

Protecting Water Quality in Development Projects

A Guidebook of Post-Construction BMP Examples



Alameda Countywide
Clean Water Program
A Consortium of Local Agencies

August 2005



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Prepared by:
EOA, Inc.

August 2005



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CREDITS

This document was prepared by the Alameda Countywide Clean Water Program (ACCWP) for use by ACCWP municipalities, other local agencies, and the land development community. ACCWP expresses its appreciation to all those who contributed to this document.

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.

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ACCWP gratefully acknowledges the Santa Clara Valley Urban Runoff Pollution Prevention Program, whose document, *Developments Protecting Water Quality: A Guidebook of Site Design Examples*, served as the inspiration and model for this guidebook.

EOA, Inc., as the NPDES permit compliance consultant to ACCWP, compiled all the project information, provided project descriptions and photographs of BMPs where needed, and coordinated the overall preparation of this document.

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Acronyms and Abbreviations

AC Transit	Alameda-Contra Costa Transit District
ADA	Americans with Disabilities Act
ACCWP	Alameda Countywide Clean Water Program
BART	Bay Area Rapid Transit
BASMAA	Bay Area Stormwater Management Agencies Association
CO	Commercial
DCIA	Directly Connected Impervious Area
MF	Multi-Family Residences
MU	Mixed Use Residential/Commercial
NPDES	National Pollutant Discharge Elimination System
PA	Public Areas
SF	Single Family Residences
Water Board	San Francisco Bay Regional Water Quality Control Board



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Post-Construction BMP Examples

SECTION I

Introduction

BACKGROUND

In February 2003, the San Francisco Bay Regional Water Quality Control Board (Water Board) adopted Order R2-2003-0021 reissuing the Alameda Countywide Clean Water Program's (ACCWP's) NPDES municipal stormwater Permit to include new requirements (New and Redevelopment Requirements) in Provision C.3. For more information on permit requirements, see the ACCWP C.3. *Stormwater Handbook*.

This Guidebook has been created as part of the effort to encourage the use of site design measures that benefit water quality in project designs. 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 site design elements in the Alameda County.

SITE PLANNING CONCEPTS

Site design measures integrate basic stormwater management and hydrologic concepts into site planning to create developments that mitigate their impact on stormwater quality. 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, and using design techniques to minimize impervious surface area and infiltrate runoff. 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)

Fire department requirements for minimum street widths and cul-de-sac radii can conflict with better site design goals. In addition, street and parking areas need to be designed to withstand the impacts of heavy load vehicles (e.g., fire, garbage and delivery trucks). For

these reasons, the fire department should be included in the development of design standards 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 areas exceed the usual parking demand. (BASMAA, 1999) In order to provide adequate but not excessive parking supply, site design features such as overflow parking and landscaped reserve areas can be used. Also, curb cuts allowing drainage into swales and landscaping, trees, and permeable pavement materials can be installed in order to reduce and treat parking lot runoff.

Use Drainage as a Design Element

Landscaping combined with site engineering (grading and drainage) can improve stormwater quality. Runoff draining to landscaping can be filtered by biota and infiltrated into the soil. Site design features that can be included are areas that drain to a detention basin; streets and parking lots draining to vegetated and rocky swales, biofilters (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.

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 automobile trips. 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 Program’s website www.basmaa.org). Of substantial benefit to project proponents, using site design techniques to help meet the requirements of Provision C.3. can also result in fewer or

smaller-sized treatment controls required and a corresponding savings in the operation and maintenance costs over the life of the project. Additional information regarding stormwater quality-friendly site designs is available on the ACCWP's website (www.cleanwater.org) and in the ACCWP's *C.3. Stormwater Handbook*.

CONTENTS OF MANUAL

This document provides examples of local site design measures that control storm water 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, cost information 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 Alameda Countywide Clean Water Program's Guidebook of Post-Construction BMP Examples.

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

Section III focuses on 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 focuses on mixed-use developments, generally high density residential units combined with commercial businesses.

Section V focuses on commercial and industrial developments. This section is divided into campus/industrial parks and other areas. Generally campus/industrial parks are on large sites dedicated for one or more businesses and include common areas that provide opportunities for features that can improve water quality.

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 site design 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.
Alameda Countywide Clean Water Program, *C.3. Stormwater Handbook*, 2004.



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Post-Construction BMP Examples

SECTION II

Single Family Residences

**Bailey Ranch
SF-1**

Site Location:

Hayward Boulevard
Hayward, CA
Constructed July 2002

Stormwater Benefits:

- Natural treatment of runoff
- Reduced velocity of flows

Features:

- Detention basin



Stormwater runoff is directed into the detention pond, allowing for settling of sediments and removal of pollutants. This detention basin was built for 56 single family homes and is maintained as part of the Bailey Ranch Home Owners Association.

Lessons Learned:

- The basin should have been designed to not allow standing water beyond 72 hours to prevent mosquito breeding and algae growth.

Municipal Contact:

Jim Lear
City of Hayward
(510) 583-4785

Site Contact:

Walsh Property Management
(510) 888-8965

**Ivywood
SF-2**

Site Location:

33801-33909 Alvarado-Niles Road
Union City, CA
Constructed 2003

Stormwater Benefits:

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

Features:

- Vegetated buffer strip
- Disconnected downspouts (not shown)



This house has a large vegetated buffer strip in front.



The front walkway drains to this vegetated area where the runoff can be treated naturally through the turf grass.



The house is surrounded by vegetated areas to allow infiltration and naturally treat the water.

Municipal Contact:

Clean Water Program Coordinator
City of Union City
(510) 675-5360

**Dublin Ranch
SF-3**

Site Location:

Fallon Road
Dublin, CA

Stormwater Benefits:

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

Feature:

- Large vegetated swale with underdrain



This vegetated swale drains runoff from the Dublin Ranch subdivision and roads.



The developers maintained the connectivity of the swale by building bridges over the swale to reach some homes.



This vegetated swale is as large, if not larger, than many detention basins, however it is equipped with an underdrain and therefore should not detain the water during storms.



This swale has an underdrain to allow the swale to drain when there is more flow than can be treated in the swale.



The houses are built directly adjacent to the swale, allowing runoff to drain from the houses into the swale.



This swale also preserves open space for residents providing an aesthetically pleasing vegetated area.

Municipal Contact:

Saied Aminian
City of Dublin
(925) 833-6632

**Bay Cove
SF-4**

Site Location:

Bay Farm Island
Alameda, CA

Features:

- Disconnected downspouts
- Permeable pavers

Stormwater Benefits:

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



The guest parking area in Bay Cove is made up of ungrouted pavers providing an area for infiltration to occur.



The permeable parking areas are not as frequently used because they are for guests and therefore do not sustain the load of typical parking areas.



The roof leaders also drain to grassy areas like this, which can naturally treat the runoff.



The disconnected roof leaders allow the water to infiltrate into the landscaping.

Municipal Contact:

James Barse
City of Alameda
(510) 749-5840

**Lindenwood
SF-5**

Site Location:

Taite Lane and Robinson Circle
Livermore, CA
Completed 2004

Stormwater Benefits:

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

Features:

- Vegetated swales
- Narrow streets
- Disconnected downspouts (not shown)



This swale is composed of rocks and vegetation to naturally treat the runoff.



The homeowners association is responsible for maintenance of this swale.

Lessons Learned:

- Install swales with underdrains to avoid ponding from landscape irrigation runoff during the summer months.
- Promote water “wise irrigation” by discouraging the use of area and “bubble-up” drains.

Municipal Contact:

Steve Aguiar
City of Livermore
(925) 960-8100
smaguiar@ci.livermore.ca.us

Site Contact:

Contact Steve Aguiar for site contact information.

**Cedar Boulevard
SF-6**

Site Location:

Cedar Boulevard
between Forbes Dr. and Central Ave.
Newark, CA
Constructed January 2002

Stormwater Benefits:

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

Features:

- Pop-up drainage emitter
- Vegetated swales



The pop-up drainage emitter discharges roof and rear yard runoff.



The runoff flows from the pop-up emitter through the vegetated swale into the storm drain inlet located here.

Lessons Learned:

- Bubble-ups should be located 10 feet from the storm drain to ensure treatment of runoff prior to discharge into the storm drain system.

Municipal Contact:

Michael Carmen
City of Newark
(510) 794-2320

michael.carmen@newark.org

**Civic Terrace Residence
SF-7**

Site Location:

5538 Civic Terrace
Newark, CA
Constructed January 2005

Features:

- Disconnected downspouts



The landscaping is beneficial in the area where the runoff flows, but the other areas are not vegetated.

Lessons Learned:

- It may be more aesthetically pleasing to use ½” to 1” diameter rocks for energy dissipation instead of splash blocks, and also to provide a wider distribution of roof runoff within the landscaping.

Stormwater Benefits:

- Reduced directly connected impervious areas (DCIA)
- Natural treatment of runoff
- Reduced velocity of flows



Rooftop runoff drains through downspouts to landscaping for treatment and infiltration.



The downspouts are directed into splash blocks and flow to an area of landscaping.

Municipal Contact:

Michael Carmen
City of Newark
(510) 794-2320

michael.carmen@newark.org

**Centex/Five Canyons
SF-8**

Site Location:

Gold Creek Avenue
Fairview (Unincorporated Alameda County), CA
Constructed 1995

Features:

- Disconnected downspouts

Stormwater Benefits:

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



Rooftop runoff is drained to vegetated areas like this, where it can infiltrate into the subsurface and reduce the velocity and volume of runoff.



Runoff from the rooftop is piped to this bubble-up, which “bubbles” the stormwater up into landscaped areas.



This roof leader bubble-up was placed too close to the sidewalk edge, preventing water from filtering through plants or soil.



Lawn mowers can cause damage to drainage systems.

Lessons Learned:

- Bubble-ups can hold standing water if there is no under drain.
- Bubble-ups can be tricky during maintenance; in this case, some were broken by lawn mowers.
- Some residents decided to re-plumb the roof leaders to the street through the curb (there were no CC&Rs prohibiting this).
- Some roof leader outfalls were placed too close to the sidewalk edge of the yard and water ends up not filtering through plants or soil.

Municipal Contact:
Diamera Bach
Alameda County
Unincorporated Area
(510) 670-5763
diamera@acpwa.org

**Mission Sienna
SF-9**

Site Location:

Mission Sienna and
Mission Tierra Place
Fremont, CA

Features:

- Disconnected downspouts

Stormwater Benefits:

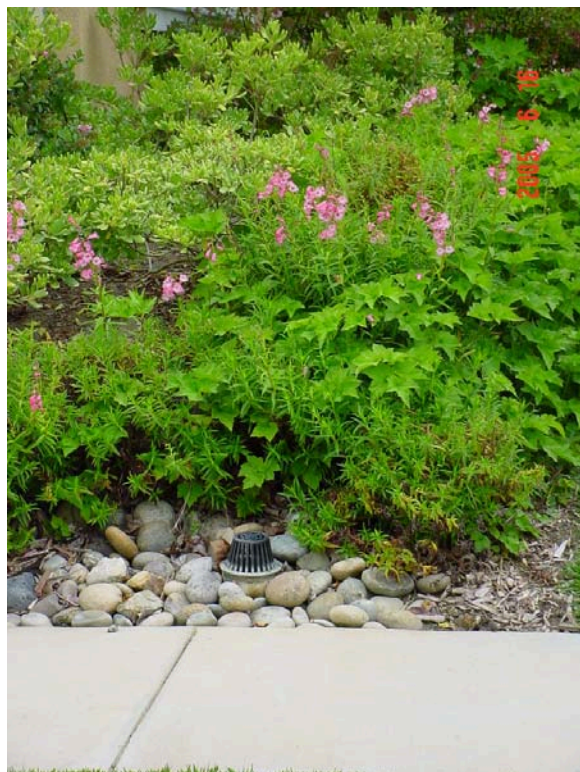
- Reduced directly connected impervious area (DCIA)



The disconnected downspouts are connected to bubblers that irrigate the landscaping. The bubbler systems are maintained by the homeowners association.



Water flows from the rooftops, down the rain gutters and through a pipe to the bubble-ups, or bubblers, where it is discharged through cobbles before reaching the vegetated areas.



Runoff is discharged through a bubbler system that drains through an area of cobbles. The cobbles around the bubbler help prevent erosion and scour around the bubbler.

This is a close up of the bubbler, where rooftop runoff is discharged through cobbles which slow the runoff before infiltrating through the vegetation.

Municipal Contact:
Shannan Szychowski

City of Fremont
(510) 494-4584

sszychowski@ci.fremont.ca.us

Site Contact:

Mike Meyer
O'Brian Group
2001 Winward Way
San Mateo, CA 94404



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SECTION III

Multi-Family Residences

**Wisteria Place
MF-1**

Site Location:

33801-33909 Alvarado-Niles Road
Union City, CA
Under construction

Features:

- High density (multi-story) senior housing with reduced building footprints
- Disconnected downspouts
- Trash enclosures
- Permeable pavers



The disconnected downspouts discharge rooftop runoff to this vegetated area.

Stormwater Benefits:

- Trash-related pollutant reduction
- Reduced impervious surface area
- Reduced volume of runoff
- Reduced directly connected impervious area (DCIA)



This walkway drains to the vegetation and permeable pavers. The pavers create temporary access to the building and utilities while minimizing impervious surface.



This is an up-close look at the permeable pavers that allow water to seep through the gaps, reducing the amount of impervious surface area.



This affordable senior housing complex was created as high density, reducing the building footprint.



This walkway at the rear of the building drains to landscaped areas, reducing the volume of runoff.



The room behind the doors is designated as an indoor trash enclosure, which prevents pollutants from the dumpster from entering the storm drain. The dumpster is wheeled out for pick up.

Municipal Contact:
Clean Water Program Coordinator
City of Union City
(510) 675-5360

Site Contact:
Eden Housing
<http://www.edenhousing.org>



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SECTION IV

Mixed Use Residential/Commercial

**Gaia Building
MU-1**

Site Location:

2180 Allston Way
Berkeley, CA
Completed August 2002

Features:

- High-density (multi-story) housing with reduced building footprints integrated with commercial areas and art space
- Located near mass transit including BART and AC Transit
- Parking lift system
- Garden area on roof



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

This multi-story development is located near the Downtown Berkeley BART station and AC Transit routes, promoting alternative transportation

Stormwater Benefits:

- Transportation-related pollutant reduction
- Reduced impervious surface area
- Reduced volume of runoff



This roof area provides a garden setting for residents instead of adding additional impervious area (walkways, etc.) around the building perimeter.



Parking lift systems reduce the impervious surface area by having parking pits with lifts that stack cars while parked, reducing the impervious surface area needed per car.

Note: This photo was taken at MU-6, where the same parking lift system is used.



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

This is photograph of the redevelopment area before the building was completed (June 2000).



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

This is a photograph was after the structure was constructed (August 2001).



Rooftop vegetation collects some of the runoff reducing the volume during rain events.

Lessons Learned:

- There are some parking lift systems that do not have approved listings for fire safety. The fire department needs to be involved early on the design phase to carefully determine fire sprinkler requirements for parking pit areas to provide the greatest fire protection.

Municipal Contact:

Nate French
City of Berkeley
(510) 981-7451
nfrench@ci.berkeley.ca.us

Site Contact:

Patrick Kennedy
Panoramic Interests
(510) 883-1000
www.panoramicinterests.com

**The Benton
MU-2**

Site Location:

Civic Center Drive
Fremont, CA

Features:

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

Stormwater Benefits:

- Transportation-related pollutant reduction
- Reduced impervious surface area



The Benton has a walking path to the Fremont BART Station (across street) and is near Lake Elizabeth-Central Park, the Shinn Historic Park, Centerville Farmers Market, and Irvington Farmers Market.



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



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



Mixed use commercial businesses located within the Benton encourage residents to walk to shops thereby reducing the reliance on motor vehicles.

Municipal Contact:
Shannan Szychowski

City of Fremont
(510) 494-4584

sszychowski@ci.fremont.ca.us

Site Contact:

The Benton in Fremont
(510) 792-1299

TheBentonInFremont.com

**Dwight Way Mixed-Use Development
MU-3**

Site Location:

2480 Martin Luther King Jr. Way
Berkeley, CA
Completed December 2003

Features:

- Live/work spaces
- Located near mass transit including AC Transit
- Disconnected downspouts
- Pervious driveway and parking area
- Tuck under parking

Stormwater Benefits:

- Transportation-related pollutant reduction
- Reduced directly connected impervious area (DCIA)
- Reduced impervious surface area
- Reduced volume of runoff



This mixed use development is located on multiple AC Transit routes and also nearby the Berkeley bike boulevard system, promoting alternative transportation.

The rooftop rain gutter drains into landscaping and dry wells reducing the amount of directly-connected impervious area (DCIA).



This section of the building allows for a covered parking area in the breezeway, reducing the amount of impervious area.



These live work spaces used many “green building” concepts including using recycled materials in a unique way to create an environmentally friendly environment.



The driveway and parking area is made of compacted road base with a decomposed granite surface layer. This pervious paving has been relatively easy to maintain and the decomposed granite has not washed out.

Lessons Learned:

- Downspouts were directed to dry wells, but the wells were undersized and the clay soil prohibited proper infiltration. The solution was to separate downspouts and add more dry wells.

Municipal Contact:

Nate French
City of Berkeley
(510) 981-7451

nfrench@ci.berkeley.ca.us

Site Contact:

Karl Wanaselja
Leger Wanaselja Architecture
(510) 848-8901

www.greendwellings.com

**Hesperian Boulevard
MU-4**

Site Location:

Hesperian Boulevard
Hayward, CA
Constructed March 2004

Stormwater Benefits:

- Natural treatment of runoff
- Reduced velocity of flows

Features:

- Detention basin



Stormwater runoff is directed into the detention pond, where pollutants are removed primarily through settling. If the pond becomes filled, water is allowed to flow through the outlet to the storm drain.

This detention basin was built in conjunction with an industrial area, sports park, and single family homes and is maintained as by the Alameda County Flood Control and Water Conservation District.

Lessons Learned:

- Although this detention basin was designed prior to the stormwater permit requirements, the basin should have been designed to not allow standing water beyond 48 hours to prevent mosquito breeding from occurring.

Municipal Contact:

Jim Lear
City of Hayward
(510) 583-4785

**Allston Lofts
MU-5**

Site Location:

2161 Allston Way
Berkeley, CA
Completed March 2003

Features:

- High density (multi-story) housing with reduced building footprints integrated with commercial areas
- Located near mass transit including BART and AC Transit
- Modular pavers
- Located building to protect existing heritage tree

Stormwater Benefits:

- Transportation-related pollutant reduction
- Reduced impervious surface area
- Reduced volume of runoff



During construction, the preparation of base material and careful observation of paver placement is required to ensure that ADA standards are met. These modular pavers provide easy access to underground utilities because no concrete needs to be removed and the pavers can be re-used.

The courtyard is made up of ungrouted modular pavers to allow runoff to seep between the pavers.



Located in downtown Berkeley, public transportation is easily accessible and there are many businesses nearby including some on the bottom floor of the Allston Lofts complex to promote pedestrian activities and alternative transportation.



The courtyard was built around this existing heritage tree, preserved during the redevelopment project.

Municipal Contact:
Nate French
City of Berkeley
(510) 981-7451
nfrench@ci.berkeley.ca.us

Site Contact:
Brani-Gerson, Bakar & Associates
(510) 845-5501

**Hillside Village
MU-6**

Site Location:

1797 Shattuck
Berkeley, CA

Features:

- High-density (multi-story) housing with reduced building footprints integrated with commercial areas
- Located near mass transit including BART and AC Transit
- Parking lift system



This building is build above a parking area that utilizes the parking lift system.



Parking lift systems reduce the impervious surface area by having parking pits with lifts that stack cars while parked, reducing the impervious surface area needed per car.

Stormwater Benefits:

- Transportation-related pollutant reduction
- Reduced impervious surface area



This dense, stacked infill residential development over commercial space is located on multiple AC Transit routes and also nearby the Berkeley bike boulevard system, promoting alternative transportation.

Lessons Learned:

- There are some parking lift systems that do not have approved listings for fire safety. The fire department needs to be involved early on the design phase to carefully determine fire sprinkler requirements for parking pit areas to provide the greatest fire protection.

Municipal Contact:

Nate French
City of Berkeley
(510) 981-7451
nfrench@ci.berkeley.ca.us

Site Contact:

Rony Rolinski
Architect
(415) 370-3141
ronyrolarchitect@aol.com



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Post-Construction BMP Examples

SECTION V

Commercial

Bayside Business Center CO-1

Site Location:

2501 Davis Street
San Leandro, CA
Constructed 2003

Features:

- Vegetated swales
- Detention pond



The parking lot is sloped to drain toward the vegetated swale which reduces the volume and velocity of runoff from the parking lot.



Parking lot runoff drains through the curb cuts into the swale where the water can be naturally treated through biofiltration.

Stormwater Benefits:

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



This pond was established for a nine (9) parcel, commercial development project. Stormwater is directed into the detention pond where pollutants and sediments are filtered out before slowly being released into the storm drain.



This is a photograph of the detention pond with the outlet structure in the center, which allows the water to slowly drain from the pond after a storm event.

Lessons Learned:

- The vegetation used in the swales should be easily established to ensure proper treatment of runoff.

Municipal Contact:

Jagtar Dhaliwal

City of San Leandro

(510) 577-3417

jdhaliwal@ci.san-leandro.ca.us

Site Contact:

Robert McClendon

McMahon Development Group

500 Stevens Avenue, Suite 200

Solana Beach, CA 92075

Central Avenue Commercial Building Complex
CO-2

Site Location:

33280 Central Avenue
Union City, CA
Completed 2004

Features:

- Vegetated swale
- Disconnected downspouts
- Bike racks promote bicycle commuting



At the end of this swale, there are flowers that are an aesthetically pleasing aspect of the swale.

Stormwater Benefits:

- Natural treatment of runoff
- Reduced velocity and velocity of runoff
- Reduced directly connected impervious areas (DCIA)
- Transportation-related pollutant reduction



The parking lot is flush with the top of the swale to allow the parking lot to drain directly into the swale



This is an up-close look at the curb cut that allows drainage from the driveway to enter the swale.



This building has disconnected downspouts that drain through rocky areas and in this case into the nearby vegetated areas.



These disconnected downspouts drain through the rocks out into the parking lot. Fortunately the parking lot drains to the swales and does not increase the amount of runoff into the storm drains.



Bike racks provide an area for employees or visitors to store their bikes, which promotes alternative transportation.

Municipal Contact:
Clean Water Program Coordinator
City of Union City
(510) 675-5360

Site Contact:
Harvest Properties Incorporated
(510) 594-2050

**ARTech Building
CO-3**

Site Location:

2002 Milvia
Berkeley, CA
Completed August 2003

Features:

- High-density (multi-story) infill office and commercial development with reduced building footprints
- Located near mass transit including BART and AC Transit
- Garden area on roof
- Parking lift system

Stormwater Benefits:

- Transportation-related pollutant reduction
- Reduced impervious surface area
- Reduced volume of runoff



This dense, stacked, infill development with offices over commercial space is located near BART and AC Transit routes, and also nearby the Berkeley bike boulevard system, promoting alternative transportation.



This roof area provides a garden setting for employees instead of adding additional impervious area (walkways, etc) around the building perimeter.



Parking lift systems reduce the impervious surface area by having parking pits with lifts that stack cars while parked, reducing the impervious surface area needed per car.

Lessons Learned:

- There are some parking lift systems that do not have approved listings for fire safety. The fire department needs to be involved early on the design phase to carefully determine fire sprinkler requirements for parking pit areas to provide the greatest fire protection.

Municipal Contact:

Nate French
City of Berkeley
(510) 981-7451
nfrench@ci.berkeley.ca.us

Site Contact:

Patrick Kennedy
Panoramic Interests
(510) 883-1000
www.panoramicinterests.com

**Kaiser Center
CO-4**

Location:

Webster and 21st Street
Oakland, CA
Constructed in 1961

Features:

- Roof garden
- Multi-story parking structure



Photograph courtesy of Camp Dresser & McKee, Inc. (CDM)

This aerial view of the building's roof garden shows the vegetative areas planted on top of the building, which create a park-like setting on top of a parking garage and also serve to conceal cars from the neighboring office buildings. The nine story parking structure reduces the building footprint required for parking.

Stormwater Benefits:

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

Other Issues:

- The large trees and water features in the roof garden require substantial structural reinforcement.



Photo taken from <http://www.jwdlifitech.com/location.html>

The entrance to the Kaiser Center visitor parking garage is between the Kaiser tower and a mall, providing public access through this pleasant walkway.

Municipal Contact:

Don Smith

City of Oakland
(510) 238-4778

dsmith@oaklandnet.com

Site Contact:

International Parking Design

Architecture, Engineering, Consulting
7700 Edgewater Drive Suite 635
Oakland, CA 94621
(510) 553 2120

www.ipd-global.com

**Park Avenue
CO-5**

Site Location:

1375 Park Avenue
Emeryville, CA
Constructed June 2004

Features:

- Pervious concrete parking lot



This parking lot was paved with pervious concrete, which allows runoff to drain through the concrete.



The inconsistent appearance of the parking lot is due to the phased construction, with differing compaction and colorants.

Stormwater Benefits:

- Reduced impervious surface area
- Reduced volume of runoff



This up close shot shows the differentiation between the appearance of the regular concrete driveway and the pervious concrete.

Lessons Learned:

- Pervious concrete must be studied carefully in relation to the soil hydrology of the site. It may be more appropriate in areas farther from the bay where the groundwater is not so high and clayey soils are not so pervasive. The use of an underdrain in areas with clayey soils may result in only minimal infiltration of stormwater. A better solution would be to excavate clayey soils and replace with Type A or B soil. Cost and aesthetics are also challenges.

Municipal Contact:
Peter Schultze-Allen
City of Emeryville
(510) 596-3728

**Venture Commerce Center
CO-6**

Site Location:

35453-35483 Dumbarton Court
Newark, CA
Constructed June 2004

Features:

- Vegetated swale
- Roofed trash enclosure with sanitary sewer connection

Stormwater Benefits:

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



This covered trash enclosure has drains that connect to the sanitary sewer system. This prevents any pollutants from the trash containers or water that comes in contact with the refuse from entering storm drains.

Lessons Learned:

- The vegetated swale should not be overwatered at the beginning stages (after planting the seeds) and inspections should confirm the adequacy of the sprinkler system and the swale design.

Municipal Contact:

Michael Carmen
City of Newark
(510) 794-2320
michael.carmen@newark.org

Site Contact:

Venture Corporation
Mill Valley office: (415) 381-1600
Silicon Valley office: (408) 778-6600
www.venture-corp.com



The vegetated swale was constructed to treat runoff naturally through the vegetation.



This vegetation in this swale did not grow because overwatering washed away the seeds.

**Costco
CO-7**

Site Location:

40580 Albrae Street
Fremont, CA

Features:

- Vegetated swale

Stormwater Benefits:

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



Rocks are used to reduce erosion at the entrance of the vegetated swale, in which water can infiltrate, reducing the amount of water entering the storm drain system.



Water flows from the parking lot, through curb cuts and rock-lined area before being treated naturally in the vegetated swale.

Municipal Contact:

Shannan Szychowski
City of Fremont
(510) 494-4584

sszychowski@ci.fremont.ca.us

**Longard Business Park
CO-8**

Site Location:

Longard Road
Livermore, CA
Constructed 2003

Features:

- Vegetated swales
- Covered trash enclosures (not shown)

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume of runoff
- Reduced velocity of runoff
- Reduced trash related pollutants



The parking lot runoff has drained to the swale, illustrating the good performance of the swale immediately after the rain.



This swale is a good example of how a swale can be designed with the trees off to the side of the swale so that they do not impede the flow.



The owner of the commercial site is responsible for maintenance of this swale, which is primarily mowing the grass.

Municipal Contact:

Steve Aguiar
City of Livermore
(925) 960-8100
smaguiar@ci.livermore.ca.us

Site Contact:

Contact Steve Aguiar for site contact information.

**Zhone Technologies
CO-9**

Site Location:

7295 Oakport Street
Oakland, CA

Stormwater Benefits:

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

Features:

- Vegetated swale



The parking lot is flush with the vegetated swale so that runoff can drain to the swale where it is naturally filtered before entering the storm drain.

Municipal Contact:

Don Smith

City of Oakland
(510) 238-4778

dsmith@oaklandnet.com

Site Contact:

Joe Ernst

(510) 864-5985

**Shea Business Center
CO-10**

Site Location:

2000 Constitution Drive
Livermore, CA
Constructed 2002

Features:

- Vegetated swales
- Disconnected roof leaders (not shown)
- Covered trash enclosures (not shown)



The parking lot is flush with the swale so that the runoff can drain directly into the vegetation.



The vegetation in the swale can treat the parking lot runoff through natural processes.

Stormwater Benefits:

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



This landscaping swale is a good example of how a swale can be designed to meet stormwater treatment requirements.

Municipal Contact:

Steve Aguiar
City of Livermore
(925) 960-8100
smaguiar@ci.livermore.ca.us

Site Contact:

Contact Steve Aguiar for site contact information.

**Zwissig Commercial Building
CO-11**

Site Location:

Zwissig
Union City, CA
Constructed 2003

Stormwater Benefits:

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

Features:

- Vegetated swale



The runoff from this walkway in front of the building drains to the vegetated swale, reducing the flow from the impervious surface.



The vegetated areas collect some of the runoff from the sidewalk, where it can naturally filter out pollutants from the water.

Municipal Contact:
Clean Water Program Coordinator
City of Union City
(510) 675-5360

**Form Factor Campus
CO-12**

Site Location:

501 Lawrence Road
Livermore, CA
Constructed 2003

Features:

- Vegetated swales
- Disconnected roof leaders (not shown)
- Covered trash enclosures (not shown)



The raised inlet directs overflow to the storm drain system to prevent excessive ponding.



The parking lot is flush with the swale so that the runoff can drain directly into the vegetation.

Stormwater Benefits:

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



This swale is a good example of how a swale can be designed with the trees off to the side of the swale so that they do not impede the flow.

Municipal Contact:

Steve Aguiar
City of Livermore
(925) 960-8100
smaguiar@ci.livermore.ca.us

Site Contact:

Contact Steve Aguiar for site contact information.

**Target Store – Albany
CO-13**

Site Location:

1057 Eastshore Highway
Albany, CA
Constructed October 2004

Stormwater Benefits:

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

Features:

- Vegetated swales
- Underground CDS unit



The parking lot is equipped proprietary underground CDS units (Vortech), which mechanically treat the runoff before entering the storm drain system.



The parking lot runoff drains to the vegetated swale, reducing the volume and velocity of runoff during storms.



The runoff drains through the curb cuts into the landscaping.

Lessons Learned:

- It is important to have the landscape architect inspect after installation to ensure proper completion, especially if the owner is responsible for maintenance as in this case.

Municipal Contact:

Billy Gross
City of Albany
(510) 528-5765
bgross@albanyca.org

Site Contacts:

**Gates + Associates,
Landscape Architects**
(925) 736-8176

AMS Associates, Engineering
(925) 943-2777

**Michael's
CO-14**

Site Location:

39170 Argonaut Way
Fremont, CA

Feature:

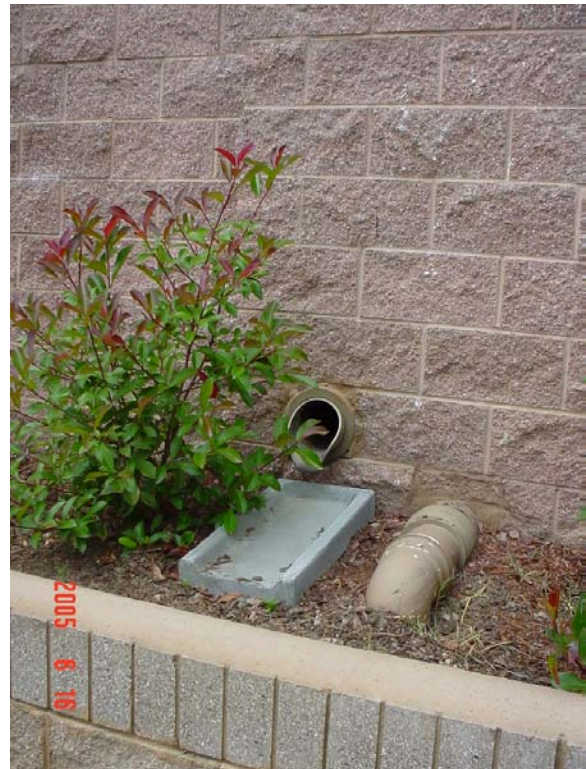
- Disconnected downspouts

Stormwater Benefits:

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



The rooftop runoff drains to the landscaping surrounding the building.



Disconnected roof downspouts reduce the amount of directly connected impervious area (DCIA).

Municipal Contact:
Shannan Szychowski
City of Fremont
(510) 494-4584

sszychowski@ci.fremont.ca.us

**Thera Sense
CO-15**

Site Location:

1360 South Loop Road
Alameda, CA

Stormwater Benefits:

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

Feature:

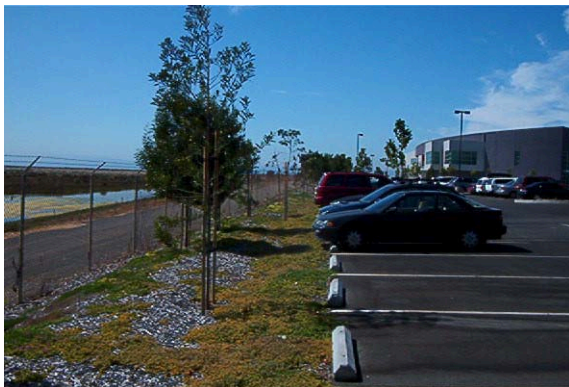
- Vegetated swales



The parking lot runoff has ample room to drain through the parking wheel stops into the swale.



This vegetated swale is filled with plants to naturally treat the runoff.



This swale provides a buffer between the parking lot and the street, which prevents runoff from reaching offsite onto the street.

Municipal Contact:

James Barse
City of Alameda
(510) 749-5840

**Target Store – Hayward
CO-16**

Site Location:

2499 Whipple Road
Hayward, CA
Constructed October 2002

Stormwater Benefits:

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

Features:

- Vegetated swales
- Underground CDS unit (not shown)



Parking lot drains through curb cuts into the swale. Oil spills may contaminate the runoff, however, the swale is capable of removing some pollutants from the water.



Trees are placed in the center of the swale, although this is aesthetically pleasing, the trees can impede flow.

Lessons Learned:

- Do not place trees at bottom of swale; it impedes flow especially when the roots grow up.

Municipal Contact:

Jim Lear
City of Hayward
(510) 583-4785

**Livermore Auto Mall
CO-17**

Site Location:

3000 Las Positas Road
Livermore, CA
Constructed 2005

Stormwater Benefits:

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

Features:

- Vegetated swales
- Disconnected roof leaders (not shown)
- Covered trash enclosures (not shown)



Parking lot runoff can drain directly into the swale because the parking lot is flush with the top end of the swale. This is possible because new cars are parked by the auto mall employees only.

The owner of the commercial site is responsible for maintenance of this swale, which is primarily mowing the turf grass.

Lessons Learned:

- Provide underdrain in swales when slope is minimal, provide greater offset of trees and light standards when located in swale area.

Municipal Contact:

Steve Aguiar
City of Livermore
(925) 960-8100
smaguiar@ci.livermore.ca.us

Site Contact:

Contact Steve Aguiar for site contact information.

**Re Max
CO-18**

Site Location:

41111 Mission Boulevard
Fremont, CA

Features:

- Vegetated swales
- Curb cuts

Stormwater Benefits:

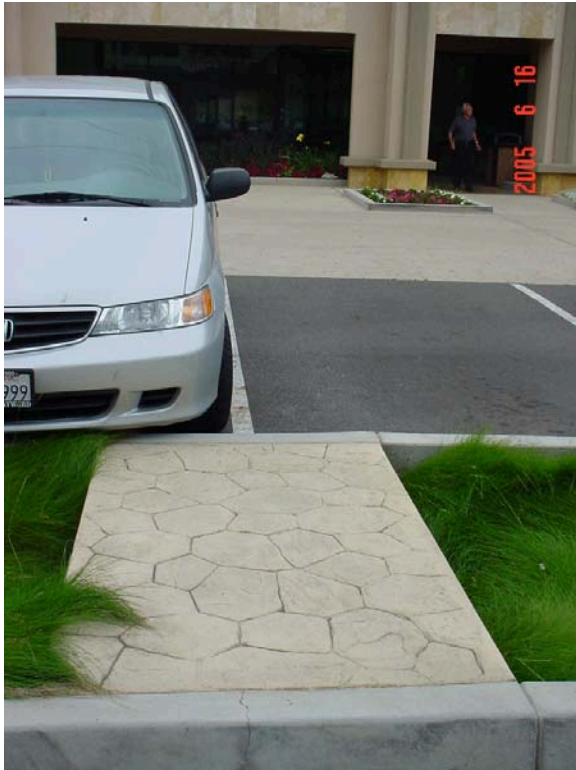
- Natural treatment of runoff
- Reduced volume of runoff
- Reduced velocity of runoff



This vegetated swale is used to reduce the velocity and volume of parking lot runoff.



Curb cuts allow runoff water to drain into the vegetated areas from the parking lot.



This walkway was constructed as a bridge so that the runoff could still flow continuously through the swale.



Cobbles prevent erosion at this storm drain inlet, to which runoff flows after filtering through the swale.

Lessons Learned:

- The walkway bridges should line up with the white lines separating the parking stalls to allow pedestrian navigation around cars.
- Ivy should not be planted in swales, because it is difficult to maintain and keep the storm drain inlets clear of vegetation.

Municipal Contact:
Shannan Szychowski

City of Fremont
(510) 494-4584

sszychowski@ci.fremont.ca.us

Site Contact:
JP Mobasher
(510) 580-8262



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Post-Construction BMP Examples

SECTION VI

Public Areas

**Vineyard Avenue Realignment
PA-1**

Site Location:

Vineyard Avenue
(East of Clara Lane)
Pleasanton, CA
Constructed April 2005

Stormwater Benefits:

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

Features:

- Vegetated swales
- Decomposed granite
- Detention pond



Detention pond not only provides an area for stormwater treatment, but also provides habitat for wildlife (egret pictured).



This grassy swale was constructed during the realignment of Vineyard Road. The roadway runoff drains to the swale, which is flush with the road.



The swale drains to the storm drain after naturally treating runoff.



Decomposed granite walkway was constructed next to the swale to provide an area for pedestrian activity.

Municipal Contact:
Kaushik Bhatt
City of Pleasanton
(925) 931-5664
KBhatt@ci.pleasanton.ca.us

Site Contact:
Jim Gotcher
(925) 931-5684

**Zone 7 Water Agency
PA-2**

Site Location:

100 North Canyons Parkway
Livermore, CA

Features:

- Vegetated swale
- Disconnected downspouts

Stormwater Benefits:

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



The roof leader from the Zone 7 office building drains into a cobble, which allows sedimentation to occur before entering into a grassy swale, and eventually ending up in the storm drain.

Municipal Contact:

Mary Lim

Zone 7

(925) 454-5036

m_lim@zone7water.com

**Pleasanton Sports Park
PA-3**

Site Location:

Hopyard Road
north of Valley Avenue
Pleasanton, CA
Constructed August 2004

Features:

- Turf block fire access
- Vegetated swales (not shown)

Stormwater Benefits:

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



This grassy area at the Pleasanton Sports Park is composed of turf block and used for fire access to maintenance building nearby. Fire trucks can drive through the fence gate and directly to the building over the turf block marked by the concrete curb.

Municipal Contact:

James Kelcourse
City of Pleasanton
(925) 931-5676

jkcourse@ci.pleasanton.ca.us

**City of Pleasanton Park and Ride Lot
PA-4**

Site Location:

7295 Johnson Drive
Pleasanton, CA
Constructed September 2005

Features:

- Vegetated swales
- Promotes alternative transportation



This parking lot serves as an area for commuters to park their cars and take public transportation.

Stormwater Benefits:

- Natural treatment of runoff
- Reduced volume of runoff
- Reduced velocity of runoff
- Reduced transportation-related pollutants



The parking lot drains through curb cuts into the vegetated swales onsite where the runoff is naturally treated.

Municipal Contact:

James Kelcourse
City of Pleasanton
(925) 931-5676

jkcourse@ci.pleasanton.ca.us

**Sycamore Road
PA-5**

Site Location:

Sycamore Road
(East of Amber Lane)
Pleasanton, CA
Constructed 2004

Stormwater Benefits:

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

Features:

- Drainage swale



The road drains to this vegetated swale where pollutants are removed naturally and the velocity and volume of runoff is reduced.

Municipal Contact:

Kaushik Bhatt
City of Pleasanton
(925) 931-5664

KBhatt@ci.pleasanton.ca.us

Site Contact:

Tim Armbruster
(925) 931-5609

**Dublin Boulevard
PA-6**

Site Location:

Dublin Boulevard
(Over Alamo Canal)
Dublin, CA
Completed 2004

Features:

- Stormceptor (mechanical treatment)

Stormwater Benefits:

- Oil and sediment pollutant removal



During the widening of Dublin Boulevard, a Stormceptor system was installed to remove oil and sediments from road runoff.

The Stormceptor system, owned and maintained by the City of Dublin is being lowered into the vault.

Lessons Learned:

- The manhole for the Stormceptor system should not be placed in the traffic lane line. Since Stormceptors need to be maintained frequently (at least once a year and after major storm events), there should be easy access, preferably not requiring closing a traffic lane.

Municipal Contact:

Ferd Del Rosario
City of Dublin
(925) 833-6630

Site Contact:

Dan Elshire
Granite
715 Comstock Street
Santa Clara, CA 95054
(408) 224-4124

Berkeley Traffic Circles PA-7

Site Location:

Grant and Addison
Berkeley, CA
Completed Summer 2005

Features:

- Converting impermeable area to permeable area



This landscaped island, provides an area for infiltration to occur.



This is another traffic circle created to maintain speeds, but also reduces the overall impervious area.

Stormwater Benefits:

- Reduced impervious surface area



This traffic island creates a bulb out for parking along this street.

Lessons Learned:

- The selection of traffic calming devices required review by the public.
- The street widths needed to maintain clearances to allow passage of fire equipment.
- The traffic circles and islands should have been created to allow roadway infiltration through curb cuts. This would allow more runoff to be treated in the landscaped areas.

Municipal Contact:

Danny Akagi
City of Berkeley
(510) 981-6394
dakagi@ci.berkeley.ca.us



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Post-Construction BMP Examples

SECTION VII

Indexes

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