Green Infrastructure Design Guide

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SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
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C/CAG Stormwater Committee

GreenSuite Update

Two documents

- **Green Infrastructure Design Guide –** Covers buildings, sites, parking lots, and streets

- **Regulated Projects Guide –** Updates C.3 Technical Guide to be consistent
  - Look and feel
  - Terminology reorganizing the GreenSuite

GI Committee comments – Feb 22

Additional input from Stormwater Committee

GI Plan Requirements (C.3.j.i(2))

General guidelines for overall streetscape and project design and construction…The guidelines should call for the Permittee to coordinate…street improvement projects so that related improvements are constructed simultaneously to minimize conflicts that may impact green infrastructure.

Standard specifications and, as appropriate, typical design details and related information necessary…to incorporate green infrastructure into projects…

Green Infrastructure Design Guide Chapters

Chapters	Content
1. Introduction	• Previously Policy and Overview Guide • Stormwater Basics, Regulations & Policies, Function
2. GI Measures and Opportunities	• 13 GI types • When to use, benefits, constraints, considerations
3. Introduction to the Design Strategies and Guidelines	• Design strategies and guidelines (general, buildings/sites and streets) • Design examples for buildings/sites and streets • Design elements and process for streets • Complete streets primer and integration into Sustainable Streets
4. Key Design and Construction Considerations	• Focused considerations for design/construction in specific conditions and applications
5. Key Implementation Strategies	• Costs • Policy and incentives • Education/outreach
6. Operations and Maintenance	• O&M Recommendations (Hardscape and Landscape)

Green Infrastructure Design Guide Appendices

Chapters	Content
1. Glossary	• Definitions of key technical phrases
2. Reference Documents	• Alphabetical listing of references compiled from Design Guide Chapters
3. Sustainable Streets Typical Design Details	• How to use typical design details, customization • SFPUC and select new/modified SFPUC/Other details *(SFPUC and list of new details previously reviewed by GI Committee)*
4. Sustainable Streets Specifications	• Pervious Pavements • Bioretention • Composted Mulch • SFPUC and Bay Area Pervious Concrete
5. Sample Maintenance Plan Forms	• Landscape Stormwater Facility Maintenance Checklist • Pervious Pavement Maintenance Checklist
6. Potential GI Funding Source Analysis & Recommendations	• Final GI Funding Report, prepared by SCI Consulting Group

Sample Sections

1.1 Sustainable Stormwater Design Basics

Sustainable Stormwater Measures

▲ *Disconnected downspouts reduce runoff from entering the storm drain.*

▲ *Permeable pavement and stormwater planters provide an attractive environment throughout the year.*

A range of measures can be used for stormwater management and treatment. There are site design measures that reduce the land disturbance and minimize the amount of impervious surface directly connected to the storm drain system. There are also source control measures or "good house-keeping practices" to prevent stormwater pollution, such as maintaining trash enclosures, street sweeping and maintaining inlets and catch-basins. Finally, there are stormwater treatment measures or "structural controls" that are designed to capture, store, and/or treat urban runoff. These include bioretention, street trees, and pervious paving, to name a few. The primary focus of the Design Guide is to provide design guidance and strategies for these types of structural stormwater measures.

To simplify the analysis of green infrastructure opportunities in San Mateo County, the Countywide Program has developed a three-tier typology of sustainable stormwater measures, including Green Streets, Site-based Low Impact Development (LID), and Regional Capture Projects. This typology was developed in the San Mateo Countywide Stormwater Resource Plan (completed in 2017) to prioritize and visualize green infrastructure opportunities in all feasible public rights of way and publicly owned parcels in the county. Below are examples of existing or conceptual projects across the three categories in San Mateo County.

Regulated and Non-regulated Projects and Treatment Measures

Green Street

The City of Burlingame was awarded a Metropolitan Transportation Commission One Bay Area Grant to implement a complete street project to calm traffic by converting a 4-lane roadway with sharrows into a 2-lane road with center turn lane and buffered bike lanes. The City also provided funds towards the project costs. Stormwater curb extensions with ADA ramp and crosswalk improvements are provided at street intersections to improve pedestrian safety crossing the streets. While the project was determined to not be a Regulated Project, the city voluntarily included the nine stormwater curb extensions to manage and treat stormwater runoff. Due to the limitations of the project and the available space for the green infrastructure, the resulting stormwater facilities are undersized to handle the full amount of runoff from the drainage area. What water that is not captured by the stormwater curb extensions flows into overflow structures within them or out of the facility and into new or existing drop inlets downstream. The stormwater curb extensions use biotreatment soil and the depth of the bioretention soil is greater around the trees to accommodate the larger root ball size of the tree and to provide more soil for the tree's roots and improved health. This approach to green street design is appropriate in more dense and urbanized areas of San Mateo County.

Sample Sections

1.1 Sustainable Stormwater Design
Sustainable Stormwater Measures

Regulated Building and Site Project

Lyngso Garden Materials, at 345 Shoreway Road in San Carlos, California, uses curb cuts and rain gardens adjacent to parking lots and disconnected building downspouts directing roof rainwater into raised bioretention planters to collect and treat runoff, as well as perform water harvesting to use the rain for irrigation. Building and site projects that are less dense typically use these types of bioinfiltration or bioretention areas in parking lots and around buildings.

Regional scaled Park

No regional scale projects have been constructed to-date in San Mateo County. However, Orange Memorial Park in the City of South San Francisco has received a state grant and Caltrans funding to design and implement a multi-jurisdictional regional stormwater capture project. Subsurface infiltration chambers are planned under athletic fields to capture, store, and infiltrate stormwater that drains from portions of South San Francisco, Colma, Daly City, and unincorporated San Mateo County. Other green infrastructure measures may be used as well. Improved water quality with the use of pretreatment measures, recharged groundwater, and community enhancement are amongst the benefits of this project. This project would also aid in alleviating flooding in the lower reaches of Colma Creek.

Example concrete infiltration chamber

Sample Sections

CHAPTER 2

2.0 Green Infrastructure Measures and Opportunities
Introduction

A Visual Guide of Green Infrastructure Measures

Stormwater Planters

Stormwater Curb Extensions

Rain Gardens

Tree Wells

Infiltration Systems

Pervious Pavement

Green Roofs

Rainwater Harvesting

Vegetated Swales

Green Gutters

Stormwater Trees

Interceptor Trees

Green Walls

Table 2.1 Green Infrastructure Measure Site Applicability

Green Infrastucture Measures	Guidance Location	Suitable Green Infrastructure Location				Regulated Project Type		Primary and Secondary Functions				
		Site	Parking Lot	Building	Street	Stand-alone Treatment	Element of Treatment Train	Infiltration [1]	Bio-Retention	Pollutant Removal	Interception	Detention
Stormwater Planter[2]	2.1	●	●		●	●		■ / □	■	■	□[3]	■ / □
Stormwater Curb Extention	2.2		●		●	●		■ / □	■	■	□[3]	■ / □
Rain Garden	2.3	●	●		●	●		■ / □	■	■	□[3]	■ / □
Tree Well	2.4	●	●		●	●		■ / □	■	■	■	■ / □
Infiltration Systems	2.5	●	●		●	●		■ / □	□	■		■ / □
Pervious Pavement	2.6	●	●		●	●	●			■		■ / □
Green Roof	2.7			●		●[4]			■	■	■	
Rainwater Harvesting[5]	2.8	●	●	●		●						■
Vegetated Swale	2.9	●	●		●		●	■ / □		□	■ / □	
Green Gutter	2.10	●	●		●			■ / □	□	□		
Stormwater Tree	2.11	●	●		●			■ / □	□		■	
Interceptor Tree	2.12	●	●	●	●					□	■	
Green Wall	2.13			●					□	□	■	

Endnotes

1. Where site-specific percolation tests confirm that an infiltration rate of 0.5/hour is realistic, see **Regulated Projects Guide** for further discussion.
2. Alternative Term: "Bioretention Swale" – linear bioretention areas, not the same as "Vegetated Swale".
3. Primary Function if trees are included in design.
4. If built to specifications approved by Regional Water Board.
5. Includes cisterns, rain barrels, and other measures and strategies for maximizing use of rain water for non-potable uses such as toilet flushing or landscape irrigation.

Legend

- ● Applicable Green Infrastructure Measure
- ■ Primary Function
- □ Secondary Function
- ■ / □ Primary or Secondary Function Depending on Site Conditions and Design

Sample Sections

CHAPTER 2

2.1 Green Infrastructure Measures and Opportunities
Stormwater Planters

▲ *This is a flow-through planter in a pedestrian plaza space that still allows for street trees.*

▲ *A stormwater planter integrated within a series of seatwalls elegantly manages stormwater runoff in areas of grade change.*

Opportunities for Buildings and Sites

Stormwater planters are a good candidate for building site applications to manage stormwater because they can often fit between pedestrian walkways, up against building alcoves, and between utilities, trees, and building furnishings. As long as there is a viable way to protect building foundations from direct contact of water and provide safe overflow conditions, flow-through stormwater planters can be placed directly against building facades and can be of varying shapes and sizes. They can also be placed offset the building foundation and used for bioretention or direct infiltration of stormwater providing soil conditions are favorable for infiltration.

▲ *This stormwater planter at a high-density residential complex accepts building runoff and integrates a seating boardwalk over the landscape.*

Opportunities for Parking Lots

Stormwater planters can also be an effective design tool for parking lot applications. Parking lot stormwater planters can be designed to take the place of a few parking spots in the form of landscaped islands, or they can fit in the long, narrow space between the front-ends of parking stalls within the medians or perimeter zones of parking lots. Because parking lots generally lack shade from tree canopy, it is best to create large enough planters to manage stormwater and support larger shade trees.

▲ *This parking lot features a narrow infiltrative stormwater planter with a series of metal check dams that help slow and retain runoff.*

▲ *A stormwater planter within a parking lot's landscape island.*

▲ *A narrow stormwater planter on the edge of a parking lot.*

▲ *A stormwater planter within the interior median of a parking lot.*

Sample Sections

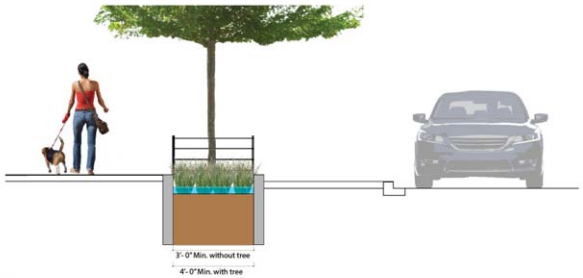
2.1 Green Infrastructure Measures and Opportunities
Stormwater Planters

▲ *A stormwater planter separates both bicycle and pedestrian circulation from vehicular traffic.*

▲ *This arterial street without on-street parking was retrofitted with a series of stormwater infiltration planters.*

Opportunities for Streets

Stormwater planters are very useful in new and retrofitted complete streets, because they provide benefits for all users of streets. They make excellent street retrofits where spatial conditions are constrained, such as locations where on-street parking demand is high, and/or if there is competion for space with street trees or utilities. Because of their versatility in size and shape, stormwater planters can be designed to capture significant runoff when built in a series along a street (i.e., "treatment train"), inserted between driveways, pedestrian walkways and other street elements. Stormwater planters can be incorporated in many street types and contexts with the exception of more rural, suburban, and industrial locations or where sidewalks do not have enough space to accommodate them or they if they have the appearance of too much hardscape for the surrounding context. Stormwater planters typically occur behind the curb, in the sidewalk, but in in shared streets, stormwater planters can be placed between the vehicle drive area and the primary pedestrian zone, as well as between vehicle travel lanes for traffic calming purposes. They can also be sited in medians and other islands in the roadway, if drainage patterns support these locations. In these scenarios, curbs or other techniques should be used to prevent vehicles or cyclists from entering the stormwater planter.



▲ *A stormwater planter located along a street should maintain at least a 3' width of vegetation, 4' minimum if the planter is also supporting a small street tree. Depending on the tree species, even wider stormwater planters may be required.*

Special Considerations for Stormwater Planter Design

Because stormwater planters are placed in areas that often have space constraints and near adjacent structures, the following design thoughts should be considered:

- Pedestrian access, perpendicular to the street, or where on-site circulation requires, will need to be provided across or through stormwater planters. This can be achieved with breaks between the planters, bridges, or other techniques.
- In lieu of breaks between planters for pedestrian access, stormwater planters can be bridged with grates, boardwalk, or pedestrian bridges to increase space provided for pedestrian travel, seating, or other pedestrian or transit infrastructure.
- Planters must be wider and deeper if a tree is planted in them. The size of the tree root ball and the number of trees in proportion to the planter must be considered to ensure that there is adequate space to plant the tree and that there is an adequate amount of soil in the planters to achieve C.3 credit.
- For street applications, sidewalks (the space between the back of curb and right of way/ property line) must be wide enough to accommodate minimum widths of a step out area, the stormwater planter, and the sidewalk. Sidewalk widths should be sized based on context and level of pedestrian use, as well as minimum path of travel requirements.
- For parking lot conditions, there should be wide enough space between a parking stall edge and a stormwater planter for people to enter and exit their vehicles without having to step onto or over stormwater planter. Egress widths should be sized based on context and level of pedestrian use, and, at least, the minimum path of travel requirements.
- Because planters have a vertical drop in grade to manage stormwater volumes, edge treatments and/or low railings are often utilized in the stormwater planter's design to help pedestrians detect the grade change from the walking surface to the planter's finish grade of soil (see section 4.1 General Design Strategies and Guidelines for additional information on planter edge treatments).
- For building applications, stormwater planters can be either elevated or in-ground to receive rooftop runoff.

▲ *Pedestrians can cross over stormwater planters using bridges or metal grates without sacrificing surface landscape space.*

▲ *Streets with on-street parking should have paved step out zones and frequent perpendicular access points to the sidewalk zone between planters.*

▲ *Where there is significant drop in vertical grade, stormwater planters can use raised edges and/or perimeter low railings to allow pedestrians to detect the drop in grade.*

Sample Sections

CHAPTER 3

3.6 Sustainable Streets Design Examples

NEVUE NGAN ASSOCIATES

▲ *EXISTING: A typical multi-lane thoroughfare in San Mateo County. [Nevue Ngan Associates]*

GOOGLE

▲ *EXAMPLE: This street uses tree wells linked with pervious paving or landscape areas.*

Mixed Use Throughway with Tree Wells

Street trees can aid in reducing the perceived width of thoroughway to calm traffic, as well as reduce heat island effect, and buffer pedestrians from fast moving traffic. The use of tree wells can add a water quality infrastructure component to trees along streets. Tree wells can be placed where there is space to maintain an adequately sized clear sidewalk space for the amount of people walking along the street. To expand stormwater treatment and storage and provide improved tree root area, the use of modular suspended pavement systems or linked tree wells should be considered. The addition of bike lanes or road diets should be considered as part of street improvements.

CDM

▲ *RETROFIT OPPORTUNITY: The same commercial street with tree wells to capture and treat stormwater runoff and bike lanes to define space for cyclists.*

Neighborhood Connector Street with Vegetated Swale and Stormwater Planters

Often, rural connectors are designed with no curb or with gutters that double as mini-swales to collect and direct stormwater. Not only do impervious surfaces contribute to the runoff, but rolling hillsides and steep terrain where rainfall cannot fully infiltrate into the soil can also concentrate runoff. Where a street is adjacent to open space is an ideal location for a vegetated swale with check dams to collect both impervious and open space flows. Curb extensions within parking lanes can also collect and treat stormwater while providing traffic calming and a buffer between pedestrians and motorists and adding to the landscaped character of the surrounding rural open space context.

CDM

▲ *RETROFIT OPPORTUNITY: The same street with a combination of a vegetated swale and stormwater curb extensions.*

CDM

▲ *EXISTING: A typical rural residential street in San Mateo County.*

NEVUE NGAN ASSOCIATES

▲ *EXAMPLE: This neighborhood connector incorporates a vegetated swale with check dams to reduce velocities on a sloping street.*

Sample Sections

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

Low-Density Residential Vegetated Swale Example

Small, linear front and back yards in low-density residential settings can be strong candidate sites for directing roof downspout runoff into vegetated swales. Simply disconnecting downspouts, re-grading the landscape, and planting with drought-tolerant plant species can retain stormwater runoff on site during the wet season and become a beautiful dry garden during summer months.

▲ *EXISTING: A typical low-density residential home front yard in San Mateo County.*

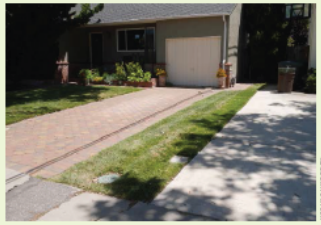
▲ *EXAMPLE: An example residential yard rain garden captures roof runoff and features low-water plant communities.*

▲ *RETROFIT OPPORTUNITY: The same residential yard that converts un-watered grass areas into a rain garden with drought-tolerant landscaping. Roof downspouts direct water into the rain garden and a bridge connects the spaces.*

Low-Density Residential Stormwater Planter Example

Another possibility to direct roof downspout runoff into landscape area next to driveways or alongside residential homes is to use stormwater planters. These planters do not have to be very deep and any excess runoff that can't be managed can overflow over the low points in the landscape.

▲ *RETROFIT OPPORTUNITY: The same residential landscape that converts a grass areas into a stormwater planter with drought-tolerant landscaping.*



▲ *EXISTING: A typical side landscape separating two residential properties in San Mateo County.*

▲ *EXAMPLE: An example residential stormwater planter that captures roof runoff first into a rain barrel and an excess runoff is directed to a stormwater planter.*

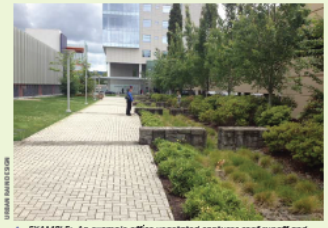
Sample Sections

3.3 Design Strategies and Guidelines
Buildings and Sites Design Examples for San Mateo County

Commercial Vegetated Swale Example

Simpler vegetated swales can also be placed along the frontages of many low-performing landscapes in San Mateo County. These landscape areas can often be retrofitted between existing vegetation such as perimeter shrubs and existing street trees.

▲ *EXISTING: A typical office side landscape in San Mateo County.*



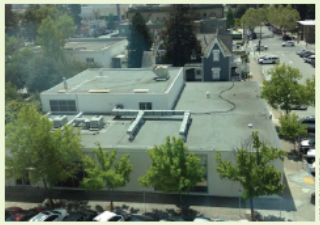
▲ *EXAMPLE: An example office vegetated captures roof runoff and features a pervious paver sidewalk.*

▲ *RETROFIT OPPORTUNITY: The same office perimeter landscape converts un-watered grass areas into a vegetated swale with drought-tolerant landscaping. Roof downspouts direct water into the vegetated swale.*

Commercial/Industrial Green Roof Example

New and existing commercial, office, and industrial buildings can utilize green roofs to limit the amount of on-site stormwater runoff. If using lighter-weight extensive green roof technology, many of these existing building types can be retrofitted with minor structural enhancements depending on the building design and age.

▲ *RETROFIT OPPORTUNITY: The same commercial/office building rooftop with a light-weight extensive green roof application.*



▲ *EXISTING: A typical commercial/office building rooftop in San Mateo County.*

▲ *EXAMPLE: An office building with an extensive green roof application.*

Sample Sections

4.8 Key Design and Construction Considerations
Capturing and Conveying Rooftop Runoff

▲ *A simple residential downspout disconnection directs roof runoff into a front yard.*

▲ *An artful rainwater conveyance system from an office rooftop.*

Residential Downspout Disconnection

Downspout disconnection is one of the simplest ways that a homeowner, even one with a small yard, can help with stormwater management. Many residential downspouts in San Mateo County are connected to a municipal storm drain system. Disconnecting the downspouts and directing runoff onto front, back, or side landscape areas slows and filters rainwater and lets it absorb into soils. Downspout disconnection can be easily integrated with rainwater harvesting or new bioretention areas such as rain gardens, stormwater planters, and vegetated swales.

Creative Routing of Stormwater Runoff

Unlike conveying water on the ground surface, directing rooftop water to the ground plane considers gravity and allows for considerable flexibility and creativity on how and where water can be moved. Water can sheet down surfaces, spill over cascading terraces, move through a series of runoffs, drip down rain chains, or be integrated into rainwater artwork.

▲ *This plaza space in Portland, Oregon directs roof runoff via a series of granite paver channels allowing water to flow through the joints of the pavers until it reaches the landscape.*

▲ *An art installation that showcases the movement of water from a schoolyard rooftop into a stormwater landscape.*

▲ *This rain garden was strategically placed to capture the roof runoff from an existing roof downspout already integrated into the wall of the building.*

▲ *A roof downspout is disconnected and routed "aqueduct style" into a rain garden at UC Davis.*

▲ *A beautiful channel system directs rainwater over a lighted art installation.*

▲ *A "fish ladder" conveys roof runoff into a stormwater landscape avoiding the trash receptacle area.*

Sample Sections

5.1 Key Implementation Strategies
Reducing Project Costs

◀ *An interpretative sign illustrating the Laurel Elementary Safe Routes to School Sustainable Stormwater Project in San Mateo.*

Strategies for Reducing Project Costs

Since the major opportunity in San Mateo County is to retrofit the existing built environment, the overall goal should be to reduce costs as much as possible and deliver additional non-stormwater-related benefits when applying design solutions. In general, retrofitting building, site, street, and parking lot projects is costlier than implementing new development projects simply because the former has site constraints that must be addressed. For example, there are often extra costs associated with removing existing concrete or asphalt in order to make way for new green space. In some cases, using a "green" approach might cost more, but the ancillary benefits (such as traffic calming, improved neighborhood aesthetics, and a safer pedestrian environment) should also be considered. The following describes four ways to reduce costs when implementing green street and parking lot projects:

Minimize Existing Impacts

One way to reduce construction costs is to minimize the impact to the existing storm drain infrastructure as much as possible and maintain existing storm drain inlet locations. Altering drain inlet locations and installing new storm drains at intersections can be very cost prohibitive in some projects. In many cases, stormwater facilities constructed up-gradient of existing storm drain inlets may require little, if any, alteration to infrastructure. Many green infrastructure projects in Portland, Oregon were built inexpensively because they minimized impacts to the existing piped infrastructure. For example, the NE Siskiyou Green Street project installed two stormwater curb extensions just upstream of the existing stormwater drain inlets and never touched the existing storm infrastructure. By avoiding any such impact, the project's overall costs were reduced significantly.

Look for High-Opportunity Projects

When searching for cost effective building, site, street, and parking lot projects, look for candidate sites that have minimal site constraints and maximum space for stormwater facilities. In some cases, there is available landscape space that can be easily regraded and planted to provide stormwater management. In other cases, there are streets and parking lots that have excess asphalt area that can be converted into a stormwater facility at minimal cost. High-opportunity projects also include building, site, street, and parking lot projects that have willing stakeholders, agencies, owners, or neighbors that can help provide advocacy or funding for a project.

Keep Design Solutions Simple

During the design phase of building, site, street, and parking lot projects, it is important to keep the design as simple as possible. Highly engineered design solutions can often increase project costs. Remember, green infrastructure relies on a natural, landscape-approach to stormwater management.

One often over-designed component in green infrastructure implementation is the means by which water gets in and out of landscape stormwater facilities. Over-designed inlet structures not only increase project costs, but they often detract from the aesthetics of a project. Keeping the design simple and allowing water to surface flow in and out of stormwater facilities will help keep costs more manageable. Likewise, using only surface overflow to an existing downstream storm drain inlet, when possible, can simplify a project's design and greatly reduce costs.

▲ *Simple rain gardens, such as this example at UC Davis, convert under-utilized landscape area into stormwater facilities. Since the improvements consist largely of regrading and planting, the projects can be very cost effective to build.*

▲ *Laurel Elementary School uses very little piped infrastructure in the design which helped reduce overall design and construction costs.*

▲ *This green street rain garden project was funded in conjunction with a pedestrian safety and traffic calming project.*

Sample Sections

6.2 Operations and Maintenance
Hardscape and Functional Maintenance Activities

▲ *Without a hard splash pad, the soil downstream of this weir is experiencing significant erosion.*

▲ *It appears that the placement of rock prevents erosion, but runoff is moving around the rock and eroding soil.*

Soil Erosion at Entry Points of Runoff

Erosion of soil and movement of mulch is commonly attributed to the lack of solid mulch material and plant root structure within the direct flow path of stormwater runoff. Stormwater flow points such as curb cuts, trench drains, roof downspouts, and downstream check dams and weirs are common areas to find evidence of soil erosion. Erosion is often exasperated in areas of moderate to steeper slopes downstream from curb cuts where water quickly moves along the soil surface.

Simply applying a layer of pea gravel mulch or installing a modular concrete splash pad downstream of check dams, weirs, or curb cuts can often remedy areas of erosion. In some cases, especially in areas of steep slopes adjacent to curb cuts, a concrete pad and side walls may need to be constructed to control the direction of water flow and dissipate energy. With any solution it is important to assure that any addition of mulch or hardscape doesn't prevent the water from entering the landscape areas. The ultimate goal is to direct and slow the water down within the landscape, not impede it from entering it.

Disconnecting roof downspouts into landscape areas such as planters, rain gardens, or even conventional landscaping is an excellent strategy in reducing stormwater runoff. However, the disconnection point between the roof downspout and landscape area is often a source point for erosion. This is also compounded with the vertical force of water moving from the building. Hence, these disconnection points should be observed frequently for erosion.

Methods for controlling water flow at building downspouts are similar to controlling water at curb cuts by providing hard surfaces for routing stormwater and/or hard surface splash zones to dissipate the vertical energy of water from the downspouts. Using concrete, metal, stone, and other hardscape materials can be added as a maintenance activity to better route and/or control the energy of water into landscape areas.

Maintenance Schedule

Routine inspection prior to the oncoming wet season, and after heavy rainfall events, should be done at curb cuts, check dams, weirs, and downspout disconnection areas to notice any signs of erosion of soil or plant damage.

▲ *This is a better curb cut option with hardscape walls and pea gravel mulch to control erosion.*

▲ *A concrete splash pad and pea gravel mulch at the spill point of water reduces the potential of erosion.*

▲ *A roof downspout uses a metal channel to direct roof stormwater into a planter area. It is critical that the planter maintains a rock mulch or concrete splash pad to dissipate the vertical energy of water spilling into the landscape area.*

▲ *A recessed concrete forebay at the end of a trench drain channel helps dissipate energy as water flows into the landscape.*

▲ *A concrete forebay at the street curb cut is placed lower than the gutter grade to disperse water flow.*

▲ *Smaller rock at the flow line of a vegetated swale reduces to potential of erosion.*

Sample Sections

6.3 Operations and Maintenance
Landscape-Related Maintenance Activities

▲ *Without regular weeding maintenance, a stormwater landscape can quickly be overtaken by undesirable plants.*

▲ *Hand weeding, on a regular basis, is the most desirable method for controlling weeds.*

Hand Weeding

Weeds in planted areas, sidewalks, curbs, gutters or pavement are to be removed as the weeds emerge. Hand weeding is the preferred maintenance approach to controlling weeds over using herbicides. With weeding, a consistent weeding schedule must be maintained, so that weed growth does not reach a point where herbicide use would be required. When pulling weeds, it is critical to remove as much of the root system as possible as new weeds can grow from root remnants left behind in the soil. Dispose of weeds off-site. The regular maintenance of a mulch layer will help minimize weeds in planted areas.

The opposite page sidebar illustrates common landscape plants that readily self-sow and grow invasively in San Mateo County. These are to be removed immediately from all stormwater facilities. Refer to the California Invasive Plant Council (Cal-IPC) for more information on invasive species.

Hand Weeding Schedule

Weeding shall occur during regular site visits, or at a minimum of four times per year. All visible weeds are to be removed.

Herbicide Use

Herbicide use should be only used as a method of last resort in response to stormwater landscape taken over by weeds. If necessary, only least toxic herbicides may be used. These include:

- Fatty acid potassium salts (herbicidal soaps e.g. Safer's Superfast Weed and Grass Killer® Dr. Bronner's Peppermint Anti-Bacterial Soap)
- Acetic and citric acids (e.g. Nature's Glory Weed and Grass Killer RTU®)
- Clove, citrus, mint and thyme oil (e.g. Matran II®, Xpress®)
- Low-toxic, low-residual herbicide [e.g. glufosinate-ammonium (Finale®), pelargoic acid (Scythe®)]

Herbicide use shall follow all State restrictions and Manufacturer's directions. Do not use herbicides 48 hours before predicted rain events or use until 48 hours after rain events. Restricted chemical herbicides may not be used under any circumstances.

Pesticide Use

The term pesticide applies to insecticides, fungicides and other substances used to control pests. Pesticides are potentially hazardous to human and environmental health. The necessary precautions must be taken to ensure the protection of the public, maintenance personnel and the environment.

Bay-Friendly Landscaping emphasizes Integrated Pest Management (IPM) practices to control pests and diseases in the landscape. IPM uses cultural, mechanical, physical and biological control methods before using pesticides. Chemical controls are applied ONLY when monitoring indicates that preventative and non-chemical methods are not keeping pests below acceptable levels. Pesticides are not to be applied on a prescheduled basis. When pesticides are required, the least toxic and least persistent pesticide that will provide adequate pest control is to be applied. Least-toxic pesticides have a high LD-50, low residual and narrow range of toxicity. Refer to OMRI (Organic Material Review Institute) for a list of pesticides that meet these requirements.

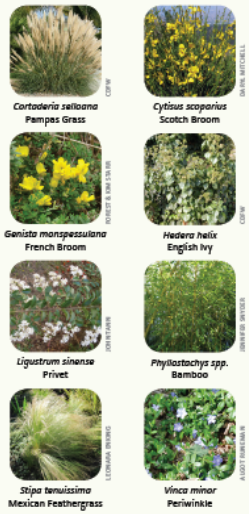
Chemicals should be applied in a safe manner and according to label instructions and local, State and Federal requirements. All chemical applications should be performed by a licensed, trained technician. A Pest Control Operator license is required by the State of California. Additionally, a California Chemical Applicators license is required by maintenance personnel for chemical applications.

Chemical Use Record-Keeping and Reporting

All herbicide and pest management activities should be documented and reported to the Project Site Owner. Each record should include the following information: target pests/weeds, type and quantity of the chemical used, site of the chemical application, date the chemical was used, name of the chemical applicator, application equipment used, and prevention and other non-chemical methods of control used. The pest/weed management record will be submitted to the Owner after any application of chemicals.

A Chemical Work Report shall be completed for each chemical application. A Chemical Usage Report should be submitted to the County Agricultural Department. Copies are to be sent to the Owner's representative as part of the monthly maintenance report, if applicable.

Common Invasive Species



Cortaderia selloana
Pampas Grass

Cytisus scoparius
Scotch Broom

Genista monspessulana
French Broom

Hedera helix
English Ivy

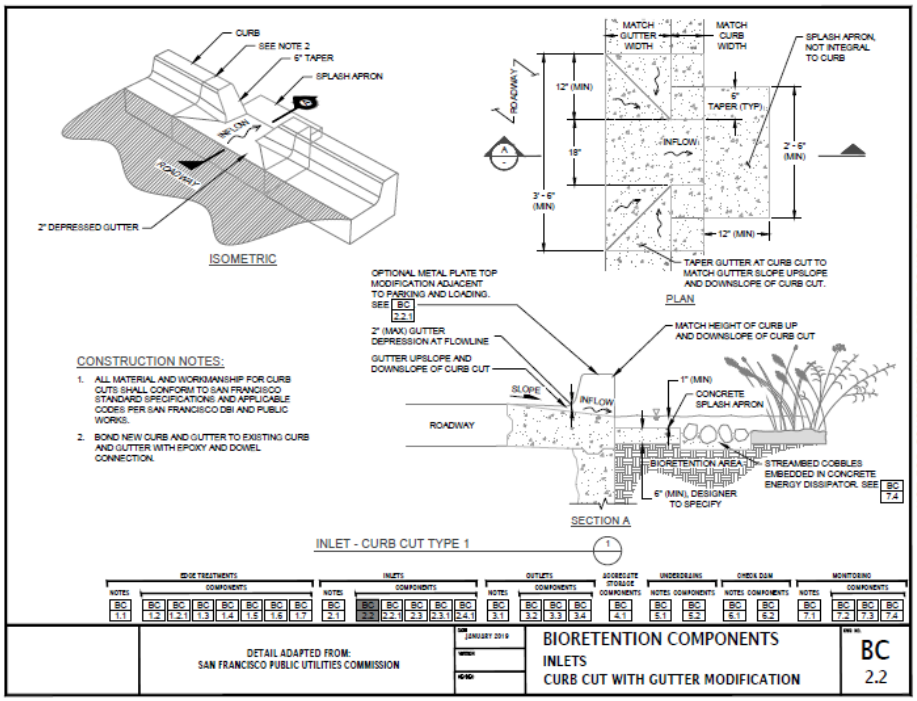
Ligustrum sinense
Privet

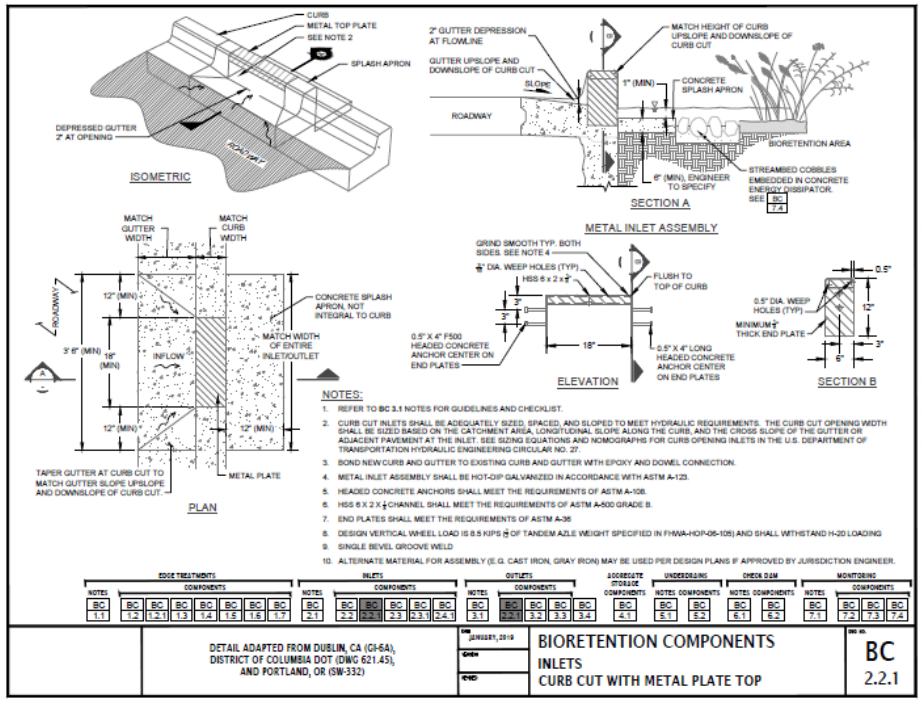
Phyllostachys spp.
Bamboo

Stipa tenuissima
Mexican Feathergrass

Vinca minor
Periwinkle

Sample Appendices





Next Steps

- **GI Design Guide**
  - New and updated sections on Sharefile
  - Written comments due Feb 22
  - Finalize mid-March
- **Regulated Projects Guide**
  - Revise and update
  - Draft provided to GI Committee Spring 2019
- **GreenSuite documents online ASAP for GI Plans**



SAN MATEO COUNTYWIDE
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Clean Water. Healthy Community.
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