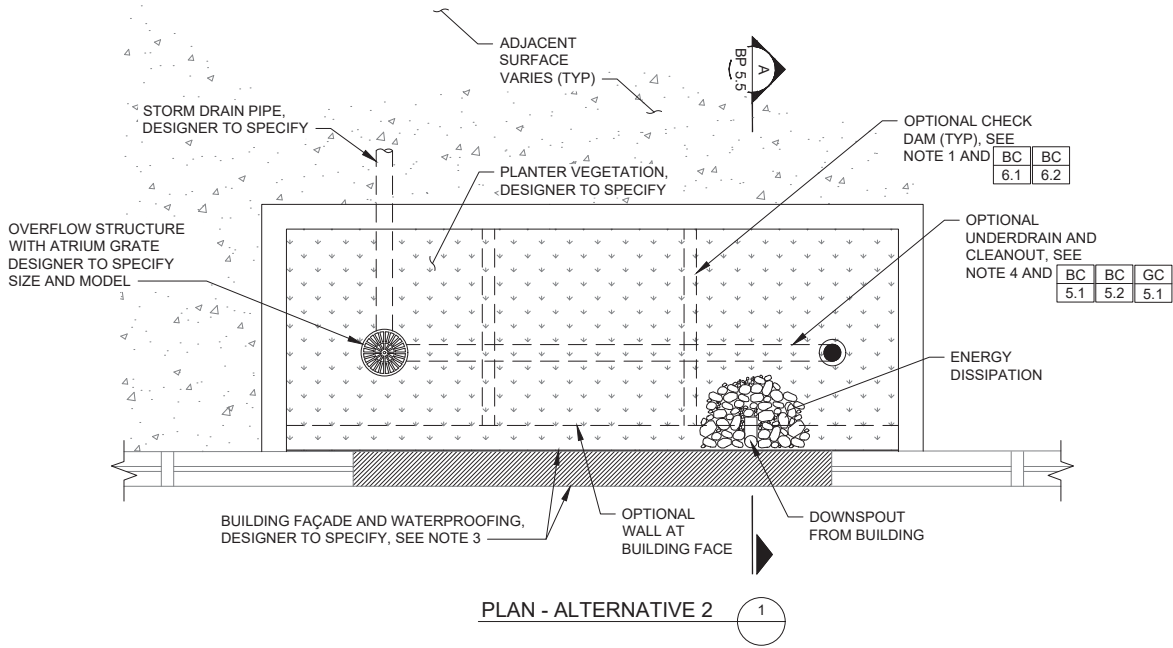
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GREEN INFRASTRUCTURE
TYPICAL DETAILS
COUNTY OF SAN MATEO

DATE: 06.2022
VERSION: 02
REVISED: N/A

BIORETENTION PLANTER
PARCEL PLANTER PLAN
ALTERNATIVE 1

FILE NO.
BP
5.3



PLAN - ALTERNATIVE 2 1

CONSTRUCTION NOTES:

1. CHECK DAMS SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN.
2. LAY OUT DRAINAGE NOTCHES TO PREVENT PONDING BEHIND PLANTER WALL WITH 5' MAXIMUM SPACING BETWEEN NOTCHES .
3. COORDINATE WATERPROOFING AT BUILDINGS WITH ARCHITECT AND ENGINEER.
4. PROVIDE ONE CLEANOUT PER PLANTER (MIN) FOR FACILITIES WITH UNDERDRAINS.
5. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT SMC ASSET PROTECTION STANDARDS AND OTHER UTILITY PROVIDER REQUIREMENTS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						PARCEL APPLICATIONS		SECTIONS				
BP	BP	BP	BP	BP	BP	BP	BP	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	BP	BP	BP	BP	BP	BP	BP
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7



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TYPICAL DETAILS
COUNTY OF SAN MATEO

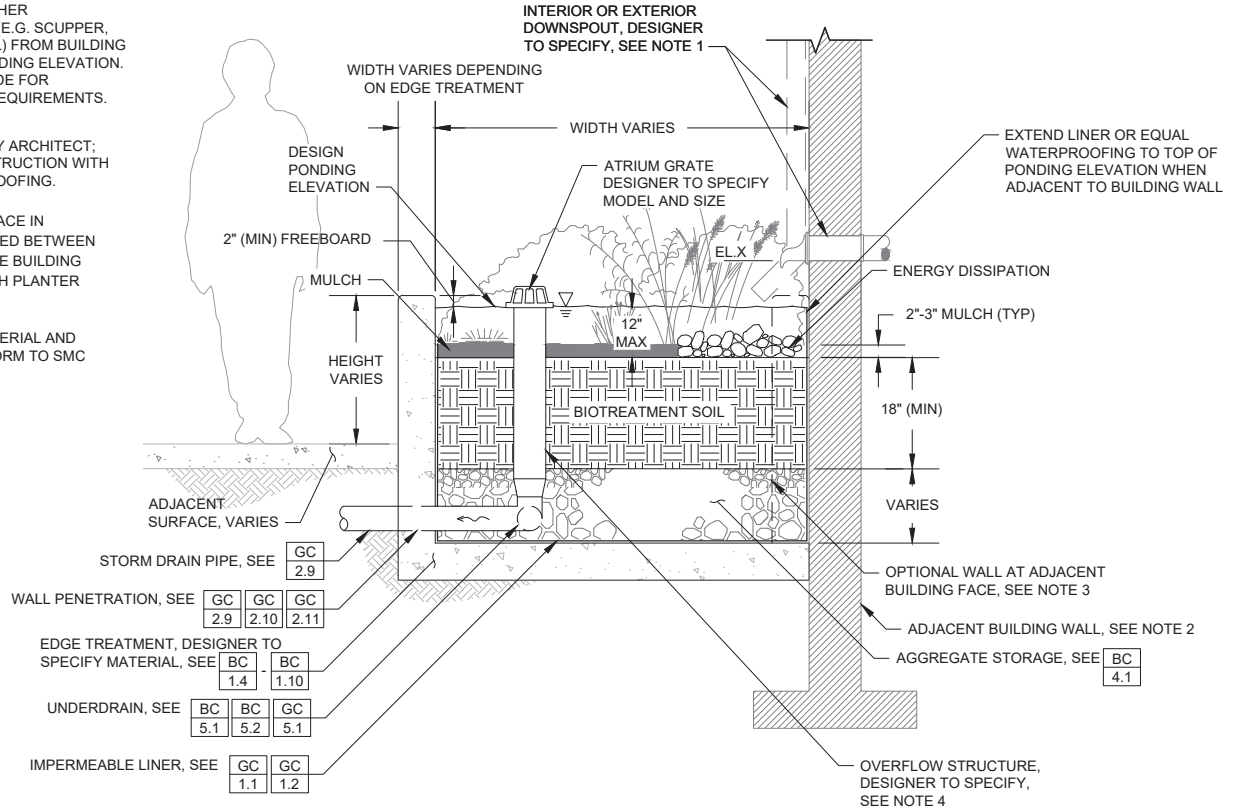
DATE 06.2022
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REVISED N/A

BIORETENTION PLANTER
PARCEL PLANTER PLAN
ALTERNATIVE 2

FILE NO.
BP
5.4

CONSTRUCTION NOTES:

1. INSTALL DOWNSPOUTS OR OTHER CONVEYANCE CONNECTIONS (E.G. SCUPPER, CHANNEL, OVERHEAD RUNNEL) FROM BUILDING TO DRAIN ABOVE DESIGN PONDING ELEVATION. REFER TO SMC PLUMBING CODE FOR CONVEYANCE CONNECTION REQUIREMENTS.
2. BUILDING WATERPROOFING BY ARCHITECT; COORDINATE PLANTER CONSTRUCTION WITH BUILDING FAÇADE / WATERPROOFING.
3. PROVIDE WALL AT BUILDING FACE IN CASES WHERE GAP IS REQUIRED BETWEEN WALL AND PLANTER OR WHERE BUILDING FAÇADE IS INCOMPATIBLE WITH PLANTER CONFIGURATION.
4. OVERFLOW STRUCTURE (MATERIAL AND WORKMANSHIP) SHALL CONFORM TO SMC PLUMBING CODE.



SECTION - RAISED BIORETENTION PLANTER (A)

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						NOTES		PLAN		SECTIONS		
BP	BP	BP	BP	BP	BP	BP	BP	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	BP	BP	BP	BP	BP	BP	BP
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7



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COUNTY OF SAN MATEO

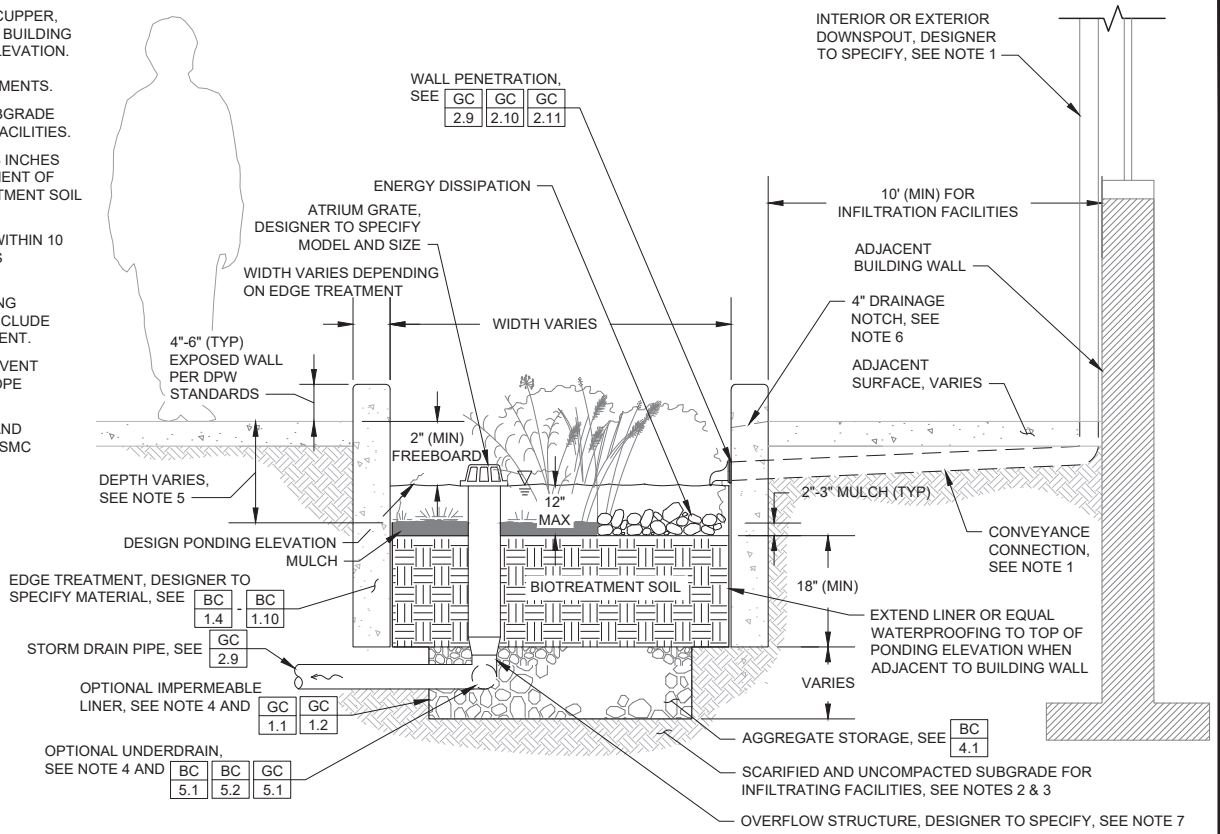
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BIORETENTION PLANTER
PARCEL PLANTER
RAISED PLANTER SECTION

FILE NO:
BP
5.5


CONSTRUCTION NOTES:

1. INSTALL DOWNSPOUTS AND OTHER CONVEYANCE CONNECTIONS (E.G. SCUPPER, CHANNEL, OVERHEAD RUNNEL) FROM BUILDING TO DRAIN ABOVE DESIGN PONDING ELEVATION. REFER TO SMC PLUMBING CODE FOR CONVEYANCE CONNECTION REQUIREMENTS.
2. AVOID COMPACTION OF EXISTING SUBGRADE BELOW PLANTER FOR INFILTRATION FACILITIES.
3. SCARIFY SUBGRADE TO A DEPTH OF 3 INCHES (MIN) IMMEDIATELY PRIOR TO PLACEMENT OF AGGREGATE STORAGE AND BIOTREATMENT SOIL MATERIALS.
4. UNDERDRAIN AND LINER REQUIRED WITHIN 10 FEET OF BUILDING ENVELOPE UNLESS APPROVED PER DESIGNER.
5. MAXIMUM DROP FROM TOP OF WALKING SURFACE TO TOP OF MULCH SHALL INCLUDE CONSIDERATIONS FOR SOIL SETTLEMENT.
6. LAY OUT DRAINAGE NOTCHES TO PREVENT PONDING BEHIND PLANTER WALL. SLOPE NOTCHES TO DRAIN TO PLANTER.
7. OVERFLOW STRUCTURE (MATERIAL AND WORKMANSHIP) SHALL CONFORM TO SMC PLUMBING CODE.



SECTION - SURFACE BIORETENTION PLANTER (B)

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						PARCEL APPLICATIONS						
BP	BP	BP	BP	BP	BP	BP	BP	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	BP	BP	BP	BP	BP	BP	BP
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7


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GREEN INFRASTRUCTURE
TYPICAL DETAILS
 COUNTY OF SAN MATEO

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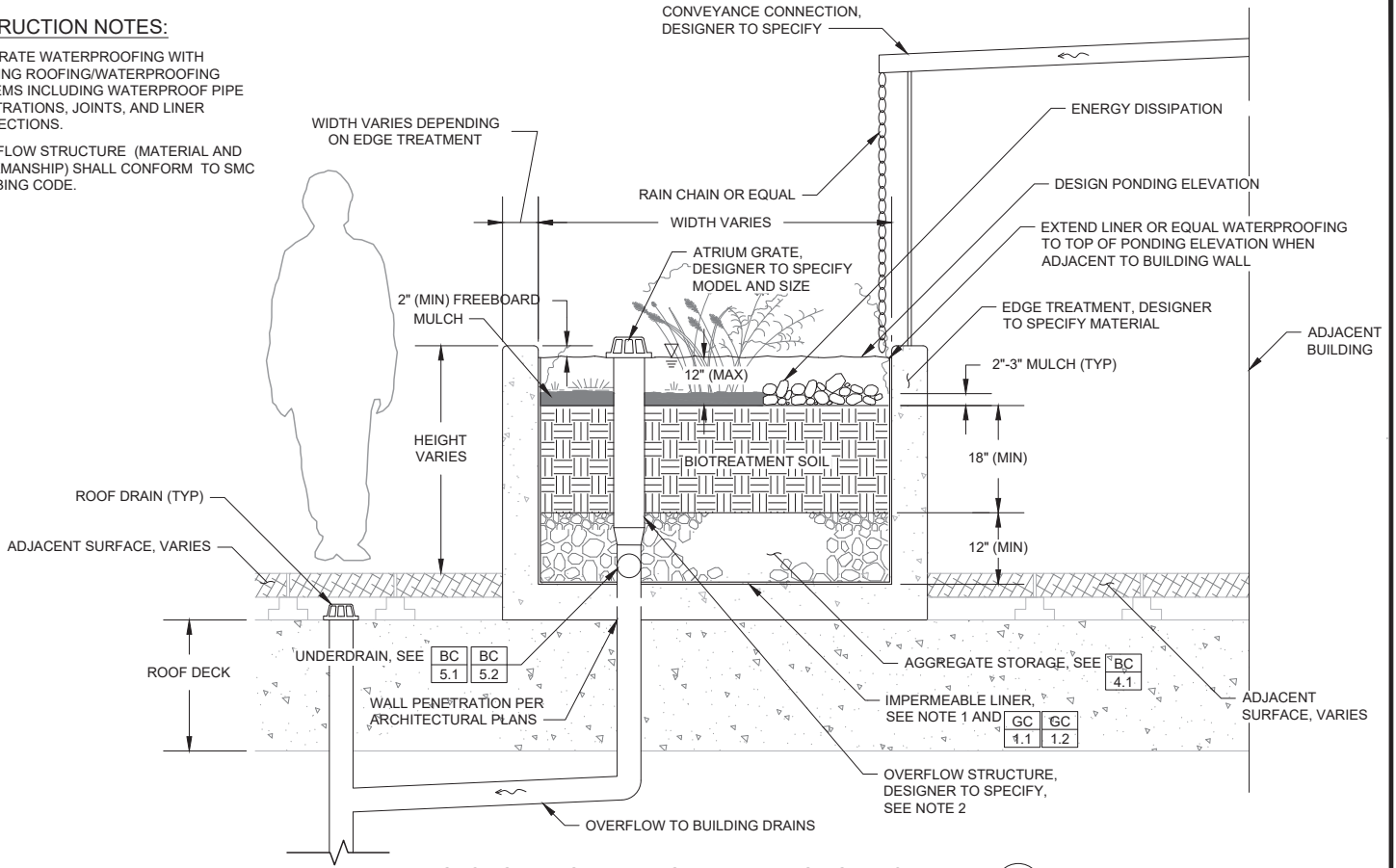
BIORETENTION PLANTER
 PARCEL PLANTER
 AT-GRADE PLANTER SECTION

FILE NO.
BP
 5.6

NOT FOR CONSTRUCTION - REFER TO USER GUIDE

CONSTRUCTION NOTES:

1. INTEGRATE WATERPROOFING WITH BUILDING ROOFING/WATERPROOFING SYSTEMS INCLUDING WATERPROOF PIPE PENETRATIONS, JOINTS, AND LINER CONNECTIONS.
2. OVERFLOW STRUCTURE (MATERIAL AND WORKMANSHIP) SHALL CONFORM TO SMC PLUMBING CODE.



SECTION - BIORETENTION PLANTER ON STRUCTURE C

NOTES		W/PARKING		W/O PARKING		BIKEWAY BARRIER		CURB EXTENSION						NOTES		PLAN		SECTIONS		
BP	BP	BP	BP	BP	BP	BP	BP	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	BP	BP	BP	BP	BP	BP	BP
1.1	1.2	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	5.4	5.5	5.6	5.7



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BIORETENTION PLANTER
PARCEL PLANTER
PLANTER ON STRUCTURE SECTION

FILE NO.
BP
5.7

NOT FOR CONSTRUCTION - REFER TO USER GUIDE

PURPOSE:

BIORETENTION BASINS CAPTURE AND TREAT STORMWATER RUNOFF VIA SURFACE AND SUBSURFACE STORAGE, FILTRATION THROUGH BIOTREATMENT SOIL, AND INFILTRATION INTO NATIVE SOIL WHERE FEASIBLE. BIORETENTION BASINS MAY ALSO BE REFERRED TO AS RAIN GARDENS AND INCLUDE 3 TYPES OF PLANTERS: INFILTRATION (NO UNDERDRAIN), BIORETENTION (UNDER-DRAINED) AND FLOW THROUGH (LINED WITH UNDERDRAIN).

DESIGNER NOTES & GUIDELINES:

- THE DESIGNER MUST ADAPT PLAN AND SECTION DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
- FACILITY AREA, PONDING DEPTH, BIOTREATMENT SOIL DEPTH, AND AGGREGATE STORAGE DEPTH MUST BE SIZED TO MEET PROJECT HYDROLOGIC PERFORMANCE GOALS.
- FACILITY DRAWDOWN TIME (I.E., TIME FOR SURFACE PONDING TO DRAIN THROUGH THE ENTIRE SECTION INCLUDING AGGREGATE STORAGE AFTER THE END OF A STORM) REQUIREMENTS:
 - 48 HOUR (PREFERRED), 72 HOUR MAXIMUM FACILITY DRAWDOWN (i.e. ORIFICE CONTROLLED SYSTEM OR EXTENDED STORAGE DEPTH WITHIN INFILTRATION SYSTEM).
- AN AGGREGATE COURSE IS REQUIRED UNDER THE BIOTREATMENT SOIL FOR BIORETENTION IN SEPARATE SEWER SYSTEM AREAS TO PROVIDE ADDITIONAL TREATMENT. SEE GUIDANCE ON BC 4.1.
- CHECK DAMS MAY BE USED TO TERRACE FACILITIES TO PROVIDE SUFFICIENT PONDING FOR HIGHER-SLOPED INSTALLATIONS. DESIGNER MUST SPECIFY CHECK DAM HEIGHT AND SPACING. REFER TO **BC 6.1** AND **BC 6.2** FOR GUIDANCE ON CHECK DAM DESIGN.
- THE FOLLOWING GUIDELINES APPLY TO RIGHT-OF-WAY APPLICATIONS:
 - BULBOUT CURB RADIUS SHALL BE 15' (MIN) PER SMCWPPP GI DESIGN GUIDE.
 - WHEN FACILITY CONSTRUCTION IMPACTS EXISTING SIDEWALK, ALL SAW CUTS MUST ADHERE TO SMC REQUIREMENTS. SAW CUTS SHOULD BE ALONG SCORE LINES AND ANY DISTURBED SIDEWALK FLAGS SHOULD BE REPLACED IN THEIR ENTIRETY.
 - DESIGNER TO SPECIFY TRANSITION OF PLANTER TO TOP OF CURB ELEVATION BETWEEN CURB CUTS OR CONTINUOUS 6 INCH REVEAL AT CURB EDGE.
- UP TO TWO PLANTERS MAY BE CONNECTED IN SERIES, IN LIEU OF MULTIPLE INLETS, PROVIDED THE CONNECTION IS A TRENCH DRAIN OR EQUAL SURFACE CONVEYANCE AND IS ADEQUATELY SIZED TO CONVEY FLOWS.
- MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT JURISDICTIONAL ASSET PROTECTION STANDARDS. IN THE ABSENCE OF THESE STANDARDS, THE DESIGNER SHALL REFER TO CHAPTER 3 OF SMCWPPP GI DESIGN GUIDE FOR BEST PRACTICES AND COORDINATE DIRECTLY WITH RELEVANT UTILITY PROVIDERS FOR REQUIREMENTS. SEE UTILITY CROSSINGS (**GC 2.1 - GC 2.12**) AND UTILITY CONFLICTS (**GC 4.1 - GC 4.4**).
- FREEBOARD REQUIREMENTS SHOWN SHOULD BE USED AS GUIDELINES BUT THE DESIGNER SHALL REFER TO THE C.3 TECHNICAL GUIDANCE MANUAL FOR ADDITIONAL FREEBOARD REQUIREMENTS, ESPECIALLY WHERE THE BIORETENTION BASIN IS LOCATED IN A SUMP AND DEPENDS ON OUTFLOW THROUGH AN OVERFLOW STRUCTURE/CATCH BASIN.

RELATED SPECIFICATIONS

BIORETENTION:
BIOTREATMENT SOIL MIXPER BASMAA SPECIFICATIONS (SEE SMCWPPP C.3 REGULATED PROJECTS GUIDE APPENDIX K)

DESIGNER CHECKLIST

(MUST SPECIFY, AS APPLICABLE):

- FACILITY WIDTH, LENGTH, SLOPES (INCLUDING SIDE, CROSS, AND LONGITUDINAL), AND SHAPE
- DEPTH OF BIOTREATMENT SOIL
- DEPTH AND TYPE OF GRAVEL STORAGE, IF ANY
- PLANTER SURFACE ELEVATION (TOP OF BIOTREATMENT SOIL) AT UPSLOPE AND DOWNSLOPE ENDS OF FACILITY
- CONTROL POINTS AT EVERY CORNER OF FACILITY AND POINT OF TANGENCY
- DIMENSIONS AND DISTANCE TO EVERY INLET, OUTLET, CHECK DAM, SIDEWALK NOTCH, ETC.
- ELEVATIONS OF EVERY INLET, OUTLET, STRUCTURE RIM AND INVERT, CHECK DAM, AND SIDEWALK NOTCH
- TYPE AND DESIGN OF FACILITY COMPONENTS (E.G., EDGE TREATMENTS, INLETS/GUTTER MODIFICATIONS, UTILITY CROSSINGS, LINER, AND PLANTING DETAILS)


LAYOUT REQUIREMENTS:

- FOR RIGHT-OF-WAY APPLICATIONS, REFER TO THE SMC DPW STANDARD DRAWINGS AND SPECIFICATIONS FOR CONSTRUCTION FOR COURTESY STRIP, THROUGHWAY, PARKING SPACE AND ACCESSIBLE PATH REQUIREMENTS.
- LOCATE CURB CUTS AND GUTTER MODIFICATIONS TO AVOID CONFLICTS WITH ACCESSIBILITY REQUIREMENTS (E.G., LOCATE OUTSIDE OF CROSSWALKS).

RELATED COMPONENTS

EDGE TREATMENTS:	BC 1.1	BC 1.12
INLETS:	BC 2.1	BC 2.6
OUTLETS:	BC 3.1	BC 3.4
SOIL & AGGREGATE LAYERS:	BC 4.1	
UNDERDRAINS:	BC 5.1	BC 5.2
CHECK DAMS:	BC 6.1	BC 6.2
LINERS:	GC 1.1	GC 1.2
UTILITY CROSSINGS:	GC 3.1	GC 3.3
UTILITY CONFLICTS:	GC 2.1	GC 2.12
OBSERVATION PORTS:	GC 4.1	GC 4.3
CLEANOUTS:	GC 5.1	

NOTES	LAYOUTS & SECTIONS					
BB 1:1	BB 2.1	BB 2.1.1	BB 2.2	BB 2.3	BB 2.4	



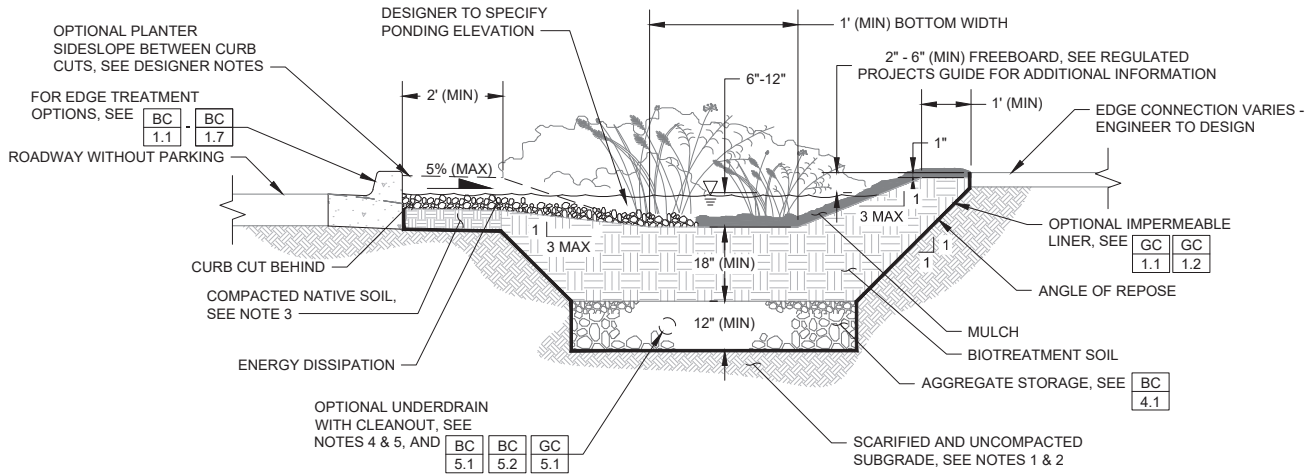
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE	06.2022
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REVISED	N/A

BIORETENTION BASIN
DESIGNER NOTES

FILE NO.
BB
1.1



CONSTRUCTION NOTES:

1. AVOID COMPACTION OF EXISTING SUBGRADE BELOW BASIN.
2. SCARIFY SUBGRADE TO A DEPTH OF 3 INCHES (MIN) IMMEDIATELY PRIOR TO PLACEMENT OF AGGREGATE STORAGE AND BIOTREATMENT SOIL MATERIALS.
3. COMPACT SOIL IMMEDIATELY BEHIND CURB TO 90% OF MAXIMUM DENSITY PER STANDARD PROCTOR TEST (ASTM D698).
4. UNDERDRAIN REQUIRED FOR ALL FACILITIES WITH IMPERMEABLE LINER.
5. PROVIDE ONE CLEANOUT PER PLANTER (MIN) FOR FACILITIES WITH UNDERDRAINS.
6. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT JURISDICTION PROTECTION STANDARDS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
7. GEOTECHNICAL OR HYDROLOGIST ENGINEER TO DETERMINE IF LINER SHALL BE USED.
8. ANGLE OF REPOSE MAY VARY BASED ON GEOTECHNICAL ENGINEER RECOMMENDATIONS.

NOTES		LAYOUTS & SECTIONS					
BB	BB	BB	BB	BB	BB	BB	
1.1	2.1	2.1.1	2.2	2.3	2.4		



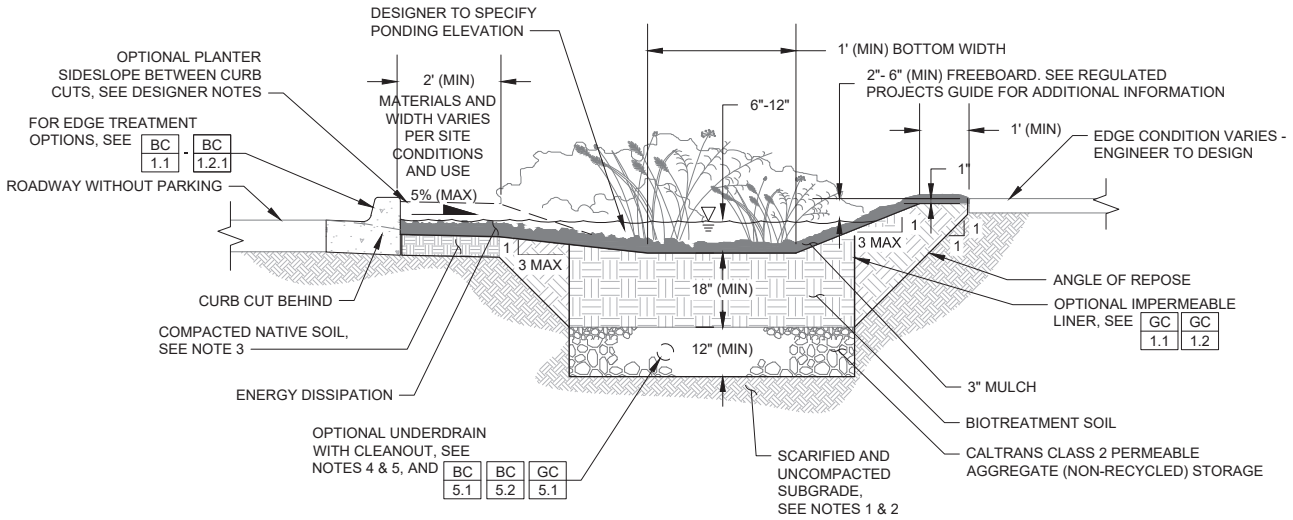
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

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BIORETENTION BASIN
ROADSIDE SECTION TYPE 1

FILE NO.
BB
2.1



CONSTRUCTION NOTES:

1. AVOID COMPACTION OF EXISTING SUBGRADE BELOW BASIN.
2. SCARIFY SUBGRADE TO A DEPTH OF 3 INCHES (MIN) IMMEDIATELY PRIOR TO PLACEMENT OF AGGREGATE STORAGE AND BIOTREATMENT SOIL MATERIALS.
3. COMPACT SOIL IMMEDIATELY BEHIND CURB TO 90% OF MAXIMUM DENSITY PER STANDARD PROCTOR TEST (ASTM D698).
4. UNDERDRAIN REQUIRED FOR ALL FACILITIES WITH IMPERMEABLE LINER.
5. PROVIDE ONE CLEANOUT PER PLANTER (MIN) FOR FACILITIES WITH UNDERDRAINS.
6. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT JURISDICTION PROTECTION STANDARDS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
7. GEOTECHNICAL OR HYDRAULOGIST ENGINEER TO DETERMINE IF LINER SHALL BE USED.
8. ANGLE OF REPOSE MAY VARY BASED ON GEOTECHNICAL ENGINEER RECOMMENDATIONS.

NOTES		LAYOUTS & SECTIONS			
BB 1.1	BB 2.1	BB 2.1.1	BB 2.2	BB 2.3	BB 2.4



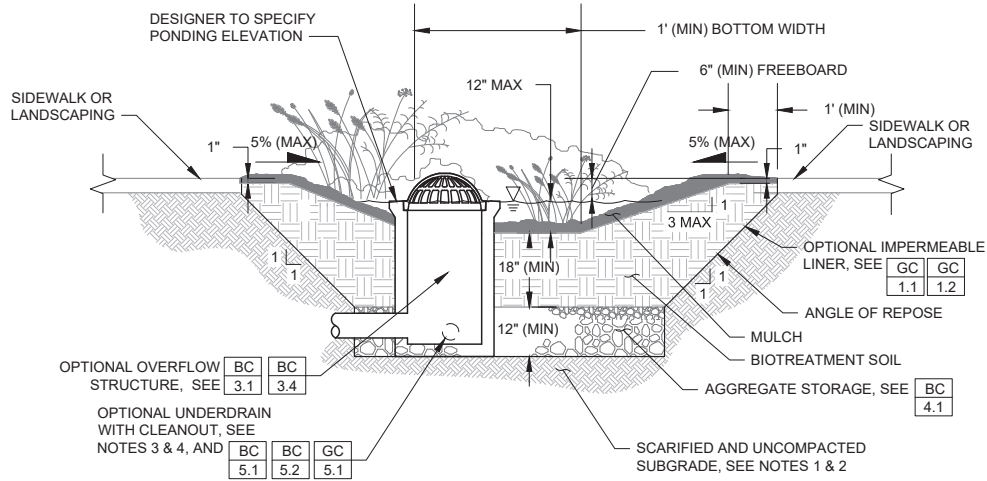
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TYPICAL DETAILS**
COUNTY OF SAN MATEO

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REVISED	N/A

BIORETENTION BASIN
ROADSIDE SECTION TYPE 2

FILE NO.
**BB
2.1.1**



CONSTRUCTION NOTES:

1. AVOID COMPACTION OF EXISTING SUBGRADE BELOW BASIN.
2. SCARIFY SUBGRADE TO A DEPTH OF 3 INCHES (MIN) IMMEDIATELY PRIOR TO PLACEMENT OF AGGREGATE STORAGE AND BIOTREATMENT SOIL MATERIALS.
3. UNDERDRAIN REQUIRED FOR ALL FACILITIES WITH IMPERMEABLE LINER.
4. PROVIDE ONE CLEANOUT PER PLANTER (MIN) FOR FACILITIES WITH UNDERDRAINS.
5. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT SMC ASSET PROTECTION STANDARDS AND OTHER UTILITY PROVIDER REQUIREMENTS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.

NOTES		LAYOUTS & SECTIONS				
BB	BB	BB	BB	BB	BB	
1.1	2.1	2.1.1	2.2	2.3	2.4	



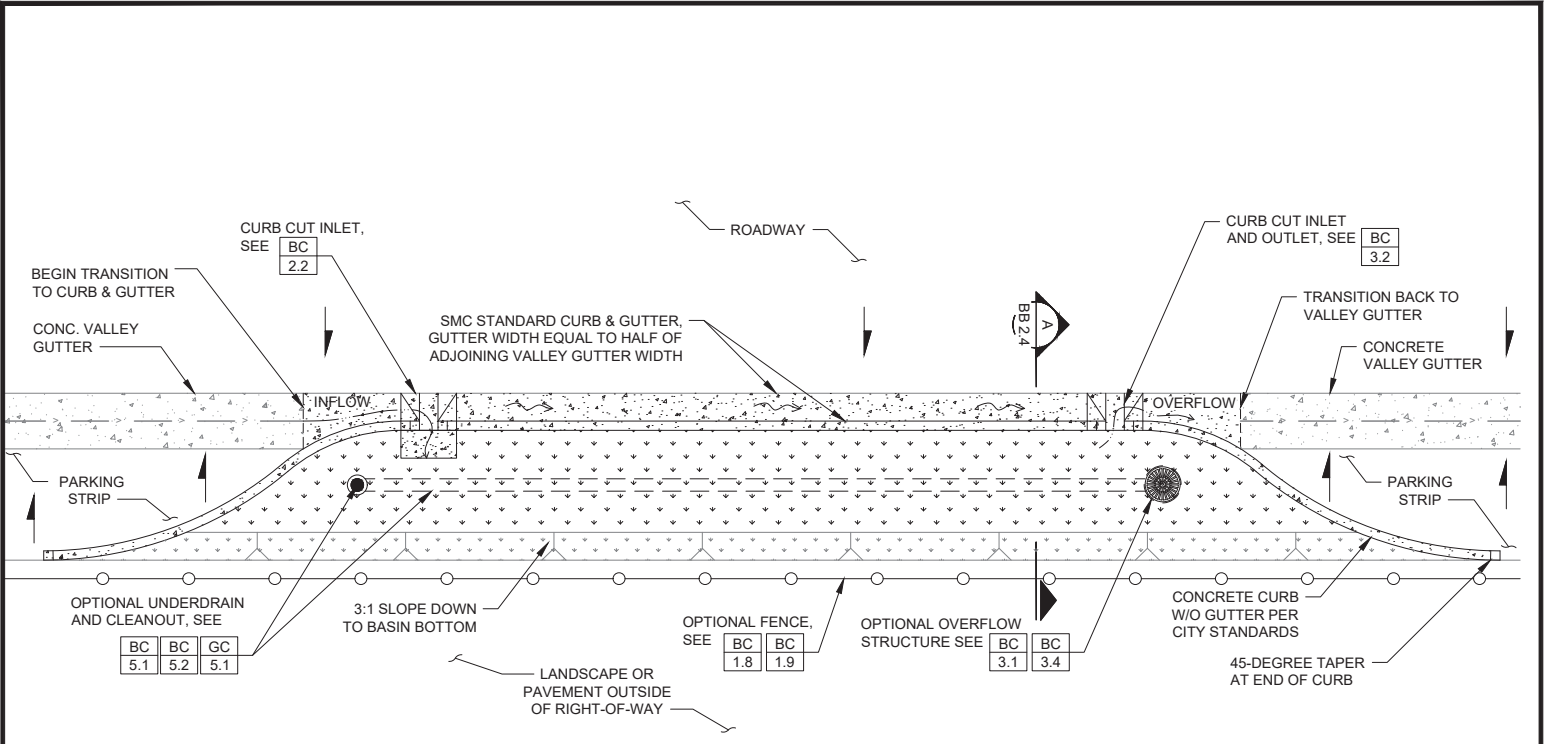
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TYPICAL DETAILS
COUNTY OF SAN MATEO


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BIORETENTION BASIN
PARCEL SECTION

FILE NO.
BB
2.2



NOTES		LAYOUTS & SECTIONS					
BB	BB	BB	BB	BB	BB	BB	
1.1	2.1	2.1.1	2.2	2.3	2.4		

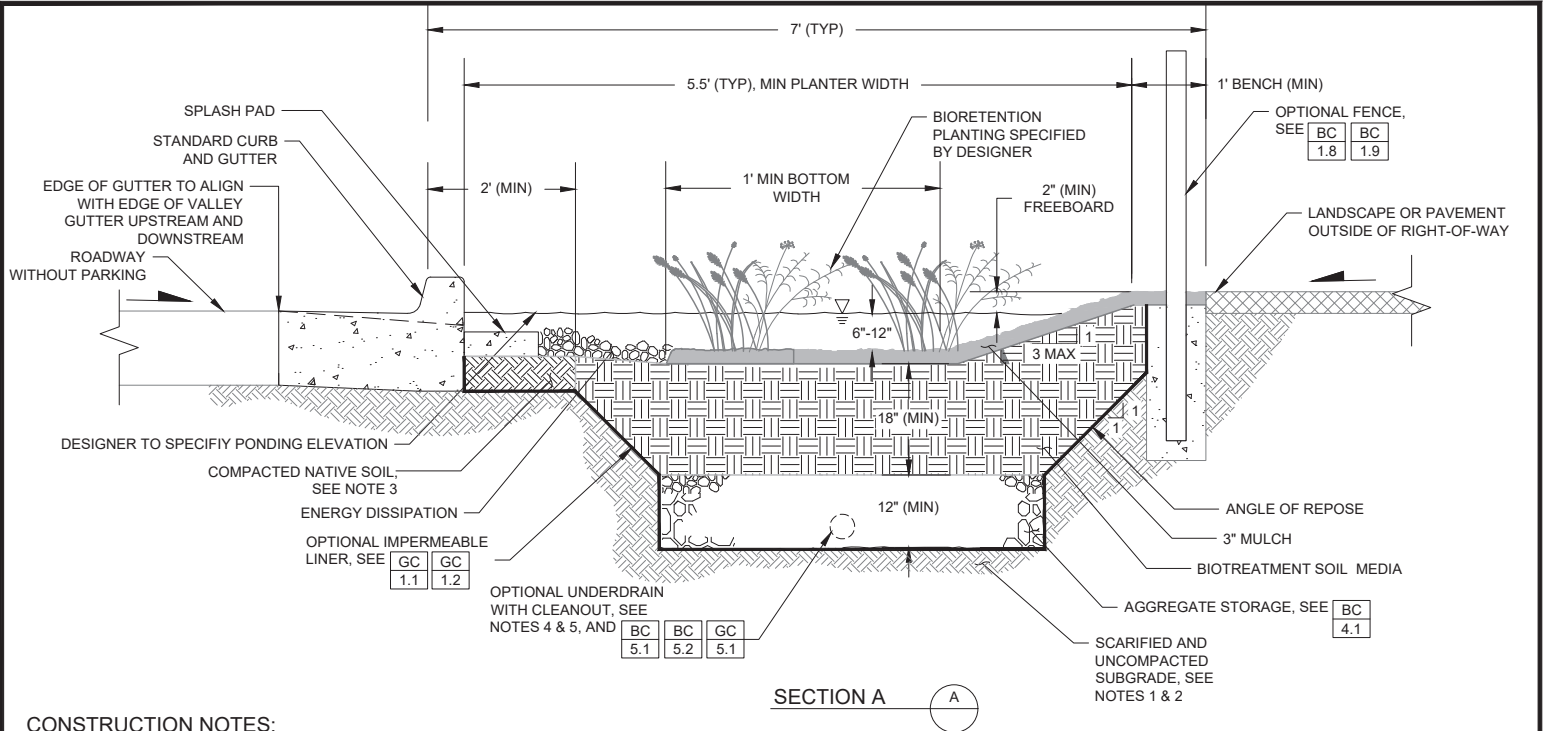

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GREEN INFRASTRUCTURE
TYPICAL DETAILS
 COUNTY OF SAN MATEO

DATE 06.2022
 VERSION 02
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BIORETENTION BASIN
 ROADSIDE LAYOUT TYPE 3
 STREET WITH VALLEY GUTTERS

FILE NO.
BB
 2.3



CONSTRUCTION NOTES:

1. AVOID COMPACTION OF EXISTING SUBGRADE BELOW BASIN.
2. SCARIFY SUBGRADE TO A DEPTH OF 3 INCHES (MIN) IMMEDIATELY PRIOR TO PLACEMENT OF AGGREGATE STORAGE AND BIORETENTION SOIL MATERIALS.
3. COMPACT NATIVE SOIL IMMEDIATELY BEHIND CURB TO 90% OF MAXIMUM DENSITY PER STANDARD PROCTOR TEST (ASTM D698).
4. UNDERDRAIN REQUIRED FOR ALL FACILITIES WITH IMPERMEABLE LINER AND PLACED 1 INCH ABOVE BOTTOM OF AGGREGATE SECTION.
5. PROVIDE ONE CLEANOUT PER PLANTER (MIN) FOR FACILITIES WITH UNDERDRAINS.
6. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT JURISDICTIONAL ASSET PROTECTION STANDARDS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
7. GEOTECHNICAL OR HYDRAULOGIST ENGINEER TO DETERMINE IF LINER SHALL BE USED.
8. ANGLE OF REPOSE MAY VARY BASED ON GEOTECHNICAL ENGINEER RECOMMENDATIONS.

NOTES		LAYOUTS & SECTIONS				
BB	BB	BB	BB	BB	BB	BB
1.1	2.1	2.1.1	2.2	2.3	2.4	

	ANN M. STILLMAN	GREEN INFRASTRUCTURE	DATE 06.2022	BIORETENTION BASIN	
	INTERIM DIRECTOR OF PUBLIC WORKS	TYPICAL DETAILS	VERSION 02	ROADSIDE SECTION TYPE 3	BB 2.4
		COUNTY OF SAN MATEO	REVISED N/A	STREET WITH VALLEY GUTTERS	

PURPOSE:

EDGE TREATMENTS ARE USED TO DEFINE THE BOUNDARIES OF A BIORETENTION FACILITY AND ARE INTENDED PRIMARILY TO STABILIZE THE EDGE OF ADJACENT PAVEMENT AND MINIMIZE LATERAL MOVEMENT OF WATER, AS APPLICABLE. IN CASES WHERE ADEQUATE SPACE IS AVAILABLE, THE FACILITY SIDESLOPE CAN BE LAID BACK SUCH THAT THE SURROUNDING NATIVE SOIL IS STABLE AND CAN FUNCTION AS THE FACILITY EDGE TREATMENT. HOWEVER, WHEN SPACE IS LIMITED, EDGE TREATMENTS SUCH AS VERTICAL WALLS MAY BE USED TO MAINTAIN THE STRUCTURAL INTEGRITY OF THE SURROUNDING SURFACES. THESE EDGE TREATMENTS RETAIN STORMWATER WITHIN THE FACILITY (AND OUT OF THE SURROUNDING PAVEMENT SECTIONS, AS APPLICABLE) UNTIL WATER INFILTRATES, IS COLLECTED BY THE UNDERDRAIN, OR OVERFLOWS VIA THE DESIGNATED OUTLETS.

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
2. MINIMUM EDGE TREATMENT EMBEDMENT DEPTHS ARE SPECIFIED TO PREVENT LATERAL SEEPAGE UNDER THE EDGE TREATMENT AND INTO ADJACENT PAVEMENT SECTIONS, AS APPLICABLE.
3. DESIGNER MAY ELIMINATE CONSTRUCTION BENCH TO INCREASE EFFECTIVE FACILITY AREA (I.E. INFILTRATION AND STORAGE FOOTPRINT) PROVIDED PLANTER WALL EXTENDS TO BOTTOM OF AGGREGATE STORAGE.
4. DESIGNER MAY SPECIFY ALTERNATIVE MATERIAL TYPE FOR EDGE TREATMENTS PROVIDED MATERIAL MEETS STRUCTURAL REQUIREMENTS FOR LOADING CONDITIONS, SERVES AS A WATER BARRIER BETWEEN THE FACILITY AND ADJACENT PAVEMENT SECTIONS (AS APPLICABLE), AND COMPLIES WITH SMC DPW STANDARD ACCESSIBILITY REQUIREMENTS.
5. FOOTING OR LATERAL BRACING SHALL BE PROVIDED FOR ALL PLANTER WALLS UNLESS THE DESIGNER DEMONSTRATES THAT THE PROPOSED WALL DESIGN MEETS LOADING REQUIREMENTS.
6. FOOTINGS AND LATERAL BRACING SHALL BE DESIGNED TO WITHSTAND ANTICIPATED LOADING ASSUMING NO REACTIVE FORCES FROM THE UNCOMPACTED BIOTREATMENT SOIL WITHIN THE FACILITY.
7. LATERAL BRACING SHALL MEET HYDROLOGIC AND HYDRAULIC DESIGN REQUIREMENTS FOR CHECK DAMS WHEN USED AS CHECK DAMS. SEE **BC 6.1** AND **BC 6.2**.
8. PLANTER WALLS EXTENDING MORE THAN 36 INCHES BELOW ADJACENT LOAD-BEARING SURFACE, OR WHEN LOCATED ADJACENT TO PAVERS, MUST HAVE FOOTING OR LATERAL BRACING. SEE **BC 1.5**

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- EDGE TREATMENT TYPE AND MATERIAL
- EDGE TREATMENT WIDTH AND HEIGHT
- EMBEDMENT DEPTH INTO SUBGRADE SOILS
- LATERAL BRACING/FOOTING REQUIREMENTS
- PIPE MATERIAL AND DIAMETER FOR ALL WALL PENETRATIONS
- WATER TIGHT CONNECTOR TYPE FOR ALL WALL PENETRATIONS (E.G., GROUTED, COMPRESSION, BOOT) SEE **GC 2.10** AND **GC 2.11**.
- ELEVATIONS - INLET, OUTLET, OVERFLOW STRUCTURE (RIM & INVERT), CLEANOUT (RIM & INVERT)
- ELEVATIONS - TOP OF SLOPE AND TOE OF SLOPE

EDGE TREATMENTS															
NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13



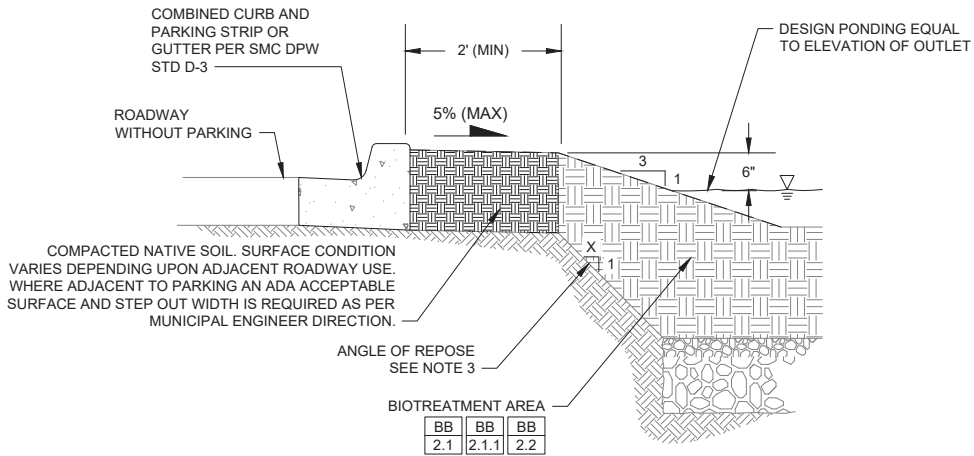
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE
06.2022
VERSION
02
REVISED
N/A

BIORETENTION COMPONENTS
EDGE TREATMENTS
DESIGNER NOTES

BC
1.1



STANDARD CURB EDGE AT BIORETENTION BASIN 1

CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR EDGE TREATMENTS SHALL CONFORM TO STANDARD SPECIFICATIONS AND APPLICABLE CODES PER RESPONSIBLE JURISDICTION.
2. COMPACT NATIVE SOIL TO 90% OF MAXIMUM DENSITY PER STANDARD PROCTOR TEST (ASTM D698). TRANSITION TO STANDARD BIOTREATMENT SOIL SECTION UPSLOPE OF DESIGN PONDING ELEVATION.
3. ANGLE OF REPOSE VARIES PER GEOTECHNICAL ENGINEER RECOMMENDATIONS.

EDGE TREATMENTS															
NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13



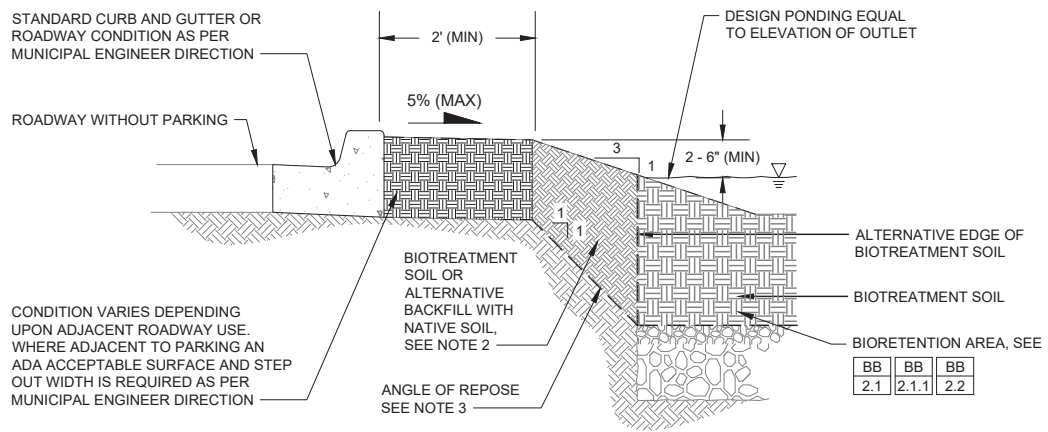
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TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE	06.2022
VERSION	02
REVISED	N/A

BIORETENTION COMPONENTS
EDGE TREATMENTS
VEHICULAR APPLICATIONS (1 OF 3)

FILE NO.
**BC
1.2**



STANDARD CURB EDGE AT BIORETENTION AREA (1)

CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR EDGE TREATMENTS SHALL CONFORM TO STANDARD SPECIFICATIONS AND APPLICABLE CODES PER RESPONSIBLE JURISDICTION.
2. COMPACT NATIVE SOIL TO 90% OF MAXIMUM DENSITY PER STANDARD PROCTOR TEST (ASTM D698). TRANSITION TO STANDARD BIOTREATMENT SOIL SECTION UPSLOPE OF DESIGN PONDING ELEVATION.
3. ANGLE OF REPOSE VARIES PER GEOTECHNICAL ENGINEER RECOMMENDATIONS.

EDGE TREATMENTS															
NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13



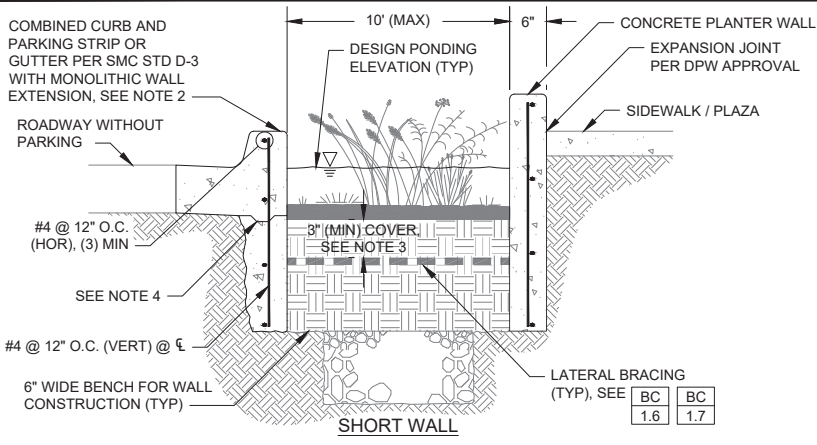
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COUNTY OF SAN MATEO

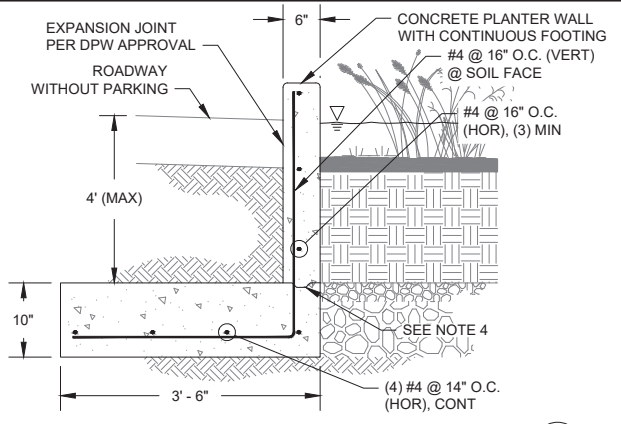
DATE	06.2022
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REVISED	N/A

BIORETENTION COMPONENTS
EDGE TREATMENTS –VEHICULAR APPLICATIONS
MODIFICATION (2 OF 3)

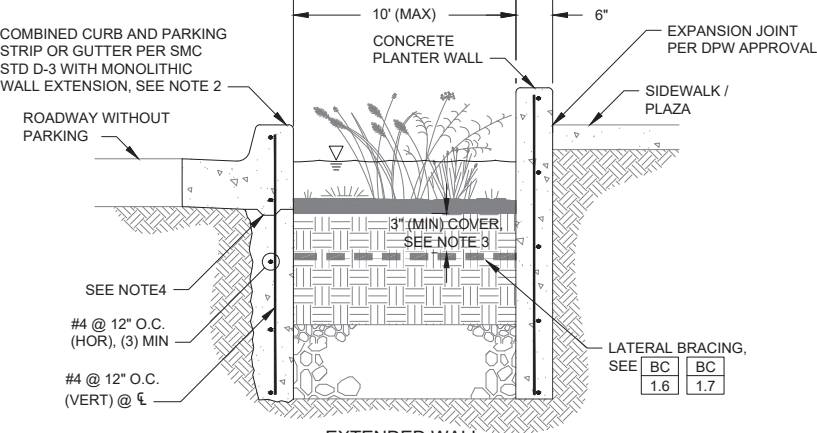
FILE NO.
BC
1.2.1



SHORT WALL



PLANTER WALL WITH CONTINUOUS FOOTING 2




EXTENDED WALL

PLANTER WALL WITH LATERAL BRACING 1

CONSTRUCTION NOTES:

1. ALL MATERIAL, REINFORCEMENT AND WORKMANSHIP FOR EDGE TREATMENTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. ALL PLANTER WALLS SHALL EXTEND TO BOTTOM OF BIOTREATMENT SOIL OR DEEPER.
3. CONTRACTOR TO PROVIDE 3 INCH MINIMUM COVER OVER ALL LATERAL BRACING FOR PLANT ESTABLISHMENT.
4. ALL CONSTRUCTION COLD JOINTS SHALL INCORPORATE EPOXY, DOWEL/TIE BAR, KEYWAY, OR WATER STOP.
5. DETAIL NOT TO BE USED WITHIN COUNTY RIGHT-OF-WAY.

EDGE TREATMENTS															
NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13

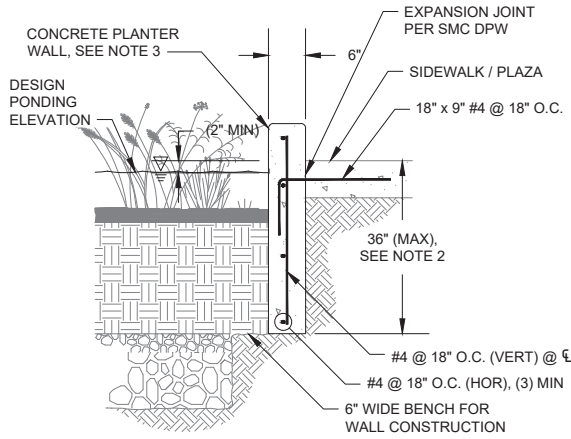

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GREEN INFRASTRUCTURE
TYPICAL DETAILS
 COUNTY OF SAN MATEO

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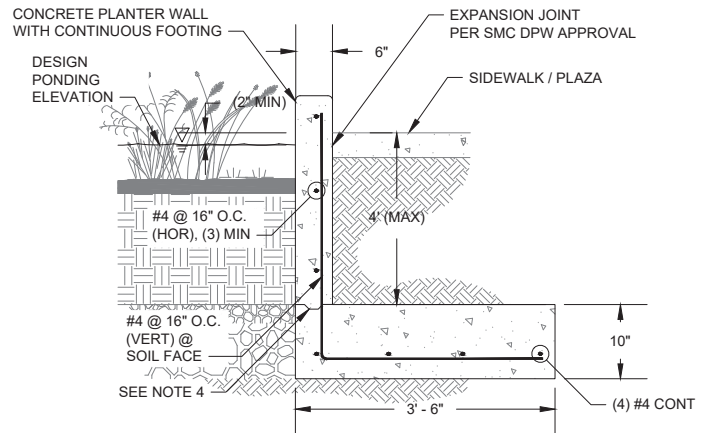
BIORETENTION COMPONENTS
 EDGE TREATMENTS
 VEHICULAR APPLICATIONS (3 OF 3)

FILE NO:
BC 1.3



PLANTER WALL - PARCEL ONLY

1



PLANTER WALL WITH CONTINUOUS FOOTING

2

CONSTRUCTION NOTES:

1. ALL MATERIAL, REINFORCEMENT AND WORKMANSHIP FOR EDGE TREATMENTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. PLANTER WALLS EXTENDING MORE THAN 36 INCHES BELOW ADJACENT LOAD-BEARING SURFACE, OR WHEN LOCATED ADJACENT TO PAVERS, MUST HAVE FOOTING OR LATERAL BRACING. COORDINATE WITH ENGINEER.
3. ALL PLANTER WALLS SHALL EXTEND TO BOTTOM OF BIOTREATMENT SOIL OR DEEPER.
4. ALL CONSTRUCTION COLD JOINTS SHALL INCORPORATE EPOXY, DOWEL/TIE BAR, OR WATER STOP.

EDGE TREATMENTS															
NOTES	COMPONENTS														
BC	BC	BC	BC	BC	BC	BC	BC	BC	BC	BC	BC	BC	BC	BC	
1.1	1.2	1.2.1	1.3	1.4	1.5	1.5.1	1.5.2	1.6	1.7	1.8	1.9	1.10	1.11	1.12	1.13



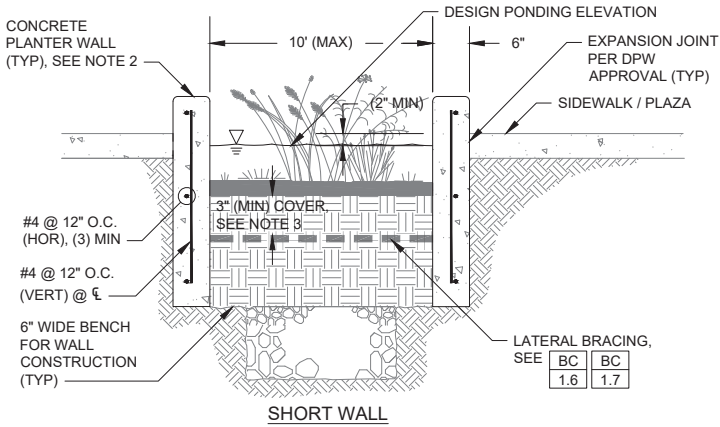
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TYPICAL DETAILS**
COUNTY OF SAN MATEO

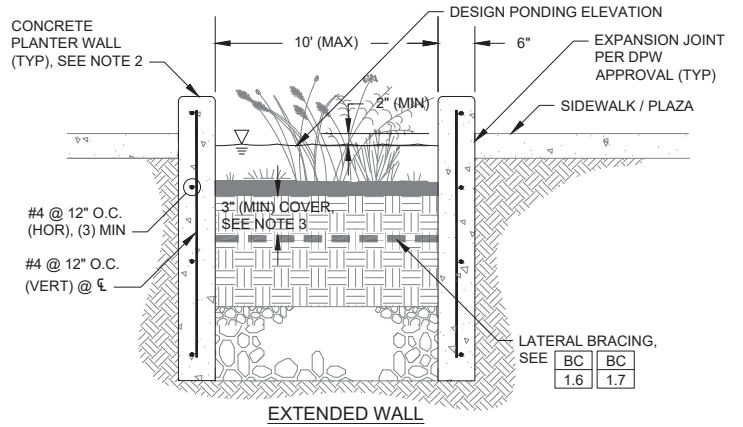
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BIORETENTION COMPONENTS
EDGE TREATMENTS
PEDESTRIAN APPLICATIONS (1 OF 4)

FILE NO.
BC
1.4



SHORT WALL



EXTENDED WALL

PLANTER WALL WITH LATERAL BRACING -SHORT 1

PLANTER WALL WITH LATERAL BRACING - EXTENDED 2

CONSTRUCTION NOTES:

1. ALL MATERIAL, REINFORCEMENT AND WORKMANSHIP FOR EDGE TREATMENTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. ALL PLANTER WALLS SHALL EXTEND TO BOTTOM OF BIOTREATMENT SOIL OR DEEPER.
3. CONTRACTOR TO PROVIDE 3 INCH MINIMUM COVER OVER ALL LATERAL BRACING FOR PLANT ESTABLISHMENT.
4. ALL CONSTRUCTION COLD JOINTS SHALL INCORPORATE EPOXY, DOWEL/TIE BAR, AND WATER STOP.

EDGE TREATMENTS															
NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13



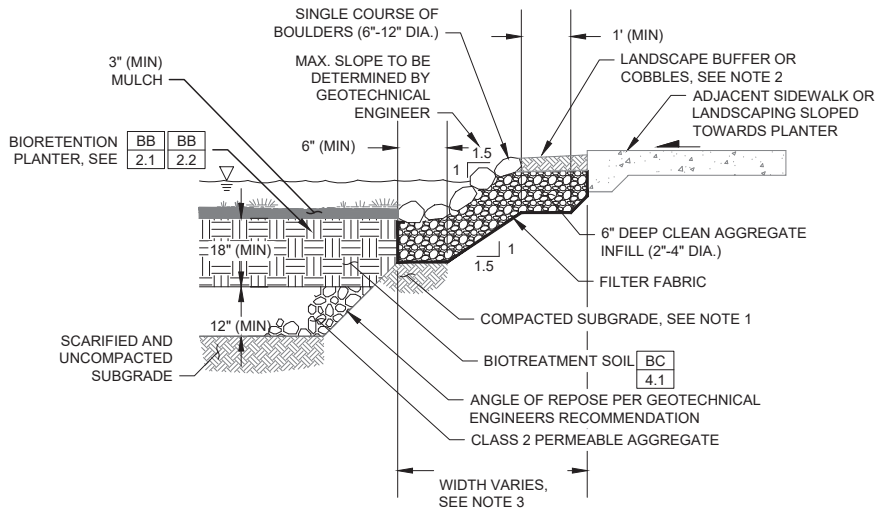
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COUNTY OF SAN MATEO

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BIORETENTION COMPONENTS
EDGE TREATMENTS
PEDESTRIAN APPLICATIONS (2 OF 4)

FILE NO.
**BC
1.5**



NOTES:

1. IF ADDITIONAL TREE ROOT VOLUME IS NEEDED FOR TREES PLANTED WITHIN THE BIORETENTION PLANTER, THE DESIGNER MAY SPECIFY THE USE OF STRUCTURAL SOIL OR SILVA CELLS UNDER THE STABILIZED SLOPE AND/OR SIDEWALK BASE WITH APPROVAL FROM GEOTECHNICAL ENGINEER AND SMC DPW.
2. IF THERE IS A RISK OF EROSION ADJACENT TO A WIDE SIDEWALK/PLAZA, COBBLES SHALL BE USED IN LIEU OF LANDSCAPING TO PROVIDE ENERGY DISSIPATION AND EROSION PROTECTION. BUFFER AREA SHALL BE DESIGNED AND MAINTAINED TO ALLOW FOR FREE FLOW OF RUNOFF FROM ADJACENT SURFACE INTO PLANTER.
3. IF SPACE CONSTRAINTS REQUIRE REDUCED WIDTH, A STEEPER SLOPE AND VERTICAL WALL EDGE RESTRAINT WITH RAISED CURB AT SIDEWALK MAY BE USED, SUBJECT TO APPROVAL BY GEOTECHNICAL ENGINEER.
4. REFER TO SMCWPPP GI DESIGN GUIDE FOR ADDITIONAL DESIGN GUIDANCE.

EDGE TREATMENTS															
NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13



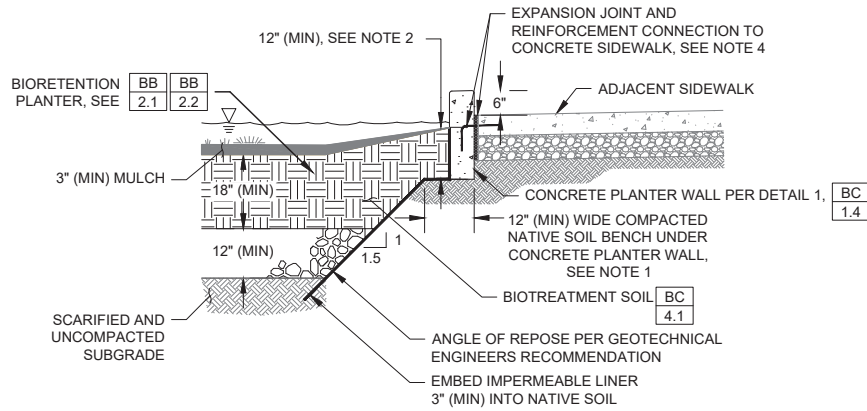
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BIORETENTION COMPONENTS
EDGE TREATMENTS – PED APPLICATIONS
(3 OF 4) ROCK STABILIZED SLOPE

FILE NO.
**BC
1.5.1**



NOTES:

1. IF ADDITIONAL TREE ROOT VOLUME IS NEEDED FOR TREES PLANTED WITHIN THE BIURETENTION PLANTER, DESIGNER MAY SPECIFY THE USE OF STRUCTURAL SOIL OR SILVA CELLS UNDER THE STABILIZED SLOPE AND/OR SIDEWALK BASE WITH APPROVAL FROM GEOTECHNICAL ENGINEER AND SMC DPW.
2. PROVIDE 12" (MIN) DEPTH OF BIOTREATMENT SOIL IMMEDIATELY ADJACENT TO PLANTER WALL. PLANTER MAY BE GRADED WITH 3:1 (MAX) SLOPED SIDES TO PROVIDE THIS 12" (MIN) SOIL DEPTH AND DECREASE THE OVERALL DEPTH OF THE CONCRETE PLANTER WALL. THE CONCRETE PLANTER WALL SHALL ALWAYS EXTEND BELOW THE BOTTOM OF THE DRAINAGE COURSE LAYER BELOW THE SIDEWALK PAVEMENT TO PREVENT WATER WITHIN THE PLANTER FROM MIGRATING UNDER THE SIDEWALK.
3. REFER TO SMCWPPP GI DESIGN GUIDE FOR ADDITIONAL DESIGN GUIDANCE.
4. SINCE COMPACTED BIURETENTION SOIL WILL NOT PROVIDE ADEQUATE RESISTANCE TO LATERAL LOADS PLACED ON THE ADJACENT SIDEWALK, SHORTENED PLANTER WALLS SHALL BE TIED INTO THE ADJACENT SIDEWALK TO PREVENT ROTATION OR SHIFTING OF THE WALL. ALL MATERIAL, REINFORCEMENT AND WORKMANSHIP FOR EDGE TREATMENTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.

EDGE TREATMENTS															
NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13



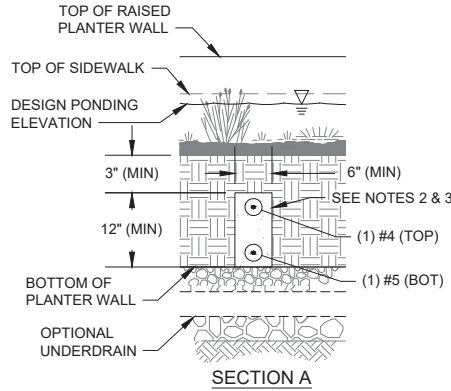
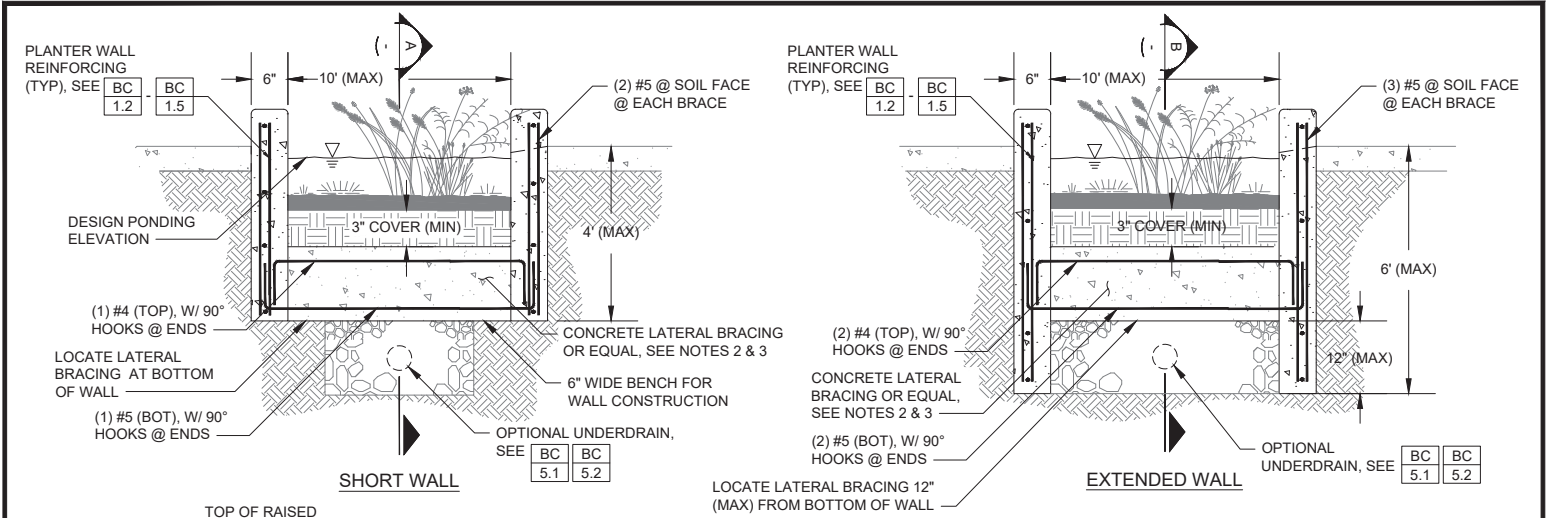
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

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BIURETENTION COMPONENTS
EDGE TREATMENTS – PED APPLICATIONS
(4 OF 4) COMPACTED SOIL BENCH

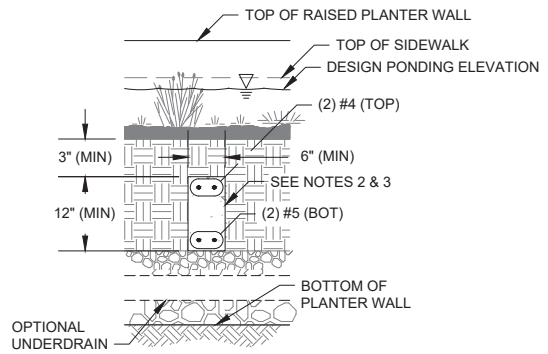
FILE NO:
BC 1.5.2



CONCRETE BRACING WALL - SHORT (1)

CONSTRUCTION NOTES:

1. ALL MATERIAL, REINFORCEMENT AND WORKMANSHIP FOR LATERAL BRACING SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. CONCRETE LATERAL BRACING SHALL BE CONTINUOUS (NO JOINTS).
3. LATERAL BRACING SHALL BE PROVIDED EVERY 6 FEET (MAX) FOR WALLS UP TO 4 FEET IN HEIGHT AND EVERY 4 FEET (MAX) FOR WALLS BETWEEN 4 AND 6 FEET IN HEIGHT. COUNTY APPROVAL IS REQUIRED FOR CASES THAT REQUIRE LATERAL BRACING.
4. THE EXTENDED WALL DETAIL IS FOR CASES IN WHICH STORAGE VOLUME NEEDS TO BE MAXIMIZED IN CONSTRAINED CONDITIONS.



CONCRETE BRACING WALL - EXTENDED (2)

NOTES		COMPONENTS																													
BC	1.1	BC	1.2	BC	1.2.1	BC	1.3	BC	1.4	BC	1.5	BC	1.5.1	BC	1.5.2	BC	1.6	BC	1.7	BC	1.8	BC	1.9	BC	1.10	BC	1.11	BC	1.12	BC	1.13



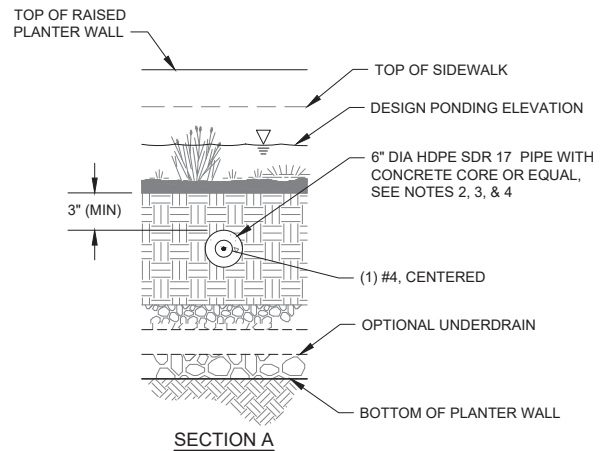
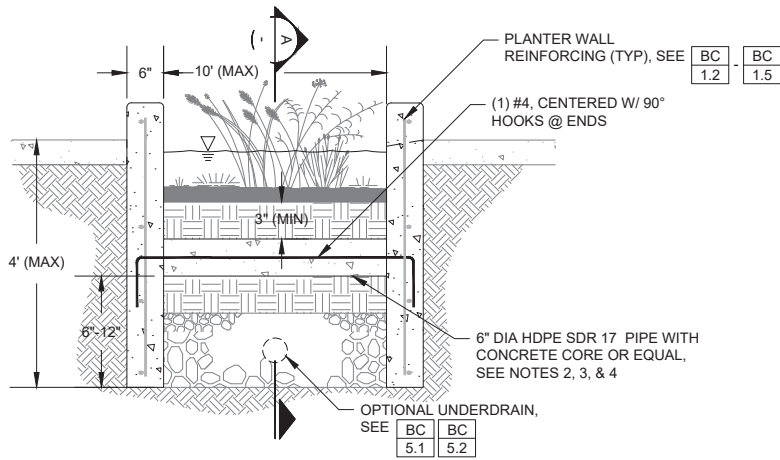
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TYPICAL DETAILS**
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BIORETENTION COMPONENTS
EDGE TREATMENTS
LATERAL BRACING (1 OF 2)

FILE NO.
BC
1.6



CONCRETE STRUT



CONSTRUCTION NOTES:

1. ALL MATERIAL, REINFORCEMENT AND WORKMANSHIP FOR LATERAL BRACING STRUCTURES SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. LATERAL BRACING SHALL BE PROVIDED EVERY 6 FEET (MAX) FOR WALLS UP TO 4 FEET IN HEIGHT.
3. OTHER MATERIALS MAY BE USED IN LIEU OF HDPE PROVIDED MATERIAL IS NON CORROSIVE, NON-LEACHING, AND SCHEDULE 40.
4. PROVIDE 3 INCH CONTINUOUS SLOT ACROSS TOP OF PIPE TO PLACE REINFORCEMENT AND ENSURE STRUT IS FREE OF VOIDS.

EDGE TREATMENTS

NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13



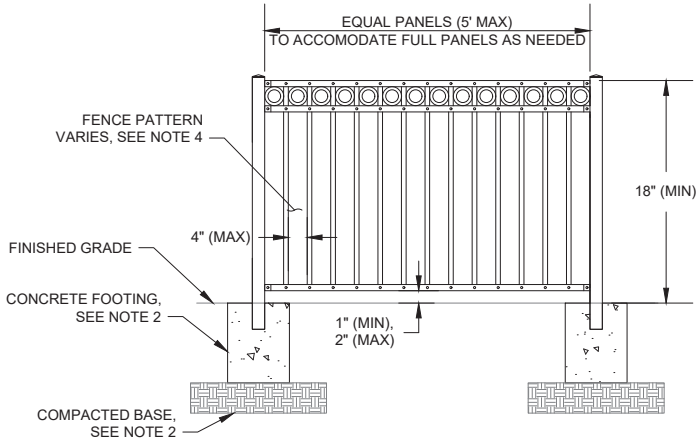
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BIORETENTION COMPONENTS
EDGE TREATMENT
LATERAL BRACING (2 OF 2)

FILE NO.
BC 1.7



TYPICAL FENCE

NOTES:

1. ALL MATERIAL, REINFORCEMENT AND WORKMANSHIP FOR EDGE TREATMENTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS, ADA REQUIREMENTS, AND OTHER APPLICABLE CODES.
2. DESIGNER TO SPECIFY FOUNDATION DETAILS.
3. FIELD MEASUREMENTS MUST BE TAKEN PRIOR TO FABRICATION.
4. SPECIFIC FENCE PATTERN, POST/RAIL DIMENSIONS, MATERIALS, COLOR, JOINTS, AND OTHER FENCE DETAILS SHALL BE SPECIFIED BY DESIGNER FOR REVIEW AND APPROVAL BY SMC.
5. POSTS MAY BE EMBEDDED IN SIDEWALK , CONCRETE CURB, OR LANDSCAPE ADJACENT TO THE BIORETENTION PLANTER. POSTS SHALL NOT BE INSTALLED INSIDE THE BIORETENTION PLANTER. SPECIFIC EMBEDMENT OF POST SHALL BE DESIGNED FOR SITE SPECIFIC CONDITIONS.

EDGE TREATMENTS															
NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13



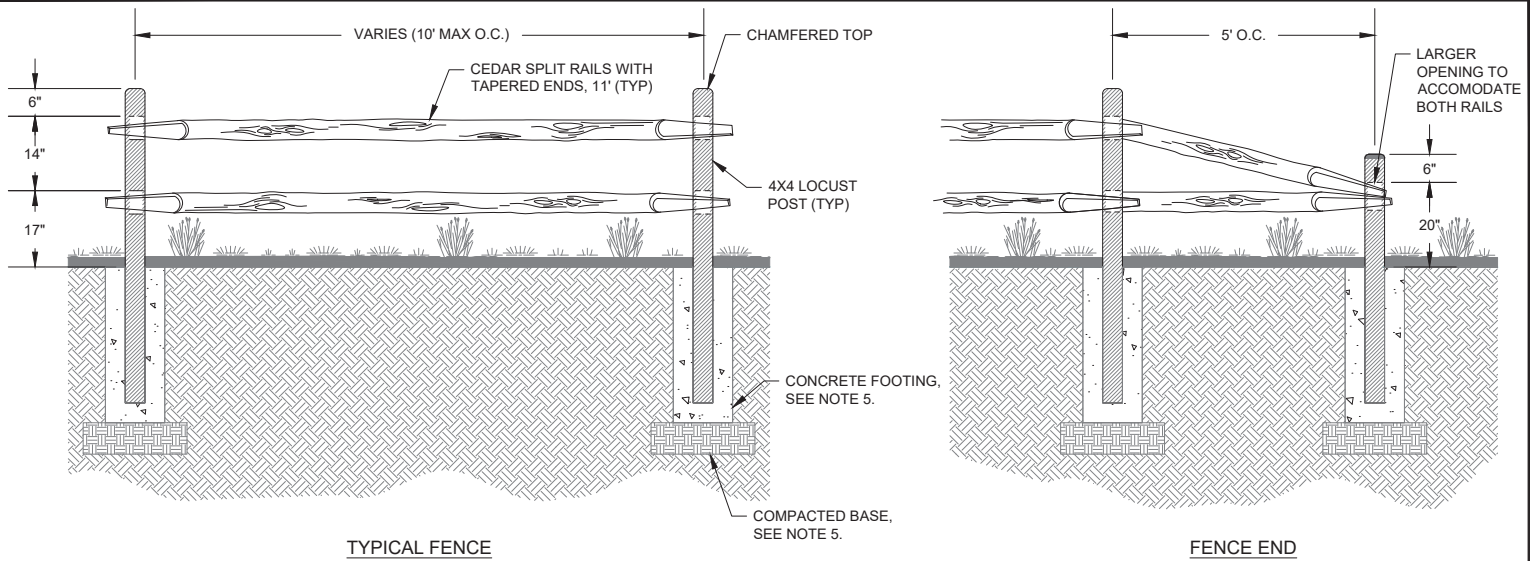
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N/A


BIORETENTION COMPONENTS
EDGE TREATMENTS
METAL FENCING

FILE NO.
BC
1.8



- NOTES:**
1. ALL MATERIAL, REINFORCEMENT AND WORKMANSHIP FOR EDGE TREATMENTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
 2. ALTERNATIVE WOOD FENCE MATERIALS MAY BE USED WITH APPROVAL FROM SMC DPW.
 3. DECK SCREWS SHALL BE USED TO TIE FASTEN RAILS TOGETHER AT POINT OF INTERSECTION AT POSTS. EACH RAIL MUST OVERLAP EACH OTHER BY 3" TO ENSURE STABILITY.
 4. FENCE END SECTION TO BE INCLUDED WHERE NOTED ON DRAWINGS.
 5. DESIGNER TO SPECIFY FOOTING DETAILS.

EDGE TREATMENTS															
NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13

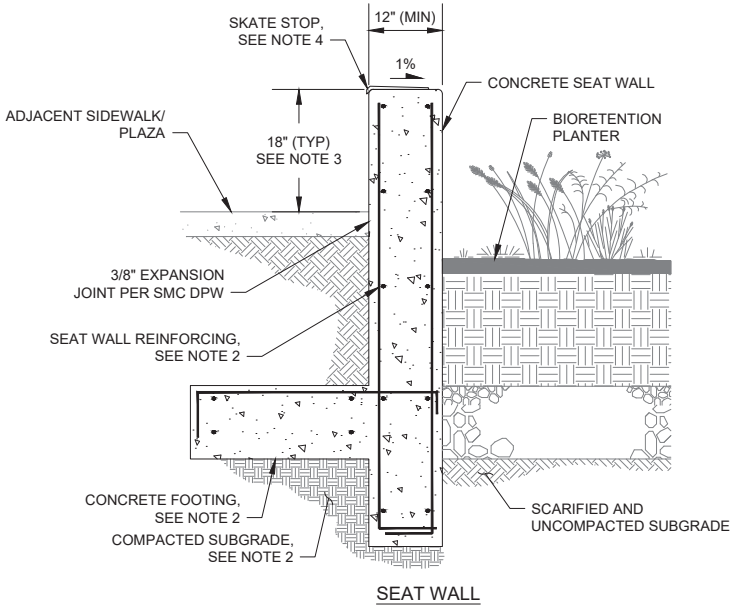

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GREEN INFRASTRUCTURE
TYPICAL DETAILS
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BIORETENTION COMPONENTS
 EDGE TREATMENTS
 WOOD FENCING

FILE NO.
BC
 1.9



DESIGNER NOTES:

1. ALL MATERIAL, REINFORCEMENT AND WORKMANSHIP FOR EDGE TREATMENTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. DESIGNER TO SPECIFY SEAT WALL REINFORCING AND FOOTING DETAILS. FOOTING DESIGN SHALL MINIMIZE IMPACT TO STORAGE VOLUME WITHIN BIORETENTION PLANTER.
3. SEAT WALL HEIGHT AND VERTICAL PROFILE MUST COMPLY WITH SMC ACCESSIBILITY REQUIREMENTS.
4. SKATE STOP TO BE STAINLESS STEEL SKATESTOPPERS DIAMOND INSERT SERIES SKATE STOP OR APPROVED EQUAL. PROVIDE SKATE STOPS AT EXPANSION JOINTS/GROUT LINES OF SEAT WALL AT NO MORE THAN 48" O.C. SPACING ALONG LENGTH OF WALL.
5. DESIGNER TO IDENTIFY WALL CONTROL JOINT LOCATIONS.

EDGE TREATMENTS													
NOTES	COMPONENTS												
BC	BC	BC	BC	BC	BC	BC	BC	BC	BC	BC	BC	BC	BC
1.1	1.2	1.2.1	1.3	1.4	1.5	1.5.1	1.5.2	1.6	1.7	1.8	1.9	1.10	1.11



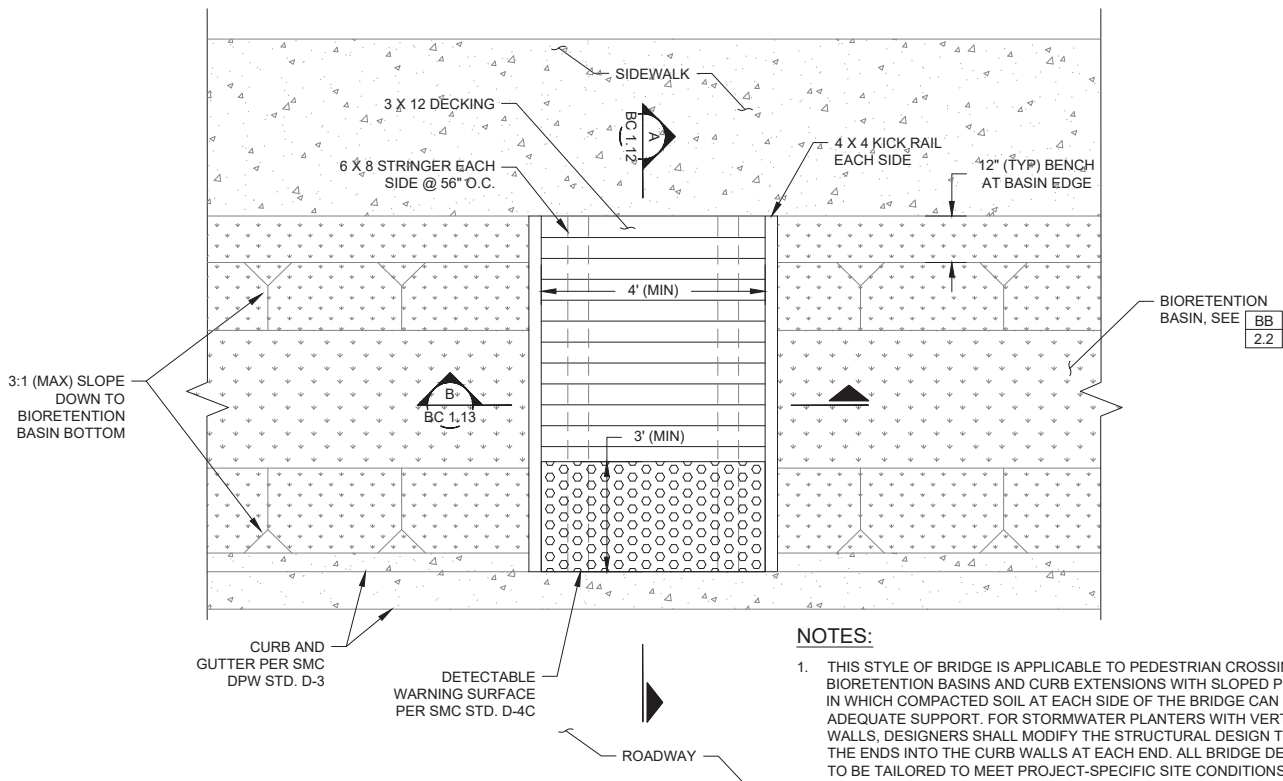
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BIORETENTION COMPONENTS
EDGE TREATMENTS
SEAT WALL

FILE NO.
BC
1.10



NOTES:

1. THIS STYLE OF BRIDGE IS APPLICABLE TO PEDESTRIAN CROSSINGS OF BIORETENTION BASINS AND CURB EXTENSIONS WITH SLOPED PLANTER SIDES IN WHICH COMPACTED SOIL AT EACH SIDE OF THE BRIDGE CAN PROVIDE ADEQUATE SUPPORT. FOR STORMWATER PLANTERS WITH VERTICAL CURB WALLS, DESIGNERS SHALL MODIFY THE STRUCTURAL DESIGN TO ANCHOR THE ENDS INTO THE CURB WALLS AT EACH END. ALL BRIDGE DESIGNS NEED TO BE TAILORED TO MEET PROJECT-SPECIFIC SITE CONDITIONS AND REQUIREMENTS.
2. ALL MATERIAL, REINFORCEMENT, AND WORKMANSHIP FOR EDGE TREATMENTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
3. ALL WEIGHT-BEARING AND SUPPORT LUMBER MUST BE STRUCTURAL SELECT GRADE.
4. BEAM FASTENERS TO BE STAINLESS STEEL, SIMPSON STRONG TIE, OR EQUAL. DECKS SCREWS TO BE HEAVY-DUTY STAINLESS STEEL.

EDGE TREATMENTS															
NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13



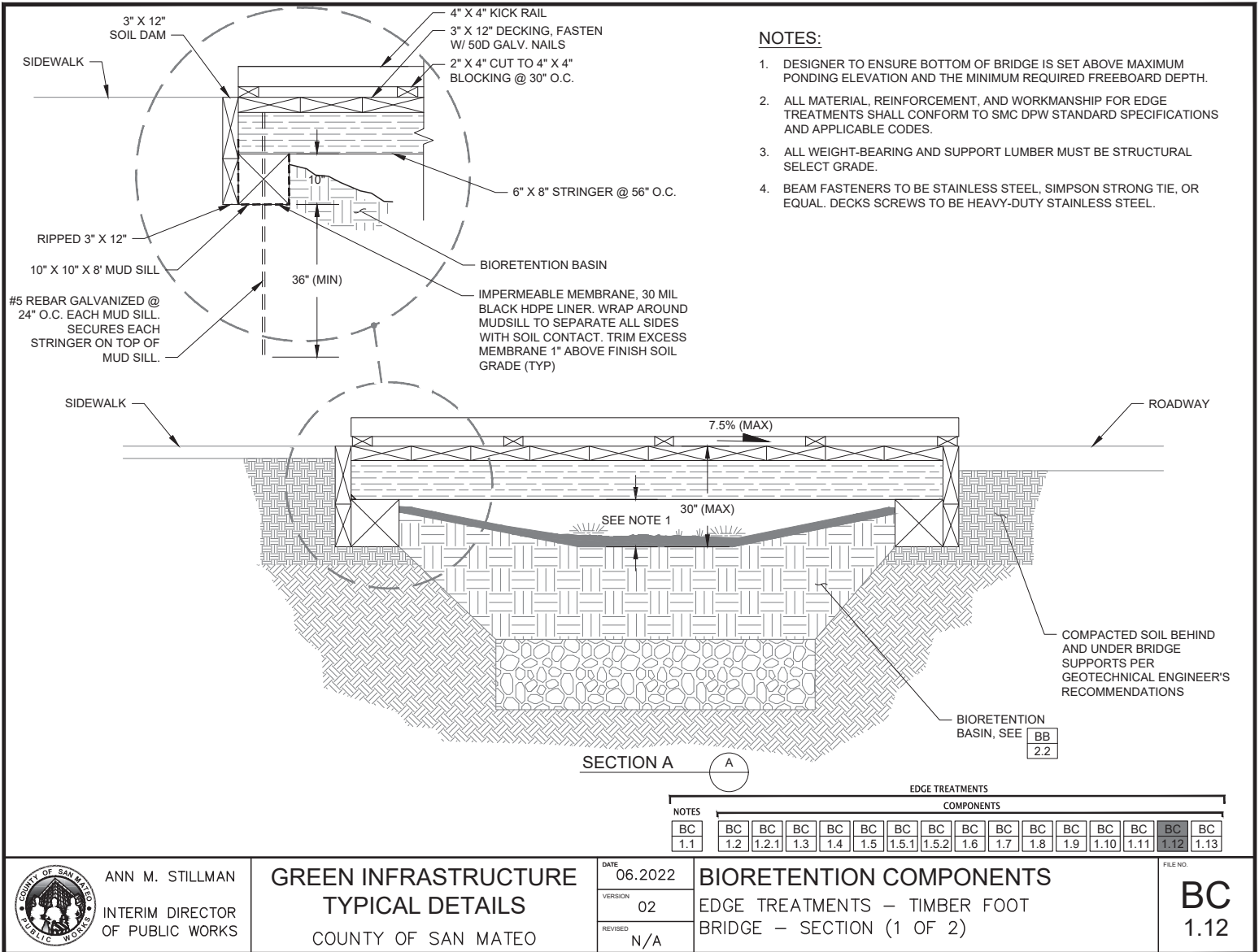
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE 06.2022
VERSION 02
REVISED N/A

BIORETENTION COMPONENTS
EDGE TREATMENTS
TIMBER FOOT BRIDGE – LAYOUT

BC
1.11



NOTES:

1. DESIGNER TO ENSURE BOTTOM OF BRIDGE IS SET ABOVE MAXIMUM PONDING ELEVATION AND THE MINIMUM REQUIRED FREEBOARD DEPTH.
2. ALL MATERIAL, REINFORCEMENT, AND WORKMANSHIP FOR EDGE TREATMENTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
3. ALL WEIGHT-BEARING AND SUPPORT LUMBER MUST BE STRUCTURAL SELECT GRADE.
4. BEAM FASTENERS TO BE STAINLESS STEEL, SIMPSON STRONG TIE, OR EQUAL. DECK SCREWS TO BE HEAVY-DUTY STAINLESS STEEL.

SECTION A



EDGE TREATMENTS

NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13



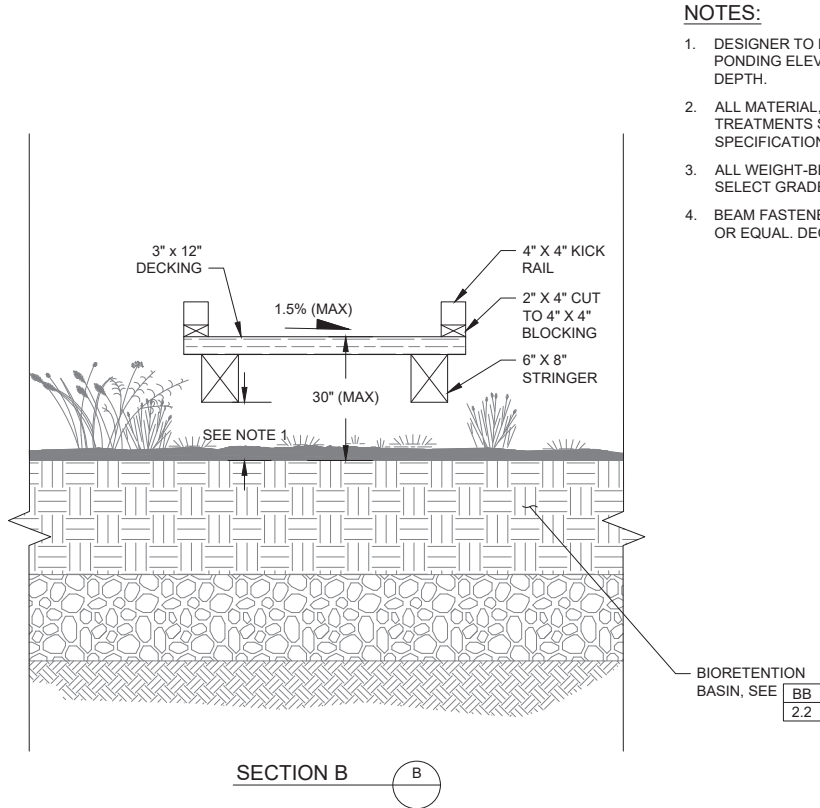
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TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE	06.2022
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REVISED	N/A

BIORETENTION COMPONENTS
EDGE TREATMENTS – TIMBER FOOT
BRIDGE – SECTION (1 OF 2)

FILE NO.
BC
1.12



NOTES:

1. DESIGNER TO ENSURE BOTTOM OF BRIDGE IS SET ABOVE MAXIMUM PONDING ELEVATION AND THE MINIMUM REQUIRED FREEBOARD DEPTH.
2. ALL MATERIAL, REINFORCEMENT, AND WORKMANSHIP FOR EDGE TREATMENTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
3. ALL WEIGHT-BEARING AND SUPPORT LUMBER MUST BE STRUCTURAL SELECT GRADE.
4. BEAM FASTENERS TO BE STAINLESS STEEL, SIMPSON STRONG TIE, OR EQUAL. DECK SCREWS TO BE HEAVY-DUTY STAINLESS STEEL.

EDGE TREATMENTS															
NOTES	COMPONENTS														
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.5.1	BC 1.5.2	BC 1.6	BC 1.7	BC 1.8	BC 1.9	BC 1.10	BC 1.11	BC 1.12	BC 1.13



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COUNTY OF SAN MATEO

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BIORETENTION COMPONENTS
EDGE TREATMENTS – TIMBER FOOT
BRIDGE – SECTION (2 OF 2)

FILE NO.
BC
1.13

PURPOSE:

CURB CUTS AND TRENCH DRAINS SERVE AS INLETS TO CONVEY STORMWATER RUNOFF TO A BIORETENTION FACILITY. CURB CUTS ARE TYPICALLY USED IN PLANTER APPLICATIONS WHEN THE FACILITY IS IMMEDIATELY ADJACENT TO THE ROADWAY (I.E. NO COURTESY STRIP), PROVIDING AN OPENING TO INTERCEPT AND CONVEY STORMWATER FROM THE GUTTER TO THE PLANTER. TRENCH DRAIN SYSTEMS ARE MOST COMMONLY USED TO CONVEY STORMWATER FROM A GUTTER THROUGH THE COURTESY STRIP TO A BIORETENTION PLANTER; PROVIDING A CONTINUOUS SURFACE FOR PEDESTRIAN ACCESS WHILE MINIMIZING ELEVATION LOSSES AT THE FACILITY INFLOW LOCATIONS. CURB CUT AND TRENCH DRAIN INLETS INCLUDE MODIFICATIONS TO THE GUTTER TO HELP DIRECT FLOW INTO THE FACILITY.

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
2. THE DESIGNER MUST ENSURE THAT CURB CUTS AND TRENCH DRAIN INLETS ARE ADEQUATELY SIZED, SPACED, AND SLOPED. THE CURB CUT OPENING WIDTH MUST BE SIZED BASED ON THE CATCHMENT AREA, LONGITUDINAL SLOPE ALONG THE CURB, AND THE CROSS SLOPE OF THE GUTTER OR ADJACENT PAVEMENT AT THE INLET. SEE SIZING EQUATIONS AND NOMOGRAPHS FOR CURB OPENING INLETS IN THE U.S. DEPARTMENT OF TRANSPORTATION HYDRAULIC ENGINEERING CIRCULAR NO. 27.
3. TRENCH DRAIN GRATES AND ASSEMBLIES MUST COMPLY WITH SMC ACCESSIBILITY REQUIREMENTS AND SMCWPPP GI DESIGN GUIDE CHAPTER 4.
4. USE CURB CUT INLET/OUTLET MODIFICATION WITH METAL PLATE TOP (BC 2.2.1) WHEN ADJACENT TO VEHICLE PARKING AND LOADING AREAS

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- CURB CUT DIMENSIONS
- FRAME AND GRATE TYPE/MATERIAL AND DIMENSIONS
- CHANNEL DIMENSIONS
- CONTROL ELEVATIONS FOR OPENINGS AT GUTTER AND PLANTER WALL
- CURBCUT TYPE WITH OR WITHOUT METAL PLATE TOP MODIFICATION

INLETS									
NOTES	COMPONENTS								
BC 2.1	BC 2.2	BC 2.2.1	BC 2.3	BC 2.3.1	BC 2.4	BC 2.4.1	BC 2.5	BC 2.6	



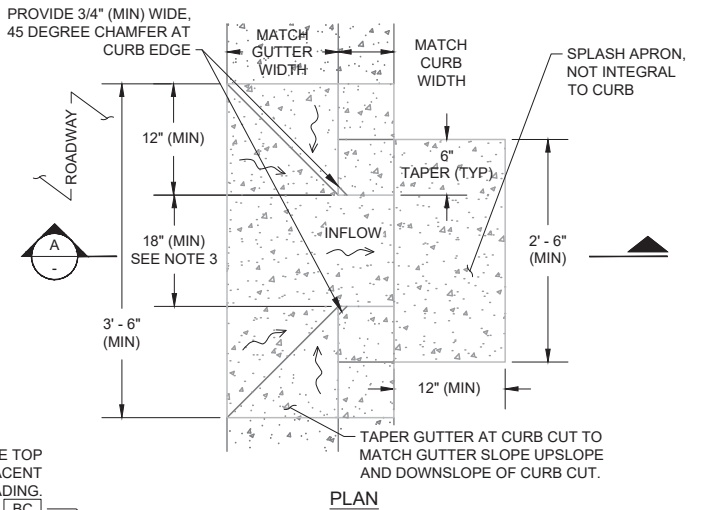
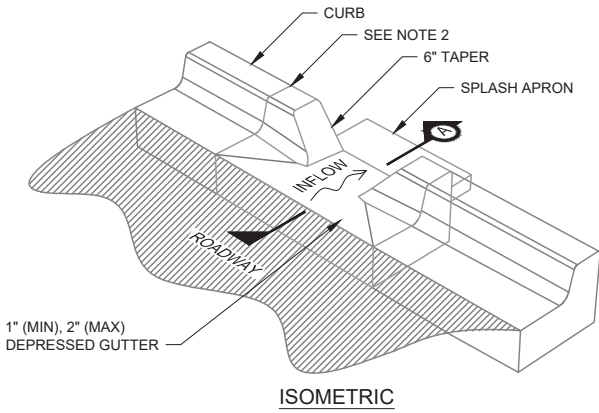
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE	06.2022
VERSION	02
REVISED	N/A

BIORETENTION COMPONENTS
INLETS
DESIGNER NOTES

FILE NO.
BC
2.1



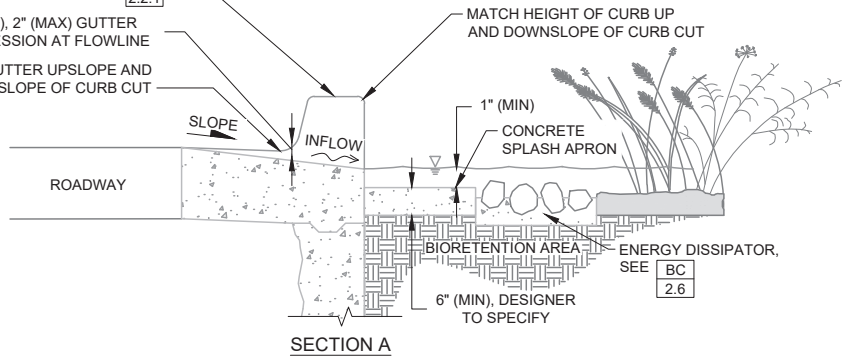
CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR CURB CUTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. BOND NEW CURB AND GUTTER TO EXISTING CURB AND GUTTER WITH EPOXY AND DOWEL CONNECTION.
3. INLET WIDTH MAY BE INCREASED ON STEEPER GUTTER SLOPES. DESIGNER TO SPECIFY.

OPTIONAL METAL PLATE TOP MODIFICATION ADJACENT TO PARKING AND LOADING. SEE BC 2.2.1

1" (MIN), 2" (MAX) GUTTER DEPRESSION AT FLOWLINE

GUTTER UPSLOPE AND DOWNSLOPE OF CURB CUT



NOTES	INLETS							
	COMPONENTS							
BC 2.1	BC 2.2	BC 2.2.1	BC 2.3	BC 2.3.1	BC 2.4	BC 2.4.1	BC 2.5	BC 2.6



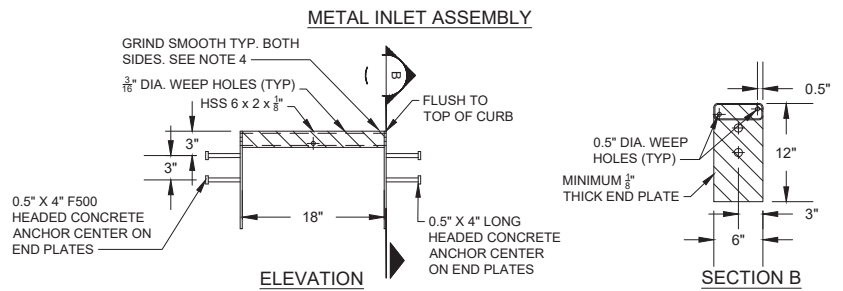
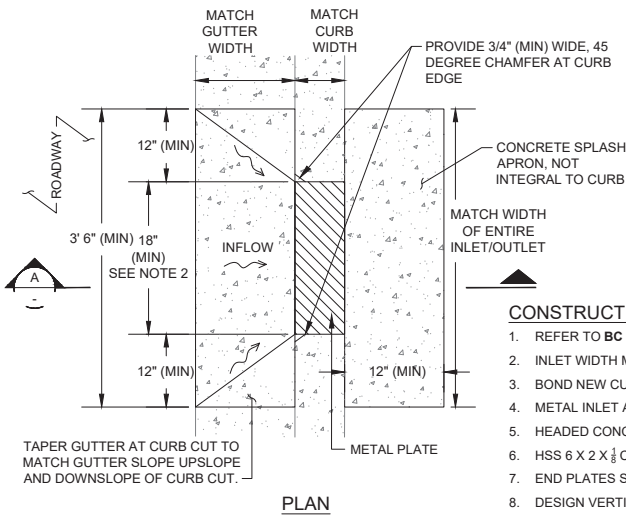
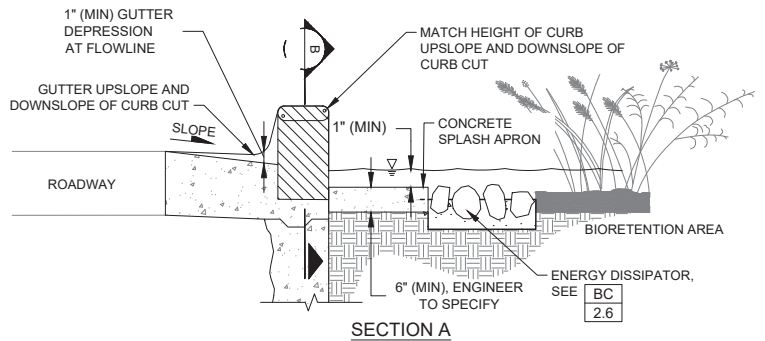
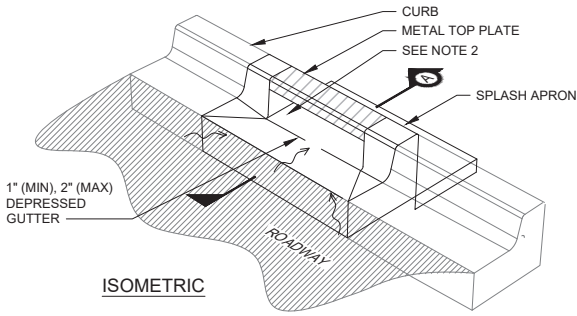
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BIORETENTION COMPONENTS
INLETS
CURB CUT WITH GUTTER MODIFICATION

FILE NO:
BC 2.2



CONSTRUCTION NOTES:

1. REFER TO BC 3.1 NOTES FOR GUIDELINES AND CHECKLIST.
2. INLET WIDTH MAY BE GREATER ON STEEP GUTTER SLOPES. DESIGNER TO SPECIFY.
3. BOND NEW CURB AND GUTTER TO EXISTING CURB AND GUTTER WITH EPOXY AND DOWEL CONNECTION.
4. METAL INLET ASSEMBLY SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A-123.
5. HEADED CONCRETE ANCHORS SHALL MEET THE REQUIREMENTS OF ASTM A-108.
6. HSS 6 X 2 X 3/8 CHANNEL SHALL MEET THE REQUIREMENTS OF ASTM A-500 GRADE B.
7. END PLATES SHALL MEET THE REQUIREMENTS OF ASTM A-36
8. DESIGN VERTICAL WHEEL LOAD IS 8.5 KIPS (1/2 OF TANDEM AZLE WEIGHT SPECIFIED IN FHWA-HOP-06-105) AND SHALL WITHSTAND H-20 LOADING
9. SINGLE BEVEL GROOVE WELD
10. ALTERNATE MATERIAL FOR ASSEMBLY (E.G. CAST IRON, GRAY IRON) MAY BE USED PER DESIGN PLANS IF APPROVED BY JURISDICTION ENGINEER.

NOTES	INLETS							
	COMPONENTS							
BC 2.1	BC 2.2	BC 2.2.1	BC 2.3	BC 2.3.1	BC 2.4	BC 2.4.1	BC 2.5	BC 2.6



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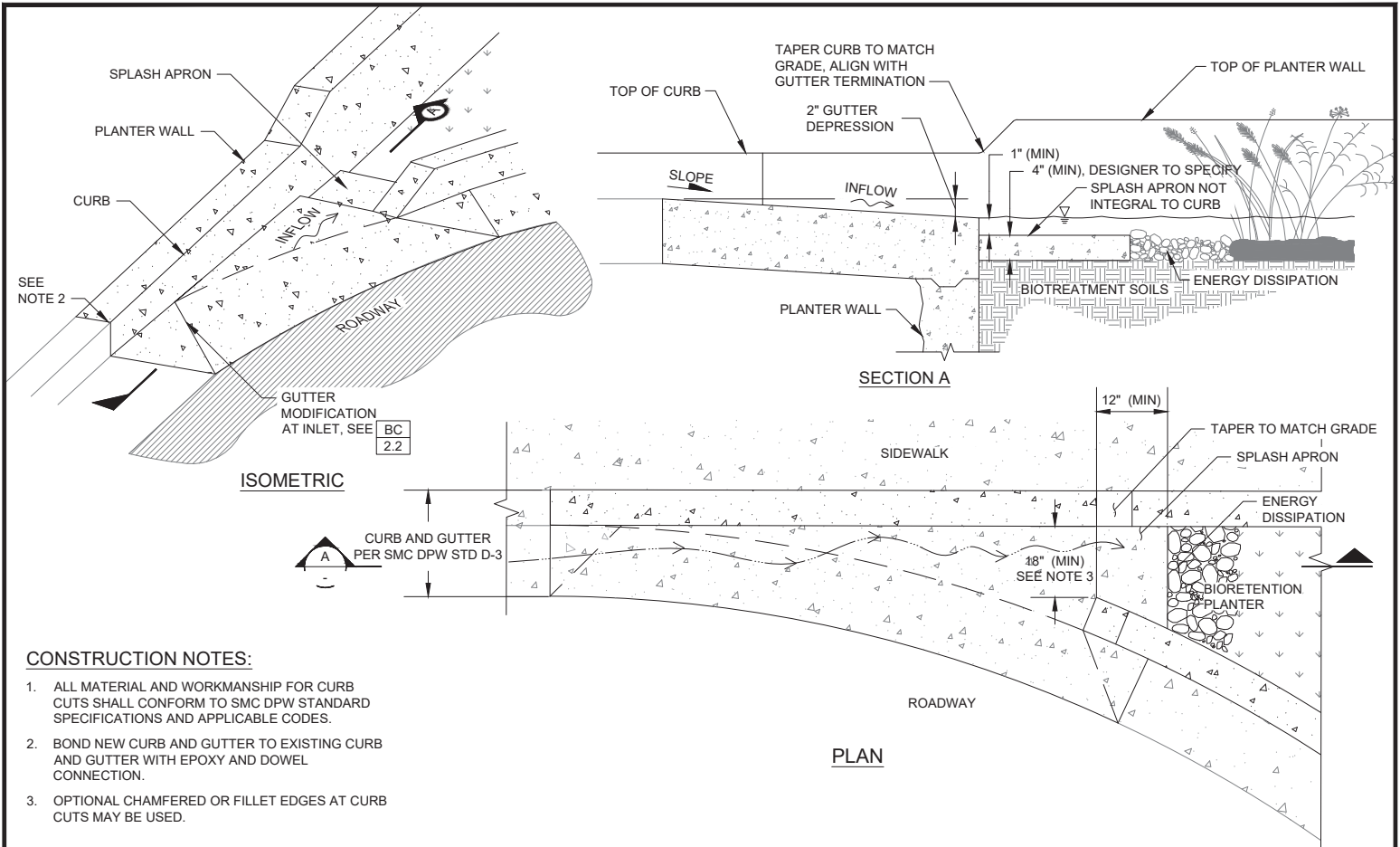
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BIORETENTION COMPONENTS
INLETS
CURB CUT WITH METAL PLATE TOP

FILE NO:
BC 2.2.1


NOT FOR CONSTRUCTION - REFER TO USER GUIDE



CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR CURB CUTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. BOND NEW CURB AND GUTTER TO EXISTING CURB AND GUTTER WITH EPOXY AND DOWEL CONNECTION.
3. OPTIONAL CHAMFERED OR FILLET EDGES AT CURB CUTS MAY BE USED.

NOTES		INLETS															
NOTES		COMPONENTS															
BC	2.1	BC	2.2	BC	2.2.1	BC	2.3	BC	2.3.1	BC	2.4	BC	2.4.1	BC	2.5	BC	2.6

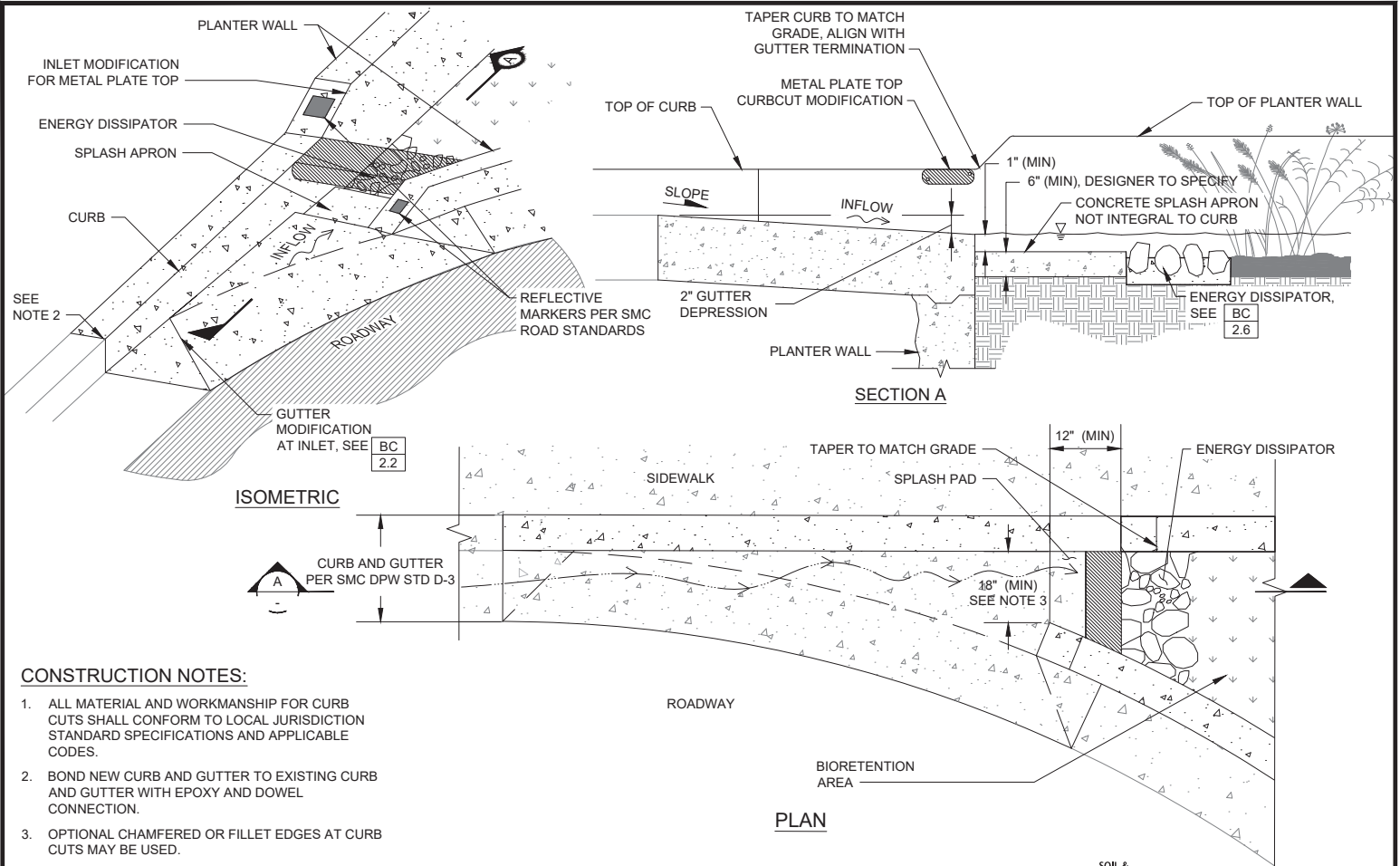

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GREEN INFRASTRUCTURE
TYPICAL DETAILS
 COUNTY OF SAN MATEO

DATE 06.2022
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BIORETENTION COMPONENTS
 INLETS
 CURB CUT AT BULB OUT


FILE NO.
BC
 2.3



CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR CURB CUTS SHALL CONFORM TO LOCAL JURISDICTION STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. BOND NEW CURB AND GUTTER TO EXISTING CURB AND GUTTER WITH EPOXY AND DOWEL CONNECTION.
3. OPTIONAL CHAMFERED OR FILLET EDGES AT CURB CUTS MAY BE USED.

EDGE TREATMENTS								INLETS						OUTLETS					SOIL & AGGREGATE LAYERS COMPONENTS		UNDERDRAINS		CHECK DAM		
NOTES	COMPONENTS							NOTES	COMPONENTS					NOTES	COMPONENTS				NOTES	COMPONENTS	NOTES	COMPONENTS			
BC 1.1	BC 1.2	BC 1.2.1	BC 1.3	BC 1.4	BC 1.5	BC 1.6	BC 1.7	BC 2.1	BC 2.2	BC 2.2.1	BC 2.3	BC 2.3.1	BC 2.4	BC 2.4.1	BC 2.5	BC 3.1	BC 3.2	BC 3.3	BC 3.3.1	BC 3.4	BC 4.1	BC 5.1	BC 5.2	BC 6.1	BC 6.2

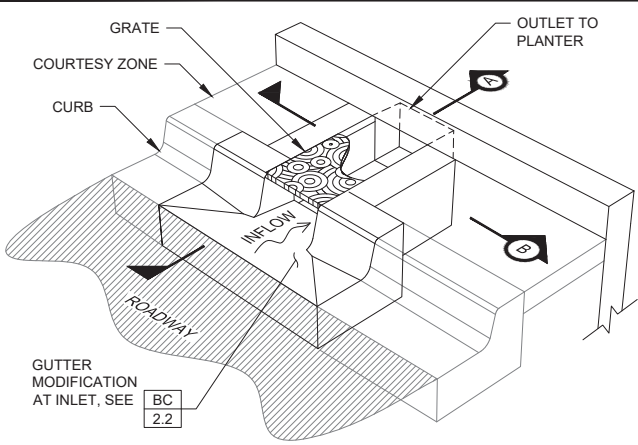

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GREEN INFRASTRUCTURE
TYPICAL DETAILS
 COUNTY OF SAN MATEO

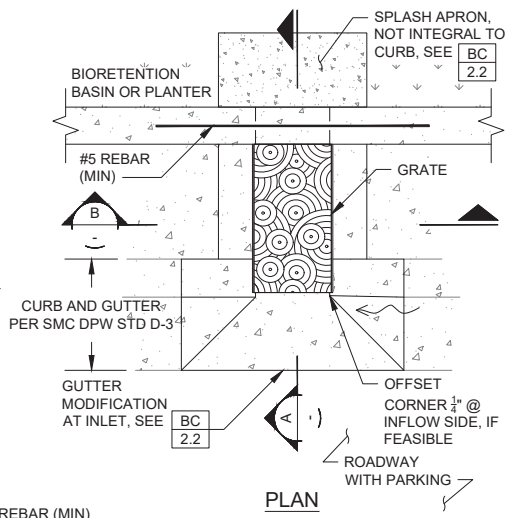
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 VERSION: 02
 REVISED: N/A

BIORETENTION COMPONENTS
 INLETS – CURB CUT AT BULB OUT
 MODIFICATION WITH METAL PLATE TOP

FILE NO:
BC
2.3.1

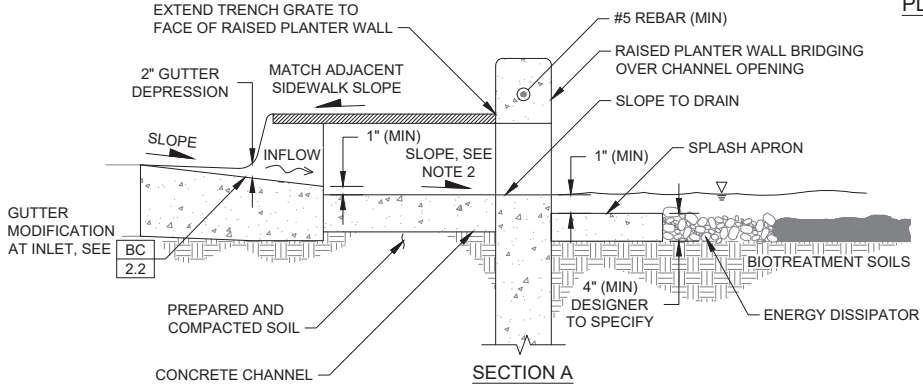


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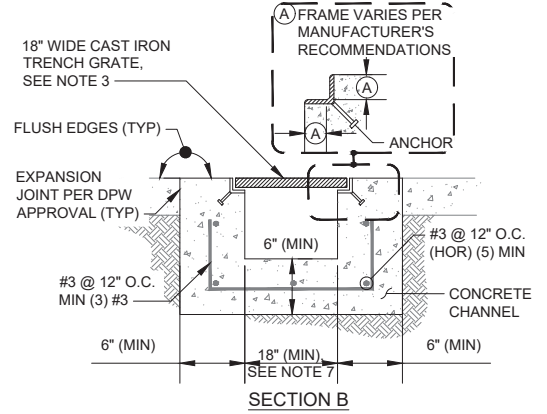


PLAN

- CONSTRUCTION NOTES:**
1. ALL MATERIAL, REINFORCEMENT AND WORKMANSHIP FOR TRENCH DRAIN ASSEMBLY SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
 2. SLOPE TO PROVIDE AT LEAST 1 INCH DROP OVER LENGTH OF CHANNEL OR A MINIMUM OF 2 PERCENT, WHICHEVER IS LARGER.
 3. ALL TRENCH GRATES SHALL BE REMOVABLE, RATED PER THE ANTICIPATED LOADING, AND BOLTED IN PLACE OR OUTFITTED WITH APPROVED TAMPER-RESISTANT LOCKING MECHANISM, FLUSH OR RECESSED IN GRATE.
 4. BOND NEW CURB AND GUTTER TO EXISTING CURB AND GUTTER WITH EPOXY AND DOWEL CONNECTION.
 5. HORIZONTAL CONTROL JOINTS SHALL BE PROVIDED EVERY 10 LINEAR FEET, OR PER MANUFACTURER'S RECOMMENDATIONS.
 6. APPLY EPOXY BONDING AGENT AT ALL TRENCH DRAIN CONSTRUCTION COLD JOINTS.
 7. INLET CURB CUT AND CONCRETE CHANNEL WIDTH SHALL BE INCREASED ON STEEPER GUTTER SLOPES. DESIGNER TO SPECIFY.




SECTION A



SECTION B

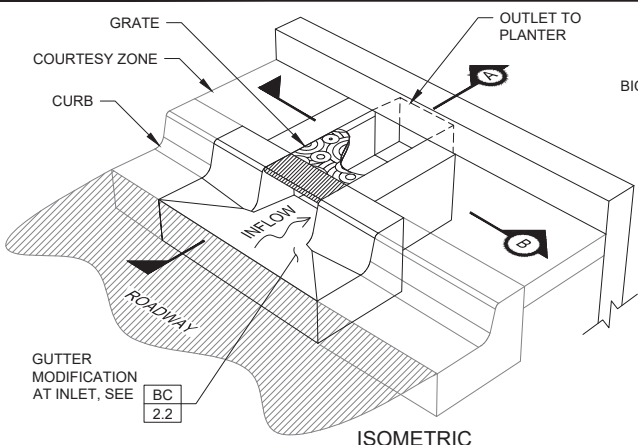
NOTES	INLETS COMPONENTS								
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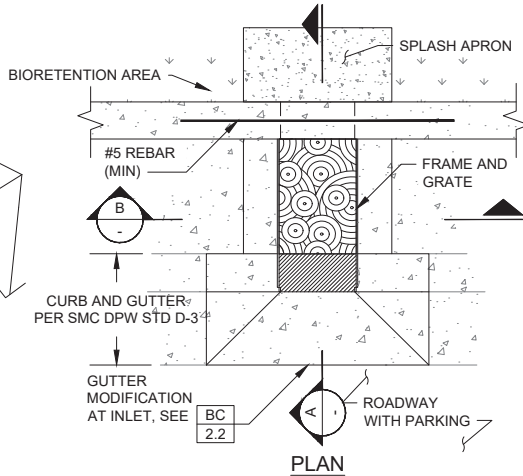
GREEN INFRASTRUCTURE
TYPICAL DETAILS
 COUNTY OF SAN MATEO

DATE: 06.2022
 VERSION: 02
 REVISED: N/A
BIORETENTION COMPONENTS
 INLETS
 CURB CUT WITH TRENCH DRAINS

FILE NO.
BC 2.4



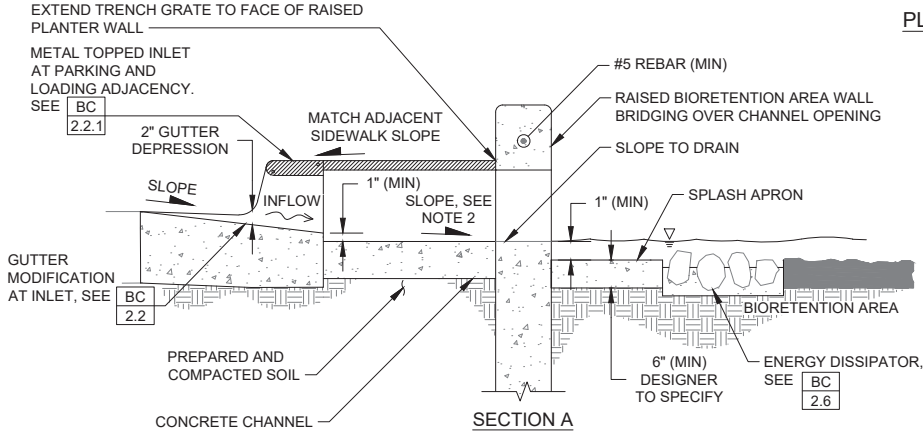
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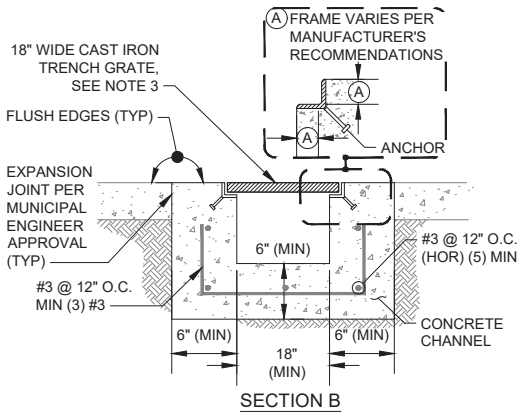
PLAN

CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR TRENCH DRAIN ASSEMBLY SHALL CONFORM TO MUNICIPAL'S STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. SLOPE TO PROVIDE AT LEAST 1 INCH DROP OVER LENGTH OF CHANNEL OR A MINIMUM OF 2 PERCENT, WHICHEVER IS LARGER.
3. ALL TRENCH GRATES SHALL BE REMOVABLE, RATED PER THE ANTICIPATED LOADING, AND BOLTED IN PLACE OR OUTFITTED WITH APPROVED TAMPER-RESISTANT LOCKING MECHANISM, FLUSH OR RECESSED IN GRATE.
4. BOND NEW CURB AND GUTTER TO EXISTING CURB AND GUTTER WITH EPOXY AND DOWEL CONNECTION.
5. HORIZONTAL CONTROL JOINTS SHALL BE PROVIDED EVERY 10 LINEAR FEET, OR PER MANUFACTURER'S RECOMMENDATIONS.
6. APPLY EPOXY BONDING AGENT AT ALL TRENCH DRAIN CONSTRUCTION COLD JOINTS.
7. INLET CURB CUT AND CONCRETE CHANNEL WIDTH SHALL BE INCREASED ON STEEPER GUTTER SLOPES. DESIGNER TO SPECIFY.




SECTION A



SECTION B

NOTES	COMPONENTS								
	BC 2.1	BC 2.2	BC 2.2.1	BC 2.3	BC 2.3.1	BC 2.4	BC 2.4.1	BC 2.5	BC 2.6

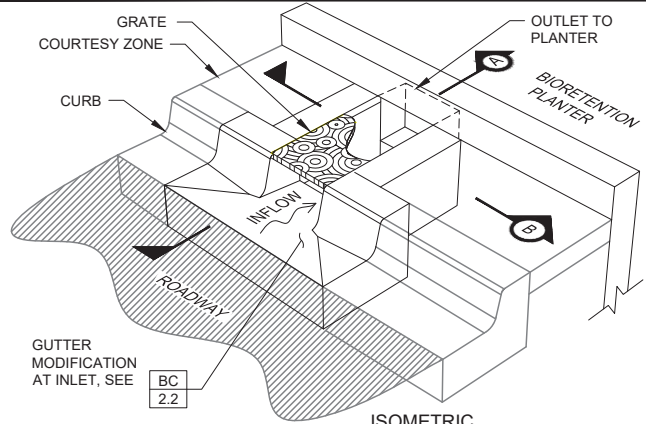

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GREEN INFRASTRUCTURE
TYPICAL DETAILS
 COUNTY OF SAN MATEO

DATE: 06.2022
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BIORETENTION COMPONENTS
 INLETS
 CURB CUT WITH TRENCH DRAINS MODIFICATION

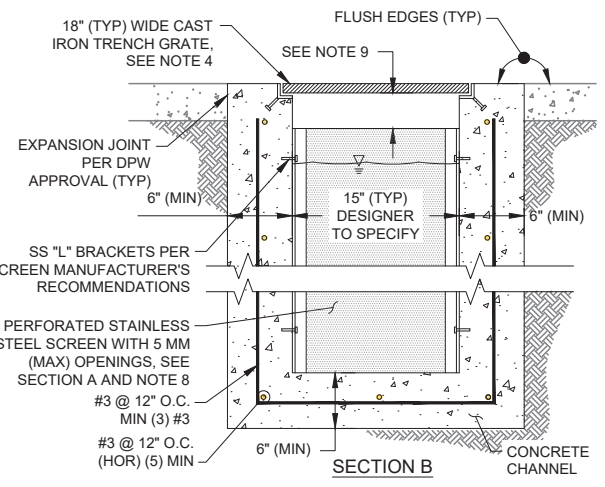
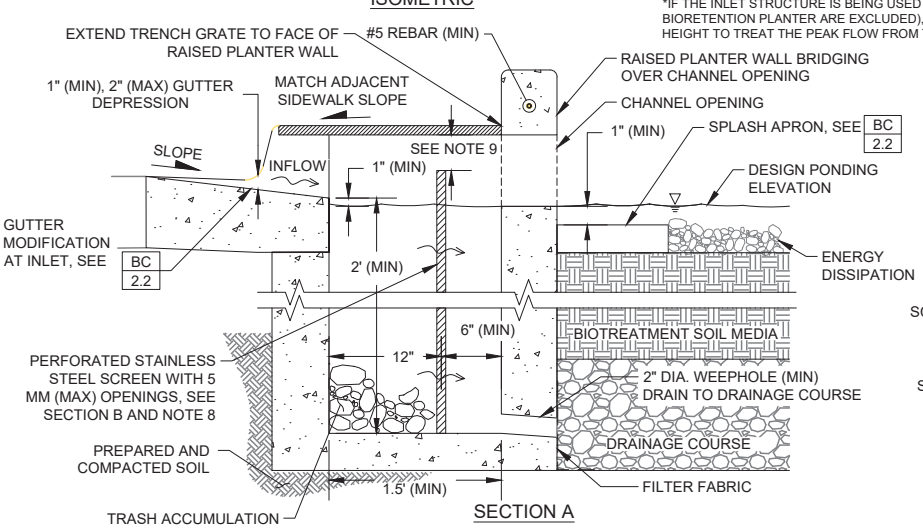
BC
2.4.1




NOTES:

1. THIS DETAIL SHOWS ONE EXAMPLE OF A CUSTOMIZED TRASH CAPTURE DEVICE THAT CAN BE PROVIDED ON THE INLET SIDE OF ROADSIDE BIORETENTION PLANTERS TO MEET THE FULL TRASH CAPTURE SYSTEM REQUIREMENTS MANDATED BY THE STATE AND REGIONAL WATER BOARDS* OR AS A PRE-TREATMENT MEASURE IF THE BIORETENTION PLANTER IS DESIGNED TO MEET THE FULL TRASH CAPTURE REQUIREMENTS.
2. ALL MATERIAL AND WORKMANSHIP FOR TRENCH DRAIN AND TRASH CAPTURE ASSEMBLY SHALL CONFORM TO COUNTY OF SAN MATEO STANDARD SPECIFICATIONS AND APPLICABLE PUBLIC WORKS CODES.
3. PROVIDE AT LEAST 1 INCH DROP BETWEEN INLET ELEVATION AT GUTTER AND PONDING ELEVATION.
4. ALL TRENCH GRATES/TRASH CAPTURE STRUCTURE LIDS SHALL BE REMOVABLE, RATED PER THE ANTICIPATED LOADING (H-20 LOADING WITHIN PUBLIC STREETS), AND BOLTED IN PLACE OR OUTFITTED WITH APPROVED TAMPER-RESISTANT LOCKING MECHANISM, FLUSH OR RECESSED IN GRATE.
5. BOND NEW CURB AND GUTTER TO EXISTING CURB AND GUTTER WITH EPOXY AND DOWEL CONNECTION.
6. HORIZONTAL CONTROL JOINTS SHALL BE PROVIDED EVERY 10 LINEAR FEET, OR PER MANUFACTURER'S RECOMMENDATIONS.
7. APPLY EPOXY BONDING AGENT AT ALL TRENCH DRAIN CONSTRUCTION COLD JOINTS.
8. SCREEN SHALL BE CUSTOMIZED VERSION OF CONNECTOR PIPE SCREEN (CPS) DEVICE THAT IS LISTED IN TABLE 1 OF THE STATE WATER BOARD'S CERTIFIED FULL CAPTURE SYSTEM LIST OF TRASH TREATMENT CONTROL DEVICES. DESIGNER TO WORK WITH SELECTED MANUFACTURER ON THE DETAILED SCREEN DESIGN AND SPECIFICATIONS.
9. DESIGNER TO SET HEIGHT OF SCREEN PER SPECIFIC PROJECT NEEDS AND HYDRAULIC CONDITIONS*. THE MINIMUM HEIGHT OF SCREEN SHALL BE AT LEAST AS HIGH AS MINIMUM FREEBOARD ON DESIGN PONDING ELEVATION (TYPICALLY 2') WHILE ALLOWING ADEQUATE CLEARANCE BETWEEN BOTTOM OF TRENCH DRAIN AND TOP OF SCREEN (IDEALLY 4').

*IF THE INLET STRUCTURE IS BEING USED TO FULFILL FULL TRASH CAPTURE SYSTEM REQUIREMENTS (AND THE BENEFITS OF THE BIORETENTION PLANTER ARE EXCLUDED), THE DESIGNER WILL NEED TO DEMONSTRATE THAT THE SCREEN IS SET AT AN ADEQUATE HEIGHT TO TREAT THE PEAK FLOW FROM THE 1-YEAR, 1-HOUR STORM IN THE AREA DRAINING TO THE INLET.



NOTES		INLETS						COMPONENTS									
BC	2.1	BC	2.2	BC	2.2.1	BC	2.3	BC	2.3.1	BC	2.4	BC	2.4.1	BC	2.5	BC	2.6

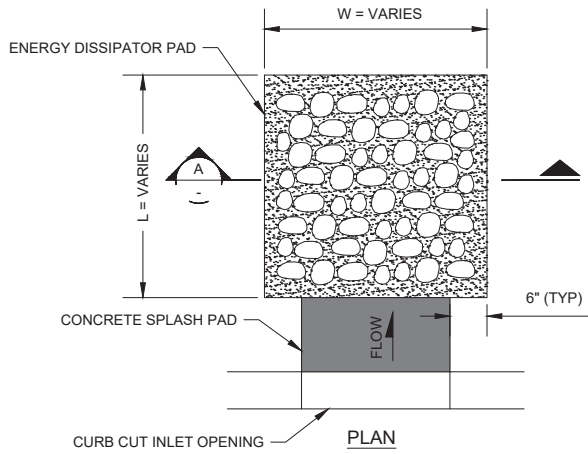

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GREEN INFRASTRUCTURE
TYPICAL DETAILS
 COUNTY OF SAN MATEO

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BIORETENTION COMPONENTS
 INLET WITH TRASH CAPTURE
 CURB CUT WITH TRENCH DRAINS

FILE NO:
BC
2.5



DIMENSIONS:

WIDTH (W) x LENGTH (L)

INLET:

W = EXTEND MIN. 12" BEYOND SPLASH APRON

L = EXTEND MIN. 12" BEYOND SPLASH APRON

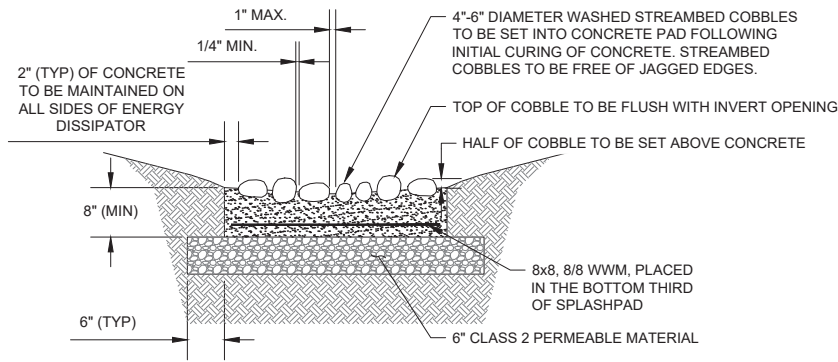
OUTLET:

W = EXTEND 6" MIN. BEYOND BOTTOM OF CURB CUT

L = 12" MIN.

CONSTRUCTION NOTES:

1. COBBLES SHALL BE ARRANGED IN PATTERN THAT PREVENTS LINEAR FLOW PATHS THROUGH THE ENERGY DISSIPATOR.
2. ENSURE THAT SOIL BENEATH ENERGY DISSIPATOR IS STABLE AND WILL NOT SETTLE OVER TIME.
3. ENSURE CONCAVITY IN BOTH DIRECTIONS OF ENERGY DISSIPATOR.



SECTION A-A

INLETS								
NOTES	COMPONENTS							
BC 2.1	BC 2.2	BC 2.2.1	BC 2.3	BC 2.3.1	BC 2.4	BC 2.4.1	BC 2.5	BC 2.6



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N/A

BIORETENTION COMPONENTS
INLETS
EMBEDDED ROCK ENERGY DISSIPATOR

FILE NO.
**BC
2.6**

PURPOSE:

BIORETENTION OUTLET STRUCTURES CONVEY SURFACE AND/OR SUBSURFACE OUTFLOWS FROM A BIORETENTION FACILITY TO AN APPROVED DISCHARGE LOCATION.

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
2. THE DESIGNER MUST SIZE CURB CUT, GRATE, AND OTHER OVERFLOW STRUCTURE FEATURES TO SATISFY RESPONSIBLE JURISDICTION HYDRAULIC REQUIREMENTS.
3. AN OUTLET STRUCTURE OR CLEANOUT(S) THAT ALLOWS MAINTENANCE ACCESS TO ALL PIPES IS REQUIRED FOR FACILITIES WITH UNDERDRAINS.
4. IF SITE CONSTRAINTS NECESSITATE STORM DRAIN PIPE IN AN AREA SUBJECT TO VEHICULAR TRAFFIC OR OTHER LOADING, APPROPRIATE COVER DEPTH AND PIPE MATERIAL MUST BE SPECIFIED.
5. OUTLET PIPES MUST BE EQUIPPED WITH CLEANOUTS, SEE CLEANOUT DETAILS (**GC 5.2**).
6. DESIGNER SHALL EVALUATE BUOYANCY OF STRUCTURES FOR SITE SPECIFIC APPLICATION AND SPECIFY THICKENED OR EXTENDED BASE / ANTI-FLOTATION COLLAR, AS NECESSARY.
7. USE CURB CUT INLET/OUTLET WITH METAL PLATE TOP (**BC 2.2.1**) WHEN ADJACENT TO VEHICLE PARKING AND LOADING AREAS

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- OUTLET STRUCTURE TYPE/MATERIAL, DIAMETER, AND DEPTH
- ATRIUM GRATE MANUFACTURER, MODEL NO., AND SIZE
- FRAME AND GRATE TYPE, MODEL NO., AND SIZE
- CONTROL ELEVATIONS FOR OUTLET STRUCTURE RIMS
- MATERIAL AND DIAMETER FOR ALL PIPES
- WATER TIGHT CONNECTOR TYPE FOR ALL WALL PENETRATIONS (E.G. GROUTED, COMPRESSION, BOOT), SEE **GC 2.9** AND **GC 2.10**
- CURB CUT WITH OR WITHOUT METAL PLATE TOP MODIFICATION

NOTES		OUTLETS COMPONENTS			
BC 3.1		BC 3.2	BC 3.3	BC 3.3.1	BC 3.4



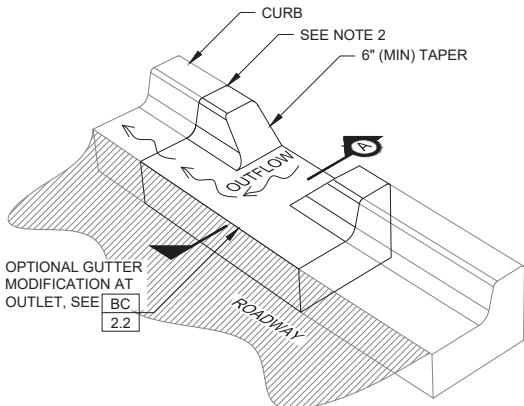
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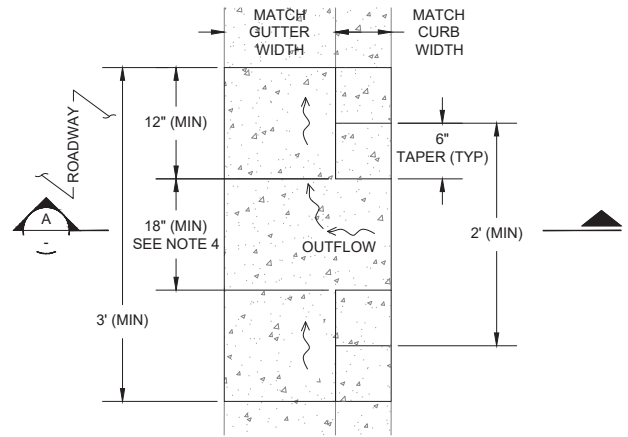
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BIORETENTION COMPONENTS
OUTLETS
DESIGNER NOTES

FILE NO.
BC
3.1



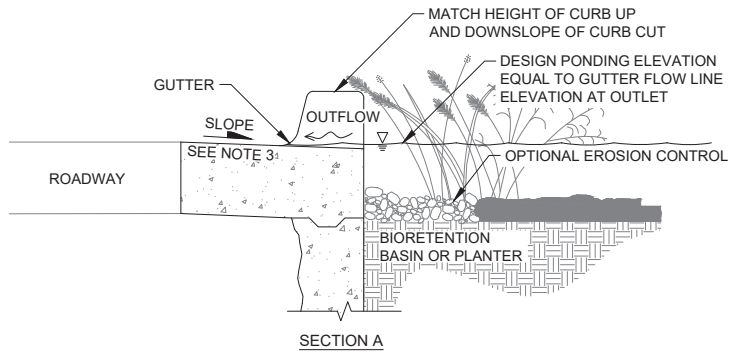
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PLAN

CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR CURB CUTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. BOND NEW CURB AND GUTTER TO EXISTING CURB AND GUTTER WITH EPOXY AND DOWEL CONNECTION.
3. MATCH GUTTER SLOPE UP AND DOWNSLOPE OF CURB CUT SLOPE SIMILAR TO INLET DETAIL UNLESS MODIFYING GUTTER
4. OUTLET CURB CUT WIDTH MAY BE INCREASED ON STEEP GUTTER SLOPES. DESIGNER TO SPECIFY.
5. OPTIONAL CHAMFERED OR FILLET EDGES AT CURB CUTS MAY BE USED.



SECTION A

OUTLET - CURB CUT



NOTES		OUTLETS COMPONENTS				
BC	3.1	BC	BC	BC	BC	BC
		3.2	3.3	3.3.1	3.4	



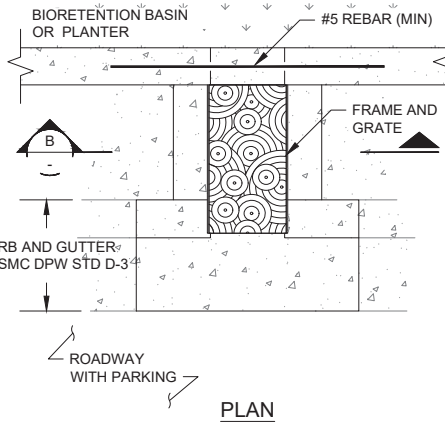
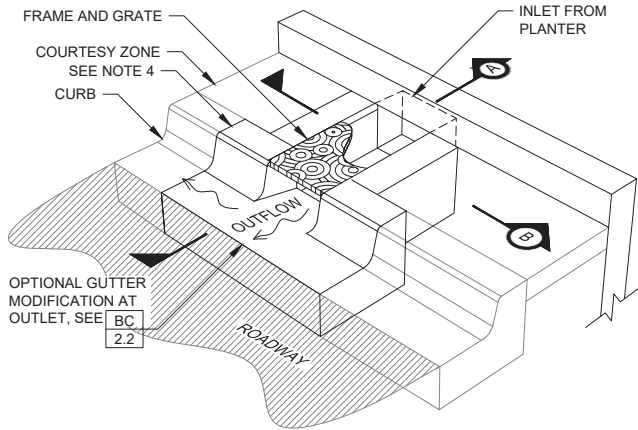
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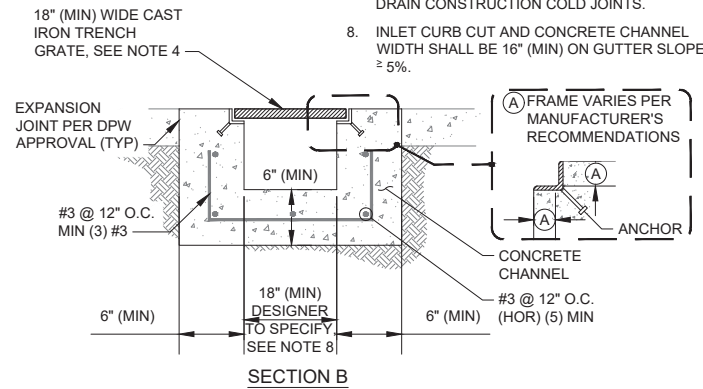
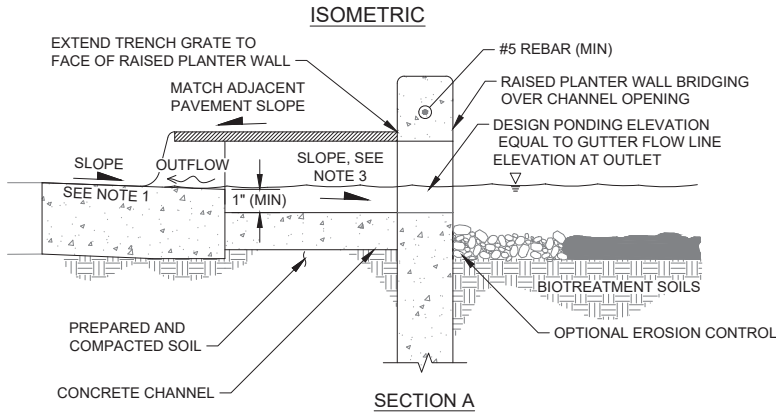
BIORETENTION COMPONENTS
OUTLETS
CURB CUT

FILE NO.
BC
3.2



CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR TRENCH DRAIN ASSEMBLY SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. MATCH GUTTER SLOPE UP AND DOWNSLOPE (UNLESS MODIFYING GUTTER SLOPE INLET DETAIL).
3. SLOPE TO PROVIDE AT LEAST 1 INCH DROP OVER LENGTH OF CHANNEL OR A MINIMUM OF 2 PERCENT, WHICHEVER IS LARGER.
4. ALL TRENCH GRATES SHALL BE REMOVABLE, RATED PER THE ANTICIPATED LOADING, AND BOLTED IN PLACE OR OUTFITTED WITH APPROVED TAMPER-RESISTANT LOCKING MECHANISM, FLUSH OR RECESSED IN GRATE.
5. HORIZONTAL CONTROL JOINTS SHALL BE PROVIDED EVERY 10 LINEAR FEET, OR PER MANUFACTURER'S RECOMMENDATIONS.
6. BOND NEW CURB AND GUTTER TO EXISTING CURB AND GUTTER WITH EPOXY AND DOWEL CONNECTION.
7. APPLY EPOXY BONDING AGENT AT ALL TRENCH DRAIN CONSTRUCTION COLD JOINTS.
8. INLET CURB CUT AND CONCRETE CHANNEL WIDTH SHALL BE 16" (MIN) ON GUTTER SLOPES \geq 5%.



NOTES	OUTLETS COMPONENTS				
	BC 3.1	BC 3.2	BC 3.3	BC 3.3.1	BC 3.4



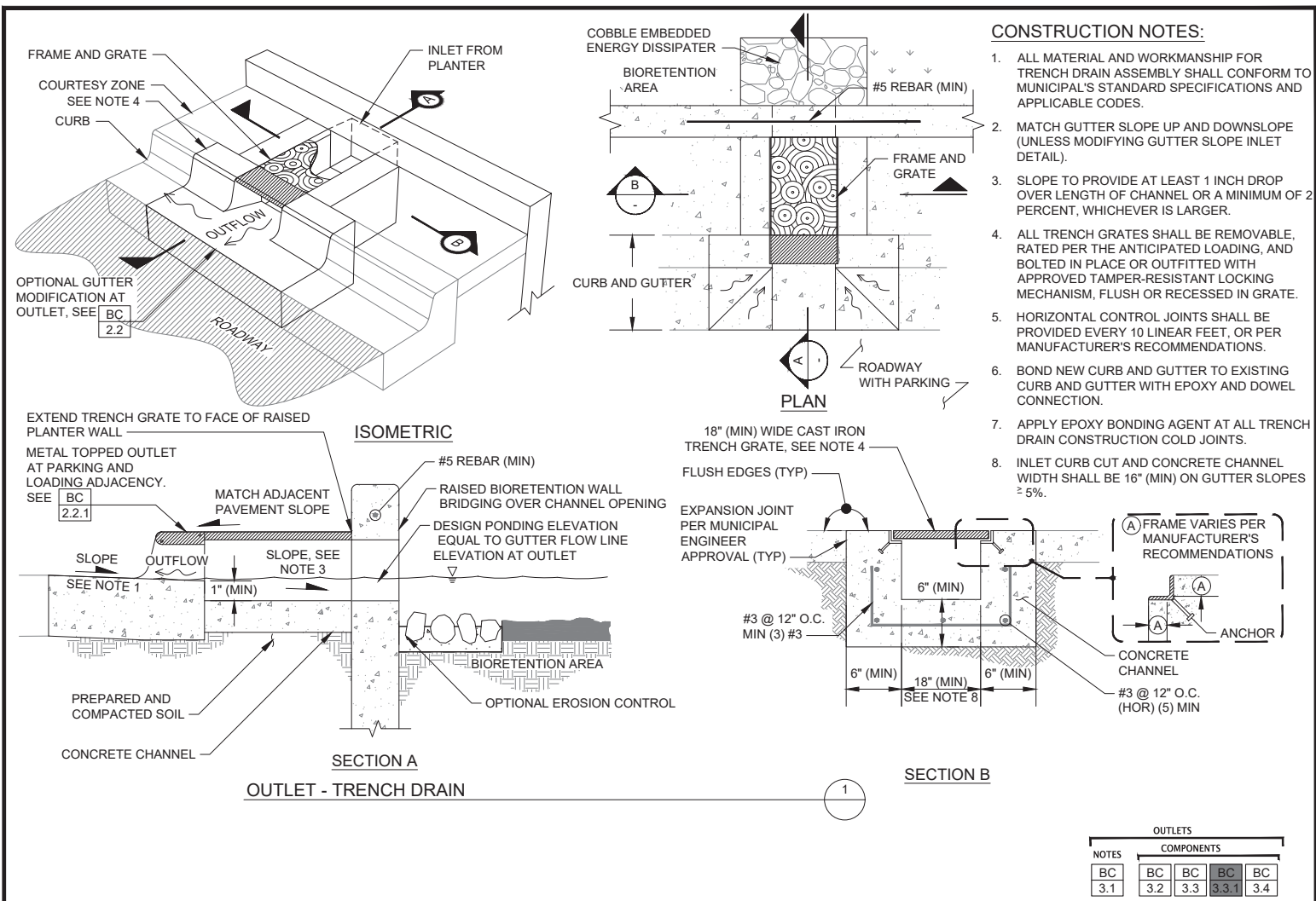
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BIORETENTION COMPONENTS
OUTLETS
CURB CUT WITH TRENCH DRAIN

FILE NO.
BC 3.3



NOTES	COMPONENTS				
	BC 3.1	BC 3.2	BC 3.3	BC 3.3.1	BC 3.4

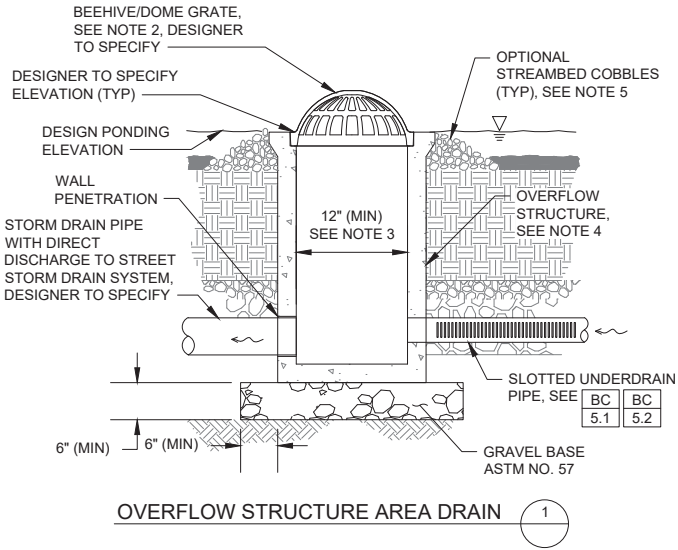

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BIORETENTION COMPONENTS
 OUTLETS – CURB CUT WITH TRENCH DRAIN
 MODIFICATION AND METAL PLATE TOP OUTLET

FILE NO.
BC 3.3.1

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OVERFLOW STRUCTURE AREA DRAIN 1

CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR OVERFLOW STRUCTURES SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. SIZE OF ATRIUM GRATE SHALL MATCH SIZE OF RISER SPECIFIED IN PLANS, SHALL BE REMOVABLE TO PROVIDE MAINTENANCE ACCESS, AND SHALL BE BOLTED IN PLACE OR OUTFITTED WITH APPROVED TAMPER-RESISTANT LOCKING MECHANISM. MAXIMUM GRATE OPENINGS SHALL BE 4 INCHES. GRATE MATERIAL SPECIFICATION SHALL CONSIDER SITE CONDITIONS, E.G. PUBLIC VS PRIVATE SETTING, TRAFFIC LOADING, UV EXPOSURE, AND PROXIMITY TO OCEAN/BAY.
3. IF INTERIOR DEPTH OF OVERFLOW STRUCTURE EXCEEDS 5 FEET, A MINIMUM CLEAR SPACE OF 30 INCH BY 30 INCH SHALL BE PROVIDED FOR MAINTENANCE ACCESS.
4. BARREL/BOX AND BASE OF CATCH BASIN MAY BE PRE-CAST WITH REINFORCING STEEL PER MANUFACTURER'S RECOMMENDATIONS, POURED IN PLACE CONCRETE WITHOUT STEEL PER SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES, OR NYLOPLAST DRAIN BASIN (2812AG OR EQUAL). ENGINEER TO SPECIFY.
5. MINIMUM STREAMBED COBBLE DIAMETER SHALL BE LARGER THAN MAXIMUM GRATE OPENING.
6. GROUT ALL PENETRATIONS, CRACKS, SEAMS, AND JOINTS WITH CLASS "C" MORTAR.

NOTES	OUTLETS				
	COMPONENTS				
BC 3.1	BC 3.2	BC 3.3	BC 3.3.1	BC 3.4	



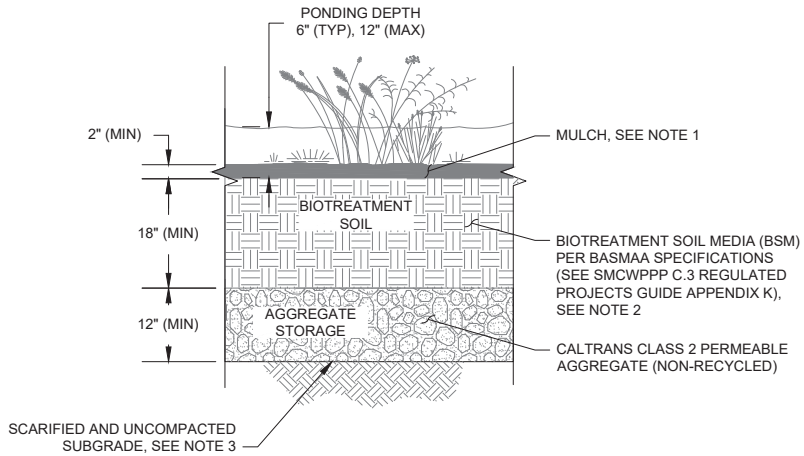
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BIORETENTION COMPONENTS
OUTLETS
OVERFLOW STRUCTURES

FILE NO.
BC
3.4



DESIGNER NOTES & GUIDELINES:

- MULCH SHALL BE AGED OR COMPOSTED WOOD MULCH OR ROCK MULCH CONFORMING TO SMCWPPP GI DESIGN GUIDE, APPENDIX A.4 AND/OR OTHER APPLICABLE SMC REQUIREMENTS.
- INSTALL BIOTREATMENT SOIL MEDIA (BSM) IN EITHER TWO 10" LIFTS AND THEN WETTED TO ACCOMODATE AN EXPECTED 2" OF SETTLING OR THREE 6" LIFTS THEN WETTED WITH ADDITIONAL BSM ADDED TO THE SURFACE AS NEEDED TO ACHIEVE A FINAL DEPTH OF 18".
- SUBGRADE SHALL BE GRADED FLAT AND THE SURFACE SHALL BE SCARIFIED TO A MINIMUM DEPTH OF 3" IMMEDIATELY PRIOR TO PLACEMENT OF AGGREGATE STORAGE. IF PLANTER IS LINED, SCARIFICATION IS NOT NECESSARY.

SOIL &
AGGREGATE
LAYERS
COMPONENTS
BC
4.1



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BIORETENTION COMPONENTS
SOIL AND AGGREGATE LAYERS

FILE NO.

BC
4.1

PURPOSE:

UNDERDRAINS ARE USED TO COLLECT STORMWATER THAT HAS BEEN FILTERED THROUGH BIOTREATMENT SOIL AND CONVEY THAT TREATED STORMWATER TO A DESIGNATED OUTLET (E.G., PLANTER OVERFLOW STRUCTURE).

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER SHOULD INCLUDE UNDERDRAINS IN FACILITY DESIGN IN THE FOLLOWING SCENARIOS:
 - INFILTRATION IS PROHIBITED OR IMPRUDENT (E.G., FACILITY NEAR SENSITIVE INFRASTRUCTURE OR STEEP SLOPES, RISK OF CONTAMINATION IS HIGH OR SITE GROUNDWATER/SOILS ARE CONTAMINATED, THERE IS POOR INFILTRATION CAPACITY DUE TO TYPE C/D SOILS OR HIGH GROUNDWATER).
 - MAXIMUM SURFACE POOL DRAWDOWN PERIOD CANNOT BE ACHIEVED (SEE **BB 1.1**, **BP 1.1**, AND **BP 5.1**).
3. AN OUTLET STRUCTURE AND/OR CLEANOUT(S) TO ALLOW MAINTENANCE ACCESS TO ALL PIPES IS REQUIRED FOR FACILITIES WITH UNDERDRAINS.
4. UNDERDRAIN PIPE SHALL HAVE A SMOOTH INTERIOR WALL TO FACILITATE MAINTENANCE WITH PRESSURIZED WATER OR ROOT CUTTING EQUIPMENT.
5. DESIGNER SHOULD CONSIDER THE INSTALLED ELEVATION OF THE UNDERDRAIN PIPE WITHIN THE BIORETENTION FACILITIES AGGREGATE STORAGE LAYER TO PROMOTE INFILTRATION, BELOW THE UNDERDRAIN, WHEN FEASIBLE. DESIGNER SHOULD ALSO CONSIDER THE USE OF ORIFICES OR OTHER CONTROL STRUCTURES TO PROVIDE ADDITIONAL INFILTRATION AND FLOW CONTROL BENEFITS WHERE APPLICABLE.
6. PIPE MATERIAL SHALL BE DESIGNED PER SMC DPW STANDARDS.

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- UNDERDRAIN MATERIAL TYPE AND SIZE
- UNDERDRAIN ELEVATION, SLOPE, AND LOCATION WITHIN BASIN OR PLANTER
- PIPE BEDDING MATERIAL SPECIFICATION (i.e. AGGREGATE STORAGE LAYER)
- DISCHARGE LOCATION TO OVERFLOW STRUCTURE
- CLEANOUT LOCATIONS AND MAINTENANCE ACCESS
- ORIFICE FLOW CONTROL STRUCTURE(S), AS APPLICABLE

UNDERDRAINS	
NOTES	COMPONENTS
BC 5.1	BC 5.2



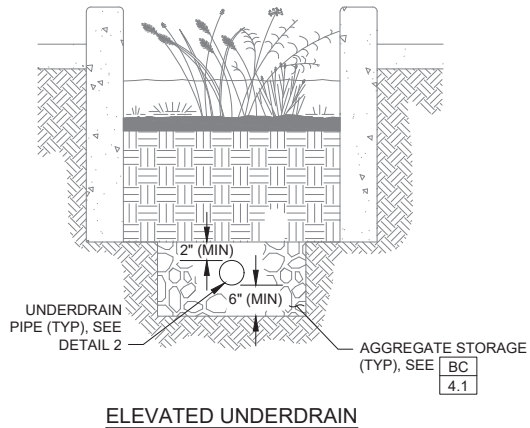
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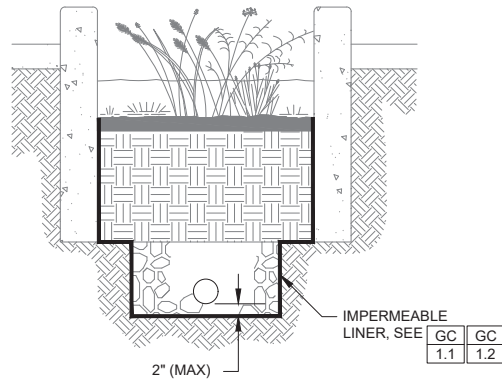
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BIORETENTION BASIN
UNDERDRAINS
DESIGNER NOTES

FILE NO.
BC
5.1



ELEVATED UNDERDRAIN

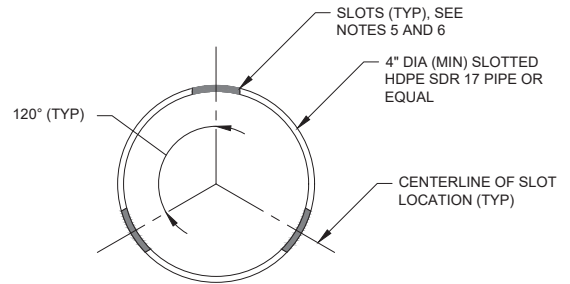


**UNDERDRAIN WITH LINER
WHERE INFILTRATION PROHIBITED**

UNDERDRAIN PLACEMENT ALTERNATIVES

CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR UNDERDRAINS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. LONGITUDINAL SLOPE OF UNDERDRAIN PIPE SHALL BE 0.5% MINIMUM.
3. UNDERDRAIN PIPE SHALL BE SLOTTED HDPE SDR 17 (PREFERRED) OR ACCEPTABLE SUBSTITUTE MATERIAL (E.G. PERFORATED PVC PIPE) PER ENGINEERS SPECIFICATION. SINGLE WALL AND DUAL WALL CORRUGATED HDPE PIPE (AASHTO M252 AND M294 TYPES C, S, AND D) ARE NOT ACCEPTABLE.
4. UNDERDRAIN PIPE SHALL BE SLOTTED TYPE, MEASURING 0.032 INCH WIDE (MAX), SPACED AT 0.25 INCH (MIN), AND PROVIDING A MINIMUM INLET AREA OF 5.0 SQUARE INCH PER LINEAR FOOT OF PIPE.
5. SLOTS SHALL BE ORIENTED PERPENDICULAR TO LONG AXIS OF PIPE, AND EVENLY SPACED AROUND CIRCUMFERENCE AND LENGTH OF PIPE.



SLOTTED UNDERDRAIN PIPE

2

UNDERDRAINS	
NOTES	COMPONENTS
BC 5.1	BC 5.2



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BIORETENTION COMPONENTS
UNDERDRAINS

FILE NO.
BC 5.2

PURPOSE:

CHECK DAMS ARE OFTEN USED IN BIORETENTION FACILITIES AT SLOPED LOCATIONS (ALIGNED PERPENDICULAR TO THE LONGITUDINAL SLOPE OF THE FACILITY) TO REDUCE FLOW VELOCITIES (AND EROSION) THROUGH THE FACILITY AND TO PROMOTE SURFACE PONDING, SUBSURFACE STORAGE, AND INFILTRATION OF STORMWATER. CHECK DAMS CAN BE CONSTRUCTED OF A VARIETY OF MATERIALS INCLUDING CONCRETE, WOOD, METAL, ROCK, OR COMPACTED SOIL.

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT SECTION DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
2. THE DESIGNER MUST ESTABLISH THE HEIGHT AND SPACING OF CHECK DAMS BASED ON THE PONDING DEPTH REQUIRED TO MEET PROJECT HYDROLOGIC PERFORMANCE GOALS AND THE MAXIMUM DESIRED DROP FROM THE SURROUNDING GRADE TO THE FACILITY BOTTOM. REFER TO CHECK DAM SPACING GUIDANCE PROVIDED ON THIS DRAWING FOR FURTHER GUIDANCE.
3. THE FACILITY SUBGRADE SHALL BE GRADED FLAT BETWEEN CHECK DAMS.
4. CONCRETE CHECK DAM SHALL MEET STRUCTURAL REQUIREMENTS FOR LATERAL BRACING WHEN USED AS LATERAL BRACING. SEE **BC 1.6** AND **BC 1.7**.

THE DESIGNER SHALL SPECIFY THE FOLLOWING, AS APPLICABLE:

- CHECK DAM TYPE AND MATERIAL
- CHECK DAM HEIGHT, WIDTH, AND ELEVATION
- CHECK DAM SPACING

CHECK DAM	
NOTES	COMPONENTS
BC 6.1	BC 6.2



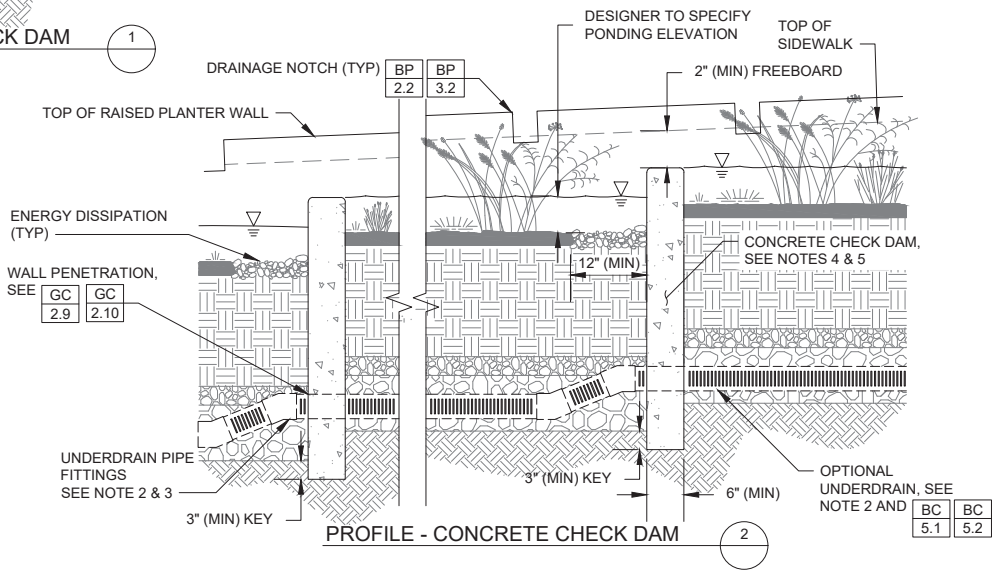
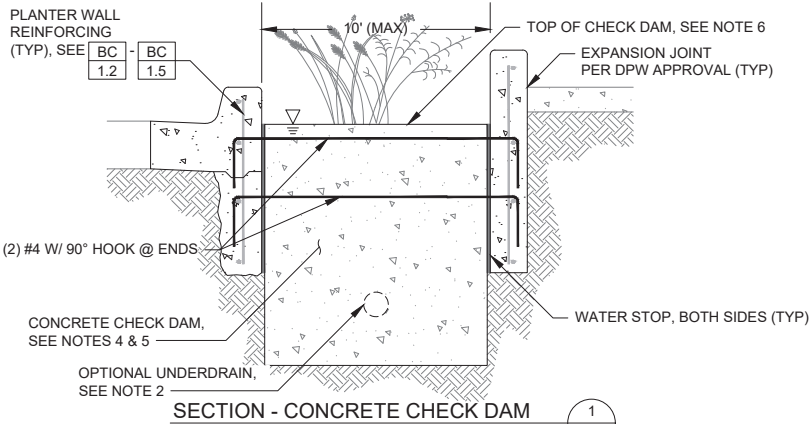
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BIORETENTION COMPONENTS
CHECK DAMS
DESIGNER NOTES

FILE NO.
**BC
6.1**



CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR CHECK DAM ASSEMBLY SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. UNDERDRAIN TO PASS THROUGH CHECK DAM IN NON-PERFORATED HDPE SDR 17 PIPE.
3. PIPE FITTINGS SHALL BE USED TO ACCOMMODATE CHANGES IN GRADE, AS NEEDED.
4. CONCRETE CHECK DAM SHALL BE CONTINUOUS (NO JOINTS) AND REINFORCED WITH #4 BAR, PLACED AT 18 INCHES ON CENTER, EACH WAY.
5. CONCRETE CHECK DAM SHALL MEET STRUCTURAL REQUIREMENTS FOR LATERAL BRACING WHEN USED AS LATERAL BRACING. COORDINATE WITH ENGINEER.
6. TOP OF CHECK DAM TO BE LEVEL WITH CREST ELEVATION MATCHING PONDING ELEVATION UNLESS NOTCH SIZED TO CONVEY DESIGN FLOWS PROVIDED.

CHECK DAM	
NOTES	COMPONENTS
[BC 6.1]	[BC 6.2]



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BIORETENTION COMPONENTS
CHECK DAMS

FILE NO.
BC 6.2

PURPOSE:

SUBSURFACE INFILTRATION SYSTEMS, ALSO KNOWN AS DRY WELLS, STORMWATER DRAINAGE WELLS, INFILTRATION GALLERIES, AND SEEPAGE PITS, CONTROL PEAK FLOWS AND VOLUMES OF STORMWATER RUNOFF THROUGH SUBSURFACE STORAGE AND INFILTRATION INTO NATIVE SOIL. WATER IS ALSO TREATED AS IT FILTERS THROUGH THE GRAVEL, SAND (IF PROVIDED), AND NATIVE SOIL.

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT PLAN AND SECTION DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
2. SUBSURFACE INFILTRATION SYSTEMS ARE CONSIDERED CLASS V INJECTION WELLS AND SUBJECT TO THE U.S. EPA UNDERGROUND INJECTION CONTROL (UIC) PROGRAM. SUBSURFACE INFILTRATION SYSTEMS MUST BE REGISTERED WITH EPA REGION IX PRIOR TO COMING ONLINE.
3. FIELD-TESTED INFILTRATION RATES OF NATIVE SOILS MUST BE BETWEEN 0.5 (INCHES PER HOUR) AND 5 (INCHES PER HOUR). FOR SITES WITH INFILTRATION RATES GREATER THAN 5 IN/HR, SUBSURFACE INFILTRATION SYSTEMS MAY STILL BE ALLOWED PROVIDED THAT THE RUNOFF IS FULLY TREATED USING UPSTREAM BMPS OR BY INSTALLING A MINIMUM OF 18 INCHES OF ASTM C33 SAND WITH AN INFILTRATION RATE LESS THAN 5 INCHES PER HOUR AT THE BASE OF THE FACILITY.
4. SUBSURFACE STORAGE DRAWDOWN TIME (I.E. TIME FOR MAXIMUM SUBSURFACE STORAGE VOLUME TO INFILTRATE INTO SUBGRADE AFTER THE END OF A STORM) SHALL BE 48-72 HOURS. DRAWDOWN TIME IS CALCULATED AS THE MAXIMUM SUBSURFACE STORAGE DEPTH DIVIDED BY THE NATIVE SOIL INFILTRATION RATE (ADJUSTED BY THE SAFETY FACTOR).
5. SUBSURFACE INFILTRATION SYSTEM SUBGRADES SHOULD BE LEVEL, REGARDLESS OF ANY LONGITUDINAL SLOPE OF THE SITE, TO PROMOTE EQUAL SUBSURFACE DISTRIBUTION OF RUNOFF.
6. DEPENDING ON THE HEIGHT AND AREA OF THE PROPOSED SUBSURFACE INFILTRATION SYSTEM, ADDITIONAL STRUCTURAL CONSIDERATIONS MAY BE REQUIRED TO ADDRESS EARTH PRESSURE AND/OR SURFACE LOADING.
7. SUBSURFACE INFILTRATION SYSTEMS ARE MOST COMMONLY USED TO MANAGE STORMWATER RUNOFF FROM ROOFS AND PARKING LOTS, BUT CAN BE USED IN OTHER APPLICATIONS. IN AREAS WITH HIGH SEDIMENT LOADS, RUNOFF SHOULD PASS THROUGH STORMWATER PRE-TREATMENT MEASURES TO REMOVE COARSE SEDIMENT THAT CAN CLOG PORE SPACES. REFER TO THE STORMWATER MANAGEMENT REQUIREMENTS APPENDIX A: BMP FACT SHEETS FOR ADDITIONAL REQUIREMENTS.
8. SUBSURFACE INFILTRATION SYSTEMS ARE NOT APPROVED AS TREATMENT MEASURES FOR RUNOFF FROM INDUSTRIAL AREAS, AREAS SUBJECT TO HIGH (GREATER THAN 15,000 VEHICLES PER DAY) TRAFFIC LOADING, AUTOMOTIVE REPAIR SHOPS, CAR WASHES, FLEET STORAGE AREAS, NURSERIES, SITES THAT STORE CHEMICALS OR HAZARDOUS MATERIALS, OR OTHER LAND USES THAT POSE A HIGH THREAT TO WATER QUALITY.

9. SUBSURFACE INFILTRATION SYSTEMS SHOULD NOT BE USED IN AREAS OF KNOWN OR PRESUMED CONTAMINATED SOIL OR GROUNDWATER, AREAS WITH CURRENT OR HISTORICAL INDUSTRIAL USE, AREAS WITHIN 100 FEET OF CURRENT OR HISTORICAL UNDERGROUND STORAGE TANKS, FILLED FORMER BAY, MARSH OR CREEK AREAS, OR AREAS WITHIN 150 FEET OF A CURRENT OR HISTORICAL HIGHWAY. SEE SETBACK REQUIREMENTS TABLE ON **SI 1.2**.
10. SMALL SYSTEMS (TYPICALLY A FEW FEET IN WIDTH) ARE KNOWN AS DRY WELLS AND ARE RECOMMENDED FOR SMALL DRAINAGE AREAS WITH LOW POLLUTANT LOADINGS, SUCH AS ROOFTOPS LESS THAN 0.25 ACRES IN SIZE. LARGER SYSTEMS (TYPICALLY 10 TO 100 FEET IN WIDTH) ARE KNOWN AS INFILTRATION GALLERIES AND CAN BE USED TO RECEIVE RUNOFF FROM DRAINAGE AREAS TYPICALLY UP TO 5 ACRES IN SIZE.
11. THE DRAWINGS PROVIDED DO NOT COVER DESIGNS THAT UTILIZE PROPRIETARY STORAGE, DISTRIBUTION, AND/OR STRUCTURAL SYSTEMS OTHER THAN PREFABRICATED DRY WELL STRUCTURES, WHICH HAVE BEEN SHOWN IN A GENERIC WAY. REFER TO THE MANUFACTURER'S RECOMMENDATIONS FOR ALL PROPRIETARY SYSTEMS.

GENERAL UTILITY NOTES:

1. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT JURISDICTIONAL ASSET PROTECTION STANDARDS. IN THE ABSENCE OF THESE STANDARDS, THE DESIGN SHALL REFER TO CHAPTER 3 OF SMCWPPP GI DESIGN GUIDE FOR BEST PRACTICES AND COORDINATE DIRECTLY WITH RELEVANT UTILITY PROVIDERS FOR REQUIREMENTS. SEE UTILITY CROSSING DESIGNER NOTES ON GC 2.1.
2. PROVIDE UTILITY TRENCH DAM, ANTI-SEEP COLLAR, OR EQUIVALENT TO PREVENT PREFERENTIAL FLOW OF WATER FROM INFILTRATIVE FACILITY INTO UTILITY TRENCH FROM CAUSING DAMAGE DOWNSTREAM. ENGINEER TO EVALUATE SITE CONDITIONS AND NEED FOR TRENCH DAM. REFER TO **GC2.12** FOR GUIDANCE ON UTILITY TRENCH DAM DESIGN.
3. PROPOSED UTILITY LINES TO BE LOCATED OUTSIDE OF FACILITY.

RELATED COMPONENTS	
UTILITY CROSSINGS:	GC 2.1 - GC 2.12
UTILITY CONFLICTS:	GC 3.1 - GC 3.3
OBSERVATION PORTS:	GC 4.1 - GC 4.3
CLEANOUTS:	GC 5.1

NOTES		LARGE SYSTEMS		SMALL SYSTEMS		DEEP SYSTEMS	
		PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS	
SI 1.1	SI 1.2	SI 2.1	SI 2.2	SI 3.1	SI 3.2	SI 4.1	SI 4.1



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SUBSURFACE INFILTRATION SYSTEMS
DESIGNER NOTES (1 OF 2)

FILE NO.	SI 1.1
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LAYOUT REQUIREMENTS:

REFER TO THE SMCWPPP C.3 REGULATED PROJECTS GUIDE AND SMCWPPP DESIGN GUIDE FOR MORE DETAILED INFORMATION ON SITING AND DESIGN REQUIREMENTS FOR INFILTRATION BASED BMPS.

- STANDARD SETBACK REQUIREMENTS PER THE SMCWPPP C.3 REGULATED PROJECTS GUIDE:
18 FEET OR 1:1 SLOPE FROM BOTTOM OF BUILDING FOUNDATION, UNLESS DIFFERENT SETBACK IS ALLOWED BY GEOTECHNICAL ENGINEER OR CUTOFF WALL IS PROVIDED.

100 FEET FROM GROUNDWATER WELLS USED FOR DRINKING WATER, OR ANY KNOWN WATER SUPPLY WELLS, SEPTIC SYSTEMS, AND UNDERGROUND STORAGE TANKS.
- REFER TO SMCWPPP GI DESIGN GUIDE CHAPTER 3 AND OTHER APPLICABLE SMC REQUIREMENTS FOR ADDITIONAL SETBACK REQUIREMENTS REGARDING WATER AND SEWER INFRASTRUCTURE.
- MINIMUM 4-FOOT VERTICAL SEPARATION FROM BASE OF SUBSURFACE INFILTRATION SYSTEM TO BEDROCK IS REQUIRED.
- MINIMUM 10-FOOT VERTICAL SEPARATION FROM BOTTOM OF DRAIN ROCK TO SEASONAL HIGH GROUNDWATER.

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- SUBSURFACE INFILTRATION SYSTEM WIDTH AND LENGTH
- DEPTH AND TYPE OF AGGREGATE STORAGE LAYER
- DEPTH AND TYPE OF FILTER SAND, IF REQUIRED
- ELEVATIONS AND CONTROL POINTS AT EVERY CORNER
- AGGREGATE STORAGE SPECIFICATIONS AND/OR DRY WELL TYPE AND DIMENSIONS
- ELEVATIONS OF EACH PIPE INLET AND OVERFLOW INVERT
- TYPE AND DESIGN OF SUBSURFACE INFILTRATION COMPONENTS (E.G. INLETS, OVERFLOWS, OBSERVATION WELLS)
- SETBACK DIMENSIONS TO BEDROCK, HIGH GROUNDWATER TABLE, PROPERTY LINES, FOUNDATIONS, WATER SUPPLY WELLS, SEWER MAINS, AND GROUND SLOPES OF 15% OR GREATER, AS APPLICABLE. SEE SMCWPPP GI DESIGN GUIDE CHAPTER 3.
- TYPE AND SIZE OF PRETREATMENT MEASURE, AS NECESSARY

SOIL TYPE GUIDANCE:

HYDROLOGIC SOIL GROUP	SOIL TYPE	CORRESPONDING UNIFIED SOIL CLASSIFICATION	DESCRIPTION
A	SAND, LOAMY SAND, OR SANDY LOAM	GW - WELL-GRADED GRAVELS, SANDY GRAVELS GP - GAP-GRADED OR UNIFORM GRAVELS, SANDY GRAVELS GM - SILTY GRAVELS, SILTY SANDY GRAVELS SW - WELL-GRADED, GRAVELLY SANDS SP - GAP-GRADED OR UNIFORM SANDS, GRAVELLY SANDS	LOW RUNOFF POTENTIAL. SOILS HAVING HIGH INFILTRATION RATES EVEN WHEN THOROUGHLY WETTED AND CONSISTING CHIEFLY OF DEEP, WELL TO EXCESSIVELY DRAINED SANDS OR GRAVELS.
B	SILT LOAM OR LOAM	SM - SILTY SANDS, SILTY GRAVELLY SANDS MH - MICACEOUS SILTS, DIATOMACEOUS SILTS, VOLCANIC ASH	SOILS HAVING MODERATE INFILTRATION RATES WHEN THOROUGHLY WETTED AND CONSISTING CHIEFLY OF MODERATELY DEEP TO DEEP, MODERATELY WELL TO WELL-DRAINED SOILS WITH MODERATELY FINE TO MODERATELY COARSE TEXTURES.
C	SANDY CLAY LOAM	ML - SILTS, VERY FINE SANDS, SILTY AND CLAYEY FINE SANDS	SOILS HAVING SLOW INFILTRATION RATES WHEN THOROUGHLY WETTED AND CONSISTING CHIEFLY OF SOILS WITH A LAYER THAT IMPEDES DOWNWARD MOVEMENT OF WATER, OR SOILS WITH MODERATELY FINE TO FINE TEXTURES.
D	CLAY LOAM, SANDY CLAY, SILTY CLAY, OR CLAY	GC - CLAYEY GRAVELS, CLAYEY SANDY GRAVELS SC - CLAYEY SANDS, CLAYEY GRAVELLY SANDS CL - LOW PLASTICITY CLAYS, SANDY OR SILTY CLAYS OL - ORGANIC SILTS AND CLAYS OF LOW PLASTICITY CH - HIGHLY PLASTIC LAYS AND SANDY CLAYS OH - ORGANIC SILTS AND CLAYS OF HIGH PLASTICITY	HIGH RUNOFF POTENTIAL. SOILS HAVING VERY SLOW INFILTRATION RATES WHEN THOROUGHLY WETTED AND CONSISTING CHIEFLY OF CLAY SOILS WITH A HIGH SWELLING POTENTIAL, SOILS WITH A PERMANENT HIGH WATER TABLE, AND SHALLOW SOILS OVER NEARLY IMPERVIOUS MATERIAL.

NOTES		LARGE SYSTEMS		SMALL SYSTEMS		DEEP SYSTEMS	
		PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS	
SI	SI	SI	SI	SI	SI	SI	SI
1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.1



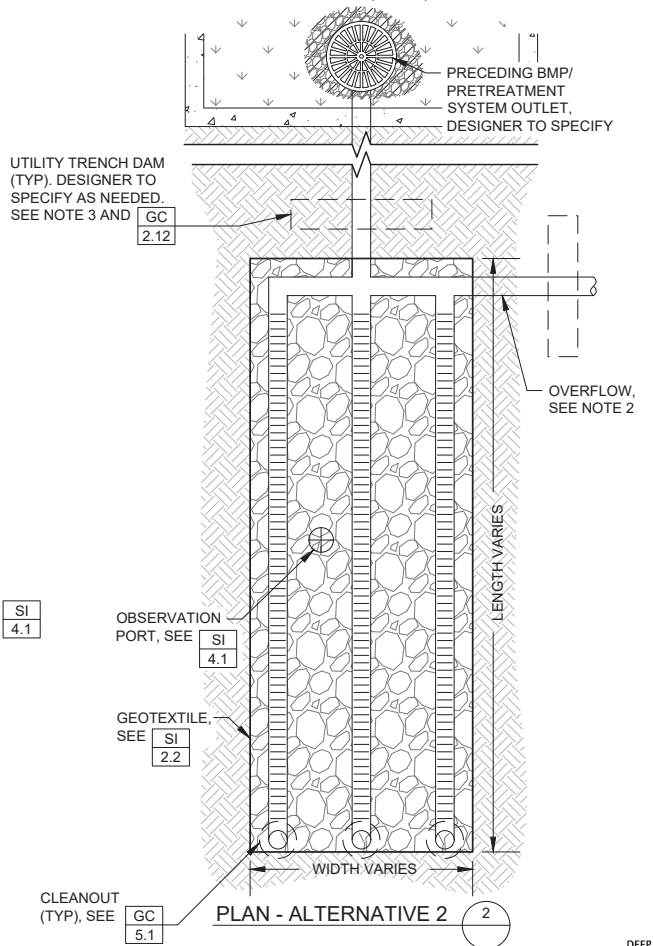
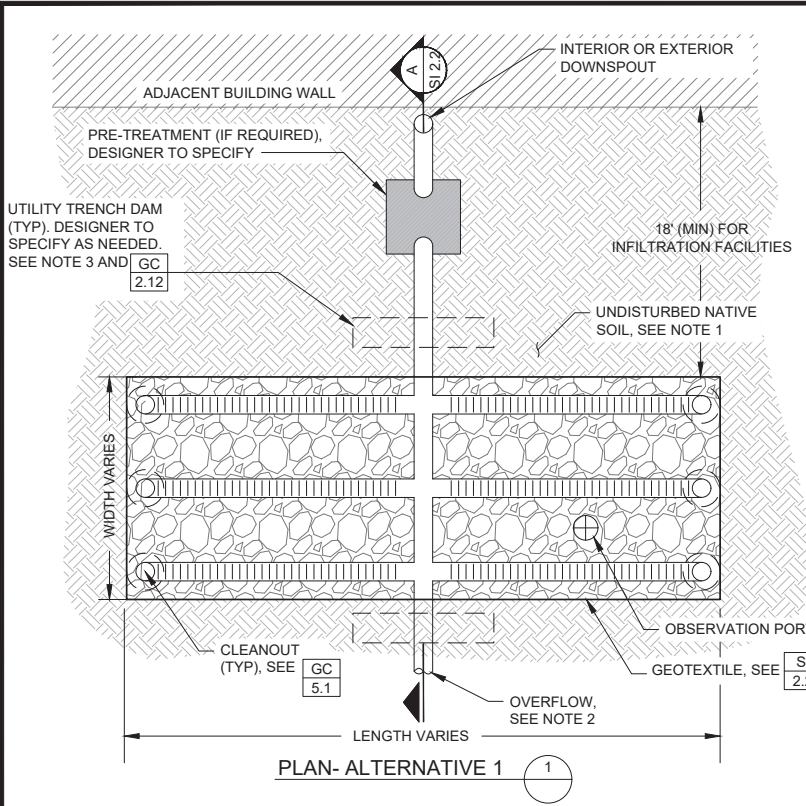
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE	06.2022
VERSION	02
REVISED	N/A

SUBSURFACE INFILTRATION SYSTEMS
DESIGNER NOTES (2 OF 2)


FILE NO.	SI
	1.2



CONSTRUCTION NOTES:

1. AVOID COMPACTION AND DISTURBANCE OF EXISTING SOIL WITHIN 5 FEET ADJACENT TO AND BELOW INFILTRATION FACILITIES DURING CONSTRUCTION.
2. ROUTE OVERFLOW PIPE TO THE STORM SEWER OR TO ANOTHER BMP FOR FURTHER TREATMENT AS SHOWN ON THE DESIGN PLANS.
3. PROVIDE UTILITY TRENCH DAM OR EQUIVALENT MEASURE OUTSIDE OF THE INFILTRATION FACILITY AT PIPE PENETRATIONS TO PREVENT PREFERENTIAL FLOW FROM SUBSURFACE INFILTRATION SYSTEM INTO UTILITY TRENCHES. COORDINATE WITH ENGINEER.

NOTES		LARGE SYSTEMS		SMALL SYSTEMS		DEEP SYSTEMS
SI	SI	SI	SI	SI	SI	SI
1.1	1.2	2.1	2.2	3.1	3.2	4.1
		2.1	2.2			


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GREEN INFRASTRUCTURE
TYPICAL DETAILS
 COUNTY OF SAN MATEO

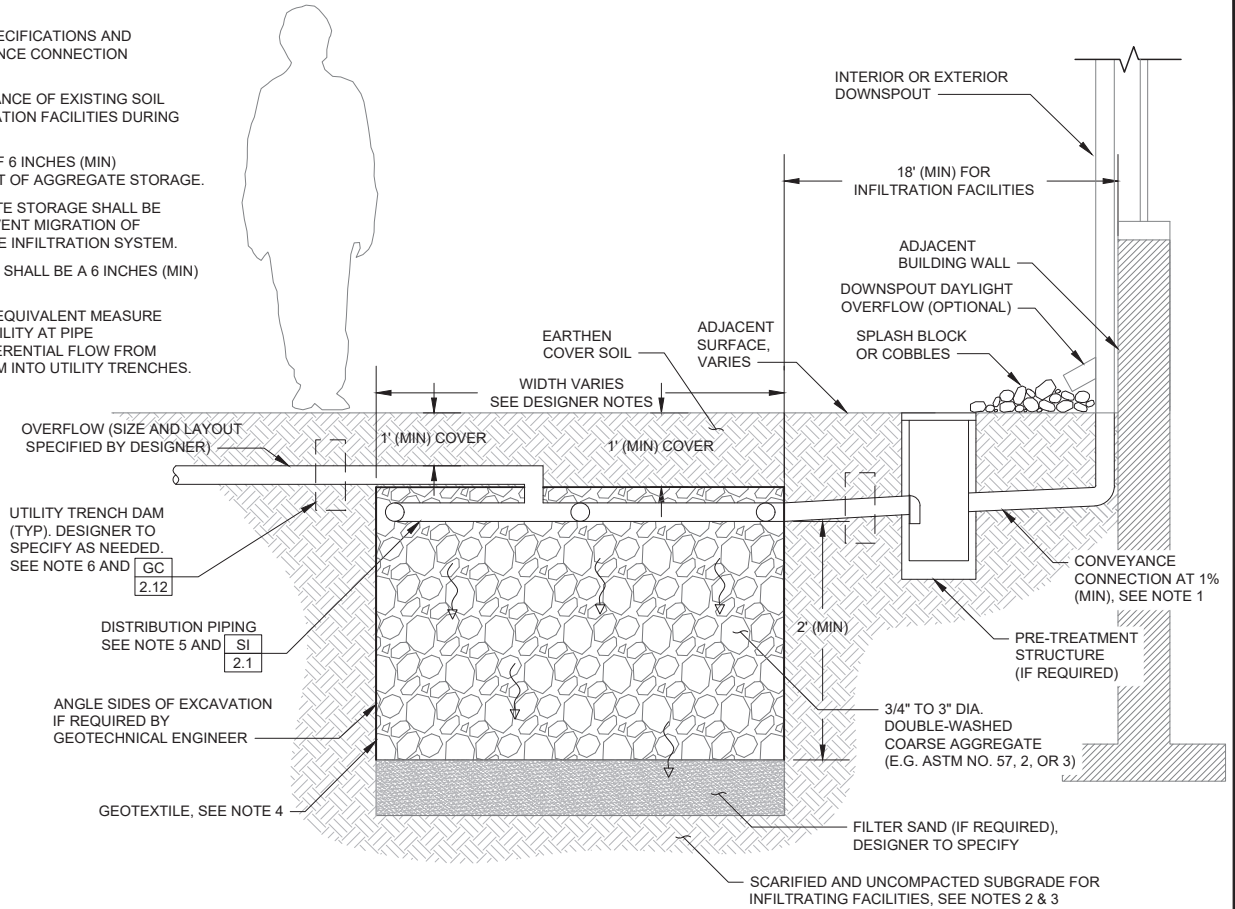
DATE 06.2022
 VERSION 02
 REVISED N/A

SUBSURFACE INFILTRATION SYSTEMS
 LARGE SYSTEM – PLAN

FILE NO.
SI
2.1

CONSTRUCTION NOTES:

1. REFER TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES FOR CONVEYANCE CONNECTION REQUIREMENTS.
2. AVOID COMPACTION AND DISTURBANCE OF EXISTING SOIL ADJACENT TO AND BELOW INFILTRATION FACILITIES DURING CONSTRUCTION.
3. SCARIFY SUBGRADE TO A DEPTH OF 6 INCHES (MIN) IMMEDIATELY PRIOR TO PLACEMENT OF AGGREGATE STORAGE.
4. SIDEWALLS AND TOP OF AGGREGATE STORAGE SHALL BE LINED WITH A GEOTEXTILE TO PREVENT MIGRATION OF ADJACENT SOILS INTO SUBSURFACE INFILTRATION SYSTEM.
5. SUBSURFACE DISTRIBUTION PIPING SHALL BE A 6 INCHES (MIN) IN DIAMETER.
6. PROVIDE UTILITY TRENCH DAM OR EQUIVALENT MEASURE OUTSIDE OF THE INFILTRATION FACILITY AT PIPE PENETRATIONS TO PREVENT PREFERENTIAL FLOW FROM SUBSURFACE INFILTRATION SYSTEM INTO UTILITY TRENCHES. COORDINATE WITH ENGINEER.



SECTION - ALTERNATIVE 1 A

NOTES		LARGE SYSTEMS		SMALL SYSTEMS		DEEP SYSTEMS
		PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS
SI 1.1	SI 1.2	SI 2.1	SI 2.2	SI 3.1	SI 3.2	SI 4.1



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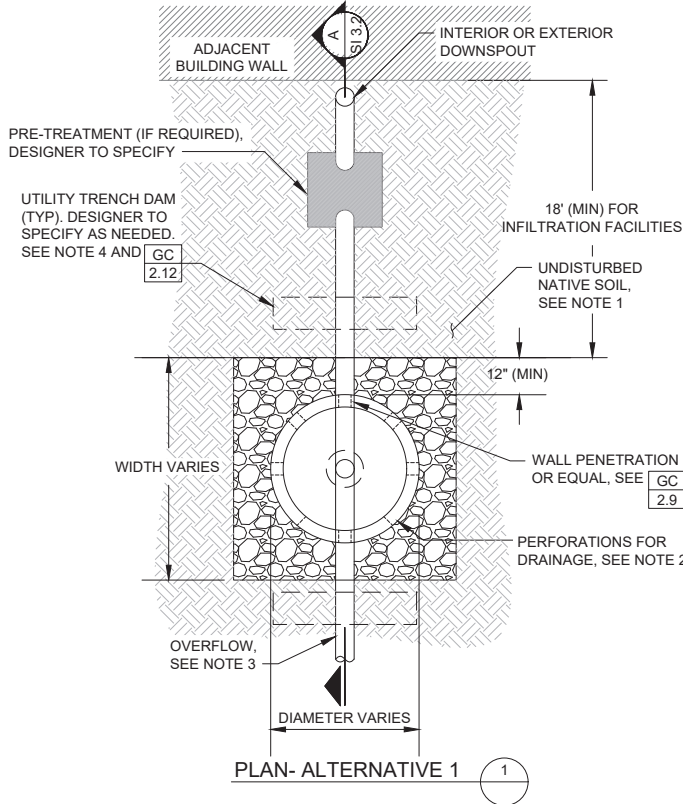
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COUNTY OF SAN MATEO

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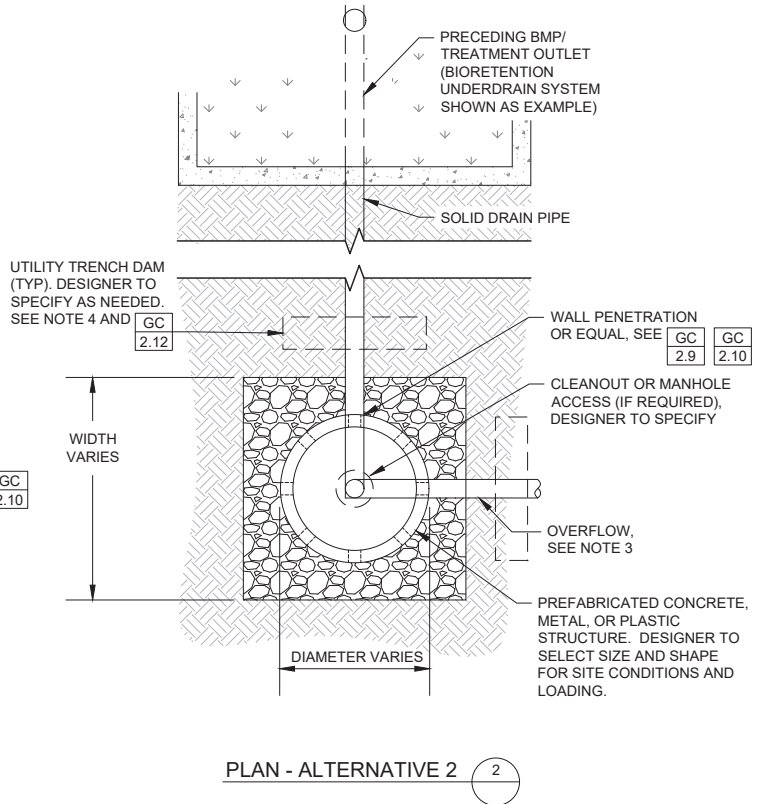
SUBSURFACE INFILTRATION SYSTEMS
LARGE SYSTEM – SECTION

FILE NO.
SI 2.2

NOT FOR CONSTRUCTION - REFER TO USER GUIDE



PLAN - ALTERNATIVE 1 (1)



PLAN - ALTERNATIVE 2 (2)

CONSTRUCTION NOTES:

1. AVOID COMPACTION AND DISTURBANCE OF EXISTING SOIL WITHIN 5 FEET ADJACENT TO AND BELOW INFILTRATION FACILITIES DURING CONSTRUCTION.
2. PREFABRICATED DRY WELLS SHALL HAVE SMALL DIAMETER PERFORATIONS TO PREVENT LATERAL MOVEMENT OF AGGREGATE INTO WELL AND SHALL BE SUFFICIENT IN NUMBER TO ALLOW FOR THE DRAINAGE OF THE STRUCTURE WITHIN 48 HOURS.
3. ROUTE OVERFLOW PIPE TO THE STORM SEWER OR TO ANOTHER BMP FOR FURTHER TREATMENT AS SHOWN ON THE DESIGN PLANS.
4. PROVIDE UTILITY TRENCH DAM OR EQUIVALENT MEASURE OUTSIDE OF THE INFILTRATION FACILITY AT PIPE PENETRATIONS TO PREVENT PREFERENTIAL FLOW FROM SUBSURFACE INFILTRATION SYSTEM INTO UTILITY TRENCHES. COORDINATE WITH ENGINEER.

NOTES		LARGE SYSTEMS		SMALL SYSTEMS		DEEP SYSTEMS	
		PLAN SECTIONS		PLAN SECTIONS		PLAN SECTIONS	
SI	SI	SI	SI	SI	SI	SI	SI
1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.1



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SUBSURFACE INFILTRATION SYSTEMS
SHALLOW DRY WELL
SMALL SYSTEM - PLAN

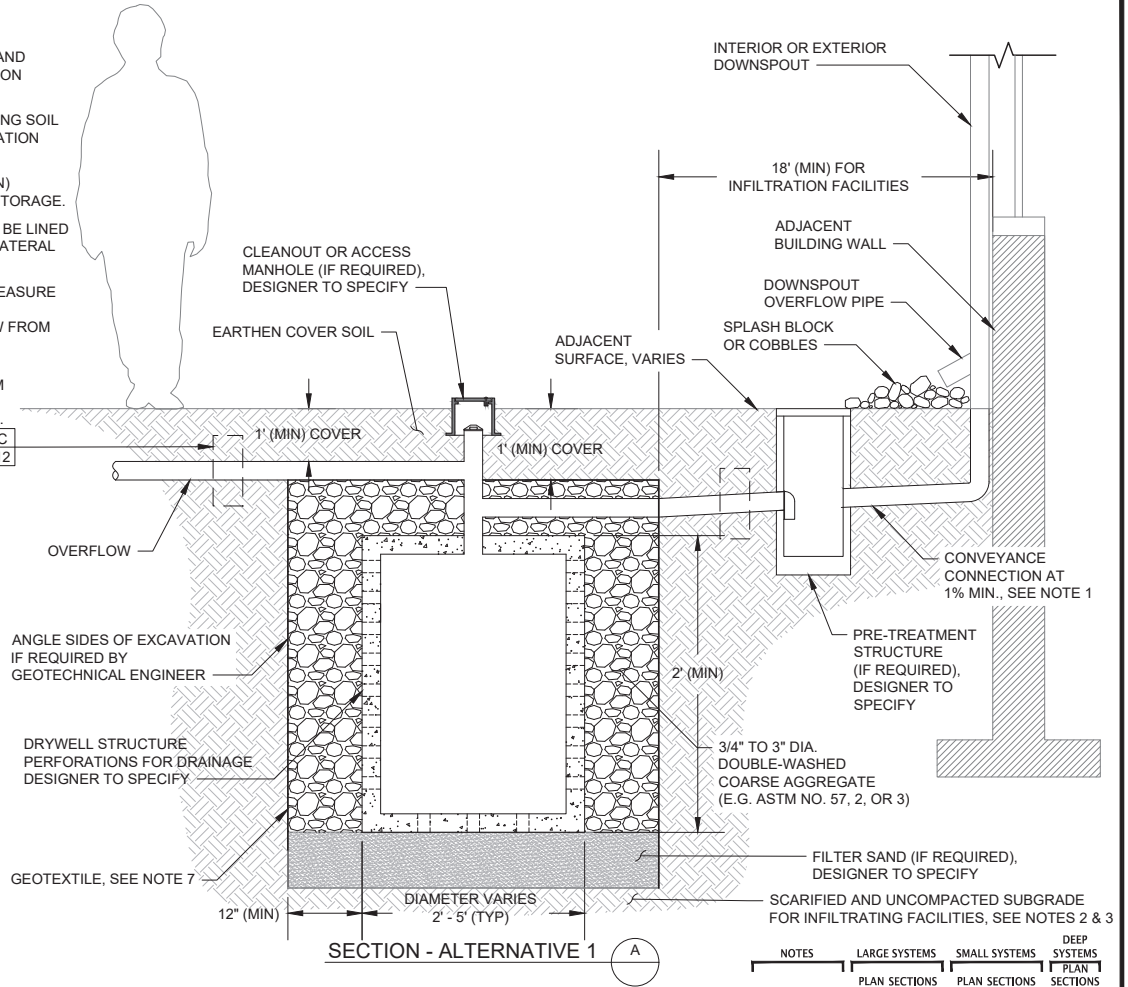
FILE NO.
SI
3.1

CONSTRUCTION NOTES:

1. REFER TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES FOR CONVEYANCE CONNECTION REQUIREMENTS.
2. AVOID COMPACTION AND DISTURBANCE OF EXISTING SOIL WITHIN 5 FEET ADJACENT TO AND BELOW INFILTRATION FACILITIES DURING CONSTRUCTION.
3. SCARIFY SUBGRADE TO A DEPTH OF 6 INCHES (MIN) IMMEDIATELY PRIOR TO PLACEMENT OF GRAVEL STORAGE.
4. SIDEWALLS AND TOP OF GRAVEL STORAGE SHALL BE LINED WITH A PERMEABLE FILTER FABRIC TO PREVENT LATERAL SOIL MOVEMENT.
5. PROVIDE UTILITY TRENCH DAM OR EQUIVALENT MEASURE OUTSIDE OF THE INFILTRATION FACILITY AT PIPE PENETRATIONS TO PREVENT PREFERENTIAL FLOW FROM SUBSURFACE INFILTRATION SYSTEM INTO UTILITY TRENCHES. COORDINATE WITH ENGINEER.

UTILITY TRENCH DAM (TYP). DESIGNER TO SPECIFY AS NEEDED. SEE NOTE 5 AND

GC
2.12



SECTION - ALTERNATIVE 1 (A)

NOTES		LARGE SYSTEMS		SMALL SYSTEMS		DEEP SYSTEMS
SI	SI	SI	SI	SI	SI	SI
1.1	1.2	2.1	2.2	3.1	3.2	4.1



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SUBSURFACE INFILTRATION SYSTEMS
SHALLOW DRY WELL
SMALL SYSTEM – SECTION – ALTERNATIVE

FILE NO:
**SI
3.2**

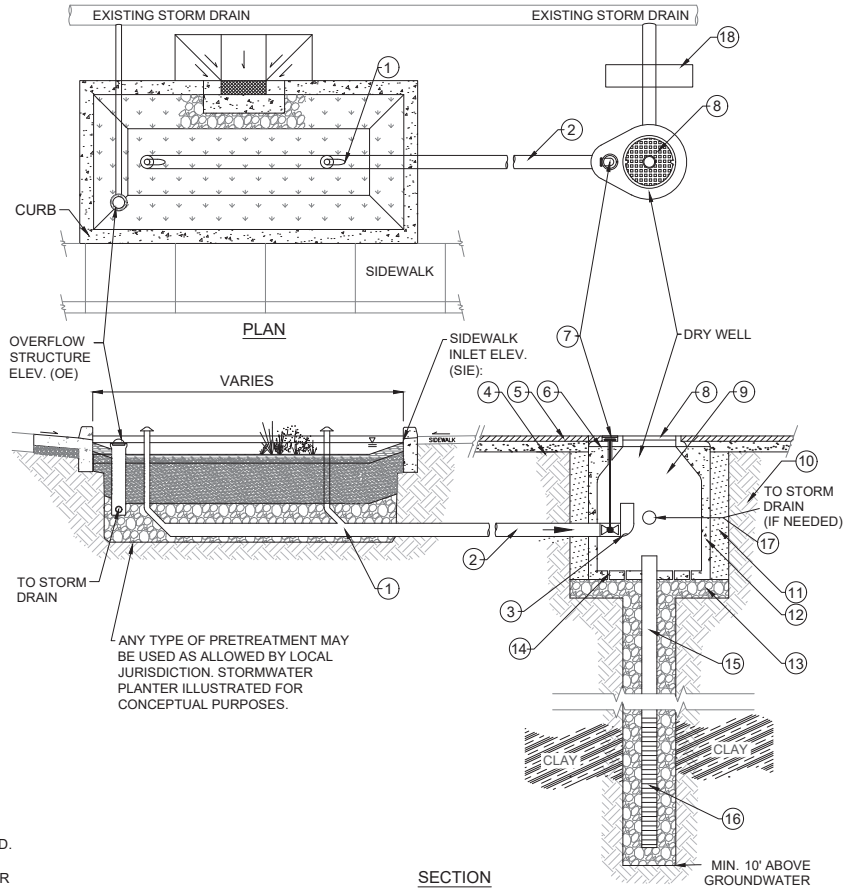
NOT FOR CONSTRUCTION - REFER TO USER GUIDE

KEY:

1. UNDERDRAIN, MIN. 4" DIA. PVC SDR 35 SLOTTED OR PERFORATED PIPE OR LARGER AS NEEDED TO CONVEY PEAK TREATED FLOWRATE WITH MINIMAL HEAD LOSS.
2. 6" (MIN) SOLID INLET PIPE OR OTHER.
3. LOW FLOW ORIFICE.
4. STABILIZED BACKFILL - TWO-SACK SLURRY MIX.
5. SIDEWALK PER MUNICIPAL STANDARDS.
6. COMPACTED BASE MATERIAL.
7. ACCESS HATCH WITH SHUT OF VALVE SWITCH. CONNECTED TO SHUT OF VALVE IN INLET PIPE.
8. MAINTENANCE HOLE COS TYPE 204-204 MH A OR B. 3/4" I.D. MIN OBSERVATION PORT.
9. MANHOLE CONE - MODIFIED FLAT BOTTOM.
10. EXISTING SOILS.
11. COMPACTED BACKFILL.
12. PRE-CAST OR INSITU CAST CONTROL VAULT.
13. ROCK - WASHED, SIZED BETWEEN 3/8" AND 1-1/2".
14. PERFORATED BASE OF CONTROL VAULT
15. DRILLED SHAFT WITH 6" WELDED STEEL OR THREADED PVC CASING
16. 6 - 8" O.D. WELDED WIRE STAINLESS STEEL WELL SCREEN OR THREADED PVC SLOTTED SCREEN. SCREEN LENGTH + LENGTH + SLOT WIDTH TO BE DETERMINED IN ACCORDANCE WITH LOCAL CONSTRAINTS .I.E. DISTANCE BETWEEN CLAY LAYER AND MIN. 10FT ABOVE SEASONAL HIGH GROUNDWATER LEVEL
17. PVC STORMDRAIN CONNECTOR PIPE. SAME DIAMETER AS INFLOW PIPE TO CONTROL VAULT.
18. UTILITY TRENCH DAM PER GC 2.12. DESIGNER TO SPECIFY AS NEEDED.

DESIGNER NOTES:

1. SEE SI 1.1 AND SI 1.2 FOR ADDITIONAL GUIDANCE.
2. BOTTOM WIDTH SHALL BE 2 FEET MINIMUM.
3. IF THE LONGITUDINAL SLOPE OF THE DRY WELL EXCEEDS 6%, CHECK DAMS SHALL BE USED.
4. SHUT-OFF VALVE MAY BE LOCATED IN THE PRETREATMENT FACILITY IF DESIRED. DESIGNER TO SPECIFY LOCATION AND WHETHER STRUCTURAL SUPPORT IS REQUIRED.
5. IN AREAS WITHOUT A STORM DRAIN SYSTEM, THE MAINTENANCE HOLE SURFACE INVERT MUST BE ABOVE THE PRETREATMENT FACILITY OVERFLOW ELEVATION.
6. ALTERNATIVE PRODUCTS SUCH AS VENDOR SUPPLIED DRY WELL PRODUCTS MAY BE USED AS A SUBSTITUTE PROVIDED THAT THE ALTERNATIVE PRODUCT IS EQUAL.



ANY TYPE OF PRETREATMENT MAY BE USED AS ALLOWED BY LOCAL JURISDICTION. STORMWATER PLANTER ILLUSTRATED FOR CONCEPTUAL PURPOSES.

NOTES		LARGE SYSTEMS		SMALL SYSTEMS		DEEP SYSTEMS
SI	SI	SI	SI	SI	SI	SI
1.1	1.2	2.1	2.2	3.1	3.2	4.1



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SUBSURFACE INFILTRATION SYSTEMS
DEEP DRY WELL
SMALL SYSTEM – PLAN & SECTION

FILE NO.
SI
4.1

PURPOSE:

IMPERMEABLE LINERS IN GREEN INFRASTRUCTURE CAN BE USED TO RESTRICT MOVEMENT OF WATER INTO UNDERLYING AND/OR ADJACENT SOILS AND/OR AGGREGATES TO PROTECT SENSITIVE INFRASTRUCTURE (E.G., IMPERMEABLE ROADWAY BASE, FOUNDATIONS, UTILITIES), MITIGATE RISK OF GEOLOGIC HAZARDS (E.G., STEEP SLOPES, CONTAMINATED SOILS), OR OTHER SITE-SPECIFIC CONDITIONS)

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
2. THE DESIGNER AND/OR GEOTECHNICAL ENGINEER SHOULD ASSESS THE RISK OF WATER LEAKAGE FROM THE PLANTER AND DETERMINE THE LINER EXTENTS AND LINER CONNECTION REQUIREMENTS (E.G., WATER TIGHT, SOIL TIGHT), DEPENDING ON DEGREE OF PROTECTION NECESSARY TO PROTECT ADJACENT INFRASTRUCTURE.
6. CONSIDER PLACING GEOTEXTILE ON PREPARED SUBGRADE PRIOR TO PLACEMENT OF LINER TO PROTECT LINER FROM DAMAGE DURING INSTALLATION.
7. DEPENDING ON ANTICIPATED FACILITY MAINTENANCE, IT MAY BE PRUDENT TO INCLUDE A GEOTEXTILE OVER THE LINER TO PROVIDE AN ADDITIONAL BARRIER BETWEEN LINER AND MAINTENANCE EQUIPMENT OR TO PROTECT AGAINST AGGRESSIVE PUNCTURES DURING PLACEMENT AND COMPACTION.

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- LINER TYPE AND EXTENTS (E.G., FULL LINER, PARTIAL LINER)
- LINER ANCHOR TYPE (E.G., WATER TIGHT, SOIL TIGHT)
- LINER JOINT WELDING/SEALING REQUIREMENTS
- OTHER CRITICAL PROJECT-SPECIFIC PLACEMENT REQUIREMENTS

NOTES	COMPONENTS
GC 1:1	GC 1.2



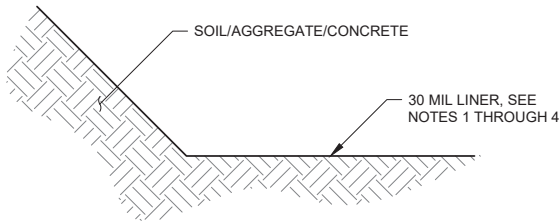
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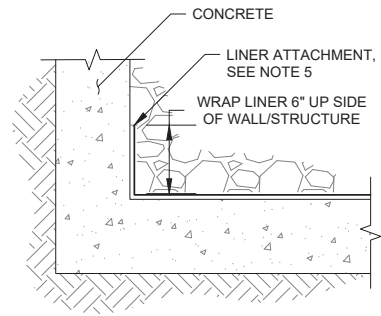
GENERAL COMPONENTS
LINERS
DESIGNER NOTES

FILE NO.
GC
1.1



IMPERMEABLE LINER

1

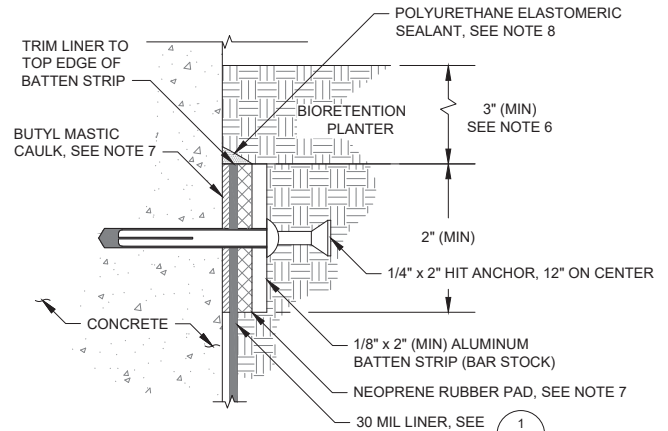


SOIL TIGHT LINER ATTACHMENT AT WALL/STRUCTURE

2

CONSTRUCTION NOTES:

1. LINER SHALL BE HDPE CONFORMING TO GEOSYNTHETIC RESEARCH INSTITUTE (GRI) GM13 OR LLDPE CONFORMING TO GRI GM17.
2. LINER SHALL LAY FLUSH WITH GROUND WITH NO AIR VOIDS BELOW THE LINER PRIOR TO BACKFILLING MATERIAL ABOVE THE LINER. CONTOUR THE SUBGRADE AS NEEDED TO ENSURE LINER LAYS FLUSH WITH GROUND.
3. OVERLAP LINER PER MANUFACTURER'S RECOMMENDATIONS.
4. ALL SEAMS SHALL BE WELDED PER MANUFACTURER'S RECOMMENDATIONS UNLESS OTHERWISE SPECIFIED.
5. SECURE LINER CONTINUOUSLY WITH DOUBLE-SIDED TAPE ALONG LINER EDGE AND SINGLE SIDED TAPE ALONG THE TOP EDGE OF LINER TO HOLD LINER IN PLACE DURING BACKFILLING.
6. TOP OF LINER TO BE AT LEAST 3" BELOW FINISH GRADE OF BIOTREATMENT SOIL MEDIA EXCEPT WHEN ADJACENT TO BUILDING WALL. WHEN ADJACENT TO BUILDING WALL, LINER OR EQUAL WATERPROOFING SHALL EXTEND TO TOP OF FREEBOARD ELEVATION.
7. APPLY BUTYL MASTIC CAULK, BATTEN STRIP, AND NEOPRENE RUBBER PAD CONTINUOUSLY ALONG TOP EDGE OF LINER.
8. APPLY BEAD OF POLYURETHANE ELASTOMERIC SEALANT CONTINUOUSLY ALONG TOP EDGE OF BATTEN STRIP ASSEMBLY.



WATER TIGHT LINER ATTACHMENT AT WALL/STRUCTURE

3

NOTES	COMPONENTS
GC 1.1	GC 1.2



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GENERAL COMPONENTS
LINERS
LINERS AND ATTACHMENTS

FILE NO.
GC 1.2

PURPOSE:

WHEN SITING GREEN INFRASTRUCTURE (GI) FACILITIES, THE DESIGNER SHOULD LOCATE AND ASSESS ALL KNOWN UTILITY CROSSINGS AND CONFLICTS AND ADJUST THE DESIGN TO AVOID AS MANY EXISTING UTILITIES AS POSSIBLE. THE CRITICALITY OF UTILITY CONFLICTS IN TERMS OF THEIR POTENTIAL IMPACT TO THE PROJECT'S DESIGN PERFORMANCE, COST, AND SCHEDULE SHOULD BE CAREFULLY EVALUATED DURING THE PLANNING PHASE.


THE PURPOSE OF THE FOLLOWING TYPICAL UTILITY CROSSING DETAILS IS TO ALERT THE DESIGNERS TO COMMON UTILITY CROSSINGS THAT OCCUR ON GI PROJECTS WITHIN THE PUBLIC RIGHT-OF-WAY AND PROVIDE GENERAL GUIDANCE ON THE PROTECTION OF THESE UTILITIES. THEY ARE PROVIDED AS TYPICAL APPLICATIONS AND DO NOT REPRESENT APPROVED COUNTY UTILITY STANDARDS AND SPECIFICATIONS. IN ADDITION TO THESE TYPICAL DETAILS, DESIGNERS MUST FOLLOW ALL APPLICABLE LOCAL AND FEDERAL REGULATIONS ASSOCIATED WITH THEIR PROJECT.

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS AND UTILITY REQUIREMENTS AND OBTAIN APPROVAL FROM ALL RELEVANT UTILITY PROVIDERS PRIOR TO CONSTRUCTION.
 - CALIFORNIA WATER SERVICE OR SMC PUBLIC WORKS FOR DOMESTIC/FIRE WATER
 - SMC PUBLIC WORKS FOR SANITARY SEWER, STORM DRAIN, AND STREET LIGHTS
 - PACIFIC GAS ELECTRIC (PGE) FOR ELECTRIC/GAS/UTILITY POLES
2. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT JURISDICTIONAL ASSET PROTECTION STANDARDS. IN THE ABSENCE OF THESE STANDARDS, THE DESIGNER SHALL REFER TO CHAPTER 3 OF THE SMCWPPP GI DESIGN GUIDE FOR BEST PRACTICES AND COORDINATE DIRECTLY WITH RELEVANT UTILITY PROVIDERS FOR REQUIREMENTS.
3. UTILITY CONFLICTS SHALL BE MITIGATED PER SMC DPW STANDARDS AND OTHER UTILITY PROVIDER REQUIREMENTS. ENGINEER TO EVALUATE CONDITIONS AND NEED TO INCLUDE MEASURES TO ENSURE WATER TIGHT UTILITY PENETRATIONS THROUGH PLANTER WALL, AS NEEDED AND TO PREVENT PREFERENTIAL FLOW INTO UTILITY TRENCHES (E.G., WATER STOP, TRENCH BLOCK, OR TRENCH COLLAR). (REFER TO **GC 2.9 - 2.12**)
4. THE DESIGNER MUST DETERMINE THE TYPE OF PROTECTION MEASURE(S) REQUIRED BASED ON THE SITE-SPECIFIC CONDITIONS, UTILITY REQUIREMENTS, AND THE FUNCTION THE PROTECTION MEASURE MUST PERFORM. THE FOLLOWING ARE BRIEF DESCRIPTIONS OF THE PROTECTION MEASURES INCLUDED IN THESE DETAILS:

- a. SOIL OR ENGINEERED FILL WITH OVERLYING IMPERMEABLE LINER: PROTECTS UTILITY FROM DAMAGE DURING FUTURE TRENCHING, EXCAVATION, AND LANDSCAPE ACTIVITIES. THE LINER PREVENTS PREFERENTIAL FLOW OF WATER INTO THE UTILITY TRENCH. THESE METHODS ARE GENERALLY ONLY ACCEPTABLE WHEN THE FACILITY DOES NOT INCLUDE AN UNDERDRAIN OR WHEN THE LINER CAN BE LOCATED BELOW THE INVERT OF THE UNDERDRAIN.
 - b. SLEEVE/CASING: BY HOUSING THE UTILITY PIPE WITHIN A LARGER CARRIER PIPE OR APPROVED SPLIT SLEEVE PRODUCT, THE UTILITY PIPE CAN BE REPLACED IF NEEDED IN THE FUTURE WITHOUT SIGNIFICANT IMPACT TO THE OVERLYING INFRASTRUCTURE. THE SLEEVE ALSO PROTECTS THE PIPE FROM IMPACT DURING CONSTRUCTION AND FUTURE TRENCHING, EXCAVATION, AND LANDSCAPE ACTIVITIES. ADDITIONALLY, SLEEVES CAN BE USED TO SEAL THE UTILITY FROM THE INFILTRATED STORMWATER AND/OR PROTECT THE INFILTRATION FACILITY FROM SEWER LATERAL LEAKAGES. SEE THE UTILITY SLEEVE GUIDANCE.
 - c. UTILITY TRENCH DAM: WHERE UTILITY TRENCHES CROSS UNDER INFILTRATIVE FACILITIES, SUBSURFACE WATER MAY PREFERENTIALLY FLOW THROUGH THE TRENCH AND CAUSE DAMAGE TO DOWNSTREAM INFRASTRUCTURE. RISKS INCLUDE BACKFILL EROSION, CREATION OF VOIDS, THE DEGRADATION OF OVERLYING FILL/PAVEMENT, AND SUBSURFACE WATER BEING DIRECTED TO BUILDING FOUNDATIONS OR BASEMENTS. UTILITY TRENCH DAMS PLACED OUTSIDE OF THE INFILTRATION FACILITY FOOTPRINT PREVENT WATER FROM TRAVELING FURTHER ALONG THE UTILITY TRENCH.
 - d. INSULATING WRAP: PROVIDES IMPACT AND WATER PROTECTION FOR EXISTING SHALLOW UTILITY SERVICE LINES THAT ARE REMAINING IN PLACE WITHIN INFILTRATION FACILITIES.
6. FOR PERVIOUS PAVEMENT FACILITIES, UTILITY CROSSINGS SHOULD BE BELOW THE BOTTOM OF THE STRUCTURAL PAVEMENT SECTION, WHENEVER POSSIBLE. IF UTILITIES ENCROACH INTO THIS SECTION, THE ENGINEER SHALL CONFIRM THAT THE STRUCTURAL INTEGRITY OF THE PAVEMENT CAN BE MAINTAINED OVER THE UTILITY.
 7. THE AREA OF SUBBASE COVERED BY SUBSURFACE CHECK DAMS, IMPERMEABLE LINERS, COMPACTED ENGINEERED FILL, CONCRETE PADS AND OTHER UTILITY INFRASTRUCTURE SHOULD BE EXCLUDED FROM HYDROLOGIC PERFORMANCE CALCULATIONS WHEN THE AREA IS SIGNIFICANT (GREATER THAN 10 PERCENT) RELATIVE TO THE INFILTRATIVE AREA.

NOTES		BIORETENTION			PERVIOUS PAVEMENT			WALL PENETRATIONS			TRENCH DAM
GC 2.1	GC 2.2	GC 2.3	GC 2.4	GC 2.5	GC 2.6	GC 2.7	GC 2.8	GC 2.9	GC 2.10	GC 2.11	GC 2.12



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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
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GENERAL COMPONENTS
UTILITY CROSSINGS
DESIGNER NOTES (1 OF 2)

FILE NO.
GC
2.1

UTILITY SLEEVE NOTES AND GUIDANCE:

THE DESIGNER MUST SPECIFY THE TYPE OF SLEEVE METHOD AND MATERIALS THAT SHALL BE USED FOR ALL APPLICABLE NEW AND EXISTING UTILITIES TO REMAIN IN PLACE WITHIN THE FOOTPRINT OF INFILTRATION FACILITIES. DEPENDING ON THE SPECIFIC SITE CONDITIONS AND GOVERNING UTILITY STANDARDS, EXISTING UTILITIES TO REMAIN IN PLACE SHALL BE SLEEVED THE ENTIRE LENGTH WITHIN THE INFILTRATION FACILITY USING ONE OF THE FOLLOWING METHODS OR AN APPROVED EQUAL:

- a. PLASTIC PIPE, 1 - 2 SIZES LARGER THAN UTILITY PIPE, CUT IN HALF, PLACED AROUND UTILITY PIPE, SEALED ALONG JOINTS WITH ADHESIVE, AND CLAMPED TOGETHER WITH STAINLESS STEEL BANDS/HOSE CLAMPS, PIPE SUPPORTS (E.G. CLOSED CELL FOAM BLOCKING) WITHIN THE SLEEVE PER UTILITY PROVIDER'S REQUIREMENTS.
- b. GEORGE FISCHER "CONTAIN-IT" PIPE CONTAINMENT SYSTEM PRODUCT, PART NO. 8326-040AA OR 8326-060AA OR EQUAL, INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.
- c. STAINLESS STEEL SPLIT SLEEVE PRODUCT INSTALLED AROUND THE EXISTING PIPE AND POSITIONED IN THE FORM TO CENTER THE UTILITY PIPE. AFTER INSTALLATION, THE MANUFACTURER'S RECOMMENDED MATERIAL IS USED TO SEAL THE ANNULAR SPACE BETWEEN THE SPLIT SLEEVE AND PIPE. USE PIPE SEAL AND INSULATOR INC., WS SPLIT SEAL/WALL SLEEVE, OR EQUAL.

EXISTING UTILITY COORDINATION NOTES:

1. THE DESIGNER SHALL LOCATE ALL EXISTING UTILITIES WITHIN THE PROJECT AREA TO THE MOST PRACTICAL EXTENT POSSIBLE UTILIZING SITE SURVEYS, AS-BUILT PLANS, SITE INVESTIGATIONS, POTHOLING, UTILITY AGENCY DATA, ETC. AND PRESENT THIS INFORMATION AND SOURCE (I.E. AS-BUILT VS. ASSUMED LOCATION) CLEARLY ON THE DESIGN DRAWINGS. THE ASSUMED LOCATION OF EXISTING UTILITIES SHALL BE PROVIDED IN THE SAME COORDINATE SYSTEM AS THE REST OF THE DESIGN DRAWINGS. DESIGN DRAWINGS SHALL ALSO INCLUDE CONTACT INFORMATION FOR ANY UTILITIES AFFECTED BY THE PROJECT.
2. IF AN EXISTING UTILITY HAS THE POTENTIAL TO IMPACT THE PROJECT DESIGN AND/OR THE PERFORMANCE OF THE GI FACILITY, THE EXACT LOCATION, DEPTH, AND CONDITION OF THIS UTILITY SHOULD BE FIELD VERIFIED DURING THE DESIGN PHASE (VIA POTHOLING OR OTHER APPROVED METHOD) TO PREVENT COSTLY REDESIGNS AND/OR PROJECT DELAYS DURING CONSTRUCTION.
3. THE CONTRACTOR SHALL VERIFY THE LOCATIONS AND DEPTH OF EXISTING UTILITIES AT THE START OF CONSTRUCTION PER THE PROJECT SPECIFICATIONS. ANY DISCREPANCIES BETWEEN THE EXISTING UTILITIES SHOWN IN THE DESIGN DRAWINGS AND THE ACTUAL FIELD CONDITIONS SHOULD BE COMMUNICATED TO THE ENGINEER IMMEDIATELY.
4. THE CHECK DAM SPACING AND HEIGHT SPECIFIED ON THE DESIGN PLANS MUST BE MAINTAINED. IF THE CHECK DAM PROTECTING THE EXISTING UTILITY WILL IMPACT THE CHECK DAM SPACING SPECIFIED ON THE PLANS, THE ENGINEER MUST EVALUATE ITS IMPACT ON THE HYDROLOGIC PERFORMANCE AND APPROVE THE VARIANCE. SEE **PC 2.1** AND **PC 2.2** FOR FURTHER DETAILS.

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- LINER EMBEDMENT DEPTH INTO SUBGRADE SOILS
- PIPE AND SLEEVE MATERIALS AND DIAMETER FOR ALL WALL PENETRATIONS
- WALL PENETRATION TYPE (E.G., GROUTED, COMPRESSION, BOOT) SEE **GC 2.9 - 2.11**.
- GEOTEXTILE FABRICS AND/OR LINER MATERIALS
- ENGINEERED BACKFILL MATERIAL
- DIMENSIONS OF ALL PROTECTION MEASURES
- MINIMUM SETBACKS TO ADJACENT INFRASTRUCTURE, PAVEMENT BASES, SURFACES
- MINIMUM PIPE COVER AS REQUIRED BY UTILITY PROVIDER

NOTES		BIORETENTION			PERVIOUS PAVEMENT			WALL PENETRATIONS			TRENCH DAM
GC 2.1	GC 2.2	GC 2.3	GC 2.4	GC 2.5	GC 2.6	GC 2.7	GC 2.8	GC 2.9	GC 2.10	GC 2.11	GC 2.12



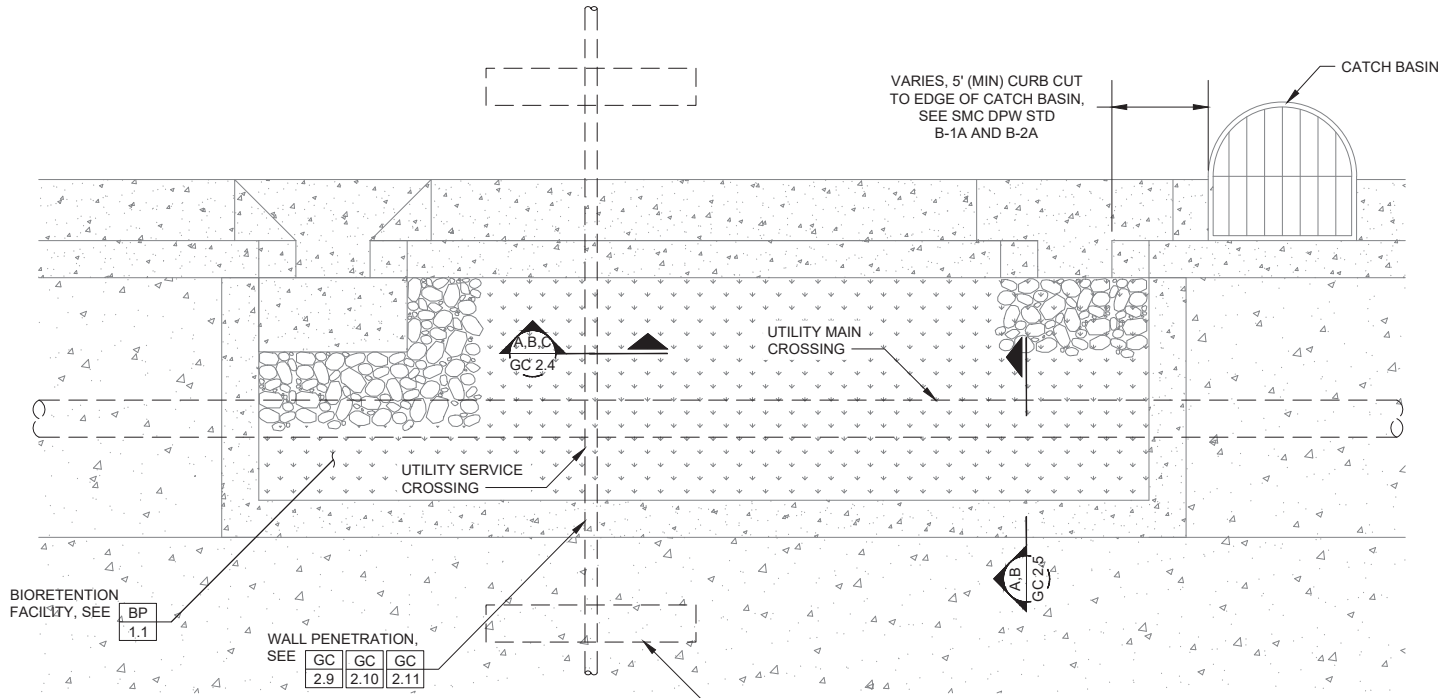
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

DATE	06.2022
VERSION	02
REVISED	N/A

GENERAL COMPONENTS
UTILITY CROSSINGS
DESIGNER NOTES (2 OF 2)

FILE NO.
GC 2.2



CONSTRUCTION NOTES:

1. ABANDONED UTILITIES WITHIN FOOTPRINT OF FACILITY AND OBSERVED DURING CONSTRUCTION MUST BE REMOVED. COORDINATE WITH MUNICIPAL OR PRIVATE OWNER AND ENGINEER.
2. PROVIDE UTILITY TRENCH DAM OR EQUIVALENT MEASURE OUTSIDE OF THE INFILTRATION FACILITY AT PIPE PENETRATIONS TO PREVENT PREFERENTIAL FLOW FROM INFILTRATION FACILITY INTO UTILITY TRENCHES. COORDINATE WITH ENGINEER.

UTILITY TRENCH DAM AS NEEDED (TYP). DESIGNER TO SPECIFY. SEE NOTE 2 AND **GC 2.12**

NOTES		BIORETENTION			PERVIOUS PAVEMENT			WALL PENETRATIONS			TRENCH DAM
GC 2.1	GC 2.2	GC 2.3	GC 2.4	GC 2.5	GC 2.6	GC 2.7	GC 2.8	GC 2.9	GC 2.10	GC 2.11	GC 2.12



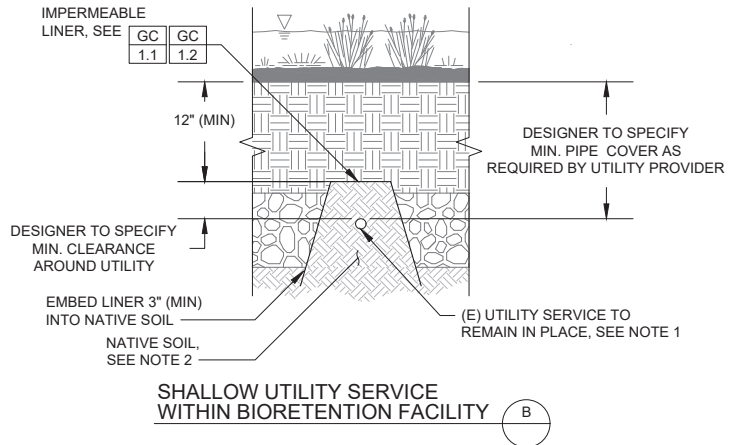
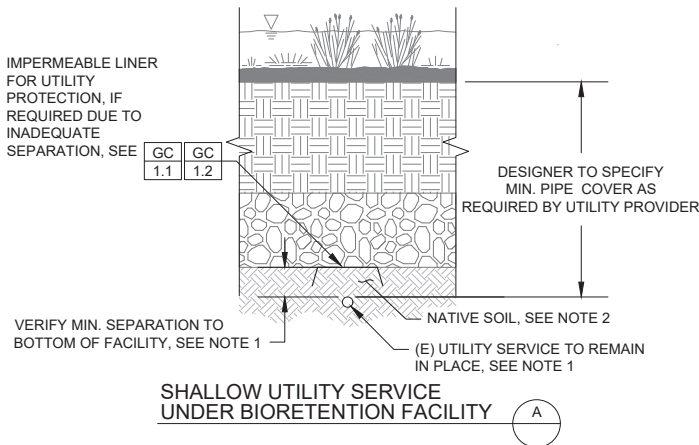
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COUNTY OF SAN MATEO

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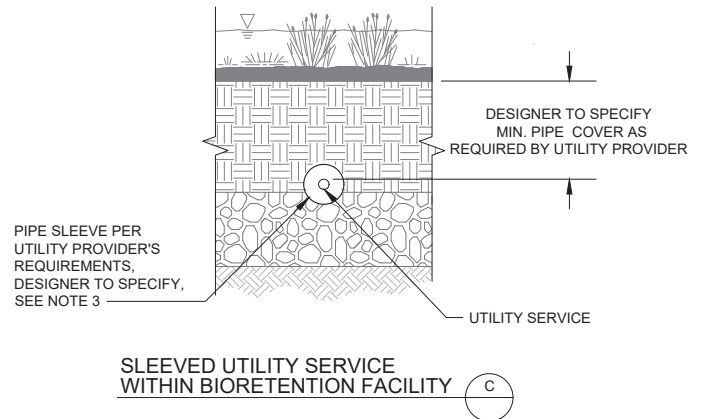
GENERAL COMPONENTS
UTILITY CROSSINGS
BIORETENTION

FILE NO.
GC 2.3



CONSTRUCTION NOTES:

1. CONTRACTOR SHALL LOCATE AND DETERMINE DEPTH OF EXISTING UTILITY WITHIN THE FOOTPRINT OF THE BIORETENTION FACILITY WHILE LIMITING THE AMOUNT OF DISTURBANCE TO THE SOIL/BACKFILL MATERIAL OVER AND AROUND THE UTILITY PIPE. IF ELECTROMAGNETIC UTILITY LOCATING, POTHOLES, OR OTHER METHOD REVEALS THAT THE UTILITY PIPE DOES NOT MEET THE REQUIRED CLEARANCE FROM THE BOTTOM OF THE BIORETENTION FACILITY, THE UTILITY PROVIDER MAY REQUIRE THAT PROTECTION MEASURES, SUCH AS THOSE SHOWN ON THIS PLAN, BE IMPLEMENTED PER THEIR STANDARDS. ANY DISCREPANCIES BETWEEN THE EXISTING UTILITIES SHOWN IN THE DESIGN DRAWINGS AND THE ACTUAL FIELD CONDITIONS SHOULD BE COMMUNICATED TO THE ENGINEER IMMEDIATELY.
2. EXISTING UTILITIES AND NATIVE SOIL AROUND EXISTING UTILITIES SHOULD REMAIN IN PLACE WHERE POSSIBLE. IF A PORTION OR ALL OF THE UTILITY IS UNCOVERED DURING EXCAVATION OR EXISTING SOIL WITHIN 1 FOOT OF THE KNOWN EXISTING UTILITY IS SCARIFIED, NATIVE SOIL OR APPROVED ENGINEERED BACKFILL SHALL BE CAREFULLY PLACED AND COMPACTED AROUND THE UTILITY PER THE UTILITY PROVIDER'S REQUIREMENTS.
3. UTILITY PROVIDER MAY ALLOW UTILITY SERVICES TO BE LEFT IN PLACE AND WRAPPED WITH A WATERTIGHT WRAP OR TAPE IN LIEU OF A SLEEVE. THIS MUST BE APPROVED PRIOR TO THE START OF CONSTRUCTION.



NOTES		BIORETENTION			PERVIOUS PAVEMENT			WALL PENETRATIONS			TRENCH DAM
GC 2.1	GC 2.2	GC 2.3	GC 2.4	GC 2.5	GC 2.6	GC 2.7	GC 2.8	GC 2.9	GC 2.10	GC 2.11	GC 2.12



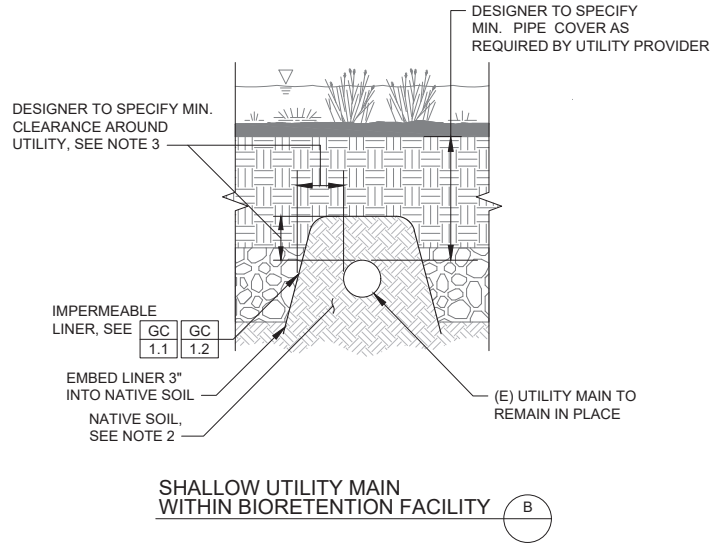
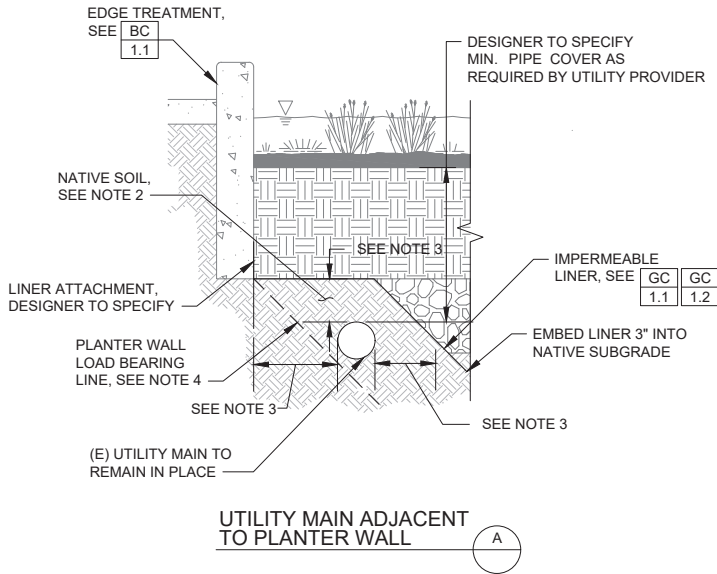
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

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GENERAL COMPONENTS
UTILITY CROSSINGS
BIORETENTION SECTIONS (1 OF 2)

FILE NO.
GC 2.4



CONSTRUCTION NOTES:

1. ANY DISCREPANCIES BETWEEN THE EXISTING UTILITIES SHOWN IN THE DESIGN DRAWINGS AND THE ACTUAL FIELD CONDITIONS SHOULD BE COMMUNICATED TO THE ENGINEER IMMEDIATELY.
2. EXISTING UTILITIES AND NATIVE SOIL AROUND EXISTING UTILITIES SHOULD REMAIN IN PLACE WHERE POSSIBLE. IF A PORTION OR ALL OF THE UTILITY IS UNCOVERED DURING EXCAVATION OR EXISTING SOIL WITHIN 1 FOOT OF THE KNOWN EXISTING UTILITY IS SCARIFIED, NATIVE SOIL OR APPROVED ENGINEERED BACKFILL SHALL BE CAREFULLY PLACED AND COMPACTED AROUND THE UTILITY PER THE UTILITY PROVIDER'S REQUIREMENTS.
3. PROVIDE THE MINIMUM CLEARANCE AROUND THE UTILITY MAIN AND SETBACKS FROM STRUCTURAL ELEMENTS PER THE UTILITY PROVIDER'S REQUIREMENTS.
4. UTILITY MAINS SHALL NOT BE SUBJECT TO LOADING FROM NEW PLANTER WALLS. LOAD BEARING LINES TO BE DETERMINED BY THE GEOTECHNICAL ENGINEER.

NOTES		BIORETENTION			PERVIOUS PAVEMENT			WALL PENETRATIONS			TRENCH DAM
GC 2.1	GC 2.2	GC 2.3	GC 2.4	GC 2.5	GC 2.6	GC 2.7	GC 2.8	GC 2.9	GC 2.10	GC 2.11	GC 2.12



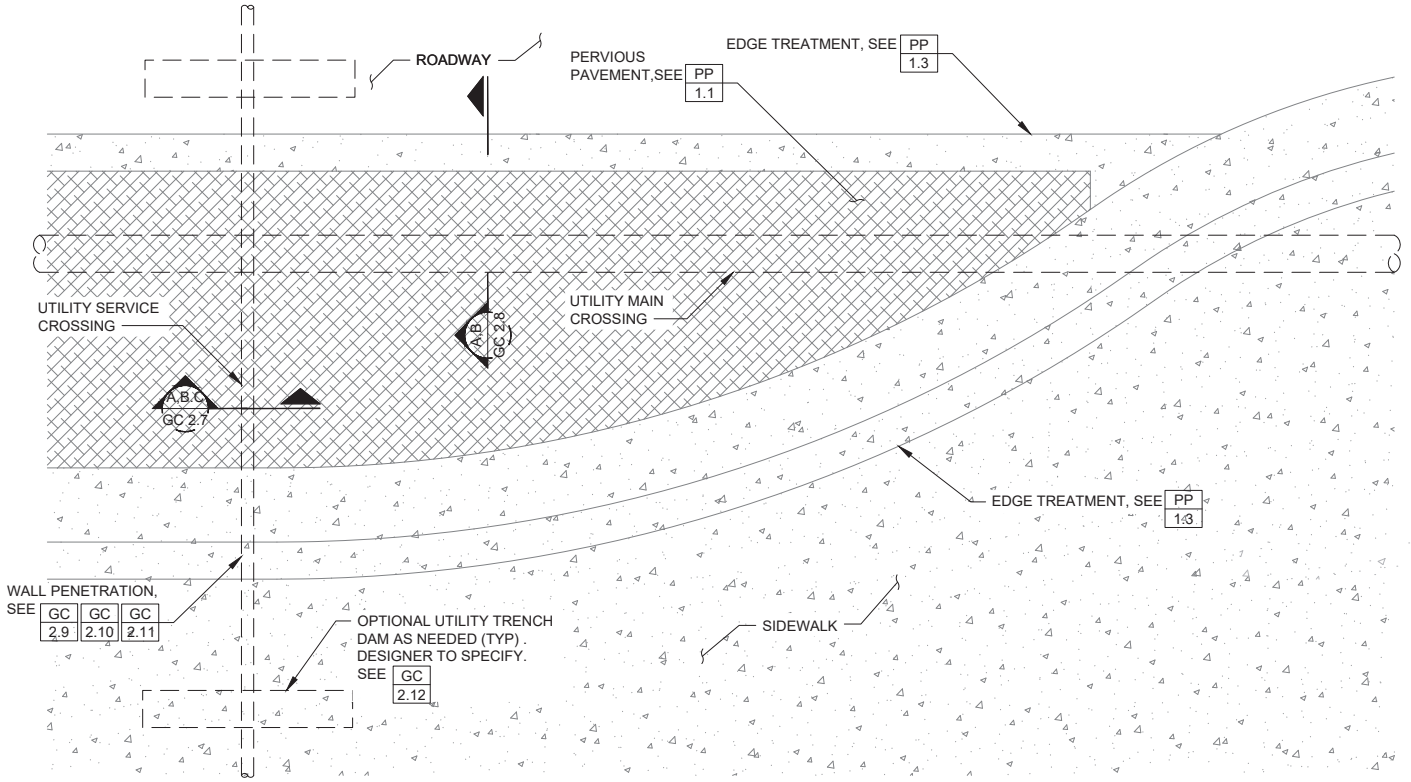
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

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REVISED: N/A

GENERAL COMPONENTS
UTILITY CROSSINGS
BIORETENTION SECTIONS (2 OF 2)

FILE NO.
**GC
2.5**



CONSTRUCTION NOTES:

1. ABANDONED UTILITIES WITHIN FOOTPRINT OF FACILITY AND OBSERVED DURING CONSTRUCTION MUST BE REMOVED. COORDINATE WITH MUNICIPAL OR PRIVATE OWNER AND ENGINEER.
2. PROVIDE UTILITY TRENCH DAM OR EQUIVALENT MEASURE OUTSIDE OF THE INFILTRATION FACILITY AT PIPE PENETRATIONS TO PREVENT PREFERENTIAL FLOW FROM INFILTRATION FACILITY INTO UTILITY TRENCHES. COORDINATE WITH ENGINEER.

NOTES			BIORETENTION			PERVIOUS PAVEMENT			WALL PENETRATIONS			TRENCH DAM
GC 2.1	GC 2.2	GC 2.3	GC 2.4	GC 2.5	GC 2.6	GC 2.7	GC 2.8	GC 2.9	GC 2.10	GC 2.11	GC 2.12	GC 2.6



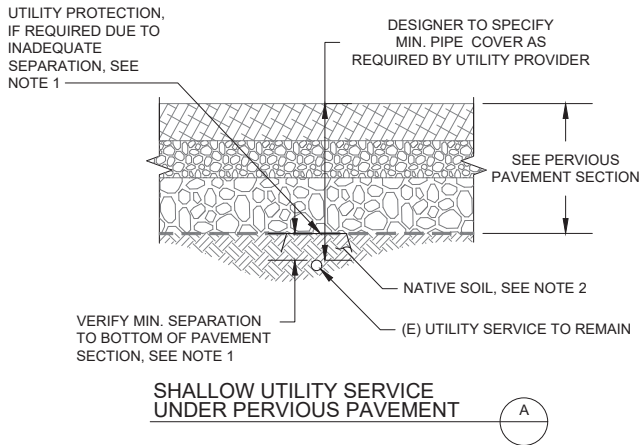
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

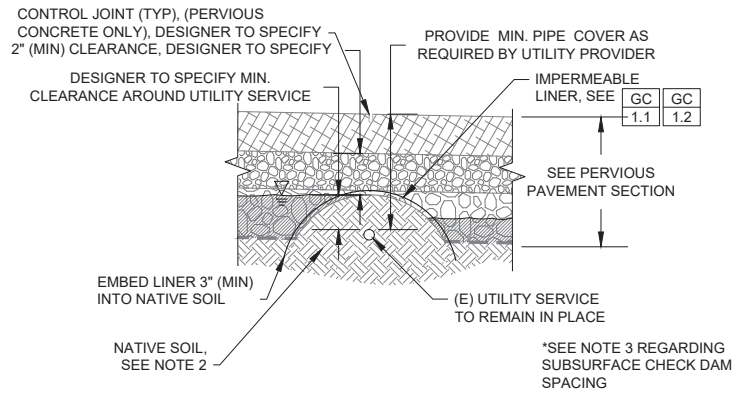
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GENERAL COMPONENTS
UTILITY CROSSINGS
PERVIOUS PAVEMENT

FILE NO.
GC 2.6



SHALLOW UTILITY SERVICE UNDER PERVIOUS PAVEMENT

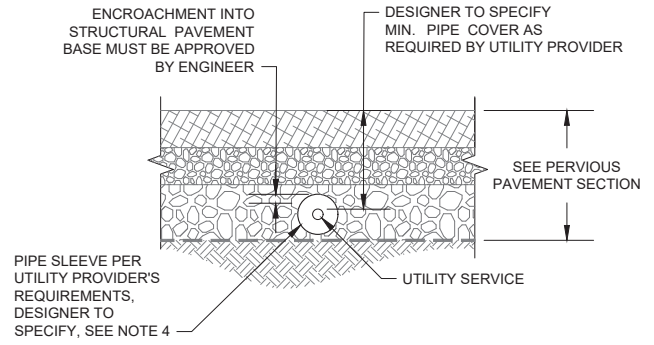


SHALLOW UTILITY SERVICE WITHIN SUBSURFACE CHECK DAM



CONSTRUCTION NOTES:

1. CONTRACTOR SHALL LOCATE AND DETERMINE DEPTH OF EXISTING UTILITY WITHIN THE FOOTPRINT OF THE PERVIOUS PAVEMENT FACILITY WHILE LIMITING THE AMOUNT OF DISTURBANCE TO THE SOIL/BACKFILL MATERIAL OVER AND AROUND THE UTILITY PIPE. IF ELECTROMAGNETIC UTILITY LOCATING, POTHOLES, OR OTHER METHOD REVEALS THAT THE UTILITY PIPE DOES NOT MEET THE REQUIRED SETBACK FROM THE BOTTOM OF THE PERVIOUS PAVEMENT SECTION, THE UTILITY PROVIDER MAY REQUIRE THAT PROTECTION MEASURES, SUCH AS THOSE SHOWN ON THIS PLAN, BE IMPLEMENTED.
2. EXISTING UTILITIES AND NATIVE SOIL AROUND EXISTING UTILITIES SHOULD REMAIN IN PLACE WHERE POSSIBLE. IF A PORTION OR ALL OF THE UTILITY IS UNCOVERED DURING EXCAVATION OR EXISTING SOIL WITHIN 1 FOOT OF THE KNOWN EXISTING UTILITY IS SCARIFIED, NATIVE SOIL OR APPROVED ENGINEERED BACKFILL SHALL BE CAREFULLY PLACED AND COMPACTED AROUND THE UTILITY PER THE UTILITY PROVIDER'S REQUIREMENTS.
3. THE CHECK DAM SPACING AND HEIGHT SPECIFIED ON THE DESIGN PLANS MUST BE MAINTAINED. IF THE CHECK DAM PROTECTING THE EXISTING UTILITY WILL IMPACT THE CHECK DAM SPACING SPECIFIED ON THE PLANS, COORDINATE WITH ENGINEER.
4. UTILITY PROVIDER MAY ALLOW SHALLOW UTILITY SERVICES TO BE LEFT IN PLACE AND WRAPPED WITH A WATERTIGHT WRAP OR TAPE IN LIEU OF A SLEEVE. THIS SHOULD BE APPROVED PRIOR TO THE START OF CONSTRUCTION.



SLEEVED UTILITY SERVICE WITHIN PERVIOUS PAVEMENT



NOTES		BIORETENTION			PERVIOUS PAVEMENT			WALL PENETRATIONS			TRENCH DAM
GC 2.1	GC 2.2	GC 2.3	GC 2.4	GC 2.5	GC 2.6	GC 2.7	GC 2.8	GC 2.9	GC 2.10	GC 2.11	GC 2.12



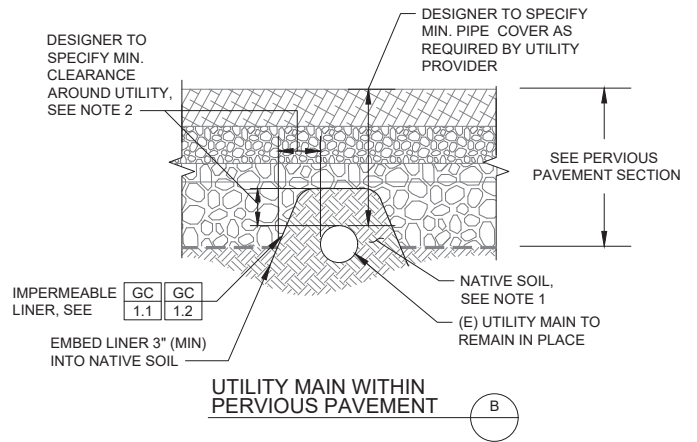
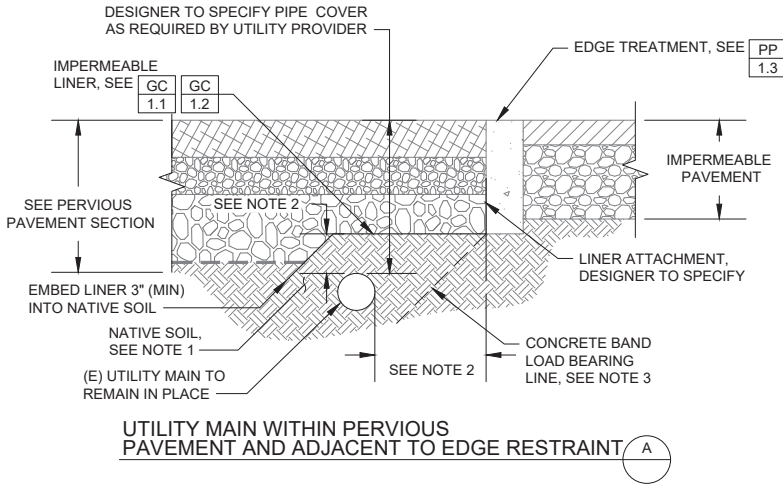
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
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GENERAL COMPONENTS
UTILITY CROSSINGS
PERVIOUS PAVEMENT SECTIONS (1 OF 2)

FILE NO.
GC 2.7



CONSTRUCTION NOTES:

- EXISTING UTILITIES AND NATIVE SOIL AROUND EXISTING UTILITIES SHOULD REMAIN IN PLACE WHERE POSSIBLE. IF A PORTION OR ALL OF THE UTILITY IS UNCOVERED DURING EXCAVATION OR EXISTING SOIL WITHIN 1 FOOT OF THE KNOWN EXISTING UTILITY IS SCARIFIED, NATIVE SOIL OR APPROVED ENGINEERED BACKFILL SHALL BE CAREFULLY PLACED AND COMPACTED AROUND THE UTILITY PER THE UTILITY PROVIDER'S REQUIREMENTS.
- PROVIDE THE MINIMUM CLEARANCE AROUND THE UTILITY MAIN AND SETBACKS FROM STRUCTURAL ELEMENTS PER THE UTILITY PROVIDER'S REQUIREMENTS.
- UTILITY MAINS SHALL NOT BE SUBJECT TO LOADING FROM NEW CURBS/WALLS. LOAD BEARING LINES TO BE DETERMINED BY THE GEOTECHNICAL ENGINEER.

NOTES		BIORETENTION			PERVIOUS PAVEMENT			WALL PENETRATIONS			TRENCH DAM
GC 2.1	GC 2.2	GC 2.3	GC 2.4	GC 2.5	GC 2.6	GC 2.7	GC 2.8	GC 2.9	GC 2.10	GC 2.11	GC 2.12



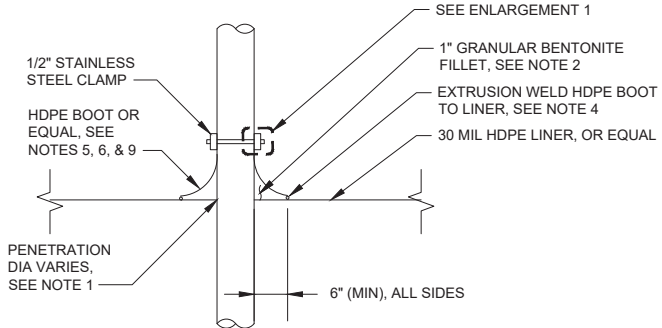
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**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
COUNTY OF SAN MATEO

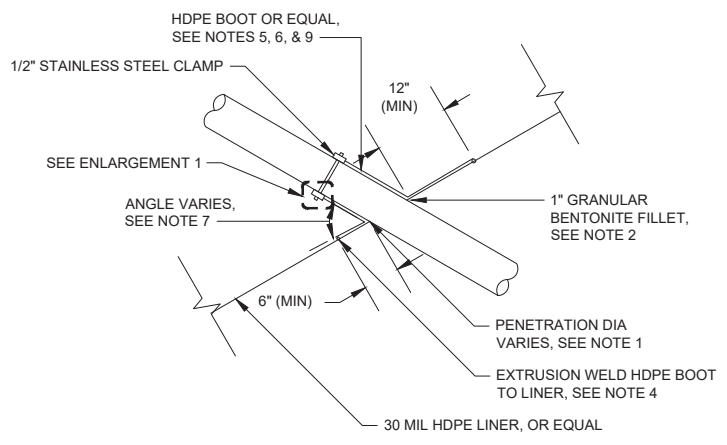
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GENERAL COMPONENTS
UTILITY CROSSINGS
PERVIOUS PAVEMENT SECTIONS (2 OF 2)

FILE NO.
GC 2.8



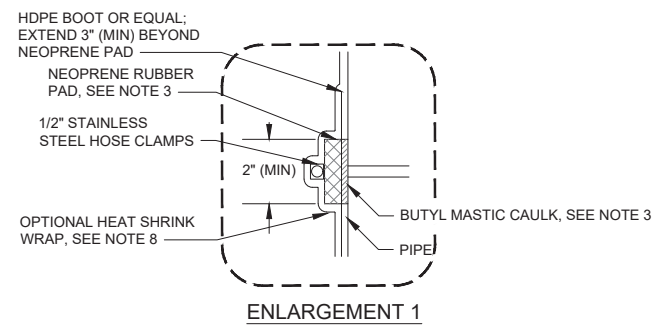
TYPICAL LINER PENETRATION - PERPENDICULAR 1



TYPICAL LINER PENETRATION - ANGLED 2


CONSTRUCTION NOTES:

1. CUT OPENING IN LINER FOR PIPE TO WITHIN 1/2" OF PIPE OUTSIDE DIAMETER.
2. FILL ANNULAR SPACE WITH 1" MINIMUM GRANULAR BENTONITE FILLET AS SHOWN.
3. APPLY BUTYL MASTIC CAULK AND NEOPRENE RUBBER PAD CONTINUOUSLY AROUND PIPE.
4. PROVIDE CONTINUOUS EXTRUSION WELD AT PIPE BOOT/LINER INTERFACE.
5. FORM BOOT WITH SUFFICIENT MATERIAL TO PREVENT OVERSTRESSING DURING BACKFILLING, BUT WITHOUT FOLDS OR WRINKLES.
6. CONSTRUCT BOOT FROM SAME MATERIAL AS THE LINER.
7. ANGLE SHOULD NOT BE LESS THAN 30°. IF ANGLE IS LESS THAN 30° ADD SOIL AROUND THE PIPE TO INCREASE THE ANGLE AND PREVENT STRESSING AND CRACKING.
8. SEAL CLAMP AND END OF BOOT WITH HEAT SHRINK WRAP. EXTEND HEAT SHRINK WRAP ONE PIPE DIAMETER (MINIMUM) BEYOND CLAMP.
9. CONTRACTOR MAY USE PREFABRICATED PIPE BOOTS IN LIEU OF FIELD-FABRICATED BOOTS. CONNECT PREFABRICATED BOOT TO LINER AND PIPE PER MANUFACTURER'S RECOMMENDATIONS.



ENLARGEMENT 1

NOTES			BIORETENTION			PERVIOUS PAVEMENT			WALL PENETRATIONS			TRENCH DAM	
GC 2.1	GC 2.2	GC 2.3	GC 2.4	GC 2.5	GC 2.6	GC 2.7	GC 2.8	GC 2.9	GC 2.10	GC 2.11	GC 2.12		



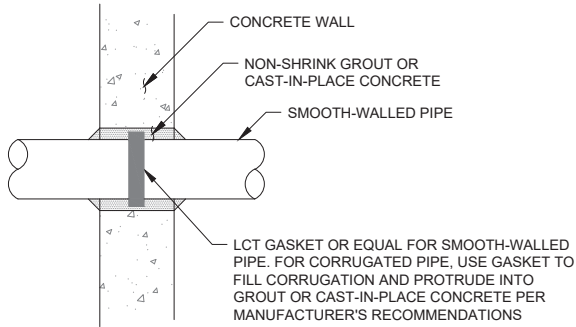
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GREEN INFRASTRUCTURE
TYPICAL DETAILS
COUNTY OF SAN MATEO

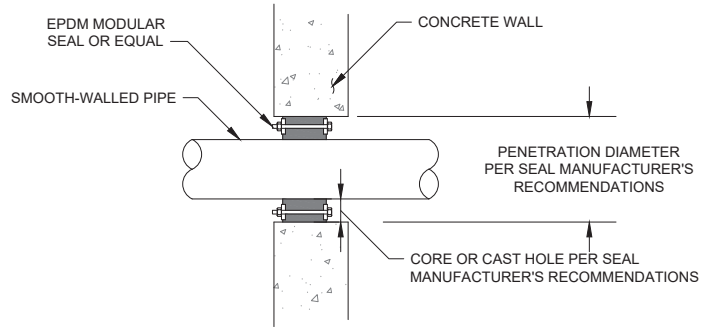
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GENERAL COMPONENTS
UTILITY CROSSINGS
LINER PENETRATIONS

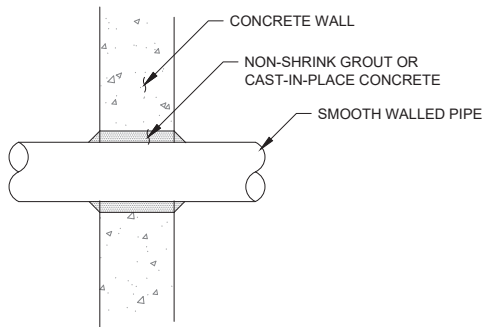
FILE NO.
GC
2.9



TYPICAL WATERTIGHT WALL PENETRATION - ALTERNATE 1 1



TYPICAL WATERTIGHT WALL PENETRATION - ALTERNATE 2 2



TYPICAL SOIL TIGHT WALL PENETRATION 3

NOTES			BIORETENTION			PERVIOUS PAVEMENT			WALL PENETRATIONS			TRENCH DAM
GC 2.1	GC 2.2	GC 2.3	GC 2.4	GC 2.5	GC 2.6	GC 2.7	GC 2.8	GC 2.9	GC 2.10	GC 2.11	GC 2.12	GC



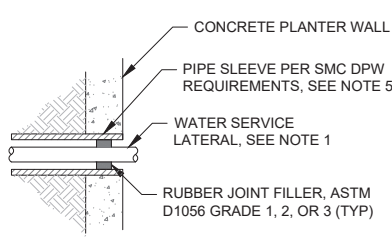
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GREEN INFRASTRUCTURE
TYPICAL DETAILS
COUNTY OF SAN MATEO

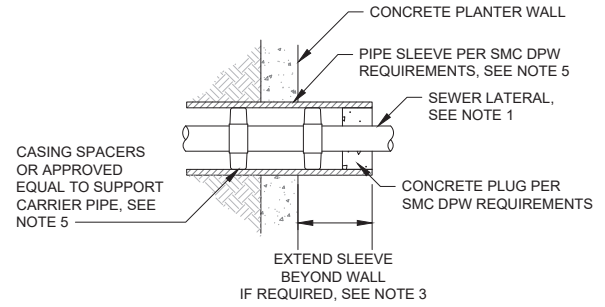
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GENERAL COMPONENTS
UTILITY CROSSINGS
WALL PENETRATIONS (1 OF 2)

FILE NO.
GC
2.10



WALL PENETRATION FOR WATER LATERALS 1



WALL PENETRATION FOR SEWER LATERALS 2

CONSTRUCTION NOTES:

1. IN CASES WHERE SHALLOW EXISTING UTILITIES, SUCH AS STREET LIGHT CONDUIT, HAVE BEEN APPROVED TO REMAIN IN PLACE PER THE UTILITY PROVIDER, AND SLEEVING FROM ONE END IS NOT FEASIBLE, THE EXISTING UTILITIES SHALL BE CAREFULLY WRAPPED WITH AN INSULATION MATERIAL (MIN. 1" THICK) AND A WATERTIGHT TAPE UNTIL THE WALLS ARE FORMED AROUND THE PIPE CROSSINGS. ONCE THE WALLS ARE SET, THE INSULATION WRAP SHALL BE REMOVED AND THE WALL PENETRATIONS SEALED.
2. DETECTABLE UTILITY MARKING TAPE SHALL BE PLACED OVER ALL UTILITIES WITHIN THE FOOTPRINT OF BIORETENTION FACILITIES. REFER TO THE TAPE MANUFACTURER'S RECOMMENDATIONS FOR MAXIMUM TAPE BURIAL DEPTH.
3. IF SEWER LATERAL IS BELOW BOTTOM OF BIORETENTION FACILITY AND WALL PENETRATION IS NOT NECESSARY, SMC DPW MAY REQUIRE THE SLEEVE AROUND NEW LATERAL PIPE TO BE EXTENDED BEYOND THE OUTSIDE OF THE PLANTER ON THE SIDEWALK SIDE. SEE DESIGN DRAWINGS FOR FURTHER DIRECTION.
4. ALL OTHER REPLACED OR NEW UTILITY SERVICES, SUCH AS GAS, TELECOM, ELECTRICAL, AND IRRIGATION RUNNING THROUGH A BIORETENTION FACILITY SHALL BE SLEEVED AND WALL PENETRATIONS SHALL BE DESIGNED TO MEET UTILITY PROVIDER'S REQUIREMENTS.
5. PIPE SLEEVE DESIGN AND MATERIALS, CONFORMING TO SMC DPW STANDARDS, SHALL BE SPECIFIED ON THE DESIGN DRAWINGS.

NOTES		BIORETENTION			PERVIOUS PAVEMENT			WALL PENETRATIONS		TRENCH DAM	
GC 2.1	GC 2.2	GC 2.3	GC 2.4	GC 2.5	GC 2.6	GC 2.7	GC 2.8	GC 2.9	GC 2.10	GC 2.11	GC 2.12



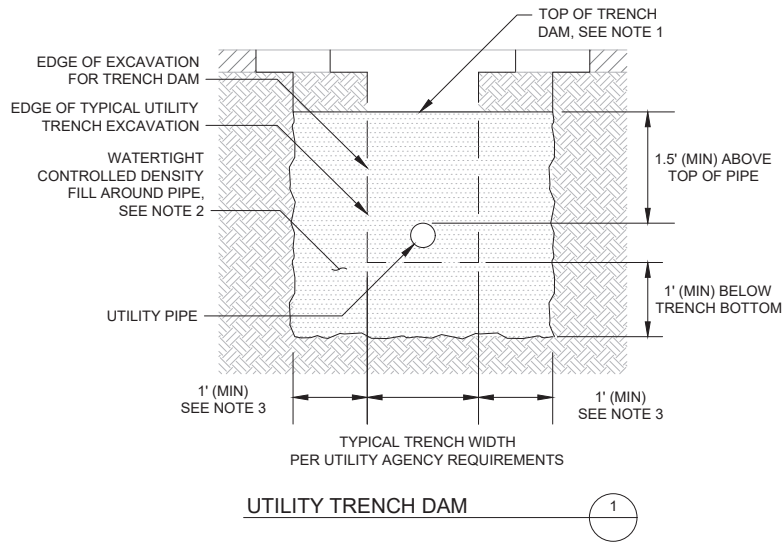
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GENERAL COMPONENTS
UTILITY CROSSINGS
WALL PENETRATIONS (2 OF 2)

FILE NO.
**GC
2.11**



CONSTRUCTION NOTES:

1. REFER TO DESIGN PLANS FOR TRENCH DAM LOCATIONS.
2. CONTROLLED DENSITY FILL SHALL BE 100 - 150 PSI STRENGTH WITH A WATER CONDUCTIVITY OF 1.0×10^{-6} CM/SEC (MAX).
3. TRENCH DAM SHALL EXTEND BEYOND THE EXISTING UTILITY TRENCH INTO THE NATIVE SOIL PER THE MINIMUM DIMENSIONS SHOWN. THE TRENCH DAM SHALL HAVE A MINIMUM THICKNESS OF 1' (MEASURED PARALLEL TO THE UTILITY PIPE LENGTH).

NOTES		BIORETENTION			PERVIOUS PAVEMENT			WALL PENETRATIONS			TRENCH DAM
GC 2.1	GC 2.2	GC 2.3	GC 2.4	GC 2.5	GC 2.6	GC 2.7	GC 2.8	GC 2.9	GC 2.10	GC 2.11	GC 2.12



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GENERAL COMPONENTS
UTILITY CROSSINGS
UTILITY TRENCH DAM

FILE NO.
GC 2.12

PURPOSE:

WHEN SITING GREEN INFRASTRUCTURE (GI) FACILITIES, THE DESIGNER SHOULD LOCATE AND ASSESS ALL KNOWN UTILITY CROSSINGS AND CONFLICTS AND ADJUST THE DESIGN TO AVOID AS MANY EXISTING UTILITIES, LIGHTS, POLES, SIGNS AND OTHER INFRASTRUCTURE AS POSSIBLE. THE CRITICALITY OF INFRASTRUCTURE CONFLICTS IN TERMS OF THEIR POTENTIAL IMPACT TO THE GI PROJECT'S DESIGN PERFORMANCE, COST, AND SCHEDULE SHOULD BE CAREFULLY EVALUATED DURING THE PLANNING PHASE.

THE PURPOSE OF THE FOLLOWING TYPICAL UTILITY CONFLICT DETAILS IS TO ALERT THE DESIGNERS TO COMMON UTILITY CONFLICTS THAT OCCUR ON GI PROJECTS WITHIN THE PUBLIC RIGHT-OF-WAY AND PROVIDE GENERAL GUIDANCE ON THE PROTECTION AND/OR RELOCATION OF THESE UTILITIES IN RELATION TO THE GI FACILITY. THEY ARE PROVIDED AS TYPICAL APPLICATIONS AND DO NOT REPRESENT APPROVED COUNTY UTILITY STANDARDS AND SPECIFICATIONS.

DESIGNER NOTES AND GUIDELINES:

1. THE DESIGNER MUST ADAPT DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS AND UTILITY REQUIREMENTS AND OBTAIN APPROVAL FROM ALL RELEVANT UTILITY PROVIDERS PRIOR TO CONSTRUCTION. COORDINATION AND APPROVAL FROM THE FOLLOWING UTILITY PROVIDERS MAY BE NECESSARY, BUT NOT EXCLUSIVELY:
 - CALIFORNIA WATER SERVICE OR SMC PUBLIC WORKS FOR DOMESTIC/FIRE WATER
 - SMC PUBLIC WORKS FOR SANITARY/STORM SEWER, STREET LIGHTS
 - PG&E FOR ELECTRIC/GAS/UTILITY POLES
2. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT JURISDICTIONAL ASSET PROTECTION STANDARDS. IN THE ABSENCE OF THESE STANDARDS, THE DESIGNER SHALL REFER TO CHAPTER 3 OF SMCWPPP GI DESIGN GUIDE FOR BEST PRACTICES AND COORDINATE DIRECTLY WITH RELEVANT UTILITY PROVIDERS FOR REQUIREMENTS.
3. THE AREA OF SUBBASE COVERED BY THE INFRASTRUCTURE FOOTINGS, COMPACTED ENGINEERED FILL, CONCRETE PADS AND OTHER UTILITY INFRASTRUCTURE SHOULD BE EXCLUDED FROM HYDROLOGIC PERFORMANCE CALCULATIONS WHEN THE AREA IS SIGNIFICANT (GREATER THAN 10 PERCENT) RELATIVE TO THE INFILTRATIVE AREA.
4. DESIGNER TO SPECIFY CONCRETE FOOTING DIMENSIONS AND REINFORCEMENT FOR ALL VERTICAL INFRASTRUCTURE.
5. SEE SMC DPW STANDARDS FOR REQUIRED SETBACKS FROM CURBS, GUARD POSTS REQUIREMENTS, AND FOOTING DESIGN STANDARDS.
6. ALL STREET SIGN PLACEMENTS SHALL BE APPROVED BY SMC DPW PRIOR TO INSTALLATION.
7. ALL PARKING METER INSTALLATIONS OR RELOCATION DESIGNS SHALL CONFORM TO SMC DPW STANDARDS.

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- STREET LIGHT, SIGN, AND UTILITY POLE FOUNDATION DIMENSIONS, REINFORCEMENT, AND SPECIFICATIONS
- GEOTEXTILE FABRICS AND/OR LINER MATERIALS
- ENGINEERED BACKFILL MATERIAL
- DIMENSIONS OF ALL PROTECTION MEASURES
- MINIMUM SETBACKS TO ADJACENT INFRASTRUCTURE, PAVEMENT BASES, SURFACES

NOTES	COMPONENTS	
GC 3.1	GC 3.2	GC 3.3



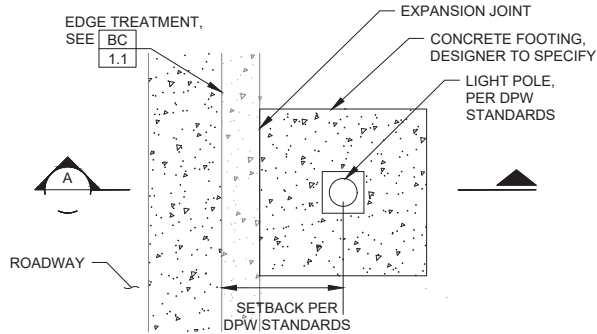
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TYPICAL DETAILS**
COUNTY OF SAN MATEO

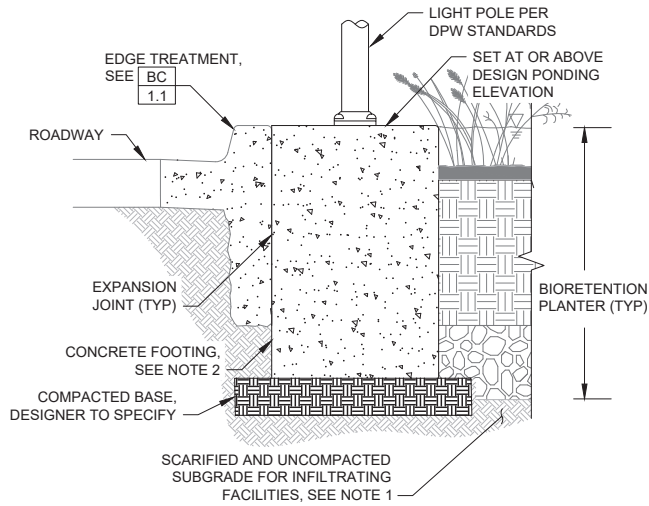
DATE	06.2022
VERSION	02
REVISED	N/A

GENERAL COMPONENTS
UTILITY CONFLICTS
DESIGNER NOTES

FILE NO.
GC
3.1



PLAN



SECTION A

UTILITY POLE AT PLANTER



CONSTRUCTION NOTES:

1. AVOID COMPACTION OF EXISTING SUBGRADE BELOW INFILTRATION FACILITIES DURING CONSTRUCTION.
2. DESIGNER TO SPECIFY FOUNDATION DETAILS. STREET LIGHT FOUNDATION SHALL COMPLY WITH SMC DPW STD. DWGS. E-1 AND SPECIFICATIONS.

NOTES		COMPONENTS	
GC	3.1	GC	GC
		3.2	3.3



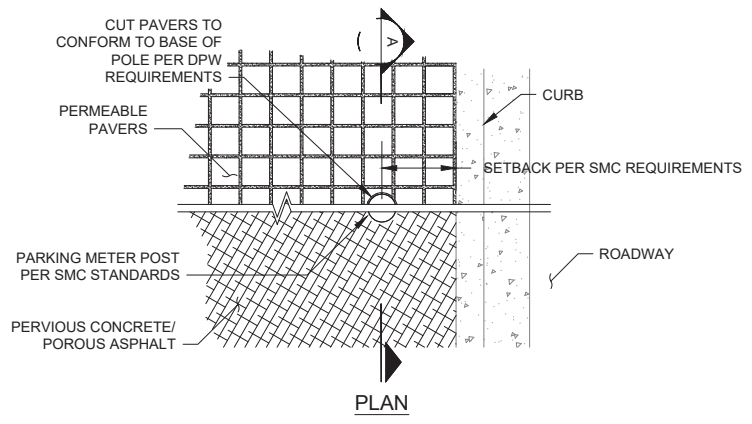
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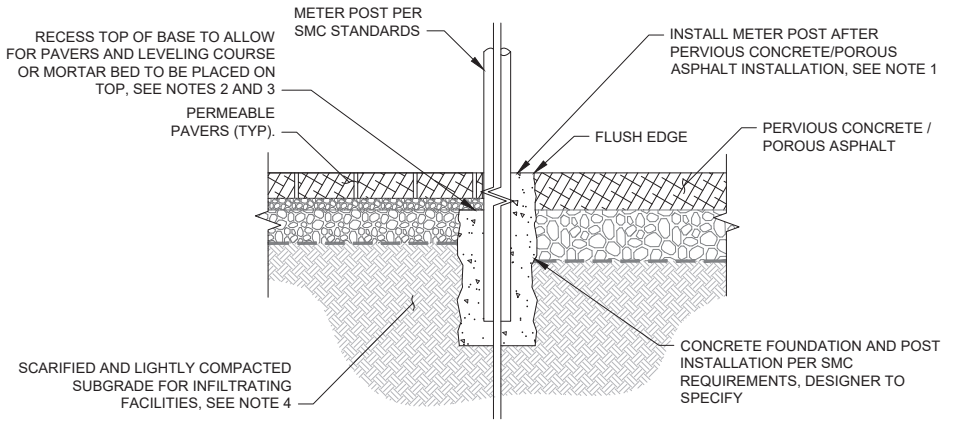
GENERAL COMPONENTS
UTILITY CONFLICTS
STREET/TRAFFIC LIGHT POLES

FILE NO.
GC
3.2



CONSTRUCTION NOTES:

1. DUE TO THE ADDED COMPLEXITY OF INSTALLING PERVIOUS CONCRETE AND POROUS ASPHALT AROUND NUMEROUS POLES/POSTS, IT IS RECOMMENDED POST HOLES BE DRILLED OUT AFTER THE PERVIOUS CONCRETE/POROUS ASPHALT HAS CURED. IF POLES ARE INSTALLED PRIOR TO THE PLACEMENT OF PERVIOUS CONCRETE/POROUS ASPHALT, THE CONTRACTOR SHALL COORDINATE WITH THE DESIGNER ON HOW THE PERVIOUS CONCRETE/POROUS ASPHALT SHALL BE INSTALLED AROUND AND/OR OVER THE POLE BASES.
2. WHERE METER POLES ARE SHOWN WITHIN A PERMEABLE PAVER AREA, THE BASES OF THE POLES SHALL BE INSTALLED BEFORE THE PAVER INSTALLATION. THE DESIGNER MAY SPECIFY THAT THE TOP OF THE BASES BE SET (OR CUT DOWN) AT A DEPTH THAT ALLOWS THE PAVERS AND LEVELING COURSE TO COVER THE TOP OF THE BASE AND REMAIN FLUSH WITH THE SURROUNDING PAVEMENT.
3. INSTALL PERVIOUS PAVEMENT OVER TOP OF FOOTING PER PROJECT SPECIFICATIONS AND MANUFACTURER'S RECOMMENDATIONS.
4. AVOID OVER-COMPACTION OF EXISTING SUBGRADE BELOW PERVIOUS PAVEMENT DURING CONSTRUCTION.



SECTION A
PARKING METER AT PERVIOUS PAVEMENT 1

NOTES	COMPONENTS	
GC 3.1	GC 3.2	GC 3.3

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**GENERAL COMPONENTS
 UTILITY CONFLICTS
 PARKING METERS**

FILE NO.
GC
3.3

PURPOSE:

OBSERVATION PORTS ALLOW FOR MEASUREMENT OF DRAWDOWN THROUGH A FACILITY (WHEN WATER LEVEL MEASUREMENTS ARE NOT OBSERVABLE AT THE SURFACE). THESE PORTS CAN ALSO BE USED FOR LONG-TERM MONITORING WITH A PRESSURE TRANSDUCER. FOR SYSTEMS INCLUDING UNDERDRAINS, CLEANOUTS MAY SERVE AS THE FACILITY OBSERVATION PORT PROVIDED LONG-TERM MONITORING IS NOT REQUIRED FOR THE FACILITY.

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
2. OBSERVATION PORTS WITHIN A BIORETENTION FACILITY ARE NOT REQUIRED TO INCLUDE A SEPARATE LOCKING COVER ASSEMBLY. HOWEVER, DESIGNERS SHOULD CONSIDER REQUIRING A LOCKING OBSERVATION PORT CAP OR PLUG IF THE RISK OF TAMPERING IS CONSIDERED TO BE HIGH.
3. WHENEVER FEASIBLE, OBSERVATION PORTS SHOULD BE LOCATED OUTSIDE OF THE TRAVELED WAY. IF SITE CONSTRAINTS NECESSITATE INSTALLATION OF OBSERVATION PORTS IN AN AREA SUBJECT TO VEHICULAR TRAFFIC OR OTHER LOADING, OBSERVATION PORT COVER ASSEMBLIES AND MANHOLES MUST BE DESIGNED TO WITHSTAND ANTICIPATED LOADING (E.G., H-20).
4. OBSERVATION PORTS SHOULD INCLUDE A 12 INCH WATERTIGHT SUMP TO ACCOMMODATE CONTINUOUS WATER LEVEL MEASUREMENT WITH A PRESSURE TRANSDUCER.

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- OBSERVATION PORT MATERIAL, DIAMETER, AND DEPTH
- OBSERVATION PORT COVER ASSEMBLY/MANHOLE TYPE AND SIZE (IF APPLICABLE)
- CONTROL ELEVATIONS FOR OBSERVATION PORT RIMS
- TYPE OF MONITORING EQUIPMENT TO BE INSTALLED (IF APPLICABLE)

NOTES	COMPONENTS	
GC 4.1	GC 4.2	GC 4.3



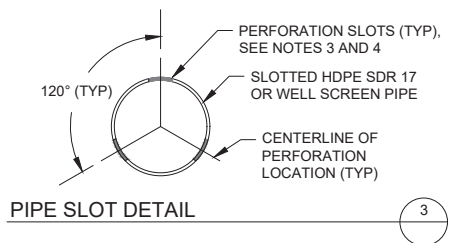
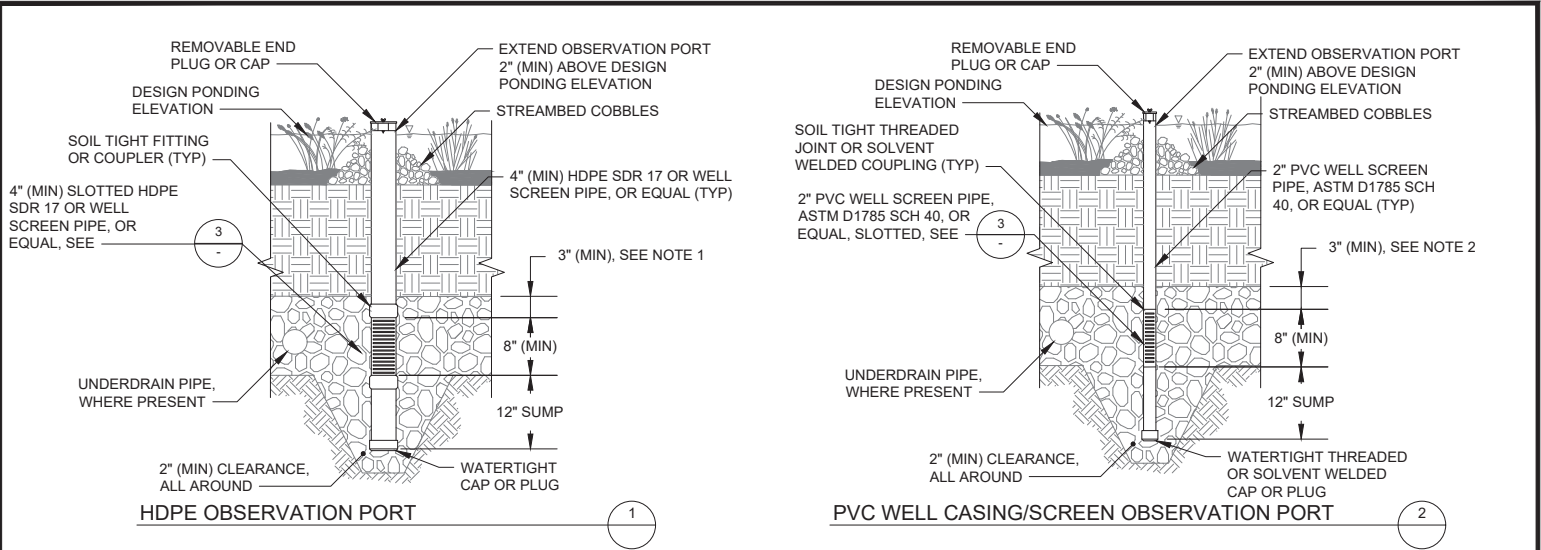
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GENERAL COMPONENTS
OBSERVATION PORT
DESIGNER NOTES


FILE NO.
GC
4.1



CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR OBSERVATION PORTS SHALL CONFORM TO SMC DPCW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. PROVIDE 3 INCH MINIMUM COVER FROM BOTTOM OF BIOTREATMENT SOIL MEDIA TO BEGINNING OF OBSERVATION PORT PERFORATIONS.
3. ALL PERFORATIONS SHALL BE SLOTTED TYPE, MEASURING 0.032 INCH WIDE (MAX), SPACED AT 0.25 INCH (MIN), AND PROVIDING A MINIMUM INLET AREA OF 5.0 SQUARE INCH PER LINEAR FOOT OF PIPE FOR PIPES 4 INCH IN DIAMETER AND LARGER AND 2.0 SQUARE INCHES PER LINEAR FOOT OF PIPE FOR PIPES SMALLER THAN 4 INCHES IN DIAMETER.
4. PERFORATIONS SHALL BE ORIENTED PERPENDICULAR TO LONG AXIS OF PIPE, AND EVENLY SPACED AROUND CIRCUMFERENCE AND LENGTH OF PIPE.
5. ALL FITTINGS SHALL BE SOIL TIGHT, UNLESS NOTED OTHERWISE.

NOTES	COMPONENTS	
GC 4.1	GC 4.2	GC 4.3

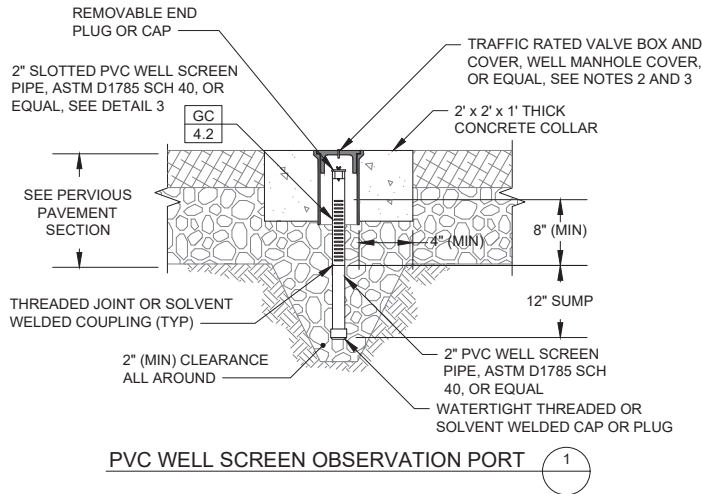

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TYPICAL DETAILS
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GENERAL COMPONENTS
 OBSERVATION PORT
 BIORETENTION


FILE NO.
GC 4.2



CONSTRUCTION NOTES:

- 1. ALL MATERIAL AND WORKMANSHIP FOR OBSERVATION PORTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
- 2. COVER SHALL BE TRAFFIC RATED WITH TAMPER RESISTANT LOCKING MECHANISM. COVER SHALL INCLUDE CASTING OF STANDARD TRIANGLE SYMBOL, "TEST WELL", "MONITORING WELL", OR EQUAL.
- 3. OBSERVATION PORT COVERS AND LIDS MUST COMPLY WITH SMC STANDARD ACCESSIBILITY REQUIREMENTS.
- 4. WELL SCREEN SLOTS SHALL BE 0.032 INCHES WIDE (MAX), SPACED AT 0.25 INCH (MIN), AND PROVIDE A MINIMUM INLET AREA OF 2.0 SQUARE INCH PER LINEAR FOOT OF PIPE.
- 5. ALL FITTINGS SHALL BE SOIL TIGHT, UNLESS NOTED OTHERWISE.

NOTES		COMPONENTS	
GC	4.1	GC	GC
		4.2	4.3

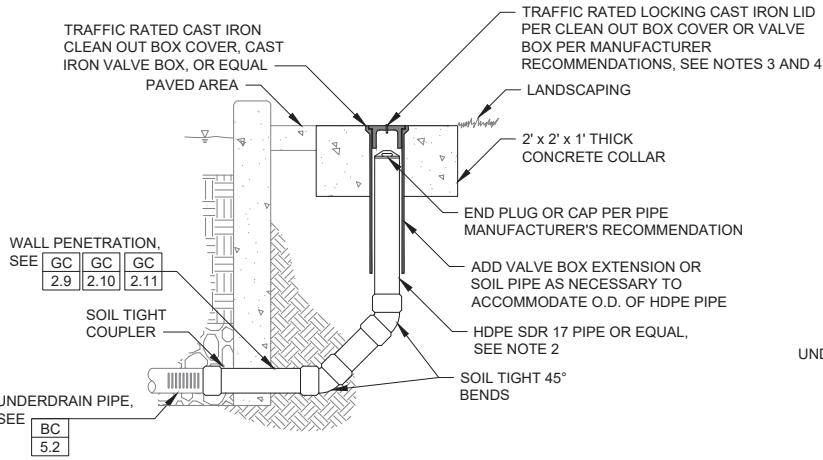
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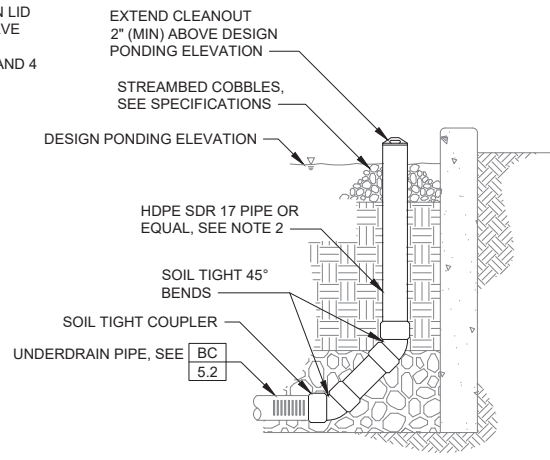
GENERAL COMPONENTS
OBSERVATION PORT
PERVIOUS PAVEMENT

FILE NO.
GC
4.3



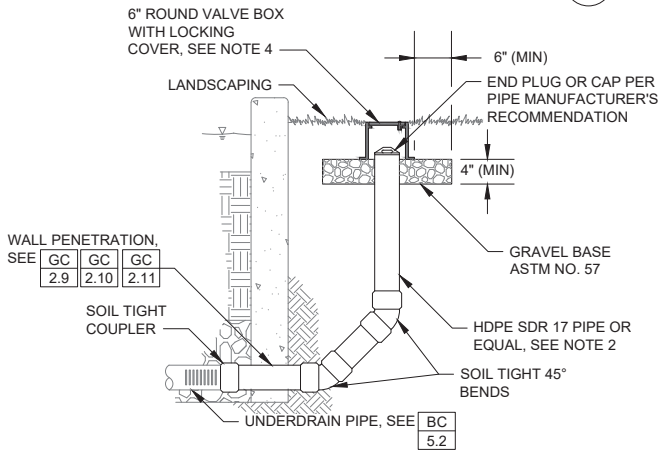
CLEANOUT - ALTERNATIVE 1

1



CLEANOUT - ALTERNATIVE 2

2



CLEANOUT - ALTERNATIVE 3 (PARCEL ONLY)

3

CONSTRUCTION NOTES:

1. ALL MATERIAL AND WORKMANSHIP FOR CLEANOUTS SHALL CONFORM TO SMC DPW STANDARD SPECIFICATIONS AND APPLICABLE CODES.
2. CLEANOUT PIPE AND FITTINGS SHALL BE SAME SIZE AND MATERIAL AS SLOTTED UNDERDRAIN PIPE.
3. COVER SHALL BE TRAFFIC RATED WITH TAMPER RESISTANT LOCKING MECHANISM. COVER SHALL INCLUDE CASTING OF "CO" OR EQUAL.
4. CLEANOUT COVERS AND LIDS MUST COMPLY WITH SMC STANDARD ACCESSIBILITY REQUIREMENTS.
5. CLEANOUT SHALL BE INSTALLED TO ALLOW FOR MAINTENANCE ACCESS TO ALL PIPES.
6. ALL FITTINGS SHALL BE SOIL TIGHT.

COMPONENTS

GC 5.1



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TYPICAL DETAILS**
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GENERAL COMPONENTS
CLEANOUTS

FILE NO.

GC
5.1

PURPOSE:

TREE WELLS CONTROL PEAK FLOWS AND VOLUMES OF STORMWATER RUNOFF BY PROVIDING SURFACE STORAGE, SUBSURFACE STORAGE, AND INFILTRATION INTO NATIVE SOIL. WATER IS ALSO TREATED AS IT FILTERS THROUGH THE BIOTREATMENT SOIL.

DESIGNER NOTES & GUIDELINES:

1. THE DESIGNER MUST ADAPT PLAN AND SECTION DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS. IF USING A MODULAR SUSPENDED PAVEMENT SYSTEM, CONTACT THE MANUFACTURER FOR DESIGN DETAILS AND GUIDANCE.
2. TREE WELL AREA, PONDING DEPTH, BIOTREATMENT SOIL DEPTH, AND AGGREGATE STORAGE DEPTH MUST BE SIZED TO MEET PROJECT HYDROLOGIC PERFORMANCE GOALS. C.3. REGULATED PROJECTS MAY REQUIRE EXPANSION OF TREE WELL VOLUME UNDER THE PAVEMENT USING INFILTRATION TRENCHES, STRUCTURAL SOIL, AND/OR MODULAR PAVEMENT SUPPORT CELLS. SEE CHAPTERS 4 AND 6 OF THE SMCWPPP C.3 REGULATED PROJECTS GUIDE FOR ADDITIONAL GUIDANCE ON SIZING, TREE WELL FILTERS, AND TREE PLANTING.
3. FACILITY DRAWDOWN TIME (i.e. TIME FOR SURFACE PONDING TO DRAIN THROUGH THE ENTIRE SECTION INCLUDING AGGREGATE STORAGE AFTER THE END OF A STORM) REQUIREMENTS:
 - 48 HOUR (PREFERRED), 72-HOUR MAXIMUM FACILITY DRAWDOWN. IF DRAWDOWN CANNOT BE ACHIEVED, UNDERDRAIN IS REQUIRED.
4. THE TREE WELL PLANTER EDGE SHOULD BE DELINEATED WITH A 6-INCH HIGH CURB (PREFERRED), LOW RAILING, OR TREE GRATE TO PREVENT PEOPLE FROM ENTERING THE PLANTER. THE VERTICAL DROP BETWEEN THE TREE WELL AND ADJACENT PATH OF TRAVEL MUST COMPLY WITH ACCESSIBILITY REQUIREMENTS. WHEN A TREE GRATE IS USED, A MINIMUM SEPARATION OF 4 INCHES BETWEEN THE GRATE AND TREE TRUNK SHOULD BE MAINTAINED. REFER TO SECTION 3.1 OF THE SMCWPPP GI DESIGN GUIDE FOR DETAILED GUIDANCE ON CURB, RAILING, AND OTHER EDGE TREATMENTS.
5. RECOMMENDED TREE ROOT VOLUME IS 400 CUBIC FEET FOR SMALL TREES (6-INCH DIAMETER TRUNK), 1,000 CUBIC FEET FOR MEDIUM SIZED TREES (16-INCH DIAMETER TRUNK), AND 1,400 CUBIC FEET FOR LARGE TREES (24-INCH DIAMETER TRUNK), WHERE VOLUMES ARE BASED ON A 3-FOOT DEPTH PLANTER AREA. IN CONSTRAINED SITES, ROOT CHANNELS, MODULAR PAVEMENT SUPPORT CELLS, AND OTHER TECHNIQUES CAN BE USED TO EXPAND THE TREE ROOT VOLUME. CONSULT WITH A DESIGN PROFESSIONAL TO ENSURE SUFFICIENT TREE ROOT VOLUME IS PROVIDED FOR TREE HEALTH.
6. WHEN A TREE WELL IS BEHIND A STREET CURB, VERTICAL ELEMENTS OF THE TREE WELL THAT ARE MORE THAN 12 INCHES ABOVE THE ROAD SURFACE SHALL BE SETBACK 18 INCHES FROM THE FACE OF CURB. TREE PLACEMENT SHOULD NOT IMPACT SIGHT DISTANCE FOR EXISTING DRIVEWAYS AND ON-STREET PARKING OR EXISTING DRIVEWAY AND PARKED VEHICLE INGRESS AND EGRESS.
7. TREE SPECIES AND UNDERSTORY PLANTS (IF USED) SHALL BE SPECIFIED BY A DESIGN PROFESSIONAL. PROVIDE MINIMUM 2-FOOT CLEARANCE BETWEEN TREE TRUNK AND UNDERSTORY PLANTS TO REDUCE COMPETITION FOR WATER, NUTRIENTS, AND ROOT SPACE WITH TREES. SEE SECTION 6.3 AND APPENDIX A OF THE SMCWPPP C.3 REGULATED PROJECTS GUIDE FOR GUIDANCE ON RECOMMENDED TREE SPECIES.
8. THE PREFERRED SIZE FOR A TREE WELL OPENING IS 6-FEET WIDE AND 6-FEET LONG. FOR A PLANTER AREA OF 36 SQUARE FEET. WHERE SIDEWALK WIDTH IS CONSTRAINED, WIDTH MAY BE 4 FEET MINIMUM AND A DESIRED LENGTH OF 8 FEET WITH A MINIMUM OF 5 FEET.
9. MULTIPLE TREES IN A TREE TRENCH SHOULD BE SPACED APPROXIMATELY 25 FEET TO 35 FEET APART DEPENDING ON TREE SPECIES.
10. IF STREET PARKING IS PROHIBITED ADJACENT TO THE SIDEWALK/TREE WELL AREA, THE STEPOUT ZONE CAN BE REMOVED AND THE TRENCH DRAIN INLET CAN BE CHANGED TO A SIMPLER CURB CUT INLET.
11. IF FULL TRASH CAPTURE IS A PROJECT REQUIREMENT, THE DESIGNER SHOULD DETERMINE IF ADDITIONAL MEASURES ARE NEEDED TO MEET THE REGIONAL WATER QUALITY BOARD'S TRASH FULL CAPTURE REQUIREMENTS, i.e. TRASH CAPTURE INLET STRUCTURE.
12. THE DESIGNER MUST EVALUATE UTILITY SURVEYS FOR POTENTIAL UTILITY CROSSINGS OR CONFLICTS. REFER TO GC 2.1 - GC 2.12 FOR UTILITY CROSSING DETAILS AND GC 3.1 - GC 3.3 FOR UTILITY CROSSING CONFLICT DETAILS.
13. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT JURISDICTIONAL ASSET PROTECTION STANDARDS. IN THE ABSENCE OF THESE STANDARDS, THE DESIGNER SHALL REFER TO CHAPTER 3 OF THE SMCWPPP GI DESIGN GUIDE FOR BEST PRACTICES AND COORDINATE DIRECTLY WITH RELEVANT UTILITY PROVIDERS FOR REQUIREMENTS.

RELATED COMPONENTS			
EDGE TREATMENTS:	BC 1.1	BC 1.7	
INLETS:	BC 1.1	BC 2.4	BC 2.5
OUTLETS:	BC 3.1	BC 3.4	
SOIL AND AGGREGATE LAYERS:	BC 4.1		
UNDERDRAINS:	GC 5.1	GC 5.2	
LINERS:	GC 1.1	GC 1.2	
UTILITY CROSSINGS:	GC 2.1	GC 2.12	
UTILITY CONFLICTS:	GC 3.1	GC 3.3	
OBSERVATION PORTS:	GC 4.1	GC 4.2	
CLEANOUTS:	GC 5.1		

NOTES	PLAN	SECTION
TW 1.1	TW 1.2	TW 1.3



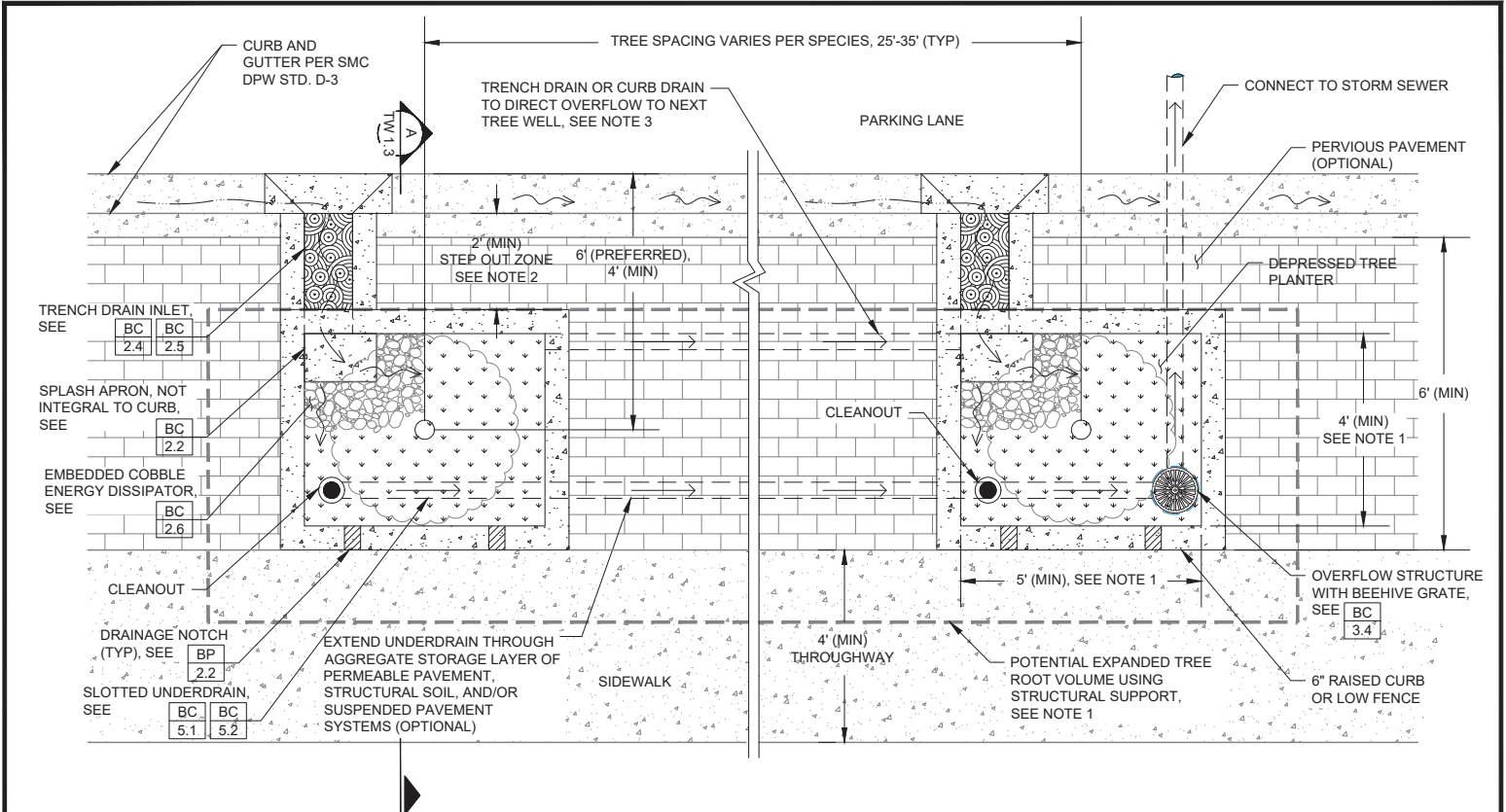
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TREE WELL FILTER
DESIGNER NOTES


FILE NO.
TW
1.1



NOTES:

- PREFERRED TREE WELL OPENING SIZE IS 6 FEET BY 6 FEET, BUT CONSTRAINED SITES CAN REDUCE WIDTH TO 4 FEET PROVIDED THEY CAN ACCOMMODATE MINIMUM REQUIRED TREE ROOT VOLUME BY INCREASING LENGTH AND/OR USING STRUCTURAL SOIL, PERVIOUS PAVEMENT, AND/OR SUSPENDED PAVEMENT SYSTEMS UNDER ADJACENT SIDEWALK. IF ADJACENT TO LANDSCAPED AREAS, EXTEND THE BOUNDARY TO BACK OF SIDEWALK TO ALLOW TREE ROOTS TO ACCESS ADJACENT LANDSCAPED AREAS WITH NATIVE SOIL.
- DESIGNER TO SPECIFY MINIMUM SIDEWALK WIDTH BEHIND AND STEP-OUT ZONE IN FRONT OF TREE WELL THAT COMPLIES WITH ALL APPLICABLE AGENCY AND ADA REQUIREMENTS. STEP-OUT ZONE CAN BE ELIMINATED IF PARKING IS PROHIBITED ALONG CURB. SEE DESIGNER NOTES.
- IF CURB DRAIN, I.E. SHALLOW PIPES, ARE USED TO CONVEY SURFACE WATER BETWEEN TREE WELLS, 3 INCH CAST IRON PIPES SHALL BE INSTALLED AND A MINIMUM COVER OF 1-1/2 INCHES OF CONCRETE OVER PIPES SHALL BE PROVIDED. IF TRENCH DRAIN IS USED, THE GRATE SHALL BE ADA COMPLIANT AND HAVE A NON-SLIP SURFACE.

NOTES	PLAN	SECTION
TW 1.1	TW 1.2	TW 1.3

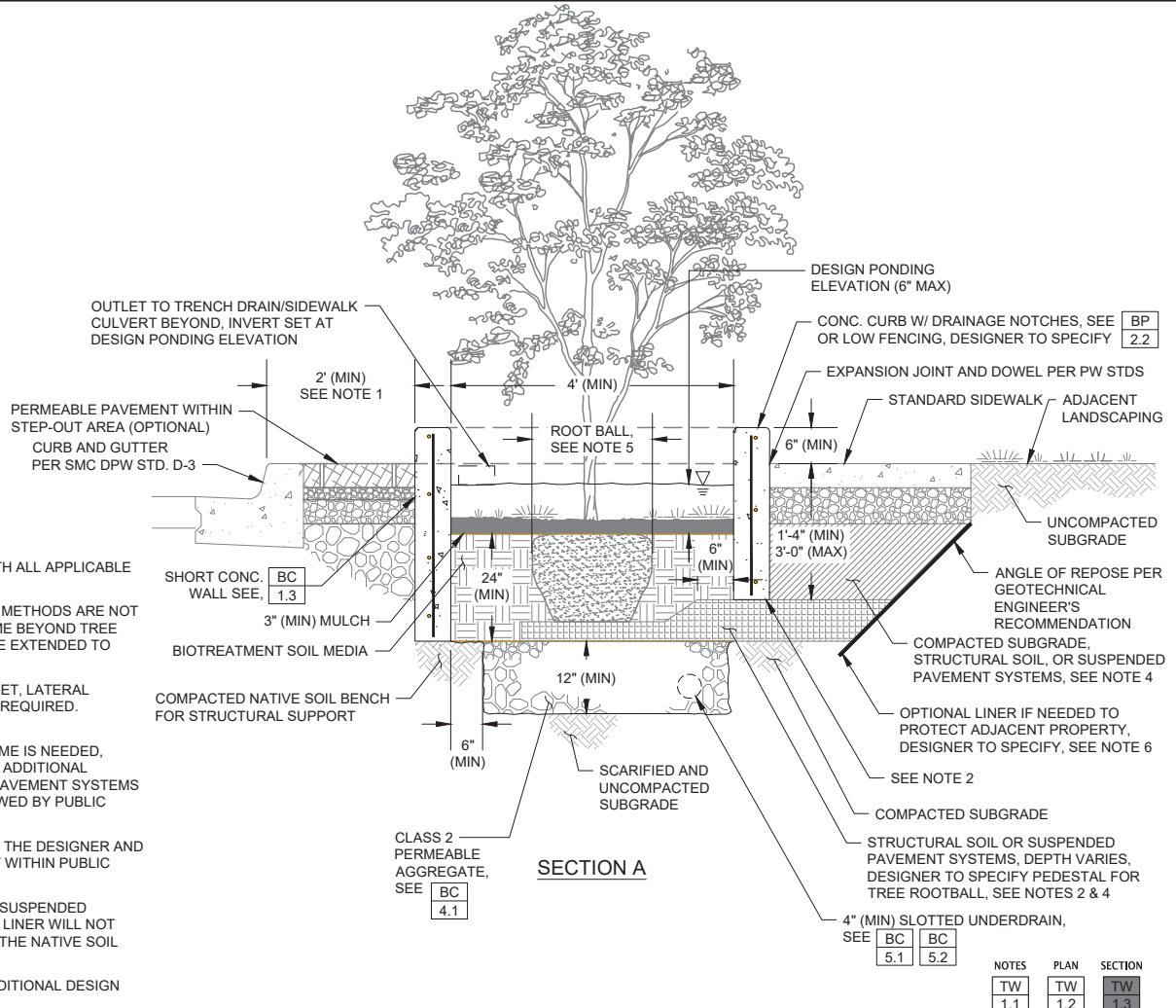

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TREE WELL FILTER
 CONNECTED TREE WELLS WITH PARKING
 PLAN

FILE NO.
TW
 1.2



NOTES:

1. STEP-OUT WIDTH SHALL COMPLY WITH ALL APPLICABLE AGENCY AND ADA STANDARDS.
2. IF STRUCTURAL SOIL AND/OR OTHER METHODS ARE NOT USED TO EXPAND TREE ROOT VOLUME BEYOND TREE PLANTER, EDGE RESTRAINT SHALL BE EXTENDED TO BOTTOM OF BIOTREATMENT SOIL.
3. IF TREE WELL LENGTH EXCEEDS 6 FEET, LATERAL BRACING AND/OR FOOTINGS MAY BE REQUIRED. DESIGNER TO SPECIFY.
4. IF ADDITIONAL ROOTABLE SOIL VOLUME IS NEEDED, DESIGNER MAY SPECIFY THE USE OF ADDITIONAL STRUCTURAL SOIL OR SUSPENDED PAVEMENT SYSTEMS UNDER THE SIDEWALK BASE IF ALLOWED BY PUBLIC WORKS.
5. ROOT BALL SIZE TO BE SPECIFIED BY THE DESIGNER AND APPROVED BY THE CITY ARBORIST IF WITHIN PUBLIC RIGHT-OF-WAY.
6. IF POSSIBLE, DO NOT USE A LINER IF SUSPENDED PAVEMENT SYSTEMS ARE USED. THE LINER WILL NOT ALLOW TREE ROOTS TO GROW INTO THE NATIVE SOIL BEHIND THE SIDEWALK.
7. REFER TO DESIGNER NOTES FOR ADDITIONAL DESIGN GUIDANCE.

NOTES	PLAN	SECTION
TW 1.1	TW 1.2	TW 1.3



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**TREE WELL FILTER
CONNECTED TREE WELLS WITH PARKING
SECTION**

FILE NO.
**TW
1.3**



Development Review Checklist

C.6 – Construction Stormwater BMPs

Identify Plan sheet showing the appropriate construction Best Management Practices (BMPs) used on this project:

(Applies to all projects with earthwork)

Yes	Plan Sheet	Best Management Practice (BMP)
<input type="checkbox"/>		Control and prevent the discharge of all potential pollutants, including pavement cutting wastes, paints, concrete, petroleum products, chemicals, wash water or sediments, rinse water from architectural copper, and non-stormwater discharges to storm drains and watercourses.
<input type="checkbox"/>		Store, handle, and dispose of construction materials/wastes properly to prevent contact with stormwater.
<input type="checkbox"/>		Do not clean, fuel, or maintain vehicles on-site, except in a designated area where wash water is contained and treated.
<input type="checkbox"/>		Train and provide instruction to all employees/subcontractors re: construction BMPs.
<input type="checkbox"/>		Protect all storm drain inlets in vicinity of site using sediment controls such as berms, fiber rolls, or filters.
<input type="checkbox"/>		Limit construction access routes and stabilize designated access points.
<input type="checkbox"/>		Attach the construction BMP plan sheet to project plans and require contractor to implement the applicable BMPs on the plan sheet.
<input type="checkbox"/>		Use temporary erosion controls to stabilize all denuded areas until permanent erosion controls are established.
<input type="checkbox"/>		Delineate with field markers clearing limits, easements, setbacks, sensitive or critical areas, buffer zones, trees, and drainage courses.
<input type="checkbox"/>		Provide notes, specifications, or attachments describing the following: <ul style="list-style-type: none"> ■ Construction, operation and maintenance of erosion and sediment controls, include inspection frequency; ■ Methods and schedule for grading, excavation, filling, clearing of vegetation, and storage and disposal of excavated or cleared material; ■ Specifications for vegetative cover & mulch, include methods and schedules for planting and fertilization; ■ Provisions for temporary and/or permanent irrigation.
<input type="checkbox"/>		Perform clearing and earth moving activities only during dry weather.
<input type="checkbox"/>		Use sediment controls or filtration to remove sediment when dewatering and obtain all necessary permits.
<input type="checkbox"/>		Trap sediment on-site, using BMPs such as sediment basins or traps, earthen dikes or berms, silt fences, check dams, soil blankets or mats, covers for soil stock piles, etc.
<input type="checkbox"/>		Divert on-site runoff around exposed areas; divert off-site runoff around the site (e.g., swales and dikes).
<input type="checkbox"/>		Protect adjacent properties and undisturbed areas from construction impacts using vegetative buffer strips, sediment barriers or filters, dikes, mulching, or other measures as appropriate.



C.3 – Source Controls

Select appropriate source controls and identify the detail/plan sheet where these elements are shown.

Yes	Detail/Plan Sheet No.	Features that require source control measures	Source Control Measures (Refer to C.3 Guidebook Appendix D Pollutant Sources/Source Control Checklist for detailed requirements)
<input type="checkbox"/>		Storm Drain	Mark on-site inlets with the words “No Dumping! Flows to Bay” or equivalent.
<input type="checkbox"/>		Floor Drains	Plumb interior floor drains to sanitary sewer [or prohibit].
<input type="checkbox"/>		Interior Parking Garage	Plumb interior parking garage floor drains to sanitary sewer. ⁸
<input type="checkbox"/>		Need for Future Indoor & Structural Pest Control	Note building design features that discourage entry of pests.
<input type="checkbox"/>		Landscape/Outdoor Pesticide Use	<ul style="list-style-type: none"> ■ 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.
<input type="checkbox"/>		Pools, Spas, Decorative Fountains, and other Water Features.	If the local municipality requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.
<input type="checkbox"/>		Food Service Equipment (non-residential)	<p>Provide sink or other area for equipment cleaning, which is:</p> <ul style="list-style-type: none"> ■ Connected to a grease interceptor prior to sanitary sewer discharge.⁸ ■ Large enough for the largest mat or piece of equipment to be cleaned. ■ Indoors or in an outdoor roofed area designed to prevent stormwater run-on and run-off, and signed to require equipment washing in this area.
<input type="checkbox"/>		Refuse Areas	<ul style="list-style-type: none"> ■ Provide a roofed and enclosed area for dumpsters, recycling containers, etc., designed to prevent stormwater run-on and runoff. ■ Connect any drains in or beneath dumpsters, compactors, and tallow bin areas serving food service facilities to the sanitary sewer.⁸ ■ 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.
<input type="checkbox"/>		Industrial Processes	If industrial processes are to be located on site, state: “All process activities to be performed indoors. No processes to drain to exterior or to storm drain system.”
<input type="checkbox"/>		Outdoor Storage of Equipment/ Materials	<ul style="list-style-type: none"> ■ Cover the area or design to avoid pollutant contact with stormwater runoff. ■ Locate area only on paved and contained areas. ■ Roof storage areas that will contain non-hazardous liquids, drain to sanitary sewer⁸, and contain by berms or similar. ■ 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. ■ Where appropriate, reference documentation of compliance with the requirements of Contra Costa Hazardous Materials Programs
<input type="checkbox"/>		Vehicle/ Equipment Cleaning	<ul style="list-style-type: none"> ■ Roofed, pave and berm wash area to prevent stormwater run-on and runoff, plumb to the sanitary sewer⁸, and sign as a designated wash area. ■ Commercial car wash facilities shall discharge to the sanitary sewer.⁸ ■ If a car wash area is not provided, describe measures taken to discourage on-site car washing and explain how these will be enforced.



C.3 – Source Controls

Select appropriate source controls and identify the detail/plan sheet where these elements are shown.

		Vehicle/ Equipment Repair and Maintenance	<ul style="list-style-type: none"> ■ Designate repair/maintenance area indoors, or an outdoors area designed to prevent stormwater run-on and runoff and provide secondary containment. Do not install drains in the secondary containment areas. ■ No floor drains unless pretreated prior to discharge to the sanitary sewer.⁸ ■ Connect containers or sinks used for parts cleaning to the sanitary sewer.⁸ ■ 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.
<input type="checkbox"/>		Fuel Dispensing Areas	<ul style="list-style-type: none"> ■ Fueling areas shall have impermeable surface that is a) minimally graded to prevent ponding and b) separated from the rest of the site by a grade break. ■ Canopy shall extend at least 10 ft. in each direction from each pump and drain away from fueling area.
<input type="checkbox"/>		Loading Docks	<ul style="list-style-type: none"> ■ Cover and/or grade to minimize run-on to and runoff from the loading area. ■ Position downspouts to direct stormwater away from the loading area. ■ Drain water from loading dock areas to the sanitary sewer.⁸ ■ Install door skirts between the trailers and the building.
<input type="checkbox"/>		Fire Sprinkler Test Water	Design for discharge of fire sprinkler test water to landscape or sanitary sewer. ⁸
<input type="checkbox"/>		Miscellaneous Drain or Wash Water or Other Sources	<ul style="list-style-type: none"> ■ Drain condensate of air conditioning units to landscaping. Large air conditioning units may connect to the sanitary sewer.⁸ ■ Roof drains from equipment drain to landscaped area where practicable. ■ Drain boiler drain lines, roof top equipment, all wash water to sanitary sewer.⁸ ■ Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water. ■ Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff. ■ Include controls for other sources as specified by local reviewer.
<input type="checkbox"/>		Plazas, Sidewalks, and Parking Lots	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.

⁸ Any connection to the sanitary sewer system is subject to sanitary district approval.

⁹ Businesses that may have outdoor process activities/equipment include machine shops, auto repair, industries with pretreatment facilities.

Worksheet C



Low Impact Development – Site Design Measures

Select Appropriate Site Design Measures *Regulated projects must meet all applicable Site Design Measures a through i. Projects that create and/or replace between 2,500 and 5,000 sq.ft. of impervious surface, and detached single family homes that create/replace between 2,500 and 10,000 sq.ft. of impervious surface, must include **one or more of Site Design Measures a through f** (Provision C.3.i requirements).¹⁰ Consult with municipal staff about requirements for your project.*

Select appropriate site design measures and Identify the Plan Sheet where these elements are shown.

Yes	Plan Sheet No.	Site Design Measures
<input type="checkbox"/>		a. Direct roof runoff into cisterns or rain barrels and use rainwater for irrigation or other non-potable use.
<input type="checkbox"/>		b. Direct roof runoff onto vegetated areas.
<input type="checkbox"/>		c. Direct runoff from sidewalks, walkways, and/or patios onto vegetated areas.
<input type="checkbox"/>		d. Direct runoff from driveways and/or uncovered parking lots onto vegetated areas.
<input type="checkbox"/>		e. Construct sidewalks, walkways, and/or patios with pervious or permeable surfaces. Use the specifications in the CCCWP C.3 Guidebook downloadable at https://www.cccleanwater.org/development-infrastructure/development
<input type="checkbox"/>		f. Construct bike lanes, driveways, and/or uncovered parking lots with pervious surfaces. Use the specifications in the CCCWP C.3 Guidebook downloadable at https://www.cccleanwater.org/development-infrastructure/development
<input type="checkbox"/>		g. Limit disturbance of natural water bodies and drainage systems; minimize compaction of highly permeable soils; protect slopes and channels; and minimize impacts from stormwater and urban runoff on the biological integrity of natural drainage systems and water bodies;
<input type="checkbox"/>		h. Conserve natural areas, including existing trees, other vegetation and soils.
<input type="checkbox"/>		i. Minimize impervious surfaces.

Regulated Projects can also consider the following site design measures to reduce treatment system sizing:

Yes	Plan Sheet No.	Site Design Measures
<input type="checkbox"/>		j. Self-treating area (see Chapter 3 Figure 3-1 of the CCCWP C.3 Guidebook)
<input type="checkbox"/>		k. Self-retaining area (see Chapter 3 Figure 3-2 of the CCCWP C.3 Guidebook)

¹⁰ See MRP Provision C.3.a.i.(6) for non-C.3 Regulated Projects, C.3.c.i.(2)(a) for Regulated Projects, C.3.i for projects that create/replace between 2,500 and 5,000 sq.ft. of impervious surface and detached single family homes that create/replace between 2,500 and 10,000 sq.ft. of impervious surface.

C.3 Regulated Projects and Non-Regulated GI Projects
Stormwater Treatment Measures and Site Design Measures by Drainage Management Area (DMA)

Check all applicable boxes, answer questions and fill in cells related to the site design and treatment measure(s) included in the project.

Drainage Management Area Summary Table

Complete the information below at the Entitlement, Building Permit and Certificate of Occupancy stages for Regulated C.3 Projects and Non-Regulated Green Infrastructure Projects. (The first four cells are automatically filled in from the Project Info sheet.)

Project Name:	
Project Address:	
Cross Streets:	
APN:	

Special Project¹¹?		of C.3.d amount of runoff treated by Non-LID Systems on the Special Project site.
--------------------------------------	--	-----------------------------------------------------------------------------------

C.3 Regulated?	
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Public or Private Project?		Public projects are those on public property or ROW; private projects are on privately-owned property but can include improvements in the public ROW required as part of the project.
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DMA Identification Number	Impervious Area ¹² (ft ²)	Pervious Area ¹³ (ft ²)	Type of Site Design Measure or Treatment Measure ¹⁴	Sizing Criteria Used ¹⁵	Size Required ¹⁶	Size Provided
Example DMA 1	5,000	2,000	Bioretention unlined with underdrain	2c: Flow	208 ft2	220 ft2
Example DMA 2	1,000	1,000	Self-retaining area	Other	< 2:1 ratio	1:1 ratio
Example DMA 3	1,000	-	Infiltration trench	1b: Volume	1,000 ft3	1,100 ft3
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
add rows, if needed						
TOTALS	-	-	N/A	N/A	N/A	N/A

Totals from Project Info Sheet Cells	-	-				
--------------------------------------	---	---	--	--	--	--

Is the project harvesting and using rainwater? Yes <input type="checkbox"/>	Rainwater Harvesting/Use Measures: <input type="checkbox"/> Rainwater Harvesting for indoor non-potable water use <input type="checkbox"/> Rainwater Harvesting for landscape irrigation use
-----------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

 A long term Operations and Maintenance (O&M) Agreement and Plan for this project will be required. Please contact the municipality for an agreement template and/or consult the CCCWP C.3 Guidebook downloadable at <https://www.cccleanwater.org/development-infrastructure/development>

11 Special Projects are smart growth, high density, transit-oriented or affordable housing developments with the criteria defined in Provision C.3.e.ii.(2), (3) or (4) (see Worksheet F).
 12 The sq.ft. of impervious area within the Drainage Management Area
 13 The sq.ft. of pervious area within the Drainage Management Area
 14 "Lined" refers to an impermeable liner placed on the bottom of a bioretention area, such that no infiltration into native soil occurs.
 15 Select from the menu which of the following Provision C.3.d.i hydraulic sizing methods was used, if any. Volume based approaches: 1(a) Urban Runoff Quality Management approach, or 1(b) 80% capture approach (recommended volume-based approach). Flow-based approaches: 2(a) 10% of 50-year peak flow approach, 2(b) 2 times the 85th percentile rainfall intensity approach, 2(c) 0.2-Inch-per-hour intensity approach (recommended flow-based approach - also known as the 4% rule for bioretention), or 3 Combination flow and volume-based approach. "Other" is used for Site Design Measures such as Self-Retaining or Self-Treating Areas.
 16 Each DMA should drain to one treatment area (unless it is self-treating or self-retaining). If multiple DMAs are draining to one treatment area, they should be combined into one DMA. If one DMA drains to multiple treatment areas, that DMA should be split up so there is one DMA per treatment area (which allows the treatment area to be properly sized).

E-1 Is the project a Hydromodification¹⁷ Management (HM) Project?

E-1.1 Is the total impervious area increased over the pre-project condition?

- Yes. Continue to E-1.2
- No. Go to Item E-1.3 and check "No."

E-1.2 Is the site located in an HM Exempt Area per the HM Applicability map (Chapter 3 of the CCCWP C.3 Guidebook)?

- No. Go to E-1.3 and Check "Yes".
- Yes. Attach map, indicating project location. Go to Item E-1.3 and check "No."

E-1.3 Is the project a Hydromodification Management Project?

- Yes. The project is subject to HM requirements in Provision C.3.g of the Municipal Regional Stormwater Permit.
- No. The project is EXEMPT from HM requirements.

▶ If the project is subject to the HM requirements, incorporate in the project flow duration control measures designed such that post-project discharge rates and durations match pre-project discharge rates and durations.

▶ The Bay Area Hydrology Model (BAHM) has been developed to help size flow duration controls. See www.clearcreeksolutions.info/downloads. Guidance is provided in Chapter 3 of the CCCWP C.3 Guidebook.

E-2 Incorporate HM Controls (if required)

Are the applicable items provided with the Plans?

Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Site plans with pre- and post-project impervious surface areas, surface flow directions of entire site, locations of flow duration controls and site design measures per HM site design requirement
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Soils report or other site-specific document showing soil type(s) on site
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If project uses the Bay Area Hydrology Model (BAHM), a list of model inputs and outputs.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If project uses custom modeling, a summary of the modeling calculations with corresponding graph showing curve matching (existing, post-project, and post-project with HM controls curves), goodness of fit, and (allowable) low flow rate.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If project uses the Impracticability Provision, a listing of all applicable costs and a brief description of the alternative HM project (name, location, date of start up, entity responsible for maintenance).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If the project uses alternatives to the default BAHM approach or settings, a written description and rationale.

¹⁷ Hydromodification is the change in a site's runoff hydrograph, including increases in flows and durations that results when land is developed (made more impervious). The effects of hydromodification include, but are not limited to, increased bed and bank erosion of receiving streams, loss of habitat, increased sediment transport and/or deposition, and increased flooding. Hydromodification control measures are designed to reduce these effects.



Complete this worksheet for projects that appear to meet the definition of "Special Project", per Provision C.3.e.ii of the Municipal Regional Stormwater Permit (MRP). The form assists in determining whether a project meets Special Project criteria, and the percentage of low impact development (LID) treatment reduction credit. Special Projects that implement less than 100% LID treatment must provide a narrative discussion of the feasibility or infeasibility of 100% LID treatment. See Chapter 3 Table 3-8 of the See Chapter 3 Table 3-8 of the CCCWP C.3 Guidebook (download at <https://www.cccleanwater.org/development-infrastructure/development>) for more information.

F-1

"Special Project" Determination (Check the boxes to determine if the project meets any of the following categories.)

Special Project Category "A"

Does the project have ALL of the following characteristics?

- Located in a municipality's designated central business district, downtown core area or downtown core zoning district, neighborhood business district or comparable pedestrian-oriented commercial district, or historic preservation site and/or district;
- Creates and/or replaces 0.5 acres or less of impervious surface - enter answer in F-2 table;
- Includes no surface parking, except for incidental parking for emergency vehicle access, ADA access, and passenger or freight loading zones;
- Has at least 85% coverage of the entire site by permanent structures. The remaining 15% portion of the site may be used for safety access, parking structure entrances, trash and recycling service, utility access, pedestrian connections, public uses, landscaping and stormwater treatment - enter answer in F-2 Table
- No (continue)
- Yes – Complete Section F-2 below

Special Project Category "B"

Does the project have ALL of the following characteristics?

- Located in a municipality's designated central business district, downtown core area or downtown core zoning district, neighborhood business district or comparable pedestrian-oriented commercial district, or historic preservation site and/or district¹⁵;
- Creates and/or replaces more than 0.5 acres of impervious area and less than 2.0 acres - enter answer in F-2 Table;
- Includes no surface parking, except for incidental parking for emergency access, ADA access, and passenger or freight loading zones;
- Has at least 85% coverage of the entire site by permanent structures. The remaining 15% portion of the site may be used for safety access, parking structure entrances, trash and recycling service, utility access, pedestrian connections, public uses, landscaping and stormwater treatment - enter answer in F-2 Table;
- Minimum gross density of either 50 dwelling units per acre (for residential projects) or a Floor Area Ratio (FAR) of 2:1 (for commercial projects) - mixed use projects may use either criterion¹⁶ - enter answer in F-2 Table;
- No (continue)
- Yes – Complete Section F-2 below

Special Project Category "C"

Complete the Special Project Category C Requirements

Does the project meet ALL of the required characteristics for Category C?

- Is a preserved housing project with a deed restriction running at least 55 years, at rent/mortgage ≤30% of the maximum Area Median Household Income (AMI) limits adjusted for household size based on the maximum percentage of AMI for each income category, according to the Federal Department of Housing and Urban Development's (HUD's) definition of affordable housing in metropolitan areas.¹⁷
- Primarily a residential project, i.e., at least two-thirds of the square footage of the project is designated for residential use.¹⁸
- Minimum Gross¹⁹ density of 40 Dwelling Units (DUs) per acre.
- No
- Yes – Complete Section F-2 below

¹⁵ And built as part of a municipality's stated objective to preserve/enhance a pedestrian-oriented type of urban design.

¹⁶ The MRP establishes definitions for "Gross Density"(GD) & FAR. GD is defined as, "the total number of residential units divided by the acreage of the entire site area, including land occupied by public rights-of-way, recreational, civic, commercial and other non-residential uses." FAR is defined as, "the Ratio of the total floor area on all floors of all buildings at a project site (except structures, floors, or floor areas dedicated to parking) to the total project site area.

¹⁷ For metropolitan areas, HUD defines Acutely Low household incomes at 0-15% of AMI, Extremely Low household incomes at 16-30% of AMI, Very Low household incomes as 31-50% of AMI, Low household incomes as 51-80% of AMI, and Moderate household incomes as 81-210% of AMI

¹⁸ Emergency homeless shelters constructed pursuant to and consistent with Government Code § 8698.4, including the definition of "homeless shelter" in subdivision (c), and that are temporary, are exempt from stormwater treatment requirements, and are required to implement site design measures (MRP Provision C.3.i) and relevant BMPs for unsheltered populations (Provision C.17).

¹⁹ Gross density is defined as the total number of residential units divided by the acreage if the entire site area, including land occupied by public rights-of-way, recreational, civic, commercial, and other non-residential uses.

Step 1 - Weighted Sum Calculation: Calculate the percentage of the project's DUs in each AMI category. Multiply the percentage of the project's DU's in each AMI category by the respective credit multiplier, per Table 1a below. Add the available credits for each affordable category to produce a weighted sum, and round to the nearest whole number

- a. Total number of DUs: _____
- b. Total number of Managers' Units²⁰: _____
- c. Total number of DUs for Affordable Credit Calculation (a-b): _____ (Use this number for calculating percentages in Table 1a)

Table 1a - Weighted Sum Calculation

AMI	Number of DUs	Density/Criteria	Credit Multiplier	Available Credit (% of DUs * Credit Multiplier)
Moderate (≤120% of AMI)			0.20	0%
Low (≤80% of AMI)			1.00	0%
Very Low (≤50% of AMI)			2.00	0%
Extremely Low (≤30% of AMI)			3.00	0%
Acutely Low (≤15% of AMI) ²¹			4.00	0%
Weighted Sum (Rounded)				0%

Step 2 - Allowable Affordable Housing Credits: Use Table 1b to identify the correct Weighted Sum Category for the Weighted Sum calculated in step 1. This is the Allowable Affordable Housing Credit. For example, if the Weighted Sum is 45%, that would fall into the 41-50% Weighted Sum Category, and the maximum Allowable Affordable Housing Credit available to the project would be 50%.

Table 1b - Allowable Affordable Housing Credit Calculation

Weighted Sum (X) Category	Allowable Affordable Housing Credit	Applicable Weighted Sum Category (Select One)
X ≤ 9%	0%	<input type="checkbox"/>
10% ≤ X ≤ 20%	20%	<input type="checkbox"/>
21% ≤ X ≤ 30%	30%	<input type="checkbox"/>
31% ≤ X ≤ 40%	40%	<input type="checkbox"/>
41% ≤ X ≤ 50%	50%	<input type="checkbox"/>
51% ≤ X ≤ 60%	60%	<input type="checkbox"/>
61% ≤ X ≤ 70%	70%	<input type="checkbox"/>
71% ≤ X ≤ 80%	80%	<input type="checkbox"/>
81% ≤ X ≤ 90%	90%	<input type="checkbox"/>
91% ≤ X	100%	<input type="checkbox"/>

F-2 LID Treatment Reduction Credit Calculation

If more than one category applies, choose only one of the applicable categories and fill out the table for that category. Fill in all cells with blue highlighting that pertain to the chosen Special Project Category.

Category	Impervious Area Created/Replaced (sq. ft.)	Site Coverage (%)	Project Density ¹⁶ or FAR ¹⁶	Density/Criteria	Allowable Credit (%)	Applied Credit (%)
A			N.A.	See above in F-1	100%	
B				Res ≥ 50 DU/ac or FAR ≥ 2:1	50%	
				Res ≥ 75 DU/ac or FAR ≥ 3:1	75%	
				Res ≥ 100 DU/ac or FAR ≥ 4:1	100%	
C		N.A.		Affordable Housing Credit - from Table	0-100%	
				Location Credit (select one):		
				Entire project is located within 1/4 mile of transit hub ²²	5%	
				Entire project is located within a planned PDA ²³	10%	
				Density Credit (select 1):		
				Res ≥ 40 DU/ac	5%	
				Res ≥ 60 DU/ac	10%	
				Res ≥ 100 DU/ac	15%	
				Parking Credit (select one):		
				No surface parking	5%	
TOTAL CREDIT =					0%	

F-3 Narrative Discussion of the Feasibility/Infeasibility of 100% LID Treatment:

If project will implement less than 100% LID, prepare a discussion of the feasibility or infeasibility of 100% LID treatment, as described in Chapter 3 of the CCCWP C.3 Guidebook.

F-4 Select Certified Non-LID Treatment Measures:

If the project will include non-LID treatment measures, select a treatment measure certified for "Basic" General Use Level Designation (GULD) by the Washington State Department of Ecology's Technical Assessment Protocol – Ecology (TAPE²⁴). See guidance in Chapter 3 of the CCCWP C.3 Guidebook.

²⁰ Up to three DUs that are used as building managers' DUs may be excluded from the percentage calculations.

²¹ DUs that are free to tenants, i.e., that do not charge tenants any rent/mortgage, are included in this category.

²² "Transit hub" is defined as a rail, light rail, or commuter rail station, ferry terminal, or bus transfer station served by three or more bus routes. (A bus stop with no supporting services does not qualify.)

²³ A "planned Priority Development Area" is an infill development area formally designated by the Association of Bay Area Government's/Metropolitan Transportation Commissions's FOCUS regional planning program.

²⁴ TAPE certification is used in order to satisfy Special Project's reporting requirements in the MRP.



G-1 Alternative Certification: Were the treatment and/or HM control sizing and design reviewed by a qualified third-party professional that is not a member of the project team or agency staff?

Yes No Name of Reviewer: _____

G-2 High Priority Site: High Priority Sites can include those located in or within 100 feet of a sensitive habitat, an Area of Special Biological Significance (ASBS), a body of water, or on "hillside projects" disturbing $\geq 5,000$ sq.ft. of land and with steep slopes (of $\geq 15\%$ - see cell **I.A.5** - or as identified by municipal criteria or map). These sites are subject to monthly inspections from Oct 1 to April 30. See MRP Provision C.6.e.ii.(2)(b) and C.6.e.ii.(2)(c).

Yes No If yes, then add site to Staff's Monthly Rainy Season Construction Site Inspection List

G-3 Inspections of Sites with Pervious Pavement: Regulated projects that are installing 3,000 sq.ft. or more of pervious pavement (see cell **I.B.1.g**) (excluding private-use patios in single family homes, townhomes, or condominiums) must have the pavement system inspected by the jurisdiction upon completion of the installation and the site must be added to the jurisdiction's list of sites needing inspections at least once every five years – see provision C.3.h. Pervious pavement systems include pervious concrete, pervious asphalt, pervious pavers and grid pavers etc. and are described in the Stormwater C.3 Guidebook downloadable at: <https://www.cccleanwater.org/development-infrastructure/development/stormwater-c-3-guidebook>.

Yes No If yes, then add site to Staff's Lists for Construction and O&M inspections (C.3 and C.3.h)

Operations and Maintenance (O&M) Submittals

G-4 Stormwater Treatment Measure and/HM Control Owner or Operator's Information:

Name: _____

Address: _____

Phone: _____ Email: _____

► Applicant must call for inspection and receive inspection at completion of installation of treatment measures and/or hydromodification management controls including any pervious pavement areas of 3,000 sq.ft. or more.

The following questions apply to C.3 Regulated Projects and Hydromodification Management Projects.

		Yes	No	N/A
G-4.1	Was maintenance plan submitted?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G-4.2	Was maintenance plan approved?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G-4.3	Was maintenance agreement submitted? (Date executed: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

► Attach the executed maintenance agreement as an appendix to this checklist.

G-5 Annual Operations and Maintenance (O&M) Submittals (for municipal staff use only):

For C.3 Regulated Projects and Hydromodification Management Projects, indicate the dates on which the Applicant submitted annual reports for project O&M:

G-6 Comments (for municipal staff use only):



G-7 NOTES (for municipal staff use only):

Project Info Notes: _____
 Worksheet A Notes: _____
 Worksheet B Notes: _____
 Worksheet C Notes: _____
 Worksheet D Notes: _____
 Worksheet E Notes: _____
 Worksheet F Notes: _____

G-8 Project Close-Out (for municipal staff use only):

		Yes	No	N/A
8.1	Were final Conditions of Approval met?	<input type="checkbox"/>	<input type="checkbox"/>	
8.2	Was initial inspection of the completed treatment/HM measure(s) conducted? (Date of inspection: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.3	Was maintenance plan submitted? (Date executed: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.4	Was project information provided to staff responsible for O&M verification inspections? (Date provided to inspection staff: _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

G-9 Project Close-Out (Continued -- for municipal staff use only):

Name of staff confirming project is closed out: _____
 Signature: _____ Date: _____
 Name of O&M staff receiving information: _____
 Signature: _____ Date: _____



Worksheet Summary
(For municipal staff use only)

C.3.b.iv.(2) ► Regulated Projects Reporting Table (part 1) – Projects Approved During the Fiscal Year Reporting Period											
Project Name	Project Location[1], Street Address	Name of Developer	Project Phase No.[2]	Project Description[3]	Project Watershed[4]	Total Site Area (Acres)	Total Area of Land Disturbed (Acres)	Total New Impervious Surface Area (ft2)[5]	Total Replaced Impervious Surface Area (ft2)[6]	Total Pre-Project Impervious Surface Area[7] (ft2)	Total Post-Project Impervious Surface Area[8] (ft2)
Private											

Public

--	--	--	--	--	--	--	--	--	--	--	--

C.3.b.iv.(2) ► Regulated Projects Reporting Table (part 2) – Projects Approved During the Fiscal Year Reporting Period													
Project Name	Application Date	Application Deemed Complete Date[9]	Application Final Approval Date[10]	Estimated or Actual Completion Date	Source Control Measures[11]	Site Design Measures[12]	Treatment Systems Approved[13]	Type of Operation & Maintenance Responsibility Mechanism[14]	Hydraulic Sizing Criteria[15]	Alternative Compliance Measures[16]/[17]	Alternative Certification[18]	HM Controls[19]/[20]	
Private													
								O&M Agreement recorded with deed					
Public													
						↑ See Worksheet B	↑ See Worksheet C	↑ See Worksheet D			↑ See Worksheet D	↑ See Worksheet G	↑ See Worksheet E

[1] Include cross streets
 [2] If a project is being constructed in phases, indicate the phase number and use a separate row entry for each phase. If not, enter "NA".
 [3] Project Type is the type of development (i.e., new and/or redevelopment). Example descriptions of development are: 5-story office building, residential with 160 single-family homes with five 4-story buildings to contain 200 condominiums, 100 unit 2-story shopping mall, mixed use retail and residential development (apartments), industrial warehouse.
 [4] State the watershed(s) in which the Regulated Project is located. Downstream watershed(s) may be included, but this is optional.



Worksheet Summary
(For municipal staff use only)

- [5] All impervious surfaces added to any area of the site that was previously existing pervious surface.
- [6] All impervious surfaces added to any area of the site that was previously existing impervious surface.
- [7] For redevelopment projects, state the pre-project impervious surface area.
- [8] For redevelopment projects, state the post-project impervious surface area.
- [9] For private projects, state project application deemed complete date. If the project did not go through discretionary review, report the building permit issuance date.
- [10] For private projects, state project application final discretionary approval date. If the project did not go through discretionary review, report the building permit issuance date.
- [11] List source control measures approved for the project. Examples include: properly designed trash storage areas; storm drain stenciling or signage; efficient landscape irrigation systems; etc. See Worksheet B.
- [12] List site design measures approved for the project. Examples include: minimize impervious surfaces; conserve natural areas, including existing trees or other vegetation, and soils; construct sidewalks, walkways, and/or patios with permeable surfaces, etc. See Worksheet C.
- [13] List all approved stormwater treatment system(s) to be installed onsite or at a joint stormwater treatment facility (e.g., flow through planter, bioretention facility, infiltration basin, etc.). See Worksheet D.
- [14] List the legal mechanism(s) (e.g., O&M agreement with private landowner; O&M agreement with homeowners' association; O&M by public entity, etc...) that have been or will be used to assign responsibility for the maintenance of the post-construction
- [15] See Provision C.3.d.i. "Numeric Sizing Criteria for Stormwater Treatment Systems" for list of hydraulic sizing design criteria. Enter the corresponding provision number of the appropriate criterion (i.e., 1.a., 1.b., 2.a., 2.b., 2.c., or 3). See Worksheet D.
- [16] For Alternative Compliance at an offsite location in accordance with Provision C.3.e.i.(1), on a separate page, give a discussion of the alternative compliance site including the information specified in Provision C.3.b.v.(1)(m)(i) for the offsite project.
- [17] For Alternative Compliance by paying in-lieu fees in accordance with Provision C.3.e.i.(2), on a separate page, provide the information specified in Provision C.3.b.v.(1)(m)(ii) for the Regional Project.
- [18] Note whether a third party was used to certify the project design complies with Provision C.3.d. See Worksheet G.
- [19] If HM control is not required, state why not. See Worksheet E.
- [20] If HM control is required, state control method used (e.g., method to design and size device(s) or method(s) used to meet the HM Standard, and description of device(s) or method(s) used, such as detention basin(s), bioretention unit(s), regional detention basin, or in-stream



Worked Examples of Hydromodification Sizing

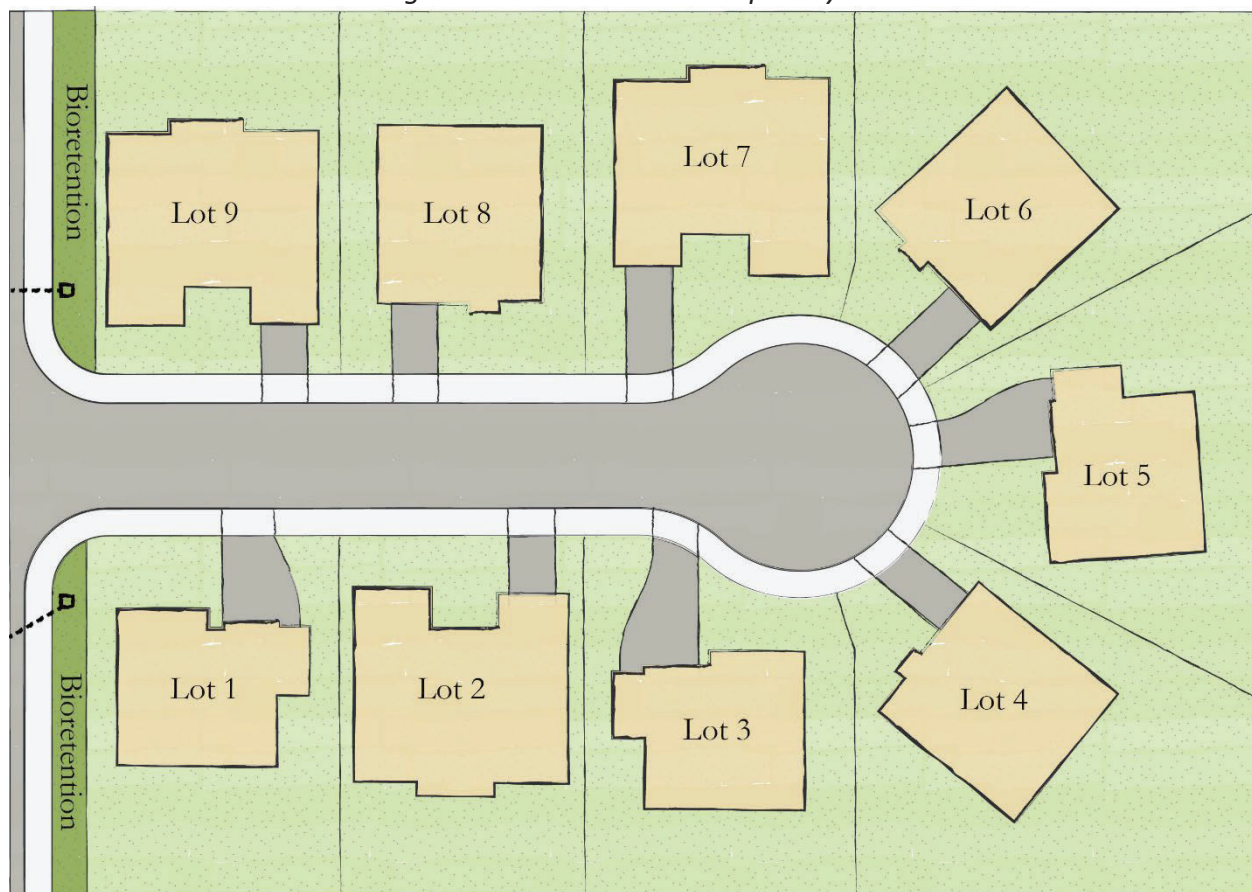
Appendix H

Worked Examples of Hydromodification Sizing

RESIDENTIAL EXAMPLE

A subdivision consisting of nine single-family home lots of unequal size and a cul-de-sac is proposed in Bay Point, CA. The rectangular, 3-acre plot consists of former agricultural land now covered with grasses with an average slope of 2% from east to west towards the existing roadway. The underlying soil is HSG Type B with an infiltration rate of 0.24 inches per hour, as determined by onsite infiltration testing during the initial planning phases of the project. The project is subject to both the treatment and hydromodification requirements of the MRP Section C.3.

Figure 3-5: Residential Example Layout



The roof, driveway, landscape, and total lot area for the proposed subdivision is provided in the table below. Each lot is between 0.25 and 0.33 acres in size and varies between 28 and 50% impervious with three different house styles. The proposed cul-de-sac roadway footprint is 19,700 sf (0.45 ac). The remaining area is being saved for IMP at a starting IMP footprint to DMA ratio of 0.05 for bioretention.

Table 3-7: Residential Example Land Use Types

LOT #	Roof Area		Driveway Area		Landscape Area		Total Lot Area	
	(sf)	(ac)	(sf)	(ac)	(sf)	(ac)	(sf)	(ac)
1	3,234	0.074	805	0.018	7,715	0.177	11,754	0.270
2	4,754	0.109	400	0.009	5,570	0.128	10,724	0.246
3	3,234	0.074	1,000	0.023	6,585	0.151	10,819	0.248
4	3,545	0.081	520	0.012	10,350	0.238	14,415	0.331
5	3,234	0.074	955	0.022	8,225	0.189	12,414	0.285
6	3,545	0.081	555	0.013	10,465	0.240	14,565	0.334
7	4,754	0.109	670	0.015	5,525	0.127	10,949	0.251
8	3,545	0.081	480	0.011	6,775	0.156	10,800	0.248
9	4,754	0.109	370	0.008	6,630	0.152	11,754	0.270
TOTAL	34,599	0.794	5,755	0.132	67,840	1.557	108,194	2.483

The following demonstrations include two options for compliance at the proposed development: centralized bioretention and dispersed IMP.

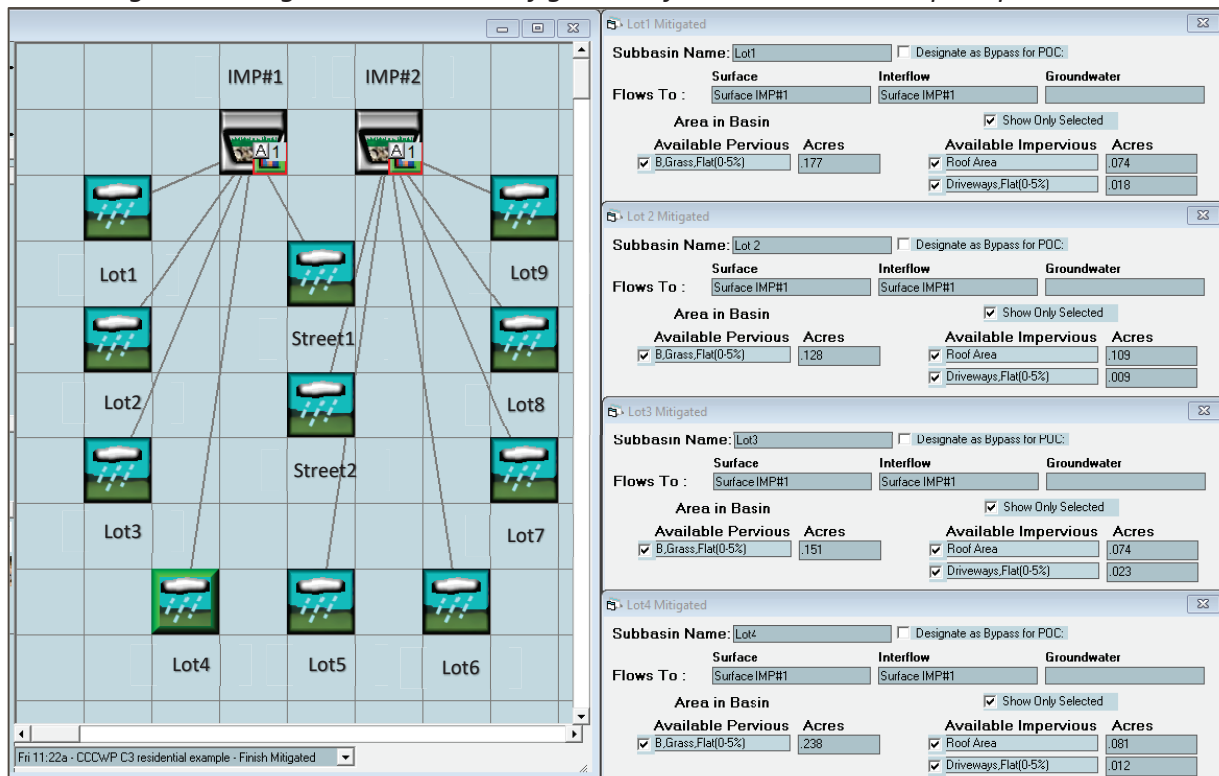
Option A – Centralized Bioretention

Post-development stormwater runoff from all nine lots of the subdivided 3-acre project site will be directed to the western edge of the site. There the stormwater will be treated and detained in one of two IMP facilities proposed on either side of the entrance to the cul-de-sac prior to being discharged to the receiving water body.

The pre-project BAHM scenario consists of a single basin [DMA] containing the full project site with the characteristics described above: 3 acres of pervious area (B, Grass, Flat 0-5%).

As centralized IMPs are proposed, the mitigated [post-project] scenario is entered into BAHM2023 as 11 different basins [DMAs]: one for each of nine subdivided lots and one for each side of the crested, cul-de-sac roadway. The acreage of impervious areas for roof (Roof Area) and driveways (Driveway, Flat, 0-5%) as well as pervious landscaped areas (B, Grass, 0-5%) are included for each of the basins with lots 1 through 4 draining to one IMP facility and lots 5 through 9 draining to the other. The mitigated scenario configuration along with the basin properties for lots 1 through 4 are shown in Figure 2.

Figure 1: Mitigated Scenario Configuration for Residential Example Option A



(Note: BAHM2023 can experience difficulty in connecting elements that are not in a straight line (same row or column) in the schematic window. To work around this issue, place and connect elements in a straight line and then move the elements to their desired location.)

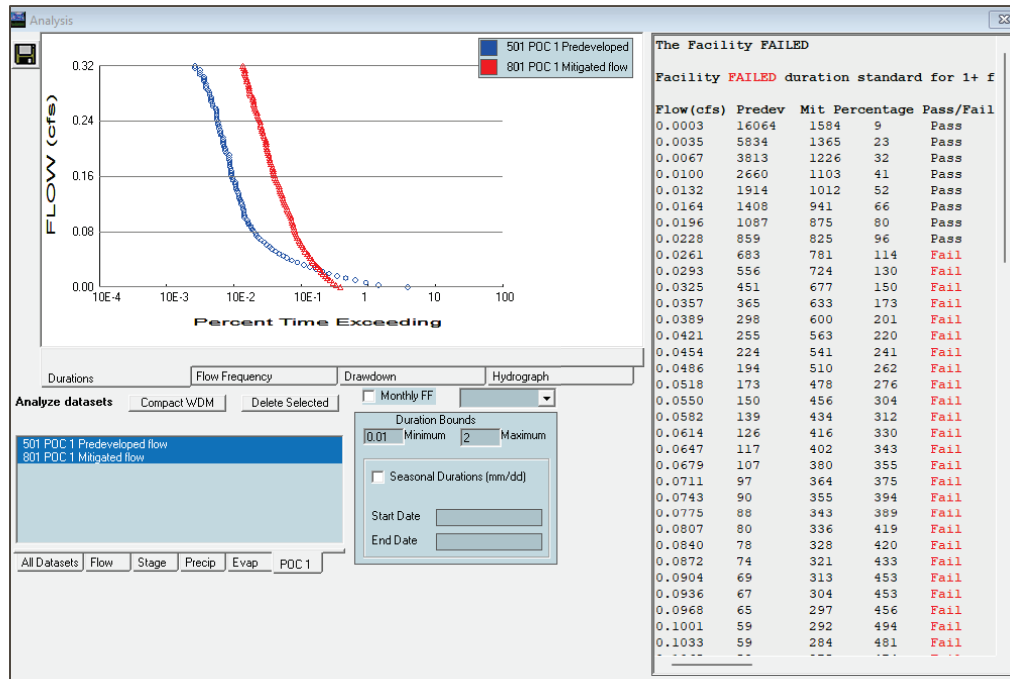
Bioretention is the proposed IMP in this scenario. The two bioretention IMP have the same properties but with slightly different footprints due to the larger impervious area draining to IMP#2. The bioretention areas are 8 feet wide with vertical concrete walls and have the following properties that were entered, as appropriate, into BAHM2023.

- Width: 8 feet
- Length: Variable (see below)
- Freeboard: 0.5 feet
- Ponding Depth: 1 foot
- Bioretention Media Depth: 1.5 feet
- Gravel Layer Depth: 2.4 feet
- Infiltration Rate: 0.24 in/hr

No underdrains are required as the soil type is conducive to infiltration. The initial lengths and corresponding footprints for each bioretention IMP are calculated by assuming a bioretention to impervious area sizing ratio of 0.04 (or 4%). The total impervious area draining from lots 1 through 4 and roughly half of the cul-de-sac roadway to IMP#1 totals roughly 26,822 feet (0.62 ac). This corresponds to an initial footprint of 1072 sf and a corresponding bioretention length of 134 feet. The remaining impervious area draining to IMP#2 totals 33,232 sf (0.76 ac) which equals an initial footprint of 1,328 sf for a corresponding length of 166 feet.

The pre-project and mitigated [*post-project*] scenario flow duration curves from the BAHM2023 model runs are shown in Figure 3. The mitigated scenario exceeds the pre-project flow conditions for all but the lowest flows and therefore the IMPs, as originally proposed, will not meet requirements for hydromodification.

Figure 2: BAHM2023 Results from Residential Example Option A with IMP Sizing Ratio of 0.04



There are several options available for reducing runoff flow rates including increasing the footprint of the IMP, increasing the storage capacity of the IMP, and/or restricting the outflow from the IMP with a smaller discharge orifice. As no underdrains are proposed, the first two options are appropriate. The IMP footprint to impervious DMA ratio is increased from 0.04 (4%) to 0.08 (8%) for each IMP facility and the depth of the gravel storage layer is increased by 0.5 feet, to 3 feet total. The additional 1,950 sf of bioretention IMP needed must be subtracted from the landscape areas of Lots 1 and 9 so as to keep the IMP facilities within the 3-acre parcel. The flow duration curves for the pre-project and mitigated (post-project) scenario model runs are shown in Figure 4. With the increase in bioretention IMP footprint, the proposed project now meets the hydromodification requirements of MRP Section C.3.

Figure 3: BAHM2023 Results from Residential Example Option A with IMP Sizing Ratio of 0.08

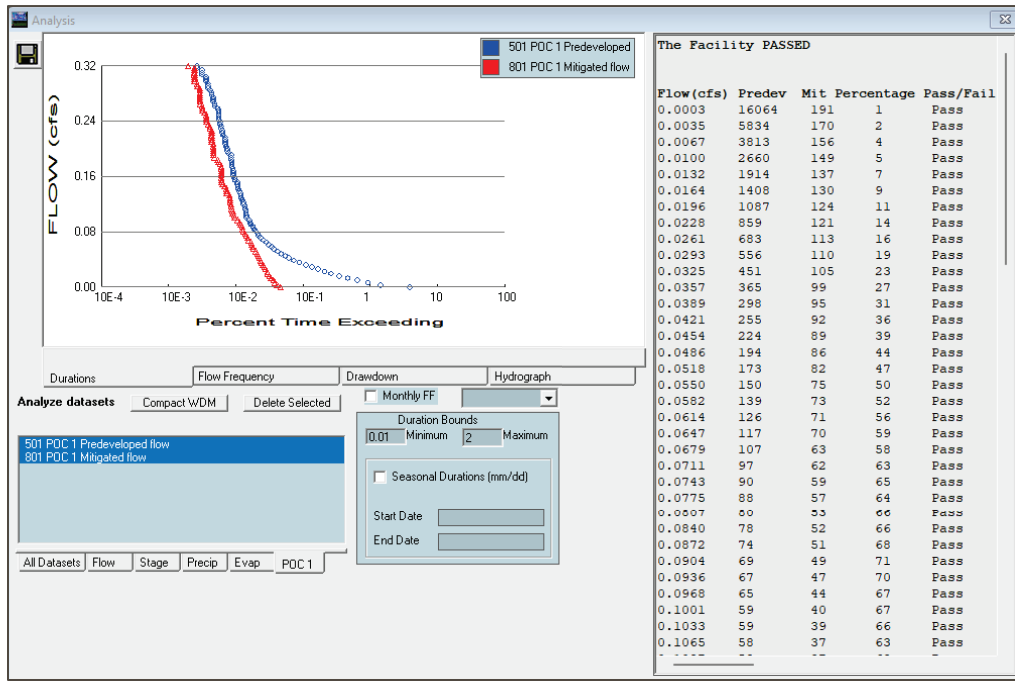
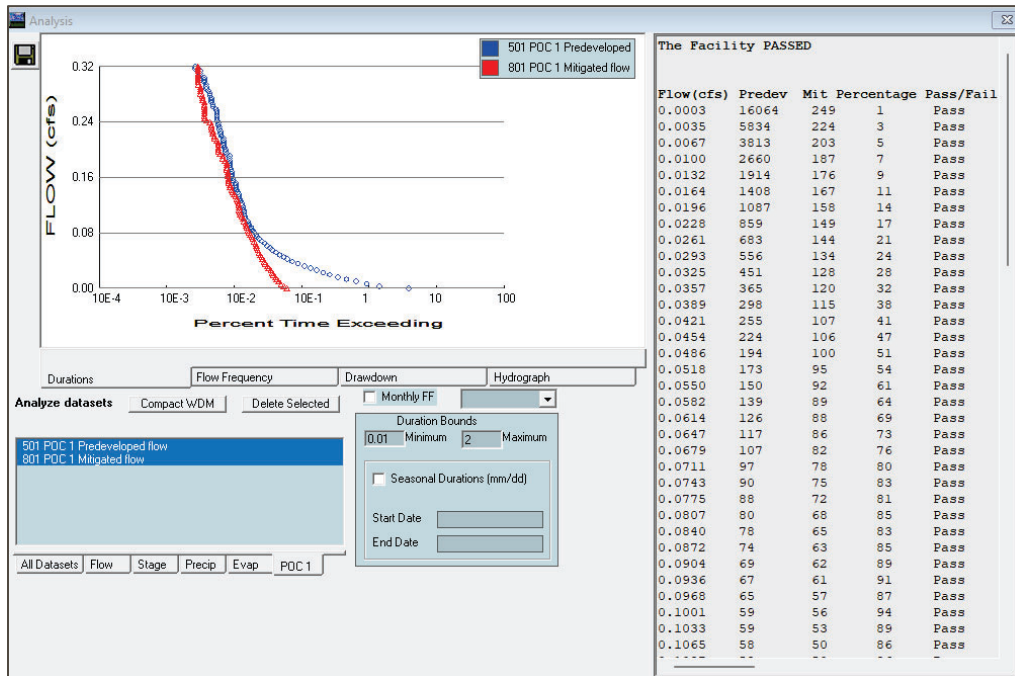


Figure 4 shows that the proposed bioretention IMP are now slightly oversized as the mitigated flow duration curve is well under the predevelopment curve. Further iterations of IMP area result in an optimized bioretention IMP footprint to impervious DMA ratio of 7.5%, which results in a total area of 2,012 sf for IMP#1 and 2,492 sf for IMP #2. The flow duration curves for the optimized IMP areas are presented in Figure 5.

Figure 4: BAHM2023 Results from Residential Example Option A with IMP Sizing Ratio of 0.075



Option B – Dispersed IMP

Post-development stormwater runoff from the nine lots of the subdivided 3-acre parcel is directed to IMPs located within each lot. These include self-retaining landscape areas in the pervious area footprint of the lot that manage runoff from the roofs and self-retaining driveways of permeable pavement. Runoff from the cul-de-sac pavement is directed towards the western edge of the site, similar to Option A. There, the stormwater will be treated and detained in one of two IMP facilities proposed on either side of the entrance to the cul-de-sac prior to being discharged to the receiving water body.

The pre-project BAHM scenario consists of a single basin [DMA] containing the full project site with the characteristics described above: 3 acres of pervious area (B, Grass, Flat 0-5%).

The number of basins to model the runoff from the nine lots is the same as in Option A but the configuration of each is much different. Each lot basin consists exclusively of the acreage for impervious roof (Roof Area). The landscape area of each lot is modeled as self-retaining area (Trapezoidal Pond) using the process described in the BAHM2023 User Manual. The driveways are modeled as permeable pavement that are connected to the bioretention IMPs. The cul-de-sac basins are connected directly to the bioretention IMPs as in Option A. Additionally, there are two new basins that consist of pervious area (B, Grass, Flat 0-5%) that are within the bioretention IMP footprint in Option A but are not in Option B given the reduced size of those IMP. This mitigated scenario configuration is shown in Figure 6 and the properties for the self-retaining landscape area and permeable pavement driveways are shown in Figure 7.

Figure 5: Mitigated Scenario Configuration for Residential Example Option B



Figure 6: Properties for Self-Retaining IMP and Permeable Pavement IMP at Lot 1

The image shows two side-by-side software panels for configuring IMP properties. The left panel is for 'Lot1_SelfRetArea Mitigated' and the right panel is for 'Lot1_PP Mitigated'.

Left Panel (Self-Retaining IMP):

- Facility Name:** Lot1_SelfRetArea
- Facility Type:** Auto Pond / Quick Pond
- Downstream Connections:** Outlet 1 (0), Outlet 2 (0), Outlet 3 (0)
- Facility Dimensions:** Facility Bottom Elevation (ft) 0, Bottom Length (ft) 87.84, Bottom Width (ft) 87.84, Effective Depth (ft) 2, Left Side Slope (H/V) 0, Bottom Side Slope (H/V) 0, Right Side Slope (H/V) 0, Top Side Slope (H/V) 0.
- Outlet Structure Data:** Riser Height (ft) 2, Riser Diameter (in) 2108, Riser Type Notched, Notch Type Rectangular, Notch Height (ft) 1.75, Notch Width (ft) 87.84.
- Infiltration:** Measured Infiltration Rate (in/hr) 0.1, Reduction Factor (infiltration factor) 1, Use Wetted Surface Area (sidewalls) NO, Total Volume Infiltrated (ac-ft) 8.048, Total Volume Through Riser (ac-ft) 0.01, Total Volume Through Facility (ac-ft) 8.06, Percent Infiltrated 99.88.
- Orifice Data:** 3 orifices with diameters 0, 0, and 0 inches and heights 0, 0, and 0 feet.
- Pond Volume at Riser Head (ac-ft):** .354
- Size Infiltration Pond:** Target %: 100

Right Panel (Permeable Pavement IMP):

- Facility Name:** Lot1_PP
- Facility Type:** Quick Pavement
- Downstream Connection:** Surface IMP#1 (0), Outlet 2 (0), Outlet 3 (0)
- Facility Dimensions:** Pavement Length (ft) 80.5, Pavement Bottom Width (ft) 10, Effective Total Depth (ft) 2, Bottom slope (ft/ft) 0.01.
- Layers for Permeable Pavement:** Pavement Thickness (ft) 0.5, Pavement porosity (0-1) 0.4, Sublayer 1 Thickness (ft) 1.5, Sublayer 1 porosity (0-1) 0.4, Sublayer 2 Thickness (ft) 0, Sublayer 2 porosity (0-1) 0.
- Infiltration:** Measured Infiltration Rate (in/hr) 0.24, Reduction Factor (infiltration factor) 1, Use Wetted Surface Area (sidewalls) NO, Total Volume Infiltrated (ac-ft) 0.633, Total Volume Through Riser (ac-ft) 0.
- Storage Volume at Top of Pavement (ac-ft):** .016
- Size Pavement:** Target %: 100

There are three types of proposed IMP in this scenario: self-retaining landscape areas, permeable pavement, and bioretention. There is a self-retaining IMP and a permeable pavement IMP for each of the nine lots along with two bioretention IMP. Each of the individual IMP types for the lots have the same properties but with different footprints to account for the variability in landscape and driveway area presented in Table 1.

The self-retaining IMP are incorporated into BAHM2023 according to the instructions for self-retaining areas on pages 76-79 of the BAHM 2023 User Manual. The entire landscape area for each lot is considered to be self-retaining and entered as a trapezoidal pond with a square area in BAHM2023 for simplicity. The roof area for each lot is the impervious DMA for the self-retaining area. Per Table 1, the impervious-to-pervious (roof-to-landscape) ratio varies from as low as 0.34 (Lot 6) to as high as 0.85 (Lot 2), which are under the maximum threshold of 1:1 for self-retaining IMP. Each self-retaining IMP was assigned an impoundment depth of 0.25 feet (3 inches) per the requirements of this chapter. The other properties and inputs remain unchanged from those presented in the BAHM 2023 User Manual.

Permeable pavement IMP all are modeled in BAHM 2023 using the same properties but with slightly different footprints equal to each proposed lot's driveway area. The permeable pavement IMP are 10 feet wide with variable lengths and have the following additional properties:

- Width: 10 feet
- Length: Variable
- Pavement Thickness: 0.5 feet
- Pavement Porosity: 0.4
- Gravel Layer Depth: 1.5 feet
- Gravel Layer Porosity: 0.4
- Ponding Depth: 0 feet

Effective Depth: 2 feet
 Effective Volume Factor: 1.00
 Infiltration Rate: 0.24 in/hr

No underdrains are required as the soil type is conducive to infiltration. The permeable pavement IMP are connected to the bioretention IMP so that any stormwater not stored or infiltrated in the permeable pavement IMP is directed as runoff to the bioretention IMP.

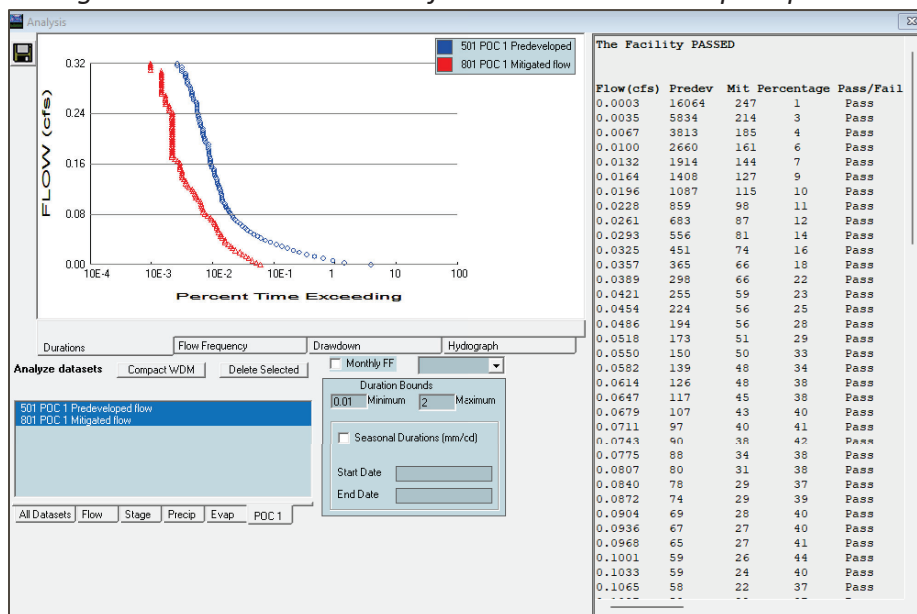
The two bioretention IMP have the same properties but with slightly different footprints due to the larger impervious area draining to IMP#2 from the cul-de-sac roadway. The bioretention areas are 8 feet wide with vertical concrete walls and have the following properties:

Width: 8 feet
 Length: Variable (see below)
 Freeboard: 0.5 feet
 Ponding Depth: 1 foot
 Bioretention Media Depth: 1.5 feet
 Gravel Layer Depth: 2.5 feet
 Infiltration Rate: 0.24 in/hr

No underdrains are required as the soil type is conducive to infiltration. The initial lengths and corresponding footprints for each bioretention IMP are calculated by assuming a bioretention to impervious area sizing ratio of 0.06 (or 6%) based the impervious DMA from the cul-de-sac roadway and an assumed amount of runoff from the permeable pavement IMP during larger storms.

The results of the pre-project and mitigated (post-project) scenarios model runs are shown in Figure 8. The mitigated scenario does not exceed the pre-project flow conditions and the project as proposed will meet requirements for hydromodification.

Figure 7: BAHM2023 Results from Residential Example Option B



The total required bioretention IMP size is 1,182 sf or roughly 24% of the bioretention IMP footprint required in Option A. Option B demonstrates how the incorporated of IMP such as self-retaining landscape into the design of the development can dramatically decrease the footprint dedicated exclusively to stormwater management.

COMMERCIAL EXAMPLE

A new office building for the Contra Costa County Fire Prevention Bureau is proposed on an L-shaped 1.09-acre site at the corner of Loveridge Road and Loveridge Circle in Pittsburg, California. The existing site consists of an unpaved dirt and gravel lot with HSG Type D soils with an infiltration rate of 0.05 inches per hour as demonstrated in onsite testing. The lot is flat with slopes of less than 2% in variable directions. The proposed project consists of a 7,000-square-foot single-story building with paved parking lot and a small outbuilding. The site can be broken into eight distinct drainage areas (or basins) based on the proposed slopes and final grades. The initial breakdown of roof, on-grade pavement, and landscape area without any IMP for stormwater management is presented in

Table 2. The project is subject to both the treatment and hydromodification requirements of the MRP Section C.3.

Figure 8: Commercial Example Layout



Table 1: Commercial Example Land Use Types without IMP

Basin	Roof Area		Pavement Area		Pervious Area	
	(sf)	(ac)	(sf)	(ac)	(sf)	(ac)
A1	4,000	0.092	230	0.005	2,124	0.049
A2	4,375	0.100	7,684	0.176	3,289	0.076
A3	0	0	1,064	0.024	0	0
A4	0	0	715	0.016	0	0
A5	0	0	2,270	0.052	344	0.008
A6	220	0.005	2,932	0.067	970	0.022
A7	0	0	0	0	12,767	0.293
A8	0	0	3,127	0.072	1,369	0.031
TOTAL	8,595	0.197	18,022	0.414	20,863	0.479

The pre-project BAHM scenario consists of a single basin [DMA] containing the full project site with the characteristics described above: 1.09 acres of pervious area (C/D, Urban, Flat 0-5%).

Bioretention IMP is proposed for the majority of the project area. The mitigated [post-project] scenario is entered into BAHM2023 as seven different basins [DMAs] and one trapezoidal pond that encapsulates the self-retaining area A7. The acreage of impervious areas for roof (Roof Area), sidewalk (Sidewalk, Flat, 0-5%) and pavement (Parking, Flat, 0-5%) as well as pervious landscaped areas (C/D, Grass, 0-5%) is entered for each basin.

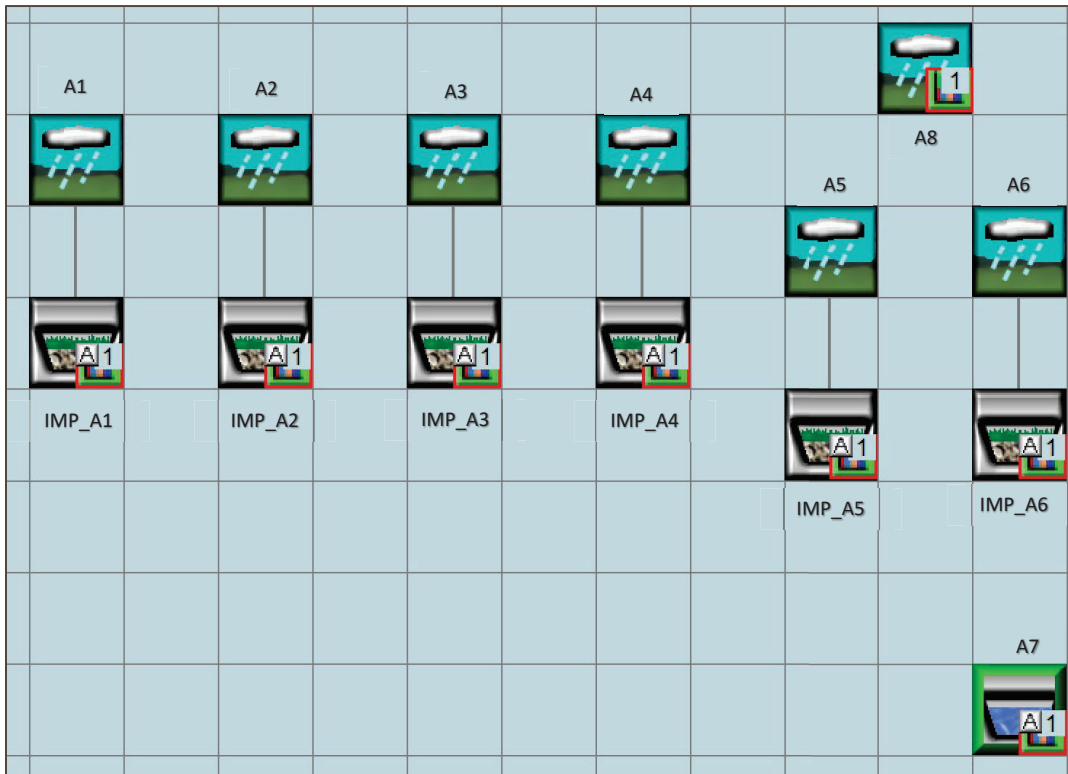
The project intends to use bioretention IMP to meet the hydromodification requirements of the MRP as detailed in the CCCWP C.3 Guidebook. Each of the proposed bioretention IMP will have vertical walls and an underdrain due to the low-infiltrating soils. The design begins with initial sizing ratio of 0.05 (5%) bioretention IMP footprint to impervious area. The footprint for the bioretention IMP will come from the pervious area for those drainage areas with proposed pervious coverage and from pavement for those areas without proposed pervious. Area A7 is entirely pervious and considered to be self-retaining. Area A8 is situated such that capture and treatment is not feasible so no IMP is proposed. Table 3 includes the land use breakdown for the initial IMP sizing ratio of 0.05 while Figure 10 shows the mitigated scenario configuration as described.

Table 2: Commercial Example Land Use Types with IMP Sizing Ratio of 0.05 per Basin

Basin	Roof Area		Pavement Area		Pervious Area		IMP Footprint	
	(sf)	(ac)	(sf)	(ac)	(sf)	(ac)	(sf)	(% Imp.)
A1	4,000	0.092	230	0.005	1,913	0.044	212	5.0%
A2	4,375	0.100	7,684	0.176	2,686	0.062	603	5.0%
A3	0	0	1,011	0.023	0	0	53	5.0%
A4	0	0	679	0.016	0	0	36	5.3%
A5	0	0	2,270	0.052	231	0.005	114	5.3%
A6	220	0.005	2,932	0.067	812	0.019	158	5.0%
A7	0	0	0	0	0	0	12,767	100.0%
A8	0	0	3,127	0.072	1,369	0.031	n/a	0.0%
TOTAL	8,595	0.197	17,933	0.412	7,010	0.161	1,175*	4.4%*

* Total, site-wide IMP footprint and IMP to impervious DMA ratio does not include the self-retaining area

Figure 9: Mitigated Scenario Configuration in BAHM2023 for Commercial Example



The bioretention IMP all have the same properties but with slightly different footprints due to varying impervious DMAs. The bioretention IMP are assumed to be 6-foot-wide planters with vertical concrete walls and have the following properties:

- Width: 6 feet
- Length: Variable
- Freeboard: 0.5 feet
- Ponding Depth: 0.5 foot
- Bioretention Media Depth: 1.5 feet
- Gravel Layer Depth: 2.0 feet
- Infiltration Rate: 0.05 in/hr
- Underdrain / Orifice Diameter: 4 inches
- Underdrain Offset: 18 inches

The self-retaining IMP is incorporated into BAHM2023 according to the instructions for self-retaining areas on pages 76-79 of the BAHM 2023 User Manual. The entire basin A7 area is self-retaining and entered as a trapezoidal pond with a square area in BAHM2023 for simplicity. The self-retaining area was assigned an impoundment depth of 0.25 feet (3 inches). The properties for the bioretention IMP associated with Basin A1 and the self-retaining IMP of Basin A7 are shown in Figure 11.

Figure 10: Properties for Bioretention IMP for A1 and Self-Retaining IMP A7

Facility Name: A1_IMP

Outlet 1: 0, **Outlet 2:** 0, **Outlet 3:** 0

Use simple Bioretention: Default Bioretention | Size Water Quality | Size Facility

Underdrain Used

Bioretention Bottom Elevation: 0

Bioretention Dimensions:
 Bioretention Length (ft): 35.3
 Bioretention Bottom Width (ft): 6.000
 Freeboard (ft): 0.500
 Over-road Flooding (ft): 0.000
 Effective Total Depth (ft): 4.5
 Bottom slope of bioretention (0-1): 0.000

Facility Dimension Diagram:
 Riser Outlet Structure: [Diagram]
 Riser Height Above bioretention surface (ft): 0.5
 Riser Diameter (in): 8
 Riser Type: Flat

Material Layers for:
 Layer 1: 1.500 ft, Soil: BAHM 5
 Layer 2: 2.000 ft, Soil: GRAVEL
 Layer 3: 0.000 ft, Soil: GRAVEL

Native Infiltration: Yes
 Measured Infiltration Rate (in/hr): 0.05
 Reduction Factor (infiltration factor): 1
 Use Wetted Surface Area (sidewalls): NO
 Total Inflow ac-ft: 4.063

Summary:
 Total Volume Infiltrated (ac-ft): 3.026
 Total Volume Through Riser (ac-ft): 0.008
 Total Volume Through Facility (ac-ft): 3.647
 Percent Infiltrated: 82.97
 Precipitation on Facility (acre-ft): 0.449
 Evaporation from Facility (acre-ft): 0.416

Basin_A7 Mitigated

Facility Name: Basin_A7, **Facility Type:** [Auto Pond | Quick Pond]

Outlet 1: 0, **Outlet 2:** 0, **Outlet 3:** 0

Precipitation Applied to Facility

Evaporation Applied to Facility

Facility Dimension Diagram:
Outlet Structure Data:
 Facility Bottom Elevation (ft): 0
 Bottom Length (ft): 113
 Bottom Width (ft): 113
 Effective Depth (ft): 2
 Left Side Slope (H/V): 0
 Bottom Side Slope (H/V): 0
 Right Side Slope (H/V): 0
 Top Side Slope (H/V): 0

Infiltration:
 Measured Infiltration Rate (in/hr): 0.1
 Reduction Factor (infiltration factor): 1
 Use Wetted Surface Area (sidewalls): NO
 Total Volume Infiltrated (ac-ft): 0
 Total Volume Through Riser (ac-ft): 0
 Total Volume Through Facility (ac-ft): 0.00
 Percent Infiltrated: 0

Orifice Dimensions:
 Orifice Number (in) (ft):
 1: 0 (in) | 0 (ft)
 2: 0 (in) | 0 (ft)
 3: 0 (in) | 0 (ft)

Pond Volume at Riser Head (ac-ft): 586

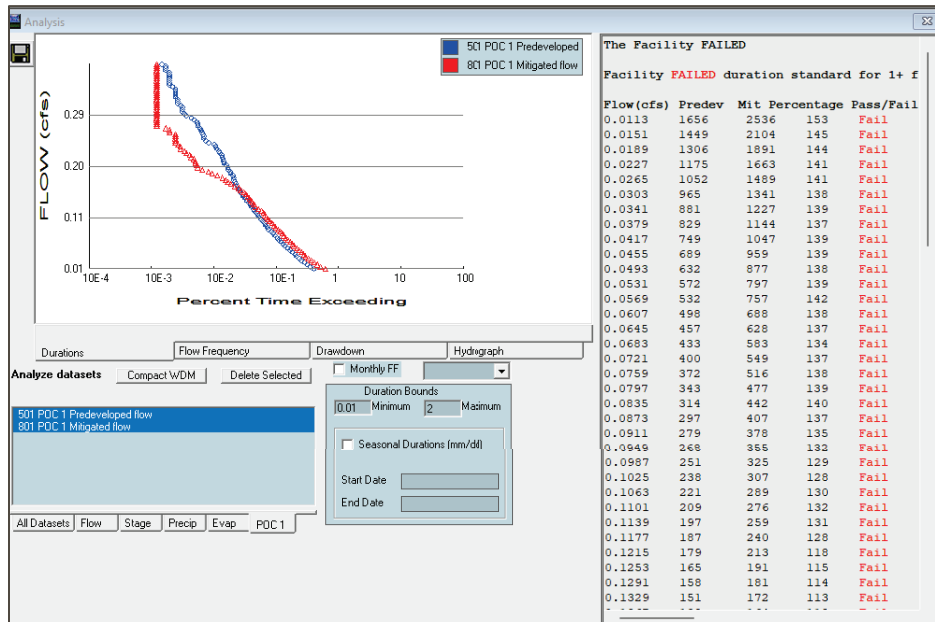
Show Pond Table: [Open Table]

Size Infiltration Pond: Target %: 100

Tide Gate: Time Series | Demand
 Use Tide Gate
 Tide Gate Elevation (ft): 0
 Downstream Connection: [Dropdown]
 Overflow Elevation (ft): 0
 Iterations: 0

As noted above, the initial design includes bioretention IMP at a ratio of 0.05 IMP footprint to impervious DMA. The pre-project and mitigated (post-project) scenario flow duration curves for the BAHM2023 model runs are shown in Figure 12. The mitigated scenario fails to match the pre-project flow conditions for the lower flow regimes and therefore the IMPs, as initially proposed, will not meet requirements for hydromodification. This non-compliance is likely due to the non-capture of area A8 and the subsequent site-wide under-sizing of the bioretention IMP.

Figure 11: BAHM2023 Results for Commercial Example with IMP Sizing Ratio of 0.05 per Basin



The size of the proposed bioretention IMP is increased to equal a site-wide IMP footprint to impervious DMA ratio of 0.08 (8%), not including the self-retaining area. The distribution of the increase in bioretention size is not consistent across the basins as, given the proposed programming at the site, some basins can be configured to allow for a larger IMP footprint than others.

Table 3: Commercial Example Land Use Types with Site-Wide IMP Sizing Ratio of 0.08

Basin	Roof Area		Pavement Area		Pervious Area		IMP Footprint	
	(sf)	(ac)	(sf)	(ac)	(sf)	(ac)	(sf)	(% Imp.)
A1	4,000	0.092	230	0.005	1,582	0.036	542	12.8%
A2	4,375	0.100	7,684	0.176	2,415	0.055	874	7.2%
A3	0	0	992	0.023	0	0	72	7.3%
A4	0	0	627	0.014	0	0	88	14.0%
A5	0	0	2,270	0.052	180	0.004	164	7.2%
A6	220	0.005	2,932	0.067	562	0.013	408	12.9%
A7	0	0	0	0	0	0	12,767	100.0%
A8	0	0	3,127	0.072	1,369	0.031	n/a	0.0%
TOTAL	8,595	0.197	17,862	0.410	6,108	0.140	2,148*	4.4%*

* Total, site-wide IMP footprint and IMP to impervious DMA ratio does not include the self-retaining area

The results of the pre-project and mitigated (post-project) scenario model runs are shown in Figure 13. With the increase in site-wide IMP sizing ratio, the proposed project now meets the hydromodification requirements of the MRP.

Figure 12: BAHM2023 Results for Commercial Example with Site-Wide IMP Sizing Ratio of 0.08

