EBMUD – Landscape Advisory Committee
February 3, 2020

Green Stormwater Infrastructure: Regulations, Benefits, Construction, and Challenges

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Outline of Presentation

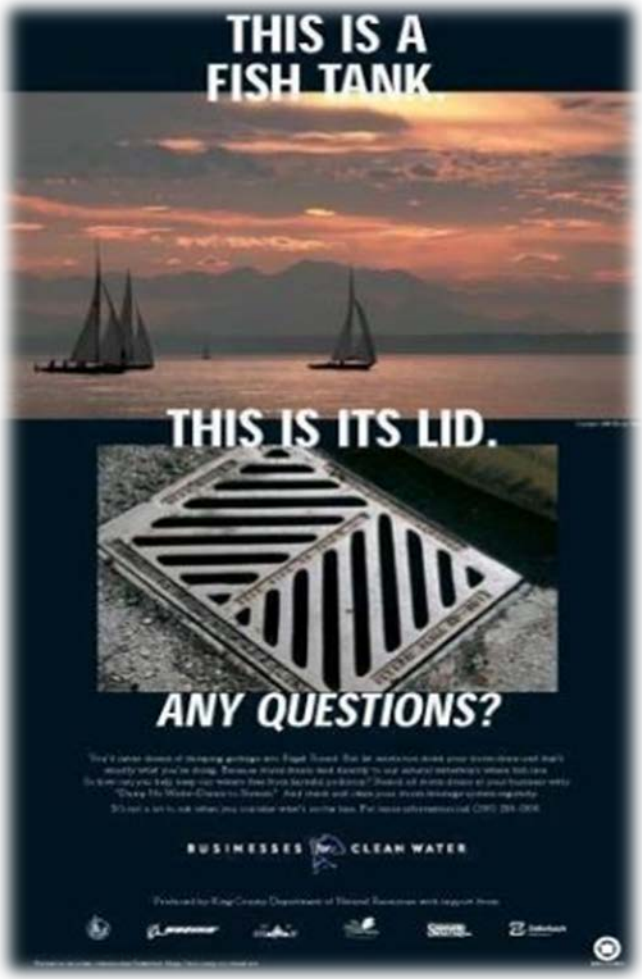
- Stormwater problems
- Regulatory solutions
- Stormwater control measure requirements
- Stormwater Terminology – LID and GSI
- Low Impact Development (LID) types
- Green Stormwater Infrastructure (GSI) types
- GSI Designs and Construction
- GSI examples

Stormwater Problems

- The San Francisco Bay and many local creeks are polluted
- Stormwater runoff carries those pollutants

Isn’t Runoff Treated?

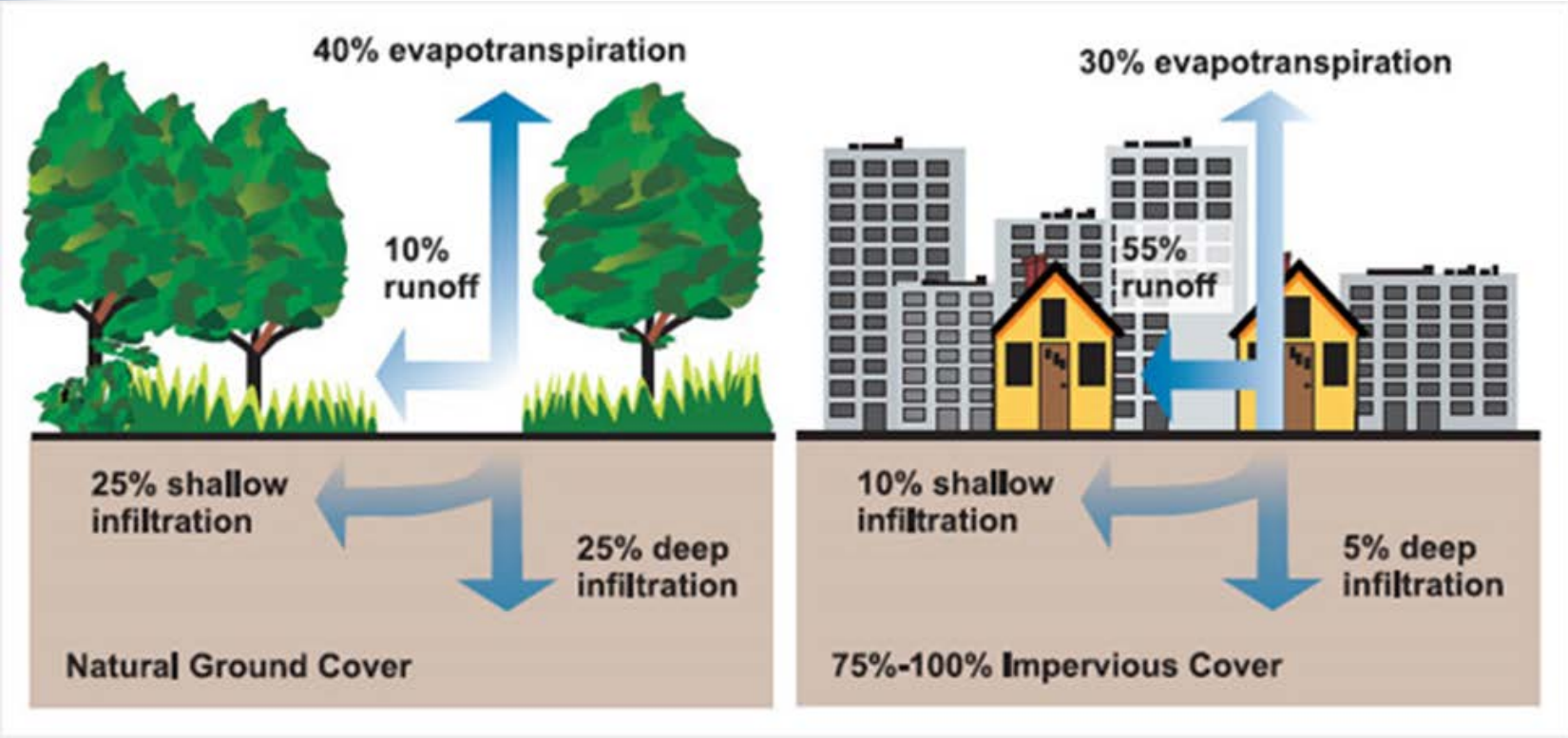
- The storm drain system is typically **completely separate** from the sanitary sewer system in the Bay Area.
- Water entering storm drains generally **receives no treatment** before flowing to creeks & the Bay.
- San Francisco is the only city in the Bay Area that has a combined storm/sewer system (in most of the City).



Pollution from Stormwater Runoff

- Pollutants can accumulate in the Bay
- PCBs and Mercury are two pollutants of concern in the Bay that affect fish and humans
- Stormwater is a source of PCBs and Mercury

How does urban development affect the hydrologic cycle?



Little runoff before development

Lots of runoff after development

Enemy #1: Impervious Surface

Concrete Lined Channel with Floodwall in Lower Matadero Creek

How do increases in flow affect creeks?

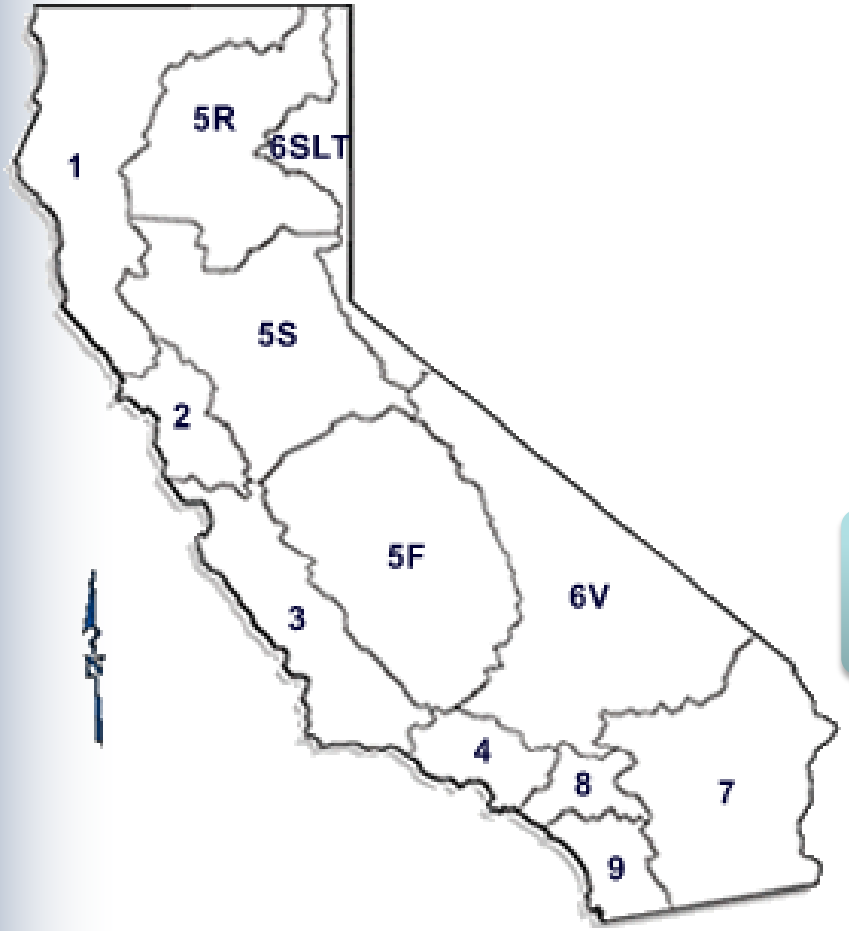
Yerba Buena Creek – upstream reach in good condition

Incision on lower Yerba Buena Creek

Regulatory Background: Municipal Stormwater Permits

- Since 1987 the federal Clean Water Act has required municipalities to obtain **permits to discharge stormwater** from municipal storm drain systems
- These are National Pollutant Discharge Elimination System (NPDES) **Municipal Stormwater** Permits
- EPA has also established construction and industrial discharge standards

NPDES Permitting Authority



U.S. EPA

State Water Resources Control Board

Regional Water Quality Control Board (9 regions)

MS4s

MS4 = Municipal separate storm sewer system

Bay Area Municipal Regional Permit (MRP)

- One regional permit for urbanized areas (total of 76 permittees):
  - San Mateo, Santa Clara, Alameda, and Contra Costa Counties, Fairfield-Suisun, and Vallejo
- Current MRP effective 1/1/16 - 12/31/20
- Key requirements:
  - Low Impact Development (LID); Green Infrastructure (GI)
  - Monitoring and control measures for pollutants of concern: Trash, Mercury, PCBs, Pesticides

What is Low Impact Development? (LID)

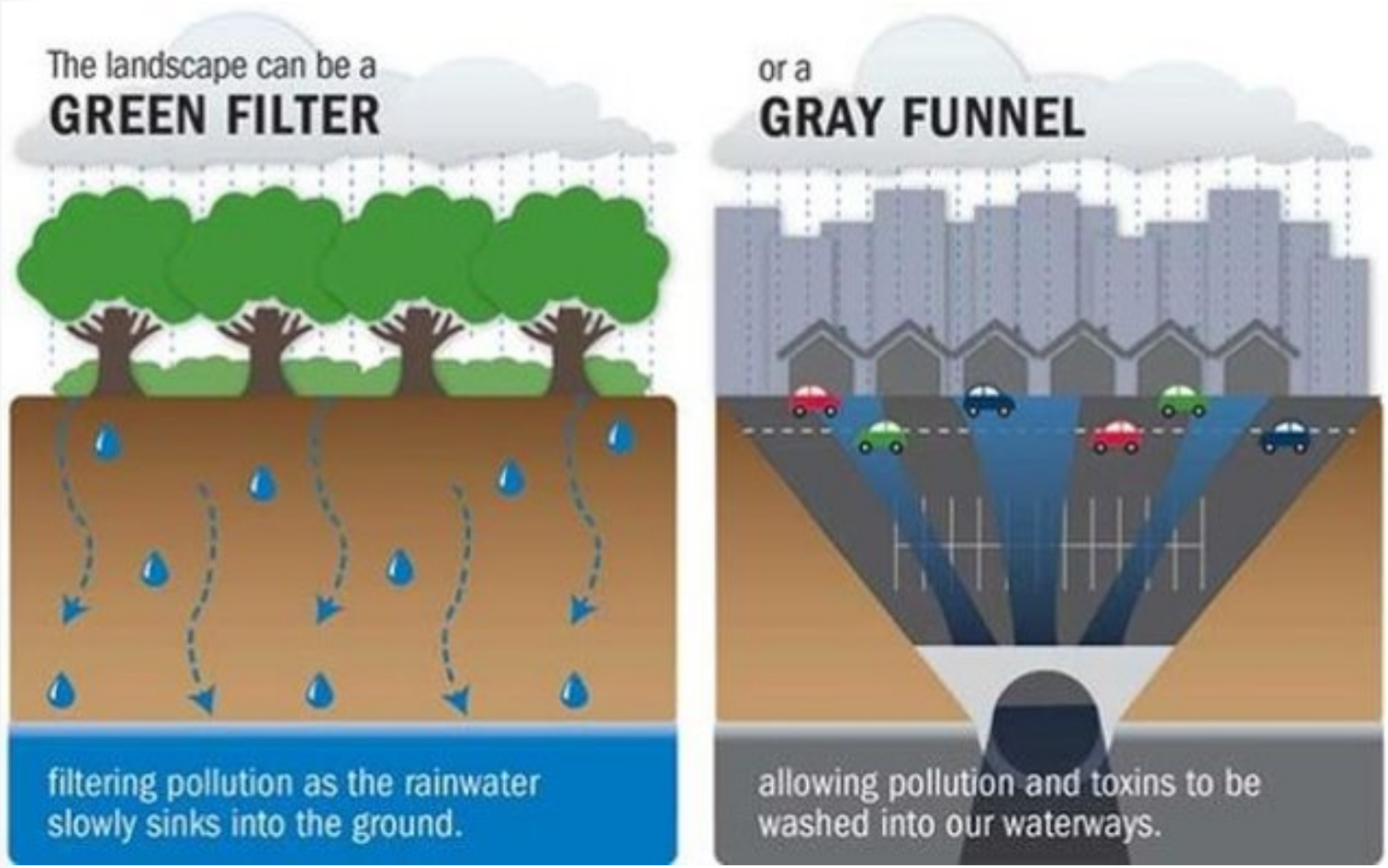
Flow-through planter

- LID mimics natural systems by using vegetation, soil and pervious surfaces to reduce stormwater runoff and increase infiltration on parcels/sites.
- Most common types of LID:
  - Biotreatment
    - Rain gardens/bioretention areas
    - Flow-through planters
    - Green roofs
  - Pervious Pavement

What is Green Stormwater Infrastructure?

GSI uses the natural processes of soil, plants and pervious surfaces to manage stormwater in streetscapes and parks.

Restoring the Urban Landscape with GSI and LID

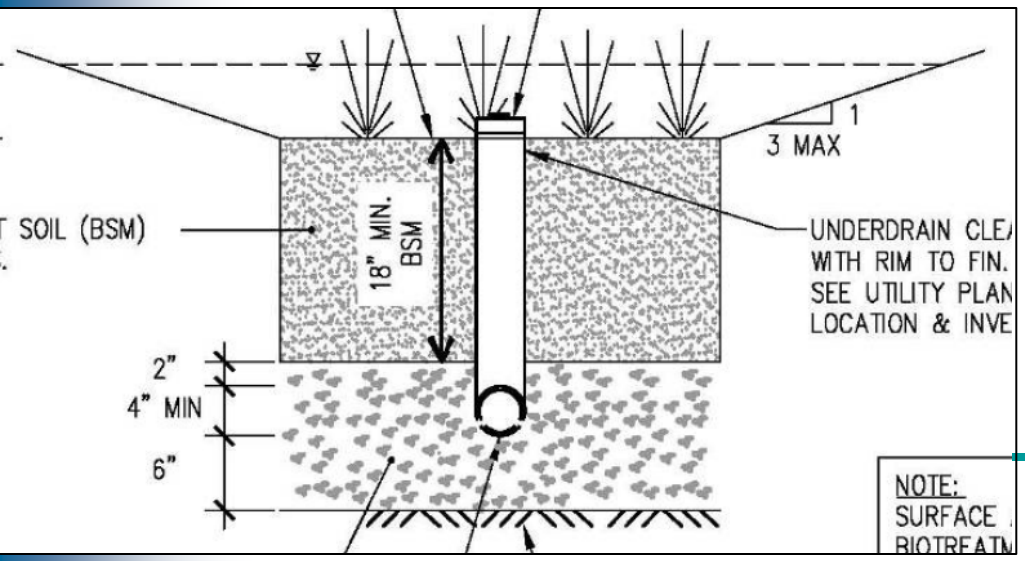


LID and GSI Benefits

- Multiple benefits:
  - Flow reduction
  - Pollutant reduction
  - Urban greening
  - Traffic calming
  - Improved bike and pedestrian safety
  - Climate benefits
  - Flood resiliency

- Promoting benefits helps get public support

Bioretention / Rain Garden



- Concave landscaped area of any shape, with sloped sides
- Engineered biotreatment soil mix with specified long term infiltration rate (5 in/hr)
- Underdrain required if clayey underlying soils
- Raise underdrain to maximize infiltration, if conditions allow

Commonly Used Plants

Juncus patens	Gray Rush
Chondropetulum tectorum	Cape Rush
Carex divulsa	Berkeley Sedge
Carex pansa	Meadow Sedge
Festuca idahoensis-Siskiyou	Blue Fescue-Siskiyou
Festuca glauca-Elijah blue	Blue Fescue-Elijah
Penstemon heterophyllus	Blue Bedder
Epilobium septentrionale	CA Fuschia
Lomandra hystrix-Katie Belles	Lomandra
Achillea millefolium-Moonshine	Moonshine Yarrow
Mimulus aurantiacus	Sticky Monkey Flower
Ceanothus gloriosus	Creeping Wild Lilac

Bioretention Areas

Flow-through Planter

- Lined planter box with vertical sides
- No infiltration to underlying soils
- Stormwater is filtered by biotreatment soil media, mulch and plants and released through underdrain
- OK to place next to building or on podium if waterproofed

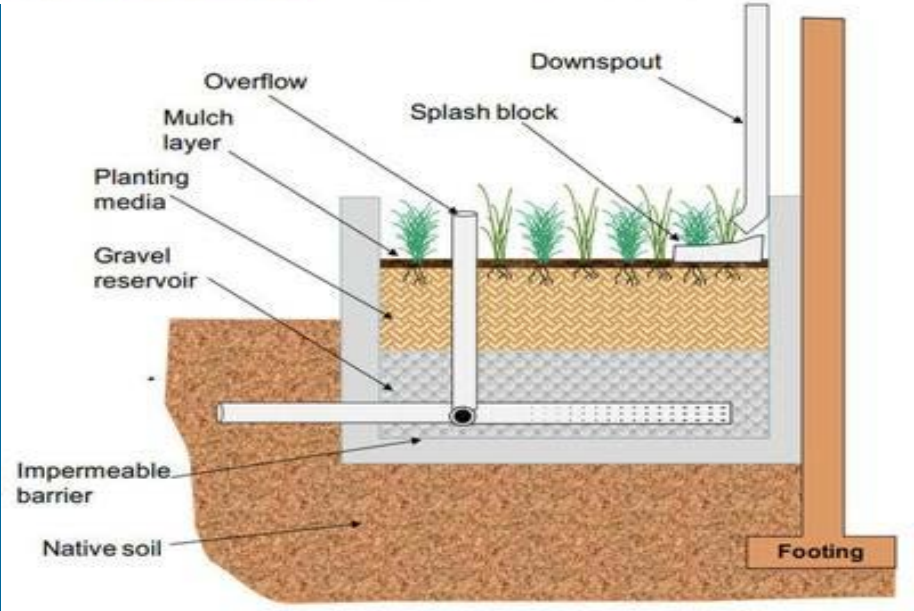
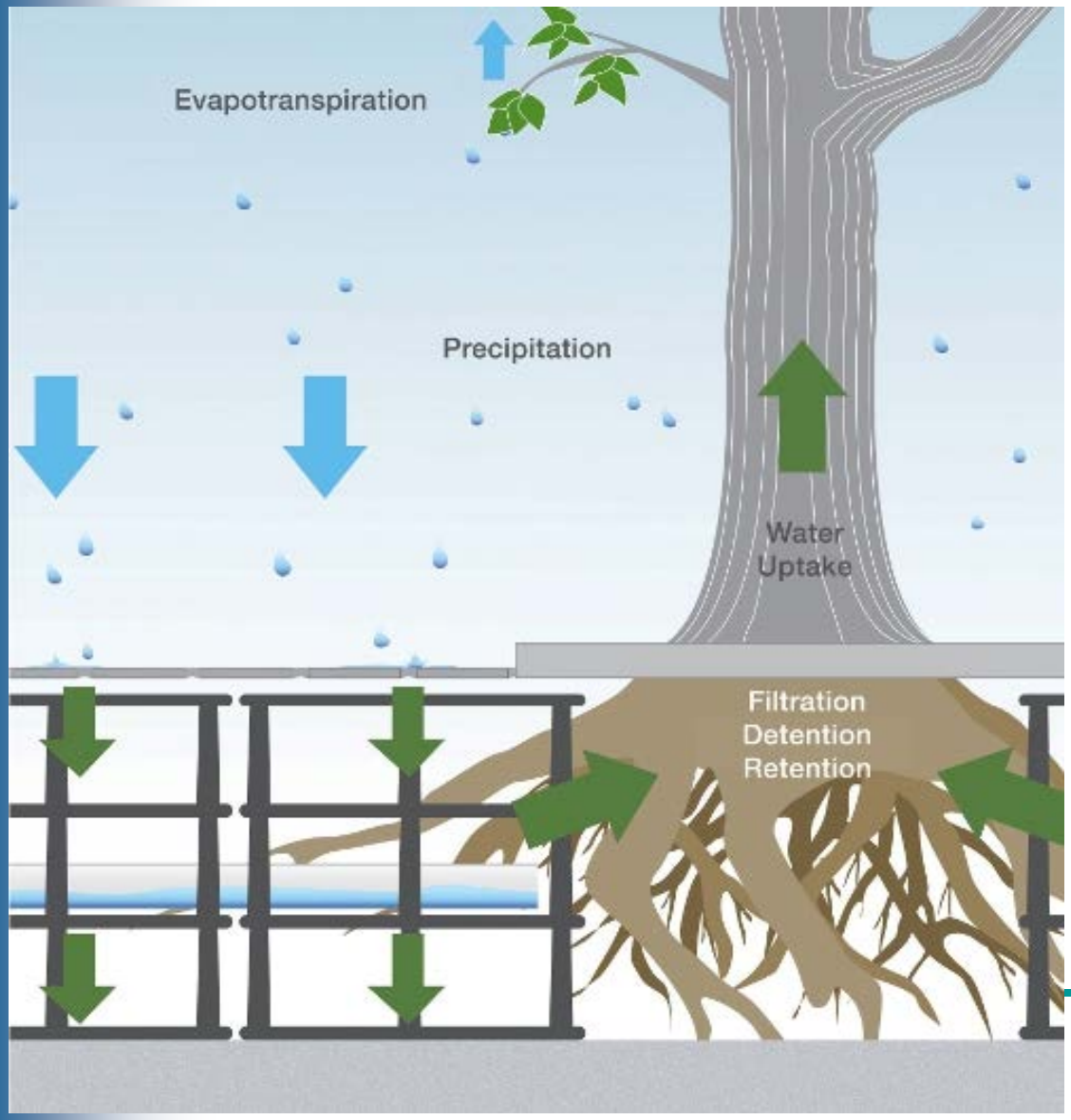
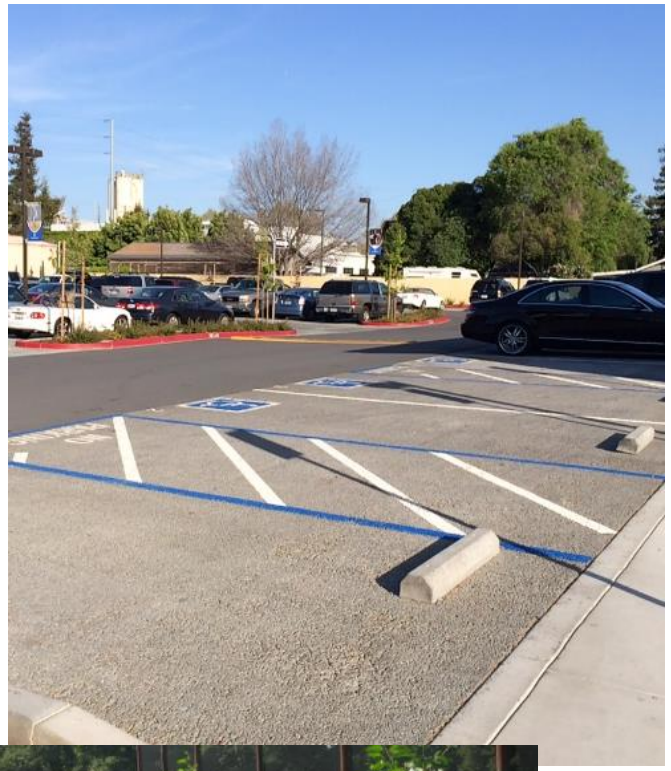


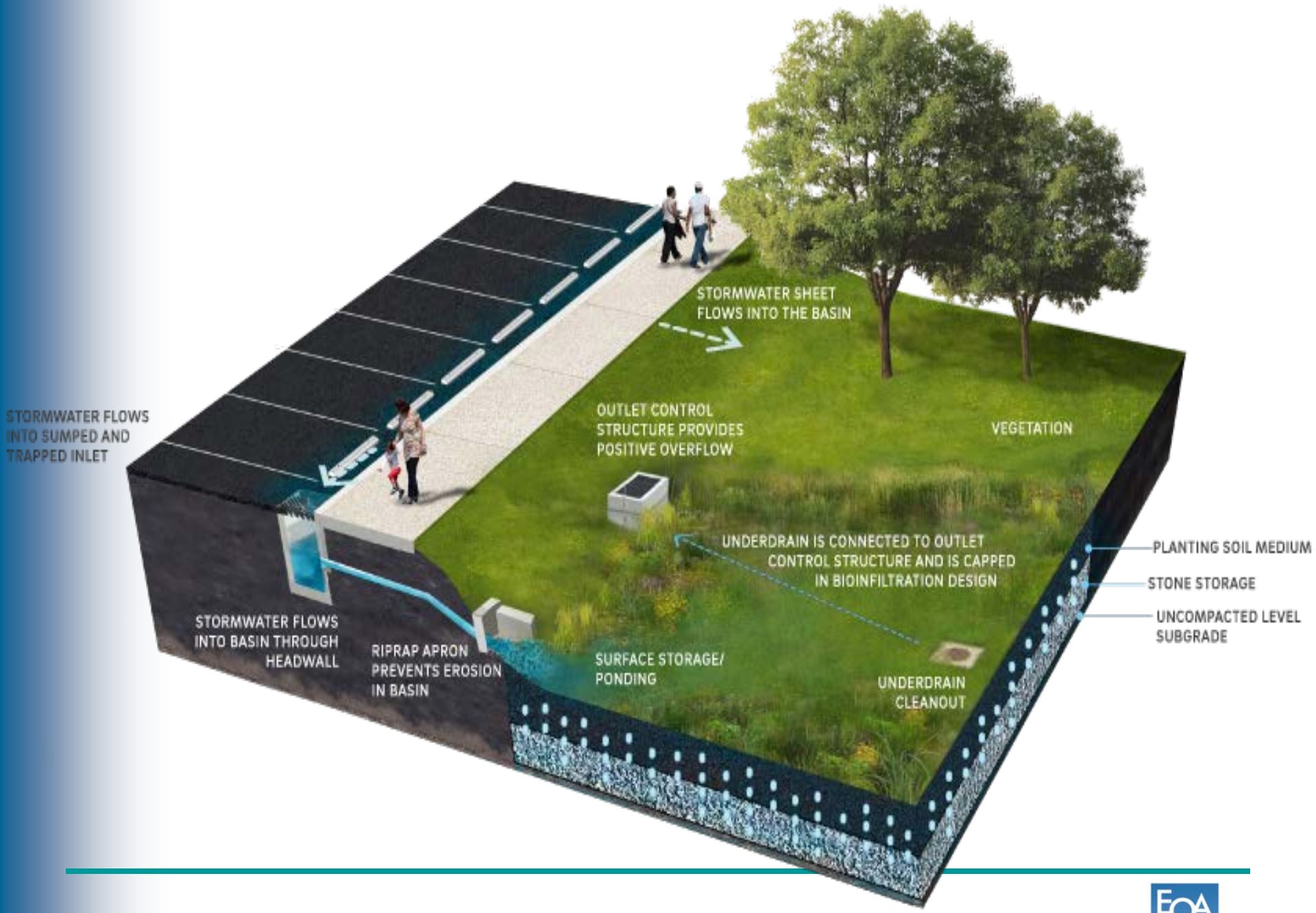
Illustration of a Planter Box

Biotreatment in Tree Trench



Pervious Pavement





WATER INFILTRATES INTO SUBGRADE IN BIOINFILTRATION DESIGN

GSI Examples

- Berkeley
- Oakland
- Campbell
- El Cerrito
- Emeryville


Berkeley
CAT
CHILOTTI


Berkeley
T300
Bobcat
Hertz Equipment Rental


Berkeley


Berkeley


Grand Ave
LANE CLOSED
Oakland


Oakland

Hacienda Ave, Campbell (Before)

Hacienda Ave, Campbell (After)


Campbell


Campbell


El Cerrito


Emeryville
STOP


Emeryville
Ocean


Emeryville

For More Information:

- ACCWP Stormwater Technical Guidance:

  cleanwaterprogram.org/businesses/development.html
- SCVURPPP GSI Handbook:

  scvurppp.org/swrp/gsi
- SMCWPPP GI Design Guide:

  flowstobay.org/gidesignguide
- Municipal Regional Stormwater Permit
  waterboards.ca.gov/sanfranciscobay/water_issues/programs/stormwater/Municipal/R2-2015-0049.pdf

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San Pablo Ave Green Stormwater Spine
San Francisco Estuary Partnership

EBMUD Landscape Advisory Committee
February 3, 2020

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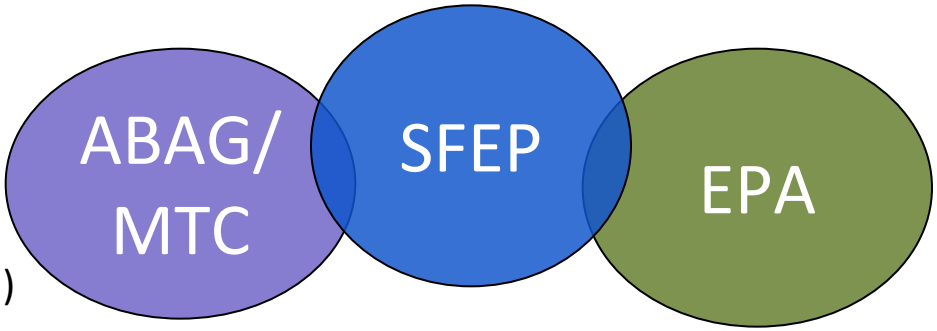
Federal, State, Local Partnership

Regional Partner
Institutional (administrative, fiscal) home of SFEP



Federal Partner
Clean Water Act – Sec 320
Legislative home of SFEP
Program approval, base funding

- **Collaborative, Non-regulatory Public Agency**
- **Protect, restore, and enhance water quality & habitat**
- ***Estuary Blueprint* – 5 year workplan**

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Green Stormwater Spine Project Preview

- Implement green retrofits in 4 cities along San Pablo Ave (originally 7)
- Treat 6 acres of impervious surface (originally 7)
- Emphasis on vegetated approaches in public right-of-way

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Four Key Project Goals

- Demonstrate Benefits and Effectiveness of Green Retrofits
- Improve Water Quality
- Increase Public Awareness
- Increase Municipal/County Acceptance

Primary Tasks	Funder	Amount
Design & Engineering	US EPA/DWR-IRWMP/MTC-BATA	$450K
Coord, Outreach, Constr. Mgmt, Monitoring, Plant Est.	DWR – IRWMP/MTC – BATA	$2M
Construction	Caltrans/MTC – BATA	$1.8M
Stand-alone El Cerrito Project	Strategic Growth Council	$720K
	TOTAL	$4.97M

Project Team

Task	Agency
Project Mgmt. & Coordination	San Francisco Estuary Partnership
Plans, Specs, Engineering, Interpretive Signage	Wilsey-Ham (civil engineering) Quadriga (landscape design) Kevin Robert Perry (visioning)
Bay Friendly Landscape Rater	Gates and Associates/incomplete
Monitoring	San Francisco Estuary Institute
Bid Package, Construction Mgmt.	Harris and Associates/MNS Engineering
Labor Compliance oversight	Labor Consultants of California/MTC Internal

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PLANNING & DESIGN

San Pablo Ave Green Stormwater Spine Challenges

- Personal and agency inexperience in public right-of-way construction
- Multiple partners, multiple funders, array of site specific conditions
- Over-committed to partners
- Funding and timing constraints
- Limited design budget, including potholing
- Lack of utility information & coordination

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Berkeley – Existing Conditions

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Stormwater Improvement Concept Plan

Scale: 1"=25'
January 2013

1. Stormwater curb extensions capture runoff from San Pablo Avenue.
2. Grated trench drains allow stormwater to flow into adjacent sidewalk planter.
3. Existing private landscaping/signage/utilities are retained.
4. Sidewalk planter accepts stormwater from San Pablo Avenue. A small concrete curb wall helps provide grade separation and protection of existing signs and utilities. This will require acceptance and coordination of improvements with private owner.
5. An existing vegetated swale is modified to capture stormwater from both San Pablo Avenue and McDonald's parking lot. This will require acceptance and coordination of improvements with private owner.
6. Grated trench drains allow stormwater overflow to flow into a stormwater curb extension in San Pablo Avenue.
7. All existing trees are retained with streetscape improvements.
8. Boardwalk allows stormwater to follow under pedestrian pathway.

San Pablo Avenue Green Stormwater Spine Project

City of Berkeley, California

[nev-ū-rion] Nevue Ngan Associates

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For Lease
Office/Medical
Jake Norton
510 874 1997
CBRE
DRIVE-

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City of Berkeley Site Rendering


CAT

Berkeley site,
Planted Jan 23, 2020

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OAKLAND

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Stormwater Improvement Concept Plan

Scale: 1"=20'
January 2013

1. Existing median is removed and travel lanes remain as asphalt.
2. New painted bike lanes are proposed on both sides of the street (by others)
3. Stormwater planters and street trees accept runoff from both San Pablo Avenue and adjacent private property.
4. Boardwalks allow pedestrians to access parking and sidewalks.
5. Parallel parking configuration allows for greater space efficiency along the street.
6. A 4.5' egress zone allows pedestrians to safely exit their vehicles and pay parking meters.
   The existing ADA marked parking stall is retained at this location.
7. The east side of San Pablo Avenue could be converted to mirror west side improvements in the future.

San Pablo Avenue Green Stormwater Spine Project

City of Oakland, California

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A Green Street Project

Oakland site, set-up


Oakland Site, Jan 24, 2020

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Emeryville – Existing Conditions

Emeryville Site

Apgar Street and San Pablo Avenue

[nev-ū-non]

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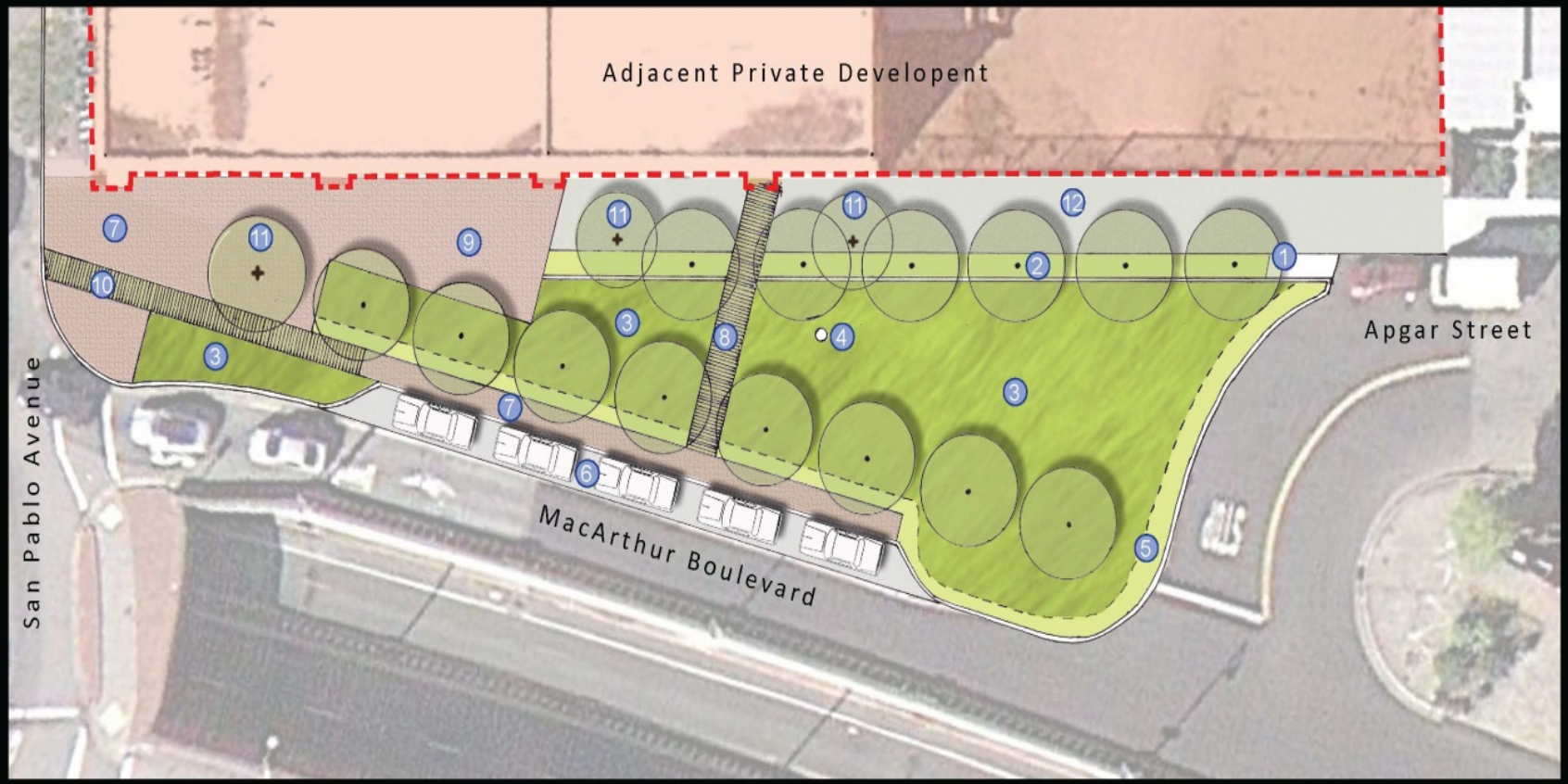

Stormwater Improvement Concept Plan

Scale: 1"=20'
January 2013

1. Entry point of stormwater flow from Apgar Street.
2. Low-flow green gutter. Higher flows spill over a small retaining wall into larger adjacent rain garden.
3. Rain garden landscape area.
4. Existing sewer manhole location.
5. Side slope landscape transitions grade from street level to the basin's finished elevations.
6. On-street asphalt parking zone (Capacity is for five vehicles)
7. New sidewalk paving to match existing brick paving along San Pablo Avenue (by private development?)
8. Pedestrian boardwalk crossing over rain garden system.
9. Expanded sidewalk area overlooks rain garden cells and allow for addition space for cafe/plaza seating.
10. Overflow from rain garden system.
11. Existing street trees to remain.
12. Sidewalk zone to be paved with standard scored concrete.

San Pablo Avenue Green Stormwater Spine Project

City of Emeryville, California

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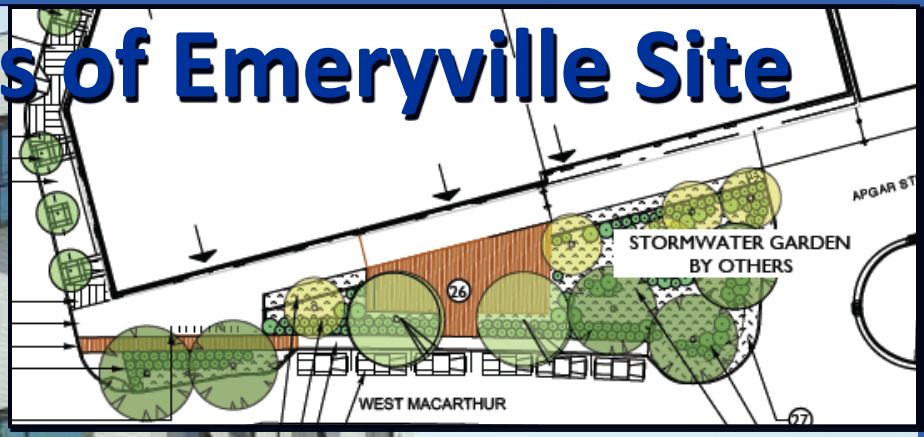
Developer Renderings of Emeryville Site



David Baker & Associates

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1

LOCATION

Moeser Lane & San Pablo Ave

Opportunities:

- Could potentially manage private stormwater along San Pablo frontage
- Wide sidewalks and relatively low parking demand along San Pablo Avenue
- Project site could potentially demonstrate multiple stormwater technologies for managing parking lot and street runoff

Constraints:

- Existing mature trees may limit the size and shape of stormwater planters
- There needs to be agreement and coordination with private developer to manage stormwater along frontage
- May need to remove upstream inlets in order to direct more stormwater to project site

Recommendation:

- The design team recommends this site in conjunction with Site # 2 due to low parking demand along San Pablo Avenue, the potential to manage private stormwater along the San Pablo Avenue frontage, and the potential to demonstrate multiple technologies for managing parking lot and street runoff

San Pablo Avenue Green Stormwater Spine Project

City of El Cerrito, California (Urban Greening Site)

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El Cerrito (Urban Greening Site)

Moeser Lane and San Pablo Avenue

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Stormwater Improvement Concept Plan

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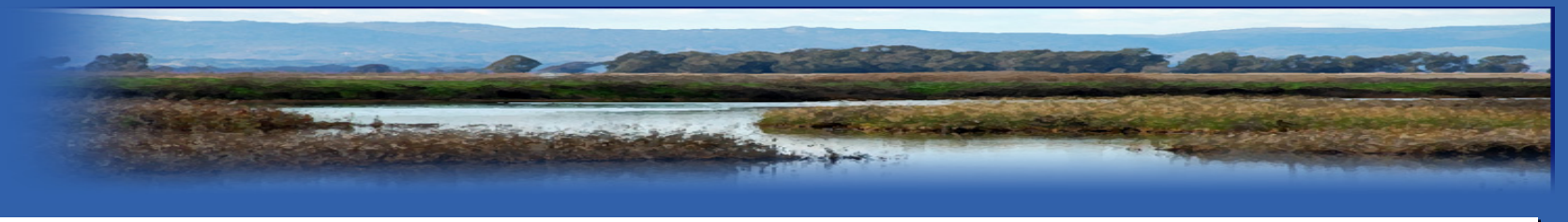

36"

22"

GREEN STREETS BLUE BAY

GREEN STREETS CLEAN POLLUTED WATER BEFORE IT DRAINS TO THE BAY

WHAT ARE GREEN STREETS?

When it rains, stormwater races off roof tops, sidewalks, and streets, picking up pollutants such as motor oil, heavy metals, pesticides, trash, and pet waste. The contaminated water typically flows untreated into storm drains, creeks, and ultimately into the San Francisco Bay.

Green Streets **collect** stormwater in specially designed basins, filled with carefully selected plants and soils. The plants and soil organisms **clean** the water by filtering and breaking down various pollutants. The cleansed stormwater **returns** to the storm drain system or soaks into the native soil (replenishing groundwater).

In addition to cleaning the water, Green Streets beautify the community, provide bird and insect habitat, and reduce localized flooding.

¿CUÁLES SON LAS CALLES VERDE?

Cuando llueve, las carreras de aguas pluviales fuera tejados, aceras y calles recogiendo contaminantes, tales como: aceite de motor, metales pesados, pesticidas, basura y desechos de mascotas. Esta agua contaminada normalmente fluye sin tratar en las alcantarillas, arroyos, y en última instancia en San Francisco Bay.

Calles Verdes **recoger** las aguas pluviales en las cuencas diseñadas especialmente llenos de plantas y suelos cuidadosamente seleccionadas. Las plantas y los organismos del suelo **limpian** el agua por filtración y romper varios contaminantes. El agua de lluvia limpia **vuelve** al sistema colector de aguas pluviales o empapa en los suelos naturales (agua subterráneas reposición).

Además de limpiar el agua, las Calles Verdes embellecer la comunidad, proveen hábitat de aves y de insectos, y reducir inundaciones localizadas.

EMERYVILLE GREEN STREET WATERSHED

Stormwater from the shaded 2 acre area indicated on the map is treated and cleaned by this Green Street.

BEFORE THE GREEN STREET

San Pablo Ave Green Stormwater Spine Lessons Learned

- **Budget for utility investigations, coordination and accommodation**
- **Limit project to 2-3 separate jurisdictions**
- **Need active participation & support from municipal partners**
- **Be flexible in project management: build low-hanging fruit projects earlier**
- **Communication with partners, funders, impacted businesses/residents is critical**
- **Any problem is solvable with enough time and money**

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San Francisco Estuary Partnership
www.sfestuary.org

Photograph by Dan Cloak






Maintenance Examples

A Flow-Through Planter…

…in good condition

A Flow-Through Planter…

…that needs a splash block

A Bioretention Area…

…that needs mulch

A Bioretention Area…

…with plants in good condition

A Bioretention Area…

…that needs plant trimming

A Bioretention Area…

…that needs mulch

A Newly Installed Bioretention Area…

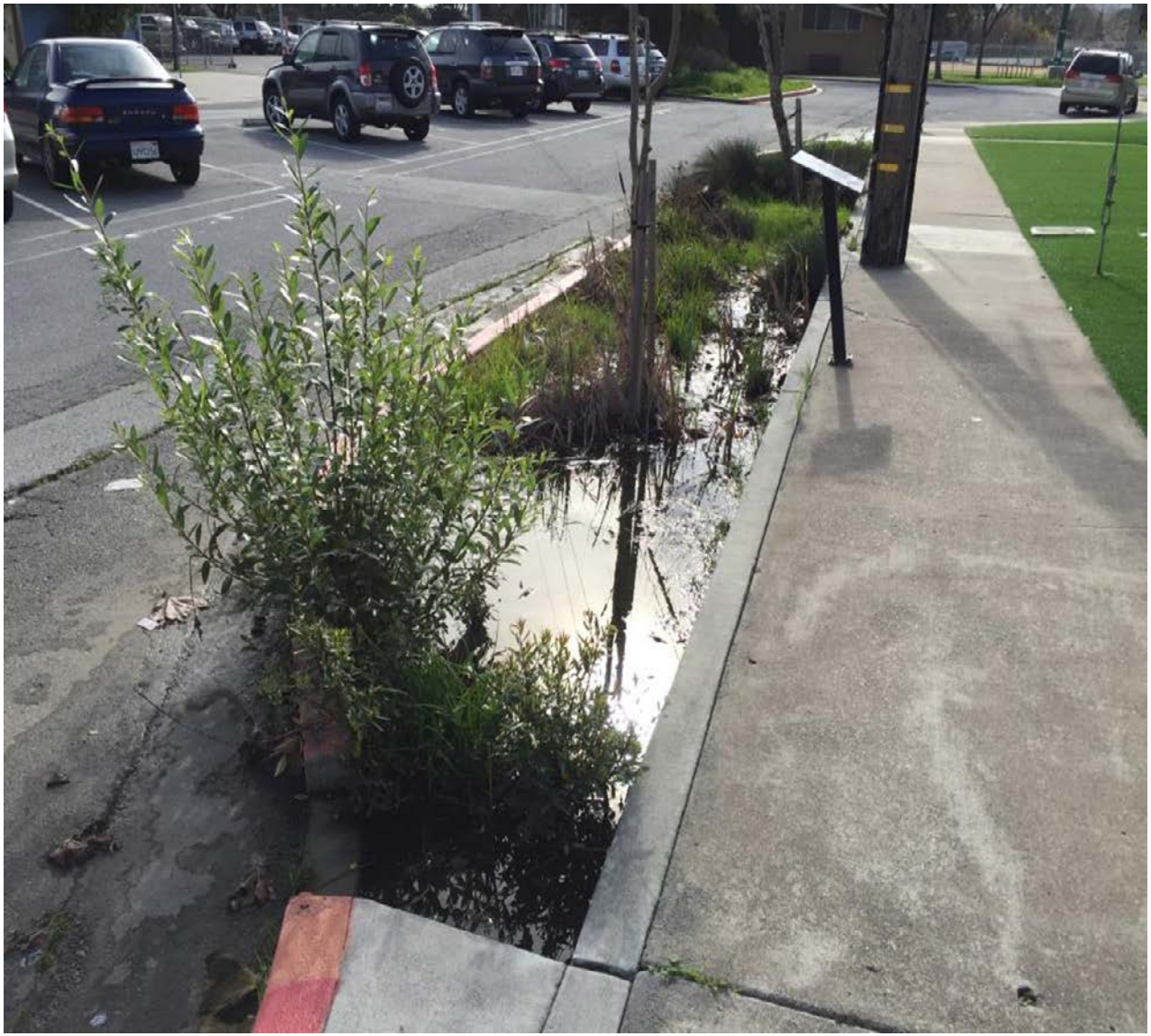
…in good condition after installation

The same system a year later…

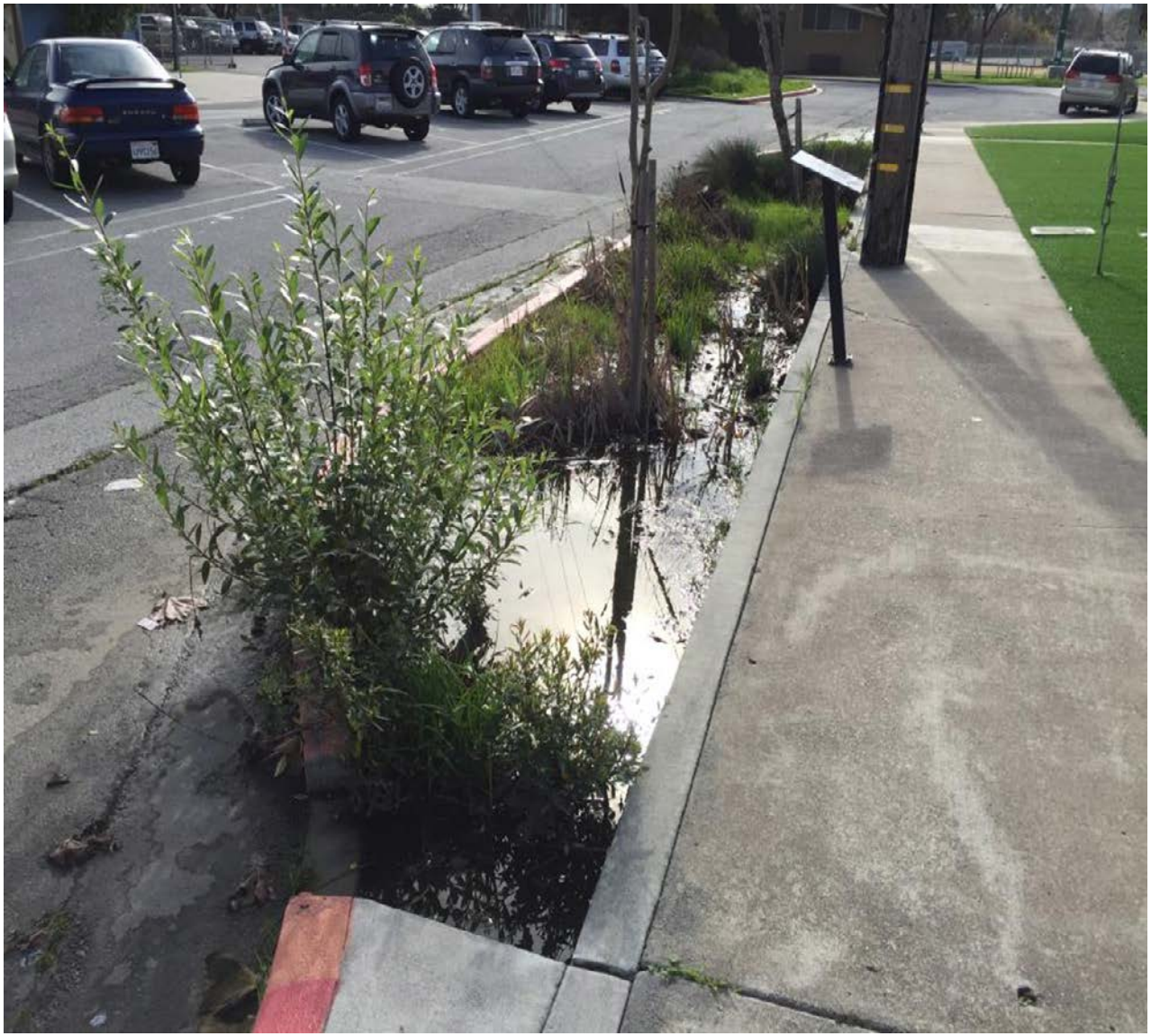
…with plants that were improperly trimmed…

Resulting in many plants failing a year later…

…and needing replanting…



A Bioretention Area…



…with standing water

…with standing water AND algae growth

A Flow-through Planter…

That needs replanting…