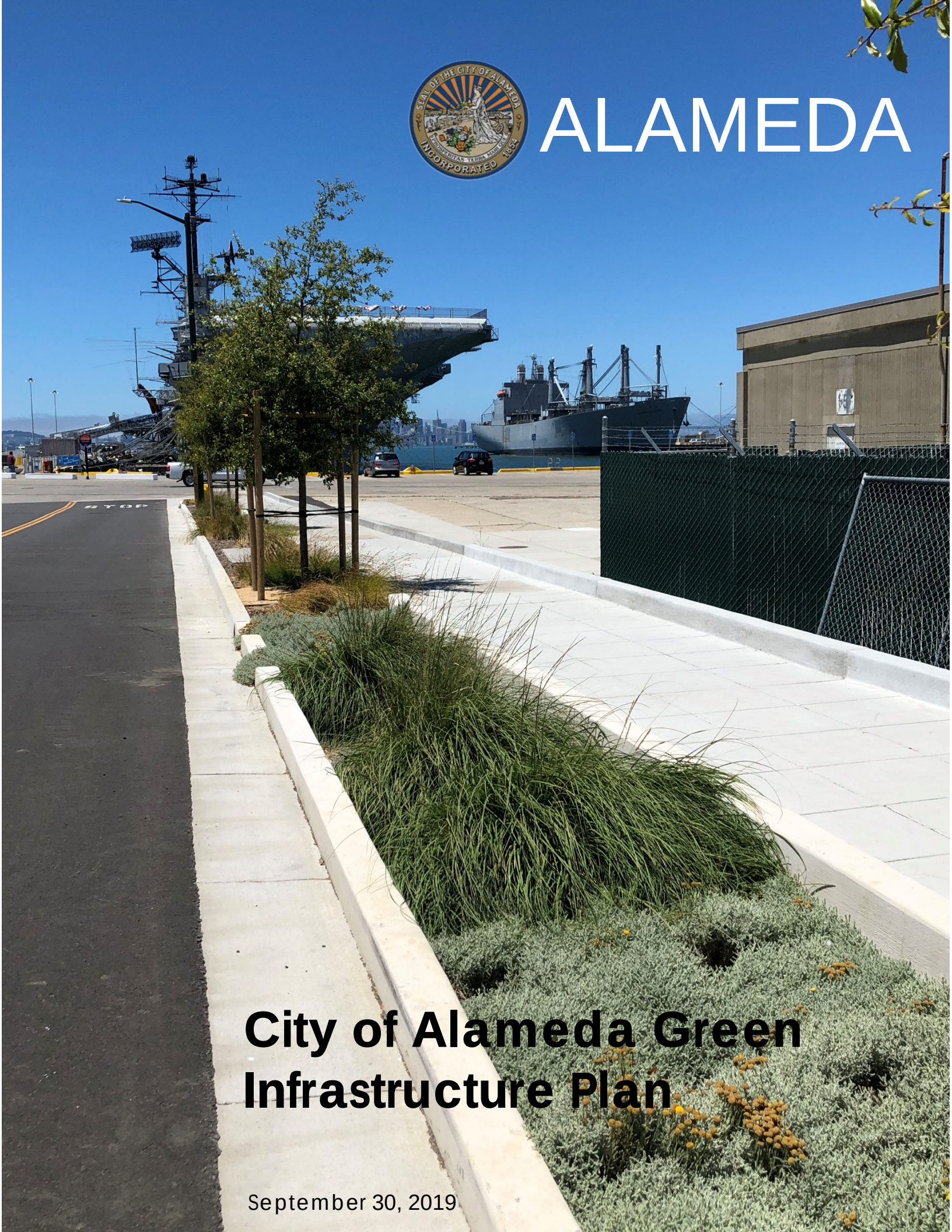

City of Alameda Green Infrastructure Plan

September 30, 2019

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City of Alameda Community Development Department

City of Alameda Planning, Building and Transportation Department staff

City of Alameda Public Works Department staff

Alameda County Clean Water Program

NCE

City of Alameda Green Infrastructure Plan

September 2019

The City of Alameda's Green Infrastructure Plan was prepared in accordance with Provision C.3.j of the Municipal Regional Permit (Order R2-2015-0049). It was adapted from the Alameda Countywide Clean Water Program's Green Infrastructure Plan template for the City of Alameda.

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9/25/2019
Date

Liam Garland
Public Works Director, City of Alameda

9/26/19
Date

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Acronyms

Acronym	Definition
ACCWP	Alameda Countywide Clean Water Program
AGOL	ArcGIS Online
AMC	Alameda Municipal Code
BAHM	Bay Area Hydrology Model
BASMAA	Bay Area Stormwater Management Agencies Association
CARP	Alameda Climate Action and Resiliency Plan
CIP	Capital Improvement Program
DMA	Drainage management area
GI	Green stormwater infrastructure
LID	Low impact development
MRP	Municipal Regional Stormwater Permit
HM	Hydromodification management
MIP	Master Infrastructure Plan
MTC	Bay Area Metropolitan Transportation Commission
PCBs	Polychlorinated biphenyls
RWQCB	San Francisco Bay Regional Water Quality Control Board
SWMP	2015 Alameda Point Preliminary Stormwater Management Plan
TMDL	Total maximum daily load

1. Introduction

1.1 Statement of Purpose

The purpose of this Green Infrastructure Plan is to guide the identification, implementation, tracking, and reporting of green infrastructure projects within the City of Alameda (City), in accordance with the Municipal Regional Stormwater Permit (MRP), Order No. R2-2015-0049, adopted by the San Francisco Bay Regional Water Quality Control Board (RWQCB) on November 15, 2015. "Green stormwater infrastructure" (GI) refers to a sustainable system that slows runoff by dispersing it to vegetated areas, harvests and uses runoff, promotes infiltration and evapotranspiration, and uses bioretention and other low impact development (LID) practices to clean stormwater runoff.

1.2 MRP Requirements

This Green Infrastructure Plan (GI Plan) has been developed to comply with GI Plan requirements in Provision C.3.j of the MRP, which states in part:

> "The GI Plan is intended to serve as an implementation guide and reporting tool during this and subsequent Permit terms to provide reasonable assurance that urban runoff TMDL wasteload allocations (e.g., for the San Francisco Bay mercury and PCBs TMDLs) will be met, and to set goals for reducing, over the long term, the adverse water quality impacts of urbanization and urban runoff on receiving waters. For this Permit term, the GI Plan is being required, in part, as an alternative to expanding the definition of Regulated Projects prescribed in Provision C.3.b to include all new and redevelopment projects that create or replace 5,000 square feet or more of impervious surface areas and road projects that just replace existing impervious surface area. It also provides a mechanism to establish and implement alternative or in-lieu compliance options for Regulated Projects and to account for and justify Special Projects in accordance with Provision C.3.e.
>
> Over the long term, the GI Plan is intended to describe how the Permittees will shift their impervious surfaces and storm drain infrastructure from gray, or traditional storm drain infrastructure where runoff flows directly into the storm drain and then the receiving water, to green—that is, to a more-resilient, sustainable system that slows runoff by dispersing it to vegetated areas, harvests and uses runoff, promotes infiltration and evapotranspiration, and uses bioretention and other GI practices to clean stormwater runoff.
>
> The GI Plan shall also identify means and methods to prioritize areas and projects within each Permittee's jurisdiction, at appropriate geographic and time scales, for

implementation of GI projects. Further, it shall include means and methods to track the area within each Permittee's jurisdiction that is treated by GI controls and the amount of directly connected impervious area. As appropriate, it shall incorporate plans required elsewhere within this Permit, and specifically plans required for the monitoring of and to ensure appropriate reductions in trash, PCBs, mercury, and other pollutants."

Table 1-1 links each section of this plan to the applicable MRP provision.

Table 1-1: GI Plan Sections and Applicable MRP Provisions

Section of GI Plan	Applicable MRP Provision
1. Introduction	C.3.j
2. Prioritizing and Mapping Planned and Potential Projects	C.3.j.i.(2)(a) – (c), and C.3.j.i.(2)(j)
2.1 Approach for Prioritizing and Mapping Projects	C.3.j.i.(2)(a)
2.2 Summary of Prioritized Projects	C.3.j.i.(2)(b)
2.3 Impervious Surface Retrofit Targets	C.3.j.i.(2)(c)
2.4 Prioritized Projects for Alternative Compliance Program or Early Implementation	C.3.j.i.(2)(j)
3. Tracking and Mapping Completed Projects	C.3.j.i.(2)(d) & C.3.d.iv.(1)
4. Summary of General Guidelines for GI Projects	C.3.j.i.(2)(e), C.3.j.i.(2)(f), C.3.j.i.(2)(g)
5. Relationship to Other Planning Documents	C.3.j.i.(2)(h) & (i)
6. Evaluation of Funding Options	C.3.j.i.(2)(k)
Appendix A. Maps and Lists of Prioritized Projects	C.3.j.i.(2)(b)
Appendix B. General Guidelines for GI Projects	C.3.j.i.(2)(e), C.3.j.i.(2)(f), C.3.j.i.(2)(g)
Appendix C. Workplan to Incorporate GI Requirements in Planning Documents	C.3.j.i.(2)(i)

1.3 City Context for GI Planning and Implementation

The regulatory requirements for the creation of this GI Plan are summarized above. Beyond the need for compliance with RWQCB requirements in the MRP, GI planning is essentially a sustainability-initiative focused on stormwater and surface water quality protection and improvement. As further discussed below, the City is actively committed to forward-thinking, sustainability-minded planning. Being an island, the City and Alamedans are firmly aware of and stake great importance in protecting and improving the water quality of San Francisco Bay (the Bay). Consequently, GI planning and implementation aligns with City and community priorities.

1.3.1 Municipal geography and demographics

The City enjoys a convenient inner Bay Area location, situated along the Bay shoreline, adjacent to Oakland and directly east of San Francisco. Easily accessible by BART, Amtrak, ferry, plane, highway or bicycle, Alameda is commuter-, business-traveler and visitor-friendly. With a population of almost 79,000 people, a relatively flat topography, tree-lined residential streets, and historic main street retail districts, Alameda provides bikeable and walkable neighborhoods,

and easy access to a two-plus mile long public beach and shoreline along the open waters of the Bay.

The City was incorporated in 1854 and became a Charter City in 1903. The City was one of the first in California to adopt the Council-Manager form of government, which it retains to the present. Under this structure, the City is governed by a five-member City Council. Programs and services are administered by a City Manager.

The City provides a broad range of services including police and fire protection; construction and maintenance of streets, parks, storm drains and other infrastructure; and recreational and cultural activities. Alamedans are civically active and sustainability-minded, as exemplified by the recently approved Climate Action and Resiliency Plan (2019), discussed further below, that was developed through a multi-year, public stakeholder process.

1.3.2 Economic and Social Trends

The City is committed to achieving economic growth, while at the same time improving the quality of life of Alameda residents and employees. Alameda continues to evolve as a thriving and resilient economy with a range of quality jobs. Efforts to support these economic and social trends include: supporting innovative businesses, entrepreneurs, and artists; providing a wide range of housing; enhancing the vibrancy of retail, restaurants, tourism, and cultural destinations; leveraging the City's unique waterfront assets; improving multimodal local and regional transportation options; and pursuing clean energy solutions, while maintaining a commitment to environmental sustainability, climate action, social equity, and fiscal health.

The City has top-tier business parks and retail centers, as well as opportunity sites to bring quality development to our City. The City's economy includes 5 major industry clusters:

I. High tech & advanced manufacturing
II. Specialty beverage and food production
III. Maritime industries
IV. Alternative energy/biotech
V. Health services

In 2018, the City adopted the City of Alameda's Economic Development Strategic Plan, a policy document that will guide the City's economic development activities over the next five to ten years.

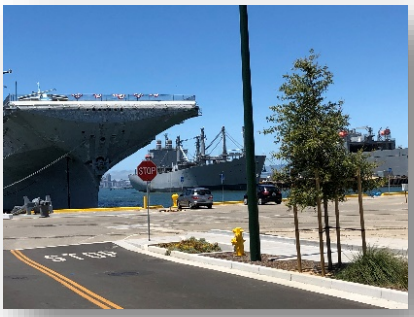
1.3.3 Development and Redevelopment Trends

Although the City is an older, centrally located, small city in the Bay Area, it still offers significant opportunity for new and redevelopment, despite some appearances of having already been built-out decades ago. The City offers Bay-front sites large enough for the development of corporate campuses. Alameda Point (the former Alameda Naval Air Station) provides significant lease and major development opportunities available on hundreds of acres of prime real estate with stunning views of the Bay and the San Francisco skyline. In addition, significant actions and opportunities are underway for redevelopment of the northern waterfront of Alameda, historically focused on maritime and maritime-associated business opportunity.

These development and redevelopment opportunities create potential for GI projects in the City and this is discussed further in Section 2, Prioritizing and Mapping Planned and Potential Projects.

1.3.4 City Watersheds-Characteristics and Challenges

The City is located within the South Bay Basin of San Francisco Bay, as identified by the RWQCB in its formal water quality protection plan-the San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) (RWQCB 2017). Alameda's low-lying shoreline location along San Francisco Bay essentially places it within the watershed of the Bay (Figure 1-1). Excavation of the Alameda-Oakland Tidal Canal connecting the Oakland Estuary with San Leandro Bay was completed in 1901, turning the City into an island. The City's primary surface water features are the Bay itself, including San Leandro Bay, the Oakland Inner Harbor and the Alameda-Oakland Tidal Canal, a few small wetlands on the west end of the City that are primarily associated with federal property formerly the Alameda Naval Air Station, the engineered lagoon systems, the golf course drainage channels and irrigation ponds, and the inter-tidal wetlands fringing some of the City's perimeter. With no other distinct natural watercourses existent in the City presently, the watershed characteristics used to help understand where surface water and stormwater flow are straightforward.



Essentially, all stormwater flows in Alameda are conveyed by surface flows on Alameda streets and within public and private storm drainage systems (i.e., storm drain pipes) to discharge directly to San Francisco Bay. The City's Public Works Department maintains storm drainage system maps that can be reviewed by anyone seeking more detailed information on specific drainage pathways from any given location.

Generally, on the main island of Alameda, the areas south and west of Central Avenue drain to the open San Francisco Bay, including San Leandro Bay, sometimes via the Alameda West

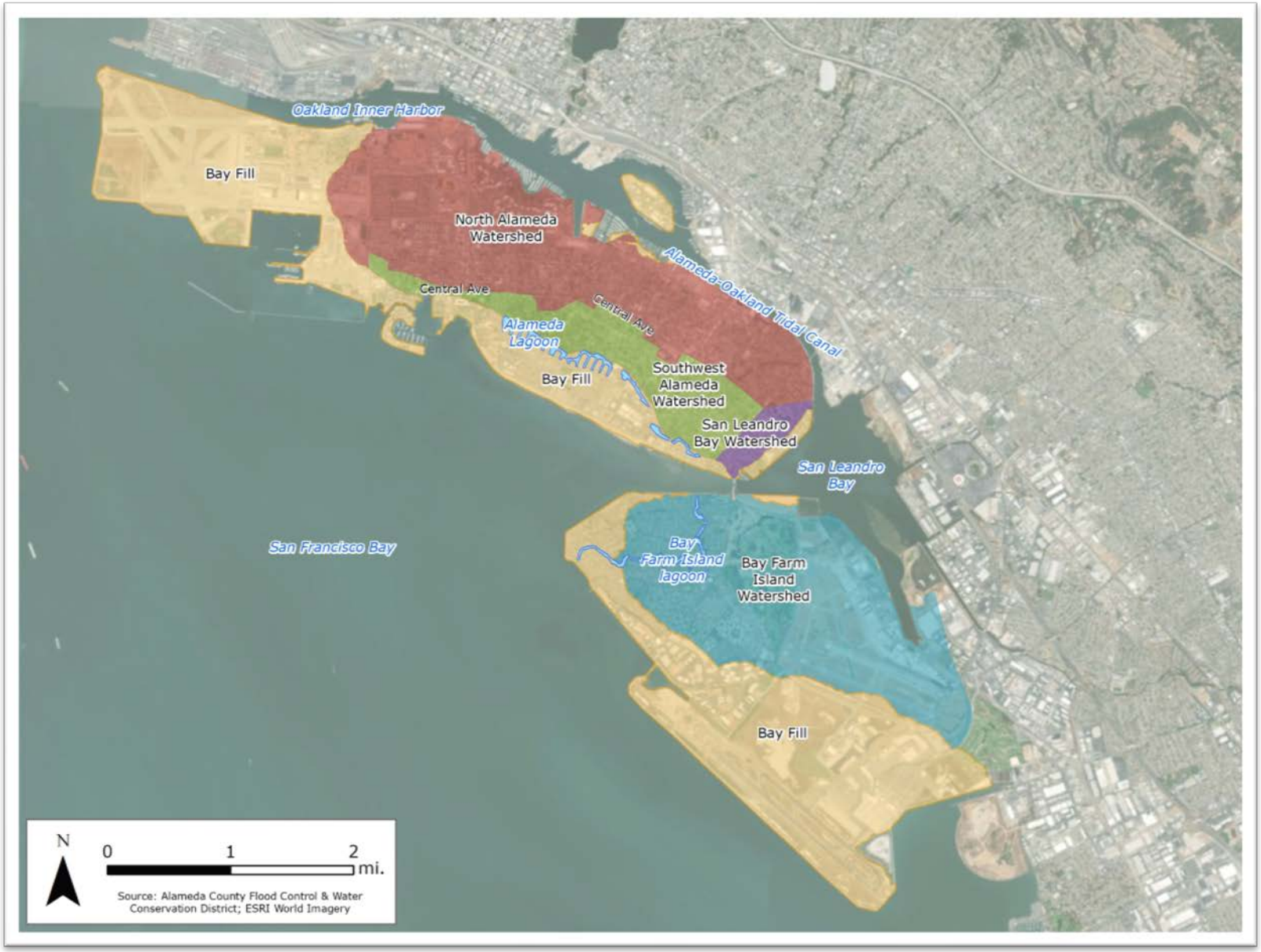


Figure 1-1: Alameda Watersheds

lagoon system. As shown on Figure 1-1, these watersheds are the Bay Fill[1], Southwest Alameda[2], and San Leandro Bay[3] watersheds. Areas north and east of Central Avenue drain to the Oakland Inner Harbor or the Alameda-Oakland Tidal Canal. As shown on Figure 1-1, this includes the North Alameda[4] watershed.

On Bay Farm Island, all areas drain to the open Bay, including San Leandro Bay, either directly in near-shoreline locations or via the lagoon system or the network of drainage channels at the golf course complex.

1.3.5 Flood Protection Challenges

Flood protection planning and infrastructure management is a priority element of City operations and maintenance activities. And, it is an important part of the City's rationale for GI Planning given the potential for GI projects to provide multiple benefits including flood control. The City's low elevation shoreline and dense urban and residential development make it uniquely vulnerable to the potential impacts of sea level rise and increased storm intensities and/or frequencies. The City's stormwater drainage system is critical for preventing roads and neighborhoods from flooding and for protecting people, property and infrastructure during storm events.

Flood protection, long-term sustainability planning, and GI elements can all go hand-in-hand. As an Alameda example, the Veteran's Court project, identified in Section 2 of this GI Plan, is a public project integrating GI concepts. It is intending to upgrade public infrastructure, aid drainage, improve the City's adaptability to sea level rise, include GI elements, increase green space and park area, and can also be viewed as a flood control project.

1.3.6 Commitment and Actions for Sustainability

The City is actively committed to sustainability. The City Council has recently (September 2019) publicly stated the intended aims to be a resilient, sustainable, and vibrant city with low vehicle traffic, well-functioning infrastructure, and beautiful natural amenities.

The Alameda Climate Action and Resiliency Plan (CARP) was approved by the City Council in early September 2019 and is a commitment (and action plan) to resiliency, sustainability, and social equity in efforts to combat climate change and adapt to climate change impacts that we already experience today. The CARP is the result of a significant multi-year process of public input and wide-ranging stakeholder interaction. It includes important emphases on GI and identifies multiple relevant GI concepts, strategies and inter-related co-benefits within its important and broad scope. Multiple benefits are identified such as improved health, better

[1] Bay fill includes areas that were originally open bay or tidal mud flats and were artificially filled to make land. All areas of Bay fill drain directly into the San Francisco Bay or San Leandro Bay-Oakland Estuary, in some places via one of Alameda's lagoon systems.
[2] The Southwest Alameda watershed drains the southwest side of the City from Central Avenue into San Francisco Bay. Most of the watershed drains through Alameda Lagoon, but areas near Crab Cove drain directly to the Bay.
[3] The San Leandro Bay watershed drains small areas along the Bayshore directly into San Leandro Bay.
[4] The North Alameda watershed is a system of storm drains and underground culverts that drains the northern side of the City into the Oakland Estuary.

stormwater runoff management, and a more livable and vibrant community in the efforts to fight climate change and promote sustainability and resiliency.

Specific GI projects, plans, strategies, and concepts highlighted in the CARP to achieve overall resiliency goals include, but are not limited to:

- The Veterans Court Seawall project, an example of adaptation planning. This public project is considering the removal of impervious surface area and the conversion of roadway area to a natural area to aid drainage and increase green space and park area.
- The landscape strategy to transform vast paved areas of Alameda Point into thriving ecosystems by removing the paving and nurturing ecological succession.
- Strategy: Expand GI. Action: Incorporate GI into new city buildings and within parks. Continue to expand GI along roadways as part of a "Complete Streets" design.
- Strategy: Ensure resilience and long-term functionality of stormwater and sewer systems. Action: Encourage the adoption of distributed GI solutions on private property (e.g., rain barrels/rain gardens, pervious pavement). Amend the Alameda Municipal Code to prohibit residents from pouring concrete (or other non-porous material) in planter strips along public roadways.
- The acknowledgement and encouragement of green roof area as an implementation strategy to increase resiliency.
- The potential for multiple GI approaches to manage and treat stormwater at Alameda Point.

The City's commitment to implement GI projects also includes active implementation of new and redevelopment oversight promoting and requiring GI. The City requires developers to develop new streets as green streets and then provide or return ownership responsibility to the City post-development.

The City's Transportation Choices Plan was adopted in 2018 and is intended to provide a framework for implementing future transit and Travel Demand Management projects and programs in the City, with the objective of reducing vehicle use in the City.

The Transportation Choices Plan includes several projects that incorporate GI elements such as planting trees and installing rain gardens and bioswales. The City is also updating its Bicycle and Pedestrian Plans as a new Active Transportation Plan.

Separately, the City has also focused attention on improved stormwater management at Alameda Point. These efforts and goals are discussed and summarized in the City's 2015 Alameda Point Preliminary Stormwater Management Plan (SWMP). The City has been leading a

multi-faceted, phased process to reuse and redevelop Alameda Point. The redevelopment of Alameda Point, including the implementation of the City's approved Master Infrastructure Plan (MIP) will greatly improve stormwater treatment at Alameda Point. The redevelopment will result in converting approximately 250 acres of impervious surface to new open space. The MIP proposes replacement of aging and deficient stormwater infrastructure to meet or exceed current regulatory standards and to account for future sea level rise. And, significantly, the City's MIP in conjunction with the SWMP create a framework to ensure that future infill development at Alameda Point meets and exceeds the LID requirements established by the MRP, establishing higher LID requirements for individual developments, eliminating certain MRP exemptions, and prioritizing the implementation of LID stormwater treatment facilities within the historically-significant Reuse Areas.

For instance, the SWMP identifies the following site design, source control measures, and LID performance standards for current and future site planning at Alameda Point:

- Reduce overall impervious cover;
- Reduce directly connected impervious areas;
- Target high pollutant load areas;
- Capture and/or treat stormwater runoff from impervious surfaces that cannot be eliminated;
- Utilize open spaces for stormwater treatment;
- Construct green streets throughout the entire 878-acre site; and
- Rainwater harvesting and reuse required for 10 percent of roof area.

The City is making significant long-term commitments to maximize stormwater treatment opportunities at Alameda Point and to prioritize the construction of remedial LID facilities.

1.3.7 Funding Sources for Maintenance and for Capital Improvements

As discussed in greater detail in Section 6, Evaluation of Funding Options, the City is currently seeking to address needs for appropriate stormwater funding for the entirety of the City's stormwater management program, also known as the City's Clean Water Program. Providing secure and stable funding for the City to implement (a) essential routine and operational maintenance for the City's existing stormwater drainage system, (b) necessary longer-term capital improvements to the municipal stormwater drainage infrastructure, (c) water quality protection, and (d) coastal flooding and sea level rise protection is a critical task for the City. The City has recently completed a detailed analysis of current and long-term needs to provide adequate revenues to fund all necessary municipal stormwater management activities. Critical program activities include, street sweeping and storm drain maintenance programs, trash capture, flooding protection, associated regulatory compliance efforts, and the pursuit of important storm drainage infrastructure investment to support sustainability initiatives and storm drainage-related climate change, flood control and resiliency programs. Funding needed for GI project implementation is specified within this analysis. In late 2019, the City is advancing Proposition 218-compliant efforts to consider a new property-related stormwater fee, the Water Quality and Flood Protection Fee.

1.3.8 Policies, Ordinances, and Legal Mechanisms

The City's authority to both establish and implement this GI Plan is included in the Alameda Municipal Code (AMC)'s Chapter 18, Article III, Storm Water Management and Discharge Control Ordinance.

The following sections of the AMC provide the City of Alameda's Public Works Director with the authority to implement requirements of stormwater Permit regulations, including the City's current municipal stormwater NPDES Permit, which requires the preparation and subsequent implementation of the GI Plan:

- AMC 18-21.4, Responsibility for Administration (Ord. No. 2605 N.S. § 2), and,
- AMC 18-21.5, Construction and Application (Ord. No. 2605 N.S. § 2)

In addition, AMC 18-22.10, Compliance with Best Management Practices, reiterates the authority of the City's Director of Public Works for compliance with all requirements.

The City believes the AMC provides sufficient authority to implement the GI Plan. In addition, recent City Council action has acknowledged the City's GI Plan as important and essential in the City's commitment to resiliency, sustainability, and the City's efforts to combat climate change. As discussed in Section 1.3., Commitment and Actions for Sustainability, the City Council formally approved, after a multi-year process of significant public input and stakeholder interaction, the City's Climate Action and Resiliency Plan (CARP) in September 2019. The City's CARP identifies and promotes multiple strategies for using GI to increase resiliency. City staff will also be bringing the CARP document and this GI Plan to the City Council in Spring 2020 to report on early implementation results of the CARP and GI Plan.

2. Prioritizing and Mapping Planned and Potential Projects

Section 2 describes the City's planning process used to identify GI projects for inclusion in this GI Plan. This section also provides the output from the planning process, which is a list and corresponding map set identifying the prioritized GI projects, both public and private, anticipated for potential (re-)development within the City by the benchmark years 2020, 2030 and 2040, and impervious area targets for these benchmark years. As required by the MRP, this section follows Provision C.3.j.i.(2)(a), which requires the City's GI Plan to describe the use of a mechanism for prioritizing and mapping GI projects, and provides a summary description of lists of prioritized GI projects and other outputs of the mechanism per Provision C.3.j.i.(2)(b).

2.1 Approach for Prioritizing and Mapping Projects (GI Mechanism)

This section summarizes the City's process and approach for identifying, prioritizing and mapping planned and potential development and redevelopment projects, both public and private within the jurisdiction of the City that will install GI features by the benchmark years 2020, 2030 and 2040. These projects are referred to as GI projects.

The City participated in the development of and has relied on regional projects and tools for initial project identification and on-going project tracking efforts, led by the Alameda Countywide Clean Water Program (ACCWP). The City also applied its knowledge of the active array of private development projects, public-private development partnerships, and on-going public Capital Improvement Program (CIP) planning efforts to provide an expanded inventory of potential and planned GI projects within the City. City planning document references, staff, and additional resources were all relied upon to generate this expanded potential project inventory. Using and screening these multiple regional and City-specific databases and records, a finalized list of GI projects within the City was developed. This process is discussed in more detail directly below. The finalized list of GI projects and the corresponding summary maps of these identified potential and planned GI projects are discussed further in the following section and are presented in Appendix A.

2.1.1 Review of Stormwater Resources Plan Project Opportunities

The ACCWP GI Mechanism was used to initiate the City's efforts to identify and prioritize areas for planned and potential GI projects. The mechanism consists of the ACCWP Stormwater Resource Plan Screening and Prioritization using Multi-Benefit Metrics Technical Memorandum[5]. This mechanism was used by the City to generate a preliminary list (and a corresponding preliminary GIS-based map) of potential, prioritized public GI projects for implementation. The mechanism included criteria for project prioritization and ranking, such as specific logistical constraints, water quality drivers (load reductions of mercury and PCBs consistent with TMDLs), and opportunities to treat runoff from private parcels in street right-of-way (ROW). This

[5] *Geosyntec. 2017. Alameda Countywide Stormwater Resource Plan Screening and Prioritization using Multi-Benefit Metrics Technical Memorandum. December 13.*

preliminary list was then subject to screening by City staff for priority overlap with pre-existing CIP project planning and infrastructure needs assessments.

2.1.2 Review of ACCWP Private Development Projections

The City also participated in a regional process to forecast private development, coordinated through the ACCWP. The process used the outputs of the UrbanSim[6] model developed by the Bay Area Metropolitan Transportation Commission (MTC). MTC forecasts growth in households and jobs and uses UrbanSim to identify development and redevelopment sites to satisfy future demand. The ACCWP process used outputs from UrbanSim to map parcels predicted to undergo development or redevelopment in each Alameda County jurisdiction for the benchmark years 2020, 2030, and 2040. The resulting UrbanSim analysis was used by City staff to screen for priority overlap with pre-existing CIP project planning and infrastructure needs assessments. The City also revised the UrbanSim output based on local knowledge. The outcomes were used as part of the development of estimated impervious area targets for private development in the City.

2.1.3 Review of Known City Planning Efforts

City staff also conducted a comprehensive internal review of known project planning efforts within the City of Alameda to complement the information gained from the ACCWP GI Mechanism and UrbanSim analysis. Staff from the Community Development, Public Works and Planning Departments participated in the process and reviewed public planning documents and the active case files of known public and private development activities, including significant public-private development partnerships, to complete the inventorying of prioritized areas for planned and potential GI projects.

The City of Alameda Sewer Master Plan (2015) summarized projected future new and re-development project planning (for system demand and capacity management assessment) and thus provided an important inventory of anticipated development activity. Reviews of Alameda Point (the former Alameda Naval Air Station) planning documents, including the Alameda Point Master Infrastructure Plan (2014), the Alameda Point Town Center and Waterfront Precise Plan (2014), and the Alameda Point Preliminary Stormwater Management Plan (2015) complemented the Sewer Master Plan assessment for the Alameda Point property area. This includes both private efforts and public-private partnerships and in some cases, site specific Master Plans have also been referenced. City Engineering, Planning, and Clean Water staff input assisted with the screening of these various development and planning documents to assess and identify project sites to include with the GI Project inventory. Public, private, and public-private partnership project sites actively in the project planning "pipeline" met practical prioritization screening criteria and are included in the GI Projects inventory presented below

[6] UrbanSim is a model developed by the Urban Analytics Lab at the University of California under contract to the Bay Area Metropolitan Transportation Commission (MTC). UrbanSim was developed to support the need for analyzing the potential effects of land use policies and infrastructure investments on the development and character of cities and regions. The Bay Area's application of UrbanSim was developed specifically to support the development of Plan Bay Area, the Bay Area's Sustainable Communities planning effort. The methods and results of the Bay Area UrbanSim model have been approved by both MTC and Association of Bay Area Government Committees for use in transportation projections and the regional Plan Bay Area development process.

and in greater detail in Appendix A. This GI Project inventory is the summary output of the City of Alameda's GI project assessment efforts.

2.1.4 Mapping of Potential and Planned Projects

The City has inventoried/identified and mapped both the public and the private development and redevelopment projects anticipated to have GI systems and/or features for the benchmark years 2020, 2030 and 2040. A map showing locations of planned projects is included in Appendix A as Figure A-1 (City of Alameda GI Projects).

As a member agency of the ACCWP, the City uses an ArcGIS online (AGOL) web application-based tool, the C3 Project Tracking and Load Reduction Accounting Tool ("AGOL Tool"), which ACCWP developed in cooperation with the Contra Costa Clean Water Program to assist its member agencies in meeting MRP requirements for tracking and mapping completed GI projects, as required by MRP Provision C.3.j.i.(2)(d). The AGOL Tool is being used by the City to track completed new and re-development projects, both public and private, that include GI/low impact development (LID) features. Those LID projects that have been completed by the close of Fiscal Year 2018-19 have been inventoried within the AGOL Tool and are also shown on Figure A-1 and indicated as the LID Sites.

2.2 Summary of Prioritized Projects (Outputs of the GI Mechanism)

As discussed above, primary outputs of this GI Plan include the identification, inventorying, and corresponding mapping of priority public and the private development and redevelopment projects/sites anticipated to have GI systems and/or features by the benchmark years 2020, 2030 and 2040 (GI Projects). This section provides a summary discussion of these GI Project outputs. The detailed City of Alameda GI Project List, "GI Plan Table A-1", and City of Alameda GI Projects, Figure A-1, are presented in Appendix A.

The City's list of GI Projects, "City of Alameda GI Projects", included in Appendix Table A-1 presents the following information regarding each project:

- Project Name
- Project Location/Address
- Project Description
- Project Type (Parcel-based or Right-of-Way (ROW))
- Development Timeframe
- Ownership (Public/Private)
- Total Project Area
- Impervious Area Treated by GI (estimated)

There is a total of 57 identified priority GI Projects within the City of Alameda included in this list. Of this total, 25 are Public projects and 32 are Private projects. The estimated Development Timeframes for these Projects is summarized as follows:

Ownership	Development Timeframe		
	2020 (# of projects)	2030 (# of projects)	2040 (# of projects)
Public	5	14	6
Private	4	23	5

Refer to Section 2.3 for the presentation of the Impervious Surface Retrofit Targets for these projects. Below is additional information important to some existing and planned public GI projects or groups of projects.

In partnership with a professional golf course management firm, the City's 328-acre municipally owned golf course property is being renovated to the forefront of sustainable property management. The City's Corica Park is a busy 45-hole municipal golf complex with two 18-hole courses, a nine-hole Par-3 course, and a driving range. While much of this area was pre-existing golf course open space, the entirety of the active play areas has been undergoing a thorough renovation, complete with significant GI features and improvements. As a result, the property has significantly reduced its water use, improved stormwater management, and reduced its energy use and carbon emissions. Additionally, the habitat for wildlife has been improved by the introduction of native plantings and additional landscaping features. The Corica Park South Course and Greenway Golf, the firm that manages this public property, were the recent recipients of the (inaugural) 2019 Water and Sustainability Innovation Award, from Audubon International and Ewing Irrigation and Landscape Supply. This nationwide award recognizes a project that addresses sustainability and water efficiency challenges and contributes to a healthy environment.

At Alameda Point on the western end of the City, extensive redevelopment activity is currently underway, including active construction, planning review and approval efforts, longer-term development negotiations, and development financing strategizing for anticipated future projects on a total of 878 acres of former federal military property. Much of this is occurring under what could be described as productive public-private partnerships. Much of the land is presently owned by the City of Alameda, recently conveyed back to the City by the federal government and the U.S. Navy, subsequent to the closure and remediation of the former Alameda Naval Air Station.

While this redevelopment activity is subject to standard stormwater treatment measures requirements of the City's municipal stormwater permit, no redevelopment activity or stormwater quality management improvements are feasible without creative and sound approaches to effectively fund, manage and complete any intended projects. The City's creative and strategic public-private partnership negotiations for redevelopment at Alameda Point have made such projects feasible. The outcomes of these negotiations and development agreements are (1) redeveloped privately-owned blocks of land all subject to necessary LID/GI requirements, (2) and an extensive network of new public green street rights-of-way and utilities, funded and constructed by City's private development partners and/or the City.

The planned redevelopment of the 27-acre Alameda Marina property site along the City's northern waterfront is another example of a public-private partnership. This is a long-term

development project, with a completed and approved Master Plan, which will produce significant new areas of publicly owned property that will have stormwater runoff treated by GI controls, along with new MRP Provision C.3.b-compliant private redevelopment lots and residential and commercial blocks. All of this is negotiated as the agreement and approval terms for the private developer to implement.

In addition to identifying planned GI Projects, the City has also summarized public and private LID projects that have been completed by the close of Fiscal Year 2018-19 (as tracked in the AGOL Tool since 2004). The summary list of these City of Alameda AGOL-tracked completed LID projects is included in Appendix Table A-2, Summary of Previously Completed LID Projects in Alameda. These completed project sites are mapped in Figure A-1 as the Private and Public LID Sites.

Appendix Table A-2 presents the following information regarding each AGOL-tracked and completed LID project:

- Project Name
- Project Location/Address
- Project Description
- Project Type (Parcel-based or Right-of-Way (ROW))
- Ownership (Public/Private)
- Date of Construction Completion

There is a total of 51 AGOL-tracked Completed LID projects in Alameda and listed in Table A-2.

As is demonstrated by these summaries, LID and GI features have been implemented at new and redevelopment project sites throughout Alameda, since 2004. There are significant potential and planned public and private GI Projects anticipated within the City of Alameda through the benchmark years 2020, 2030, and 2040.

2.3 Impervious Surface Retrofit Targets

The City has identified targets for impervious surface, from public and private projects within its jurisdiction (including redevelopment projects regulated under Provision C.3.b of the MRP), to be retrofitted and created by 2020, 2030, and 2040. The targets are presented in Table 2-1.

The time schedules shown in this table are consistent with the timeframes for assessing load reductions for mercury and PCBs specified in Provisions C.11 and C.12 of the MRP. The City is currently participating in a regional effort to perform a Reasonable Assurance Analysis, that demonstrates how GI will be implemented to achieve PCB and mercury load reductions. To the extent that the implementation of this GI Plan may support load reductions for mercury and PCBs, as outputs from the Regional Assurance Analysis become available, the City may revisit the targets presented in Table 2-1. Due to uncertainties related to the funding of public GI projects and the reliability of projections for private development projects, the City will track the progress toward achieving the targets presented in Table 2-1 and identify any challenges that arise in achieving these targets.

Table 2-1: Target Amounts of Existing Impervious Surface to be Retrofitted by 2020, 2030 and 2040 (Acres)

Ownership	Total Completed LID Projects	Total Planned by 2020	Cumulative 2003-2020	Total 2021-2030	Cumulative by 2030	Total 2031-2040	Cumulative by 2040
Public	59	16	75	60	136	173	309
Private	155	6	161	185	346	70	416
TOTAL	215	22	237	245	482	243	725

Notes:

1. Amounts shown in the table represent areas of impervious surface existing within the City as of July 1, 2003, that are anticipated to be retrofitted by the target years as a result of both public and private projects.
2. Projections of existing impervious surface to be retrofitted are based on local knowledge of planned future development; anticipated availability of funding; and future development scenarios generated with the Bay Area UrbanSim model used by the MTC.
3. The total acreage reported for "Total Completed LID Projects" (215) and "Cumulative 2003-2020" (237) are rounded numbers resulting from the number of significant figures reported in the table.

2.4 Prioritized Projects for Alternative Compliance Program or Early Implementation

The City is not presently anticipating or actively participating in an Alternative or In-Lieu Compliance Program, consistent with the stated (alternative) requirements of Provision C.3.e. of the MRP. The City, in order to comply with its requirements for GI or LID measures implementation and oversight at all new or redevelopment project sites, has not established or otherwise made the necessary arrangements to either:

- Treat any portion of a given project's necessary Provision C.3.d on-site runoff with LID treatment at another (offsite) location or separate joint stormwater treatment facility, OR,
- Otherwise pay equivalent in-lieu fees to treat any portion of a given project's necessary Provision C.3.d on-site runoff with LID treatment at a separate Regional Project site (another offsite project area).

Rather, the City continues to expect, condition, and approve that Provision C.3.d. Regulated Projects provide the necessary on-site runoff with LID/GI treatment on the actual project site (on-site). There are no City projects, either public or private, listed within this GI Plan that are presently anticipated to participate in an alternative or in-lieu compliance program.

3. Tracking and Mapping Completed GI Projects

The process for tracking and mapping completed GI projects, both public and private, and making the information publicly available, as required by Provision C.3.j.i.(2)(d), is described below. This process was developed by the ACCWP, which participated in regional coordination with the Bay Area Stormwater Management Agencies Association (BASMAA), to comply with the requirement in Provision C.3.j.iv.(1) that "Permittees shall, individually or collectively, develop and implement regionally-consistent methods to track and report implementation GI measures including treated area and connected and disconnected impervious area on both public and private parcels within their jurisdictions."

3.1 Project Tracking and Load Reduction Accounting Tool

As discussed above, the City uses the AGOL Tool to enter information about public and private LID projects completed to date. Detailed information and instructions on the tool can be found in the C3 Project Tracking and Load Reduction Accounting Tool Guidance Document (ACCWP 2017).

The general process for entering GI projects into the AGOL Tool involves logging in to the ArcGIS online web application, opening the tool, and entering data. There are two methods for entering data, but, in general both involve: locating the project area, drawing the project boundary, entering project attributes, drawing the stormwater treatment facility(-ies), and entering facility attributes. Project attributes include fields such as jurisdiction, location description, type of project, project name, and additional optional fields that can be populated if the information is known. Facility attributes include hydraulic sizing criterion, project ID, facility type, treatment, and percent of project area treated by the facility.

The City will continue to use the AGOL Tool into its processes for reviewing, approving and reporting public and private C.3 Regulated Projects as well as non-C.3 Regulated projects that include GI. The tool includes a feature for generating tables of C.3 Regulated Projects and GI projects that include MRP-required project data for annual reporting purposes.

3.2 Making Information Publicly Available

As required by the MRP, the process for tracking and mapping completed projects (public and private) includes making the information generated by the tool publicly available. Information from the City's GI program will be made publicly available as follows.

- The City will coordinate with ACCWP to develop a viewable version of the AGOL tool, which is anticipated to be embedded on ACCWP's public website and may also be accessible via the City's website. This will be the mechanism that the City will use to make the information from the ACCWP AGOL tool publicly available.
- On an annual basis, the City will include in its Annual Report on Stormwater Program activities information in the form of (1) a reference to this GI Plan which lists planned GI projects, public and private; (2) a list of GI projects (public and private) that are planned

for implementation during the permit term as required in Provision C.3.j.ii, and (3) a list of Regulated Projects approved during the fiscal year reporting period as required in MRP Provision C.3.b.iv.

4. Summary of General Guidelines for GI Projects

General GI Guidelines are presented in Appendix B to guide the City in designing projects to effectively implement GI measures. The General Guidelines include hydraulic sizing guidance, standard specifications, and typical designs for GI projects that the City will consider for public projects that are not regulated under MRP Provision C.3.b ("non-Regulated Projects"). Additional information about the General Guidelines is summarized below.

4.1 Implementing Projects with a Unified, Complete Design

The General Guidelines presented in Appendix B focus on designing and coordinating projects that implement a range of functions appropriate to the type of project. For example, the guidelines for designing street projects address a range of functions including pedestrian travel, use as public space, bicycle usage, transit, vehicle movement, and urban forestry promotion. The guidelines for coordination identify measures for implementation during construction to minimize conflicts that may impact GI.

4.2 Hydraulic Sizing Requirements

Provision C.3.j.i.(2)(g) of the MRP states that GI projects are required to meet the treatment sizing requirements included in Provisions C.3.c and C.3.d of the MRP. However, an exception to this requirement is provided in Provision C.3.j.i.(2)(g) for non-Regulated street Projects.

The General Guidelines in Appendix B provide hydraulic sizing guidance for GI projects, addressing the hydraulic sizing criteria in MRP Provisions C.3.c and C.3.d, as well as the alternate sizing approach for constrained street projects developed by BASMAA. These guidelines do not address Regulated Projects as defined in Provision C.3.b of the MRP.

Some non-Regulated Projects are required to implement site design measures in accordance with Provision C.3.i of the MRP. Appendix L of the C.3 Technical Guidance explains how to determine whether Provision C.3.i applies to your project, and how to incorporate applicable site design measures, if required.

Table 4-1 presents a summary of where to find hydraulic sizing guidance, and other applicable guidance, for different types of projects.

Table 4-1: Where to Find Hydraulic Sizing Guidance and Other Guidance - by Project Type

Type of Project	Where to Find Guidance	
	Provision C.3.i or HM Guidance, if Applicable	Hydraulic Sizing Guidance
Non-Regulated GI Project (public or private project) that is NOT subject to Provision C.3.i[7]	Not applicable	Appendix B – General Guidelines for GI Projects
Non-Regulated GI Project (public or private project) that IS subject to Provision C.3.i	ACCWP C.3 Technical Guidance (Appendix L, Site Design Requirements for Small Projects)	
Regulated Project that is NOT a Hydromodification Management (HM) Project[8]	Not applicable	ACCWP C.3 Technical Guidance (Section 5.1, Hydraulic Sizing Criteria)
Regulated Project that IS an HM Project	ACCWP C.3 Technical Guidance (Chapter 7, Hydromodification Management Measures)	

4.3 Standard Specifications and Typical Designs

ACCWP has adopted, as general guidance, the City of Dublin's standard specifications and details for stormwater treatment facilities, which are included in Appendix B, Attachment B-4 of this GI Plan. These include typical design drawings and standard specifications for GI projects that address various types of land use, transportation, and site characteristics. GI projects may also utilize design guidance provided in Chapter 6 of the C.3 Technical Guidance manual (ACCWP 2017b) for other types of LID stormwater treatment facilities, subject to municipal staff approval.

[7] MRP Provision C.3.i applies to projects that create and/or replace at least 2,500 but less than 10,000 square feet of impervious surface; and Individual single -family home projects that create and/or replace 2,500 square feet or more of impervious surface.

[8] An HM Project is a Regulated Project that creates and/or replaces one acre or more of impervious surface, will increase impervious surface over pre-project conditions, and is in a susceptible area, as shown on the ACCWP default susceptibility map. Projects within the City of Alameda are not in the mapped susceptibility area.

5. GI Requirements in Other Planning Documents

In compliance with Provision C.3.j.i.(2)(h), the City evaluated a number of its relevant planning documents and is in the process of those updating planning documents that may affect the future alignment, configuration, or design of impervious surfaces within the Permittee's jurisdiction, including, but not limited to, streets, alleys, parking lots, sidewalks, plazas, roofs, and drainage infrastructure. Appendix Table C-1 summarizes the City's planning documents that were reviewed for language supporting GI or GI requirements. An important subset of these planning documents is highlighted below. In addition, the City's CARP document (September 2019) is an important and relevant update to the previous Local Action Plan for Climate Protection (2008); the CARP provides a nexus with this GI Plan.

City planning documents that have been identified for and are presently under updates, include:

- General Plan (1991) Elements including Open Space and Conservation, Land Use and Transportation (pending for 2019-2020)
- Transportation Choices Plan (2018)
- Bicycle Master Plan (2010)
- Pedestrian Plan (2009)

The City's Transportation Choices Plan identifies multiple corridor projects that could include GI treatments. The Bicycle Master Plan and Pedestrian Plan are currently being updated as the Active Transportation Plan. And the 1991 General Plan Open Space and Conservation Element is being re-written and updated as the new General Plan Conservation and Climate Change Element, with references to the GI Plan being incorporated. Appendix Table C-2 provides a summary of the City's Planning documents that are new or are in the process of being updated and will incorporate GI language.

6. Evaluation of Funding Options

6.1 Current Status of Stormwater Funding

The City has been and is currently active in addressing needs for appropriate stormwater funding. The City has had a stormwater fee since the early 1990s, prompted by the onset of federal stormwater regulations directed at municipal separate storm sewer system operations. The stormwater fund revenues from this stormwater fee have been used to actively and effectively implement operations, capital, and regulatory requirements of the City's aging stormwater system. However, given that State law requires that any increase in the stormwater fee must be approved by a ballot and be supported by a fee study, the City's stormwater fee has not been increased and has remained flat at approximately $56 annually per single family home for nearly fifteen years, with no effective escalator to account for increases in costs for labor, benefits, materials, vendors, and additional regulations. As a result, the City's stormwater fund is struggling to keep up with the sum of significant operations, capital, and regulatory requirements of the stormwater system. The budgetary and operational challenges of simply maintaining an aging stormwater system is only compounded by climate change, which causes sea level rise and more frequent, intense storms.

The need for additional revenue for the stormwater system was identified in the last three cycles of City capital budgets (FY2015-17, 2017-19, and 2019-21). Between February and July 2018, the City Council discussed the stormwater fee and its possible adjustment in the context of various other needed and prioritized municipal revenue measures, including a stormwater infrastructure bond. Nonetheless, the City's stormwater fund is depleted; the most recent assessment shows that this stormwater fund is running a $1M annual deficit. The City's adopted FY2019-21 budget included $0 in stormwater funds for new capital improvements because there is simply no money available in the stormwater fund for this work.

Without additional revenue, the City foresees the possibility that it may be forced to eliminate and/or significantly cut its street sweeping and storm drain maintenance programs, in addition to foregoing the pursuit of important storm drainage infrastructure investment, sustainability initiatives and climate change-related flood control and resiliency programs.

At the time of the GI Plan preparation and in efforts to responsibly manage this situation, the City is advancing Proposition 218-compliant efforts to consider a new property-related stormwater fee. The City Council has approved a Water Quality and Flood Protection Fee Report (2019), the stormwater fee study report. Based on the stormwater fee study report, the City's stormwater system has at least $30M in high priority unmet needs including necessary upgrades to pump stations and pipes from the 1940s and earlier. Included within this $30M total is $2.1M for potential GI investment between now and the year 2030.

6.2 Funding Priorities

As indicated above, at the time of this GI Plan preparation, the City is advancing Proposition 218-compliant efforts to consider a new property-related stormwater fee, the 2019 Water Quality and Flood Protection Fee, to fund at least $30M in high-priority unmet needs in the City's stormwater system. Funding priorities for the City's stormwater system include: maintaining

existing operations and maintenance of the municipal stormwater system; continuing water quality and clean beaches protection programs; implementing high-priority unmet capital improvement needs to the municipal storm drainage infrastructure; implementing local and coastal flooding protection; continuing to implement the City's Clean Water Program and municipal stormwater permit responsibilities; and, keeping up with these significant operating, capital, and regulatory requirements. The City's 2019 Water Quality and Flood Protection Fee Report provides a more detailed discussion of these stormwater program funding priorities for the City of Alameda.

As discussed in the City's 2019 CARP document, to meet the challenges of sea level rise, rising groundwater, and more frequent and intense storms, the City's on-going and future funding of its stormwater pumps, pump stations, and pipes must be commensurate with its maintenance, operations, and capital needs. The increasing of revenue to get closer to the stormwater system's current and projected needs, including the support of significant GI investment, is an important, near-term actions recommended in the CARP.

The CARP states, "In addition, some portion of the overall costs will need to be covered by locally raised revenues from congestion pricing, stormwater fees, special districts, and/or an infrastructure bond." The CARP emphasizes multiple benefits at every opportunity. Identifying multiple benefits ensures the City is getting the most value out of every investment made. Maximizing multiple benefits also recognizes that the City's CARP vision is not simply to reduce emissions or better protect against climate hazards, but also to become a more sustainable, livable, and vibrant community overall. Identifying these multiple benefits is critical to maximizing efficiency in implementation and reducing overall costs.

7. Community Information and Resources

This section of the GI Plan is intended to summarize resources and information for the Alameda community to learn more about GI concepts and how GI can be integrated at home, in neighborhoods, and throughout the City.

The City works with other local agencies from around Alameda County in the regional stormwater agency consortium known as the Alameda Countywide Clean Water Program (ACCWP). The ACCWP fosters stewardship of our shorelines, wetlands, local creeks, and the Bay, also in concert with other regional stormwater agency associations. These different regional consortiums have produced useful informational brochures and fact sheets for residents, homeowners, gardeners, DIYers, engineers, consultants and more on GI-related topics.

The two-page ACCWP brochure "Detain the Rain" provides an overview of GI examples that can be used around the home to enhance one's property and protect the Bay. A copy of this brochure is in Appendix D. The brochure can also be downloaded from the ACCWP website at:

https://www.cleanwaterprogram.org/resources/recources/residents.html

The regional stormwater consortium BASMAA has produced a series of GI Fact Sheets for small private property GI projects entitled:

- "Landscape Designs for Stormwater Management";
- "Rain Gardens";
- "Rain Barrels and Cisterns"; and
- "Pervious Pavement"

Copies of these BASMAA Fact Sheets are in Appendix D and can also be found with the Document Search function at the ACCWP website:

https://www.cleanwaterprogram.org/resources/recources.html

Appendix B, Attachment B-4 of this GI Plan includes copies Typical Detail Drawings adopted by the ACCWP for several GI structural systems for engineered construction projects.

The City's CARP (September 2019), listed in the References section, includes multiple GI strategies that will be useful in Citywide efforts to both combat climate change and promote resiliency and sustainability. Examples include, but are not limited to identifying the Veterans Court Seawall project which is considering the removal of impervious surface area and increasing green space and park area; encouraging green roof areas as an implementation strategy to increase resiliency; providing a Case Study on Alameda Point and GI to Manage and Treat Stormwater. The CARP document is available at the City's website, as follows:

https://www.alamedaca.gov/Departments/Public-Works/Climate-Action

The City, through its oversight authority for all planning and building activity in town, is also actively working to promote, ensure, and require the integration of GI elements in new and redevelopment projects. The City is mandated to do this under terms of MRP issued to the City by the RWQCB for its operation of the City's storm drainage system. The MRP is listed in the Reference section and can be referenced on the RWQCB's website at:

https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/stormwater/Municipal/index.html

In brief, the MRP requirements direct the City to use its planning authorities to include appropriate source control, site design, and stormwater treatment measures in new development and redevelopment projects to address stormwater runoff pollutant discharges. This goal is to be accomplished primarily through the implementation of GI techniques, also known as LID techniques. The bioswales and rain gardens that can be seen in newer shopping center and housing developments and along newer streets are examples of the results of these efforts.

The regional ACCWP has developed the C3 Technical Guidance Manual (Manual) for developers, builders, engineers, consultants, planners, and project applicants. This Manual is intended to help development project sponsors include post-construction stormwater controls in their projects, in order to meet local municipal requirements and RWQCB requirements in the MRP. This is a detailed and relevant reference that is included in the list of References and can be viewed from the ACCCWP website at:

https://www.cleanwaterprogram.org/c3-guidance-table.html

To obtain more information about the general GI improvements planned for and unfolding through the redevelopment at Alameda Point, two City planning documents will be good references. These documents are the Alameda Point Master Infrastructure Plan (March 2014) and the Alameda Point Town Center and Waterfront Precise Plan (July 2014). Both documents are available for review on the City's website, Base Re-Use Department, under Final Planning Documents at:

https://www.alamedaca.gov/Departments/Base-Reuse-Alameda-Point

Two resources for green roofs are as follows:

California Stormwater Quality Association Fact Sheet:

https://www.casqa.org/sites/default/files/downloads/green_roof.pdf

Bay Localize Guidebook: http://rootedinresilience.org/resources/

The websites and references identified above and/or included in the Reference section and Appendices of this GI Plan provide a good starting point for residents wanting to learn more about GI or seeking to implement GI at their homes or within the community.

8. References

Alameda Countywide Clean Water Program. 2017. C3 Project Tracking and Load Reduction Accounting Tool Guidance Document.

Alameda Countywide Clean Water Program. 2017b. C.3 Technical Guidance Manual, Version 6. https://www.cleanwaterprogram.org/c3-guidance-table.html

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City of Alameda. 2015. Alameda Point Preliminary Stormwater Management Plan.

City of Alameda. 2019. Climate Action and Resiliency Plan. https://www.alamedaca.gov/Departments/Public-Works/Climate-Action

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City of Dublin, California. 2018. Typical Green Infrastructure Designs and Standard Specifications.

Geosyntec. 2017. Alameda Countywide Stormwater Resource Plan Screening and Prioritization using Multi-Benefit Metrics Technical Memorandum. December 13.

National Association of City Transportation Officials. 2017. Urban Street Stormwater Guide.

San Francisco Bay Regional Water Quality Control Board. (RWQCB) 2015. Order No. R2-2015-0049, Municipal Regional Stormwater Permit (MRP).

San Francisco Bay Regional Water Quality Control Board (RWQCB). 2017. San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan). Incorporating all amendments approved by the Office of Administrative Law as of May 4, 2017.

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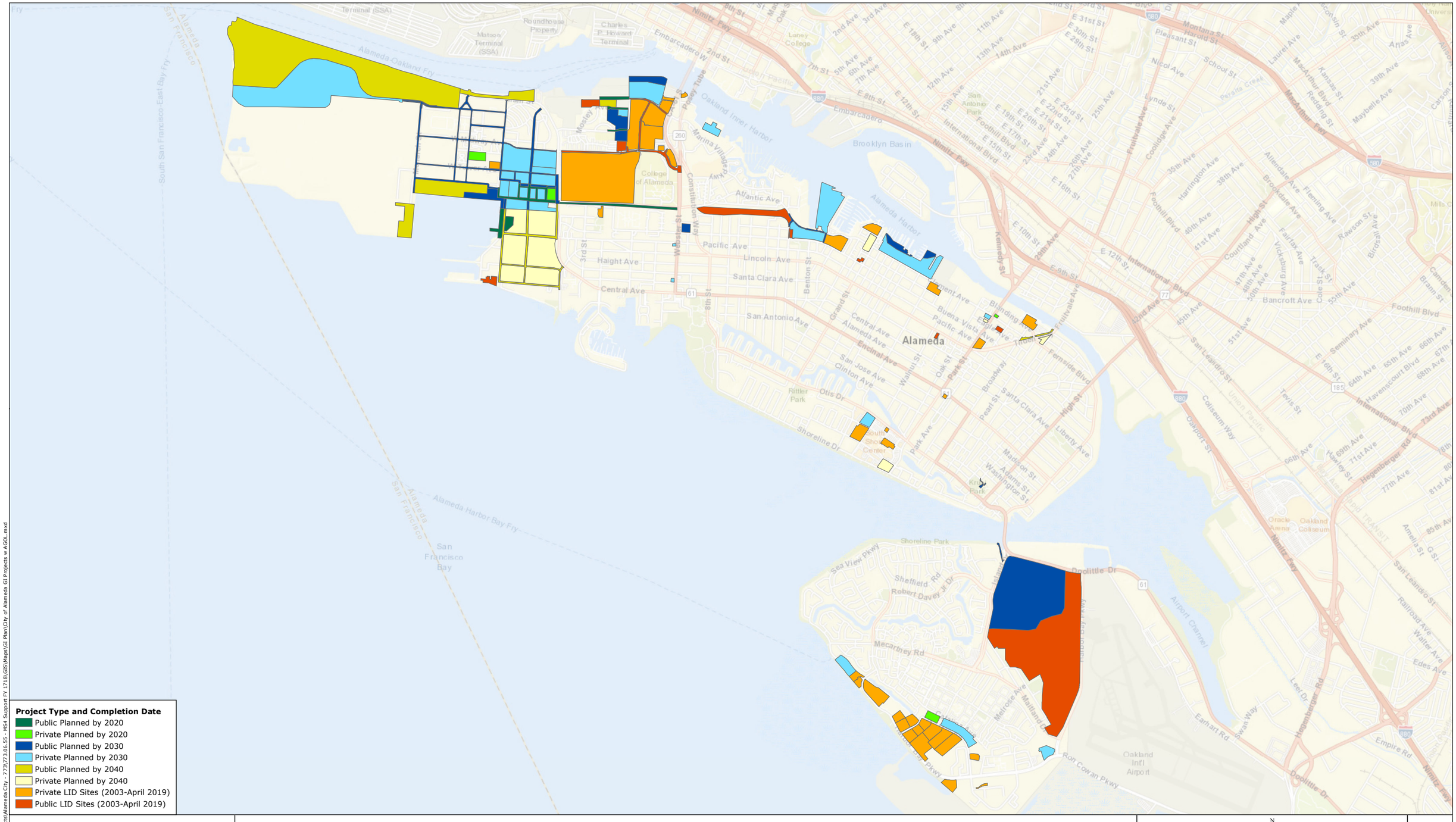
Skidmore, Owings & Merrill LLP, et.al., for the City of Alameda. 2014. Alameda Point Town Center and Waterfront Precise Plan. https://www.alamedaca.gov/Departments/Base-Reuse-Alameda-Point; see Final Planning Documents

Appendix A. Map and List of Planned and Potential GI Projects; List of Completed LID Projects



CITY OF ALAMEDA, CALIFORNIA
PREVIOUSLY COMPLETED LID PROJECTS AND POTENTIAL GREEN INFRASTRUCTURE PROJECTS TO BE COMPLETED BY 2040

N
1 inch = 0.6 miles
0 0.3 0.6 miles

FIGURE
A-1

SOURCE	JOB NUMBER	DRAWN	DATE	REVISED	APPROVED
Esri Street Basemap, City of Alameda	773.06.55	kando	7/17/2019	9/18/2019	dbodine

Document Path: P:\Active Projects\Alameda City - 773\773.06.55 - MS4 Support FY 1718\GIS\Maps\GI Plan\City of Alameda GI Projects w AGOL.mxd

Table A-1
City of Alameda GI Project List

Project Name	Project Location/Address	Project Description	Project Type	Development Timeframe	Ownership [Private/Public]	Total Project Area [Acres]	Impervious Area Treated by GI [acres]
Singleton and Mosley Ave Extensions	Singleton Ave and Mosley Ave	Creates two new street sections (extending the pre-existing Singleton and Mosley Aves) to connect the existing Coast Guard Housing area to the new Alameda Landing neighborhood to the east. Approximately 68,000 sq ft of new GI infrastructure including new underground utilities, landscaping improvements	ROW	2020	Public	2.0	1.3
CAT - RAMP project	Atlantic Ave from Webster St to Main St	Redevelopment of 7.0 acre former railroad right-of-way parcel into linear bike/pedestrian trail with C.3 measures, self-retaining areas, landscape areas. Entirety of linear open space directly south of Ralph Appezzato Parkway.	ROW	2020	Public	7.0	4.7
Site A - Phase 1 Backbone Infrastructure	Various streets centering around W Atlantic Ave and Orion St	New Green Streets construction. New public right-of-ways, utilities infrastructure components of Alameda Point Site A redevelopment. Construction is currently on-going.	ROW	2020	Public	8.7	5.4
Ferry Terminal - Seaplane Lagoon	Ferry Point south of W Atlantic Ave	Public transportation infrastructure development with Parking Lot (C.3 compliant/GI) and waterfront causeway.	Parcel	2020	Public	7.0	3.2
Mitchell Avenue Extension	Mitchell Ave from Bette St to Estuary Park parking lot.	Roadway extension of Mitchell Ave westward from intersection with Bette St to be a northerly drive access to the Estuary Park parking lot. 30' wide ROW includes new 22' wide C.3-compliant) green street and approx 8' wide self-treating bike path/gravel pedestrian trail.	ROW	2020	Public	2.3	1.5
Housing Authority Redevelopment Sub-area	Mosley Ave, Mayport Cir and Lakehurst Cir	Housing Authority facilitated housing redevelopment.	Parcel	2030	Public	11.7	7.3
Alameda Landing (Phase II) Northern Waterfront - eastern half	Located north of Mitchell Ave, on the waterfront	Public ROW associated with proposed redevelopment to mixed-use public waterfront park and residential redevelopment.	Parcel	2030	Public	6.8	2.8
Del Monte Site Perimeter Public ROW	Clement Ave and Sherman St	Streets to be built as C.3-compliant green streets by private developer then dedicated as public ROW.	ROW	2030	Public	2.0	1.6
Alameda Marina	1801 Clement	Public ROW associated with private development.	Parcel	2030	Public	5.8	4.2
Golf Complex North Course Renovations	Island Dr and Doolittle Dr	Golf course complex North Course and drainage renovations, resulting in greatly improved rainwater and run-on retention for irrigation reuse. Site North Course receives significant run-on flows from Island Drive and Doolittle Drive. Renovations anticipated to be completed by the end of calendar year 2021.	Parcel	2030	Public	120	13.1
Veteran's Ct project area	Veteran's Ct north of Island Dr	Public CIP street/drainage project with green street located west of Veterans Memorial Park.	Parcel	2030	Public	0.68	0.30
Rosefield Village	Webster St and Buena Vista Ave	Public Housing Authority redevelopment of a Housing Authority housing complex.	Parcel	2030	Public	2.0	1.4
Site A - Phase 1 Block 5	On the waterfront west of Ferry Point	Public open space waterfront park.	Parcel	2030	Public	8.3	3.2
Site A - Phase 1 Neighborhood Park	W Trident Ave and Orion St	1.92 acre public open space neighborhood park.	Parcel	2030	Public	1.9	1.2
Site A, Phase 2 Backbone	Various streets along Ave F including Main St	Public ROW associated with residential, commercial and green street redevelopment along northern tier of Site A area.	ROW	2030	Public	6.4	4.1
Site A, Phase 3 Backbone	Street section south of pending extension of Ralph Appezzato Memorial Parkway, within Phase 3 area.	Public ROW associated with residential, commercial and green street redevelopment along southern tier of Site A area.	ROW	2030	Public	1.2	0.6
West Redline Ave Extension Project - VA	W Redline Ave east and west of Monarch St	Green Street and intersection construction/redevelopment to provide access to VA Clinic site.	ROW	2030	Public	2.4	1.5
Adaptive Re-Use Public ROW areas	Various streets centering around W Midway Ave and Saratoga St	Long-term intent is for public right-of-way green streets as infrastructure and utility upgrades are implemented.	ROW	2030	Public	30.1	19.0
Krusi Park Recreation Center Renovation	Otis Dr and High St	Park facility upgrades with C.3 compliance and GI/LID features.	Parcel	2030	Public	0.41	0.11
Estuary Park Eastern Sub-area	North of Mosley Ave at Lakehurst Cir	Undeveloped parcel. Planned City Park renovation/restoration.	Parcel	2040	Public	3.2	2.0
Enterprise Area backbone/roadways	Various streets centering around W Ticonderoga Ave and Orion St	Long-term intent is for public right-of-way green streets as infrastructure and utility upgrades are implemented.	ROW	2040	Public	17.3	10.9
Main Street Waterfront Improvements	Main St at the waterfront	Long-term intent is for the public right-of-way green streets and C.3 compliance as the infrastructure and utility upgrades are implemented.	ROW	2040	Public	11.4	6.7
Alameda Point Recreational Areas	Main St at the waterfront	Public open space waterfront park along northern waterfront of Alameda Point.	Parcel	2040	Public	211	130
Waterfront Towne Center, Waterfront (lagoon) Park, and DePave Park	On the waterfront south of Monarch St	Seaplane Lagoon margins redevelopment beyond scope of Site A redevelopment.	Parcel	2040	Public	38.2	21.9
Fruitvale Bridge Pathway Access	Along Tilden Way @ Blanding Ave	Idled railroad parcels identified for potential redevelopment for pedestrian/bike access/use.	Parcel	2040	Public	1.4	1.1
2175 North Loop Road Warehouse Complex	N Loop Rd south of Admiralty Ln	Commercial/industrial redevelopment.	Parcel	2020	Private	2.8	1.4
Dunkin' Donuts	Park St and Clement Ave	Redevelopment of downtown commercial parcel into a C.3-compliant new Dunkin' Donuts facility with parking lot improvements. Parcel is the former auto-service facility.	Parcel	2020	Private	0.31	0.26

Table A-1
City of Alameda GI Project List

Project Name	Project Location/Address	Project Description	Project Type	Development Timeframe	Ownership [Private/Public]	Total Project Area [Acres]	Impervious Area Treated by GI [acres]
Site A - Phase 1 Block 6	W Atlantic Ave and Main St	Housing development.	Parcel	2020	Private	2.8	1.8
Alameda Point Building 8	W Ranger Ave and Saratoga St	Building restoration with interior improvements: Partial green roof feature; pavement runoff directed to newly created tree well landscape areas.	Parcel	2020	Private	4.1	2.6
Habitat for Humanity Redevelopment sub-area	Mosley Ave and Bette St	Habitat for Humanity facilitated housing redevelopment on approx 2 acres.	Parcel	2030	Private	2.0	1.2
Alameda Landing (Phase II) Northern Waterfront - eastern half	Located north of Mitchell Ave, on the waterfront	Proposed redevelopment to mixed-use public waterfront park and residential redevelopment.	Parcel	2030	Private	16.9	10.7
Shipways	1200 Marina Village Parkway	Planned for residential re-development.	Parcel	2030	Private	4.0	2.6
Del Monte (Warehouse Redevelopment)	Sherman St and Buena Vista Ave	Planned for mixed-use residential and commercial complex.	Parcel	2030	Private	9.8	7.9
Encinal Terminal	Located north of Entrance Rd, on the waterfront	Currently low intensity industrial uses. Potential redevelopment for mixed-use residential, commercial and waterfront use.	Parcel	2030	Private	22.1	14.4
Alameda Marina	1801 Clement	Master Plan redevelopment for mixed residential, commercial and waterfront use.	Parcel	2030	Private	21.8	15.0
Holiday Inn Express site (was Former Ron Goode Toyota (- North))	1825 Park St	Commercial Hotel. 2020-2021 timeframe	Parcel	2030	Private	0.73	0.63
Marriott Residence Inn Alameda (was Esplanade)	Adelphian Way south of Mecartney Rd	Five-story hotel/restaurant project, 2020-2022 timeframe.	Parcel	2030	Private	5.5	2.8
Potential Hotel	Harbor Bay Pkwy and Maitland Dr	Potential Hotel	Parcel	2030	Private	3.7	2.0
1955 North Loop Road Warehouse Complex	N Loop Rd and Leeward Ln	Commercial/industrial redevelopment.	Parcel	2030	Private	9.0	4.4
1435 Webster Street	1435 Webster Street	Redevelopment of parking lot into 3-story mixed-use development.	Parcel	2030	Private	0.33	0.24
South Shore Center Redevelopment, Phase 1	Otis Dr east of Willow St	Residential and retail redevelopment.	Parcel	2030	Private	3.6	2.7
Site A - Phase 1 Block 7	W Seaplane Lagoon Ave east of Orion St	Housing development.	Parcel	2030	Private	2.2	1.4
Site A - Phase 1 Block 8	W Seaplane Lagoon Ave east of Orion St	Two-building affordable housing block: Affordable Senior Housing and Affordable Family Housing.	Parcel	2030	Private	1.6	1.0
Site A - Phase 1 Block 9	W Seaplane Lagoon Ave east of Ferry Point	Residential. Provision C.3 Regulated Project, with Special Project exemptions totaling a maximum of 50% LID Treatment reduction credit	Parcel	2030	Private	2.3	1.5
Site A - Phase 1 Block 10	W Seaplane Lagoon Ave and Ferry Point	Adaptive Re-Use area with maximum of 50% LID treatment reduction credit.	Parcel	2030	Private	4.2	2.7
Site A - Phase 1 Block 11	W Seaplane Lagoon Ave and Ferry Point	Mixed-use residential. Provision C.3 Regulated Project, with Special Project exemptions totaling a maximum of 50% LID Treatment reduction credit.	Parcel	2030	Private	4.0	2.5
Site A, Phase 2, north area	Ave F and Orion St	Residential and commercial redevelopment along northern tier of Site A area	Parcel	2030	Private	15.3	9.7
Site A, Phase 3 south area	W Atlantic Ave and 8th St	Residential, commercial-redevelopment along southern tier of Site A area.	Parcel	2030	Private	11.3	7.2
RESHAP	Willie Stargell Ave and Glenview	Mixed-use affordable housing neighborhood/complex with open space, community center.	Parcel	2030	Private	10.9	6.9
West Midway Site	Willie Stargell Ave and Orion Ave	Housing/neighborhood redevelopment.	Parcel	2030	Private	24.7	15.6
Veteran's Administration (VA) Outpatient Clinic and Columbarium	W Redline Ave south of Oakland Inner Harbor	Federal project on Alameda Point property retained by the Federal government.	Parcel	2030	Private	114	71.5
1639 Webster Street	1639 Webster Street	Mixed-use residential redevelopment.	Parcel	2030	Private	0.23	0.15
Pennzoil Site	Fortman Way and Grand St	Currently used as low intensity industrial uses. Planned for potential future residential development and extension of public street right-of-way.	Parcel	2040	Private	3.6	2.6
Former Ron Goode Toyota - South	1801 Park St	Planned for potential resiential redevelopment.	Parcel	2040	Private	0.34	0.29
Mapes Ranch	Versailles Ave and Tilden Way	11 single family residential dwelling units on vacant open space but formerly industrial-use land.	Parcel	2040	Private	1.4	0.8
South Shore Center Redevelopment, Phase 2	Shoreline Dr and Park St	Residential and retail redevelopment.	Parcel	2040	Private	3.4	2.6
Alameda Point Enterprise Area	W Ticonderoga Ave and Skyhawk St	Building preservation and re-use, not redevelopment. C.3 compliance with Special Project LID credits for spot transit-oriented re-development that does occur.	Parcel	2040	Private	101	63.9

Table A-2
Summary of Previously Completed LID Projects in Alameda

Project Name	Project Location/Address	Project Description	Project Type	Construction Completed	Ownership [Private/Public]
Cheeseworks	2200 North Loop Road, Alameda, CA 94502	Commercial warehousing/manufacturing development	Parcel	Sep-04	Private
Allergy Research Group	2300 North Loop Road, Alameda, CA 94502	Commercial warehousing/manufacturing development	Parcel	Feb-2005	Private
Venture Commerce Center Phase I	2340 North Loop Road, Alameda, CA 94502	Office Park complex development	Parcel	Mar-2005	Private
Willie Stargell Avenue Extension, including Bayport Stormwater Pump Station	Willie Stargell Avenue, between Main Street and Fifth Street, Alameda, CA 94501	Municipal street and intersection infrastructure	ROW	Aug-2005	Public
Ettore Products Inc.	2100 North Loop Road, Alameda, CA 94502	Commercial warehousing/manufacturing development	Parcel	Mar-2006	Private
Peet's Coffee & Tea	2001 Harbor Bay Parkway, Alameda, CA 94502	Commercial warehousing/manufacturing development	Parcel	Dec-2006	Private
North Loop Center AssociationL, Phase I	2000-block (even) North Loop Road, Alameda, CA 94502	Commercial warehousing/manufacturing development	Parcel	Dec-06	Private
Venture Commerce Center Phase II	2201-2263 Harbor Bay Parkway, Alameda, CA 94502	Office Park complex development	Parcel	Jan-07	Private
Bridgeside Shopping Center	2501-2631 Blanding Ave, Alameda, CA 94501	Commercial retail center	Parcel	Feb-2007	Private
North Loop Center AssociationL, Phase II	1900-block (even) North Loop Road, Alameda, CA 94502	Commercial warehousing/manufacturing development	Parcel	Feb-2008	Private
Zephyr Ventilation Inc	2275 Harbor Bay Parkway, Alameda, CA 94502	Commercial warehousing/manufacturing development	Parcel	May-2008	Private
Hampton Inn & Suites	1700 Harbor Bay Parkway, Alameda, CA 94502	Commercial hotel development	Parcel	Jun-2008	Private
Abbott Diabetes Care	1420 Harbor Bay Parkway, Alameda, CA 94502	Commercial Health Services facility renovation	Parcel	Aug-08	Private
Safeway Fueling Center	2234 Otis Drive, Alameda, CA 94501	Retail facility development	Parcel	Jan-09	Private
Alameda South Shore Center Remodel	2227 South Shore Center, Alameda, CA 94501	Commercial retail center renovation	Parcel	Jun-09	Private
Kentucky Fried Chicken - Alameda	2424 Encinal Avenue, Alameda, CA 94501	Retail food facility development	Parcel	Jun-09	Private
Bayport Residential Development	Residential neighborhood bordered between Ralph Appezatto Parkway and Willie Stargell Ave, and between Fifth Street and Main Street	Residential neighborhood development	Parcel	Jun-2009	Private
Alameda Towne Center Lot 10	2130 South Shore Center, Alameda, Ca 94501	Commercial retail center renovation	Parcel	Aug-09	Private
Shinshei Gardens	401 Willie Stargell Avenue, Alameda, CA 94501	Affordable housing complex	Parcel	Sep-2009	Public
Boys & Girls Club - Alameda	1900 Third Street, Rear Building, Alameda, CA 94501	Non-profit youth recreation facility	Parcel	Feb-11	Private
Webster-Stargell Intersection Project	Stargell Ave and intersections with Mariner Square Loop and Webster Street Alameda, CA 94501	Municipal street and intersection infrastructure	ROW	Jun-11	Public
Bay Area Chinese Bible Church (BACBC)	1803 North Loop Road, Alameda, CA 94502	School and religious facility development	Parcel	Jun-11	Private
Grand Marina Village	Fortmann Way @ Grand Street, residential block, Alameda, CA 94501	Residential neighborhood development	Parcel	May-12	Private
VF Outdoors	2601-2901 Harbor Bay Parkway, Alameda, CA 94502	Corporate office complex	Parcel	Jun-12	Private
Stacy & Witbeck	2800 Harbo Bay Parkway, Alameda, CA 94502	Corporate office	Parcel	Jun-12	Private
Aquatech Swim School	2203 Mariner Square Loop, Alameda, CA 94501	Commercial recreational facility	Parcel	Mar-13	Private
Alameda Landing Commercial Ph 1 - Target Store	2700 Fifth Street, Alameda, CA 94501	Commercial retail center	Parcel	Oct-13	Private
Alameda Landing Backbone	New street extensions of Fifth Street and Mitchell Avenue, Alameda, CA 94501	New public streets and right-of-way backbone	ROW	Oct-13	Public
Jack Capon Villa	2216 Lincoln Avenue, Alameda, CA 94501	Affordable housing complex	Parcel	Jan-14	Public
Alameda Station	1600-1646 Park Street, Alameda, CA 94501	Commercial retail center	Parcel	Aug-14	Private
Alameda Landing Retail Center - Phase Two	2600-2690 (even) Fifth St, Alameda, CA 94501	Commercial retail center	Parcel	Apr-2015	Private
Alameda Landing - Alameda Gateway	501-555 Willie Stargell Ave, Alameda, CA 94501	Commercial retail center	Parcel	Apr-2015	Private
Oakmont/Cardinal Point II	2400 Mariner Square Drive, Alameda, CA 94501	Senior Housing and Care facility	Parcel	Apr-2015	Private
VF Outdoors South	2321 North Loop Road, Alameda, CA 94502	Corporate office	Parcel	Jan-2016	Private
Alameda Landing - Residential (Phase One)	West of Fifth Street, between Singleton and Mitchell Avenues, Alameda, CA 94501	Residential neighborhood development	Parcel	Mar-2016	Private
City Emergency Operations Center and Fire Station #3	1809 Grand St and 1625 Buena Vista Ave, Alameda, CA 94501	Municipal facilities development	Parcel	Apr-2017	Public
McGuire & Hester	2810 Harbor Bay Parkway, Alameda, CA 94502	Corporate headquarters office	Parcel	Apr-2017	Private

Table A-2
Summary of Previously Completed LID Projects in Alameda

Project Name	Project Location/Address	Project Description	Project Type	Construction Completed	Ownership [Private/Public]
Alameda Landing - Residential Affordable Housing Site (Stargell Commons)	2700-2726 Bette Street, Alameda, CA 94501	Affordable housing complex	Parcel	May-2017	Public
Marina Cove II	1551 Buena Vista Ave, Alameda, CA 94501	Residential neighborhood development	Parcel	Jun-2017	Private
Alameda Landing - Residential (Phase Two)	North of Mitchell Avenue @ Diller Street (new), Alameda, CA 94501	Residential neighborhood development	Parcel	Jun-2017	Private
Alameda Point Bld 91 Renovation	651 West Tower Ave, Alameda, CA 94501	Building renovation project	Parcel	Nov-2017	Private
Estuary Park, Phase One	200 Mosley Avenue, Alameda, Ca 94501	Public Park and Athletic Fields development	Parcel	Jan-2018	Public
Alameda Landing Project - Residential (Phase Three)	Neighborhood bordered by Fifth Street and Bette Streets, and by Stargell Ave and Singleton Ave, Alameda, CA 94501	Residential neighborhood development	Parcel	Mar-2018	Private
WETA Central Bay Maintenance Facility	670 West Hornet Avenue @ Ferry Point. Alameda, CA 94501	Public Agency transportation facility development with new green streets	Parcel & ROW	June 2018	Public
Del Monte Senior Housing complex	On Sherman Street @ 1301 Buena Vista Avenue, Alameda, CA 94501	Affordable senior housing complex	Parcel	Jun-2018	Public
Del Monte Senior Housing public site perimeter	On Sherman Street @ 1301 Buena Vista Avenue, Alameda, CA 94501	New Green street section along perimeter of the affordable senior housing complex	ROW	Jun-2018	Public
Jean Sweeney Open Space Preserve/park	Sherman Street at Marina Village Parkway, Alameda, CA 94501	27-acre public open space/park development	Parcel	Oct-2018	Public
Eagle Housing complex	2437 Eagle Avenue, Alameda, CA 94501	Affordable family housing complex	Parcel	Dec-2018	Public
Mulberry Alameda	2100 Clement Avenue, Alameda, CA 94501	Residential neighborhood development	Parcel	Jun-2019	Private
Home 2 Suites facility	1660 Harbor Bay Parkway, Alameda, CA 94502	Commercial hotel development	Parcel	June 2019	Private
Golf Complex South Area Renovations	Island Drive and Clubhouse Memorial Road	Already completed Golf course complex and drainage renovations for the South Course, Par-3 Course, and the Driving Range. Site receives significant run-on flows from Island Drive, Harbor Bay Parkway and Bay Farm Island residential neighborhoods.	Parcel	June 2018	Public

Appendix B. General Guidelines for GI Projects

Appendix B. General Guidelines for GI Projects

These General Guidelines have been developed to guide the City of Alameda in designing a project that has a unified, complete design that implements the range of functions associated with GI projects, and in providing for appropriate coordination of projects and project elements. The guidelines apply to projects that incorporate GI into an existing roadway segment or a previously developed public parcel and are **not** Regulated Projects as defined in Provision C.3.b of the MRP. The guidelines are organized as follows.

B.1 Functions Associated with GI

The functions associated with GI retrofits of existing streets and GI retrofits of public parcels are identified below.

B.1.1 Functions Associated with GI Retrofits of Existing Streets

The following functions are associated with GI retrofits of existing streets:

- Street use for stormwater management, including treatment;
- Safe pedestrian travel;
- Use as public space for bicycle, transit, and vehicle movement/parking; and
- Use as locations for urban forestry.

B.1.2 Functions Associated with GI Retrofits of Public Parcels

Existing facilities on public parcels may be retrofitted with GI. Although there are potentially a wide range of public uses that could occur on various parcels, key issues are associated with the outdoor use of public parcels for landscaping and parking. The following functions are associated with GI retrofits of public parcels:

- Site use for stormwater management and landscaping
- Circulation and parking within the site

B.2 Guidelines for GI Retrofits of Existing Streets

Streets must perform the range of functions described in Section B.1.1. The following guidelines provide general guidelines for designing and constructing GI facilities within the right-of-way of existing streets, to address the full range of functions. Additional design guidance for GI facilities, which are also referred to as low impact development (LID) stormwater treatment facilities, is provided in Chapters 5 and 6 of the Alameda Countywide Clean Water Program's C.3 Technical Guidance, which may be downloaded at, www.cleanwaterprogram.org (click Businesses, then Development).

B.2.1 Guidelines Addressing Street Use for Stormwater Management

The GI guidelines to support street functionality for stormwater management are organized around the following objectives:

- Convey stormwater to GI facilities,
- Identify the appropriate GI typical designs for the project, and
- Convey stormwater away from transportation facilities.

Convey Stormwater to GI Facilities

GI retrofits of existing streets must be designed to convey stormwater runoff from the roadway surface to the proposed GI facilities. Key issues include working with the street profile, working with the existing drainage system, and considering conveyance facilities where needed.

Work with the Existing Street Profile

Modifying the profile of an existing street is costly. Therefore, the designs of GI street retrofits should generally maintain the existing street profile where feasible. The street profile affects how stormwater runoff flows off of a street and is considered in the design of GI facilities. The most common street profile is crowned, although some streets may be reverse crowned, or may drain to one side, as illustrated in Figures B-1 through B-3. Occasionally, a street may have a flat profile, such as the example shown in Figure B-4 in which a street is designed to drain into pervious pavement. Unless pervious pavement is used for the full width of the street, GI facilities would be located downslope from the roadway surface. In a crowned street, this may allow for GI facilities on both sides of the street. In a reverse crowned street, GI facilities may be considered in the median; and in a side-sloping street, GI facilities would be located on the downslope side.

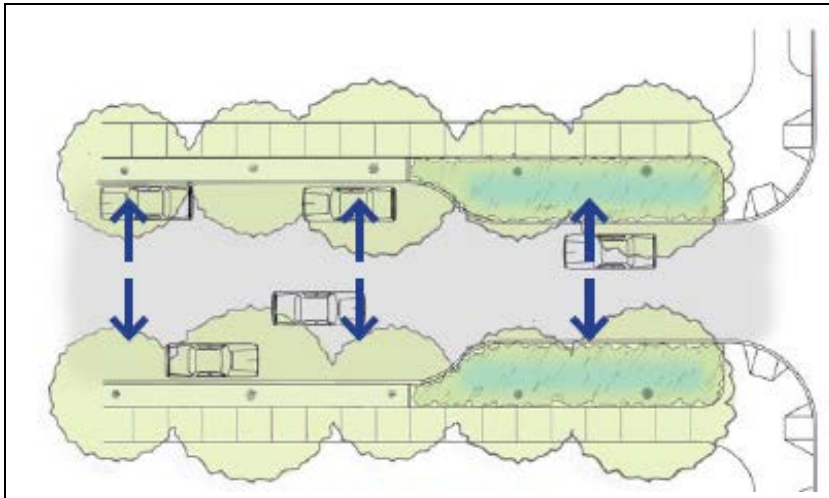


Figure B-1. Crowned Street Profile. A crowned street is designed so that the highest elevation is in the middle of the street, such that stormwater runoff drains to the sides of the street. GI facilities may be located on either side of the street.

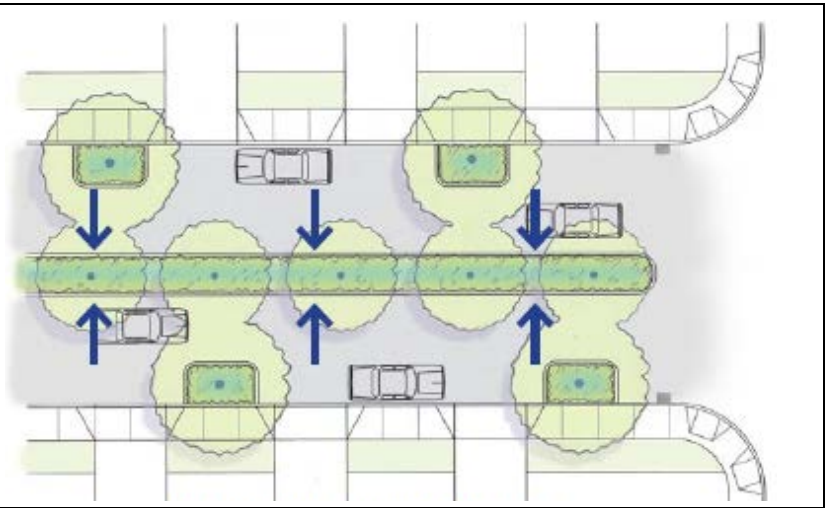


Figure B-2. Reverse Crowned Street Profile. A reversed crowned street is the opposite of a crowned street and directs runoff to the center line of the street. GI facilities may be considered in the median.

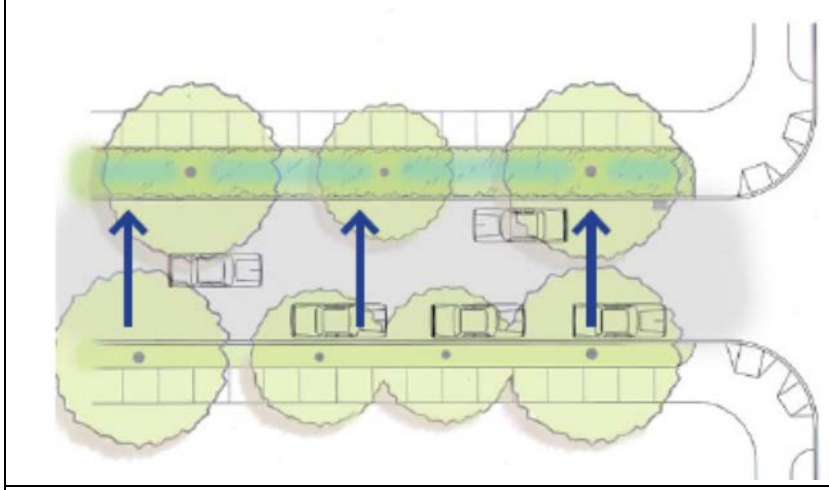


Figure B-3. Side Shed Street Profile. Side shed streets are designed to shed all water to one side of the street. GI facilities would be located on the downslope side.

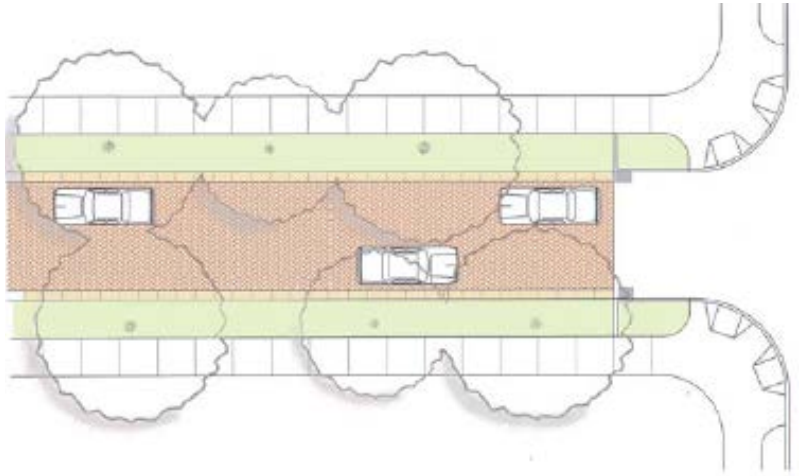


Figure B-4. Flat Street Profile. Flat streets are designed to drain through pervious paving. While these facilities do not have a marked slope, they may be graded slightly so that they drain to the sides or center of the street when there is too much water.

Source: San Mateo Countywide Water Pollution Prevention Program/Nevue Ngan

Work with the Existing Drainage System

If an underdrain will be included in the GI facility design, a street retrofit site should have an existing storm drain line, to which the underdrain may be connected. If there is no existing storm drain line, subject to municipal approval, in lieu of an underdrain, sites with poorly draining soils may potentially be designed with an oversized reservoir layer of rock below the GI facility. The rock layer would be sized to hold the amount of runoff identified in Section 6, Hydraulic Sizing Requirements. This approach was used in the City of Burlingame's Donnelly Street green street project (Figure B-5), because there was no available storm drain line.

Figure B-5. Donnelly Street Green Street Project. The Donnelly Street Green Street Project includes a rain garden, pictured at right, which captures runoff from the adjacent commercial buildings and parking lot. The rain garden was designed with no underdrain and an enlarged subsurface layer of rock, which serves as a reservoir and allows runoff to slowly infiltrate to the underlying soil. The system was designed for onsite management of flows that exceed the 30-year storm. An overflow to the curb is provided for a 50- to 100-year event scenario.
Source: City of Burlingame

Consider Conveyance Facilities

In some cases, a street retrofit project may be located near an appropriate site for a larger stormwater facility than can be accommodated in the typical street right-of-way. For example, a street retrofit project may be designed to convey stormwater runoff to a bioretention facility that will be constructed on an adjacent park or greenway. This approach is illustrated by the City of El Cerrito's Ohlone Greenway Natural Area and Rain Garden project's incorporation of a rain garden (Figure B-6) that captures and treats stormwater runoff from an adjacent segment of Fairmont Boulevard. Various methods may be considered for conveying runoff to nearby GI facilities, including trench drains (Figure B-7) and vegetated swales or vegetated channels (Figure B-8).

Figure B-6. Ohlone Greenway Natural Area and Rain Garden. This rain garden captures and treats runoff from an adjacent segment of Fairmont Boulevard. In this instance, the rain garden location provided an opportunity to convey and treat stormwater outside the street right-of-way.
Source: PlaceWorks

Figure B-7. Trench Drain. A trench drain can be used to convey runoff to GI facilities.

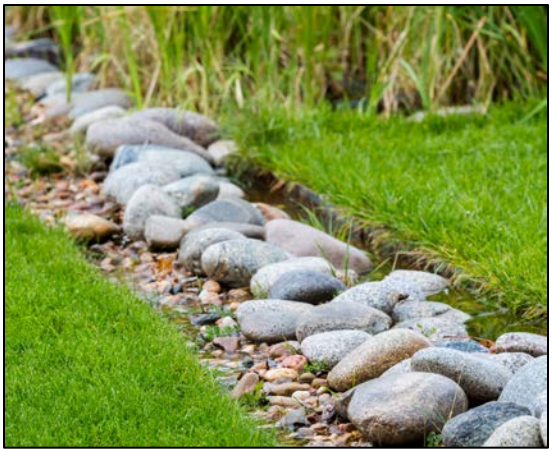


Figure B-8. Pervious Drainage Channel. Pervious, unlined drainage channels can be designed to convey runoff to GI facilities.

Identify the Appropriate Typical Design for Street Project Site

Refer to Attachment B-4 of this appendix to identify appropriate typical design drawings for the project. Typical designs have been developed for various conditions that may occur at a project site. GI projects may also utilize design guidance provided in Chapter 6 of the C.3 Technical Guidance manual for other types of low impact development storm water treatment facilities, subject to municipal staff approval.

Apply the Appropriate Hydraulic Sizing Criteria

Refer to Attachment B-1 for guidance on identifying and using the appropriate hydraulic sizing criteria for the proposed project.

Convey Stormwater away from Transportation Facilities

To manage the risk of flooding, adequate drainage facilities must be provided for all segments of roadway, in accordance with the City's storm drainage design standards, including design criteria, standards, policies, and procedures for storm drainage improvements. All storm drainage facilities must be designed in accordance with the applicable standards and accepted engineering principles, as directed by Department of Public Works.

B.2.2 Guidelines Addressing Pedestrian Travel within Street Right of Way

To help reduce pollution from automobiles, the City has a goal to improve and expand transportation choices, including the pedestrian mode of travel. As part of meeting this goal, the design of GI retrofits of existing streets should incorporate measures that seek to enhance the safety and attractiveness for pedestrians. The following measures may be considered:

- Incorporate into project intersections curb extensions, also referred to as bulbouts, which reduce the street width at intersections and shorten the length of street crossings for pedestrians, while also providing space for GI facilities (see Figure B-9).
- Provide attractive landscaping designs that enhance the sense of place for pedestrians and may potentially include amenities such as shade trees and seating areas.
- Locate the GI facility between the sidewalk and vehicle travel lanes, in order to enhance pedestrian safety by providing protected sidewalks.

Figure B-9. Curb Extension. In addition to reducing the street width and shortening the length of street crossings for pedestrians, curb extensions, or "bulbouts," such as this example in Albany, also provide space for GI facilities.
Source: bluegreenbldg.com

B.2.3 Guidelines Addressing Street Use for Bicycle, Transit, and Vehicle Movement/Parking

Complete streets balance the needs of pedestrian, bicycle, automobile, and public transit modes of travel. To meet the goal of improving and expanding transportation choices, described in Section B.2.2, in addition to pedestrian transportation, GI retrofits of existing streets must also be designed to accommodate bicycles, motor vehicles, and, where appropriate, public transit. The design and construction of each GI project should incorporate appropriate measures to enhance transportation safety and help improve the attractiveness of alternative modes of travel. The following measures may be considered:

Bicycle-Friendly Measures

- Include bicycle lanes in GI retrofits of existing streets.
- Provide a protected bicycle lane by locating a GI facility or other landscaped area, or a lane of parking, between a bicycle lane and lanes of motor vehicle travel.
- Include bicycle racks in GI street retrofit projects.

Public Transit-Friendly Measures

- Enhance the comfort of public transit users by providing shelter, shade, and greenscape at bus stops and other public transit stops.
- Integrate GI into transit facilities, such as boarding bulbs and islands, or rooftops of transit shelters.
- Provide bicycle racks at public transit stops.

Motor Vehicle-Friendly Measures

- Implement GI with geometric changes that reduce vehicle speed and/or improve visibility. This may include "road diet" projects that reduce the number of lanes of travel, or traffic calming projects that incorporate areas of landscaping, such as traffic islands, as visual cues to help slow down traffic.
- Provide visual cues to help slow down traffic and alert drivers to the presence of GI facilities, to help prevent motor vehicles from driving into a stormwater facility. Visual cues may include curbs and landscaping that is readily visible to drivers.

B.2.4 Guidelines Addressing Urban Forestry in Public Right of Way

Increasing the planting of street trees in the City is anticipated to benefit local water quality, air quality, energy efficiency, and property values. GI projects should incorporate measures to preserve existing street trees and promote the planting of new street trees. The following measures should be incorporated, as appropriate:

- Prioritize the preservation of existing mature trees.
- Replace any mature trees that are removed by the project.
- Maximize the planting of new trees in accordance with the requirements of Recreation and Parks Department.
- The planting of trees within a GI facility should follow guidance, including the identification of appropriate species, provided in Appendix B of the ACCWP C.3

Technical Guidance, which may be downloaded at www.cleanwaterprogram.org (click Businesses, then Development).

B.3 Guidelines for GI Retrofits of Public Parcels

Public parcels must perform the range of functions described in Section B.1. The following guidelines provide general guidelines for GI retrofitting of public parcels, to address the full range of functions. Additional design guidance for GI facilities, which are also referred to as low impact development (LID) storm water treatment facilities, is provided in Chapters 5 and 6 of the ACCWP C.3 Technical Guidance, which may be downloaded at, www.cleanwaterprogram.org (click Businesses, then Development).

B.3.1 Guidelines to Address Parking Lot Use for Landscaping and Stormwater Management

Parking lots often contain excess parking spots and oversized parking spaces and drive aisles. GI retrofits of public parcels should consider options to reduce any unnecessary parking areas, in order to provide space for landscaping, stormwater management, and pedestrian walkways. The following measures may be considered:

Maximize Space for GI and other Landscaping

To allow more space for GI and other landscaping, shorten parking stall lengths to 15 feet, and drive/back-up aisle widths to 22 feet, subject to municipal approval. Parking should be designed to meet "average day" needs and utilize pervious overflow parking zones to meet peak parking needs.

Consider Specifying Pervious Paving Pervious paving may be used in parking lot designs. Where pervious paving is underlain with pervious soil or pervious storage material sufficient to hold the Municipal Stormwater Regional Permit Provision C.3.d volume of rainfall runoff, it is not considered impervious and can function as a self-treating area. Please see Section 6.6 of the C.3 Technical Guidance for further design guidance for pervious pavement installations.

Convey Stormwater to GI Facilities

GI retrofits of existing sites must be designed to convey stormwater runoff from impervious surfaces (roofs and/or parking lots) to the proposed GI facilities. Key issues include working with the existing drainage system and considering conveyance facilities where needed.

Work with the Existing Drainage System

If an underdrain will be included in the GI facility design, the site should have access to an existing storm drain line, to which the underdrain may be connected. If there is no existing storm drain line, subject to municipal approval, in lieu of an underdrain, sites with poorly draining soils may potentially be designed with an oversized reservoir layer of rock below the GI facility. The rock layer would be sized to hold the amount of runoff identified in Section 6, Hydraulic Sizing Requirements. This approach was used in the City of Burlingame's Donnelly Street green street project (Figure B-5), because there was no available storm drain line.

Consider Conveyance Facilities

Various methods may be considered for conveying runoff from impervious surfaces to GI facilities, including trench drains (Figure B-7) and vegetated swales or vegetated channels (Figure B-8). In parking lots that include speed bumps, consider using speed bumps to help direct stormwater runoff to GI facilities.

Identify the Appropriate Typical Design for the Project Site

Refer to Attachment B-4, included in this appendix, to identify appropriate typical design drawings for the project. Typical designs have been developed for various conditions that may occur at a project site. GI projects may also utilize design guidance provided in Chapter 6 of the C.3 Technical Guidance manual for other types of low impact development storm water treatment facilities, subject to municipal staff approval.

Apply the Hydraulic Sizing Criteria Identified in Provisions C.3.c and C.3.d

Refer to Attachment B-1 for guidance on using the appropriate hydraulic sizing criteria in MRP Provisions C.3.c and C.3.d as applicable to design GI projects that are not regulated by Provision C.3.b ("non-Regulated Projects).

Prioritize Tree Preservation and Planting

In order to benefit local water quality, air quality, energy efficiency, and property values, GI projects on public parcels should incorporate measures to preserve existing street trees and promote the planting of new trees. The following measures should be incorporated, as appropriate:

- Prioritize the preservation of existing mature trees.
- Replace any mature trees that are removed by the project.
- Maximize the planting of new trees in accordance with the requirements of the Recreation and Parks Department.
- Incorporate trees in landscaped areas within parking lots – which serves to shade vehicles and paved surfaces, improve air and water quality, intercept stormwater in the tree canopy, and take up stormwater through the root system.
- The planting of trees within a GI facility should follow guidance, including the identification of appropriate species, provided in Appendix B of the ACCWP C.3 Technical Guidance, which may be downloaded at www.cleanwaterprogram.org (click Businesses, then Development).

B.3.2 Guidelines to Address Parking Lot Use for Vehicular Parking

GI retrofits of public parcels should provide for adequate motor vehicle and bicycle parking for the proposed public use. The following measures may be considered:

- Include bicycle parking facilities.
- Provide pedestrian walkways within parking lots, including bridged walkways across GI facilities.

- Provide safe pedestrian access to and directional signage for adjacent public transit stops.
- Consider other improvements to enhance existing pedestrian circulation and safety.
- Depending on the type of use, larger public parcel retrofits should consider providing bicycle storage, changing rooms, and preferred parking for carpooling

B.4 Guidelines for Coordination of Projects

Installing GI components at a project prior to the completion of that project, or the construction of an adjacent project, has the potential to degrade the functioning of the GI facility. Street improvement or other infrastructure projects, the development of public parcels, and other public and private projects should therefore include coordination of construction schedules to minimize impacts to GI.

The following measures shall be implemented in all GI projects to protect investments in GI:

1. GI facilities shall not be used as temporary sediment basins during construction.
2. Erosion control plans shall include protections for GI; erosion control plans are subject to the requirements in Alameda Municipal Code 30-84.12.
3. Installed GI facilities shall be protected from construction runoff and kept offline until the contributing drainage area is stabilized.

Contractors are encouraged to construct GI facilities at the end of a project, to help protect the facilities from construction-related impacts.

Attachment B-1: Hydraulic Sizing Criteria

This provides guidance on the following topics:

- Hydraulic sizing criteria in MRP Provisions C.3.c and C.3.d as applicable to GI projects that are not regulated by Provision C.3.b ("non-Regulated Projects)
- Alternate sizing approach for constrained street projects

B1.1 Hydraulic Sizing Criteria in MRP Provisions C.3.c and C.3.d

Provision C.3.c requires the use of low impact development (LID) stormwater controls. To meet the MRP definition of LID, bioretention facilities must have a surface area no smaller than what is required to accommodate a 5 inches/hour stormwater runoff surface loading rate, and infiltrate runoff through biotreatment soil media at a minimum of 5 inches per hour.

Provision C.3.d of the MRP includes volume-based, flow-based, and the combination volume- and flow-based hydraulic sizing criteria. Bioretention areas may be sized using a simplified flow-based hydraulic sizing method, known as the "4 percent method," in which the surface area of the bioretention area is 4 percent of the effective impervious surface area that is treated. However, by using a combination volume- and flow-based hydraulic sizing approach, it may be possible to provide a bioretention area that is less than 4 percent of the effective impervious surface area, which can help reduce costs. Step-by-step instructions for using the 4 percent method and the volume-based sizing criteria are provided in Section 5.1 of the C.3 Technical Guidance. Guidance for using the combination flow and volume criteria from Section 5.1 of the C.3 Technical Guidance document are copied below. The worksheet for using this method is provided in Attachment B-2.

The implementation of LID stormwater treatment facilities designed in accordance with Provisions C.3.c and C.3.d of the MRP will provide hydromodification management benefits by infiltrating and detaining stormwater runoff.

Step-by-Step Guidance for Combination Flow and Volume Method

To apply the combination flow and volume approach, use the following steps, which may be performed using the combination flow and volume sizing criteria Excel worksheet provided in Attachment B-2 of this appendix.

1. **Mean Annual Precipitation**
    - Determine the mean annual precipitation (MAP) for the project site using the Mean Annual Precipitation Map of Alameda County (Attachment B-3). Use the Oakland Airport unit basin storage volume values from Table B1-1(below) if the project location's mean annual precipitation is 16.4 inches or greater and the San Jose values if it is less than 16.4 inches.
    - In order to account for the difference between MAP of the project site and the two rainfall locations shown, calculate the ***MAP adjustment factor*** by dividing the project MAP by the MAP for the applicable rain gauge, as shown below: MAP adjustment factor = (project location mean annual precipitation

$$Map\ adjustment\ factor = \frac{(project\ location\ mean\ annual\ precipitation)}{(18.35\ or\ 14.4, as\ appropriate)}$$

2. Effective Impervious Area for the Drainage Management Area

- Based on the topography of the site and configuration of buildings, divide the site into drainage management areas (DMAs), each of which will drain to a treatment measure. Implement the steps below for each DMA with a volume-based treatment measure.
- Minimize the amount of landscaping or pervious pavement that will contribute runoff to the treatment measures. Refer to Sections 4.1 and 4.2 of the C.3 Stormwater Technical Guidance to design areas of landscaping or pervious pavement as "self-treating areas" or "self-retaining areas," so that they do not contribute runoff to the LID treatment measure and may be excluded from the DMAs for the treatment measures.
- For each DMA in which the area that will contribute runoff to the treatment measure includes pervious surfaces (landscaping or properly designed pervious paving), multiply the area of pervious surface by a factor of 0.1.
- For applicable DMAs, add the product obtained in the previous step to the area of impervious surface, to obtain the "***effective impervious area***." (For DMAs that are 100% impervious, use the entire DMA area.)

3. Unit Basin Storage Volume

- The effective impervious area of a DMA has a runoff coefficient of 1.0. Refer to Table B1-1 to obtain the ***unit basin storage volume*** that corresponds to your rain gauge area. For example, using the Oakland Airport gauge, the unit basin storage volume would be 0.67 inches. Adjust the unit basin storage volume for the site by multiplying the unit basin storage volume value by the MAP adjustment factor calculated in Step 1.
- Calculate the ***required capture volume*** by multiplying the effective impervious area of the DMA calculated in Step 2 by the adjusted unit basin storage volume. Due to the mixed units that result, such as acre-inches, it is recommended that the resulting volume be converted to cubic feet for use during design. For example, say you determined the adjusted unit basin storage volume to be 0.5 inches, and the effective impervious area draining to the bioretention facility is 7,000 square feet. Then the required capture volume would be:

$$Required\ capture\ volume = 0.5\ inches\ \times \left(\frac{1\ foot}{12\ inches}\right) \times 7{,}000\ feet^2 = 292\ cubic\ feet$$

Table B1-1. Unit Basin Storage Volume (Inches) for 80 Percent Capture with 48-Hour Drawdown Time		
		Unit Basin Storage Volume for Effective Impervious Area of Drainage Management Area
Location	**Mean Annual Precipitation (inches)**	**Coefficient of 1.00**
Oakland Airport	18.35	0.67
San Jose	14.4	0.56
Source: CASQA 2003, cited in Table 6-2 of the C.3 Technical Guidance.		

4. Depth of Infiltration Trench or Pervious Paving Base Layer

- Assume that the rain event that generates the required capture volume of runoff determined in Step 3 occurs at a constant rainfall intensity of 0.2 inches/hour from the start of the storm (i.e., assume a rectangular hydrograph). Calculate the ***duration of the rain event*** by dividing the unit basin storage volume by the intensity. In other words, determine the amount of time required for the unit basin storage volume to be achieved at a rate of 0.2 inches/hour. For example, if the unit basin storage volume is 0.5 inches, the rain event duration is 0.5 inches ÷ 0.2 inches/hour = 2.5 hours.

5. Preliminary Estimate of the Surface Area the Facility

- Make a ***preliminary estimate of the surface area*** of the bioretention facility by multiplying the DMA's impervious area (or effective impervious surface if applicable) by the 4 percent method sizing factor of 0.04. For example, a drainage area of 7,000 square feet of impervious surface × 0.04 = 280 square feet of bioretention treatment area.
- Assume a bioretention area that is about 25% smaller than the bioretention area calculated with the 4 percent method. Using the example above, 280 – (0.25 × 280) = 210 square feet.
- ***Calculate the volume of runoff that filters through the biotreatment soil*** at a rate of 5 inches per hour (the design surface loading rate for bioretention facilities), for the duration of the rain event calculated in Step 4. For example, for a bioretention treatment area of 210 square feet, with an infiltration rate of 5 inches per hour for a duration of 2.5 hours, the volume of treated runoff = 210 square feet × 5 inches/hour × (1 foot/12 inches) × 2.5 hours = 219 cubic feet. (Note: when calculating ponding depth, the mulch layer is not included in the calculation.)

6. Initial Adjustment of Depth of Surface Ponding Area

- Calculate the portion of the required capture volume ***remaining after treatment is accomplished by filtering*** through the treatment soil. The result is the amount that must be stored in the ponding area above the reduced bioretention area assumed in Step 6. For example, the amount remaining to be stored comparing Step 3 and Step 5 is 292 cubic feet – 219 cubic feet = 73 cubic feet. If this volume

is stored over a surface area of 210 square feet, the ***average ponding depth*** would be 73 cubic feet ÷210 square feet = 0.35 feet or 4.2 inches.

- Check to see if the ***average ponding depth is between 6 and 12 inches***, which is the recommended allowance for ponding in a bioretention facility or flow-through planter.

7. Optimize the Size of the Treatment Measure

- If the ponding depth is greater than 12 inches, a larger surface area will be required. (In the above example, the optimal size of the bioretention area is 190 square feet with a ponding depth of 6 inches.) In order to build conservatism into this sizing method, the Countywide Program recommends that municipalities not approve the design of any bioretention areas or rain gardens that have a surface area that is less than 3 percent of the effective impervious area within the DMA.

Please note that Appendix C of the C.3 Stormwater Technical Guidance includes an example of sizing bioretention areas using the combination flow- and volume-based method.

B1.2 Alternate Sizing Approach for Constrained Street Projects

Provision C.3.j.i.(2)(g) of the MRP allows the jurisdictions subject to the MRP (MRP Permittees) to develop an alternate sizing approach for street projects that are not subject to Provision C.3.b.ii. (non-Regulated Projects) in which project constraints preclude fully meeting the C.3.d sizing requirements. This approach, developed by the Bay Area Stormwater Management Agencies Association, and referred to as *Green Infrastructure Facility Sizing for Non-Regulated Street Projects* (June 2019) is described below and included as Attachment B-6.

- Bioretention facilities in street projects should be sized as large as feasible and meet the C.3.d. criteria where possible. Constraints in the public right-of-way may affect the size of these facilities and warrant the use of smaller sizing factors. Bioretention facilities in street projects may use the sizing curves in the document titled "Green Infrastructure Facility Sizing for Non-Regulated Street Projects (BASMAA and Dubin Environmental, 2017) to meet the C.3.d criteria. Local municipal staff involved with other assets in the public right of way should be consulted to provide further guidance to design teams as early in the process as possible.
- Bioretention facilities in street projects smaller than what would be required to meet Provision C.3.d. criteria may be appropriate in some circumstances. Where feasible such facilities can be designed as "off-line" facilities, where the bypassed runoff is not treated or is treated in a different facility further downstream. In these cases, the proportion of total runoff captured and treated should be estimated using the results in the BASMAA and Dubin Environmental document. In cases where "in-line" bioretention systems cannot meet C.3.d criteria. The facilities should incorporate erosion control as needed to protect the facility from high flows.

Attachment B-2: Worksheet for Calculating the Combination Flow and Volume Method

The worksheet for calculating the combination flow and volume method is provided on the following page.

Worksheet for Calculating the Combination Flow and Volume Method

Instructions: After completing Section 1, make a copy of this Excel file for each Drainage Management Area within the project. Enter information specific to the project and DMA in the cells shaded in yellow. Cells shaded in light blue contain formulas and values that will be automatically calculated.

1.0 Project Information

1-1 Project Name:

1-2 City application ID:

1-3 Site Address or APN:

1-4 Tract or Parcel Map No:

1-5 Site Mean Annual Precip. (MAP)[1] **Inches**

Refer to the Mean Annual Precipitation Map in Appendix D of the C.3 Technical Guidance to determine the MAP, in inches, for the site. Click here for map

1-6 Applicable Rain Gauge[2]

Enter "Oakland Airport" if the site MAP is 16.4 inches or greater. Enter "San Jose" if the site MAP is less than 16.4 inches.

MAP adjustment factor is automatically calculated as:

(The "Site Mean Annual Precipitation (MAP)" is divided by the MAP for the applicable rain gauge, shown in Table 5.2, below.)

The calculations presented here are based on the **combination flow and volume hydraulic sizing method** provided in the Clean Water Program Alameda County C.3 Technical Guidance, Version 4.0. The steps presented below are explained in Chapter 5, Section 5.1 of the guidance manual, applicable portions of which are included in this file, in the tab called "Guidance from Chapter 5".

2.0 Calculate Percentage of Impervious Surface for Drainage Management Area (DMA)

2-1 Name of DMA:

For items 2-2 and 2-3, enter the areas in square feet for each type of surface within the DMA.

	Type of Surface	Area of surface type within DMA (Sq. Ft)	Adjust Pervious Surface	Effective Impervious Area
2-2	Impervious surface		1.0	
2-3	Pervious service		0.1	
	Total DMA Area (square feet) =			

2-4 ***Total Effective Impervious Area (EIA)*** **Square feet**

3.0 Calculate Unit Basin Storage Volume in Inches

Table 5-2: Unit Basin Storage Volumes (in inches) for 80 Percent Capture Using 48-Hour Drawdowns

		Unit Basin Storage Volume (in) for Applicable Runoff Coefficients
Applicable Rain Gauge	**Mean Annual Precipitation (in)**	**Coefficient of 1.00**
Oakland Airport	18.35	0.67
San Jose	14.4	0.56

3-1 ***Unit basin storage volume from Table 5.2:*** **Inches**

(The coefficient for this method is 1.00, due to the conversion of any landscaping to effective impervious area)

3-2 ***Adjusted unit basin storage volume:*** **Inches**

(The unit basin storage volume is adjusted by applying the MAP adjustment factor.)

3-3 ***Required Capture Volume (in cubic feet):*** **Cubic feet**

(The adjusted unit basin sizing volume [inches] is multiplied by the size of the DMA and converted to feet)

4.0 Calculate the Duration of the Rain Event

4-1 Rainfall intensity **0.2 Inches per hour**

4-2 Divide Item 3-2 by Item 4-1 **Hours of Rain Event Duration**

5.0 Preliminary Estimate of Surface Area of Treatment Measure

5-1 4% of DMA impervious surface **Square feet**

5-2 Area 25% smaller than item 5-1 **Square feet**

5-3 Volume of treated runoff for area in Item 5-2 **Cubic feet** (Item 5-2 * 5 inches per hour * 1/12 * Item 4-2)

6.0 Initial Adjustment of Depth of Surface Ponding Area

6-1 Subtract Item 5-3 from Item 3-3 **Cubic feet** (Amount of runoff to be stored in ponding area)

6-2 Divide Item 6-1 by Item 5-2 **Feet** (Depth of stored runoff in surface ponding area)

6-3 Convert Item 6-2 from ft to inches **Inches** (Depth of stored runoff in surface ponding area)

6-4 If ponding depth in Item 6-3 meets your target depth, skip to Item 8-1. If not, continue to Step 7-1.

7.0 Optimize Size of Treatment Measure

7-1 Enter an area larger or smaller than Item 5-2 **Sq.ft.** (enter larger area if you need less ponding depth; smaller for more depth.)

7-2 Volume of treated runoff for area in Item 7-1 **Cubic feet** (Item 7-1 * 5 inches per hour * 1/12 * Item 4-2)

7-3 Subtract Item 7-2 from Item 3-3 **Cubic feet** (Amount of runoff to be stored in ponding area)

7-4 Divide Item 7-3 by Item 7-1 **Feet** (Depth of stored runoff in surface ponding area)

7-5 Convert Item 7-4 from feet to inches **Inches** (Depth of stored runoff in surface ponding area)

7-6 If the ponding depth in Item 7-5 meets target, stop here. If not, repeat Steps 7-1 through 7-5 until you obtain target depth.

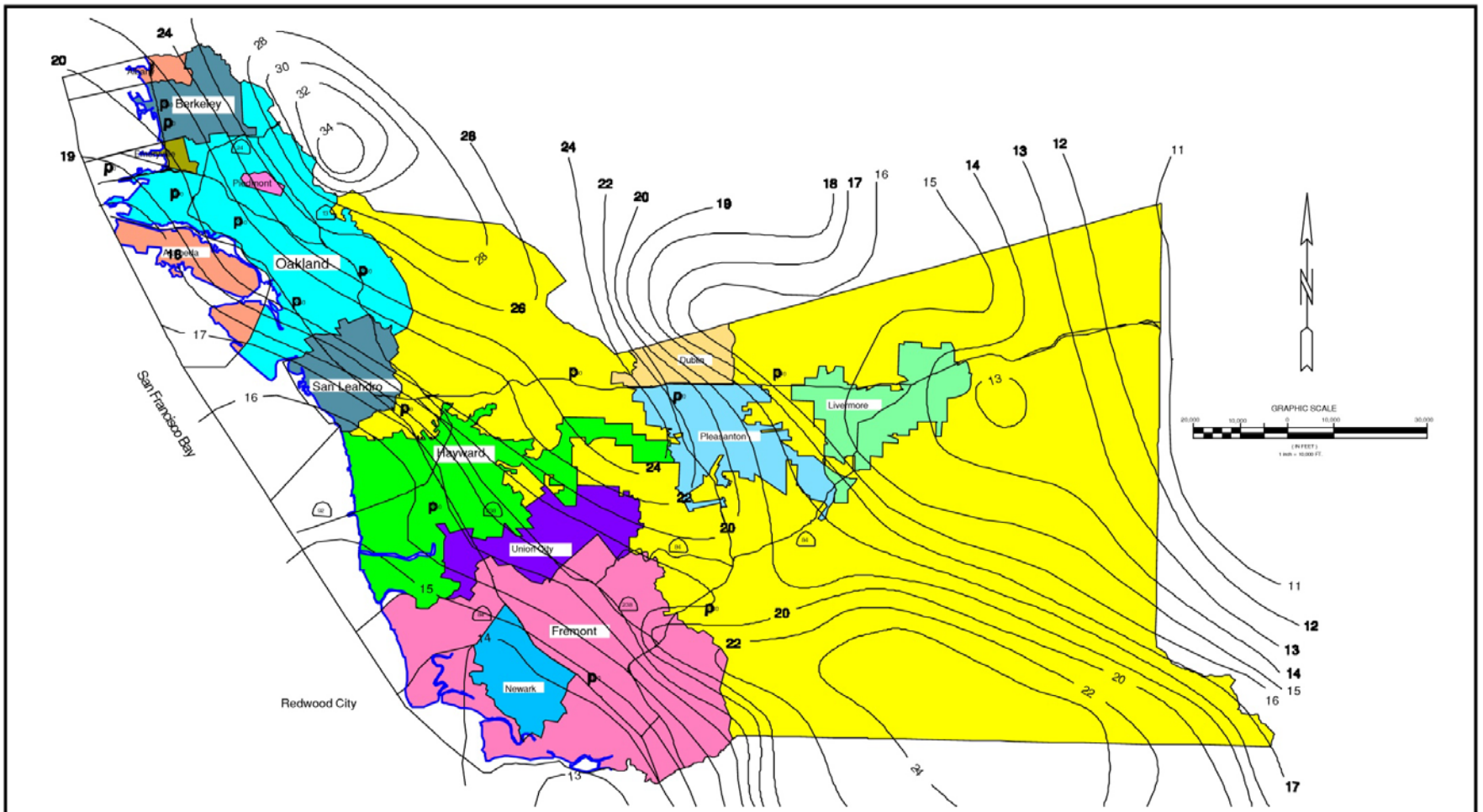
8.0 Surface Area of Treatment Measure for DMA

8-1 Final surface area of treatment* **Square feet** (Either Item 5-2 or final amount in Item 7-1)

**Note: Check with the local jurisdiction as to its policy regarding the minimum biotreatment surface area allowed.*

Attachment B-3: Mean Annual Precipitation Map

The Mean Annual Precipitation Map for Alameda County is provided on the following page.



ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT	MEAN ANNUAL PRECIPITATION (VALUES IN INCHES)	DATE: MAY 2003 **ATTACHMENT-6**

Attachment B-4: Standard Specifications and Typical Designs

The ACCWP adopted the City of Dublin's standard specifications and details. Standard specifications and typical design drawings for GI projects are provided on the following pages, as indicated in Table B5-1.

Table B5-1: ACCWP GI Typical Designs/Standard Specifications

Sheet No.	Title of Drawing/Standard Specifications	Site Characteristics		
		Land Use	Street Classification	Other
GI-2A	Bioretention area: Plan view with street parking	Commercial, industrial, or residential	Arterial, collector, or local streets	Parking lane
GI-2B	Bioretention area: Bulbout plan view	Commercial, industrial, or residential	Arterial, collector, or local streets	Intersection with sidewalks
GI-2C	Bioretention area: Street Median	Commercial, industrial, or residential	Arterial, collector, or local streets	--
GI-3A	Bioretention Area: Sloped Sides Cross Section	Commercial, industrial, or residential	Arterial, collector, or local streets	Sidewalk
GI-3B	Bioretention Area: Vertical Side Wall Cross Section	Commercial, industrial, or residential	Arterial, collector, or local streets	Parking lane and sidewalk
GI-4	Bioretention Components: Outlet Detail	Commercial, industrial, or residential	Arterial, collector, or local streets	--
GI-5	Bioretention Components: Edge Treatment Detail	Commercial, industrial, or residential	Arterial, collector, or local streets	No parking
GI-6A	Bioretention Components: Gutter Curb Cut Inlet Detail	Commercial, industrial, or residential	Arterial, collector, or local streets	--
GI-6B	Bioretention Components: Trench Drain Curb Cut Inlet Detail	Commercial, industrial, or residential	Arterial, collector, or local streets	Parking lane and sidewalk
GI-6C	Bioretention Components: Curb Cut At Bulbout Inlet Detail	Commercial, industrial, or residential	Arterial, collector, or local streets	Intersection with Sidewalks
GI-7	Bioretention Components: Check Dam Detail	Commercial, industrial, or residential	Arterial, collector, or local streets	Slope requiring check dams
GI-8	Bioretention area with bike lane plan view	Commercial, industrial, or residential	Arterial, collector, or local streets	Bike lane

PURPOSE:

PROVISION C.3 OF THE MUNICIPAL REGIONAL STORMWATER NPDES PERMIT (MRP) REQUIRES TREATMENT OF IMPERVIOUS SURFACES USING GREEN INFRASTRUCTURE FOR BOTH PUBLIC AND PRIVATE DEVELOPMENT PROJECTS. BIORETENTION AREAS ARE EXPECTED TO BE THE MOST COMMON GREEN INFRASTRUCTURE APPLICATION IN PUBLIC RIGHT-OF-WAY (ROW). THE PURPOSE OF THE BIORETENTION AREA IS TO IMPROVE WATER QUALITY BY FILTRATION THROUGH THE BIOTREATMENT SOIL AND TO CONTROL RUNOFF PEAK FLOW RATES AND VOLUMES THROUGH STORAGE AND INFILTRATION.

NOTES & GUIDELINES:

1. THE ENGINEER SHALL ADAPT PLAN AND SECTION DRAWINGS TO ADDRESS SITE-SPECIFIC CONDITIONS.
2. BIORETENTION AREA SHALL BE SIZED TO MEET THE REQUIREMENTS OF MRP PROVISION C.3 SIZING.
3. 48 HOUR MAXIMUM FACILITY DRAWDOWN TIME (TIME FOR MAXIMUM SURFACE PONDING TO DRAIN THROUGH THE BIOTREATMENT SOIL AFTER THE END OF A STORM). REFER TO C.3 TECHNICAL GUIDANCE MANUAL (ACCWP) FOR DRAINAGE CONSIDERATIONS.
4. A STORAGE LAYER OF CALTRANS STANDARD CLASS II PERMEABLE MATERIAL IS REQUIRED UNDER THE BIOTREATMENT SOIL. REFER TO C.3 TECHNICAL GUIDANCE MANUAL (ACCWP) FOR SPECIFICATIONS.
5. CHECK DAMS SHALL BE USED TO TERRACE FACILITIES TO PROVIDE SUFFICIENT PONDING FOR SLOPED INSTALLATIONS. ENGINEER SHALL SPECIFY CHECK DAM HEIGHT AND SPACING. REFER TO DETAIL **GI-7** FOR GUIDANCE ON CHECK DAM DESIGN.
6. DEPENDING ON THE DEPTH OF THE BIORETENTION AREA, ADDITIONAL STRUCTURAL CONSIDERATIONS MAY BE REQUIRED TO ADDRESS HORIZONTAL LOADING. REFER TO DETAIL **GI-5** FOR GUIDANCE ON EDGE TREATMENTS.
7. WHEN FACILITY CONSTRUCTION IMPACTS EXISTING SIDEWALK, ALL SAW CUTS SHALL ADHERE TO LOCAL JURISDICTION STANDARDS. SAW CUTS SHALL BE ALONG SCORE LINES OR ALONG CONSTRUCTION JOINTS, AS DETERMINED BY THE CITY ENGINEER, AND ANY DISTURBED SIDEWALK FLAGS SHALL BE REPLACED IN THEIR ENTIRETY.
8. BIORETENTION AREAS IN PUBLIC RIGHT OF WAY SHALL BE DESIGNED WITH AN EMERGENCY OVERFLOW. IN THE EVENT THE BIORETENTION AREA OVERFLOW DRAIN IS OBSTRUCTED OR CLOGGED, THE INUNDATION AREA SHALL BE CONTAINED WITHIN THE STREET AND SHALL NOT BE WITHIN ADJACENT PRIVATE PROPERTIES.
9. BIORETENTION AREA VEGETATION SHALL BE SPECIFIED BY LANDSCAPE DESIGN PROFESSIONAL. SEE C.3 TECHNICAL GUIDANCE MANUAL (ACCWP) FOR PLANT LIST AND VEGETATION GUIDANCE.
10. THE ENGINEER SHALL EVALUATE THE NEED FOR EROSION PROTECTION AT ALL INLET LOCATIONS. ALL COBBLES USED FOR ENERGY DISSIPATION SHALL BE GROUTED. ENGINEER TO CONSIDER MAINTENANCE REQUIREMENTS TO FACILITATE EASY SEDIMENT REMOVAL AND ADEQUATE VECTOR CONTROL.
11. THE PROJECT PLANS SHALL SHOW ALL EXISTING UTILITIES AND INDICATE POTENTIAL UTILITY CROSSINGS OR CONFLICTS.
12. CHECK WITH LOCAL JURISDICTION FOR UTILITY CROSSING PROVISIONS.
13. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES SHALL CONFORM TO CURRENT LOCAL JURISDICTION STANDARDS AND OTHER UTILITY PROVIDER REQUIREMENTS.
14. VERTICAL SIDEWALLS EXTENDING INTO EXISTING STORM DRAIN PIPE TRENCH BACKFILL SHALL BE DESIGNED WITH A CONCRETE BACKFILL ACCEPTABLE TO THE CITY ENGINEER.
15. OVERFLOW RISER MUST BE FORMED SUCH THAT IT IS A MINIMUM OF 6" ABOVE THE BOTTOM OF THE SYSTEM INLET, OR AS DESIGNED. PLACE STRUCTURE ADJACENT TO PEDESTRIAN EDGE TO ALLOW FOR MONITORING ACCESS.
16. DETAILS WERE ADAPTED FROM SFPUC GREEN INFRASTRUCTURE TYPICAL DETAILS AND SPECIFICATIONS.
17. DETAILS WERE DEVELOPED BY GEOSYNTEC CONSULTANTS.

ENGINEER CHECKLIST (SHALL SPECIFY, AS APPLICABLE):

- ☐ BIORETENTION AREA WIDTH AND LENGTH
- ☐ DEPTH OF PONDING
- ☐ AMOUNT OF FREEBOARD PROVIDED
- ☐ DEPTH OF BIOTREATMENT SOIL (18" MIN)
- ☐ UNDERDRAIN SPECIFICATIONS AND LOCATION (IF FACILITY IS LINED PLACE UNDERDRAIN AT BOTTOM OF FACILITY)
- ☐ BIORETENTION SURFACE ELEVATION (TOP OF BIOTREATMENT SOIL) AT UPSLOPE AND DOWNSLOPE ENDS OF FACILITY
- ☐ CONTROL POINTS AT EVERY BIORETENTION WALL CORNER AND POINT OF TANGENCY
- ☐ DIMENSIONS AND DISTANCE TO EVERY INLET, OUTLET, CHECK DAM, SIDEWALK NOTCH, ETC.
- ☐ ELEVATIONS OF EVERY INLET, OVERFLOW RISER, STRUCTURE RIM AND INVERT CHECK DAM, BIORETENTION AREA WALL CORNER, AND SIDEWALK NOTCH
- ☐ TYPE AND DESIGN OF BIORETENTION AREA COMPONENTS (E.G., EDGE TREATMENTS, INLETS/GUTTER MODIFICATIONS, UTILITY CROSSINGS, LINER, AND PLANTING DETAILS)
- ☐ DEPTH AND TYPE OF MULCH (NON-FLOATING; ORGANICALLY-DERIVED; NOT BARK OR GORILLA HAIR; 3" MIN)

RELATED TECHNICAL GUIDANCE	SOURCE
BIORETENTION: - BIOTREATMENT SOIL MIX - CALTRANS CLASS II PERM LAYER STORAGE - PERFORATED UNDERDRAIN - NON-FLOATING MULCH	C.3 TECHNICAL GUIDANCE MANUAL (ACCWP)

NOT FOR CONSTRUCTION

cleanwater PROGRAM

BIORETENTION AREA: NOTES

GREEN INFRASTRUCTURE EXAMPLE DETAILS

ALAMEDA COUNTYWIDE CLEAN WATER PROGRAM

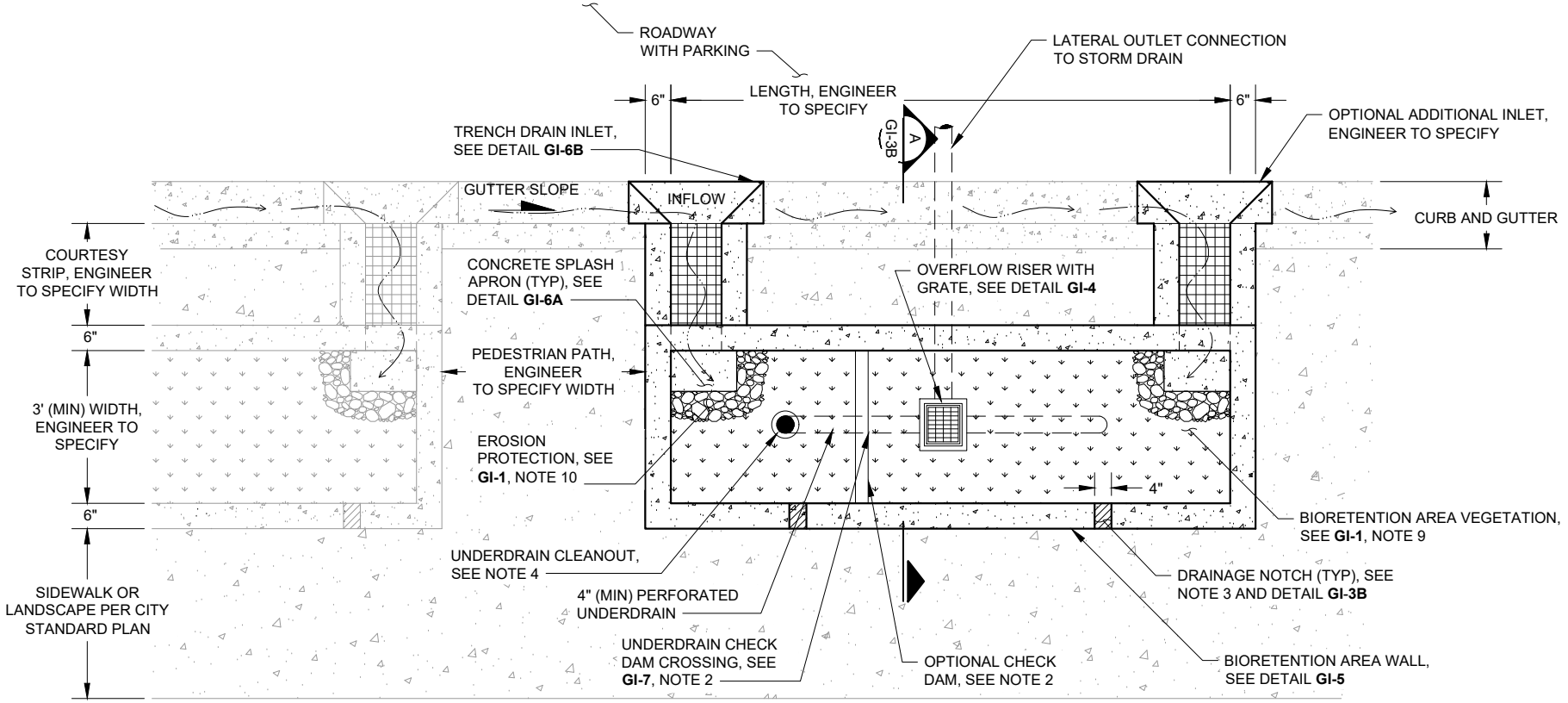
SCALE: NOT TO SCALE

DATE: MAY 11, 2018 REVISED: JUNE 11, 2019

DRAWN BY: K. K. REVISED BY: E. F.

CHECKED BY: A. R.

GI-1



NOTES:

1. REFER TO **GI-1** NOTES FOR GUIDELINES AND CHECKLIST.
2. CHECK DAMS SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN (SEE DETAIL **GI-7**).
3. LAY OUT DRAINAGE NOTCHES AS APPLICABLE TO PREVENT PONDING BEHIND BIORETENTION AREA WALL WITH 5' MAXIMUM SPACING BETWEEN NOTCHES.
4. PROVIDE ONE UNDERDRAIN CLEANOUT PER BIORETENTION AREA (MIN). CLEANOUT REQUIRED AT UPSTREAM END AND PIPE ANGLE POINTS EXCEEDING 45 DEGREES. LONGITUDINAL SLOPE OF PIPE SHALL BE 0.5% (MIN).

NOT FOR CONSTRUCTION

cleanwater PROGRAM

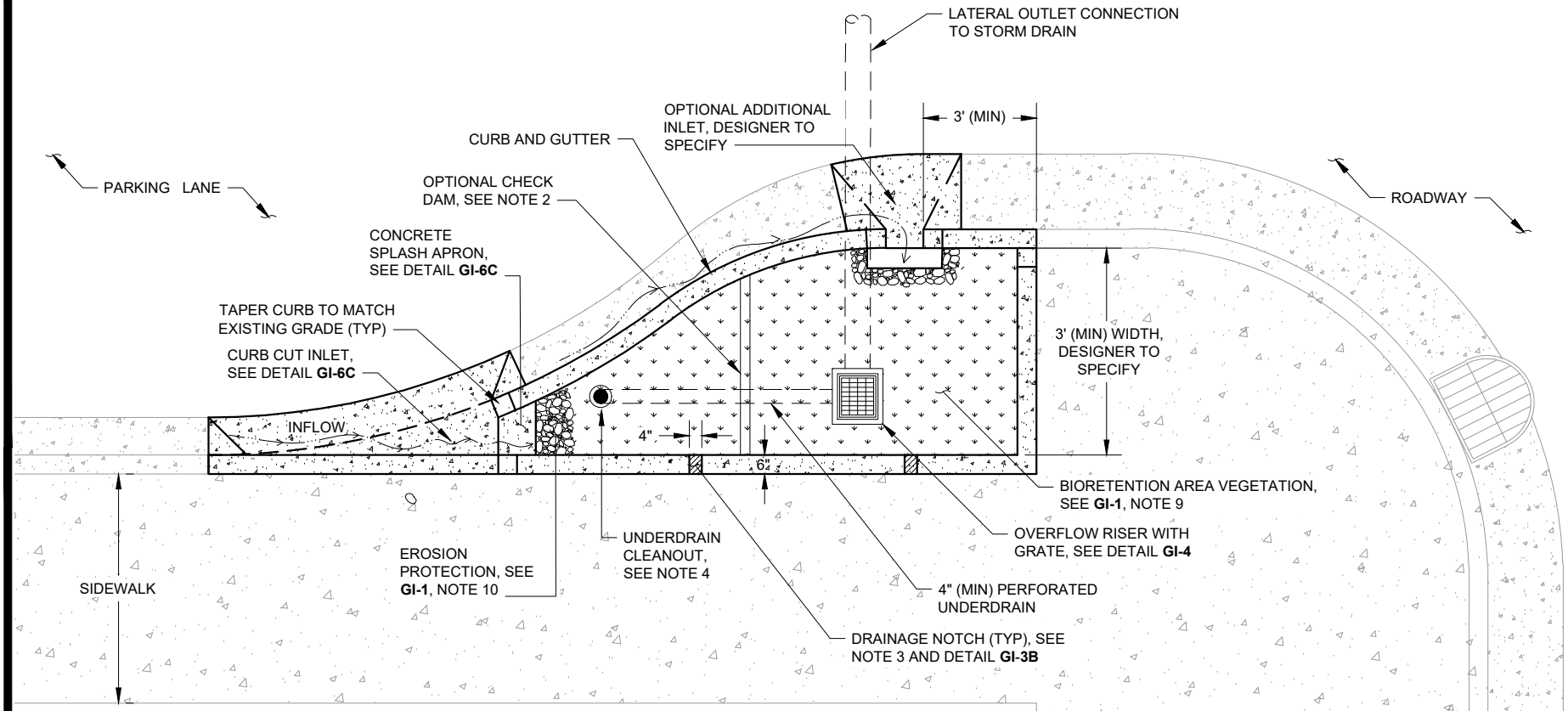
BIORETENTION AREA: PLAN VIEW WITH STREET PARKING

GREEN INFRASTRUCTURE EXAMPLE DETAILS

ALAMEDA COUNTYWIDE CLEAN WATER PROGRAM

SCALE: NOT TO SCALE	
DATE: MAY 11, 2018	REVISED: JUNE 11, 2019
DRAWN BY: K. K	REVISED BY: E. F.
CHECKED BY: A. R.	

GI-2A



NOTES:

1. REFER TO **GI-1** NOTES FOR GUIDELINES AND CHECKLIST.
2. CHECK DAMS SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN (SEE DETAIL **GI-7**).
3. LAY OUT DRAINAGE NOTCHES TO PREVENT PONDING BEHIND BIORETENTION AREA WALL WITH 5' MAXIMUM SPACING BETWEEN NOTCHES.
4. PROVIDE ONE UNDERDRAIN CLEANOUT PER BIORETENTION AREA (MIN). CLEANOUT REQUIRED AT UPSTREAM END AND PIPE ANGLE POINTS EXCEEDING 45 DEGREES. LONGITUDINAL SLOPE OF PIPE SHALL BE 0.5% (MIN).

NOT FOR CONSTRUCTION

BIORETENTION AREA: BULBOUT PLAN VIEW

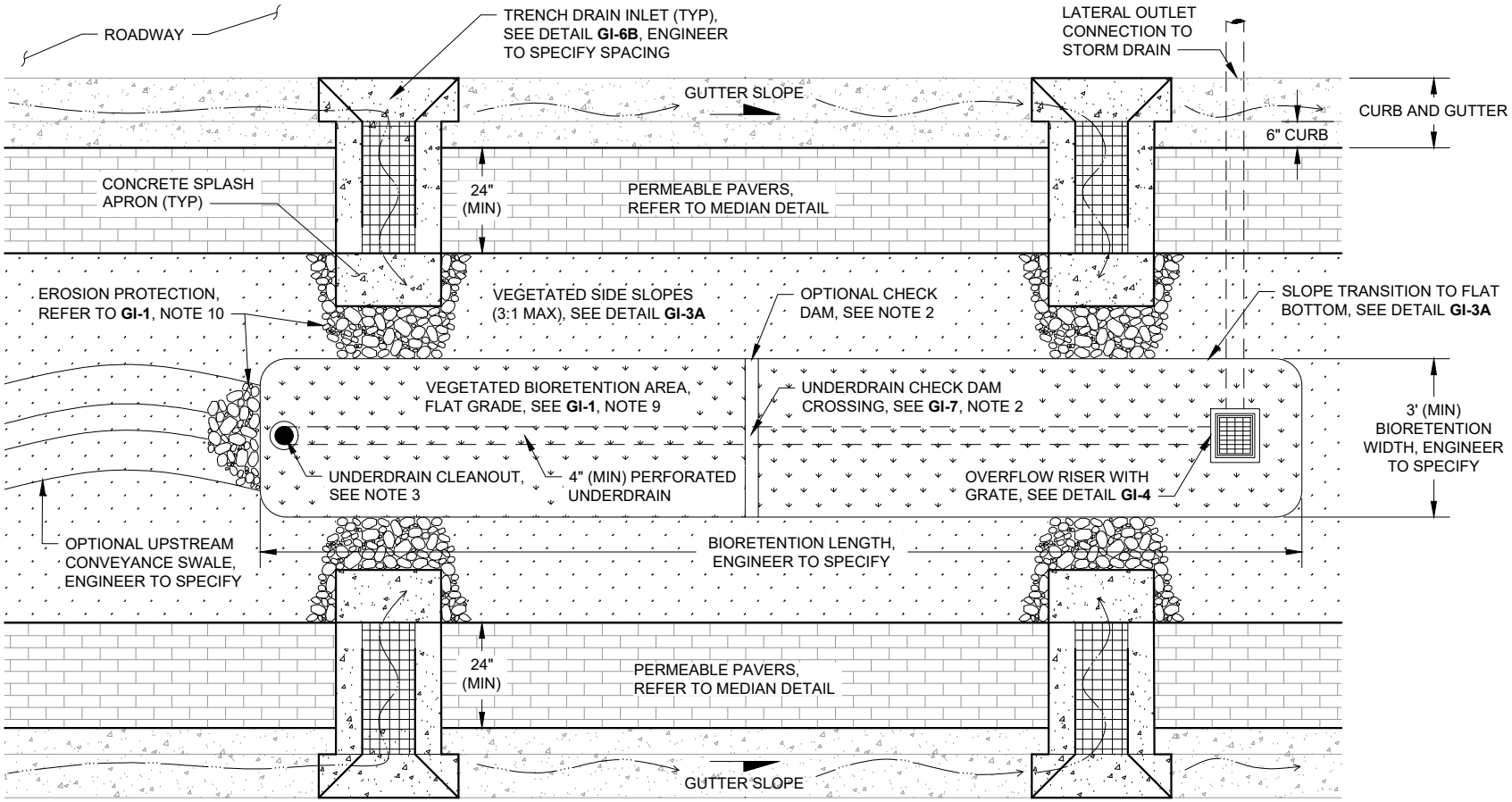
cleanwater PROGRAM

GREEN INFRASTRUCTURE EXAMPLE DETAILS

ALAMEDA COUNTYWIDE CLEAN WATER PROGRAM

SCALE: NOT TO SCALE	
DATE: MAY 11, 2018	REVISED: JUNE 11, 2019
DRAWN BY: K. K.	REVISED BY: E. F.
CHECKED BY: A. R.	

GI-2B



NOTES:

1. REFER TO **GI-1** NOTES FOR GUIDELINES AND CHECKLIST.
2. CHECK DAMS SHALL BE SPACED TO PROVIDE PONDING PER SITE SPECIFIC DESIGN (SEE DETAIL **GI-7**).
3. PROVIDE ONE UNDERDRAIN CLEANOUT PER BIORETENTION AREA (MIN). CLEANOUT REQUIRED AT UPSTREAM END AND PIPE ANGLE POINTS EXCEEDING 45 DEGREES. LONGITUDINAL SLOPE OF PIPE SHALL BE 0.5% (MIN).
4. DESIGNERS TO REFERENCE AASHTO ROADSIDE SAFETY DESIGN REQUIREMENTS AND CONSIDER USE OF MEDIAN BIORETENTION AREAS IN RELATION TO STREET CLASSIFICATION AND STREET SPEEDS.
5. A STORAGE VOLUME SAFETY FACTOR OF 1.5 SHALL BE INCLUDED IN THE DESIGN OF MEDIAN BIORETENTION AREAS TO PREVENT FLOODING.
6. SLOPED SIDES (**GI-3A**) DEPICTED IN PLAN VIEW ABOVE, REFER TO **GI-3B** IF VERTICAL SIDE WALLS ARE USED.

NOT FOR CONSTRUCTION

BIORETENTION AREA: STREET MEDIAN

cleanwater PROGRAM

GREEN INFRASTRUCTURE EXAMPLE DETAILS

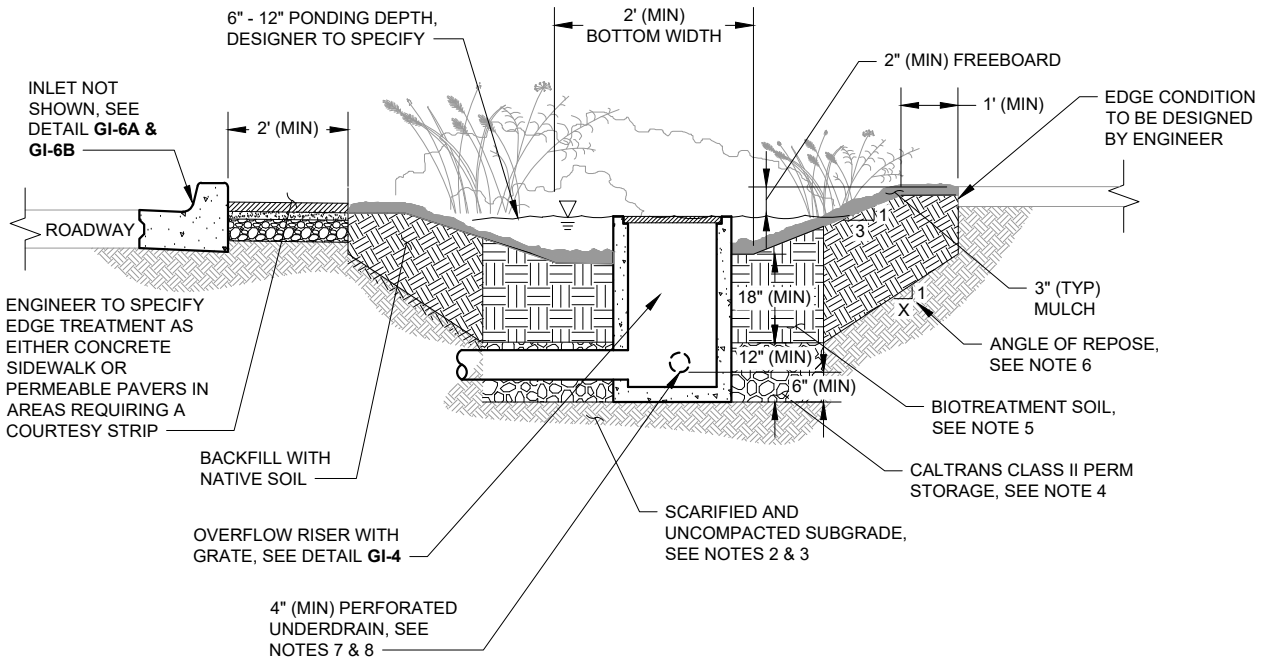
ALAMEDA COUNTYWIDE CLEAN WATER PROGRAM

SCALE: NOT TO SCALE	
DATE: MAY 11, 2018	REVISED: JUNE 11, 2019
DRAWN BY: K. K.	REVISED BY: E. F.
CHECKED BY: A. R.	

GI-2C

NOTES:

1. REFER TO **GI-1** NOTES FOR GUIDELINES AND CHECKLIST.
2. AVOID UNNECESSARY COMPACTION OF EXISTING SUBGRADE BELOW AREA.
3. SCARIFY SUBGRADE TO A DEPTH OF 3" (MIN) IMMEDIATELY PRIOR TO PLACEMENT OF CALTRANS CLASS 2 PERMEABLE MATERIAL STORAGE LAYER AND BIOTREATMENT SOIL MATERIALS.
4. AGGREGATE STORAGE LAYER COMPRISED OF 12" MIN CALTRANS CLASS 2 PERMEABLE MATERIAL.
5. REFER TO C.3 TECHNICAL GUIDANCE MANUAL (ACCWP) FOR BIOTREATMENT SOIL MIX SPECIFICATIONS. INSTALL BIOTREATMENT SOIL AT 85% COMPACTION FOLLOWING BASMAA INSTALLATION GUIDANCE.
6. ANGLE OF REPOSE VARIES PER GEOTECHNICAL ENGINEER RECOMMENDATIONS.
7. UNDERDRAIN AND CLEAN OUT PIPE (1 MIN PER FACILITY) REQUIRED, REFER TO C.3 TECHNICAL GUIDANCE MANUAL (ACCWP) FOR DESIGN CONSIDERATIONS. UNDERDRAINS SHOULD BE ELEVATED 6" (MIN) WITHIN THE CALTRANS CLASS 2 PERMEABLE MATERIAL STORAGE LAYER TO PROMOTE INFILTRATION. IN FACILITIES WITH AN IMPERMEABLE LINER, THE UNDERDRAIN SHOULD BE PLACED AT THE BOTTOM OF THE CALTRANS CLASS 2 PERMEABLE MATERIAL STORAGE LAYER. PERFORATED/SLOT DRAINS SHOULD BE DOWNWARD FACING TO FACILITATE BETTER STORAGE IN THE GRAVEL LAYER.
8. THE UNDERDRAIN IN ALL FACILITIES LOCATED IN THE PUBLIC RIGHT-OF-WAY SHALL BE VIDEO RECORDED AND PROVIDED TO THE CITY FOR REVIEW PRIOR TO PROJECT ACCEPTANCE.
9. REFER TO LOCAL JURISDICTION STANDARDS FOR CURB AND SIDEWALK DETAILS.



NOT FOR CONSTRUCTION

cleanwater PROGRAM

BIORETENTION AREA: SLOPED SIDES CROSS SECTION

GREEN INFRASTRUCTURE EXAMPLE DETAILS

ALAMEDA COUNTYWIDE CLEAN WATER PROGRAM

SCALE: NOT TO SCALE	
DATE: MAY 11, 2018	REVISED: JUNE 11, 2019
DRAWN BY: K. K.	REVISED BY: E. F.
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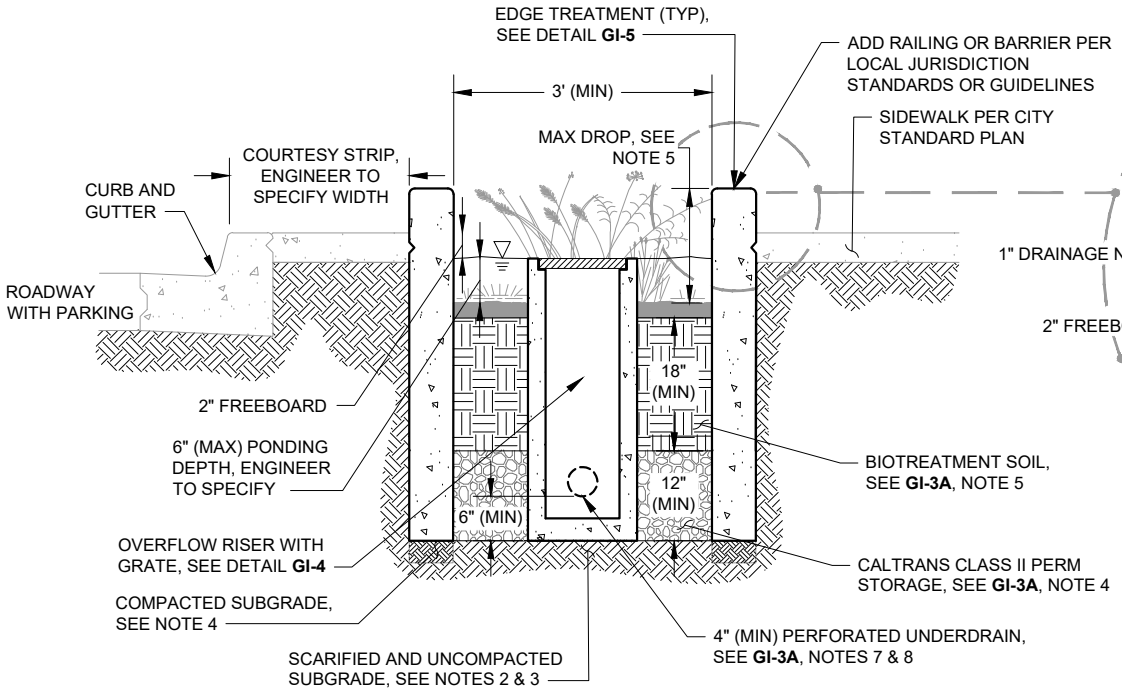
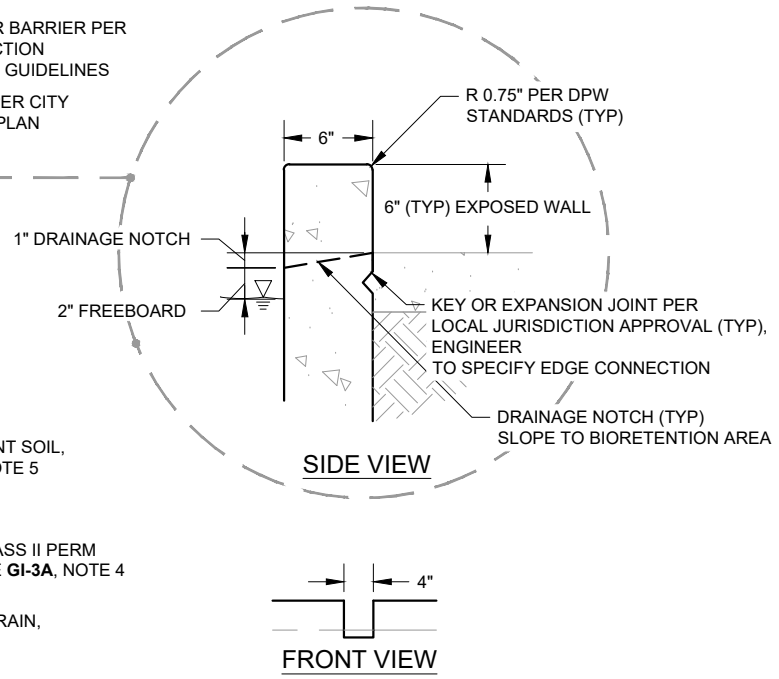
GI-3A



BIORETENTION AREA WITH VERTICAL SIDE WALLS (A)



DRAINAGE NOTCH DETAIL

NOTES:

1. REFER TO **GI-1** NOTES FOR GUIDELINES AND CHECKLIST.
2. AVOID UNNECESSARY COMPACTION OF EXISTING SUBGRADE BELOW BIORETENTION AREA.
3. SCARIFY SUBGRADE TO A DEPTH OF 3" (MIN) IMMEDIATELY PRIOR TO PLACEMENT OF AGGREGATE STORAGE AND BIOTREATMENT SOIL MATERIAL.
4. FOR STRUCTURAL SUPPORT, SUBGRADE UNDER WALLS ONLY COMPACTED PER ENGINEER SPECIFICATIONS.
5. MAXIMUM DROP, PER LOCAL BUILDING CODE, FROM TOP OF CURB TO TOP OF BIOTREATMENT SOIL SHALL INCLUDE CONSIDERATIONS FOR BIOTREATMENT SOIL SETTLEMENT. THE DROP IS THE SUM OF PONDING DEPTH (6" TYP), FREEBOARD (2" TYP), AND CURB HEIGHT (6" TYP).
6. REFER TO LOCAL JURISDICTION STANDARDS FOR CURB AND SIDEWALK DETAILS.

NOT FOR CONSTRUCTION

BIORETENTION AREA: VERTICAL SIDE WALL CROSS SECTION

GREEN INFRASTRUCTURE EXAMPLE DETAILS

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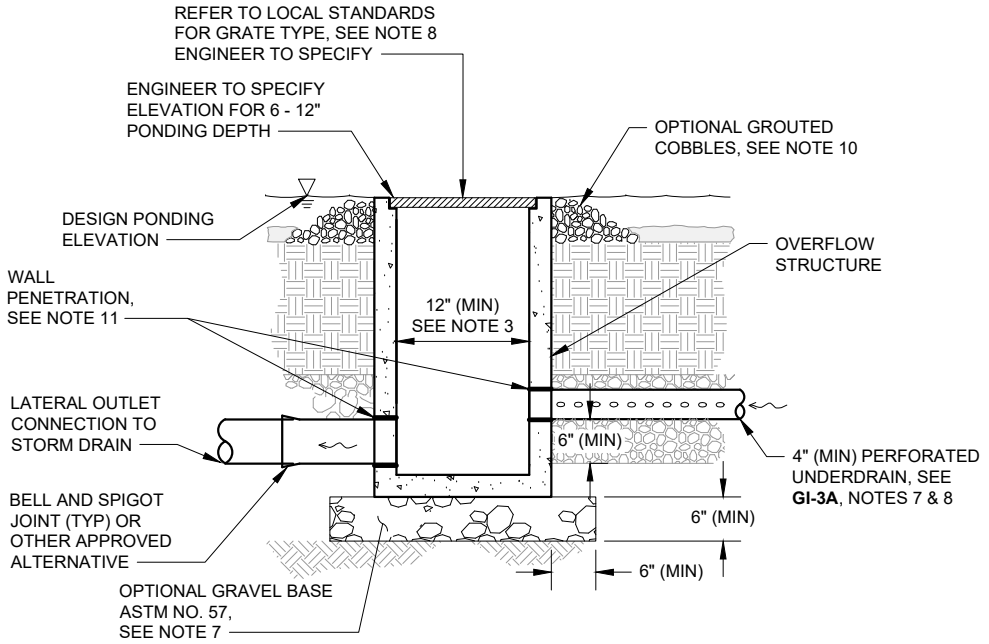
GI-3B

NOTES:

1. REFER TO **GI-1** NOTES FOR GUIDELINES AND CHECKLIST.
2. ALL MATERIAL AND WORKMANSHIP FOR OVERFLOW STRUCTURES SHALL CONFORM TO LOCAL JURISDICTION STANDARDS.
3. DESIGN OVERFLOW WEIR AND OUTLET PIPE TO CONVEY 10-YR, 24-HR STORM FLOW OR DESIGN INLET TO DIVERT FLOWS LARGER THAN THE DESIGN STORM DIRECTLY TO THE STORM DRAIN. LOCATE ALL OVERFLOW PIPES AT AN ELEVATION HIGHER THAN THE STORM SEWER HYDRAULIC GRADE LINE TO PREVENT BACKFLOW INTO THE BIORETENTION FACILITY.
4. STORM DRAIN OUTLET PIPES SHALL BE SIZED TO MEET HYDRAULIC REQUIREMENTS WITH APPROPRIATE COVER DEPTH AND PIPE MATERIAL.
5. PERFORATED UNDERDRAINS WITH CLEANOUT PIPES ARE REQUIRED. PERFORATED/SLOT DRAINS SHOULD BE DOWNWARD FACING TO FACILITATE BETTER STORAGE IN THE GRAVEL LAYER.
6. MAINTENANCE ACCESS IS REQUIRED FOR ALL OUTLET STRUCTURES AND CLEANOUT FACILITIES. 12" (MIN) CLEARANCE WITHIN OVERFLOW STRUCTURE SHALL BE PROVIDED FOR MAINTENANCE ACCESS.
7. ENGINEER SHALL REFER TO LOCAL JURISDICTION STANDARDS AND/OR ASSESS NEED FOR GRAVEL BASE. ENGINEER SHALL EVALUATE BUOYANCY OF STRUCTURES FOR SITE SPECIFIC APPLICATION AND SPECIFY THICKENED OR EXTENDED BASE / ANTI-FLOATATION COLLAR, AS NECESSARY.
8. SIZE OF 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 OPENING SHALL BE 2".
9. IF INTERIOR DEPTH OF OVERFLOW STRUCTURE EXCEEDS 5', A PERMANENT BOLTED LADDER AND MINIMUM CLEAR SPACE OF 30" BY 30" SHALL BE PROVIDED FOR MAINTENANCE ACCESS.
10. MINIMUM DIAMETER OF OPTIONAL GROUTED COBBLES SHALL BE LARGER THAN MAXIMUM GRATE OPENING.
11. GROUT ALL PENETRATIONS, CRACKS, SEAMS, AND JOINTS WITH CLASS "C" MORTAR.



NOT FOR CONSTRUCTION

cleanwater PROGRAM

BIORETENTION COMPONENTS: OUTLET DETAIL

GREEN INFRASTRUCTURE EXAMPLE DETAILS

ALAMEDA COUNTYWIDE CLEAN WATER PROGRAM

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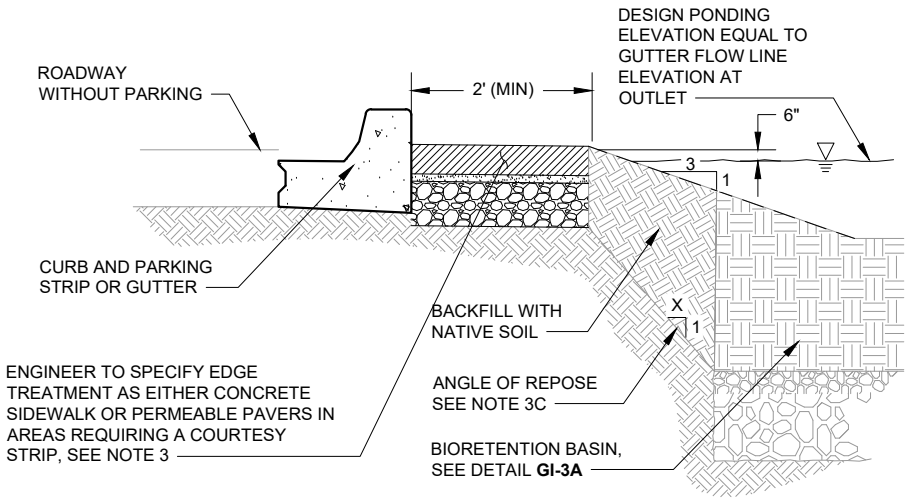
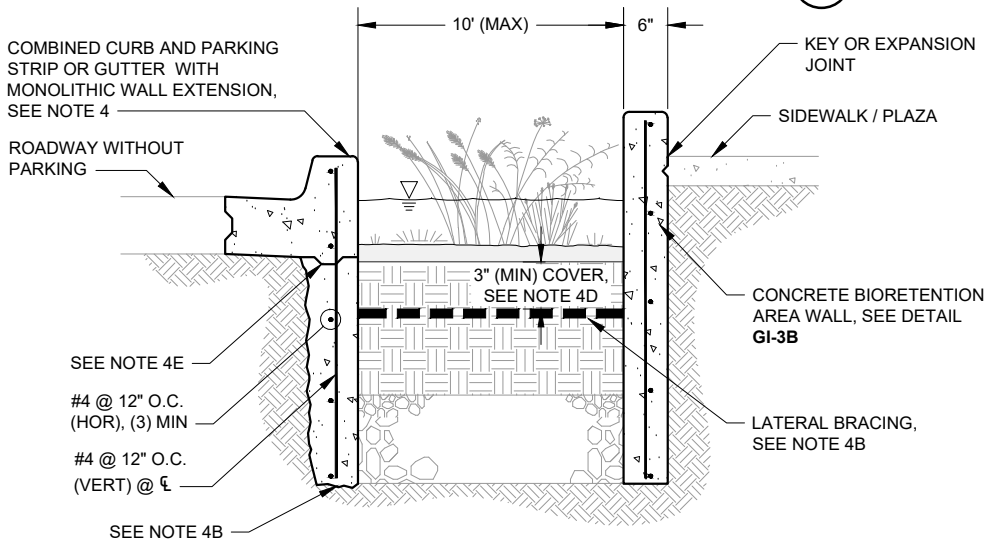
GI-4

NOTES:

1. REFER TO **GI-1** NOTES FOR GUIDELINES AND CHECKLIST.
2. THE ENGINEER SHALL ADAPT EDGE TREATMENT DESIGN TO ADDRESS SITE SPECIFIC CONSTRAINTS TO EFFECTIVELY STABILIZE ADJACENT PAVEMENT AND MINIMIZE LATERAL MOVEMENT OF WATER.
3. STANDARD CURB EDGE (WHEN SPACE AVAILABLE):
   A. REFER TO LOCAL JURISDICTION STANDARDS FOR CURB AND SIDEWALK DETAILS.
   B. ANGLE OF REPOSE VARIES PER GEOTECHNICAL ENGINEERS RECOMMENDATIONS.
4. VERTICAL SIDE WALLS (WHEN SPACE LIMITED):
   A. ALL BIORETENTION AREA WALLS SHALL EXTEND TO BOTTOM OF AGGREGATE STORAGE LAYER OR DEEPER. MINIMUM DEPTHS SHALL BE DESIGNED TO PREVENT LATERAL SEEPAGE INTO THE ADJACENT PAVEMENT SECTION.
   B. FOOTING AND/OR LATERAL BRACING SHALL SHALL BE DESIGNED BY THE ENGINEER TO WITHSTAND ANTICIPATED LOADING ASSUMING NO REACTIVE FORCES FROM THE UNCOMPACTED BIOTREATMENT SOIL.
   C. BIORETENTION AREA WALLS EXTENDING MORE THAN 36" BELOW ADJACENT LOAD-BEARING SURFACE, OR WHEN LOCATED ADJACENT TO PAVERS, SHALL HAVE FOOTING OR LATERAL BRACING. FOOTING OR LATERAL BRACING MAY BE EXCLUDED ONLY IF THE ENGINEER DEMONSTRATES THAT THE PROPOSED WALL DESIGN MEETS LOADING REQUIREMENTS. WALL SHALL NOT ENCROACH INTO TREATMENT AREA.
   D. CONTRACTOR TO PROVIDE 3" MINIMUM COVER OVER ALL LATERAL BRACING FOR PLANT ESTABLISHMENT.
   E. ALL CONSTRUCTION COLD JOINTS SHALL INCORPORATE EPOXY, DOWEL/TIE BAR, KEYWAY, OR WATER STOP.



STANDARD CURB EDGE AT BIORETENTION BASIN (1)



EXTENDED BIORETENTION AREA WALL WITH LATERAL BRACING (2)

NOT FOR CONSTRUCTION

BIORETENTION COMPONENTS: EDGE TREATMENT DETAIL

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GREEN INFRASTRUCTURE EXAMPLE DETAILS

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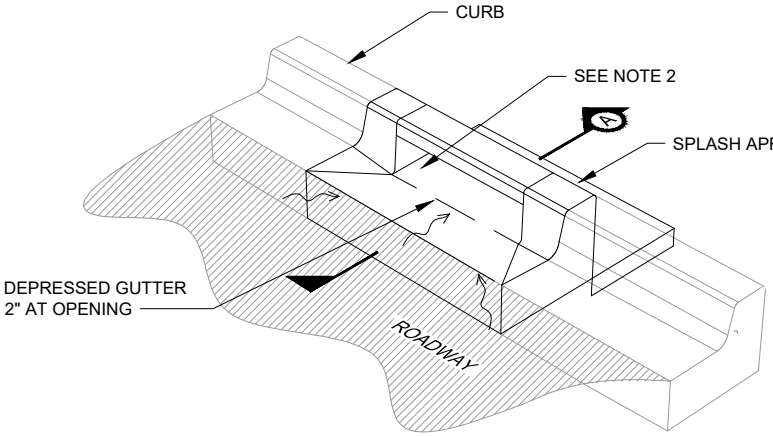
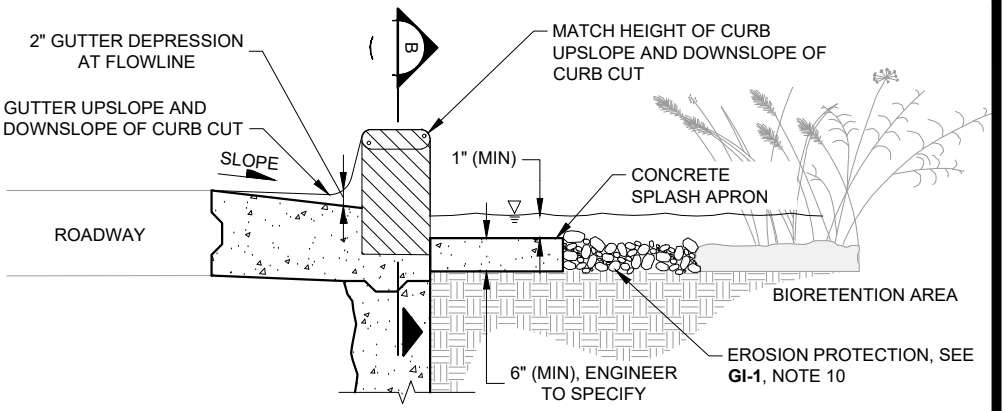
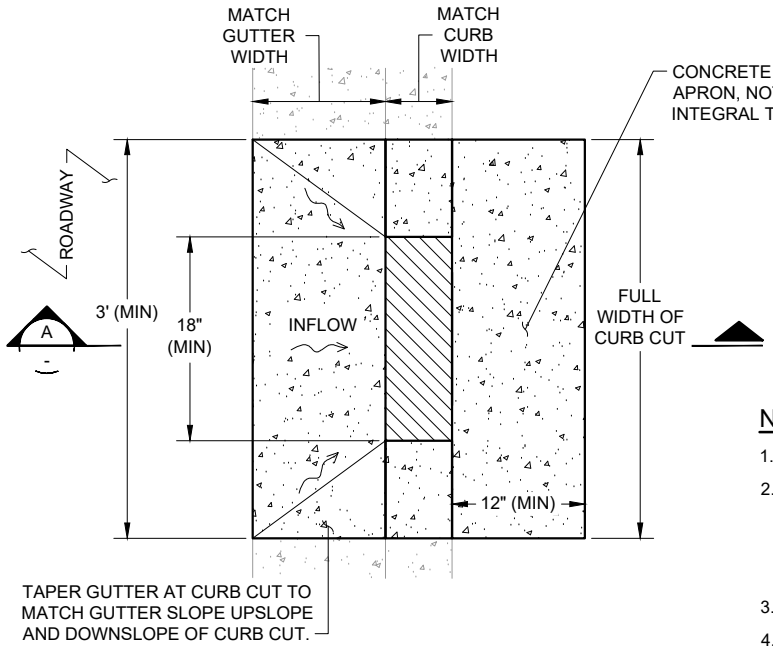
GI-5



ISOMETRIC

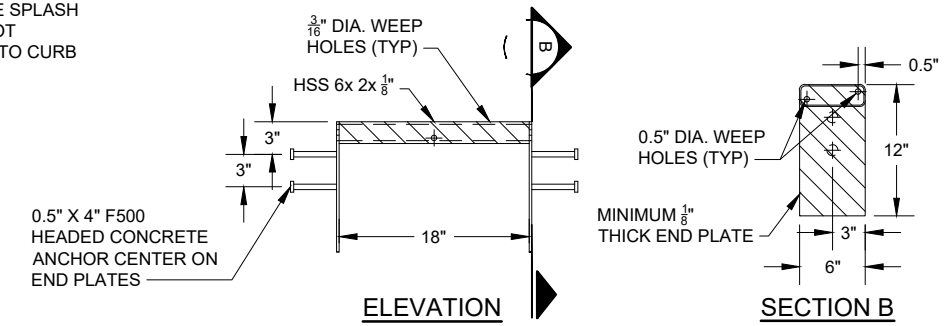


SECTION A



PLAN

METAL INLET ASSEMBLY



ELEVATION

SECTION B

NOTES:

1. REFER TO **GI-1** NOTES FOR GUIDELINES AND CHECKLIST.
2. CURB CUT INLETS SHALL BE ADEQUATELY SIZED, SPACED, AND SLOPED TO MEET HYDRAULIC REQUIREMENTS. THE CURB CUT OPENING WIDTH SHALL 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. 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.

NOT FOR CONSTRUCTION

BIORETENTION COMPONENTS: GUTTER CURB CUT INLET DETAIL

cleanwater PROGRAM

GREEN INFRASTRUCTURE EXAMPLE DETAILS

ALAMEDA COUNTYWIDE CLEAN WATER PROGRAM

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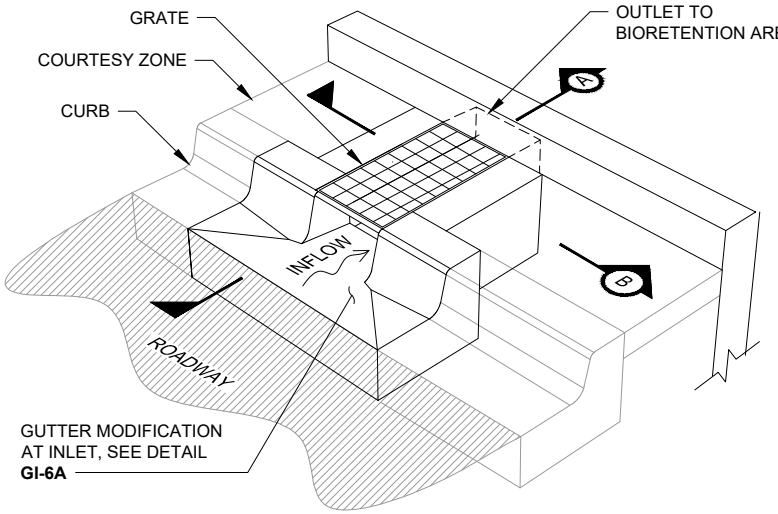
CHECKED BY: A. R.	

GI-6A

NOTES:

1. REFER TO **GI-1** NOTES FOR GUIDELINES AND CHECKLIST.
2. ALL MATERIAL AND WORKMANSHIP FOR TRENCH DRAIN ASSEMBLY SHALL CONFORM TO LOCAL JURISDICTION STANDARDS.
3. TRENCH DRAIN INLETS SHALL BE ADEQUATELY SIZED, SPACED, AND SLOPED TO MEET HYDRAULIC REQUIREMENTS. SEE NOTE 2 DETAIL **GI-6A** FOR REFERENCE.
4. SLOPE TO PROVIDE AT LEAST 1" DROP OVER LENGTH OF CHANNEL OR A MINIMUM OF 2%, WHICHEVER IS LARGER.
5. 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.
6. BOND NEW CURB AND GUTTER TO EXISTING CURB AND GUTTER WITH EPOXY AND DOWEL CONNECTION.
7. HORIZONTAL CONTROL JOINTS SHALL BE PROVIDED EVERY 10' (LINEAR), OR PER MANUFACTURER'S RECOMMENDATIONS.
8. APPLY EPOXY BONDING AGENT AT ALL TRENCH DRAIN CONSTRUCTION COLD JOINTS.
9. INLET CURB CUT AND CONCRETE CHANNEL WIDTH SHALL BE SIZED TO ACCOUNT FOR CATCHMENT AREA AND GUTTER SLOPE.



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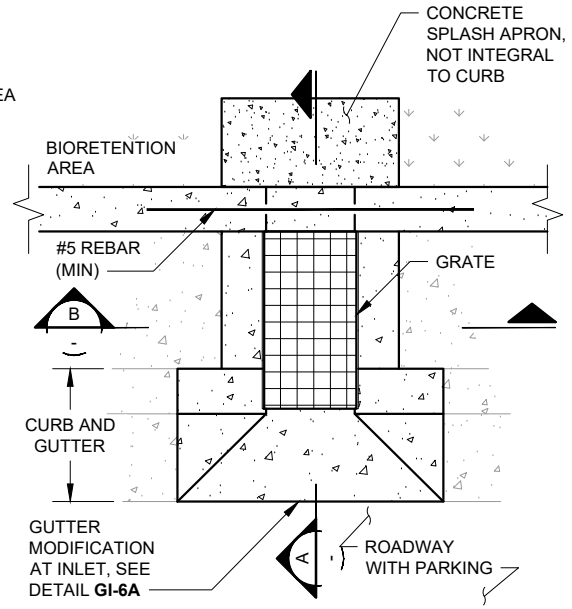
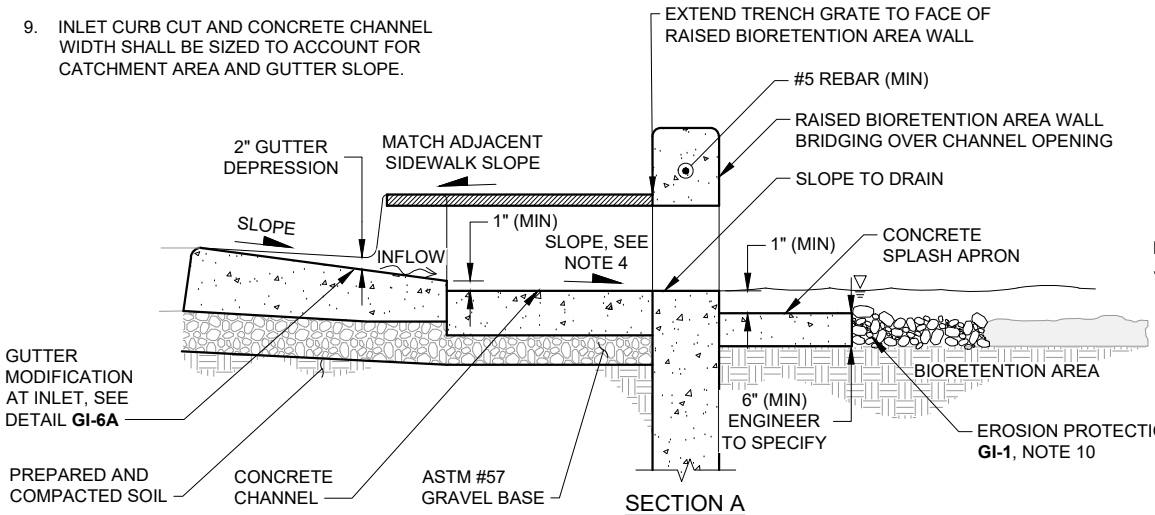
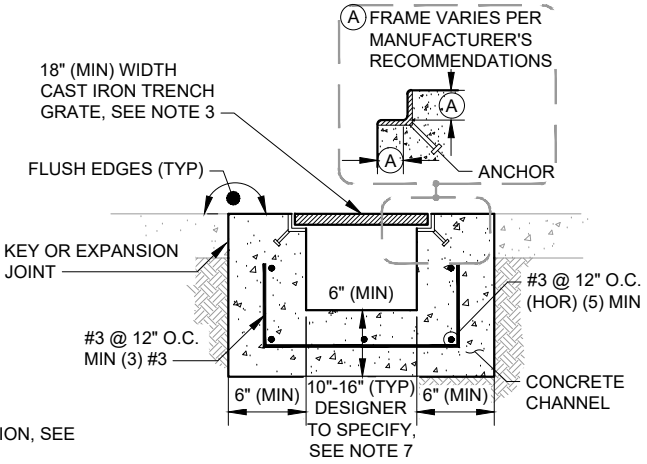




SECTION A



SECTION B

NOT FOR CONSTRUCTION

BIORETENTION COMPONENTS: TRENCH DRAIN CURB CUT INLET DETAIL

GREEN INFRASTRUCTURE EXAMPLE DETAILS

ALAMEDA COUNTYWIDE CLEAN WATER PROGRAM

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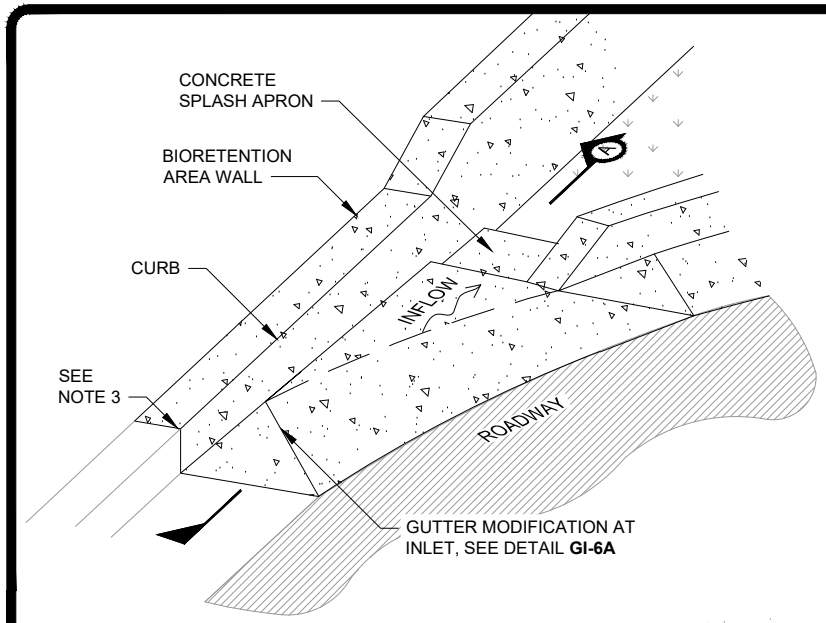
GI-6B



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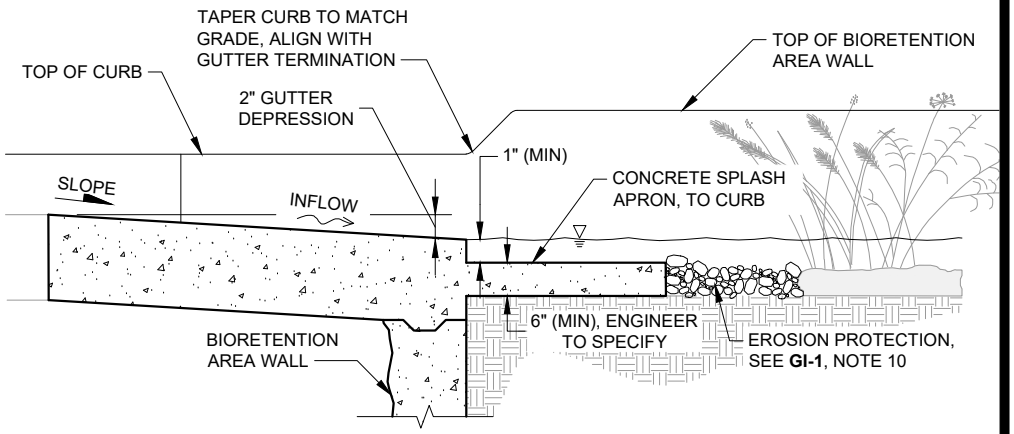
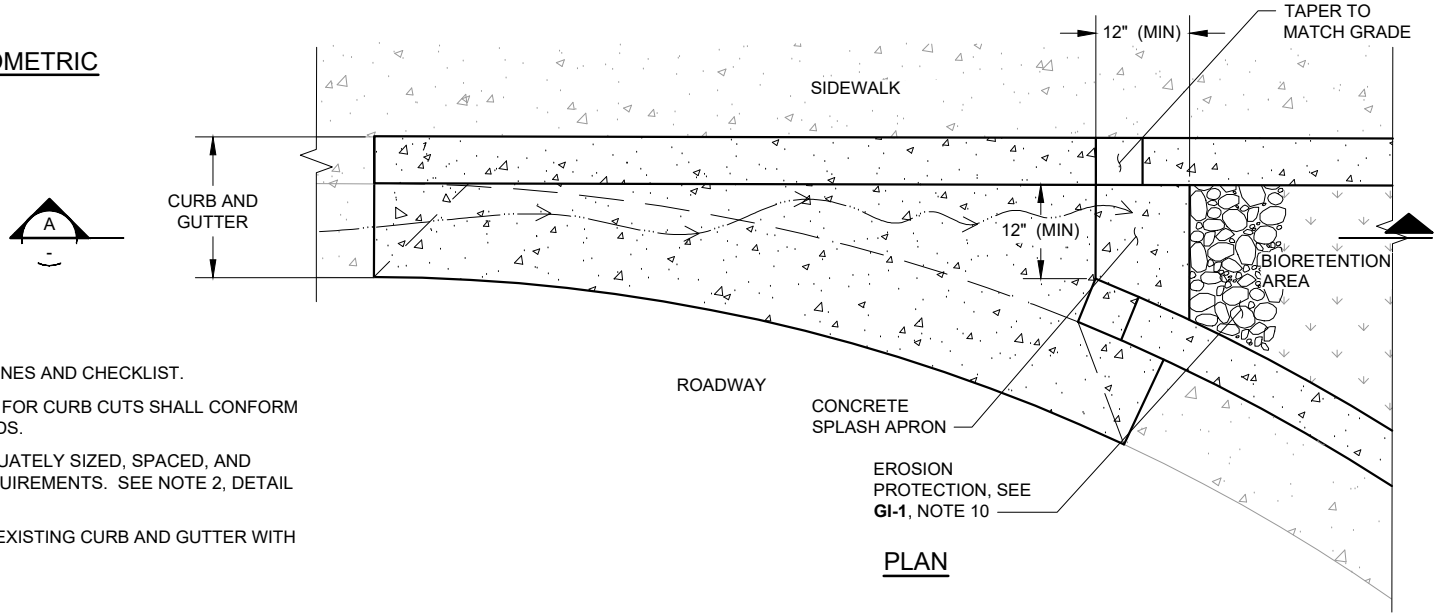


SECTION A



PLAN

NOTES:

1. REFER TO **GI-1** NOTES FOR GUIDELINES AND CHECKLIST.
2. ALL MATERIAL AND WORKMANSHIP FOR CURB CUTS SHALL CONFORM TO LOCAL JURISDICTION STANDARDS.
3. CURB CUT INLETS SHALL BE ADEQUATELY SIZED, SPACED, AND SLOPED TO MEET HYDRAULIC REQUIREMENTS. SEE NOTE 2, DETAIL **GI-6A** FOR REFERENCE.
4. BOND NEW CURB AND GUTTER TO EXISTING CURB AND GUTTER WITH EPOXY AND DOWEL CONNECTION.

NOT FOR CONSTRUCTION

BIORETENTION COMPONENTS: CURB CUT AT BULBOUT INLET DETAIL

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GREEN INFRASTRUCTURE EXAMPLE DETAILS

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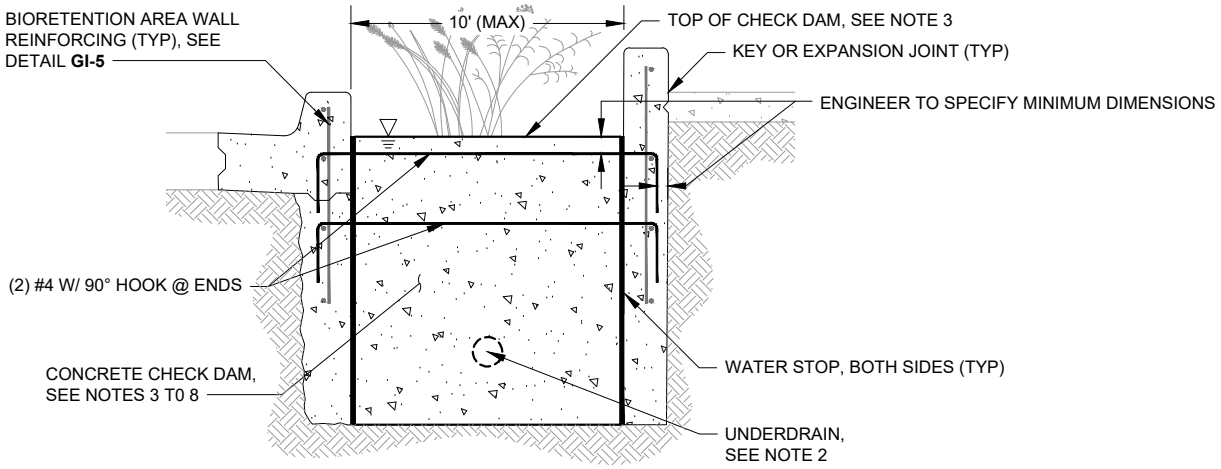
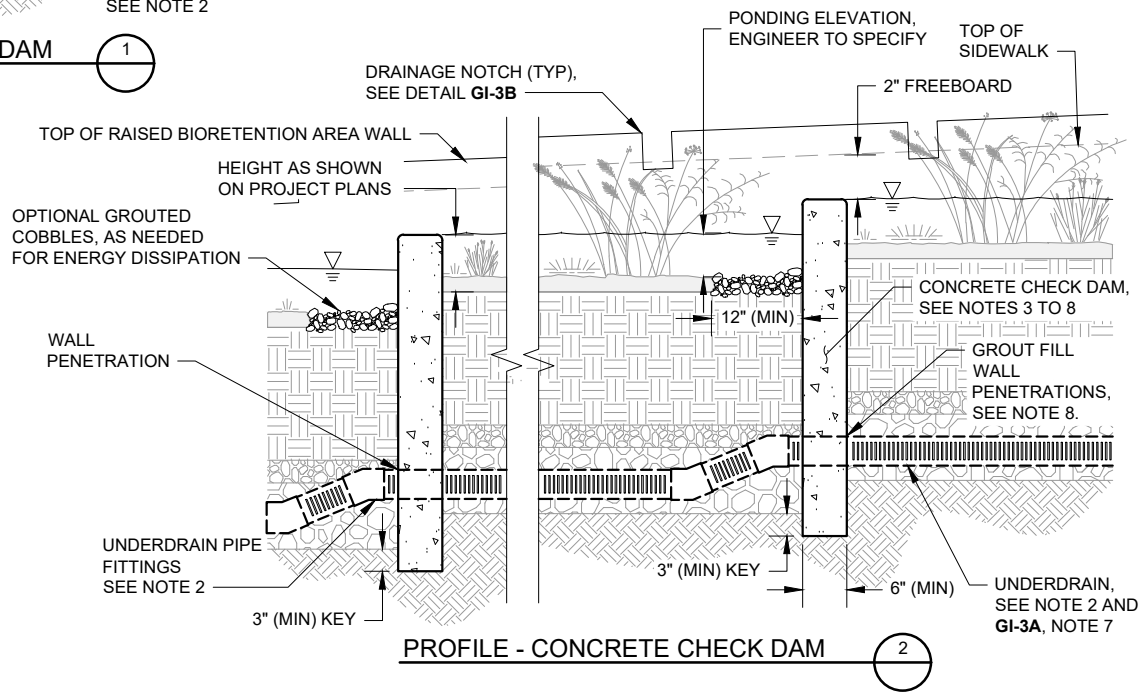
GI-6C



SECTION - CONCRETE CHECK DAM 1



PROFILE - CONCRETE CHECK DAM 2

NOTES:

1. REFER TO **GI-1** NOTES FOR GUIDELINES AND CHECKLIST.
2. UNDERDRAIN TO PASS THROUGH CHECK DAM IN NON-PERFORATED PIPE. PIPE FITTINGS SHALL BE USED TO ACCOMMODATE CHANGES IN GRADE, AS NEEDED.
3. HEIGHT AND SPACING OF CHECK DAMS SHALL BE ESTABLISHED 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.
4. ALL MATERIAL AND WORKMANSHIP FOR CHECK DAM ASSEMBLY SHALL CONFORM TO LOCAL JURISDICTION STANDARD SPECIFICATIONS.
5. CONCRETE CHECK DAM SHALL BE CONTINUOUS (NO JOINTS) AND REINFORCED WITH #4 BAR, PLACED AT 18" ON CENTER, EACH WAY.
6. CONCRETE CHECK DAM SHALL BE DESIGNED BY THE ENGINEER AND MEET STRUCTURAL REQUIREMENTS FOR LATERAL BRACING WHEN USED AS LATERAL BRACING.
7. TOP OF CHECK DAM TO BE LEVEL WITH CREST ELEVATION MATCHING PONDING ELEVATION UNLESS NOTCH SIZED TO CONVEY DESIGN FLOWS PROVIDED.
8. GROUT ALL PENETRATIONS, CRACKS, SEAMS, AND JOINTS WITH CLASS "C" MORTAR.

NOT FOR CONSTRUCTION

BIORETENTION COMPONENTS: CHECK DAM DETAIL

GREEN INFRASTRUCTURE EXAMPLE DETAILS

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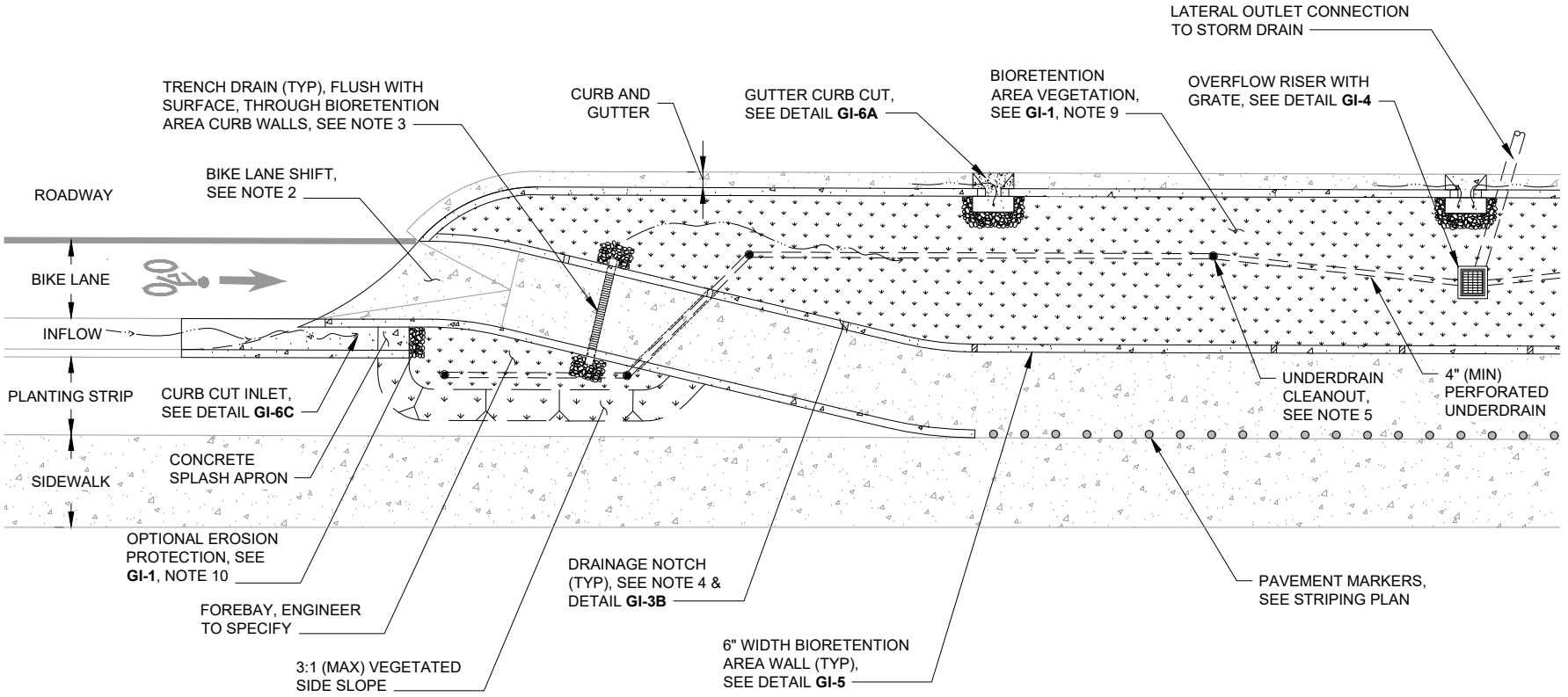
GI-7



NOTES:

1. REFER TO **GI-1** NOTES FOR GUIDELINES AND CHECKLIST.
2. RAMP BIKE LANE UP ONTO BULBOUT AND SHIFT LANE OVER. MAXIMUM 1:5 HORIZONTAL TRANSITION RATE. TRANSITION GEOMETRY SHALL CONFORM TO LOCAL JURISDICTION STANDARDS.
3. HYDRAULIC CONNECTION OF SEPARATED BIORETENTION AREAS PROVIDED BY TRENCH DRAINS. ENGINEER TO SPECIFY, FOLLOWING FLOW AND STRUCTURAL REQUIREMENTS.
4. LAY OUT DRAINAGE NOTCHES AS APPLICABLE TO PREVENT PONDING BEHIND BIORETENTION AREA WALL WITH 5' MAXIMUM SPACING BETWEEN NOTCHES.
5. PROVIDE ONE UNDERDRAIN CLEANOUT PER BIORETENTION AREA (MIN). CLEANOUT REQUIRED AT UPSTREAM END AND PIPE ANGLE POINTS EXCEEDING 45 DEGREES. LONGITUDINAL SLOPE OF PIPE SHALL BE 0.5% (MIN). PIPE SLEEVES REQUIRED FOR UNDERDRAINS TRANSITIONING BETWEEN BIORETENTION AREAS.
6. DRAWING GI-XX MODIFIED FROM THE BASMAA URBAN GREENING BAY AREA TYPICAL GI DETAILS FIGURE C-1.4.

NOT FOR CONSTRUCTION

BIORETENTION AREA: WITH BIKE LANE PLAN VIEW

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GREEN INFRASTRUCTURE EXAMPLE DETAILS

ALAMEDA COUNTYWIDE CLEAN WATER PROGRAM

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GI-8

Attachment B-5: Capital Improvement Projects Sign-off Form

The Clean Water Program's Capital Improvement Projects Sign-off Form is provided on the following page. This form is used by the agency to document whether a Regulated Project (as defined in Provision C.3.b) has complied with Provision C.3 requirements, and whether a non-Regulated Project has been evaluated for GI potential.

How to Use the

C.3 Stormwater Compliance Sign-off Form for Capital Improvement Program (CIP) Projects

Introduction

The attached checklist is for Alameda Countywide Clean Water Program (Clean Water Program) member agencies to document that capital improvement program (CIP) projects either are exempt or have complied with the requirements for C.3 Regulated Projects, as defined in Provision C.3.b of the Municipal Regional Stormwater Permit (MRP), issued by the San Francisco Bay Regional Water Quality Control Board on November 19, 2015.

Step-by-Step Instructions

1. Fill out the project information at the top of the form (Project Name, Address, etc.)

2. Review the project description and the square footage of impervious surfaces that will be created and/or replaced by the project to determine whether the project may meet any of the conditions identified in the form, under the heading, "Project is NOT a C.3 Regulated Project and the Review of GI Potential Is Documented." If the project meets any of those conditions, check the appropriate box (or boxes).
   - If one or more boxes are checked, the project is NOT a C.3 Regulated Project. Continue to Step 3.
   - If no boxes are checked, the project IS a C.3 Regulated Project. Skip to Step 4.

3. Refer to the Clean Water Program's Worksheet for Identifying GI Potential in Municipal CIP Projects[1] (or your agency's equivalent worksheet or form) to evaluate the project for the potential to include green infrastructure (GI). In the C.3 Stormwater Compliance Sign-off Form for CIP Projects, under the subheading, "Green Infrastructure Potential Review," check the box to indicate the name of the worksheet or form that was used for this review, and indicate the date on which the worksheet or form was completed.
   - Skip to Step 5.

4. Refer to the project's stormwater control plan, construction documents, and/or other project documentation, such as a completed Stormwater Requirements Checklist[2], to determine whether the requirements for C.3 Regulated Projects have been met. If all requirements have been met, including the hydromodification management (HM) requirements in Provision C.3.g (if applicable) and the documentation of operation and maintenance responsibility as required by Provision C.3.h.ii.(1), check the box to indicate the name of the applicable document(s), and write the date of the document(s).
   - Continue to Step 5.

5. Sign and date the completed C.3 Stormwater Compliance Sign-off Form for CIP Projects.

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[1] The worksheet is available on the New Development Subcommittee's members only website at: https://cleanwaterprogram.org/index.php/committees/new-development-committee.html.

[2] The checklist is available on the Clean Water Program's public website at: https://cleanwaterprogram.org/. Click on "Resources," then "Development," and scroll down to "Stormwater Requirements Checklist."

C.3 Stormwater Compliance Sign-off Form for Capital Improvement Program (CIP) Projects

This form references Provision C.3 of the Municipal Regional Stormwater Permit (MRP), issued by the San Francisco Bay Regional Water Quality Control Board on November 19, 2015.

Project Name: _____

Project Address: _____ APN: _____

Contact Person: _____

Contact Phone: _____ Contact Email: _____

☐ **Project is NOT a C.3 "Regulated Project" and the Review of "GI Potential" Is Documented.**

C.3 "Regulated Project" Review

The project is NOT a C.3 "Regulated Project" based on the Regulated Project definitions in Provision C.3.b as indicated below. Please check the applicable box(es):

☐ Project would create and/or replace less than 5,000 square feet of impervious area.

☐ Project would create and/or replace less than 10,000 square feet of impervious area **AND** project does not include auto service/maintenance facilities, restaurants, uncovered parking areas (stand-alone or as part of a larger project), or structures with rooftop parking.

☐ Project is a Road Project **AND** project would construct less than 10,000 square feet of new contiguous impervious area when the following are excluded from the calculation:[3]

- o Sidewalks built as part of new streets or roads that direct stormwater runoff to adjacent vegetated areas.
- o Bicycle lanes built as part of new streets or roads that are not hydraulically connected to the new streets or roads and that direct stormwater runoff to adjacent impervious areas.
- o Impervious trails that are:

  A. less than 10 feet wide and more than 50 feet away from the top of a creek bank.

  OR

  B. designed to direct stormwater runoff to adjacent vegetated areas or other non-erodible permeable areas (preferably away from creeks or towards the outboard side of levees).
- o Sidewalks, bicycle lanes, or trails constructed with permeable surfaces (pervious concrete, porous asphalt, unit pavers, or granular materials).
- o Caltrans highway projects and associated facilities.

☐ Project consists of interior remodel.

☐ Project consists of routine maintenance and repairs (e.g., roof replacement, replacement of exterior wall surface, and/or pavement resurfacing) within the existing footprint.

[3] *When calculating the impervious area of a Road Project, include all roadway surfaces related to creation of additional traffic lanes (including, for example, passing lanes and turning pockets). Shoulders and widened portion of existing lanes may be excluded from the calculation.*

"Green Infrastructure (GI) Potential" Review

Capital improvement program (CIP) projects that are NOT C.3 Regulated Projects must be reviewed to determine whether they have green infrastructure (GI) potential, as required in Provision C.3.j.ii.(2). When conducting these reviews, agencies should follow the Bay Area Municipal Stormwater Management Agencies Association's (BASMAA) Guidance for Identifying GI Potential in Municipal CIP Projects. One way to follow this guidance is to use the Clean Water Program's Worksheet for Identifying GI Potential in Municipal CIP Projects. These documents can be downloaded from www.cleanwaterprogram.com (click "Resources," then "Development"). Please attach documentation to demonstrate that the project was reviewed for GI potential.

The non-C.3 Regulated Project has been reviewed for GI potential as shown in the following document(s):

- ☐ Worksheet for Identifying GI Potential in Municipal CIP Projects, dated: _____
- ☐ Other documentation (describe): _____

☐ **Project IS a C.3 "Regulated Project" — Compliance Documented.**

The C.3 Regulated Project has met all requirements for C.3 Regulated Projects as shown in the following documents:

- ☐ Stormwater Control Plan, dated: _____
- ☐ Construction Documents, dated: _____
- ☐ Other documentation (describe): _____

Signature Date

Name Title

Attachment B-6: Guidance for Sizing Green Infrastructure Facilities in Street Projects

The Guidance for Sizing Green Infrastructure Facilities in Street Projects, provided by the Bay Area Stormwater Management Agencies Association (BASMAA), is included on the following page of this GI Plan.

Guidance for Sizing Green Infrastructure Facilities in Street Projects

Prepared by
Dan Cloak Environmental Consulting
EOA, Inc.

June 2019

Introduction and Regulatory Background

Provision C.3.j. in the reissued Municipal Regional Stormwater Permit[1] (MRP) requires each Permittee to "complete and implement a Green Infrastructure (GI) Plan for the inclusion of low impact development drainage design into storm drain infrastructure on public and private lands, including streets, roads, storm drains, parking lots, building roofs, and other storm drain infrastructure elements."

Provision C.3.j.i.(g) further mandates that these plans include:

> *Requirements that projects be designed to meet the treatment and hydromodification sizing requirements in Provisions C.3.c. and C.3.d. For street projects not subject to Provision C.3.b.ii. (i.e., non-Regulated Projects) Permittees may collectively propose a single approach with their Green Infrastructure Plans for how to proceed should project constraints preclude fully meeting the C.3.d. sizing requirements. The single approach can include different options to address specific issues or scenarios. That is, the approach shall identify the specific constraints that would preclude meeting the sizing requirements and the design approach(es) to take in that situation. The approach should also consider whether a broad effort to incorporate hydromodification controls into green infrastructure, even where not otherwise required, could significantly improve creek health and whether such implementation may be appropriate, plus all other information as appropriate (e.g., how to account for load reduction for the PCBs or mercury TMDLs).*

This document represents the "single approach" collectively proposed by the Permittees for how to proceed when constraints on GI projects affect facility sizing in street projects. For other types of projects, information on hydraulic sizing is provided in the technical guidance manuals for Provision C.3 developed by each countywide stormwater program.

Hydraulic Sizing Requirements

MRP Provision C.3.d contains criteria for sizing stormwater treatment facilities. Facilities may be sized on the basis of flow, volume, or a combination of flow and volume. With adoption of 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 continuous 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.

[1] Order R2-2015-0049

Such an analysis was conducted for BASMAA by Dubin Environmental Consulting and is described in the attached Technical Report. The analysis shows that bioretention facilities with the current-standard cross-section can capture and treat the Provision C.3.d amount of runoff when sized to 1.5% - 3% of tributary equivalent impervious area, depending on location.

Hydromodification Management

A principal objective of LID is to mimic natural hydrology in the post-development condition. This is accomplished by retaining and infiltrating runoff flows during small to medium events. Flows from larger events are detained and slowed.

MRP Provision C.3.g. includes requirements and criteria for implementing hydromodification management (HM). These HM requirements apply to Regulated Projects that create or replace an acre or more of impervious area, increase the amount of impervious area over the pre-project condition, and flow to creeks that are at risk of erosion. As such, the HM requirements do not apply to street projects that retrofit drainage systems that receive runoff from existing roofs and paving.

However, Provision C.3.j.i.(g) states that the Permittees' approach to sizing GI facilities "…should also consider whether a broad effort to incorporate hydromodification controls into green infrastructure, even where not otherwise required, could significantly improve creek health and whether such implementation may be appropriate…"

Various criteria for HM design have been used in California and throughout the U.S. These criteria have been based on one or more of the following principles:

- Maintaining watershed processes
- Maintaining a site-specific water balance
- Maintaining the value of the curve number used in the NRCS method of computing peak runoff
- Controlling increases in peak flows from a specified storm size
- Controlling increases in the duration of flows at each intensity within a specified range (flow duration control)
- Controlling the likelihood of downstream erosion in streams (erosion potential, or Ep)

Generally, for any HM criterion used, facilities with more storage and a larger infiltrative area will be more effective in meeting the criterion than facilities with less storage and a smaller infiltrative area.

In the statewide municipal stormwater NPDES permit for small MS4s, Provision E.12.f. includes the following HM standard applicable to Bay Area small MS4s: "Post-project runoff shall not exceed estimated pre-project flow rate for the 2-year, 24-hour storm…"

Dubin (2014) conducted modeling to evaluate whether this standard would be met in the San Francisco Phase II counties (Marin, Sonoma, Napa, and Solano) by a bioretention facility meeting the minimum requirements in that permit's Provision

E.12.f. Dubin's analysis found that a facility sized to 4% of tributary equivalent impervious area, and having a 6-inch deep reservoir with 2 inches of freeboard, 18 inches of treatment soil, and a 12-inch-deep "dead storage" gravel layer below the underdrain, would meet this standard, even in the wettest portions of the Bay Area.

Additional Considerations for Bioretention Sizing

In summary, bioretention facilities for street projects sized to 1.5% - 3% of tributary equivalent impervious area (depending on their location in the Bay Area) can meet the criteria in Provision C.3.d., according to the modeling study documented in the attached Technical Memo.

There are many reasons to design and build facilities larger than the Provision C.3.d. minimum. Building larger facilities helps ensure the facilities perform to the minimum hydraulic capacity intended, despite minor flaws in design, construction, and maintenance, providing an engineering safety factor for the project. Further, larger-sized facilities may more effectively address objectives to maximize the removal of pollutants (particularly pollutants in dissolved form), to operate as full trash capture devices, and to manage hydromodification effects.

However, municipalities often face considerable challenges in retrofitting existing streetscapes with GI facilities. Constraints and design challenges typically encountered in the public right-of-way include:

- The presence of existing underground utilities (known and unknown during the design phase);
- The presence of existing above-ground fixtures such as street lights, fire hydrants, utility boxes, etc.;
- The presence of existing mature trees and root systems;
- The elevation of or lack of existing storm drains in the area to which to connect underdrains or overflow structures;
- Challenges of defining and controlling any catchment areas on adjacent private parcels that drain to the roadway surface;
- Low soil permeability and strength, and the need to protect the adjacent roadway structure;
- Competition with other assets & uses for limited right-of-way area; and
- Presence of archeologic/cultural deposits.

Use of the sizing factors in the attached Technical Memo will provide municipalities flexibility in design of bioretention facilities for street projects where constraints are present.

Recommendations for Sizing Approaches for Green Infrastructure Retrofit Facilities in Street Projects

1. Bioretention facilities in street projects should be sized as large as feasible and meet the C.3.d criteria where possible. Constraints in the public right-of-way may affect the size of these facilities and warrant the use of smaller sizing factors.

Bioretention facilities in street projects may use the sizing curves in the attached memorandum to meet the C.3.d criteria. Local municipal staff involved with other assets in the public right of way should be consulted to provide further guidance to design teams as early in the process as possible.

2. Bioretention facilities in street projects smaller than what would be required to meet the Provision C.3.d criteria may be appropriate in some circumstances. As an example, it might be appropriate to construct a bioretention facility where a small proportion of runoff is diverted from a larger runoff stream. Where feasible, such facilities can be designed as "off-line" facilities, where the bypassed runoff is not treated or is treated in a different facility further downstream. In these cases, the proportion of total runoff captured and treated should be estimated using the results of the attached memorandum. In cases where "in-line" bioretention systems cannot meet the C.3.d criteria, the facilities should incorporate erosion control as needed to protect the facility from high flows. See Figures 1 and 2 below for illustration of the in-line and off-line concepts.
3. Pollutant reduction achieved by GI facilities in street projects will be estimated in accordance with the Interim Accounting Methodology[i] or the applicable Reasonable Assurance Analysis[ii].

Figure 1: Off-line system in El Cerrito where low flow is diverted to the sidewalk planter and high flows continue down the gutter.

Figure 2: In-line system in Berkeley/Albany where low and high flows enter the system and overflows exit through a drain within the system.

[i] The Interim Accounting Methodology for TMDL Loads Reduced Report (BASMAA 2017) describes the methodology that is being used to demonstrate progress towards achieving the PCB and mercury load reductions required during the term of MRP 2.0. The methodology is based on the conversion of land use from a higher to a lower PCB or mercury loading rate during the redevelopment of a parcel. See: www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/stormwater/Municipal/POC/Final%20Interim%20Accounting%20Methodology%20Report%20v.1.1%20(Revised%20March%202017).pdf

[ii] A Reasonable Assurance Analysis (RAA) is a methodology used to demonstrate that implementation of pollutant control measures (such as GI facilities) over a specified time period will meet required pollutant load reductions associated with a TMDL. The Bay Area Reasonable Assurance Analysis Guidance Document (BASMAA 2017) establishes a regional framework and provides guidance for conducting PCBs and mercury RAAs in the San Francisco Bay Area. See: http://basmaa.org/Announcements/bay-area-reasonable-assurance-analysis-guidance-document

Appendix C. Summary of Planning Documents Reviewed for Green Infrastructure and Workplan to Incorporate Green Infrastructure Requirements in Planning Documents

Table C-1
Summary of City of Alameda Planning Documents Evaluated for Green Infrastructure

Type of Document	Agency has this plan?			Name of Document	Department Responsible for Document	Contact Person in Department	Do Policies, Guidance, or Requirements in Document Create…		Describe Opportunities and/or Conflicts	Is Document Appropriate to Update?		
							Opportunities to Install GI? (Y/N)	Conflicts with GI? (Y/N)				
	Yes	No	TBD							Yes	No	Reason, if No
General Plan	✓	☐	☐	City of Alameda General Plan (1990) Alameda Point General Plan Amendment (2014)	Planning, Building and Transportation (PBT) Department	Andrew Thomas, PBT Director	Y	N	**Opportunity: 8. Safety and Noise Element:** SN-22. Require the use of "Green Infrastructure", landscaping, pervious surfaces, green roofs, and on-site stormwater retention facilities to reduce surface runoff and storm drain flooding during storm events. **No Conflicts.**	✓	☐	Open Space (Parks) and Land Use Elements are being updated. Revisions to the Transportation Element can also be considered. A new Conservation and Climate Change Element is being created.
Specific Plan(s) (Redevelopment)	✓	☐	☐	Alameda Point Northern Waterfront General Plan Amendment (2007)	Planning, Building and Transportation	Andrew Thomas, PBT	N	N	**No Conflicts**.	☐	✓	GI requirements for projects subject to MRP C.3 are covered by the City's plan check and review process.
Specific Plan(s) (Redevelopment)	✓			Alameda Point Master Infrastructure Plan (March 2014)	Public Works (PW); Planning, Building and Transportation	Scott Wikstrom, PW	Y	N	The Master Infrastructure Plan (MIP) establishes the requirements and standards for the backbone infrastructure to support the redevelopment and reuse of Alameda Point. Section XII., Sustainability Considerations, states "The key sustainable elements of the backbone infrastructure include creating a seismically stable site that can adapt to the potential impacts of climate change, utilize existing utility capacities available at the Project Site, harness the green infrastructure of the utility agencies serving the Project Site, conserve and restore natural resources, promote the well-being of the community through numerous active parks and open space areas and allow for future green infrastructure enhancements to be implemented within future in-tract/ onsite development areas. **No Conflicts**.	☐	✓	Current language supports GI.

Table C-1
Summary of City of Alameda Planning Documents Evaluated for Green Infrastructure

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							Opportunities to Install GI? (Y/N)	Conflicts with GI? (Y/N)		Yes	No	Reason, if No
Specific Plan(s) (Redevelopment)	✓			Alameda Point Town Center and Waterfront Precise Plan (July 2014)	Planning, Building and Transportation	Andrew Thomas, PBT	Y	N	• Sustainable Urbanism. The promotion of urban sustainability underlies the entire Precise Plan framework, including transit and mobility provisions, land use and density regulations, urban form, green infrastructure and other development control guidance. • Address climate change and sea level rise issues through the integration of flood protection and green infrastructure (includes illustrative GI concepts). **No Conflicts**.		✓	Current language supports GI.
Complete Street Plan(s)	✓	☐	☐	Complete Streets Resolution and Policy (2013)	Public Works, PBT	Scott Wikstrom, PW; Rochelle Wheeler, PBT	N	N	**No Conflicts.**	✓	☐	Policy could be updated to include GI.
Active Transportation Plan(s)	✓	☐	☐	Alameda Community-Based Transportation Plan (2009); Pedestrian Plan (2009); Pedestrian Design Guidelines (2011); Bicycle Master Plan (2010).	Planning, Building and Transportation; PW, Alameda County Congestion Management Agency	Rochelle Wheeler, PBT	y	N	**Opportunity:** *Pedestrian Design Guidelines* support GI principles. **No Conflicts.**	✓	☐	The Bicycle Master Plan and Pedestrian Plan are currently being updated as the Active Transportation Plan. The Community-Based Transportation Plan is outdated, however the projects are part of other plans that are up to date.
Active Transportation Plan(s)	✓	☐	☐	Transportation Choices Plan: Transit and Transportation Demand (January 2018)	Planning, Building and Transportation	Gail Payne, PBT	y	N	**Opportunity:** The Transportation Choices Plan is intended to provide a framework for implementing future transit and Travel Demand Management projects and programs in the City. Projects are reviewed for GI potential including planting trees and installing rain gardens and bioswales.	☐	✓	Individual projects are reviewed for GI potential.
Storm Drain Master Plan(s)	✓	☐	☐	Storm Drain Master Plan (2008)	Public Works	Scott Wikstrom	N	N	**No Conflicts**.	✓	☐	Plan could be updated to include GI.

Table C-1
Summary of City of Alameda Planning Documents Evaluated for Green Infrastructure

Type of Document	Agency has this plan?			Name of Document	Department Responsible for Document	Contact Person in Department	Do Policies, Guidance, or Requirements in Document Create…		Describe Opportunities and/or Conflicts	Is Document Appropriate to Update?		
							Opportunities to Install GI? (Y/N)	Conflicts with GI? (Y/N)				
	Yes	No	TBD							Yes	No	Reason, if No
Urban Forestry Plan(s)	✓	☐	☐	Master Street Tree Plan Volumes 1 & 2	Public Works; Alameda Recreation and Parks Department (ARPD)	Scott Wiksrom, PW	Y	N	**Opportunity**: Guidance and policies support GI opportunities. **No Conflicts**.	☐	✓	Current guiding principles and policies language support GI.
Urban Forestry Plan(s)	✓	☐	☐	Urban Greening + Parks Improvement Assessment (2012)	Alameda Recreation and Parks Department; Public Works;	Amy Wooldridge, ARPD	Y	N	**Opportunity**: Guidance and policies support GI opportunities. **No Conflicts**.	☐	✓	Current guiding principles and policies language support GI. The Alameda Point MIP integrates existing and new
Other Plans That May Affect Impervious Surfaces and Drainage: Climate Change Resiliency	✓	☐	☐	Local Action Plan for Climate Protection (2008)	Climate Protection Task Force, and Planning and Building Dept.	Erin Simth, PW	N	N	**No Conflicts**.	✓	☐	This plan was updated as the Climate Action and Resiliency Plan (CARP) in July 2019.

Table C-2
Summary of Planning Documents to be Updated

Name of Document	Sections of Document Identified for Update	Language in Support of GI	Department Responsible for Document	Contact Person in Department	Governing Body or Official that Approves Update	Date Example Text Provided to Department	Date of Public Circulation of Draft Document	Date of Final Document
1. Climate Action and Resiliency Plan	New document, replaces Local Action Plan for Climate Protection (2008), commensurate with March 2019 City Council's approval of climate emergency declaration.	• Provides nexus with GI Plan. • GI is presented as a strategy for GHG reduction. • Action E4. Green roof installations on new developments at Alameda Point. Require at least 10% of roof areas on new development in Alameda Point to be installed as green roofs. This action aligns with the Alameda Point Stormwater Management Plan requirements. • A strategy for buildings (Buildings) is to investigate and adopt requirements for managing runoff from impervious surfaces using green infrastructure. This includes establishment of an in-lieu fee program. • Buildings. Consider design modifications for infiltration-based green infrastructure in areas with shallow groundwater. • Land Use. Stormwater management plans for the City's future development at Alameda Point call for 100 percent treated stormwater. This will be accomplished through 100 percent green streets, basins connected to outfalls that will be adaptable to sea level rise, drastic decreases in impervious surfaces, and rainwater harvesting, among other approaches. • Utilities. Address rising groundwater as it relates to GI. Encourage the adoption of distributed GI solutions on private property. Implement the recommendations, guidance, and strategies of the City's Green Infrastructure Plan where appropriate. Incorporate green infrastructure into new city buildings and within parks. Continue to expand green infrastructure along roadways as part of a "Complete Streets" design.	Public Works (PW), Green Working Team; Planning, Building and Transportation; Alameda Municipal Power (AMP)	Erin Smith, PW	City Council approved a process to update the 2008 Plan in December 2017	April 2019	July 16, 2019 public meeting	City Council approved Final Plan September 3, 2019
2. Active Transportation Plan	New plan that updates the Bicycle Master Plan and Pedestrian Plan	• Will provide a nexus with the GI Plan	Planning, Building and Transportation	Rochelle Wheeler	City Council	2020	Public outreach has begun. Draft by August 2020	City Council adoption planned for December 2020
3. General Plan	Conservation and Climate Change Element, Open Space (Parks) and Land Use Elements, and potentially, the Transportation Element	• Conservation and Climate Change Element staff input includes Policies to promote and support green infrastructure and references to the GI Plan	Planning, Building and Transportation	Andrew Thomas	City Council	August 2019	Scheduled to go to Planning Board in Autumn 2019, Spring 2020	TBD

Appendix D. Community Information and Resources

Before you begin planning your system:
Review the rainwater harvesting fact sheets, *Rain Barrels and Cisterns*, *Rain Gardens, Managing Stormwater in Landscaping,* and *Pervious Paving,* downloadable from our Detain the Rain webpage: www.cleanwaterprogram.org/residents/detain-the-rain.

Factors to consider when choosing your rainwater capture system:

Local Regulations
Contact your local jurisdiction for guidelines on how to comply with any local requirements for installation.

Site Conditions
A variety of factors, including slopes, soil types, high groundwater and slope stability, may limit or prevent the use of certain capture systems. Please consult with an appropriate professional, such as an engineer, to determine what kind of rainwater capture system is appropriate for your property.

Mosquito Prevention
When implemented correctly, rainwater capture systems do not allow mosquitoes to breed. Ensure that water infiltrates into the ground within five days, and that stored water is sealed off to prevent mosquito access. For more information contact the Alameda County Mosquito Abatement District.

cleanwater PROGRAM

Having clean and healthy waterways is important to our daily lives. The Clean Water Program fosters an appreciation of the local environment, inspiring people to do their part to prevent water pollution during everyday activities.

Learn more about preventing water pollution and the Clean Water Program at www.cleanwaterprogram.org.

More Information

Clean Water Progam Alameda County

www.cleanwaterprogram.org/residents/detain-the-rain

The Program's website provides photos of local projects; contact information for local jurisdictions; and fact sheets on rain barrels and cisterns, rain gardens, pervious paving, and managing stormwater in landscaping.

Related Information

Bay Friendly Gardening
Gardening and landscaping practices that foster healthy soils, conserve water and prevent pollution.
www.bayfriendly.org
(510) 891-6500

The Alameda County Mosquito Abatement District
Mosquito breeding prevention tips.
www.mosquitoes.org
(510) 783-7744

cleanwater PROGRAM

Protecting Alameda County Creeks, Wetlands & the Bay

Member Agencies
Cities of Alameda, Albany, Berkeley, Dublin, Emeryville, Fremont, Hayward, Livermore, Newark, Oakland, Piedmont, Pleasanton, San Leandro, Union City; the County of Alameda; the Alameda County Flood Control and Water Conservation District; and Zone 7 Water Agency.



Detain the Rain

Your yard can make a difference for the Bay.

cleanwater PROGRAM

Protecting Alameda County Creeks, Wetlands & the Bay

Enhance Your Property and Protect Our Creeks and the Bay

Rainwater capture systems installed on your property can help reduce flooding and protect the water quality of your local creeks and San Francisco Bay. Landscape designs featuring rainwater capture systems retain water during a storm then slowly release the water over a period of time. These systems conserve water *and* reduce flooding, stormwater pollution and erosion, while protecting our local creeks and the Bay.

Some of these systems require technical guidance. For steep slopes and erodible soils please consult with an appropriate professional such as a landscape architect or engineer.

LANDSCAPE DESIGNS FOR STORMWATER MANAGEMENT

Stormwater Control for Small Projects

Bay Area Stormwater Management Agencies Association

Dry creek infiltrates and conveys runoff.

Designing landscaped areas to soak up rainfall runoff from building roofs and paved areas helps protect water quality in local creeks and waterways. These landscape designs reduce polluted runoff and help prevent creek erosion.

As the runoff flows over vegetation and soil in the landscaped area, the water percolates into the ground and pollutants are filtered out or broken down by the soil and plants.

This fact sheet shows how you can design your landscape to absorb runoff from impervious surfaces, such as roofs, patios, driveways, and sidewalks, with landscape designs that can be very attractive.

If you are interested in capturing and storing water for irrigation use, see the Rain Barrel fact sheet in this series.

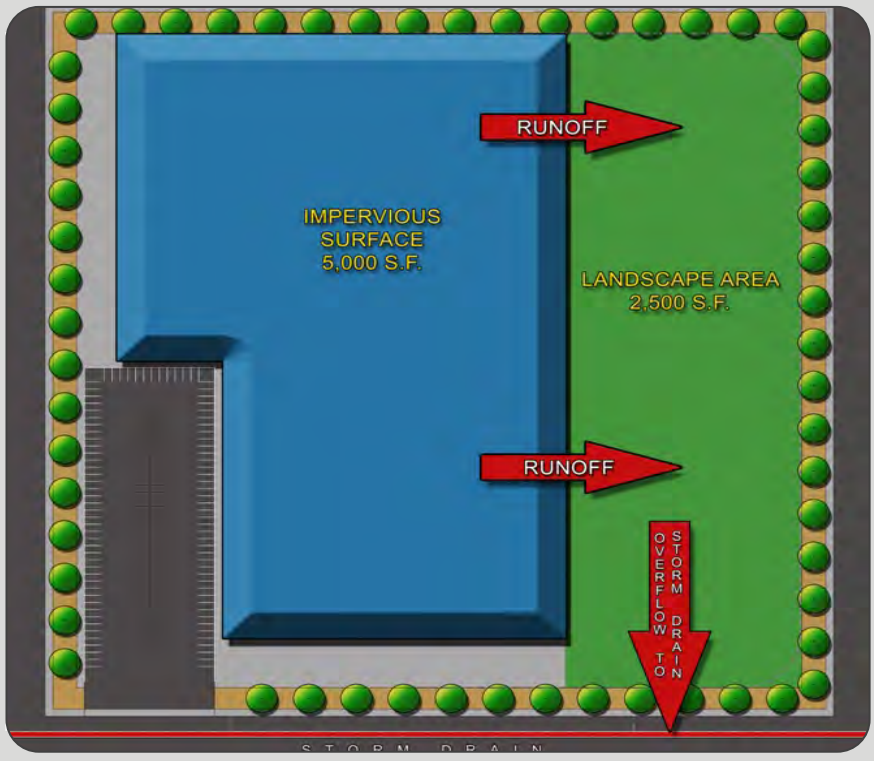
Can My Project Manage Stormwater in the Landscape?

Directing stormwater runoff to the landscape is suitable for sites with the following conditions:

- Roofs, driveways, parking areas, patios, and walkways that can drain to an existing landscape, or an area that may be converted to landscape.
- Areas of landscape with a slope of 5% or less are preferred; check with the municipality regarding requirements for steeper sites.
- Works best in well-drained soil; soil amendments may be used in areas with poor drainage.
- Landscaped areas that total at least 1/2 the size of the impervious area draining to it.
- Direct runoff away from building foundations.
- Runoff should not create ponding around trees and plants that won't tolerate wet conditions.

How Do I Size My Landscape?

The landscaped area should be 50% of the size of the contributing impervious surface. For example (see below), to manage runoff from a 5,000 square foot roof or paved surface, you should have 2,500 square feet of landscaping.

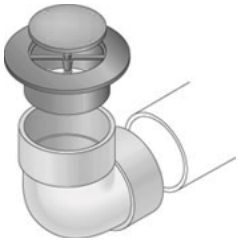


Techniques to Manage Stormwater in Landscaping

Direct Roof Runoff to Landscape

- Use additional piping to connect the downspout to the landscape if needed.
- Direct runoff away from building foundation.
- Prevent erosion by installing:
  - Splash blocks,
  - Rain chains,
  - Gravel area under a gutterless roof,
  - Pop-up drainage emitter connected to a pipe that carries runoff away from the foundation, or
  - Other energy dissipation technique.

Splash block

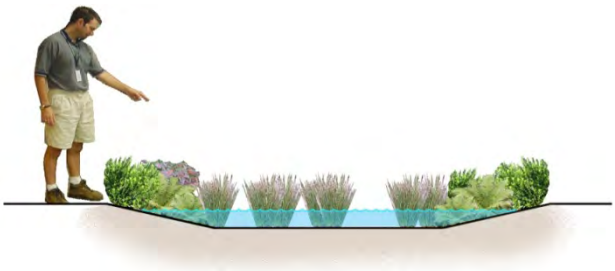


Pop-up emitter

Gravel area under a gutterless roof

Rain chain

Swales or Dry Creeks



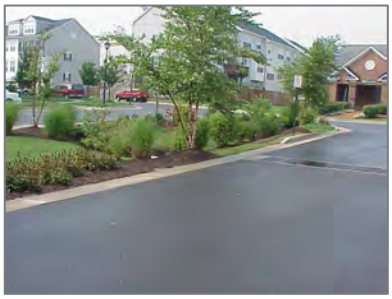
Cross section

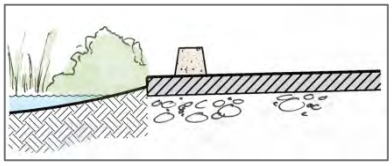
Swales and dry creeks are narrow, linear depressions designed to capture and convey water. Swales imitate a natural creek's ability to slow, infiltrate, and filter stormwater. To install a swale follow these steps:

- Excavate a narrow linear depression that slopes down to provide a flow path for runoff. The path length (10 to 15 feet or more) should meander to slow water and prevent erosion.
- Use plants from creek and river ecosystems to help reduce erosion and increase evaporation of runoff.
- The end of the swale requires an outlet for high flows (another landscaped area or a yard drain). Talk to municipal staff to identify an appropriate discharge location.
- Contact municipal staff for a local list of plants suitable for swales.

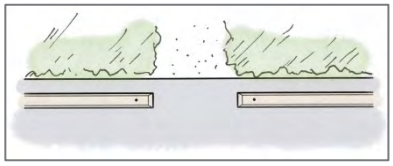
Techniques to Manage Stormwater in Landscaping

Direct Parking Lot Runoff to Landscape





Cross section



View from above

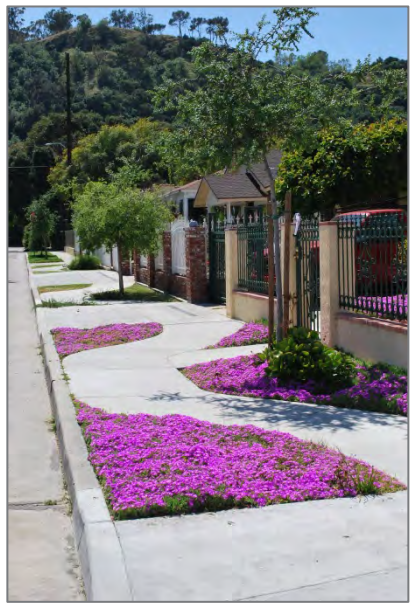
During storms, parking lots generate large amounts of runoff, which picks up oils, grease, and metals from vehicles. Landscaped areas can be designed to absorb and filter this runoff.

- Landscaped areas must be below the paved elevation. Allow an elevation change of 4 to 6 inches between the pavement and the soil, so that vegetation or mulch build-up does not block the flow.
- Grade the paved area to direct runoff towards the landscaping.
- If possible, provide a long path for runoff to infiltrate (while meeting the landscaped area sizing on page 1).
- Provide multiple access points for runoff to enter the landscape. Install curb cuts or separate wheel stops for the water to flow through. Provide cobbles or other permanent erosion control at points of concentrated flow.

Manage Runoff from Driveways/Small Paved Areas

Driveways, sidewalks, patios, walkways, and other small paved areas can offer creative opportunities to drain runoff to landscaping.

- Install landscape adjacent to the paved surface, and grade the paved area so runoff flows toward the landscaping.
- Landscaped areas must be below the paved elevation. Allow an elevation change of 4 to 6 inches between the pavement and the soil, so that vegetation or mulch build-up does not block the flow.
- Install cobbles or rocks where runoff enters the landscape to avoid erosion.
- Use sizing ratio described on page 1.
- Use drought-tolerant native or climate-adapted plants to reduce irrigation.



Design Checklist

- ❑ Maximize the use of landscaping and natural areas that already exist. Try to design new landscapes immediately adjacent to impervious surfaces.
- ❑ Water should flow evenly (without concentrating runoff into small streams) from the impervious surface to the landscape; this will maximize the filtration and settling of sediment and pollutants and prevent erosion. The design should avoid allowing straight channels and streams to form.
- ❑ Amend soils to improve drainage, when necessary.
- ❑ If the project is located next to standard asphalt or concrete pavement, and there is concern about water undermining the pavement, include a water barrier in the design.
- ❑ Use curb cuts to create places where water can flow through to the landscape.
- ❑ Disconnect roof downspouts and redirect flow to adjacent landscapes. Disconnected downspout systems should incorporate a splash block to slow the runoff flow rate; a landscape flow path length of 10 to 15 feet is recommended.
- ❑ Use drought-tolerant native or climate-adapted plant species whenever possible. Avoid invasive or pest species. A list of invasive species may be found at the California Invasive Plant Council website (www.cal-ipc.org). Contact municipal staff for a list of plants suitable for stormwater management areas.
- ❑ Design the landscape area so that overflow from large storms discharges to another landscaped area or the storm drain system to prevent flooding.

Maintain Your Landscape

The following practices will help maintain your landscape to keep it attractive and managing stormwater runoff effectively.

- ❑ During dry months, irrigate during the first year to encourage root growth and establish the plants. In subsequent years, irrigate as needed by the plant species to maintain plant health.
- ❑ Repair signs of erosion immediately and prevent further erosion by reinforcing the surrounding area with ground cover or using rocks for energy dissipation.
- ❑ If standing water remains in the landscaped area for more than 4 days, use soil amendments to improve infiltration.
- ❑ Inspect the locations where water flows into a landscaped area from adjacent pavement to ensure that there is positive flow into the landscape, and vegetation or debris does not block the entrance point.

The City of Los Angeles and Geosyntec Consultants are acknowledged for providing text, formatting and various images used in this fact sheet. The Sonoma Valley Groundwater Management Program, San Mateo Countywide Water Pollution Prevention Program, City of San Jose, Sacramento Stormwater Quality Partnership, and the Purissima Hills Water District are acknowledged for images used in the fact sheet.

PERVIOUS PAVEMENT

Stormwater Control for Small Projects

Bay Area Stormwater Management Agencies Association

Permeable Interlocking Concrete Pavers

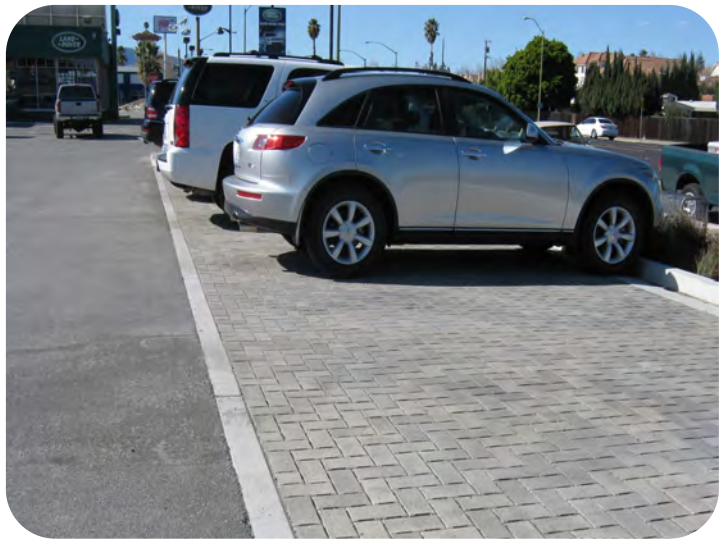
Pervious pavement, also referred to as permeable pavement, contains pores or separation joints that allow water to flow through and seep into a base material (typically gravel or drain rock). Types of pervious pavement include porous asphalt and concrete, open joint pavers, interlocking concrete or permeable pavers, and plastic or concrete grid systems with gravel-filled voids.

Pervious pavement systems allow infiltration of stormwater into soils, thereby reducing runoff and the amount of pollutants that enter creeks, San Francisco Bay, the Pacific Ocean, and other water bodies. This improves water quality, helps reduce creek erosion, and can facilitate groundwater recharge. Pervious pavement is available in many different types that offer environmentally-friendly and aesthetically pleasing options for driveways, walkways, parking areas, and patios.

Is Pervious Pavement Feasible for My Project?

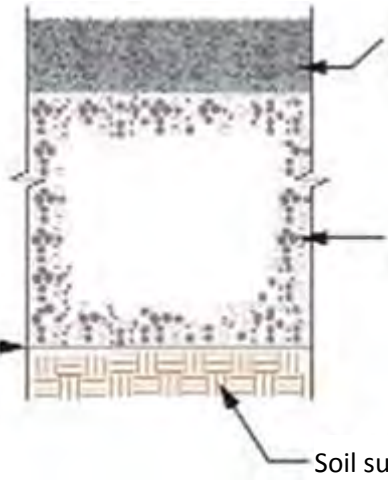
Pervious pavement is appropriate in locations with the following characteristics:

- The location is flat or nearly flat (a maximum 2% slope).
- The location is not in a seasonally wet area.
- The location is not close to a building foundation, unless measures are taken to prevent infiltration under the structure. (See Design Checklist.)

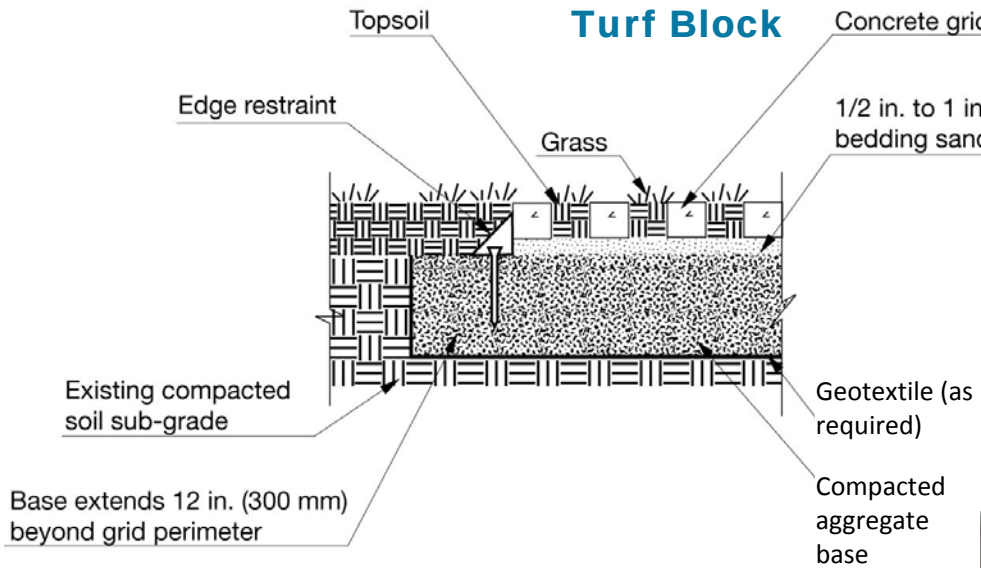


Typical Materials and Example Applications

Pervious Concrete

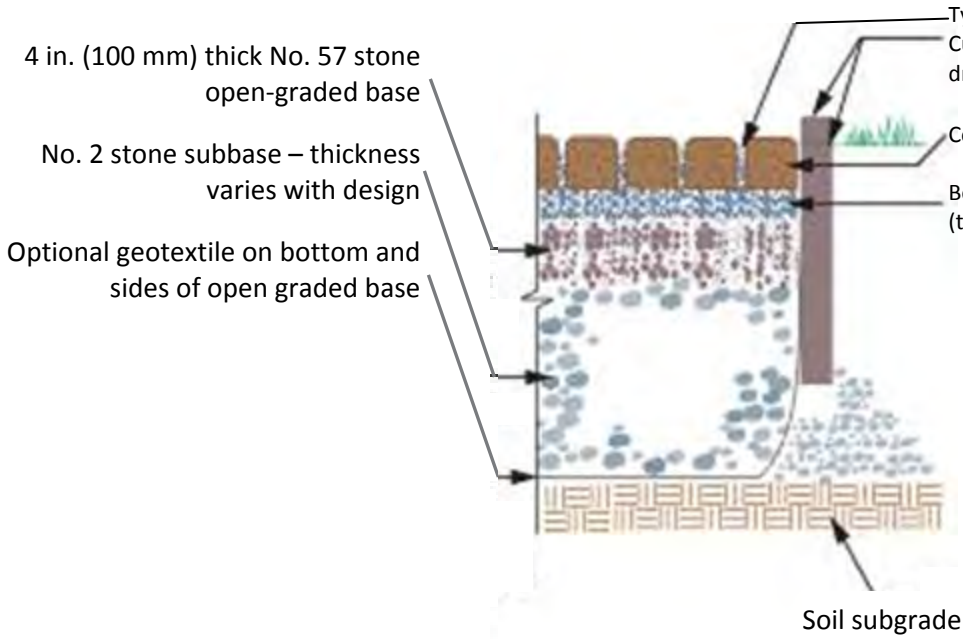


Turf Block



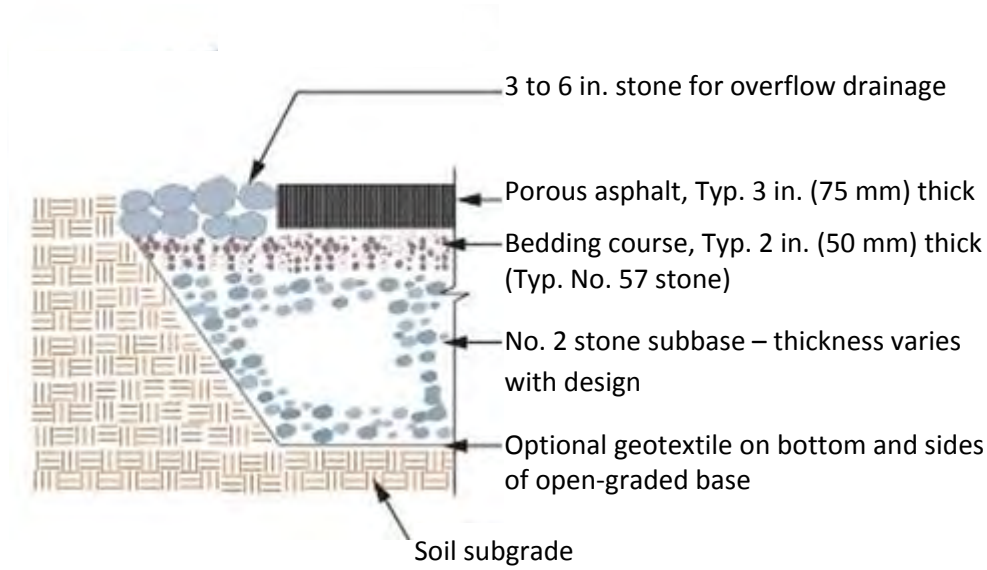
Typical Materials and Example Applications

Permeable Interlocking Concrete Pavers



Note: ASTM No. 3 or 4 stone may be substituted for No. 2 stone.
ASTM No. 89 or 9 stone may be used in the paver openings.

Porous Asphalt



Note: ASTM No. 3 or 4 stone may be substituted for No. 2 stone.
ASTM No. 89 or 9 stone may be used in the paver openings.

Design Checklist

When installing pervious pavement, the following design criteria should be considered.

- ❑ An open-graded base of crushed stone, which has 35 to 45 percent pore space, is installed below the surface pavement. The recommended base thickness is 6 inches for pedestrian use and 10 inches for driveways to provide adequate structural strength.
- ❑ Slope is flat or nearly flat (not greater than 2 percent).
- ❑ Flow directed to pervious pavement is dispersed so as not to be concentrated at a small area of pavement.
- ❑ No erodible areas drain onto the pavement.
- ❑ The subgrade is uniform and compaction is the minimum required for structural stability.
- ❑ If a subdrain is provided, its outlet elevation is a minimum of 3 inches above the bottom of the base course.
- ❑ A rigid edge is provided to retain granular pavements and unit pavers.
- ❑ If paving is close to a building, a barrier or impermeable liner may be required to keep water away from the building foundation.
- ❑ Pavers have a minimum thickness of 80 mm (3 1/8 inches) and are set in sand or gravel with minimum 3/8-inch gaps between pavers.
- ❑ Proprietary products must be installed per the manufacturer's specifications.
- ❑ The project complies with applicable sections of the current municipal code, including disabled access requirements and site drainage requirements, if applicable.

Maintenance Considerations

Once pervious pavement is installed, the following maintenance criteria should be followed:

- ❑ The use of leaf blowers on permeable pavement can force dirt and debris into pavement void spaces. Avoid blowing leaves, grass trimmings and other debris across permeable pavement.
- ❑ Remove weeds from pavement and replace missing sand or gravel between pavers as needed.
- ❑ Inspect subdrain outlets (if applicable) yearly to verify they are not blocked.
- ❑ Inspect pavement after rains for ponding or other visible problems. If there are problems with standing water, vacuum sweeping with specialized equipment may be required. Concrete grid pavers do not require sweeping.

Open Joint Pavers

The City of Los Angeles and Geosyntec Consultants are acknowledged for providing text, formatting and various images used in this fact sheet. The Interlocking Concrete Pavement Institute is acknowledged for contributing pavement sections, design details and specifications. The San Mateo Countywide Water Pollution Prevention Program, Santa Clara Valley Urban Runoff Pollution Prevention Program, and City of San Jose are acknowledged for images used in the fact sheet.

Design Checklist

When installing rain barrels and cisterns, consider the following criteria unless otherwise instructed by the municipality.

- ❑ Do not use flexible piping, to prevent mosquito breeding in water that may pool in flexible pipes. If irrigating edible landscapes, consider pipes that meet FDA food grade standards.
- ❑ When designing the overflow path, remember that in heavy storms rain barrels and cisterns *will* overflow. A 1,000-sq.-ft. roof will produce about 600 gallons of runoff during a storm that has produces a depth of 1 inch of rain.
- ❑ There shall be no direct connection of any rain barrel or cistern and/or rainwater collection piping to any potable water pipe system. Rainwater systems shall be completely separate from potable water piping systems.
- ❑ Place the bottom of the barrel at a higher elevation than the landscape, to use gravity flow.
- ❑ All rain barrels and cisterns should have a screen to ensure mosquitoes cannot enter.
- ❑ Allow overflow to drain to your landscape or a rain garden. Ensure that areas receiving overflow do not have standing water for more than 48-hours.
- ❑ The low water pressure from a small rain barrel will not operate in-ground sprinkler or low-volume devices. Consider using a soaker hose.
- ❑ If using a soaker hose, remove the pressure-reducing washer to increase the water flow.
- ❑ If the water is not needed for irrigation during the rainy season, consider releasing the water to a vegetated area between storms, so the barrels will be empty to catch rain from the next storm. This will help protect your watershed by reducing the quantity and speed of water entering local creeks during storms. Install a spigot and drip tape to allow the rain barrel or cistern to slowly drain between storms. You can store the water captured towards the end of the rainy season to irrigate your garden in the dry season.
- ❑ For more information, ask municipal staff to refer you to countywide stormwater guidance.

Operation and Maintenance

After installing your rain barrel or cistern, follow these tips for long-term safety and functionality.

- ❑ Regularly check the gutters and gutter guards to make sure debris is not entering the rainwater harvesting system.
- ❑ Inspect the screens on the rain barrel or cistern prior to the wet season to make sure debris is not collecting on the surface and that there are not holes allowing mosquitoes to enter the rain barrel. Inspect screens more frequently if there are trees that drop debris on the roof.
- ❑ Clean the inside of the rain barrel once a year (preferably at the end of the dry season when the rain barrel has been fully drained) to prevent buildup of debris. If debris cannot be removed by rinsing, use vinegar or another non-toxic cleaner. Use a large scrub brush on a long stick, and avoid actually entering the rain barrel. Drain washwater to landscaping.
- ❑ Clean out debris from cisterns once a year, preferably at the end of the dry season.

Daisy-chained system
Courtesy of Acterra

The City of Los Angeles and Geosyntec Consultants are acknowledged for providing text and formatting used in this fact sheet. The City of Oakland, Acterra, Gutter Glove, and Stephanie Morris are acknowledged for images used in the fact sheet.

RAIN BARRELS AND CISTERNS

Stormwater Control for Small Projects

Bay Area Stormwater Management Agencies Association

Daisy chained system of 205-gallon rain barrels
Courtesy of The City of Oakland

Rain barrels and cisterns can be installed to capture stormwater runoff from rooftops and store it for later use. They are low-cost systems that will allow you to supplement your water supply with a sustainable source and help preserve local watersheds by detaining rainfall.

Collected rainwater may be used for landscape irrigation. Subject to permitting requirements, harvested rainwater may be allowed for toilet flushing; contact municipal staff for more information. Capturing even a small amount of your roof runoff will have environmental benefits because it will reduce the quantity and speed of stormwater runoff flowing to local creeks.

Rain barrels typically store between 50 and 200 gallons. They require very little space and can be connected or "daisy chained" to increase total storage capacity.

Cisterns are larger storage containers that can store 200 to over 10,000 gallons. These come in many shapes, sizes, and materials, and can be installed underground to save space.

How Much Storage is Recommended?

The number of rain barrels recommended to capture runoff from a given roof (or other impervious area) is shown in the following table.

Are Rain Barrels or Cisterns Feasible for My Project?

Rain barrels and cisterns are appropriate for sites with the following characteristics:

- Roof areas that drain to downspouts.
- A level, firm surface is needed to support a rain barrel(s) or cistern to prevent shifting or falling over. A full 55-gallon rain barrel will weigh over 400 lbs.
- A landscaped area where the captured water can be used (and where it can be drained by gravity flow) should be located within a reasonable distance from the rain barrel(s).
- A landscaped area or safe path to the storm drain system that can handle overflow.

Roof or Impervious Area (sq. ft.)	Suggested Minimum Number of 55 Gallon Rain Barrels*
Up to 750	1-2
750 – 1,250	2-3
1,250 – 1,750	3-4
1,750 – 2,250**	4-5

* Or equivalent capture using larger rain barrels or a cistern.
** To harvest rainwater from an area greater than 2,250 sq. ft. install 1 additional rain barrel per each additional 500 sq. ft.

Approved August 23, 2012

Roofing Materials

Wood shingle roof
Courtesy of Gutter Glove

Technically, any impervious surface can be used for harvesting rainwater; however, the surface materials will affect the quality of captured rainwater, which has implications for the recommended uses.

Although it is technically possible to harvest runoff from parking lots, patios, and walkways, it is more difficult since a subterranean cistern or a pump is usually needed to move the water into an above-ground rain barrel or cistern. Also, there are typically greater levels of debris and contaminants that must be filtered out of the runoff before it enters the storage system. Due to these complexities, it is more common to harvest rainwater from rooftops, which is the focus of this fact sheet.

When designing your system, consider the roofing material on the building.

- If you have asphalt or wooden shingles, use the harvested rainwater only for non-edible landscapes, unless the water is treated first. Petroleum or other chemicals from these roofing materials can leach into the rain water.
- Roofs with cement, clay, or metal surfaces are ideal for harvesting water for a wide variety of uses.

Gutters and Downspouts

Properly sized and maintained gutters and downspouts are essential to a rainwater harvesting system.

- Strategically locate any new downspouts in an area where the rain barrel or cistern will be most useful.
- Consider the height of the rain barrel and the first flush device. Existing downspouts may have to be shortened to make room for the rain barrel and first flush device.
- Install a fine mesh gutter guard on gutters to keep leaves and other debris from entering and clogging the gutters. This will reduce the need for cleaning gutters and the rain barrel or cistern.
- As needed, consult a professional roofer to aid in gutter and downspout installation.

This gutter is covered by a fine mesh gutter guard to keep debris out.
Courtesy of Gutter Glove

Rain Barrel and Cistern Accessories to Keep Water Clean

First flush and downspout diverter installation
Courtesy of The City of Oakland

Various accessories to rain barrels and cisterns help protect the quality of harvested water and reduce maintenance. These accessories include “first flush” diverters, filters, and screens.

Leaves, twigs, sediment, and animal waste are common in runoff, especially at the beginning of a storm (“first flush”). This debris can result in clogging and encourage bacterial growth. A first flush diverter helps remove debris and contaminants by directing the first few gallons of runoff from the roof to landscaping, away from the rain barrel or cistern.

The following tips will help you keep the water in your system clean.

- Install a first flush diverter directly under your downspout. You may have to cut the downspout to connect the first flush diverter above the rain barrel.
- Use the same diameter pipe for the first flush diverter, the downspout, and the connector to the rain barrel. Avoid changing diameters of pipes in order to keep the system from backing up.
- Design the first flush diverter to discharge the first flush to non-edible landscaping.
- Install mosquito-proof screens under the lid of the rain barrel and inside the overflow outlet.

Foundation and Overflow

Before installing a rain barrel or cistern, prepare the site so that the system will function safely.

- Find or create a level location near the downspout on which to place the rain barrel or cistern.
- A concrete or stone paver foundation may be appropriate for smaller rain barrels. A more substantial foundation will likely be required for large cisterns.
- Secure rain barrels and cisterns to your structure with metal strapping, or anchor to the foundation, to prevent tipping in an earthquake.
- Maintain clear access to the rain barrel outlets and cleaning access points.
- Design an overflow path, so that overflow from the rain barrel(s) will discharge safely to a landscaped area, or storm drain system.
- Where possible, direct overflow to a rain garden, swale, or other landscaped area to maximize retention of rainwater onsite.
- Direct the overflow away from the rain barrel, building foundation, and neighboring properties.
- Consult with the municipality to identify overflow locations.

Large unit installed at a single family residence.
Courtesy of Stephanie Morris

RAIN GARDENS

Stormwater Control for Small Projects

Bay Area Stormwater Management Agencies Association

Large Residential Rain Garden

Rain gardens are landscaped areas designed to capture and treat rainwater that runs off roof and paved surfaces. Runoff is directed toward a depression in the ground, which is planted with flood and drought-resistant plants. As the water nourishes the plants, the garden stores, evaporates, and infiltrates rainwater into the soil. The soil absorbs runoff pollutants, which are broken down over time by microorganisms and plant roots.

Rain gardens are a relatively low-cost, effective, and aesthetically pleasing way to reduce the amount of stormwater that runs off your property and washes pollutants into storm drains, local streams, and the San Francisco Bay. While protecting water quality, rain gardens also provide attractive landscaping and habitat for birds, butterflies, and other animals, especially when planted with native plants.

Is a Rain Garden Feasible for My Project?

Rain gardens are appropriate where the following site characteristics are present:

- Rain gardens should be installed at least 10 feet from building foundations. The ground adjacent to the building should slope away at a 2% minimum slope. A downspout extension or "swale" (landscaped channel) can be used to convey rain from a roof directly into a rain garden. Rain gardens can also be located downstream from a rain barrel overflow path.
- Rain gardens should be at least 3 feet from public sidewalks (or have an appropriate impermeable barrier installed), 5 feet from property lines, and in an area where potential overflow will not run onto neighboring properties.
- The site should have well-drained soil and be relatively flat. Soil amendments can improve infiltration in areas with poor drainage. Add about 3 inches of compost to any soil type and till it in to a depth of about 12 inches.
- A front or backyard can work well for a rain garden, especially in areas where the slope naturally takes the stormwater.

How Large Does My Rain Garden Need to Be?

A general recommendation for a garden with a 6-inch ponding depth is to size the rain garden to approximately 4% of the contributing impervious area. Your soil type will affect how the rain garden should be sized because the water infiltration rate depends on the soil type; rain gardens should be larger in areas with slower infiltration. The following table can be used as general guidance.

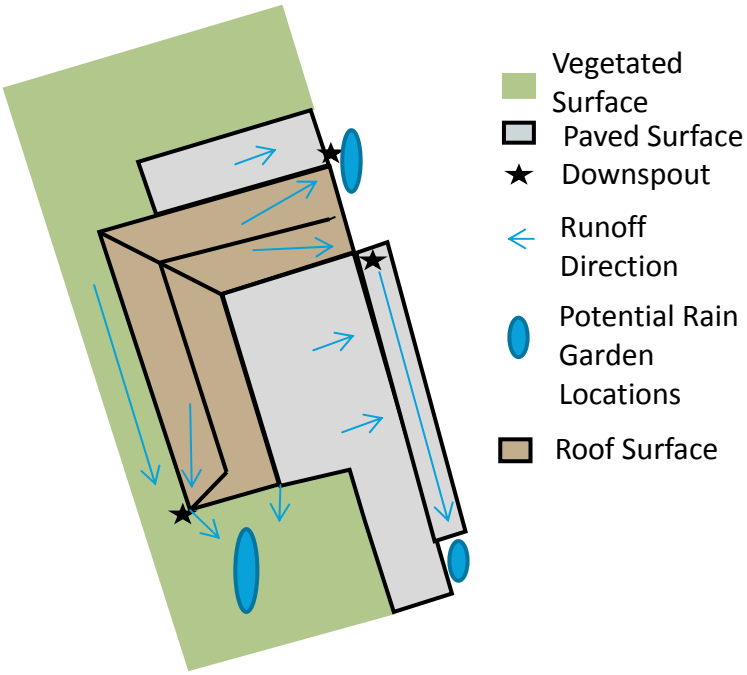
Contributing Area (sq. ft.)	Rain Garden Area (sq. ft.)
500 – 700	24
701 – 900	32
901 – 1,100	40
1,101 – 1,300	48
1,301 – 1,500	56
1,501 – 2000*	70

*Projects adding roof or other impervious areas in excess of 2,000 sq. ft. should add 20 sq. ft. of rain garden surface area per every 500 sq. ft. of additional area.

Approved August 23, 2012 -- corrected November 27, 2012

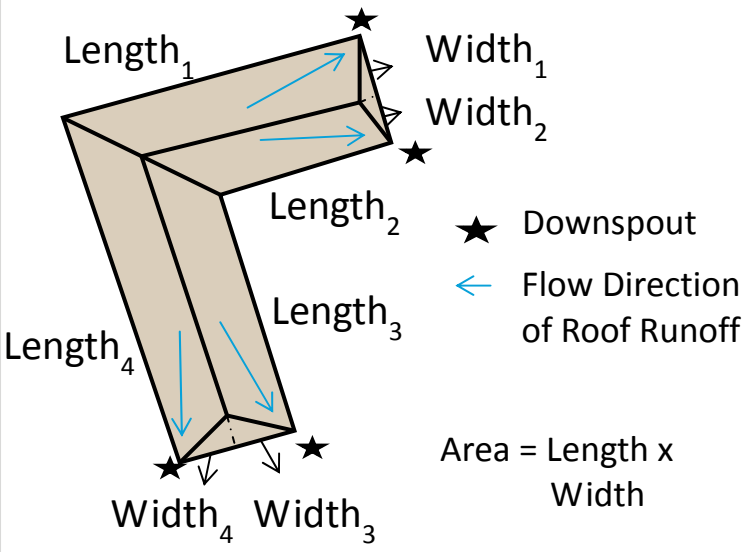
How to Plan and Install a Rain Garden

Select a Location and Plan for Overflow



- Before choosing the location of your rain garden, observe how rainwater is distributed across your home and yard. The ideal rain garden location is a flat or gently sloped area and is down slope from a runoff source.
- Site your garden at least 10 feet away from any structures (unless an impermeable barrier is used) and 5 feet from property lines.
- Avoid siting your garden over underground utilities and septic systems, near large trees, or next to a creek, stream or other water body.
- Your rain garden will overflow in large storms. Therefore, all garden designs should include an overflow system. One option is to build the perimeter of the garden so that it is perfectly level and to allow water to gently spill over the top during large storms. Another option is to build in a spillway that connects to another landscaped area, or the storm drain system.

Plan the Size of Your Rain Garden

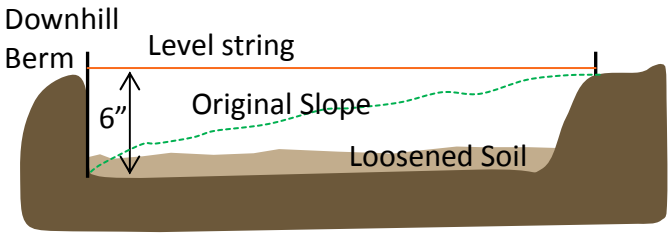


- Once you have determined where your garden will be sited, look at the surrounding area and identify which surfaces will contribute runoff to the garden. Is it all or just a part of the roof, patio, or driveway?
- Estimate the roof area by measuring the length and width of the building foundation and adding a few inches for the overhang. Multiply the length times the width to determine the contributing area. Once you have calculated the area of each contributing surface, add them up to obtain the total contributing area.
- Refer to the chart on page 1 to identify the size of the rain garden you will need to manage runoff from the contributing area.

If you do not have the space, budget, or interest in building a garden of this size, you may consider capturing some of your roof runoff in rain barrels to reduce the amount of runoff, or discharge the overflow to another landscaped area.

How to Plan and Install a Rain Garden

Install your Rain Garden



- Once you have selected a site and planned the size of your rain garden, lay out the shape using a string or tape to define the outline of where you will dig.
- If the yard is level, dig to a depth of 6-inches and slope the sides. If the site is sloped, you may need to dig out soil on the uphill side of the area and use the soil to construct a small berm (a compacted wall of soil) along the down slope side of the garden.
- Use a string level to help level the top of the garden and maintain an even 6-inch depth.
- Once the garden is excavated, loosen the soil on the bottom of the area so you have about 12 inches of soft soil for plants to root in. Mix in about 3 inches of compost to help the plants get established and improve the water-holding capacity of the soil.
- If water enters the garden quickly, include a layer of gravel or river rock at the entry points to prevent erosion.

Select Appropriate Plants

You can design your rain garden to be as beautiful as any other type of garden. Select plants that are appropriate for your location and the extremes of living in a rain garden

Site Considerations:

- How much light will your garden receive?
- Is your property near the coast or located in an inland area (this affects sun and temperature)?
- Are there high winds near your home?

Recommended plant characteristics:

- Native plants adapted to local soil and climate,
- Drought tolerant,
- Flood tolerant,
- Not invasive weedy plants,
- Non-aggressive root systems to avoid damaging water pipes,
- Attracts birds and beneficial insects.

*Contact municipal staff to obtain a full list of recommended plants, provided in the countywide stormwater guidance.

Design Checklist

When installing a rain garden, the following design considerations are recommended.

- ❑ Locate the rain garden at least 10 feet from home foundation, 3 feet from public sidewalks, and 5 feet from private property lines. If rain gardens need to be located closer to buildings and infrastructure, use an impermeable barrier.
- ❑ Locate the rain garden to intercept and collect runoff from a roof downspout or adjacent impervious area.
- ❑ Size the rain garden appropriately based on the soil type and drainage area (see Page 1).
- ❑ Do not locate the rain garden over septic systems or shallow utilities. Locate utilities before digging by calling Underground Service Alert at 811 or (800) 227-2600.
- ❑ Locate the rain garden on a relatively flat area, away from steep slopes. If you plan on moving a large quantity of soil, you may need a grading permit. Contact your local municipality for further assistance.
- ❑ Consider installing an underdrain to enhance infiltration in very clayey soils. Contact municipal staff for guidance on how to properly install an underdrain.
- ❑ An overflow should been incorporated in the rain garden to move water that does not infiltrate to another pervious area and away from the home's foundation or neighboring property.
- ❑ Drought and flood resistant native plants are highly recommended and a variety of species should be planted. Avoid invasive plants. Contact municipal staff for a list of plants appropriate for rain gardens from the applicable countywide stormwater guidance. A list of invasive species may be found at the California Invasive Plant Council website (www.cal-ipc.org).

Maintenance Considerations

Once a rain garden is installed, the following steps will help the garden function effectively.

- ❑ Rain gardens should be irrigated periodically (as needed) during dry months, especially while plants are being established. Plants should be inspected for health and weeds should be removed as often as necessary.
- ❑ Apply about 2 inches of mulch and replace as needed. Mulch with a material that will not float away such as compost or a larger sized hardwood mulch (avoid microbark, for example).
- ❑ Areas of erosion should be repaired. Further erosion can be prevented by stabilizing the eroding soil with ground cover or using energy dispersion techniques (e.g., splashblock or cobbles) below downspouts.
- ❑ Avoid using synthetic fertilizers or herbicides in your rain garden because these chemicals are water pollutants.
- ❑ Standing water should not remain in a rain garden for more than 3 days. Extended periods of flooding will not only kill vegetation, but may result in the breeding of mosquitos or other vectors.

The City of Los Angeles and Geosyntec Consultants are acknowledged for providing text, formatting and various images used in this fact sheet. Contra Costa County is acknowledged for an image used in the fact sheet.