

Developments Protecting Water Quality

A Guidebook of Low Impact Development Examples



SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

December 2009

Developments Protecting Water Quality

A Guidebook of Low Impact Development Examples



Prepared by:
EOA, Inc.

December 2009

A Program of the City/County Association of Governments

CREDITS

This document was prepared by the San Mateo Countywide Water Pollution Prevention Program (Countywide Program) for use by the County of San Mateo municipalities, other local agencies, and the land development community. The Countywide Program expresses its appreciation to all those who contributed to this document.

Program Management Consultant:

EOA, Inc.
1410 Jackson Street
Oakland, CA 94612
(510) 832-2852

Project Manager

Fred Jarvis, Supervising Engineer
Laura Prickett, Senior Planner

Project Planner

Carina Chen, Associate Engineer
Christina Hovland, Senior Planner

This document was developed under the guidance of the New Development Subcommittee. We appreciate the comments, suggestions, and guidance provided by the participating Subcommittee members.

New Development Subcommittee – Active Members

Michael Wasmann	Atherton	Elizabeth Claycomb	Pacifica
Gilbert Yau	Belmont	Leslie Lambert	Portola Valley
Matt Fabry	Brisbane	Paul Willis	Redwood City
Kiley Kinnon	Burlingame	Laura Russell	San Bruno
Muneer Ahmed	Colma	Gavin Moynahan	San Carlos
Jeanne Naughton	Daly City	Ken Pacini	San Mateo
Lucy Chen	East Palo Alto	Martin Quan	San Mateo
Norm Dorais	Foster City	Camille Leung	San Mateo County
Sean Gallegos	Half Moon Bay	Cassie Prudhel	South San Francisco
Catherine Chan	Hillsborough	Daniel Fulford	South San Francisco
Shaun Mao	Menlo Park	Gratien Etchebehere	Woodside
Florian Ebo	Millbrae		

SMCWPPP would also like to thank the following people who provided additional information for the guidebook:

Matt Fabry	City of Brisbane
Catherine Barber	City of Burlingame
Jen Chen	Town of Hillsborough
Kathryn Farbstein	City of Pacifica
Jon Lynch	City of Redwood City
Kristina Woerner	City of San Carlos
Ken Pacini	City of San Mateo
Kelly Ann Posusney	Town of Woodside
Elizabeth Claycomb	City of Pacifica
Jeanne Naughton	City of Daly City
Laura Russell	City of San Bruno
Leslie Lambert	Town of Portola Valley
Claudia Olalla	City of Redwood City
Paul Willis	City of Redwood City

SMCWPPP would also like to thank Jen Chen (Town of Hillsborough), Elizabeth Claycomb (City of Pacifica), Jeanne Naughton (City of Daly City), Laura Russell (City of San Bruno), Leslie Lambert (Town of Portola Valley), Matt Fabry (City of Brisbane, Claudia Olalla (City of Redwood City), Bill Southard (DES Architects and Engineers) and Paul Kephart (Rana Creek Habitat Restoration) for providing photographs for this guidebook.

EOA, Inc., as the NPDES permit compliance consultant, coordinated and compiled the information, and was responsible for the overall preparation of this document. Photographs were taken by Carina Chen or other EOA staff, unless otherwise noted.

Table of Contents

	<i>Page</i>
I. Introduction	
Background	I-1
Site Planning Concepts	I-1
Additional Resources	I-2
Contents of Manual	I-3
References	I-4
II. Single Family Residences	
SF-1: McCormick Residence	II-1
SF-2: Vintage Oaks	II-2
SF-3: Mountain Wood Court	II-4
SF-4: Lennox	II-5
SF-5: 17 th Avenue	II-6
SF-6: Villareal	II-8
SF-7: Bonfiglio	II-9
III. Multi-Family Residences	
MF-1: Marie La Rocca Estates	III-1
MF-2: Meridian at the Crossing	III-3
MF-3: Cambridge Condominiums	III-4
MF-4: Metropolitan Apartments	III-6
MF-5: Lesley Gardens	III-7
IV. Mixed Use Residential/Commercial	
MU-1: Edgeworth Mixed Use Project	IV-1
V. Commercial	
CO-1: Pacific Shores Center	V-1
CO-2: Gap Corporate Headquarters.....	V-4
CO-3: Sea Crest Private School	V-6
CO-4: IKEA	V-8
CO-5: Woodside Town Center	V-9
CO-6: Bay Area Self Storage	V-10
CO-7: J&J Hawaiian BBQ	V-11
CO-8: Douglas	V-13
CO-9: Ocean View Driving Range	V-14
CO-10: Brisbane Technology Park	V-16
CO-11: Wilson Plaza	V-17
CO-12: Quality Suites Hotel	V-18

Table of Contents (continued)

	<i>Page</i>
VI. Public Areas	
PA-1: San Mateo Shoreline	VI-1
PA-2: Waste Water Treatment Plant	VI-3
PA-3: Cypress Lawn Cemetery	VI-4
PA-4: Pacifica State Beach	VI-5
PA-5: Peninsula Temple Shalom	VI-7
PA-6: South County Fire Station 14	VI-8
PA-7: Hillside Historical Park and Community Center	VI-10
PA-8: Millbrae BART Station	VI-12
PA-9: St. Pius Facilities.....	VI-14
PA-10: Alma Street Walkway	VI-15
PA-11: Public Works Maintenance Yard	VI-16
PA-12: San Carlos Caltrain Station	VI-17
PA-13: Riparian Restoration	VI-18
PA-14: Brisbane City Hall Rain Garden	VI-19
PA-15: Redwood City Post Office Paseo	VI-23
PA-16: Serramonte Library / Gellert Park Parking Lot.....	VI-27
PA-17: Belle Air / Third Avenue Street Creek.....	VI-31
PA-18: Portola Valley Town Center	VI-34
VII. Indices	
a. LID Examples by Best Management Practice.....	VII-1
b. LID Examples by Municipality	VII-2

Acronyms and Abbreviations

BASMAA	Bay Area Stormwater Management Agencies Association
CO	Commercial
DCIA	Directly Connected Impervious Area
HVAC	Heating, Venting, and Air Conditioning
LID	Low Impact Development
MF	Multi-Family Residences
MRP	Municipal Regional Stormwater Permit
MU	Mixed Use Residential/Commercial
PA	Public Areas
Countywide Program	San Mateo Countywide Water Pollution Prevention Program
SF	Single Family Residences
Water Board	San Francisco Bay Regional Water Quality Control Board

SECTION I

Introduction

BACKGROUND

In February 2003, the San Francisco Bay Regional Water Quality Control Board (Water Board) adopted Order R2-2003-0023, amending the San Mateo Countywide Water Pollution Prevention Program's (Countywide Program) NPDES municipal stormwater permit to include new requirements (New and Redevelopment Requirements) in Provision C.3. These requirements were continued and expanded in the new Municipal Regional Stormwater Permit (MRP) for all Bay Area stormwater programs, which went into effect on December 1, 2009. For more information on permit requirements, see the Countywide Program's *C.3. Technical Guidance Manual*.

This Guidebook has been created as part of the effort to encourage the use of low impact development (LID) site design measures that benefit water quality. It is intended to serve as a reference during the conceptual design and review stage and to be used by both project applicants and municipal staff. This document provides examples of innovative LID designs in San Mateo County.

LOW IMPACT DEVELOPMENT (LID) CONCEPTS

The low impact development (LID) approach to site design is intended to reduce runoff and mimic a site's pre-development hydrology. This is accomplished by minimizing disturbed areas and impervious cover, and then infiltrating, storing, detaining, evapotranspiring, and/or biotreating stormwater runoff close to its source (Water Board 2009). Examples include working with the natural topography of a site, clustering the development on the least sensitive portions of a site while protecting sensitive areas, using design techniques to minimize impervious surface area and infiltrate runoff, and biotreating stormwater runoff using landscape-based stormwater treatment systems, such as vegetated swales and rain gardens / bioretention areas.. This document presents examples of site designs that incorporate the following approaches.

Protect Sensitive Areas from Encroachment

This concept includes such techniques as ensuring adequate protective setbacks from creeks, wetlands, and riparian areas; preserving significant trees and native or significant vegetation to protect soil structure, increase soil permeability and reduce the volume and velocity of rainwater runoff; and avoiding construction on and disturbance of erosive soils and slopes, such as steep or large continuous slopes, soils high in silt or fine sand, or soils lacking vegetative cover.

Minimize Impervious Surface Area

❖ *Street and right-of-way widths*

Streets make up about 25% of a development's total land area, and street pavement makes the largest contribution to a site's impervious land coverage. Designing streets with less surface area by reducing widths, incorporating parking pullouts, or using

permeable pavements for low use or parking areas can protect water quality while preserving the street's primary function (BASMAA, 1999). The Countywide Program prepared a *Sustainable Green Streets and Parking Lots Design Guidebook*, which offers a wide range of design concepts for incorporating LID designs in roadway projects (Countywide Program 2009).

Fire department requirements for minimum street widths and cul-de-sac radii can conflict with LID goals. In addition, street and parking areas need to be designed to withstand the impacts of heavy load vehicles (i.e., fire, garbage and delivery trucks). For these reasons, the fire department should be included in the process for revising design standards in order to ensure safety while allowing measures such as narrow streets, alternative turnarounds, and permeable pavement such as turf block.

❖ *Cluster or infill development*

Clustering high-density development on a portion of the site while preserving high quality open space elsewhere on the site can improve overall watershed health. Although the densely developed area has a high percentage of impervious land coverage, the total impervious area is reduced and land disturbance is minimized (BASMAA, 1999).

❖ *Parking lots*

Parking lots make up a large portion of land use and are constructed mostly of impervious pavement. Some municipal zoning codes and standards mandate that parking exceed the usual parking demand (BASMAA, 1999). In order to provide adequate but not excessive amounts of parking space, site design features such as overflow parking and landscaped reserve areas can be used. Also, curb cuts that allow drainage into vegetated swales and landscaping, trees, and permeable pavement materials can be installed as a way to reduce and treat parking lot runoff. More concepts for incorporating LID into parking lot designs are available in the *Sustainable Green Streets and Parking Lots Design Guidebook* (Countywide Program 2009).

Use Drainage as a Design Element

Landscaping combined with site engineering (grading and drainage) can improve stormwater quality. Runoff that drains to landscaping allows particulate-associated pollutants to settle and runoff to infiltrate the soil. Site design features that can be included are areas that drain to a detention basin; streets and parking lots draining to vegetated swales, vegetated channels, vegetated cul-de-sacs or turnarounds; and roof downspouts that drain to landscaping ("disconnected downspouts"). Disconnecting impervious surface areas (i.e., allowing runoff to drain to pervious surfaces in between impervious surfaces) reduces the velocity and amount of water, lowers downstream peak flows and reduces flood and erosion potential.

Stormwater Biotreatment Systems

Stormwater biotreatment systems are landscaped areas that have been hydraulically sized to remove pollutants from stormwater runoff using natural processes such as filtration, infiltration, floatation, and sedimentation. Examples include vegetated swales, bioretention areas/rain gardens, and detention basins. The difference between stormwater biotreatment systems and site design features that use drainage as a design element is that stormwater biotreatment systems are hydraulically sized to treat a specified rate or volume of stormwater runoff. Stormwater biotreatment systems must be sized to comply with hydraulic sizing criteria listed in Provision C.3.d of the MRP. Beginning December 1, 2010, biotreatment systems may be used to meet the MRP requirements for stormwater treatment only for projects in which it is infeasible to “treat” the C.3.d volume of stormwater runoff with rainwater harvesting and reuse, infiltration, and/or evapotranspiration (Water Board 2009). The Countywide Program will develop guidance for complying with this requirement, which will be posted on its website, www.flowstobay.org.

Promote Alternatives to Automobiles

Automobiles are a major source of water pollution. Designing sites that promote a variety of transportation alternatives has the potential to reduce automotive use. Design examples are provided that promote bicycling, walking, carpooling, and mass transit.

ADDITIONAL RESOURCES

For more detailed descriptions and guidelines on these topics, refer to the Bay Area Stormwater Management Agencies Association’s (BASMAA’s) *Start at the Source Manual* (1999) and its companion document *Using Site Design Techniques to Meet Development Standards for Stormwater Quality* (2003) (available at the BASMAA’s website www.basmaa.org). Using site design techniques to help meet the requirements of Provision C.3 of the MRP can also reduce the number and size of stormwater treatment controls and result in savings on operation and maintenance costs over the life of the project. Additional information about stormwater quality-friendly site designs is available on the Countywide Program’s website (<http://www.flowstobay.org/>) and in the Countywide Program’s *C.3. Stormwater Handbook*, and the *Sustainable Green Streets and Parking Lots Guidebook*.

CONTENTS OF MANUAL

This document provides examples of local LID designs that control stormwater quality impacts. The examples are organized into Sections II through VII, based on type of development. For each site, the design examples provide the location, features with pictures, and lessons learned (where available), and contact information. Contacts were asked for additional information including construction and maintenance costs and considerations, project size and completion date. This information is provided where available.

Section I contains the background and introduction to the Countywide Water Program's Guidebook of LID Examples.

Section II focuses on single-family residences, where many LID techniques can be integrated for maximum effectiveness.

Section III highlights multi-family residences. For the purposes of this document, the distinguishing factor between single- and multi- family houses is that in the latter, the residences share adjoining walls.

Section IV describes one mixed-use development that consists of high-density residential units combined with commercial businesses.

Section V focuses on commercial developments. This section includes campus type office parks and other commercial business use areas. Generally campus type office parks are on large sites dedicated to one or more businesses and include common areas that provide opportunities for landscape features that can improve water quality. One example project in this section, Woodside Town Center CO-5), includes a combination of town government and commercial use.

Section VI focuses on projects that are on publicly owned and managed land. These include greenbelts, bike paths to parks, and public buildings.

Section VII includes two indices to assist the user in locating: 1) particular LID techniques illustrated in this document; and 2) all the examples within a specific municipality.

REFERENCES

Bay Area Stormwater Management Agencies Association, *Start at the Source*, 1999.

San Mateo Countywide Water Pollution Prevention Program (Countywide Program), *Sustainable Green Streets and Parking Lots Design Guidebook*, 2009.

San Francisco Bay Regional Water Quality Control Board (Water Board), Municipal Regional Stormwater Permit, 2009.

SECTION II

Single Family Residences

**McCormick Residence
SF-1**

Site Location:

65 McCormick Lane
Atherton, CA

Features:

- Maintains runoff on-site
- Vegetated buffers



The construction of this new detached garage prompted the re-grading of the driveway so that all of the runoff will stay onsite by infiltrating into landscaping.



This large tree was preserved in the design of the new driveway.

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume of runoff
- Reduced velocity of runoff
- Reduced impervious surface area



There are numerous vegetated islands where the runoff can drain to.



The driveway exits to McCormick Lane which has vegetation across the private street to capture and runoff that gets out of the driveway.

Municipal Contact:

Steve Tyler

Town of Atherton

styler@ci.atherton.ca.us

Vintage Oaks SF-2

Site Location:

Between Middlefield & Coleman
(North of Willow)
Menlo Park, CA

Stormwater Benefits:

- Reduced impervious surface area
- Reduced volume of flows
- Reduced velocity of flows

Features:

- Narrow streets
- Parking pullouts
- Sidewalk only on one side of the street



This subdivision was developed with skinny streets (22 ft) and bulb-out parking. Parking pullouts allow narrower streets that require less land area and provide more space for trees and grass. These landscaped areas reduce the volume and velocity of rainwater and maximize infiltration. Properties on narrow streets with tree-lined landscapes typically have higher property values. The use of narrow streets also reduces construction costs. There are also no sidewalks on the left side of the street.

Other Issues:

- When there is not adequate parking (or not convenient enough) people may use the street for parking (as seen above). This may cause a safety concern in terms of fire access for the area. This may be prevented using proper signage or educating the residents.

Municipal Contact:

Shaun Mao

City of Menlo Park

symao@menlopark.org

Mountain Wood Court SF-3

Site Location:

15 Mountain Wood Court
Hillsborough, CA

Stormwater Benefits:

- Reduced volume of flows
- Reduced velocity of flows

Features:

- Detention basin



This is a close-up view of the detention basin's manhole, which provides access for operations and maintenance (i.e., clean up and sediment removal).

This photograph is a picture of the detention basin being installed. The 3" diameter outlet, placed at the low end of the chamber, will control the flow volume and velocity.

Municipal Contact:

Jen Chen

Town of Hillsborough
(650) 375-7488

JChen@HILLSBOROUGH.NET

Lennox Residence SF-4

Site Location:

209 Lennox Avenue
Menlo Park, CA

Features:

- Vegetated swale
- Disconnected downspouts (not shown)

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume of runoff
- Reduced velocity of runoff
- Reduced directly-connected impervious area (DCIA)



A vegetative swale in the front lawn provides for infiltration of runoff. Rooftop runoff also drains to the swale through a bubbler box on the lawn.



The grassy swale can be incorporated with a walkway to provide aesthetically pleasing access to the residence.

Municipal Contact:

Shaun Mao
City of Menlo Park
symao@menlopark.org

17th Avenue SF-5

Site Location:

17th Avenue
Menlo Park, CA

Features:

- Gravel parking and driveways
- Landscaped turnabout islands



There are no sidewalks in this neighborhood and some residences do not have driveways and park their vehicles on the grass or gravel.



These cars are parked on gravel driveways that provide areas for runoff to infiltrate.

Stormwater Benefits:

- Reduced impervious surface area



Drive around circle has a landscaped island, providing an area for infiltration.



This residence has a gravel driveway up until the carport (under the overhang) where there is concrete.

Other Opportunities:

- To improve the site design from a stormwater quality perspective, the island could have been designed to accept runoff from the street through such features as concave landscaping with pavement protection, curb cuts, and grading the street to drain to the island.

Municipal Contact:

Shaun Mao

City of Menlo Park

symao@menlopark.org

Villareal Residence SF-6

Site Location:

130 Meadowood Drive
Portola Valley, CA

Features:

- Vegetated swales
- French drains (not shown)



Driveway runoff can drain into the vegetated swales reducing the volume and velocity of runoff.



Once the vegetation has grown in, runoff will have opportunity for sedimentation and filtration before draining into this storm drain.

Stormwater Benefits:

- Natural treatment of runoff
- Reduced impervious surface area
- Reduced volume of flows
- Reduced velocity of flows
- Reduced directly connected impervious area (DCIA)



This landscaped area provides an area for the residents to enjoy while also reducing the amount of impervious surface area.

Municipal Contact:

Leslie Lambert

Town of Portola Valley

llambert@portolavalley.net

Bonfiglio Residence SF-7

Site Location:

8 Redberry Ridge
Portola Valley, CA

Features:

- Vegetated swales
- French drains (not shown)



The driveway drains to vegetated swales where runoff can remove pollutants through sedimentation and infiltration.

Stormwater Benefits:

- Natural treatment of runoff
- Reduced impervious surface area
- Reduced volume of flows
- Reduced velocity of flows
- Reduced directly connected impervious area (DCIA)



This landscaped area provides an area for the residents to enjoy while also reducing the amount of impervious surface area.



The deck drains into landscaped areas, reducing the amount of pervious surfaces.

Municipal Contact:

Leslie Lambert

Town of Portola Valley

llambert@portolavalley.net

SECTION III

Multi-Family Residences

**Marie La Rocca Estates
MF-1**

Site Location:

1425 Kentfield Avenue
Redwood City, CA

Features:

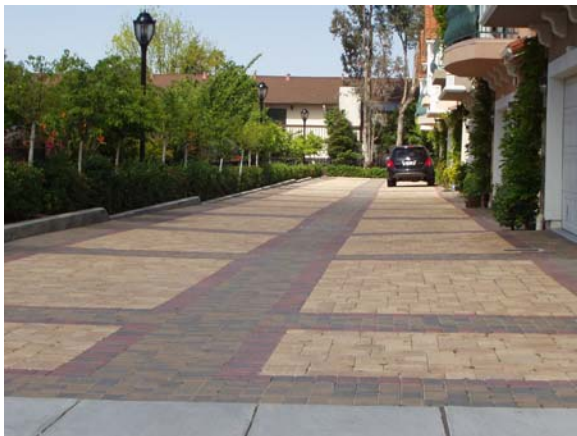
- Modular pavers
- Infiltrative landscaping
- Narrow shared driveway
- “Tucked under” parking reduces the building footprint

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume of runoff
- Reduced velocity of runoff
- Reduced impervious surface area



This is a close up of the pervious pavers with no grouting, so that water can infiltrate through the gaps.



Modular pavers in this private road were used to look aesthetically pleasing as well as function for infiltration purposes.



Multi-story buildings with tucked under parking and a shared driveway reduces the impervious surface area per unit by reducing the building footprint. More land would be required if the parking garages were separate, not underneath the living areas.



Infiltrative landscaping was placed along the side of road.



Landscaping provides areas for runoff to infiltrate into the subsurface, not only providing natural treatment, but also reducing the runoff volume and velocity.

Other Opportunities:

- To improve the site design from a stormwater quality perspective, runoff from the road/driveway could have been graded to the landscaping located along the side of the road and curb cuts added to allow drainage into the landscaping.

Municipal Contact:
Paul Willis
City of Redwood City
pwillis@redwoodcity.org

Meridian at the Crossing MF-2

Site Location:

1099 Admiral Court
San Bruno, CA

Features:

- High density apartments near BART and Caltrain station
- Multi-story buildings reduce the building footprint
- Vegetated swale



A vegetated swale has been constructed in this new development to reduce the volume and velocity of stormwater.

Stormwater Benefits:

- Reduced impervious surface area
- Reduced velocity and volume of runoff
- Transportation-related pollution reduction



The Meridian Apartments are located near BART and Caltrain, promoting the use of alternative transportation.

Municipal Contact:

Laura Russell
City of San Bruno
lrussell@ci.sanbruno.ca.us

Site Contact:

Meridian Luxury Apartments
(866) 88-MERIDIAN
<http://meridianatthecrossing.com/>

Cambridge Condominiums MF-3

Site Location:

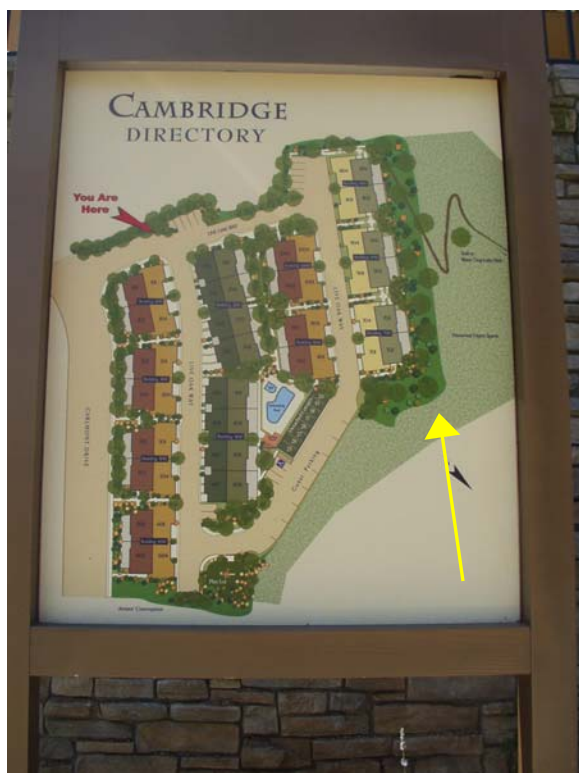
2440 Carlmont Drive
Belmont, CA

Features:

- Vegetated swales
- Multi-story housing reduce the building footprint
- Disconnected downspouts and concrete decks drain to landscaping
- Riparian buffer

Stormwater Benefits:

- Natural treatment of runoff
- Reduced velocity and volume of runoff
- Reduced directly-connected impervious area (DCIA)

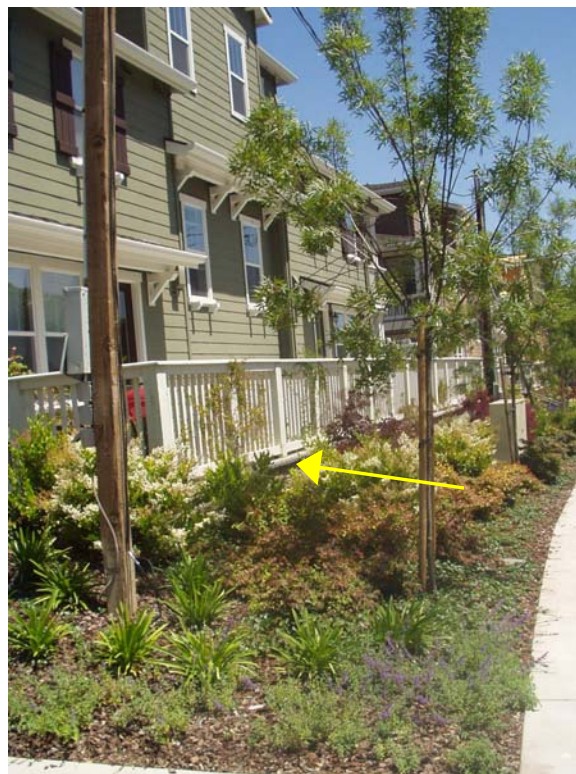


Multi-story housing reduces the building footprint and, thus, impervious surface area.

Open space areas are preserved and also provide a riparian buffer along the back of the complex for Belmont Creek.



This rain gutter drains into landscaping reducing the amount of directly-connected impervious area (DCIA).



Concrete surfaced decks drain directly to vegetated swales also reducing the amount of DCIA.

Municipal Contact:

Gilbert Yau

City of Belmont

gyau@ci.belmont.ca.us

Metropolitan Apartments MF-4

Site Location:

3rd Avenue and Eldorado
San Mateo, CA

Features:

- High density housing near San Mateo Caltrain station
- Located near downtown
- Underground parking
- Multi-story buildings reduce the building footprint
- Interior waste enclosures (not shown)

Stormwater Benefits:

- Reduced impervious surface area
- Transportation-related pollution reduction



The Metropolitan Apartments is located just a few blocks from pedestrian-oriented downtown, Central Park, and the Caltrain station, promoting the use of alternative transportation.



This is the entrance to the underground parking garage, which reduces the amount of impervious surface area required for the complex.

Municipal Contact:

Ken Pacini

City of San Mateo

kpacini@cityofsanmateo.org

**Lesley Gardens
MF-5**

Site Location:

701 Arnold Way
Half Moon Bay, CA

Features:

- Disconnected downspouts drain to landscaping
- Permeable walkways and courtyard

Stormwater Benefits:

- Natural treatment of runoff
- Reduced directly-connected impervious area (DCIA)
- Reduced impervious surface area



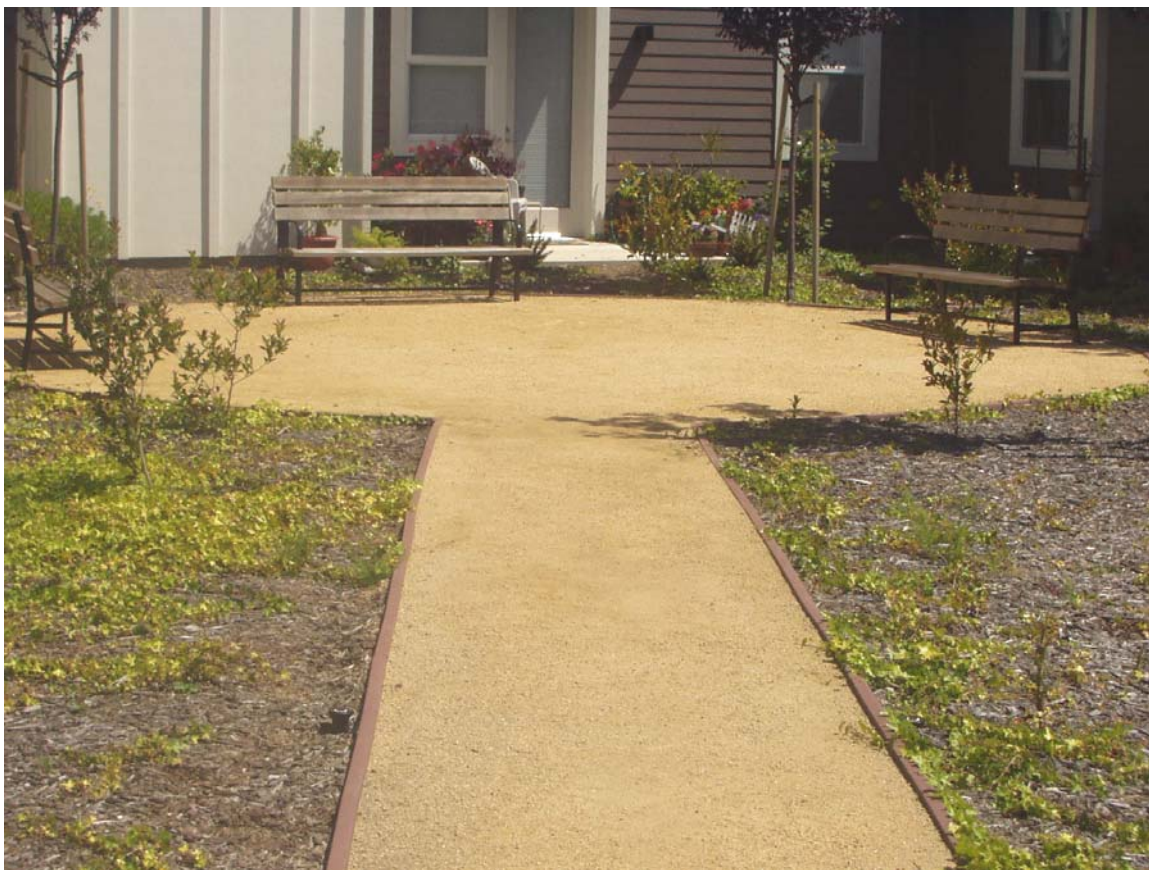
Rooftop runoff drains through downspouts to landscaping where it has the opportunity to be filtered by plant material and infiltrate into the soil. Disconnecting impervious surface area reduces the volume and velocity of stormwater runoff which can reduce erosion potential.



Multi-story housing reduces the building footprint and, thus, impervious surface area.



Sand walkways surrounded by grass reduce the amount of impervious surface area.



This courtyard with a sand surface provides an area for neighbors to enjoy the garden and providing an area for infiltration to occur.

Municipal Contact:
Sean Gallegos
City of Half Moon Bay
seang@hmbcity.com

SECTION IV

Mixed Use Residential/Commercial

**Edgeworth Mixed Use Project
MU-1**

Site Location:

1611-1629 Edgeworth Avenue
Daly City, CA

Features:

- High density (multi-story) housing with reduced building footprints integrated with commercial areas
- Located near mass transit including SamTrans station



Mixed use commercial businesses will be located in the bottom floor to encourage residents and neighbors to walk to shops and the SamTrans station (a few blocks away), thereby reducing the reliance on motor vehicles.

Note:

When the photograph was taken, the site was still under construction.

There were no residents or businesses yet.

Stormwater Benefits:

- Transportation-related pollution reduction
- Reduced impervious surface area



Multi-story housing reduces the building footprint and thus, impervious surface area.

Municipal Contact:

Ward Donnelly

City of Daly City

Water Quality

(650) 991-8208

WDonnelly@dalycity.org

SECTION V

Commercial

**Pacific Shores Center
CO-1**



Site Location:

1500 Seaport Boulevard
Redwood City, CA

Features:

- Multi-purpose detention basin and playing fields
- Three additional primary on-site detention basins
- Additional secondary detention basin before discharge into SF Bay
- Parking lot vegetated swales
- 3 miles of paved trails that are an extension of the Bay Trail

Stormwater Benefits:

- Reduced amount of impervious surface area
- Natural treatment of runoff
- Reduced volume and velocity of runoff
- Reduced directly-connected impervious area (DCIA)



Photograph taken by Wendy Edde (EOA, Inc.)

This athletic field also serves as a detention basin. The basin is designed to fill up to a two-foot depth and drain within two days from the 100-year storm.



Photograph taken from: <http://www.pacificshores.com/>

This photograph offers an aerial view of baseball fields which also serves as a detention basin.



Photograph taken from: <http://www.pacificshores.com/>

The multi-story buildings allow for vast landscaping that helps reduce the amount of runoff from the site.



Photograph taken from: <http://www.pacificshores.com/>

Aerial view of Pacific Shores Center shows an ideal area to enjoy the Bay Trail.



Photograph taken by Wendy Edde (EOA, Inc.)

Parking lot dividers are used as infiltration areas with vegetated swales and trees. Boulders are used to prevent automobile encroachment across the swale.



Photograph taken by Wendy Edde (EOA, Inc.)

The parking lot is graded to drain to these vegetated swales, planted with vegetation and trees. The swales were excavated and backfilled with imported sandy loam soil to increase porosity, and constructed with perforated sub-drains. The concrete strip protects the asphalt from water damage. This photograph was taken before the vegetation has been established.



Photograph courtesy of Bill Southard (DES, Architects and Engineers)

Cobbles along this extended detention basin run for several hundred feet.



Photograph courtesy of Bill Southard (DES, Architects and Engineers)

This photo shows the vegetated swale after the native vegetation has grown in.

Lessons Learned:

- Trees planted with only two (2) stakes for support in sandy loam soil within the vegetated swales blew over during a windstorm prior to root establishment. Using three (3) stakes per tree are now recommended.
- The personnel performing the maintenance on the storm drainage system must understand the workings of the system so that cleaning of debris at critical locations can be targeted prior to major storm events.

Site Contact:

Jay Paul Company
pacificshores@jaypaul.com
(415) 263-7400 V
(415) 362-0698 F

Landscape Designer Contact:
DES Architects and Engineers
(650) 364-6453

Civil Engineer Contact:
Pete Bohley
Bohley Consulting
(650) 358-1484
pete@bohleyconsulting.com

Gap Corporate Headquarters CO-2



Photograph courtesy of Paul Kephart (Rana Creek Habitat Restoration)

Aerial view of the building's roof garden shows the vegetative areas planted on top of the building made to appear like rolling hills.

Location:

901 Cherry Avenue
San Bruno, CA
Completed 1997
195,000 sq. ft.

Costs:

- Roof garden: approx. \$24/sq.ft. (\$1.6 million)²
- Total cost for building ~ \$60 million

Stormwater Benefits:

- Reduced impervious surface area
- Natural treatment of runoff
- Reduced volume and velocity of runoff

Features:

- 69,000 sq. ft. green roof blends in with surrounding hillside grasslands
- Native grasses and wildflowers
- Natural day lighting
- Raised floor for individually-controlled air delivery
- Preserved grove of native oaks
- 2nd most energy-efficient building in California (exceeds requirements by 30%)
- Received a Green Roofs Award of Excellence in 2003.

² Paul Kephart estimates that the costs for green roofs have dropped to roughly \$8-11 per square foot in the United States (pers. comm., November 12, 2003).

Project Details:

- It is estimated that the roof garden captures and stores about 70% of the rainfall. Other benefits include better insulation of the building, reducing the costs of heating and cooling, and mitigating the “heat island effect.”
- The roof irrigation system and annual mowing help mitigate fire risks. The roof is irrigated once per year and mowed by 10 gardeners armed with “weed eaters” in early July. The clippings are left on the roof to provide nutrients for the vegetation.
- The roof membrane has a 40-year warranty against leakage.
- GIS is used to map and manage the roof garden, allowing the building owner to index plants and locate utilities, such as water and electrical lines for maintenance purposes.
- The roof was planted using live plugs of six (6) different types of grasses (as opposed to hydroseeding or hand broadcasting) in six (6) inches of soil. The vegetation has grown to form a 5-inch mat of fibrous roots.

Lessons Learned:

- Gap estimates that the cost of the roof, HVAC, lighting, and other environmental features will be repaid in cost savings from reduced energy and maintenance bills within eight (8) years.
- The roof provides an effective acoustic barrier from the nearby San Francisco Airport.
- Cost-benefit study shows annual maintenance costs are about 70% of the costs for a conventional roof.

For more information, go to: <http://www.bayareacouncil.org/bp/bestpractices/bp185.html>

Living Roof Design Specialist:

Paul Kephart
Rana Creek Restoration
(831) 659-3820
www.ranacreek.com

Gap Inc. Corporate Architecture Department

901 Cherry Avenue
San Bruno, CA 94066

Architect:

William McDonough & Partners
410 East Water St.
Charlottesville, VA 22902
www.mcdonoughpartners.com

Architect of Record/Interior Design:
**Gensler Architecture, Design & Planning
Worldwide**

600 California Street
San Francisco, CA 94108

Landscape Architect:
Hargreaves Associates

Mechanical, Electrical and Structural Engineers:

Ove Arup and Partners USA
901 Market Street, Suite 260
San Francisco, CA 94103
Client and Project Manager:

**Sea Crest Private School
CO-3**

Site Location:

901 Arnold Way
Half Moon Bay, CA

Features:

- Vegetated swale
- Detention pond
- Stream erosion control

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume and velocity of runoff
- Reduced impervious surface area
- Reduced erosion impacts



This vegetated swale treats runoff naturally, removing pollutants from runoff.



These trees were preserved during the construction process and serve as a buffer and part of the riparian corridor to help avoid stream erosion impacts from the school.



Soccer field also serves as a detention basin, where the vegetation can treat stormwater runoff through sedimentation.



The basketball court blacktop drains to the soccer field which also serves as a detention basin.

Municipal Contact:
Sean Gallegos
City of Half Moon Bay
seang@hmbcity.com

**IKEA
CO-4**

Site Location:

1700 East Bayshore
East Palo Alto, CA

Features:

- Vegetated buffer strip
- Multi-story building and parking garages reduce building footprint

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume of runoff
- Reduced velocity of runoff
- Reduced directly-connected impervious area (DCIA)



A vegetative buffer strip surrounds the parking structure and IKEA building, reducing the volume of runoff during storms.



Rooftop planters line the exterior wall on both the second and third floor parking areas reducing the amount of impervious surface area.

Municipal Contact:

Lucy Chen

City of East Palo Alto

lchen@cityofepa.org

Woodside Town Center CO-5

This site includes a combination of town government and commercial business use.

Site Location:

2961 Woodside Road
Woodside, CA

Features:

- Vegetated swale
- Revegetation buffer
- Stream corridor setbacks



The parking lot runoff drains into this vegetated swale.



Disconnected downspouts drain toward vegetated areas in parking lot.

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume and velocity of runoff
- Reduced directly-connected impervious area (DCIA)



The revegetation buffer allows for natural treatment of parking lot runoff, reducing the volume and velocity of water before entering the creek and also provides a setback area to protect the creek from development encroachment.

Municipal Contact:

Gratien Etchebehere
Town of Woodside

getchebehere@woodsidetown.org

Bay Area Self Storage CO-6

Site Location:

338 Manzanita
Redwood City, CA

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume and velocity of runoff

Features:

- Vegetated buffer strip



The front entrance of the self storage is a vegetated buffer strip which provides a drainage area for runoff.



Stormwater runoff drains through this buffer strip, reducing the volume and velocity before reaching the street.

Municipal Contact:

Paul Willis

City of Redwood City

pwillis@redwoodcity.org

**J & J Hawaiian BBQ
CO-7**

Site Location:

1170 Alma Street
Menlo Park, CA

Features:

- Roof and surface water drain to in-site landscaping
- Curb cuts into swales in parking lot

Note:

- This small shopping center was rebuilt due to a fire a couple of years back, this allowed for them to redesign the parking lot with vegetation to drain to on-site landscaping and have on-site infiltration.

Stormwater Benefits:

- Reduced impervious surface area
- Reduce volume and velocity of runoff



The parking lot drains through curb cuts to vegetated areas like this one.



Rooftops drain down rain gutters to parking lot where runoff flows into vegetated areas.



This is a close-up photo of curb cuts.

Lessons Learned:

- The curb cuts are too small to allow adequate runoff flows during storms and can easily be blocked with leaves and other debris. Curb cuts should be designed to be at least six (6) inches for adequate drainage.

Municipal Contact:
Shaun Mao
City of Menlo Park
symao@menlopark.org

**Douglas
CO-8**

Site Location:

888 Portola Road
Portola Valley, CA

Features:

- Vegetated swales
- French drains

Stormwater Benefits:

- Natural treatment of runoff
- Reduced impervious surface area
- Reduced volume and velocity of flows
- Reduced directly connected impervious area (DCIA)



Rooftop runoff is directed into the French drain, which runs beneath the vegetated area, disconnecting the directly connected impervious area.



This vegetated area reduces the amount of impervious area.



Driveway runoff can drain into the vegetated swale, reducing the amount of runoff generated at the site.

Municipal Contact:

Leslie Lambert

Town of Portola Valley

llambert@portolavalley.net

Ocean View Driving Range CO-9

Site Location:

227 Kelly Avenue
Half Moon Bay, CA

Features:

- Vegetated swale
- Detention pond
- Stream erosion control
- Gravel driveway and parking area

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume and velocity of runoff
- Reduced impervious surface area



Gravel driveway and parking areas allows infiltration to occur during the rainy season.



This swale collects runoff from the parking area and naturally treats the water before entering the storm drain under the bridge.



In order to protect customers from tripping in the concave area of the swale, bridges were built over the storm drains.



Driving range also serves as a detention basin to reduce the volume and velocity of runoff.



Another view of the detention basin/driving range, which can detain and treat a large volume of water.



Parking lot drains to vegetated areas, reducing the amount of runoff from the parking lot.

Municipal Contact:
Sean Gallegos
City of Half Moon Bay
seang@hmbcity.com

**Brisbane Technology Park
CO-10**

Site Location:

3200-3280 Bayshore Blvd.
Brisbane, CA

Features:

- Vegetated swale

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume of runoff
- Reduced velocity of runoff



This walkway drains into vegetated areas, reducing the volume and velocity of runoff.



The vegetated swale serves as a buffer between the parking lot and the roadway above.

Municipal Contact:

Matt Fabry
City of Brisbane
mfabry@ci.brisbane.ca.us

Wilson Plaza CO-11

Site Location:

1 Rollins Road
Millbrae, CA

Features:

- Parking lot drains to landscaped area



In the high-traffic areas of the parking lot, curbs with curb cuts are inserted to protect the cars from accidentally entering the landscaping while allowing infiltration to occur.

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume and velocity of runoff



The parking lot is flush with the landscaped area to allow the runoff to drain directly into the swale.



Stormwater runoff drains into this landscaped area, which reduces the volume and velocity of runoff entering the storm drain.

Municipal Contact:

Khee Lim
City of Millbrae
klim@ci.millbrae.ca.us

**Quality Suites Hotel
CO-12**

Site Location:

250 El Camino Real
Millbrae, CA

Stormwater Benefits:

- Reduced impervious surface area

Features:

- Porous pavement



This is a close-up photograph of the modular pavers used without grouting, allowing infiltration to occur.

The loading driveway for this hotel has permeable pavement which reduces the amount of impervious surface area.

Municipal Contact:

Khee Lim

City of Millbrae

klim@ci.millbrae.ca.us

SECTION VI

Public Areas

Shoreline Parks PA-1

Site Location:

San Mateo Shoreline
along J Hart Clinton Drive
San Mateo, CA

Features:

- Vegetated swales
- Constructed wetland
- Detention basin



Wetland vegetation helps to remove dissolved metals and nutrients. This pond shows that a stormwater treatment measure can benefit the environment and be aesthetically pleasing.

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume of runoff
- Reduced velocity of runoff
- Reduced impervious surface area



The City created these wetlands in order to mitigate wetlands that were removed during the construction process of the landfill under the park.



The water feature serves a dual purpose not only as a wetland, but also as a detention pond which drains through this outlet.



The site has completed construction, however the vegetated swale has not been properly watered yet to maintain healthy vegetation that can treat the stormwater runoff.



Since the site is a former landfill site, the swale is gradually sloped to capture all of the runoff to prevent seepage into the landfill underneath.

Municipal Contact:

Ken Pacini

City of San Mateo

kpacini@cityofsanmateo.org

Waste Water Treatment Plant PA-2

Site Location:

700 Coast Highway
Pacifica, CA

Features:

- Green roof – laboratory underground
- Multi-story buildings reduce building footprint

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume and velocity of runoff
- Reduced impervious surface area



Photograph taken by Wendy Edde (EOA, Inc.)

The laboratory facilities at this wastewater treatment plant are underground, covered by a landscaped hill. This picture was taken during construction and the roof garden is now fully grown, providing not only aesthetic benefits, but also a large area for stormwater infiltration to occur.

Municipal Contact:

Elizabeth Claycomb

City of Pacifica

claycombe@ci.pacifica.ca.us

Cypress Lawn Cemetery PA-3

Site Location:

1701 Hillside Blvd
Colma, CA

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume and velocity of runoff
- Reduced impervious surface area

Features:

- Detention basin
- Vegetative swales (not shown)



Photograph courtesy of Meliza Cruz (Town of Colma)

The purpose of these detention ponds is to allow the stormwater to travel through landscaped areas for treatment and to maximize infiltration to groundwater. The stormwater is then detained in the ponds and slowly released into the Town's storm drain system. During the rainy season, detention ponds are kept at half capacity in order to accommodate larger amounts of rainwater.

Municipal Contact:

Muneer Ahmed

Town of Colma

Muneer.ahmed@colma.ca.gov

**Pacifica State Beach
PA-4**

Site Location:

Pacific Coast Highway (Hwy 1)
between Linda Mar and Crespi
Pacifica, CA

Features:

- Vegetated swales
- 45,000 square feet of wetlands

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume of runoff
- Reduced velocity of runoff
- Reduced impervious surface area



This roadside swale collects and treats water from the parking lot and overflow drainage from Highway 1.



Curb cuts allow runoff water to drain toward rock cobbles, then into the vegetated areas. The cobbles help prevent the runoff from eroding the soil and vegetation where the water runs from the parking lot into the swale.



The vegetated swale runs along the stretch of Highway 1, reducing the impervious surface area.



This parking lot drains directly to the wetlands, where the runoff is treated naturally.



The wetland captures water from this walkway through curb cuts.



This is a close up shot of the curb cut where water drains to the wetlands. Wetland vegetation helps remove pollutants from runoff.

Municipal Contact:
Elizabeth Claycomb
City of Pacifica
claycombe@ci.pacifica.ca.us

Peninsula Temple Shalom PA-5

Site Location:

1655 Sebastian Drive
Burlingame, CA

Features:

- Vegetated swale
- Pervious walkways

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume and velocity of runoff



This walkway is constructed of sand, which promotes infiltration.



The new classroom wing construction created the opportunity for the construction of the vegetated swale.



Grassy swale drains toward storm drain after treating runoff.

Municipal Contact:

Kiley Kinnon

City of Burlingame

kiley.kinnon@veoliawaturna.com

South County Fire Station 14 PA-6

Site Location:

911 Granada
Belmont, CA

Features:

- Vegetated swales
- Disconnected downspouts drain to landscaping

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume and velocity of runoff
- Reduced directly-connected impervious area (DCIA)



This fire station was reconstructed allowing for the site to be regraded and stormwater landscaping features to be added.



The parking lot drains through curb cuts into vegetated areas.



The vegetated swale surrounds the fire station, reducing the volume and velocity of runoff, while naturally treating the water.



The reconstruction of the fire station included ample landscaping onsite for rooftop drainage and aesthetics.



Rooftop runoff drains to landscaping, breaking up directly-connected impervious area (DCIA).

Municipal Contact:
Gilbert Yau
City of Belmont
gyau@ci.belmont.ca.us

Hillside Historical Park and Community Center PA-7

Site Location:

1520 Hillside Blvd.
Colma, CA

Features:

- Vegetative buffer strip
- Permeable surfaces
- Bike racks promote bicycle commuting



The concrete walkways drain toward this vegetated buffer strip which provides natural treatment of runoff.



Bike racks encourage visitors to bike to the community center, promoting alternative transportation.

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume and velocity of runoff
- Reduced impervious surface area
- Transportation-related pollutant reduction



The vegetated buffer strip drains toward the storm drain after treating runoff.



This area preserving the historic buildings is surrounded by sand surfaces, which promotes infiltration.

Municipal Contact:
Muneer Ahmed
Town of Colma
Muneer.ahmed@colma.ca.gov

**Millbrae BART Station
PA-8**

Site Location:

Millbrae Ave. at Rollins Road
Millbrae, CA

Features:

- Vegetated swales

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume and velocity of runoff
- Reduced directly-connected impervious area (DCIA)



At the completion of the project, observers take note of the swale.



This parking lot has curb cuts in order for the water to drain from the parking lot into the vegetative swale.



The parking lot is graded above the swale in order for the water to flow into the vegetated areas.



Multiple curb-cuts allow water to enter the swale at many points from the parking lot.



This picture provides a closer look at the curb cut and the storm drain inlet in the swale.

Municipal Contact:
Khee Lim
City of Millbrae
klim@ci.millbrae.ca.us

**St. Pius Facilities
PA-9**

Site Location:

1100 Woodside Road
Redwood City, CA

Features:

- Vegetated swale

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume of runoff
- Reduced velocity of runoff



The cobbles were placed at the end of the swale to prevent the vegetation from blocking the storm drain inlet.



The new multi-purpose room at St. Pius construction prompted to the construction of the vegetated swale.



Swale runs between parking lot and large grass field. The runoff drains to the sloped area of the swale.

Municipal Contact:

Paul Willis

City of Redwood City

pwillis@redwoodcity.org

**Alma Street Walkway
PA-10**

Site Location:

Alma Street between Ravenswood
and San Francisquito Creek
Menlo Park, CA

Features:

- Decomposed granite walkway
- Pedestrian and bike access trail to creek



Walkway is nicely sheltered with trees, which reduce the velocity of stormwater runoff.

Stormwater Benefits:

- Reduced impervious surface area



The walkway is made up of decomposed granite which allows runoff to infiltrate into the soil.



There is a path at the end of the walkway, which provides pedestrians access to a creek trail system.

Municipal Contact:

Shaun Mao

City of Menlo Park

symao@menlopark.org

Public Works Maintenance Yard PA-11

Site Location:

550 North Canal
Public Works Maintenance Yard
South San Francisco, CA

Stormwater Benefits:

- Washwater treatment through sanitary sewer
- Reduced pollutants

Features:

- Area dedicated as a covered wash area plumbed to the sanitary sewer.



Municipal maintenance activities are conducted to maximize removal of pollutants such as street sweeping and using good practices and controls during maintenance activities to minimize discharges, such as using this wash rack at the South San Francisco Corporation Yard.

Municipal Contact:

Cassie Prudhel

City of South San Francisco

Cassie.prudhel@ssf.net

**San Carlos Caltrain Station
PA-12**

Site Location:

El Camino Real and Holly
San Carlos, CA

Features:

- Drains to vegetation

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume and velocity of runoff
- Reduced directly-connected impervious area (DCIA)



Landscaped area captures the runoff from the boarding area.



Some of the water that goes into this drain outlets into landscaping.



Runoff from the boarding area drains to landscaped areas.

Municipal Contact:

Gavin Moynahan

City of San Carlos

gmoynahan@cityofsancarlos.org

Riparian Restoration PA-13

Site Location:

Pacifica, CA

Features:

- Riparian Restoration
- Native vegetation

Stormwater Benefits:

- Reduced impervious surface area
- Riparian buffer
- Open space benefits



Photograph taken by Wendy Edde (EOA, Inc.)

The riparian drainage in this valley was, over the years, manually shifted from one side of the valley to the other. This project returned the riparian drainage to its ‘natural’ location and replanted riparian vegetation. Rather than an underground pipe and a completely encroached-upon waterway, this creek will become an amenity to the site.

Municipal Contact:

Elizabeth Claycomb

City of Pacifica

claycombe@ci.pacifica.ca.us

Brisbane City Hall Rain Garden PA-14

Site Location:

50 Park Place
Brisbane, CA

Features:

- Rain garden/bioretention area in parking lot treats roof and parking lot runoff
- Vegetated swale along Valley Drive treats roof and parking lot runoff
- Drought-tolerant plantings in the rain garden/bioretention area

Stormwater Benefits:

- Naturally treats stormwater runoff to remove pollutant
- Reduces the rate and volume of stormwater flows
- Reduced amount of impervious surface directly connected to the storm drain system.



Photograph courtesy of Matt Fabry, City of Brisbane

The underdrain system beneath the rain garden carries treated stormwater runoff to the Brisbane Lagoon and out to the Bay.



Photograph courtesy of Matt Fabry, City of Brisbane

The rain garden, or bioretention area, in the parking lot is an engineered system for treating stormwater runoff. It collects stormwater runoff from the parking lot and building roof. Runoff is treated as it filters through the specially-selected vegetation and soaks into the ground.



Photograph courtesy of Matt Fabry, City of Brisbane

Water ponds in the rain garden when it rains, then slowly infiltrates into the underlying soils. During heavy rain, excess water may spill over into the storm drain to prevent flooding.



Photograph courtesy of Matt Fabry, City of Brisbane

A vegetated swale is located on the opposite side of City Hall along Valley Drive. In this system, parking lot and roof runoff is treated as it gradually flows along the length of the swale, being filtered by the grass and soaking into the ground before reaching the City's storm drain system and flowing to Brisbane Lagoon and out into the Bay. These treatment systems help keep pollutants from our cars out of the Bay.

Lessons Learned:

- The notched curb openings, cut into the face of the curb to allow water to drain to the rain garden, may clog with leaves and debris during storms and require more maintenance than other, larger types of curb openings.
- Downspouts from the roof near the swale outlet should have been routed further "upstream" in the swale to allow water to be retained in the swale longer.

Municipal Contact:
Matthew Fabry
City of Brisbane
mfabry@ci.brisbane.ca.us

Post Office Paseo Stormwater Demonstration Site PA-15

Site Location:

855 Jefferson Avenue
Redwood City, CA

Features:

- Bioretention area
- Underground detention basin
- Vegetated swales
- Disconnected downspouts
- Demonstration site for stormwater runoff best management practices

Stormwater Benefits:

- Roof runoff is captured in the vegetated swale on the west side of the Post Office building where pollutants are naturally removed by the ryegrass.
- On the east side of the building, roof runoff and sheets of rainwater from the concrete patio are captured in the drain trench, which flows into the bioretention area.
- After it is naturally treated to remove pollutants, large amounts of water can be stored in the underground detention basin beneath the bioretention area and slowly released into the stormwater system.



All photographs of Post Office Paseo courtesy of Claudia Olalla, City of Redwood City

This is the site (looking north) before any work. The Post Office building is on the left side of the image. The City of Redwood City and the federal authorities came to an agreement regarding the use and maintenance of the land.



This image shows the site (looking north) approximately 2 years after construction. The bioretention area is in the center of the photo.



Photo shows the graphics placed in the informational podium near the bioretention area located on the east side of the site as part of the demonstration aspect of the project.





The detention basin was included in the project to show residents a way to capture stormwater on smaller sites without the space for a swale. Information at the podium explains that you can build such a device underground and cover it with gravel or crushed stone leaving the surface available for parking or other non-structural uses. On this site, a bioretention area was built above the detention basin to receive the treated water before entering the storm drain system.



Another informational podium was placed on the west side of the site near the vegetated swale. The podium was placed along the walkway by the 10-minute parking area (which serves the Post Office) to the Post Office front door. It is viewed by hundreds of residents every week.



This image shows the bioretention area installed. There were several trees on the site that were incorporated into the design of the project. Due to large roots from the redwood tree, the design was altered. The bioretention area became smaller than originally intended. In the original design, part of the walkway acted as a bridge over the bioretention area.

Lessons Learned:

- Originally the design called for “eco-pavers” in the Post Office parking area (10-minute parking). The water table was too high for the pavers to work properly as a permeable alternative to concrete.
- Ryegrass goes through short “browning” phase during the year. It comes back quite beautifully and is a low maintenance alternative to lawn if you like “long hair.”
- Having a landscape team that is open to experimenting and trying out new plants is a benefit that Redwood City appreciates.

Site Contact:

John Fraher

Pacific Facilities Service
United States Post Office
395 Oyster Point Blvd., Suite 225
South San Francisco, CA 94080-0300

Municipal Contact:

Claudia Olalla, ASLA

City of Redwood City
colalla@redwoodcity.org
650-780-7294

**Serramonte Library / Gellert Park Parking Lot
Green Streets Demonstration Project
PA-16**

Site Location:

40 Wembley Drive, Daly City, CA

Features:

- Bioretention rain gardens
- Pervious pavement
- Demonstration site for stormwater runoff best management practices

Stormwater Benefits:

- Stormwater runoff from the parking lot is diverted to four bioretention rain gardens for treatment.
- Underdrains collect treated stormwater and convey it to the stormdrain system. Overflow drains convey untreated water to adjacent rain gardens.
- Pervious pavement filters stormwater before it drains to the stormdrain system.



All photographs of Serramonte Library courtesy of Jeannie Naughton, City of Daly City

Bioretention rain gardens at the front of the library treat stormwater runoff from the adjacent parking lot. An overflow collects untreated runoff and directs it to other rain gardens for treatment.



The rain gardens are constructed with 12-18 inches of soil media, two inches of mulch and are landscaped with native plants.



Photos show the graphics placed near the bioretention areas as part of the demonstration aspect of the project.





Educational gathering areas feature pervious sand and invite public visitation.





Pervious pavement constructed in the parking area in front of the library main entrance as an example of a hard surface suitable for pedestrian and/or vehicle traffic while still allowing stormwater to infiltrate. The pavement is made of porous paverstones underlain by sand bedding, drain rock drainage diaphragm and a subdrain that conveys the filtered water to the stormdrain system.

Municipal Contact:
Jeannie Naughton
City of Daly City
jnaughton@dalycity.org
650-991-8035

Belle Air/Third Avenue Street Creek PA-17

Site Location:

450 Third Avenue
San Bruno, CA

Features:

- A 600 square foot curb extension was constructed on the west side of 3rd Avenue, between entrances to two parking lots, in the vicinity of Belle Air Elementary School. Project design helps calm traffic from school drop-offs/pick-ups, reduce on-street ponding, and remove pollutants. Stormwater enters the curb extension via curb cuts and is detained and filtered by drought tolerant vegetation and soils.

Stormwater Benefits:

- Naturally treats stormwater runoff to remove pollutant
- Reduces the rate and volume of stormwater flows
- Reduced amount of impervious surface directly connected to the storm drain system.



All photographs of Belle Air / Third Ave. Street Creek courtesy of Jim Shannon, City of San Bruno

Earthmovers dig out concrete where new curb extension and swale will be located.



Curb extension begins to take shape.



City crews fill the curb extension with specially selected soils that help rainwater to infiltrate into the ground, and with plants that are chosen for their ability to withstand both long periods without rain and short bouts of flooding.



Curb cut allows water to flow from the street and surrounding parking lot into the completed “street creek,” or drainage swale, where plants and soil filter the runoff while it infiltrates into the ground.

Lessons Learned:

- Pea gravel makes good mulch and helped to reduce the size of the street creek basin. The first few rains after construction resulted in 1) wood mulch floating away, and 2) rainwater not percolating through the soil fast enough, leaving standing water in the basin long after rain events. Adding a layer of pea gravel on top kept the wood mulch beneath from floating away and functionally reduced the amount of water the basin would retain, to help avoid problems with standing water.

Municipal Contact:
Laura Russell
City of San Bruno
russell@sanbruno.ca.gov

**Portola Valley Town Center
PA-18**

Site Location:

765 Portola Road, Portola Valley
Portola Valley, CA

Features:

- Parking lot runoff drains to vegetated swales and landscaped traffic circle
- Roof runoff drains to landscaped areas
- Native and drought tolerant plantings and preservation of mature trees
- Daylighted segment of Sausal Creek
- Decomposed granite used for pervious walkways
- Paved areas reduced by 20 percent, compared to former school use at this site
- LEED certification as a green building, including various energy- and water-saving features such as dual flush toilets and using recycled materials in construction.

Stormwater Benefits:

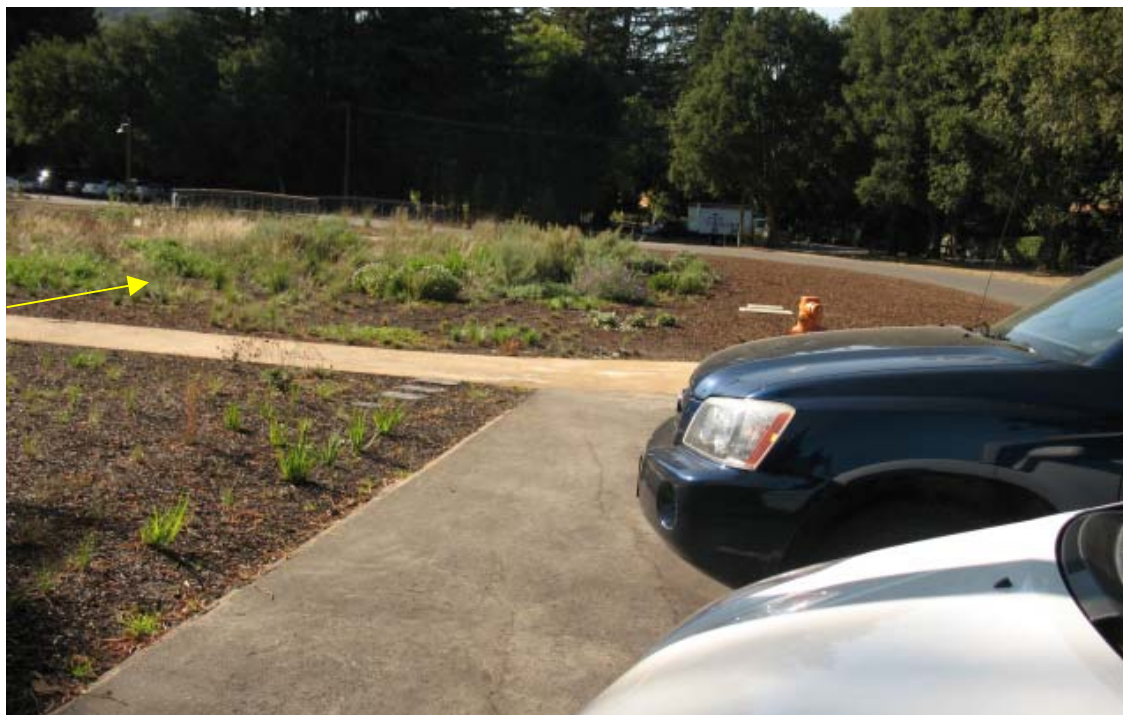
- Naturally treats stormwater runoff to remove pollutants
- Reduces the rate and volume of stormwater flows
- Reduced amount of impervious surface directly connected to the storm drain system.
- Restoration of natural riparian habitat



Town Center includes a library (pictured here), Town Hall, and Community Hall. A formerly culverted segment of Sausal Creek was restored; riparian habitat is visible at right.



The daylighted segment of Sausal Creek is shown here, passing under a pedestrian bridge that connects Town Center to an adjacent park.



This parking lot was designed without curbs to allow stormwater runoff to drain to a vegetated swale (indicated with arrow).



This view of the same vegetated swale shows a section of walkway paved with decomposed granite, which allows some infiltration to underlying soils.



Openings between wood curbs allows stormwater runoff to drain into the landscaped traffic island. Mature trees along this parking lot were preserved.



Stormwater runoff from the roof of the Community Hall drains to an area of decorative drain rock. Drought tolerant plantings were used in adjacent landscaped area.

Municipal Contact:
Leslie Lambert
Town of Portola Valley
llambert@portolavalley.net

SECTION VII

Indexes

INDEX

LID Examples by Best Management Practice

	Better Site Design Techniques	Alternative Transportation - Bicycling	Alternative Transportation - Pedestrian	Alternative Transportation - Public	Bioretention Area / Rain Garden	Clearly Marked Storm Drain Inlets	Detention Basin	Disconnected Downspouts	Interior Waste Enclosures	Narrow Streets	Native Plants	Open Space Areas	Permeable Pavement	Reduced Building Footprint (Multi-story Buildings)	Riparian Protection	Rooftop Landscaping/Green Roof	Shared Driveway	Tuck Under Parking	Underground Parking	Vegetated Buffer Strip	Vegetative Swale/Biofilter	Other (Describe)
SAS Pg. #*	31	31	31			93, 142, 143	67				18, 41	47, 100	98		70	64, 88-89	30, 84-85			70, 139		Other Description
	PA-1	MF-4	MF-2	PA-14	PA-1	CO-1	CO-8	MF-4	SF-2	PA-13	CO-1	CO-9	CO-9	CO-8	CO-2	MF-1	MF-1	MF-4	CO-4	CO-1	PA-11	Covered Car Wash
	PA-7	PA-10	MF-4	PA-15	PA-4	CO-3	MF-3			PA-14	PA-13	CO-12	MF-2	MF-3	PA-2				CO-6	CO-3	PA-15	Stormwater Demonstration Site
			MU-1	PA-16		CO-9	MF-5			PA-15		MF-1	MF-3	MF-5					PA-7	CO-5	PA-16	Stormwater Demonstration Site
						PA-1	PA-6			PA-16		MF-5	MF-4	PA-6					SF-1	CO-8		
						PA-3	PA-15			PA-17		PA-5	MU-1	PA-18						CO-9		
						SF-3	PA-18			PA-18		PA-7	PA-13							CO-10		
												PA-10								MF-3		
												SF-5								PA-1		
												PA-16								PA-4		
												PA-18								PA-5		
																				PA-9		
																				SF-4		
																				SF-6		
																				SF-7		
																				PA-14		
																				PA-15		
																				PA-17		
																				PA-18		

*SAS refers to Start At the Source (BASMAA 1999)

LID Examples by Municipality

- A. Town of Atherton
 - SF-1:** McCormick Residence
- B. City of Belmont
 - MF-3:** Cambridge Condominiums
 - PA-6:** South County Fire Station 14
- C. City of Brisbane
 - CO-10:** Brisbane Technology Park
 - PA-14:** Brisbane City Hall Rain Garden
- D. City of Burlingame
 - PA-5:** Peninsula Temple Shalom
- E. Town of Colma
 - PA-3:** Cypress Lawn Cemetery
 - PA-7:** Hillside Historical Park and Community Center
- F. City of Daly City
 - MU-1:** Edgeworth Mixed Use Project
 - PA-16:** Serramonte Library / Gellert Park Parking Lot
- G. City of East Palo Alto
 - CO-4:** IKEA
- H. City of Half Moon Bay
 - CO-3:** Sea Crest Private School
 - CO-9:** Ocean View Driving Range
 - MF-5:** Lesley Gardens
- I. Town of Hillsborough
 - SF-3:** Mountain Wood Court
- J. City of Menlo Park
 - CO-7:** J&J Hawaiian BBQ
 - PA-10:** Alma Street Walkway
 - SF-2:** Vintage Oaks
 - SF-4:** Lennox Residence
 - SF-5:** 17th Avenue
- K. City of Millbrae
 - PA-8:** Millbrae BART Station
 - CO-11:** Wilson Plaza
 - CO-12:** Quality Suites Hotel
- L. City of Pacifica
 - PA-2:** Waste Water Treatment Plant
 - PA-4:** Pacifica State Beach
 - PA-13:** Riparian Restoration

- M. Town of Portola Valley
 - CO-8:** Douglas
 - SF-6:** Villareal
 - SF-7:** Bonfiglio
 - PA-18:** Portola Valley Town Center
- N. City of Redwood City
 - CO-1:** Pacific Shores Center
 - CO-6:** Bay Area Self Storage
 - MF-1:** Marie La Rocca Estates
 - PA-9:** St. Pius Facilities
 - PA-15:** Redwood City Post Office Paseo
- O. City of San Bruno
 - CO-2:** Gap Headquarters
 - MF-2:** Meridian at the Crossing
 - PA-17:** Belle Air / Third Avenue Street Creek
- P. City of San Carlos
 - PA-12:** San Carlos Caltrain Station
- Q. City of San Mateo
 - MF-4:** Metropolitan Apartments
 - PA-1:** San Mateo Shoreline
- R. City of South San Francisco
 - PA-11:** Public Works Maintenance Yard
- S. Town of Woodside
 - CO-5:** Woodside Town Center