

Green Stormwater Infrastructure Handbook



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EOA / SCVURPPP

November 29, 2018

Outline of Presentation

- Overview
- Handbook Contents
- Example Details

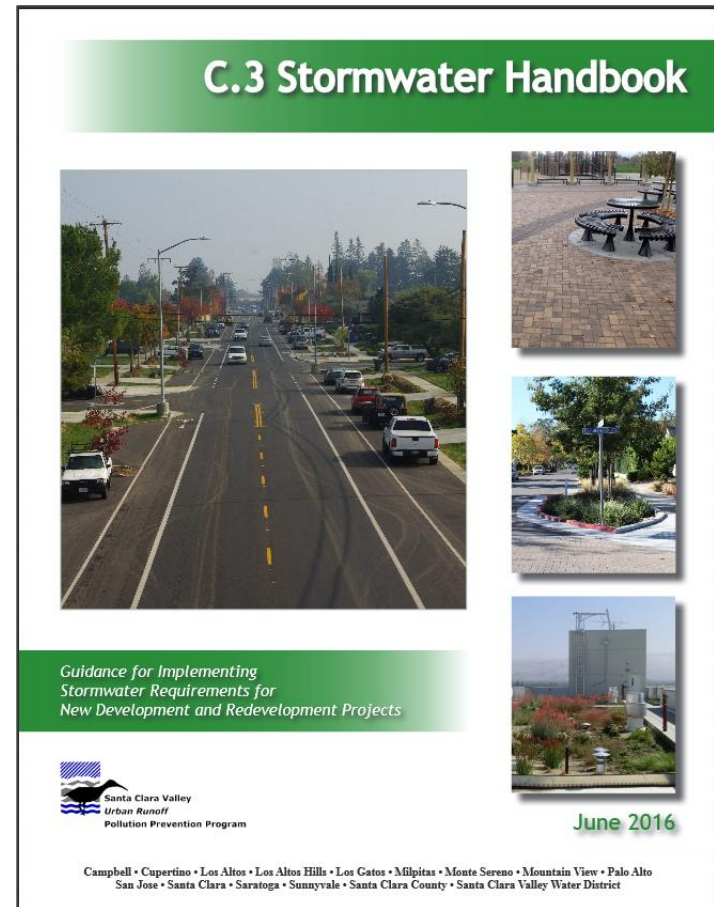


Overview

- MRP requires GSI Plans to include general design guidelines, details, and specifications
- SCVURPPP members requested county-wide guidance document
- Companion to C.3 Stormwater Handbook (June 2016)
 - **Guidance for Regulated Projects**

C.3 Stormwater Handbook


- Municipal Staff and Project Applicants
- Concepts
 - LID site design
 - Treatment Measures
 - Sizing Methodology
- Technical Guidance
 - Bioretention Area
 - Tree Well Filter
 - Pervious Pavement
 - Infiltration Trench




GSI Handbook

- Part 1–General Guidelines
 - Final Draft February 2018
 - SCVURPPP SWRP webpage
- Part 2–Details & Specifications
 - Revised Draft June 2018
 - Final available early 2019

Green Stormwater Infrastructure Handbook



Guidance for Implementing Green Stormwater Infrastructure in Public Streetscapes, Parking Lots and Parks



**Santa Clara Valley
Urban Runoff
Pollution Prevention Program**

FINAL DRAFT February 2018

Campbell • Cupertino • Los Altos • Los Altos Hills • Los Gatos • Milpitas • Monte Sereno • Mountain View • Palo Alto
San Jose • Santa Clara • Saratoga • Sunnyvale • Santa Clara County • Santa Clara Valley Water District

Part 1

- Chapter 1: Introduction
- Chapter 2: Integration of GSI w/Public Streets, Parking Lots, and Parks
- Chapter 3: Design Guidance for GSI Measures
- Chapter 4: Sizing Methodology for GSI Measures
- Chapter 5: Post Construction Maintenance
- Chapter 6: Example GSI Applications

Chapter 1

- Non-Regulated Projects
- Integration of LID into public rights-of-way
 - Streets and sidewalks
 - Parking lots
 - Public parks/landscape areas
- Focus on special considerations
 - Retrofits
 - Streetscape vs parcel

Chapter 2

- Integration of GSI with:
 - Public Streets
 - Parking Lots
 - Parks and other Public Outdoor Areas
- Considerations unique to streets and public rights-of-way
- Public Street Terminology

Chapter 2

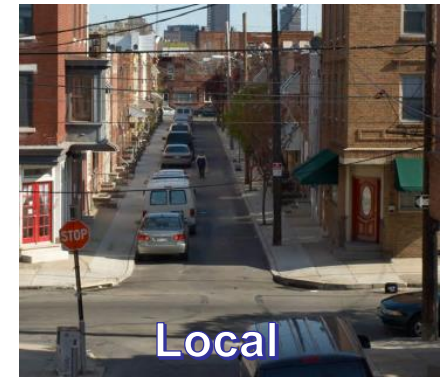
- Street Cross Section



Figure 2-1. Street and sidewalk cross section, conceptual example (courtesy of Streetmix.net)

Chapter 2

- Street Functional Classification



Chapter 2

- Cycling Infrastructure Typologies



Class I – Paths/Trails



Class II - Lanes



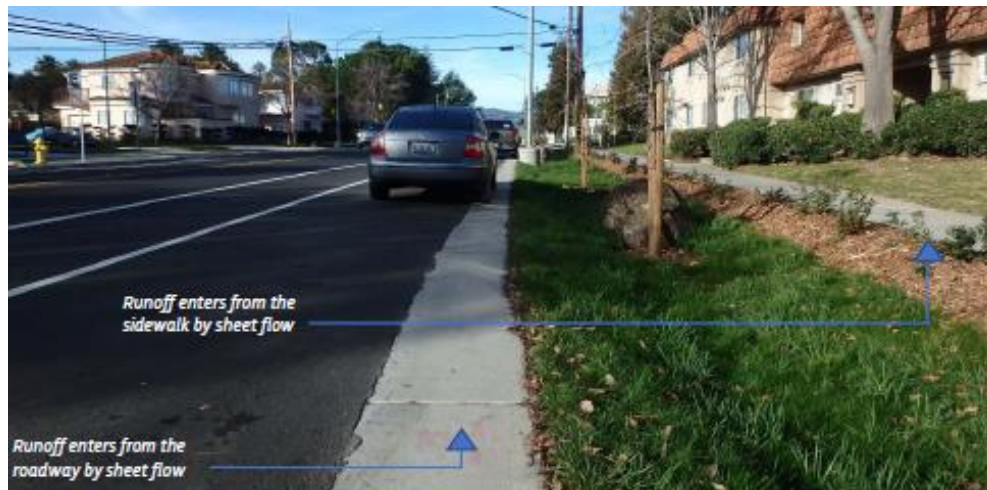
Class III - Routes



Class IV - Protected

Chapter 2

- LID Treatment Measures in Public Spaces
 - Benefits
 - Potential Constraints and Considerations
 - Potential Locations



Treatment Measures

- Bioretention
 - Stormwater Planter
 - Stormwater Curb Extension (corner and mid-block)
 - Stormwater Tree Well Filter



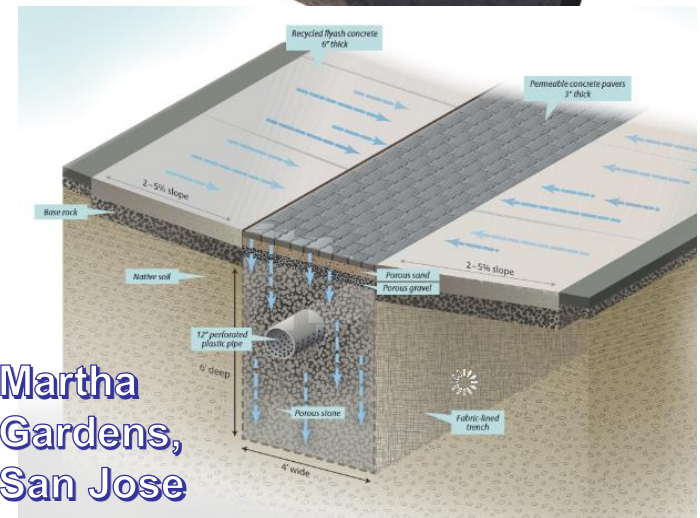
Treatment Measures

- Pervious Pavement
 - Cross walks
 - Sidewalks
 - Parking areas
 - Streets



Treatment Measures

- Infiltration Facilities
 - Dry wells (deep)
 - Trenches (shallow)
 - Subsurface systems



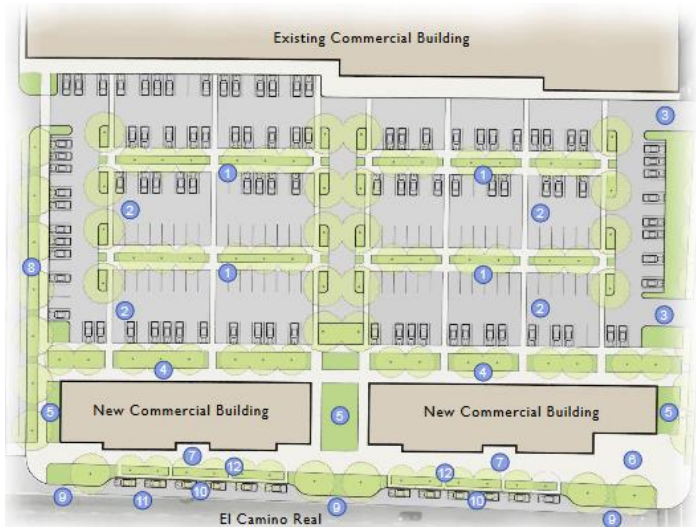
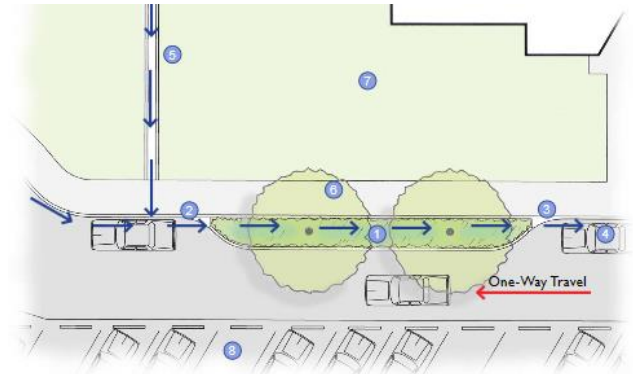
Identify Potential Sites

- Leverage Planned Projects
 - Capital Improvement Projects
 - Utility maintenance or relocation
 - Public school redevelopment
 - Partnerships with private redevelopment projects
- Suitable Project Sites for Landscape GSI
- Siting Considerations
 - Parking Lots
 - Parks/Plazas/Outdoor Areas
 - Public Rights of Way

Identify Potential Sites

■ Parking Lots

- Shortening parking stalls for planters
- Leftover space e.g., in front of and/or next to angled parking
- Perimeter locations
- Permeable pavement in parking stalls



SMCWPPP
Green Streets
Guidebook

Identify Potential Sites

■ Parks/Plazas/Outdoor Areas

- Combine with public art projects
- Use park as off-site area or regional project
- Use C.3 Handbook for parcel-based areas
- National Recreation and Park Association Guide

RESOURCE GUIDE FOR PLANNING,
DESIGNING AND IMPLEMENTING

GREEN INFRASTRUCTURE IN PARKS



Identify Potential Sites

- Public Right of Way (ROW)
 - Street Functional Classification
 - Land Use Type
 - Low density residential
 - High density residential
 - Commercial main street
 - Industrial
 - Alley

	Local – Low Density Residential
Stormwater Planter	☑
Stormwater Curb Extension: Midblock	☑
Stormwater Curb Extension: Corner	☑
Stormwater Tree Well Filter	☑
Pervious Pavement	☑
Infiltration Trench	○
Dry Well	○
Subsurface Infiltration System	☒

☒ = Not Recommended
○ = Potential ☑ = Recommended



Identify Potential Sites

- Public ROW (continued)
 - Other Components/Travel Use
 - High volume pedestrian
 - Walkable commercial corridor
 - Auto oriented
 - Transit focus
 - Bike focus (bike route)
 - Truck/freight route
 - Emergency routes
 - Shared



Philadelphia
Handbook

Identify Potential Sites

- Public ROW (continued)
 - Site Conditions (existing and future)
 - Gradient/drainage patterns
 - Storm drain system
 - Subterranean conditions (soil & groundwater depth)
 - Assess Street Trees
 - Utilities
 - Roadway width (road diets)
 - Sidewalk width

Chapter 3

- Design Guidance
- Integration w/Parks, Plazas & Public Outdoor Areas
- Integration w/Roadway Design
 - Lane width
 - Diverters/closures

*Full closure
concept courtesy
of City of
Emeryville*



Chapter 3

- Integration with Cycling Facilities
- Integration with Pedestrian Facilities
 - Curb extensions – traffic calming
 - ADA issues



Figure 3-12. One-way, class III bikeway with pervious pavement and Silva Cells for street tree planting in Bothell, WA. (Courtesy of DeepRoot GSI, LLC)



Figure 3-10. Cycletrack with parking and stormwater tree well filters. (Courtesy of massDOT)

Chapter 3

■ Utility Coordination

- Avoidance – change project location
- Acceptance – protect utility in place
- Mitigation – change project design
- Relocation – move/replace utility

Gas

Phone/Internet Cable

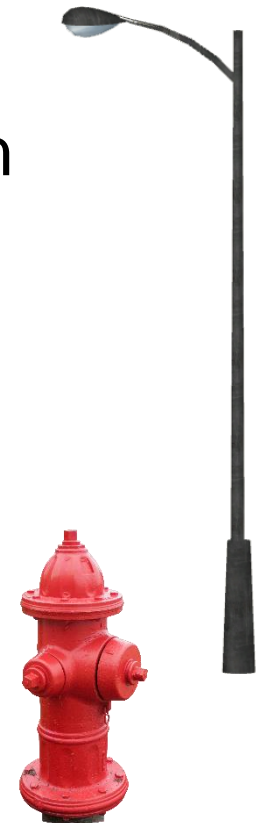
Sewer

Power (Underground and Overhead)

Water

Streetlights, traffic signals

Fire Hydrants



Chapter 3

- Landscape Design
 - Sustainable landscape principles
 - Plant selection
 - Plant spacing/location
 - Tree planting
 - Minimum soil volume
 - Strategies for achieving larger soil volumes
 - Biotreatment Soil Media (BSM)
 - Mulch

Chapter 3

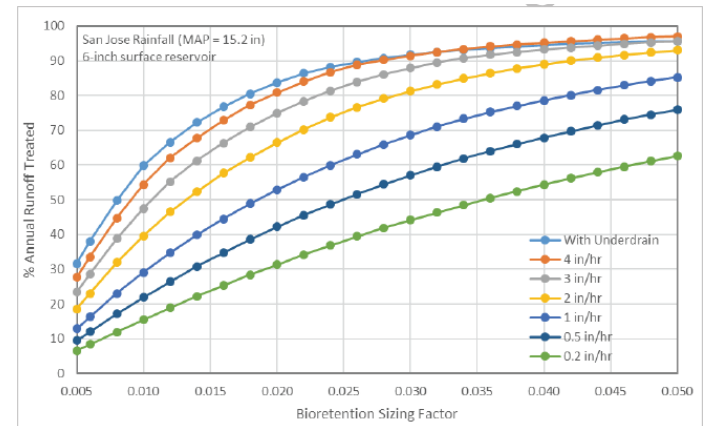
- Design with Maintenance in Mind
 - Work in high traffic areas
 - Safety
 - Equipment
 - Street sweeper
 - Litter
- Trash/Litter Capture Guidance



Figure 3-64. Litter needing manual collection in a stormwater planter in the City of San Mateo. (Credit EOA)

Chapter 4

- Sizing Methodology
- Standard
 - C.3 Stormwater Handbook
 - C.3.d volume for Regulated Projects
- Alternative – BASMAA Guidance



Dubin Environmental Report for BASMAA

- Document project constraints
- Use sizing chart to determine smallest size that will meet C.3.d
- If this facility size is still infeasible, identify variations needed from standard design
- Estimate percent of C.3.d volume that will be treated and evaluate cost-effectiveness

Chapter 5

- Post-construction Maintenance Guidance
 - Train staff
- May change over time
 - Establishing vegetation
 - Maintenance of vegetation
- Surface level
 - Pruning/weeding/invasive vegetation control
 - Replacing treatment soil and mulch
 - Watering
 - Vacuum/street sweeper (permeable pavement)

Maintenance Guidance

- Cleaning actions
 - Trash removal
 - Sediment removal
- Erosion control
 - Mulch
 - Cobbles/splash blocks/flow dissipaters
- Inlet/outlet cleaning
- Subsurface maintenance
 - Pipe flushing




Maintenance Guidance

- Minor structural and functional repairs
 - Replacing broken or damaged pervious pavement
 - Regrade soil surface
- Suggested frequencies



Chapter 6

- Sample Applications
 - Public Streets
 - Functional classifications
 - Land use
 - Parking Lots
 - Parks
 - Other Public Outdoor Areas
- Case Studies
 - Key elements
 - Additional benefits
 - Project outcomes and lessons learned

 Santa Clara Valley Urban Runoff Pollution Prevention Program
Green Stormwater Infrastructure Case Study

HACIENDA AVENUE

GREEN STREET PROJECT
CAMPBELL, CALIFORNIA

Project Description
The goals of the project were to reconstruct the asphalt pavement, increase pedestrian and cyclist safety, improve connectivity between neighborhoods, install better lighting, encourage more active transportation along the improved linear parkway connecting to Los Gatos Creek County Park and Trail and reduce the roadway carbon footprint. After undergoing the "road diet" project, the pavement width on Hacienda Avenue went from 65-70 feet to 52 feet, accommodating 11-foot vehicle lanes, parking lanes, and new bike lanes.

Completion Date
November 2015

Project Duration
3 years (design: 2012 - 2014 & construction: 2014-2015)

Costs
Total Project Cost \$6,779,115
Construction - \$5,837,997
Design - \$448,608
Project Management - \$492,510


Key Elements

- Hacienda Avenue is a high capacity, residential collector street
- The project addressed 1.1 miles of road with an 18-acre drainage area.
- 63 biotreatment areas along both sides of the street for a total surface area of 26,000 square ft.
- New bulb-outs at intersections calm traffic and improve pedestrian safety by reducing crosswalk distance

Funding
\$4,145,115
- City Funds (60%)
\$2,634,000
- Grants (40%)


Grants
State Department Water Resources Proposition 84
Chapter 2 Integrated Regional Water Management (IRWM) Grant Program
Valley Transportation Authority's Community Design and Transportation Program

Stormwater Control Measures




Biotreatment
63 biotreatment areas treat stormwater runoff from the street and sidewalk.

Other Project Features
Recycled materials
Low H2O landscaping
New street trees
Bike lanes & bus stops
Traffic calming



LOCATION
Hacienda Avenue from Winchester Boulevard to Burrows Road
Campbell, CA

Before Photo **After Photo**



Chapter 6: Southgate

- Local, narrow streets
- Low density residential area w/ on-street parking



Figure 6-5. Localized ponding before green stormwater infrastructure upgrades in the Southgate Neighborhood. (Credit: Palo Alto.)

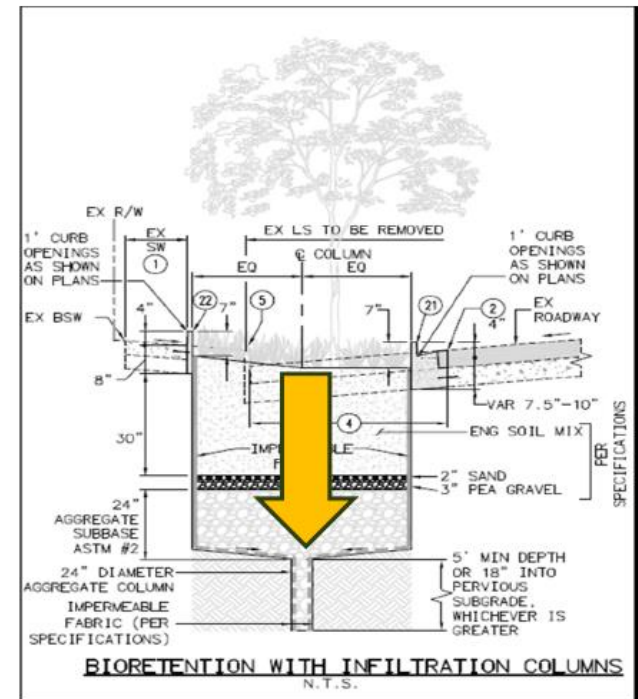
Chapter 6: Southgate

- 16 bioretention stormwater planters & corner curb extensions
- Permeable concrete pavers in intersection crosswalks and pedestrian walkway



Chapter 6: Southgate

- Bioretention areas
 - Underdrains or infiltration columns
 - Shape affected by
 - Utility conflicts
 - Existing, mature trees
 - Flat slope
- Corner curb extensions
 - Traffic calming
 - Minimize parking loss



Graphic from Carlet presentation 6/4/14

Chapter 6: Southgate

- Permeable pavers
 - Infiltration columns w/sand layer to protect GW
 - Concrete bands prevent paver migration in crosswalks



Figure 6-4. Southgate Neighborhood project bioretention areas and pervious pavement on crosswalks. (Credit: City of Palo Alto)



Figure 6-7. A paseo with permeable pavers and an infiltration trench connects Southgate Neighborhood to El Camino Real. (Credit: EOA)

Part 2: Details & Specs

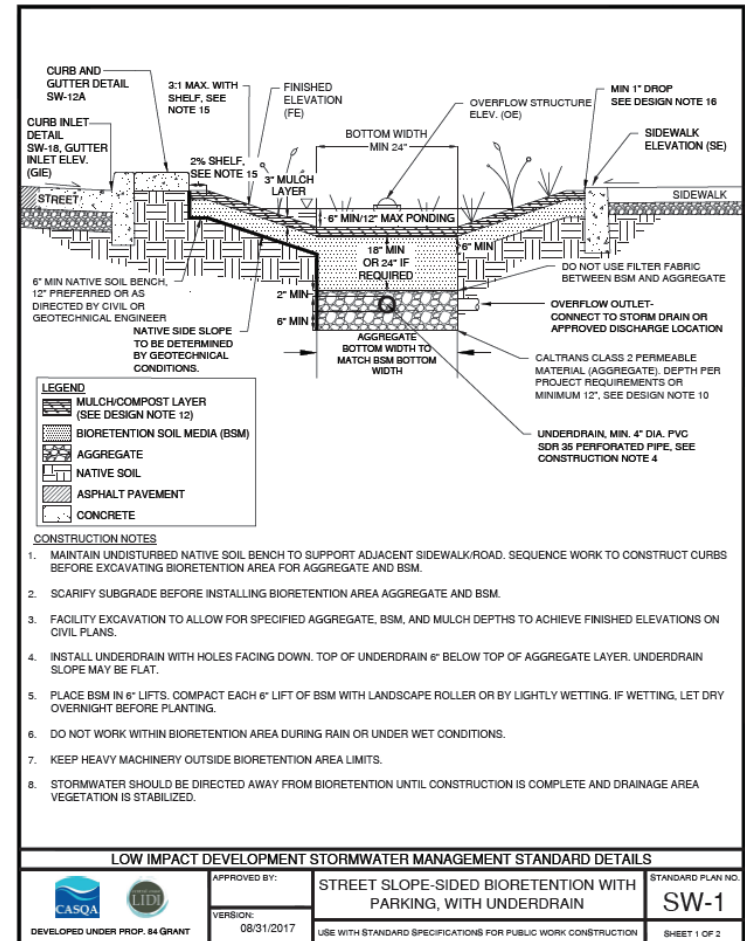
- Compilation of available details and specifications from:
 - BASMAA
 - Central Coast Low Impact Development Initiative
 - Other jurisdictions (revised for local area as needed)
 - SFPUC (2016)
 - CalTrans (2016)
 - Philadelphia (2011)
 - District of Columbia (2014)
 - Denver (2016)
 - New York City (2014)
 - Portland OR (2016)
 - Seattle (2016)
 - Moreland Australia (2013)

Part 2: Details & Specs

- Pervious pavement
- Stormwater Planter
- Stormwater Curb Extension
- Stormwater Tree Well Filter
- Infiltration Facilities (trenches and dry wells)
- Components
 - Edge treatment
 - Utility Clearances
 - Inlet/curb cuts
 - Outlet/Overflow
 - Underdrain

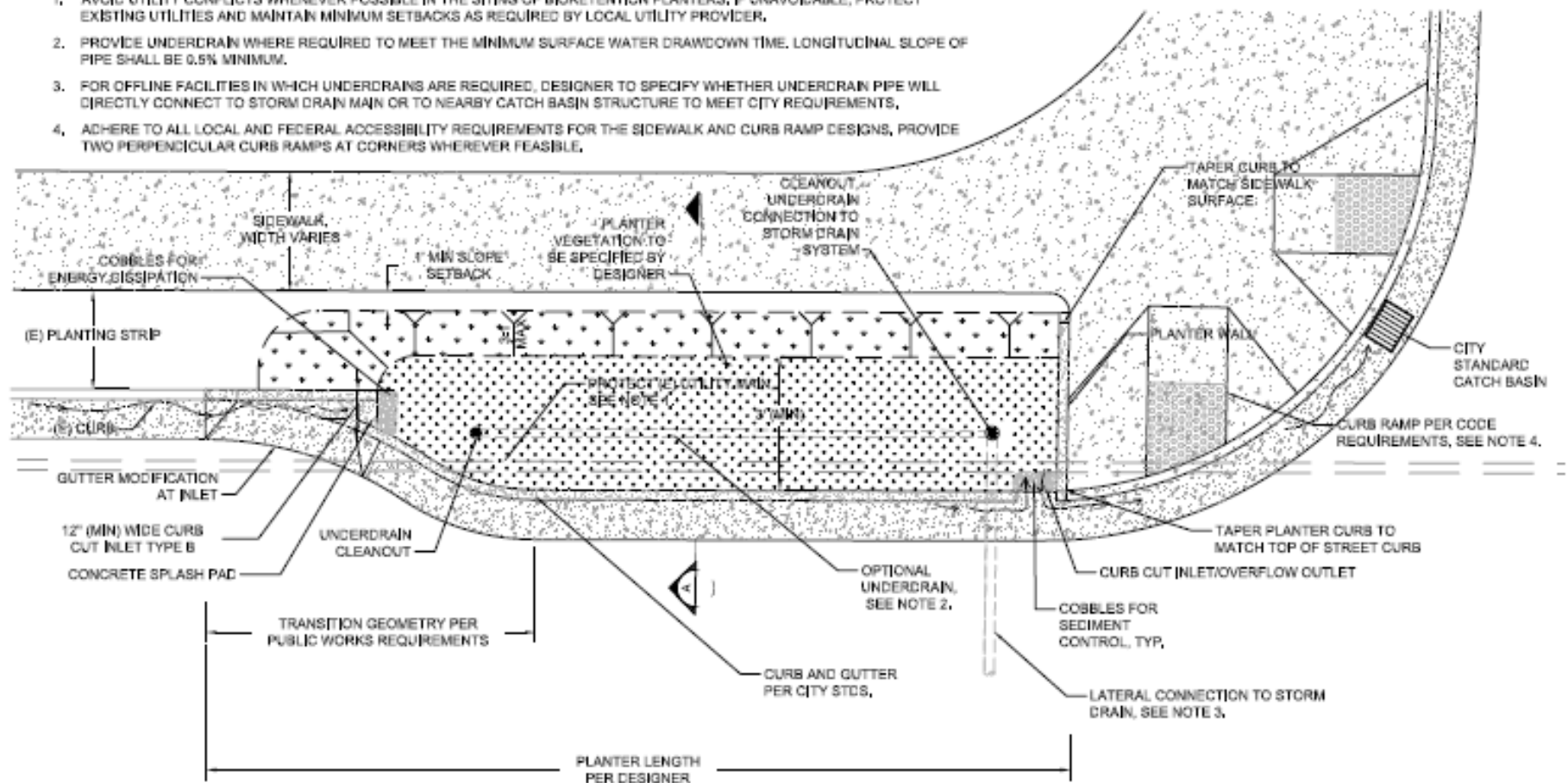
Part 2: Details & Specs

- Reviewed by SCVURPPP member agencies
- Series of workshops
- Now focusing on SFPUC, BASMAA and Central Coast LIDI details
- Revise for SCVURPPP typical details (early 2019)



NOTES:

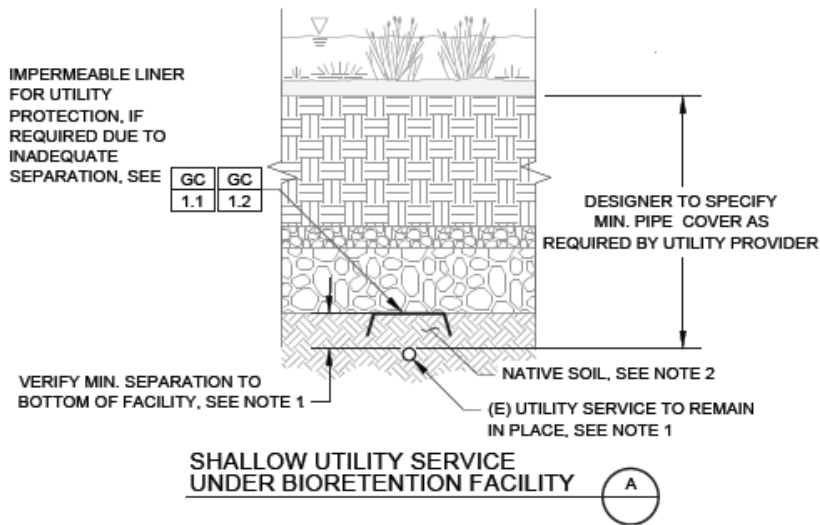
1. AVOID UTILITY CONFLICTS WHENEVER POSSIBLE IN THE SITING OF BIORETENTION PLANTERS. IF UNAVOIDABLE, PROTECT EXISTING UTILITIES AND MAINTAIN MINIMUM SETBACKS AS REQUIRED BY LOCAL UTILITY PROVIDER.
2. PROVIDE UNDERDRAIN WHERE REQUIRED TO MEET THE MINIMUM SURFACE WATER DRAWDOWN TIME. LONGITUDINAL SLOPE OF PIPE SHALL BE 0.5% MINIMUM.
3. FOR OFFLINE FACILITIES IN WHICH UNDERDRAINS ARE REQUIRED, DESIGNER TO SPECIFY WHETHER UNDERDRAIN PIPE WILL DIRECTLY CONNECT TO STORM DRAIN MAIN OR TO NEARBY CATCH BASIN STRUCTURE TO MEET CITY REQUIREMENTS.
4. ADHERE TO ALL LOCAL AND FEDERAL ACCESSIBILITY REQUIREMENTS FOR THE SIDEWALK AND CURB RAMP DESIGNS, PROVIDE TWO PERPENDICULAR CURB RAMPS AT CORNERS WHEREVER FEASIBLE.



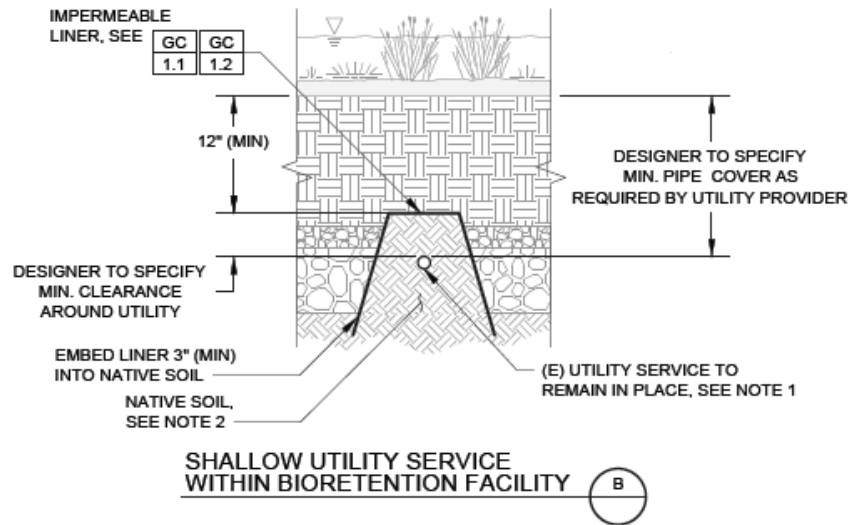
**BASMAA URBAN GREENING TYPICAL GI DETAILS
BULBOUT ALTERNATIVE 3**

SLOPED AND WALLED SIDES, CURB CUT INLET TYPE B, CURB CUT OVERFLOW ONLY

DATE 14	DATE APRIL 14, 2017
DESIGNED BY M	SHEET NUMBER C-13
CHECKED BY SD	



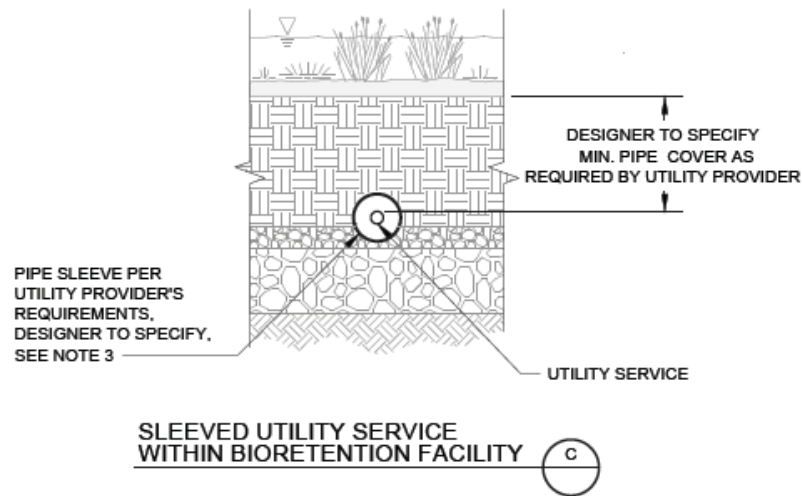
SHALLOW UTILITY SERVICE UNDER BIORETENTION FACILITY (A)



SHALLOW UTILITY SERVICE WITHIN BIORETENTION FACILITY (B)

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, POTHOLING, 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.



SLEEVED UTILITY SERVICE WITHIN BIORETENTION FACILITY (C)

NOTES		BIORETENTION			PERMEABLE 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

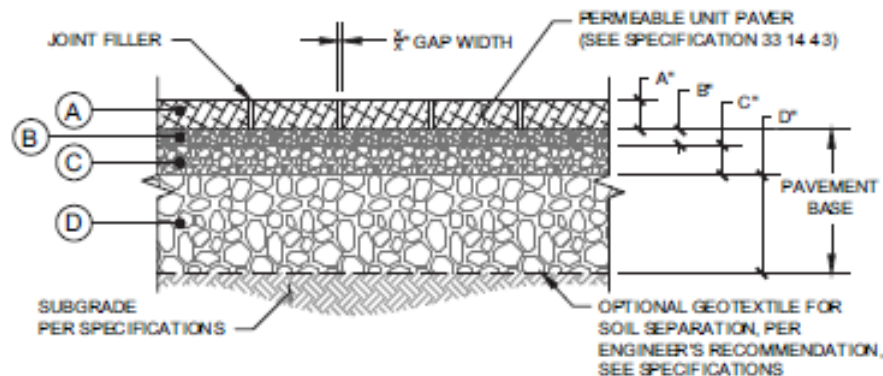


**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
SAN FRANCISCO PUBLIC UTILITIES COMMISSION

DATE: SEPTEMBER 2016
VERSION: 2.0
REVISED:

**GENERAL COMPONENTS
UTILITY CROSSINGS
BIORETENTION SECTIONS (1 OF 2)**

DWG NO. **GC 2.4**



PERMEABLE UNIT PAVERS 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)	PERMEABLE UNIT 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	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 POROUS PAVERS ONLY, ASTM NO. 20 SAND NOT ALLOWED PER MANUFACTURERS RECOMMENDATIONS.

CONSTRUCTION NOTES:

- SEE PERMEABLE/POROUS UNIT PAVER SPECIFICATIONS FOR WEARING COURSE, PAVEMENT BASE, SUBGRADE, AND OTHER REQUIREMENTS FOR PERMEABLE/POROUS UNIT PAVER FACILITIES.
- MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT SFPUC ASSET PROTECTION STANDARDS 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



**GREEN INFRASTRUCTURE
TYPICAL DETAILS**
SAN FRANCISCO PUBLIC UTILITIES COMMISSION

DATE: SEPTEMBER 2016
VERSION: 2.0
ISSUED:

**PERMEABLE PAVEMENT
MATERIAL SECTIONS
PERMEABLE UNIT PAVERS**

DATE:

**PP
2.1**

Part 2: Details & Specs

- Municipal GSI Plans will
 - Reference Handbook
 - Incorporate into local standards (modified as needed)
 - Combination
 - Incorporate most commonly used details
 - Reference others

Contact Information

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