

Multi-tasking with runoff:

Beneficial uses for an under-appreciated by-product of development



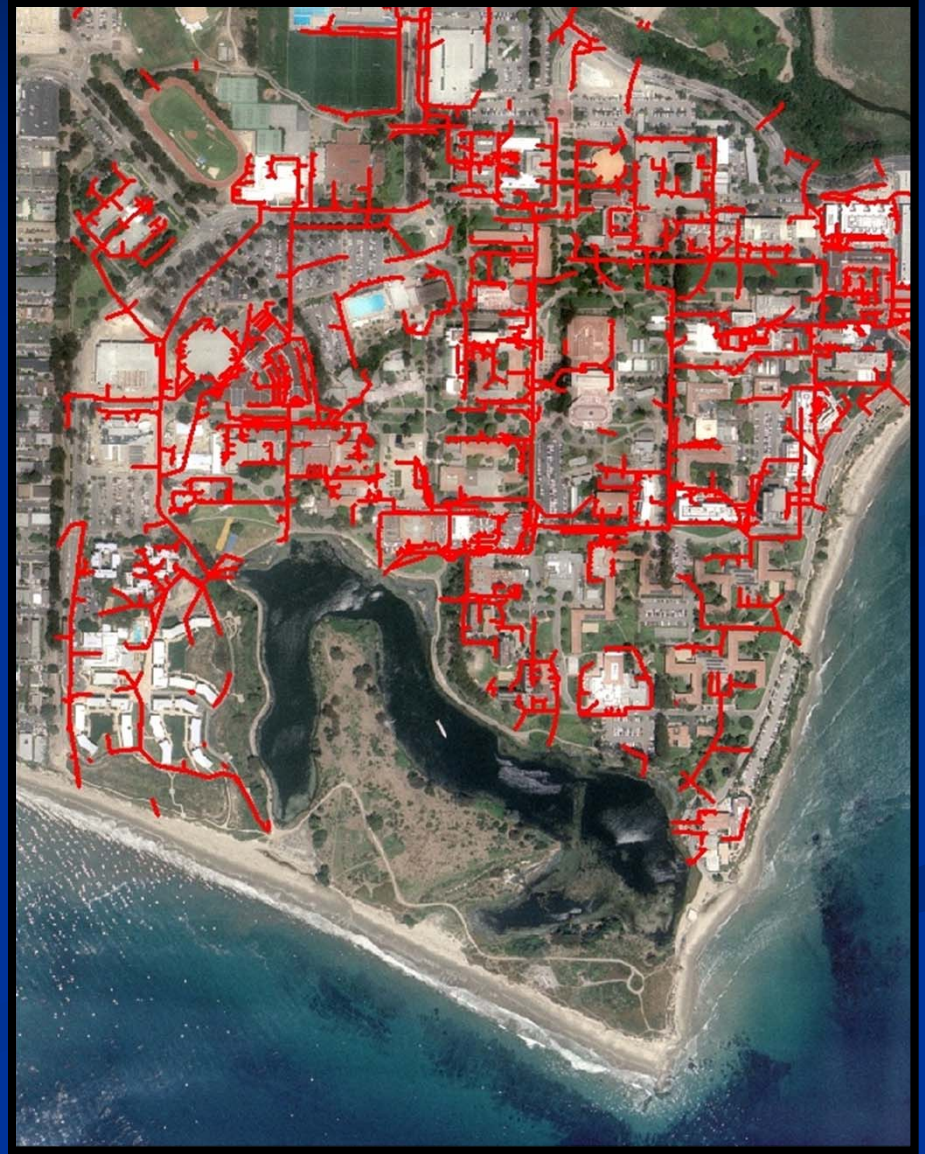
Lisa Stratton



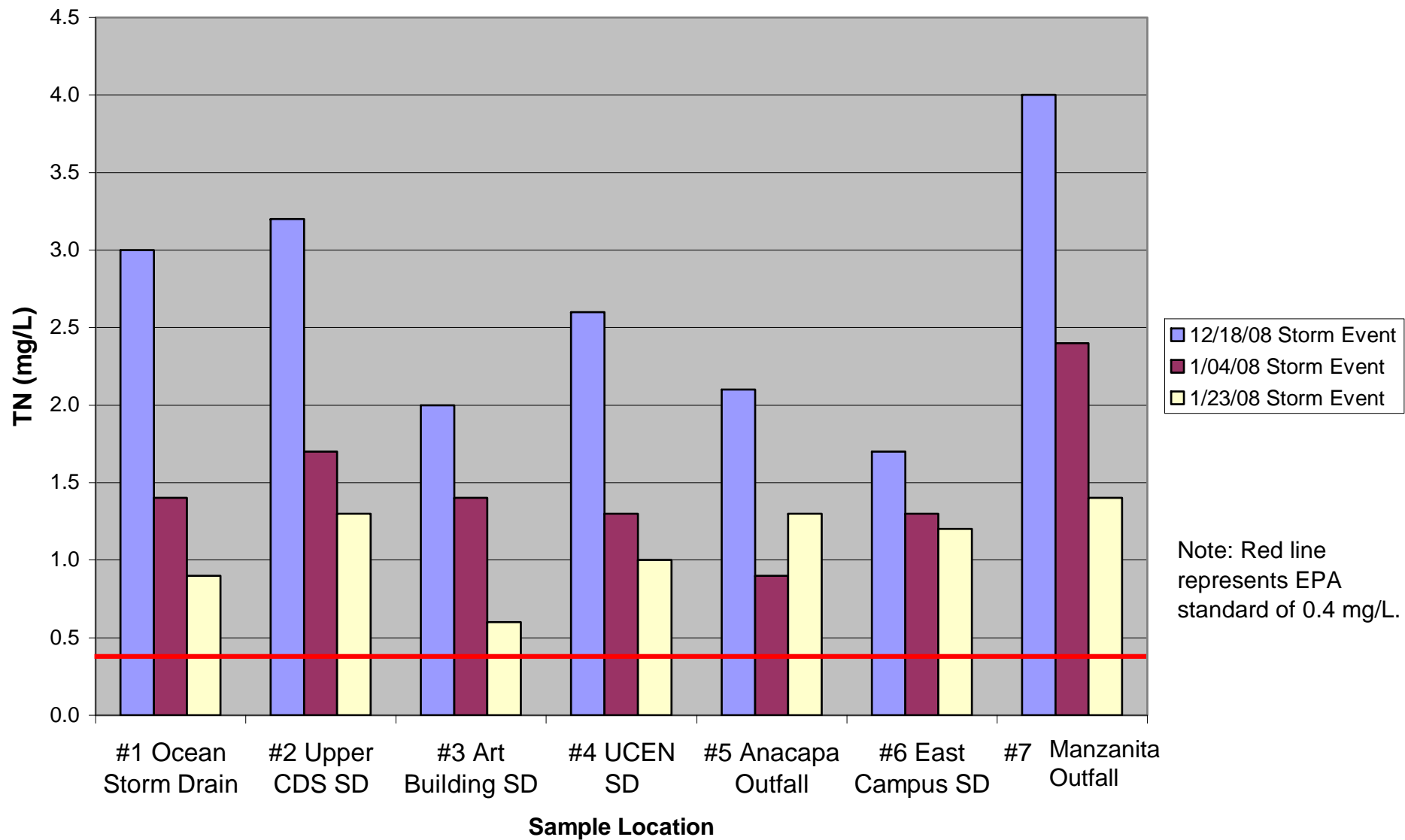
Conventional Stormwater Treatment



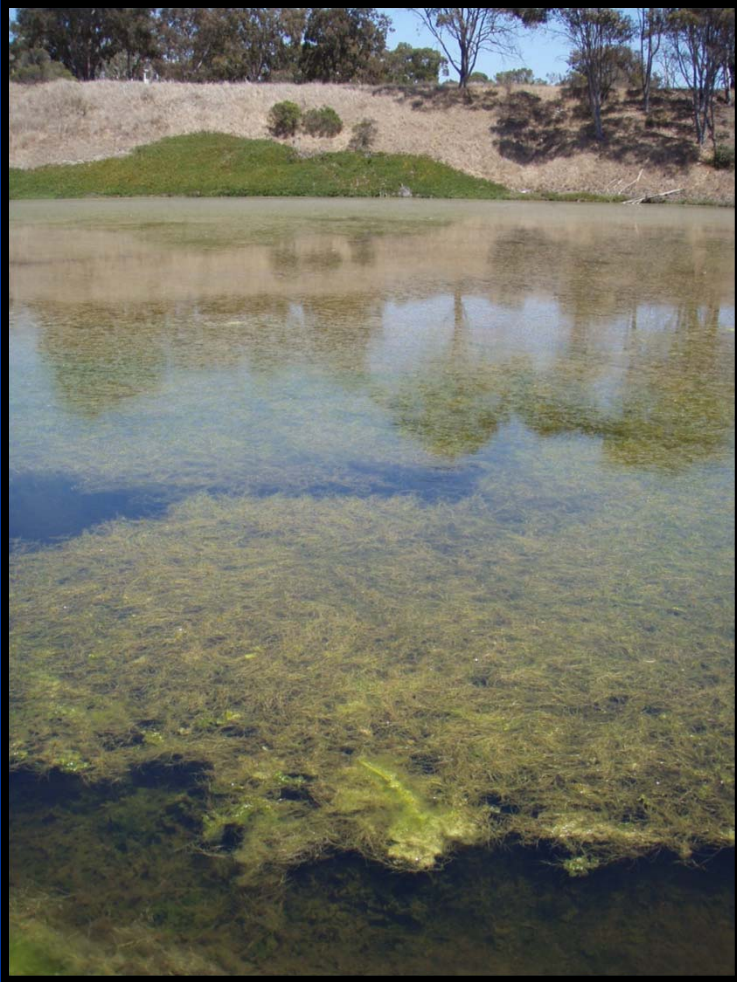
UCSB Watershed and Storm Drain Infrastructure



Total Nitrogen

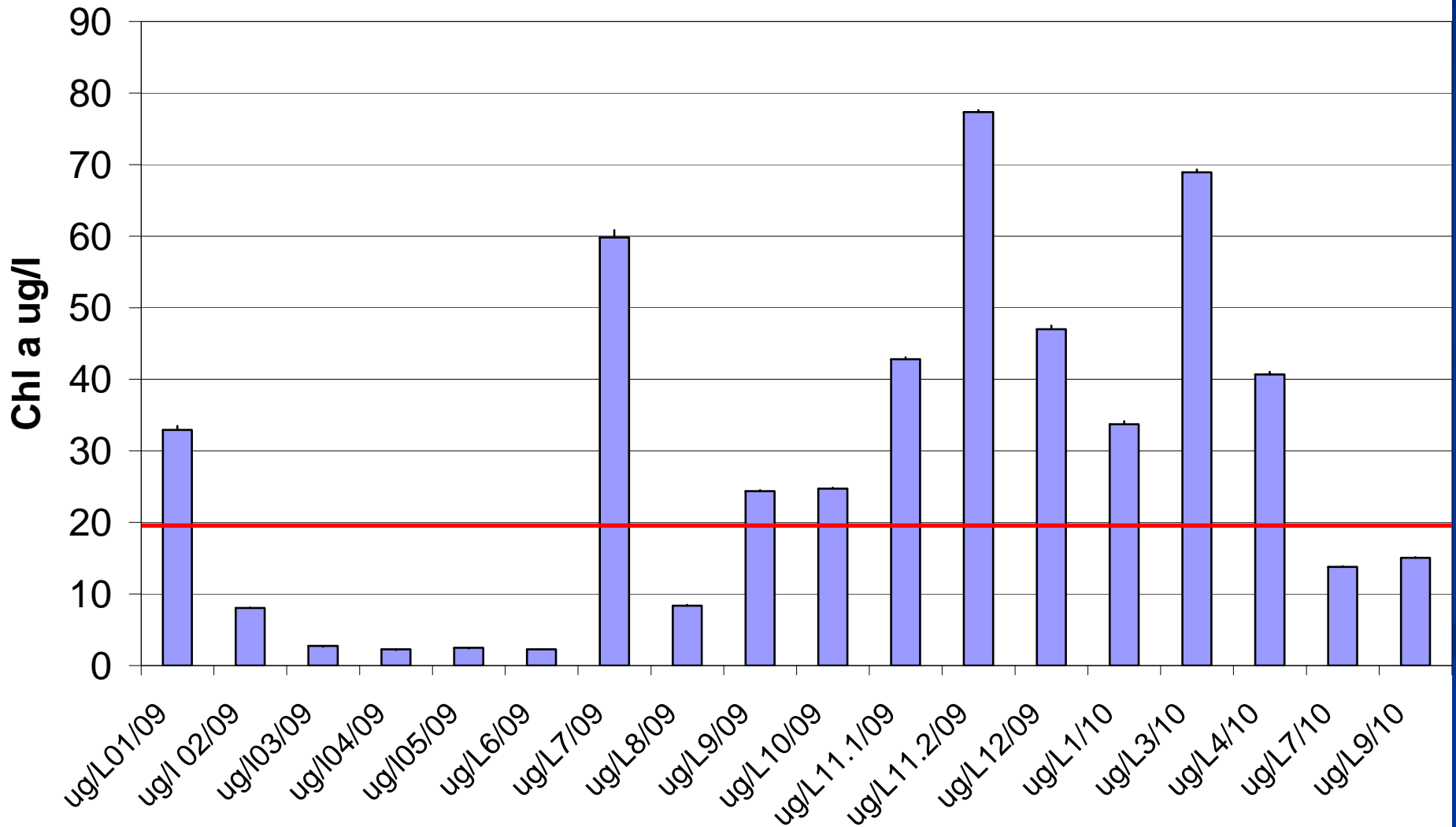


Algal blooms and submerged aquatic vegetation



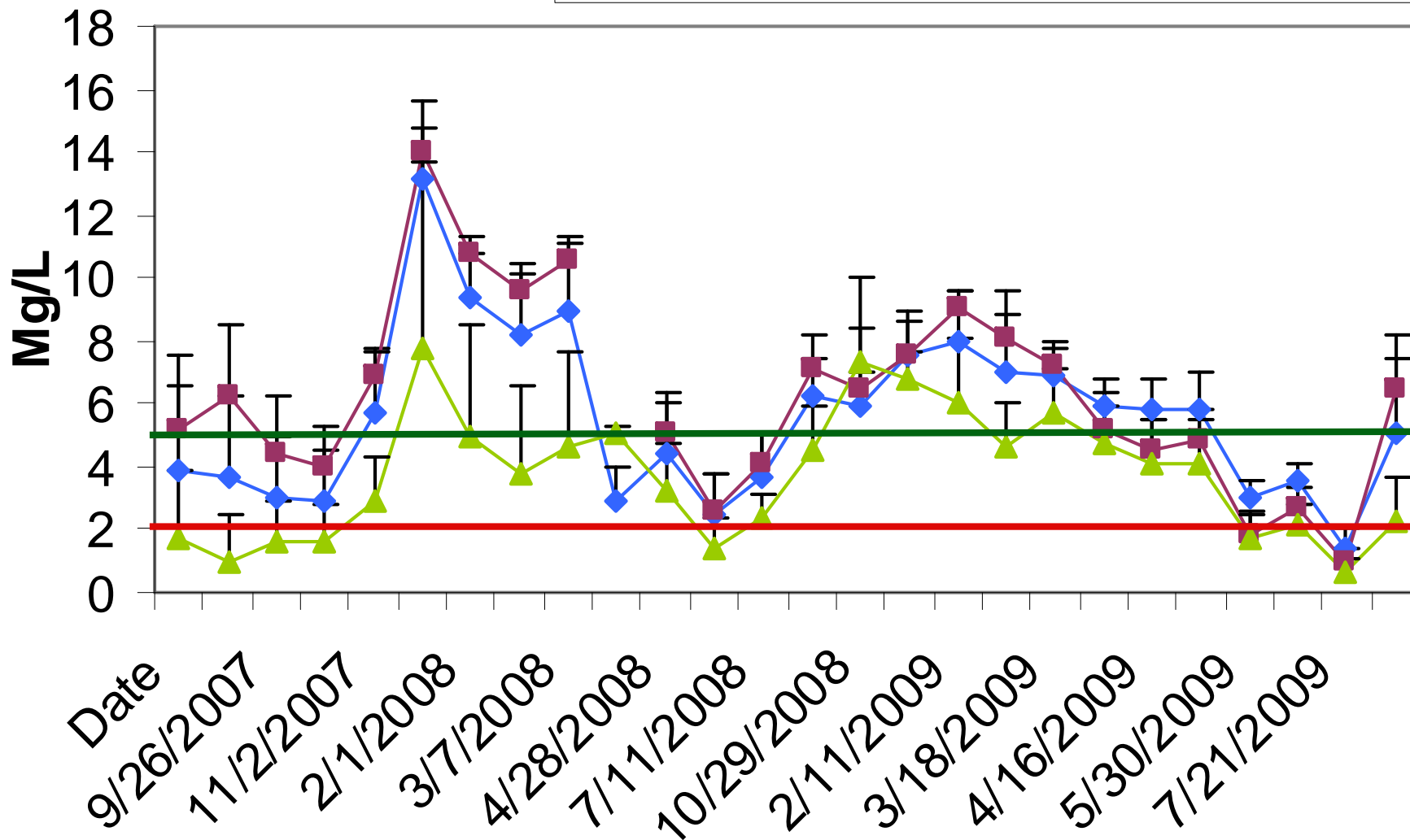
Why is the water green and opaque?

Chl a fluorescence monthly means

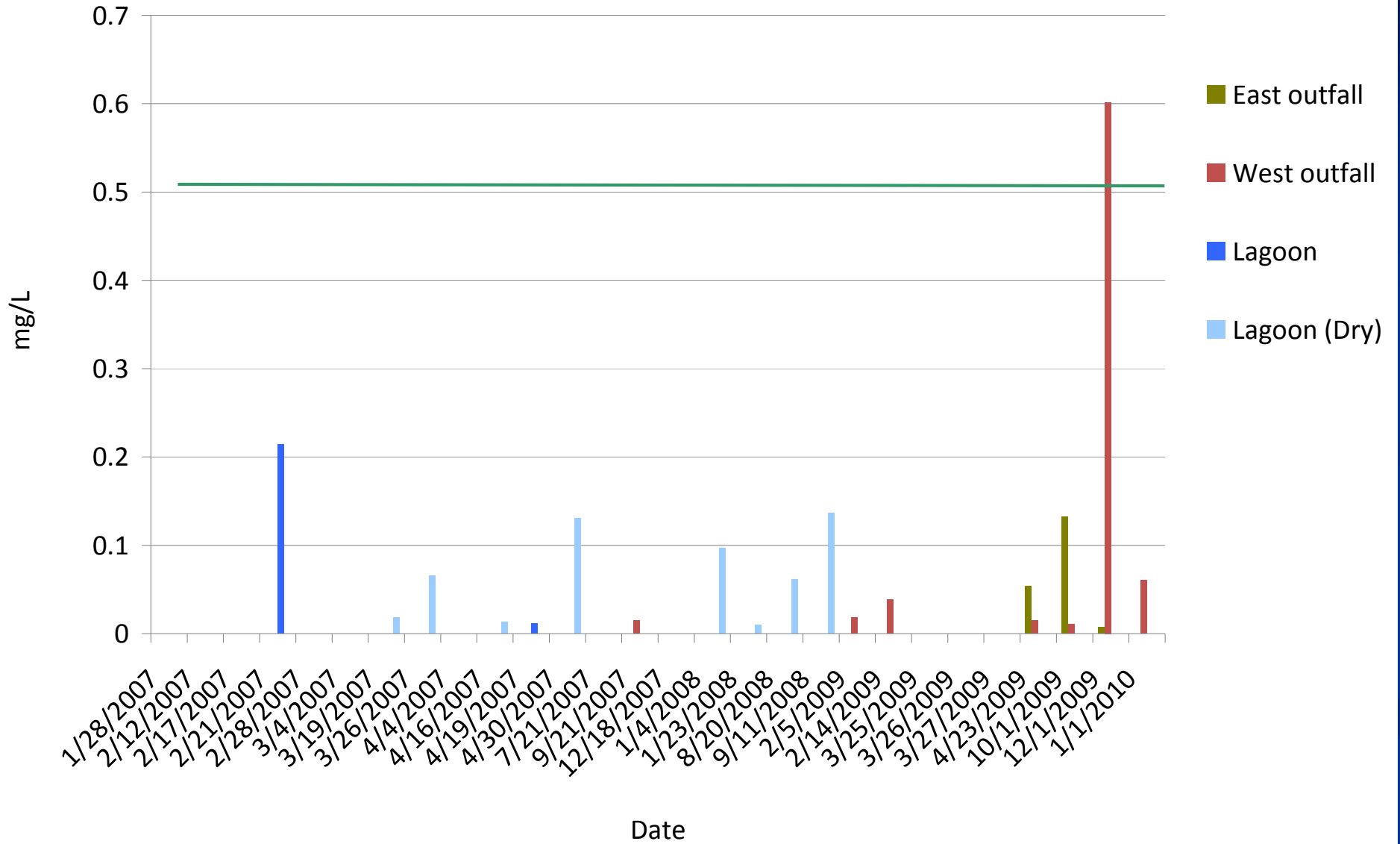


Dawn DO

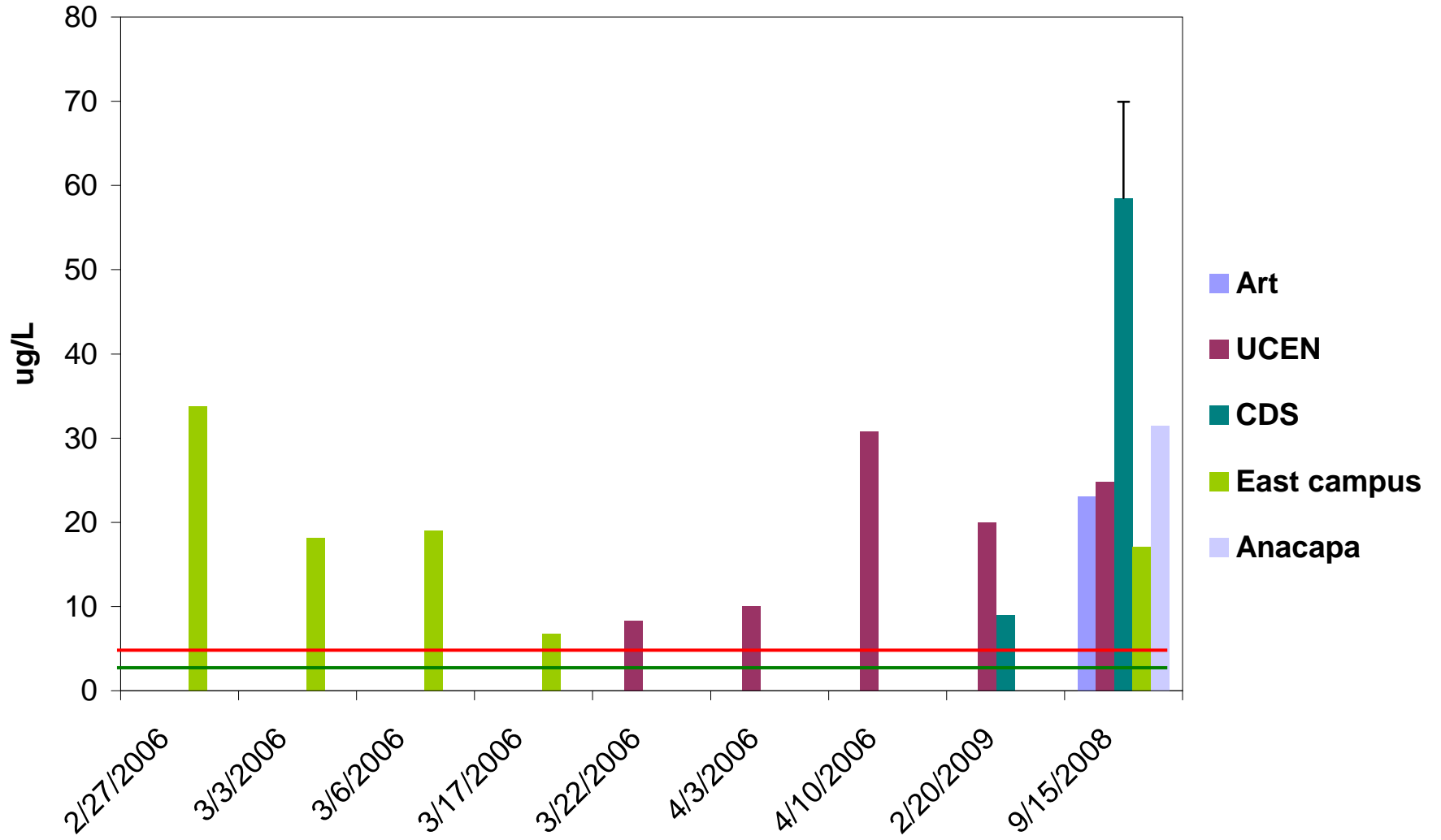
◆ Surface ■ 1 meter ▲ Bottom



Nitrate + Nitrite



Storm Drain Copper



Manzanita Bioswale System



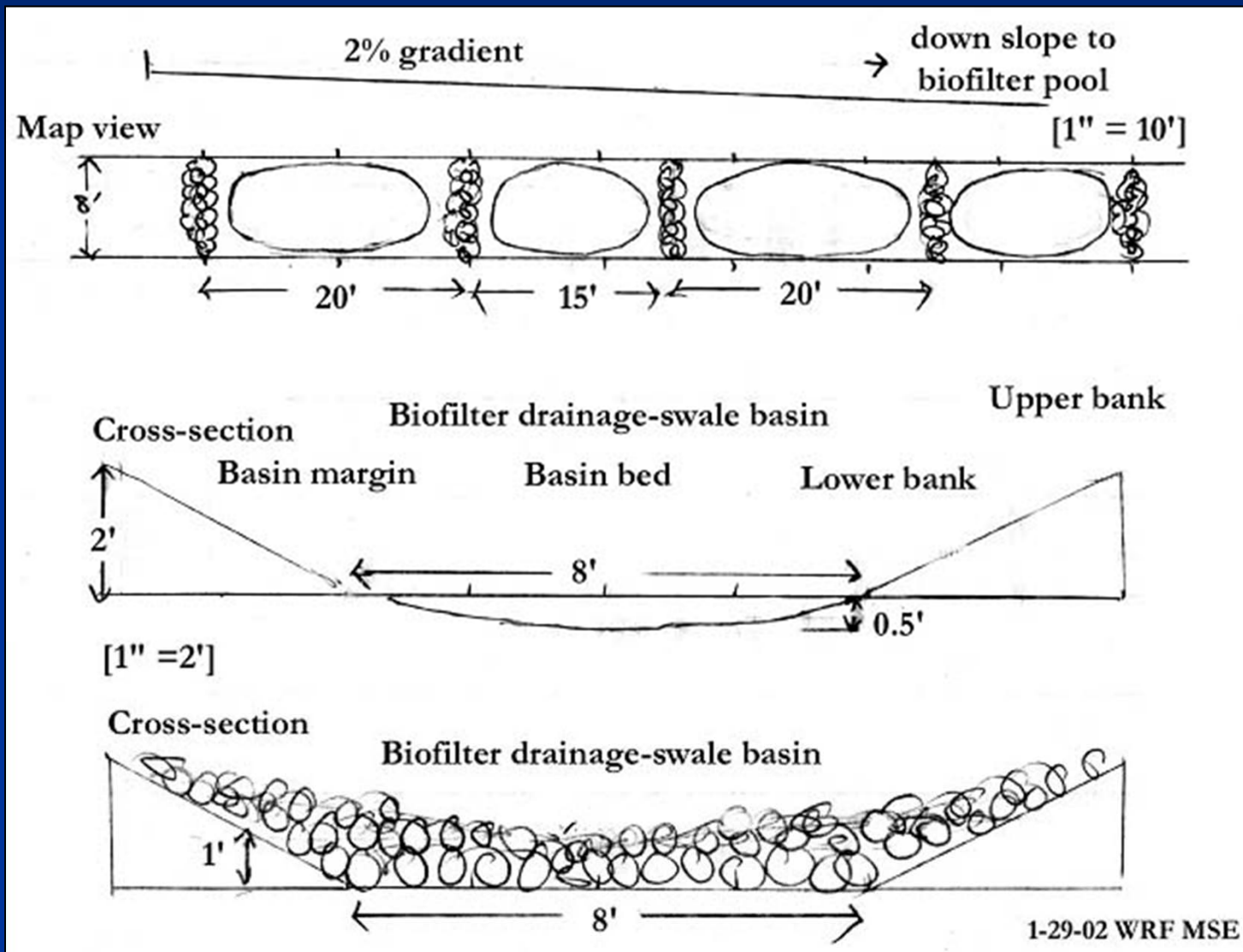


Bioswales

Constructed Wetlands



Manzanita Bioswale Design



Bioswale Cross-section



Anemopsis californica *Euthamia occidentalis*
Baccharis douglasii *Frankenia salina*
Distichlis spicata *Juncus textilis*
Leymus triticoides

Lower Bank

Juncus mexicanus *Juncus patens*
Juncus phaeocephalus

Basin Bed

lo- marsh zone

Schoenoplectus americanus
Schoenoplectus californicus

hi-marsh zone

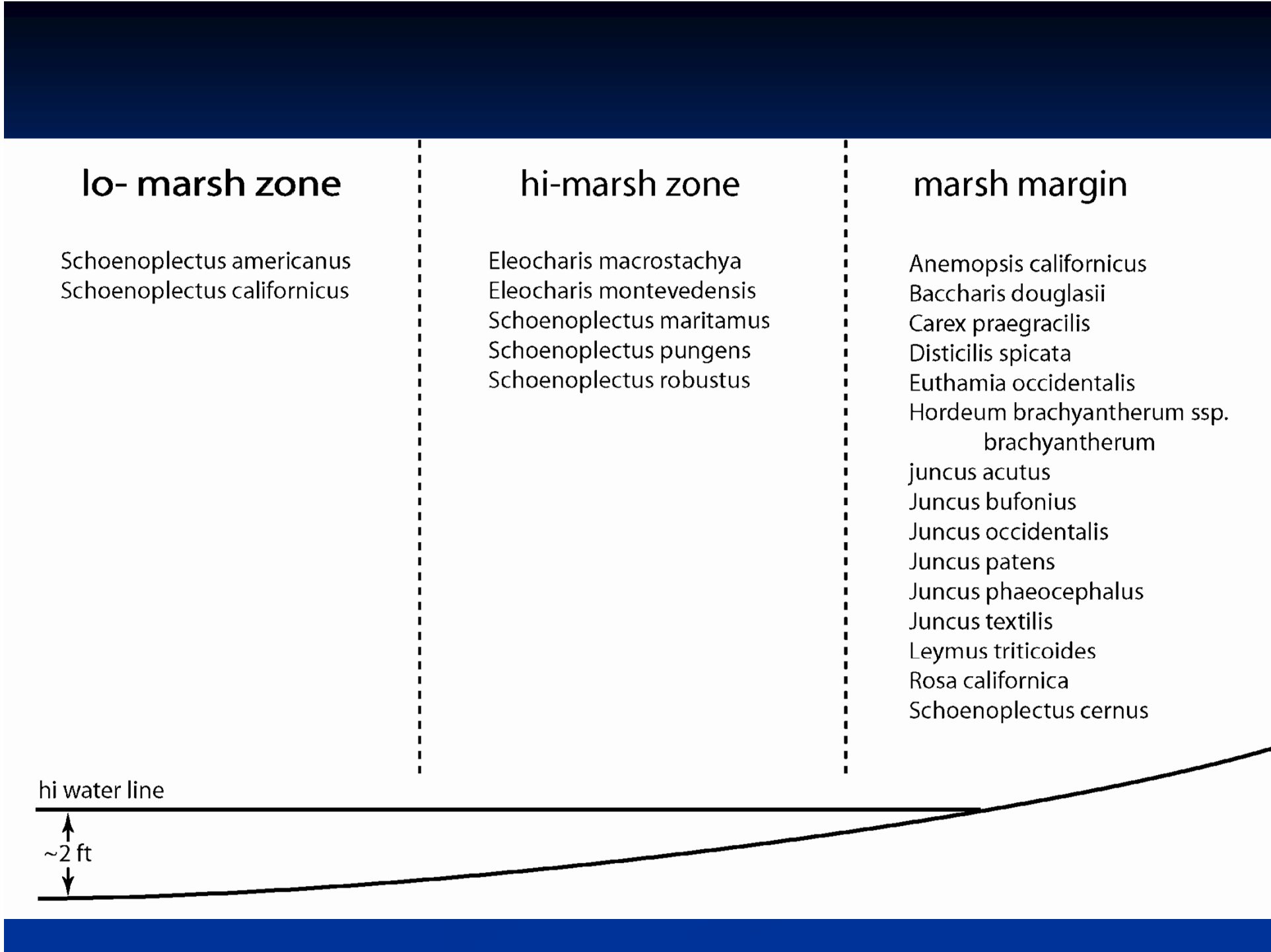
Eleocharis macrostachya
Eleocharis montevedensis
Schoenoplectus maritamus
Schoenoplectus pungens
Schoenoplectus robustus

marsh margin

Anemopsis californicus
Baccharis douglasii
Carex praegracilis
Disticlis spicata
Euthamia occidentalis
Hordeum brachyantherum ssp.
brachyantherum
juncus acutus
Juncus bufonius
Juncus occidentalis
Juncus patens
Juncus phaeocephalus
Juncus textilis
Leymus triticoides
Rosa californica
Schoenoplectus cernus

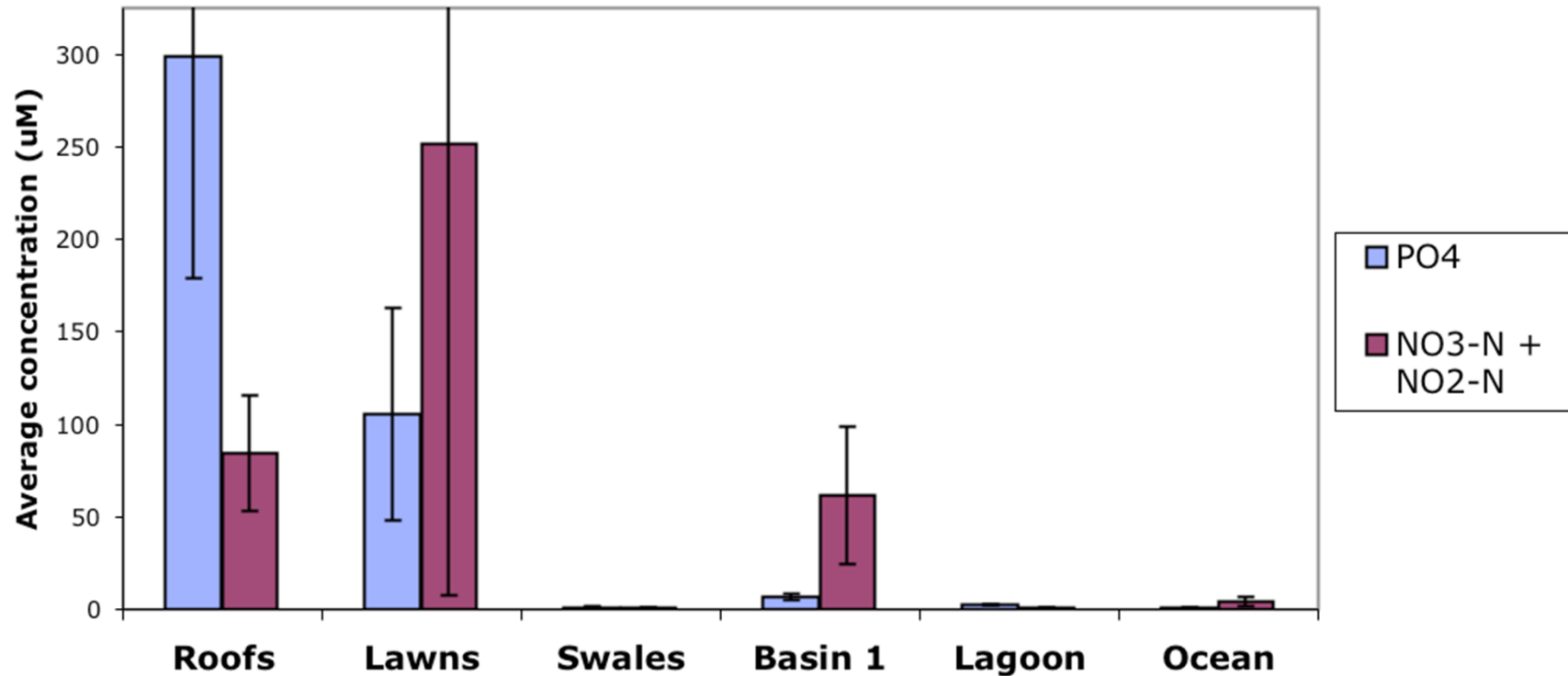
hi water line

↑
~2 ft
↓



Monitoring

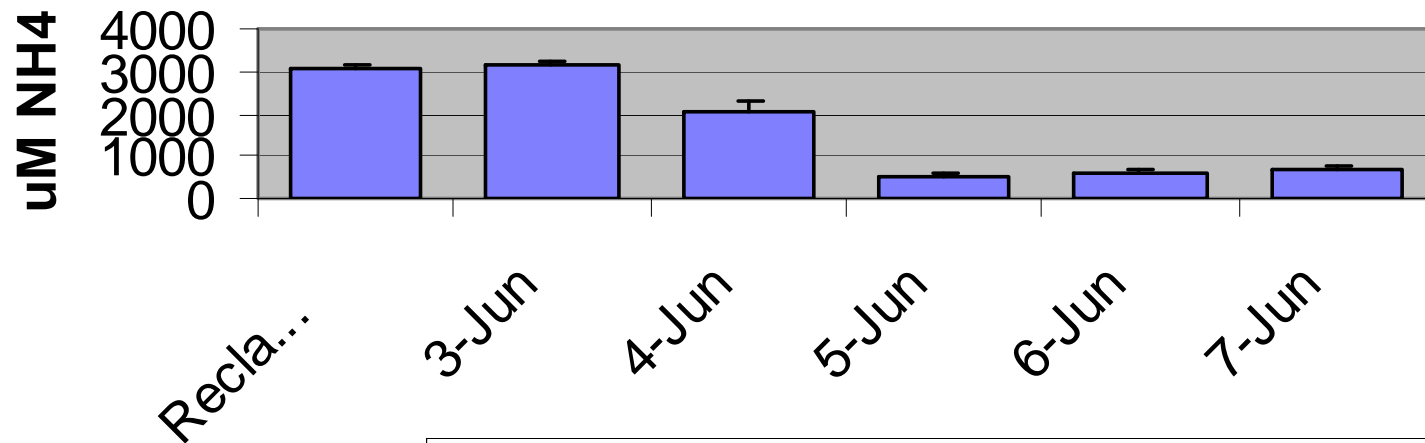
Average concentration of Nutrients at Manzanita Village from Roofs to Ocean



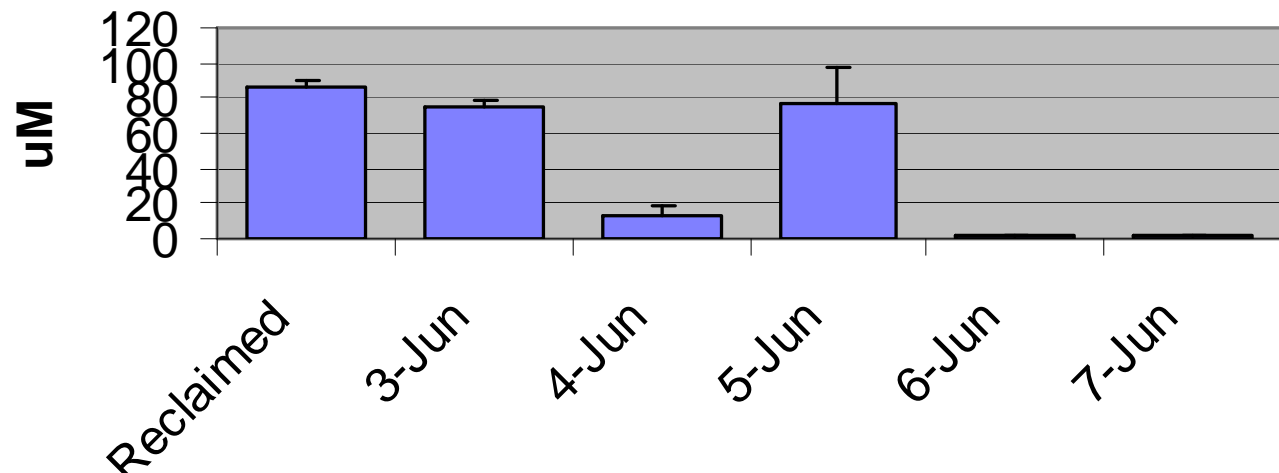
50-60% reduction in concentrations of phosphate and nitrogen respectively, from downspout to upper bioswale basin during a rainfall event.

Bioswale nutrient reduction

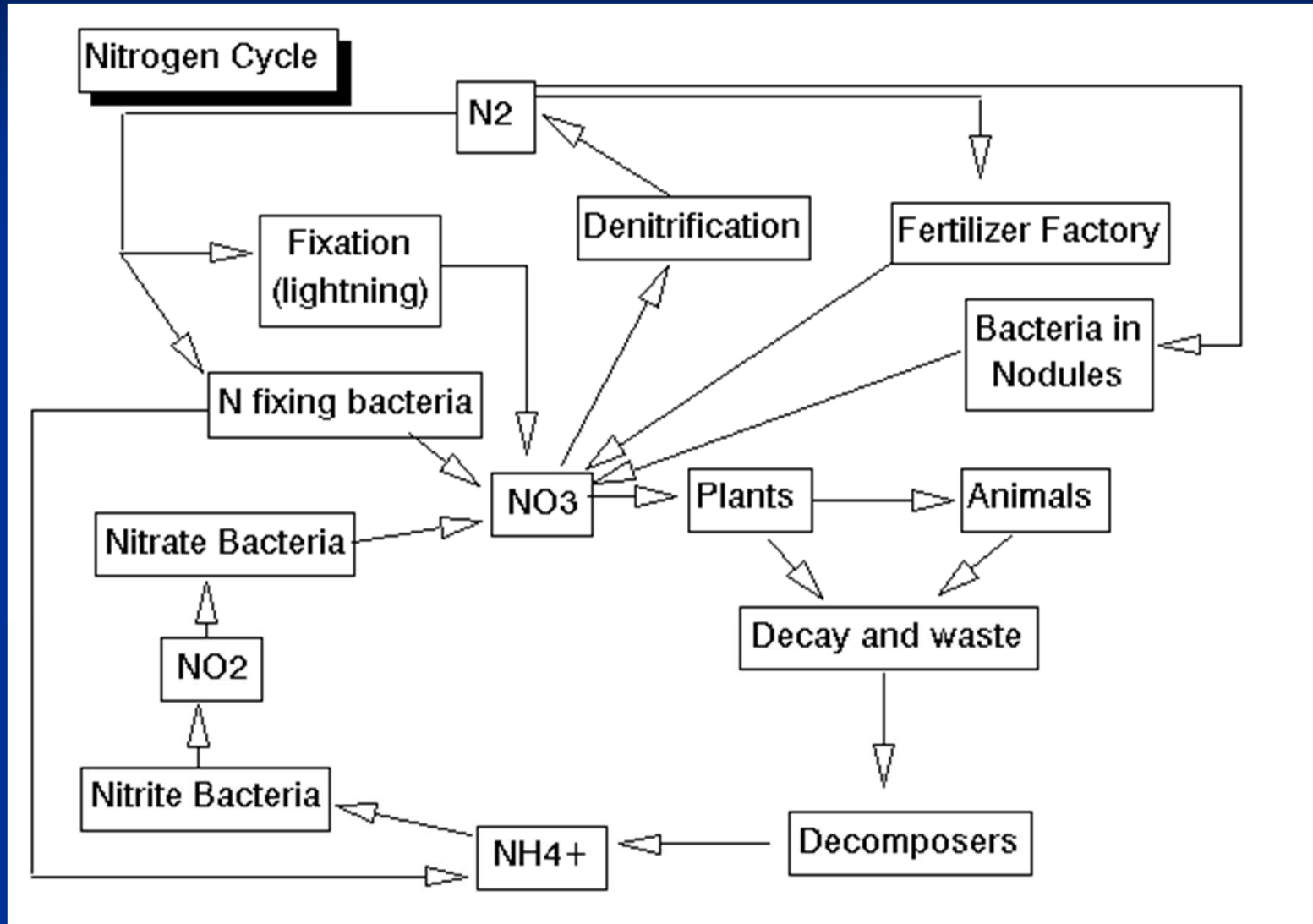
Ammonium (n=6) s.e.



Nitrite and Nitrate (n=6) s.e.



The Nitrogen Cycle



UCSB Campus Lagoon

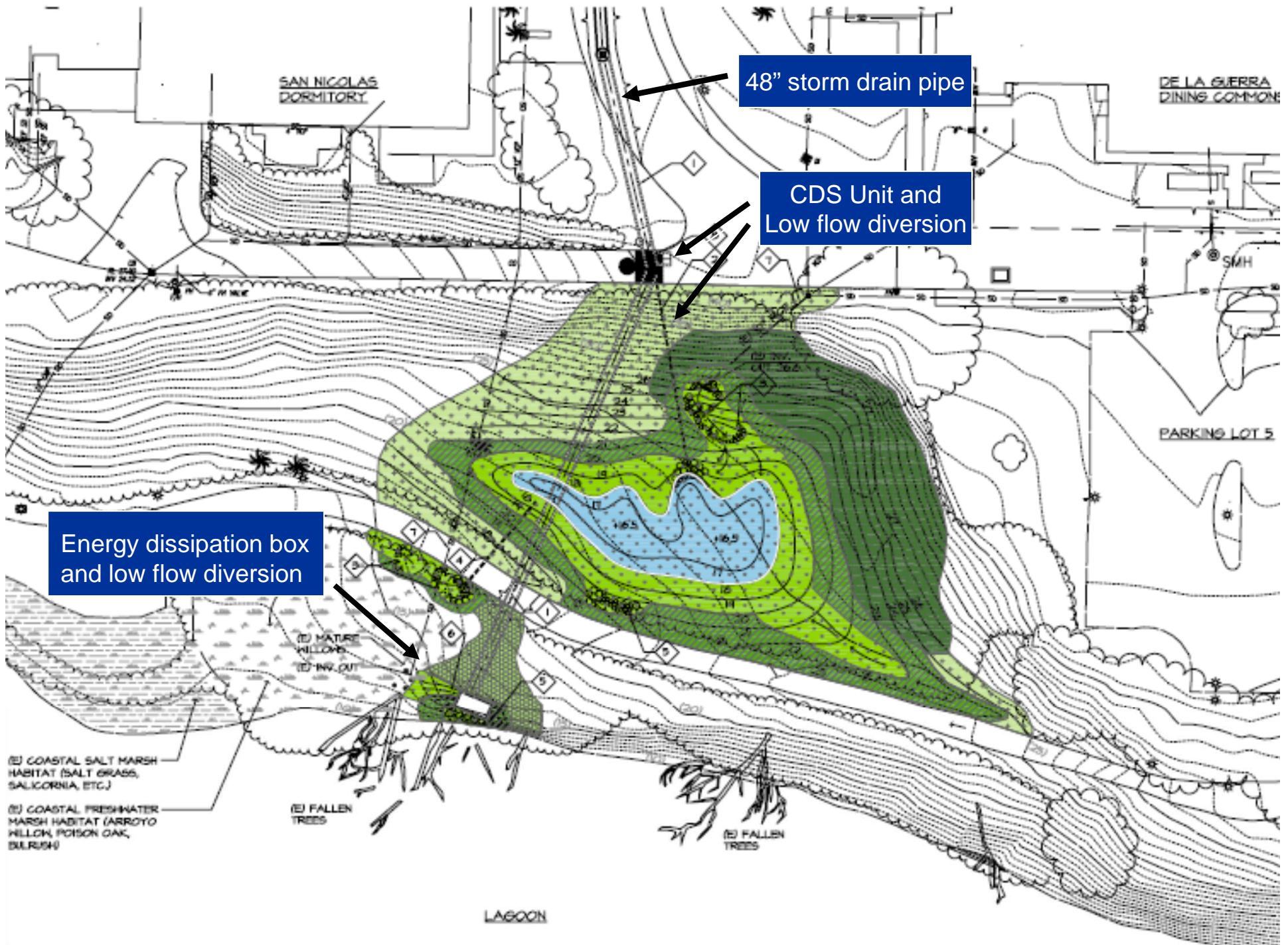
- Naturally formed lagoon that receives runoff from campus
- Continuous ocean water input pumped in at 600 gal/min

San Nicolas Wetland Project



San Nicolas Wetland site





48" storm drain pipe

CDS Unit and Low flow diversion

Energy dissipation box and low flow diversion

(E) COASTAL SALT MARSH HABITAT (SALT GRASS, SALICORNIA, ETC.)
(E) COASTAL FRESHWATER MARSH HABITAT (ARROYO WILLOW, POISON OAK, BULRUSH)

(E) FALLEN TREES

(E) FALLEN TREES

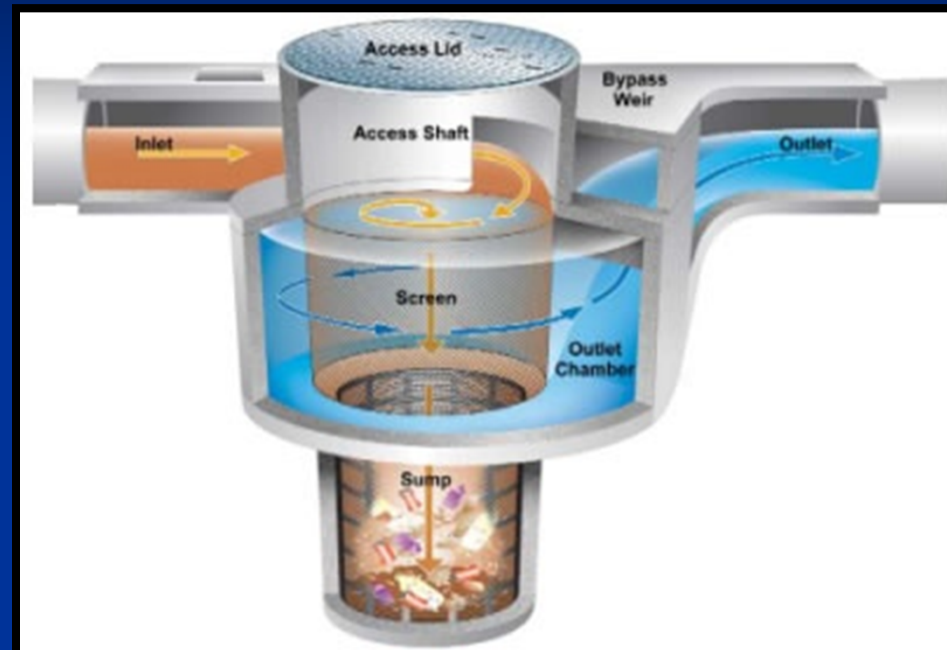
LAGOON

DE LA GUERRA DINING COMMONS

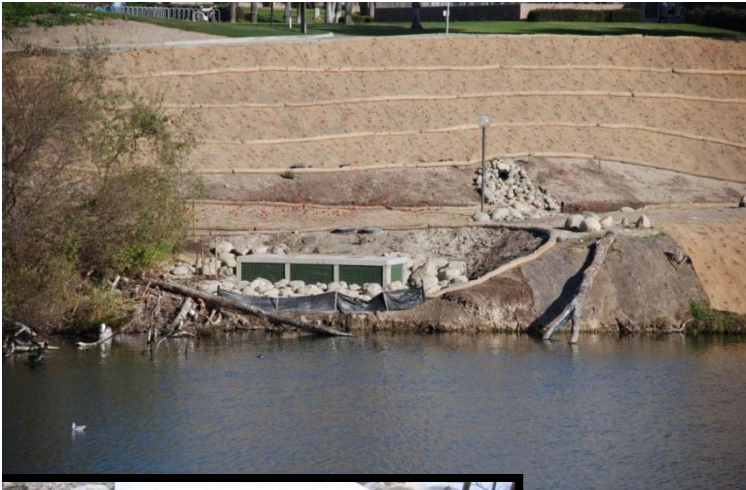
PARKING LOT 5

SMH

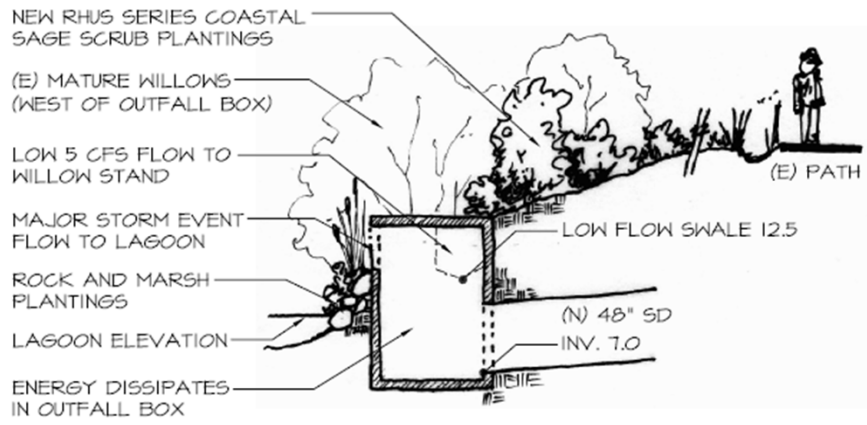
Continuous Deflection Separator (CDS Unit)



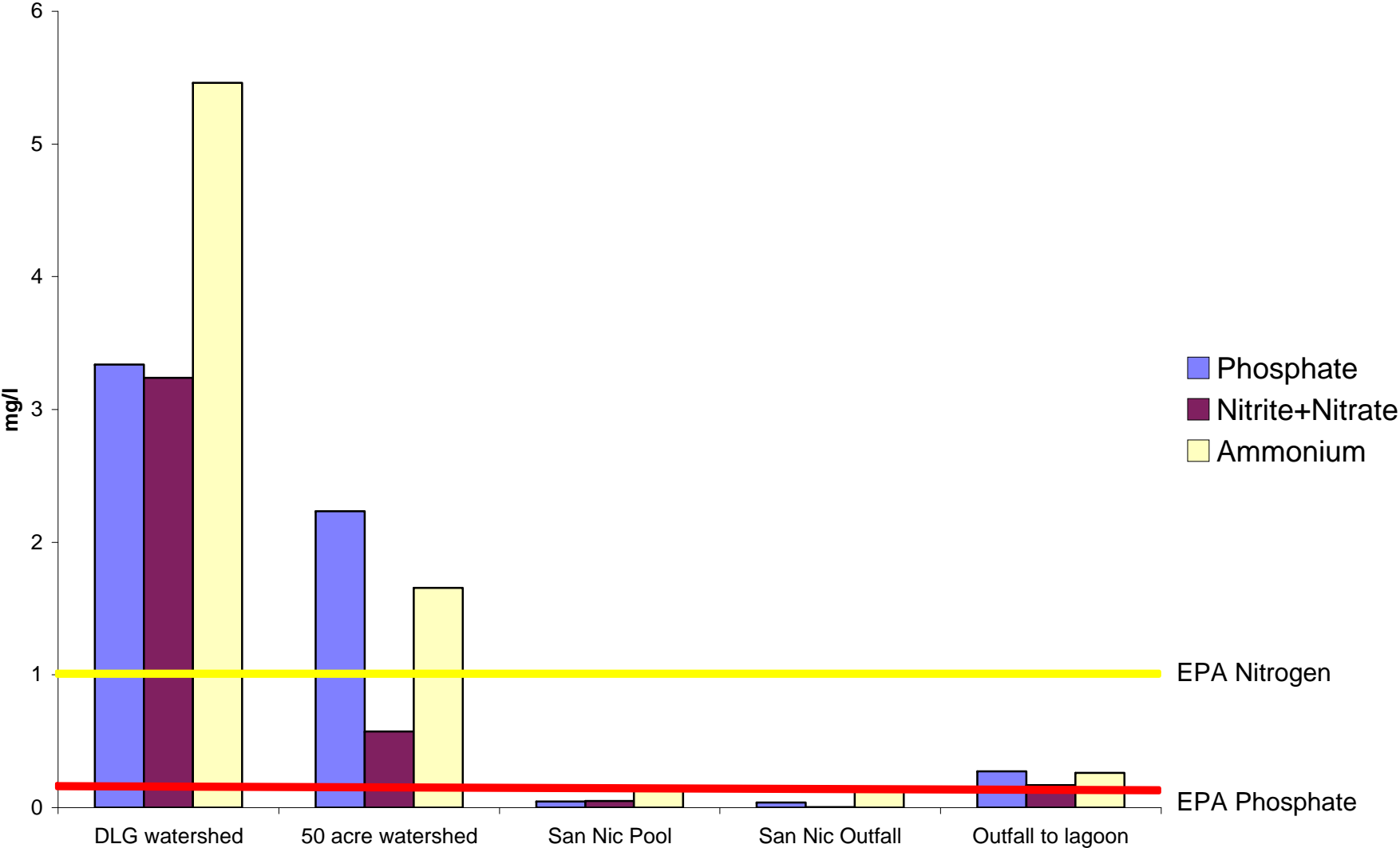
Energy Dissipation Box



LAGOON OUTFALL PLANTING



San Nicolas Wetland Dry Season Nutrient treatment





090610



090910



121510



032011



Mimulus guttatus and Anemopsis californica (Yerba mansa)



Lasthenia glabrata (salt marsh goldfields)









September 2010



December 2010



March 2011



June 2011



September 2010



December 2010



March 2011



June 2011

Project Collaboration

Wetland Recovery Project

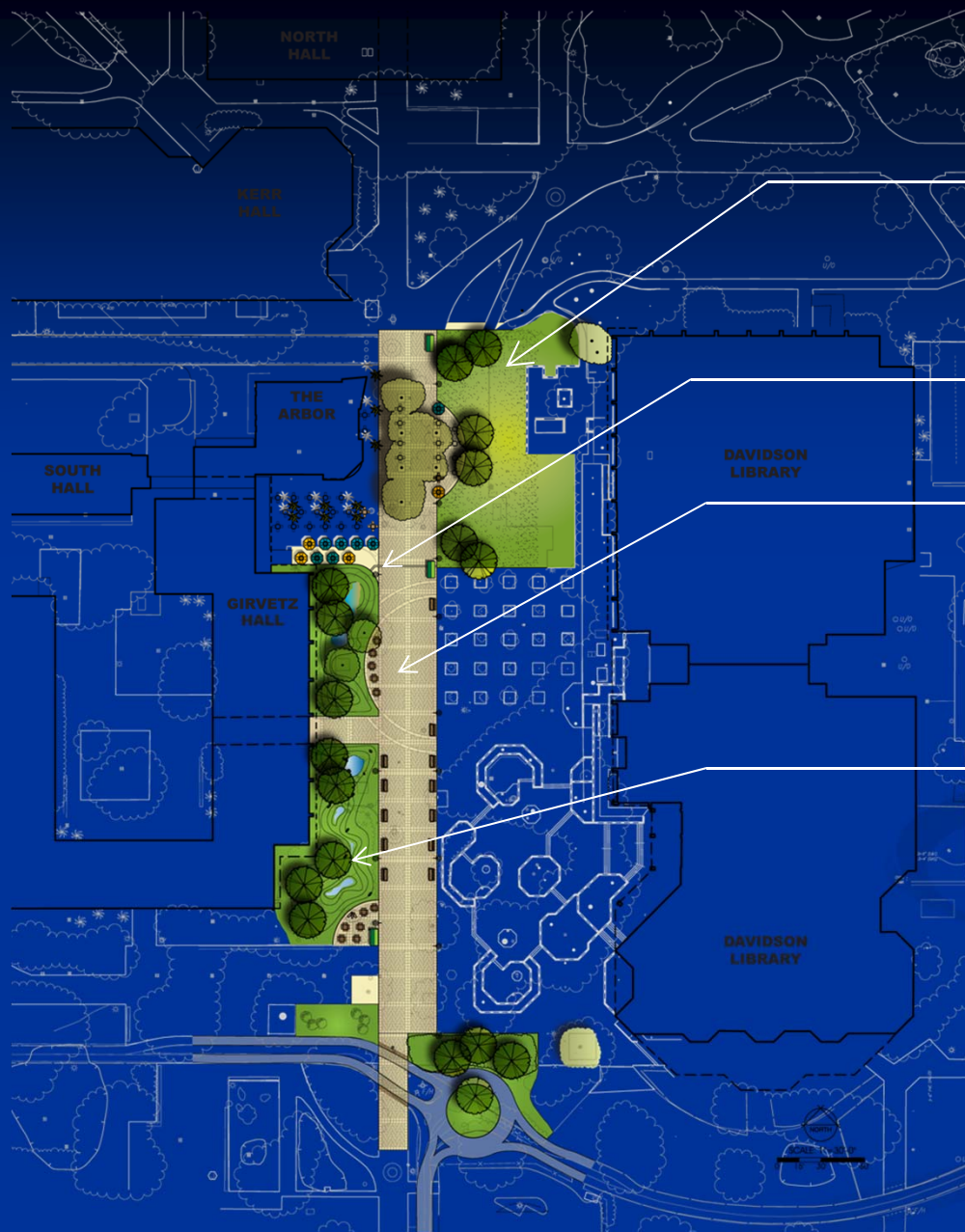
Coastal Fund

UCSB Design & Construction

Local Students

UCSB Student interns





Raised berm lawn – increases permeable area and reduces runoff quantity

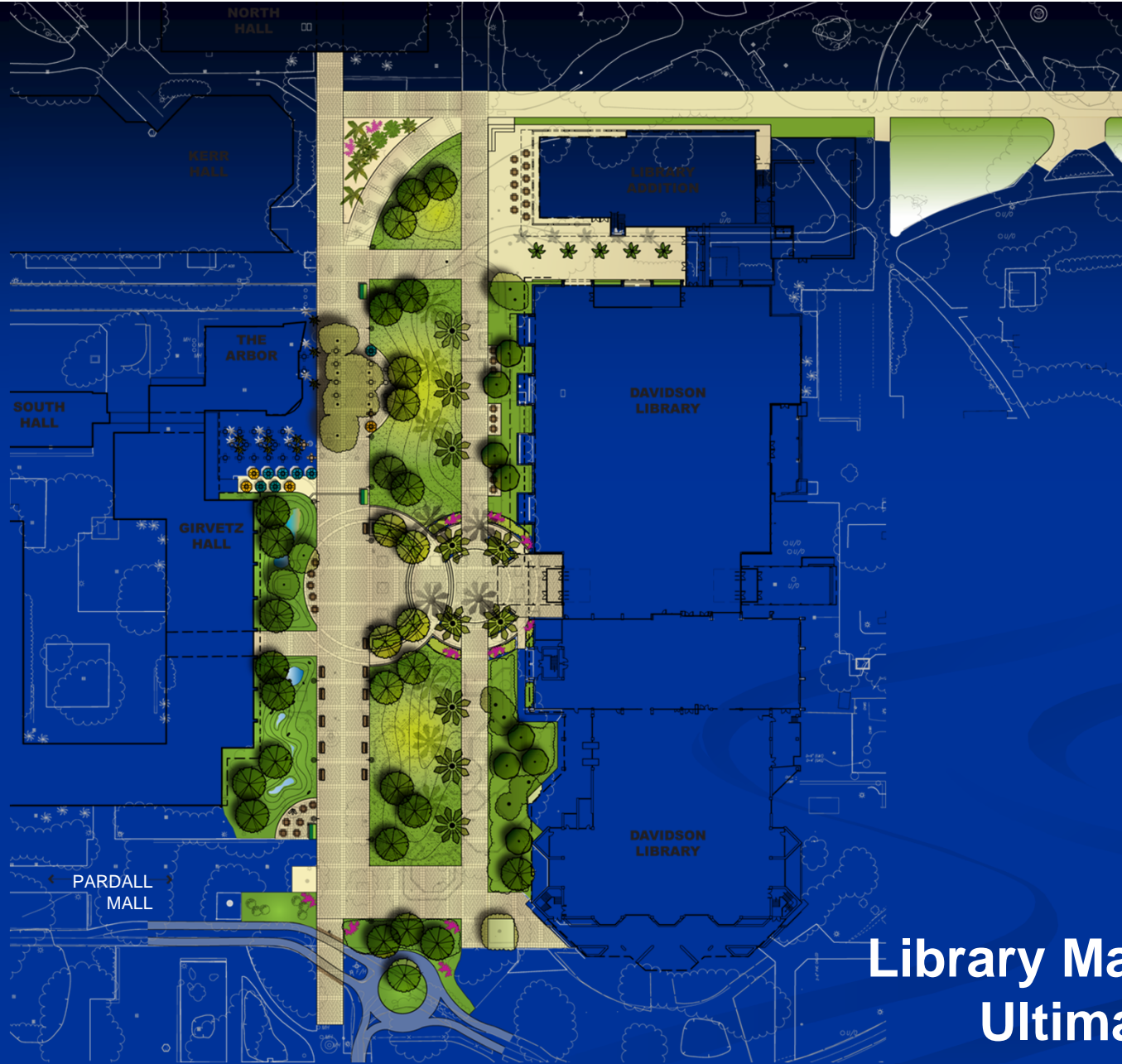
Lawn drains to rain garden

Rhythmic Permeable paving reduces runoff volume and allows rainwater to percolate

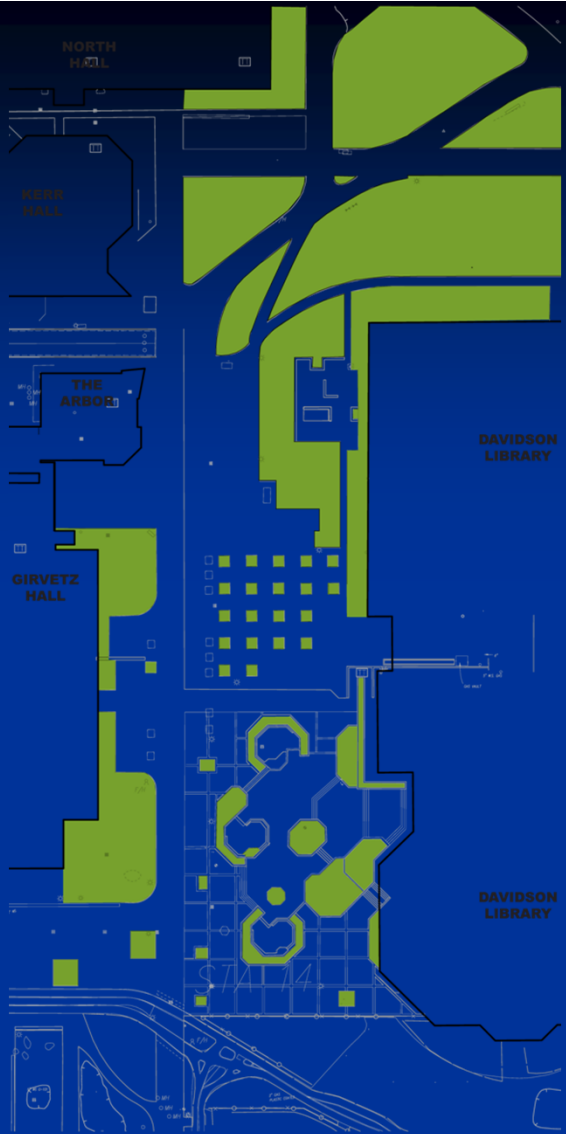
Rain garden cleans low flow and first flush water before it drains to the lagoon

Library Master Plan Infrastructure Phase

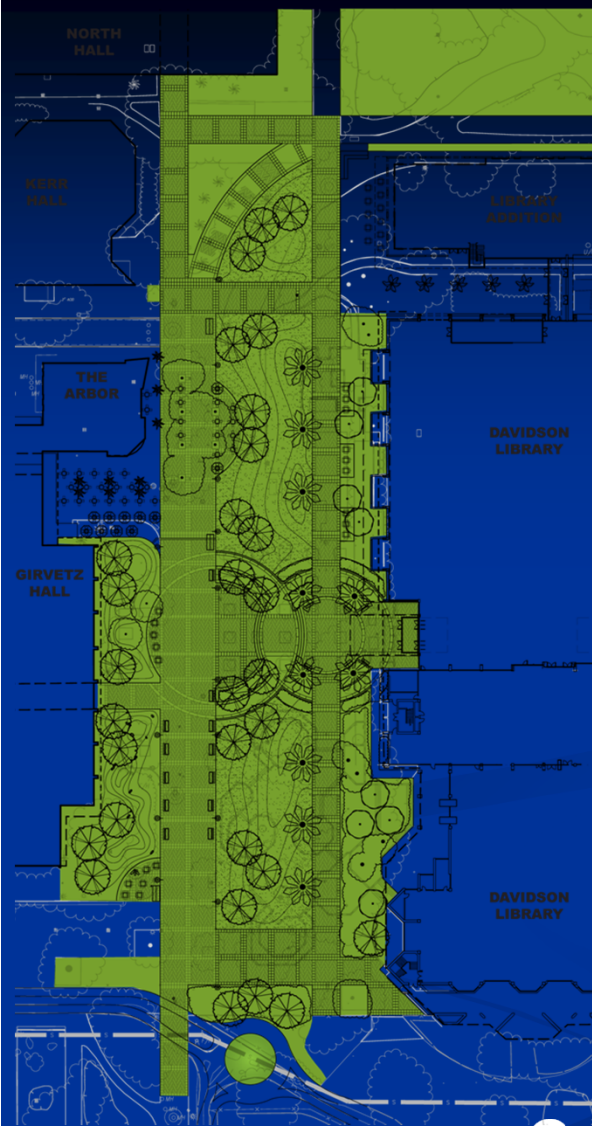
Concept Plan LID Features



Library Master Plan Ultimate Phase Concept Plan



Existing



Proposed

Increase in permeable surfaces

Decreases runoff

Increases percolation

Filters water in rain garden, slows rate of runoff entering lagoon

Campus Water Quality

Permeability Analysis

site photographs



Library Mall



Girvetz to the Library



The Arbor at Noon



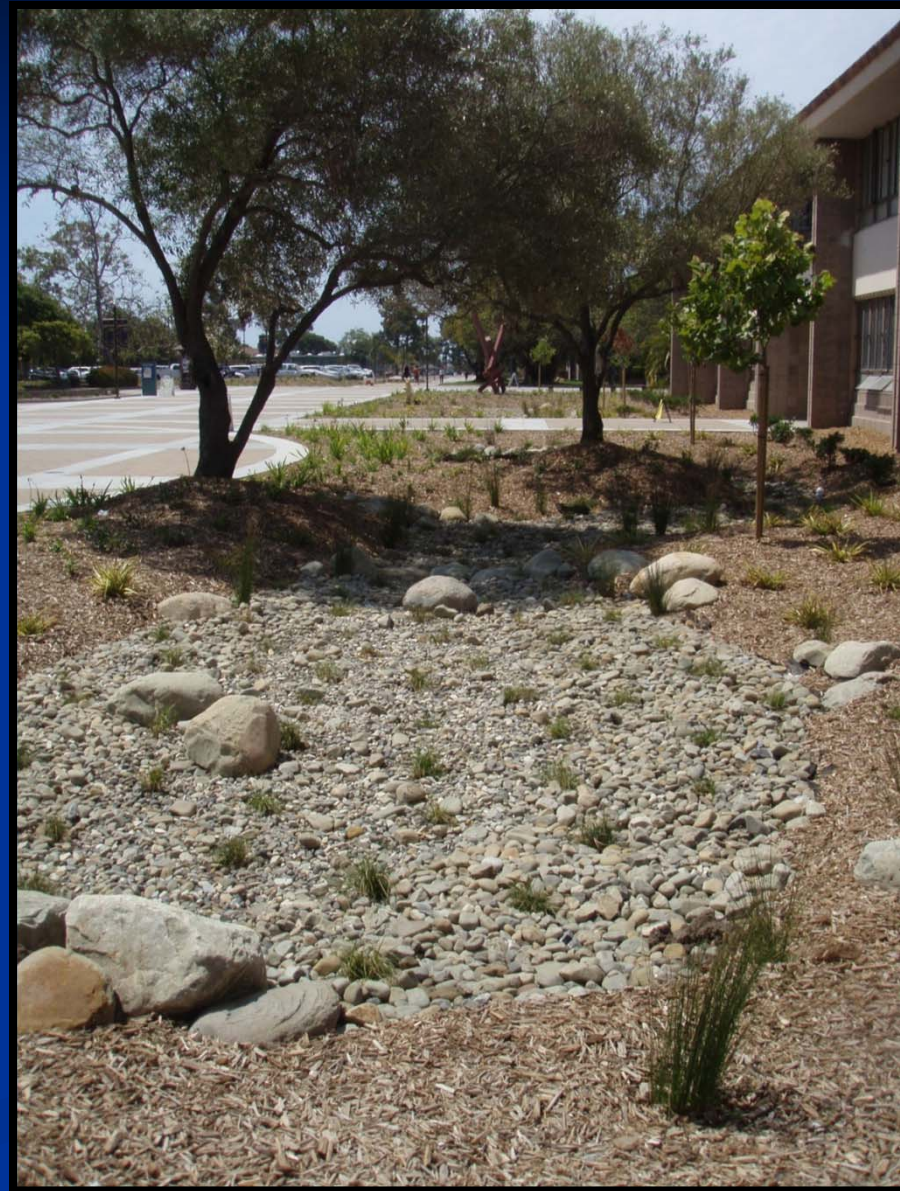
Library Corridor

Permeable Pavers



Rain Gardens



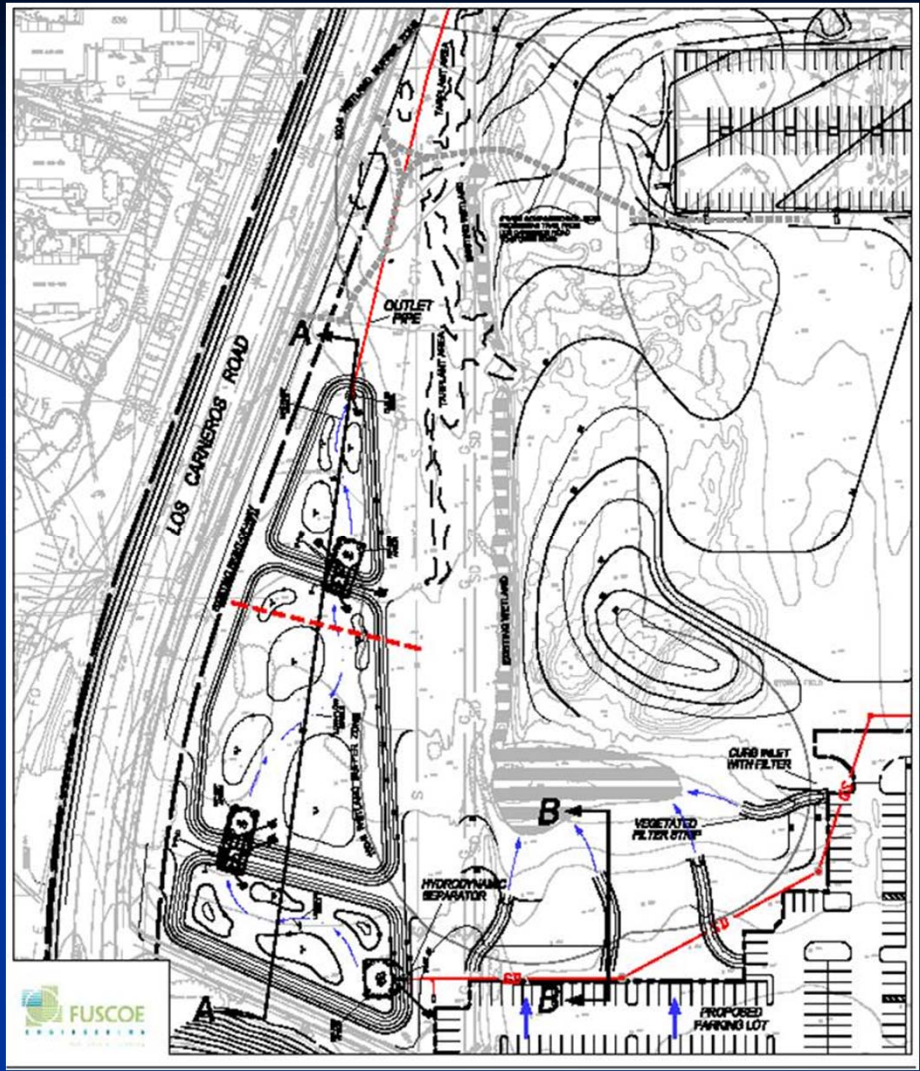
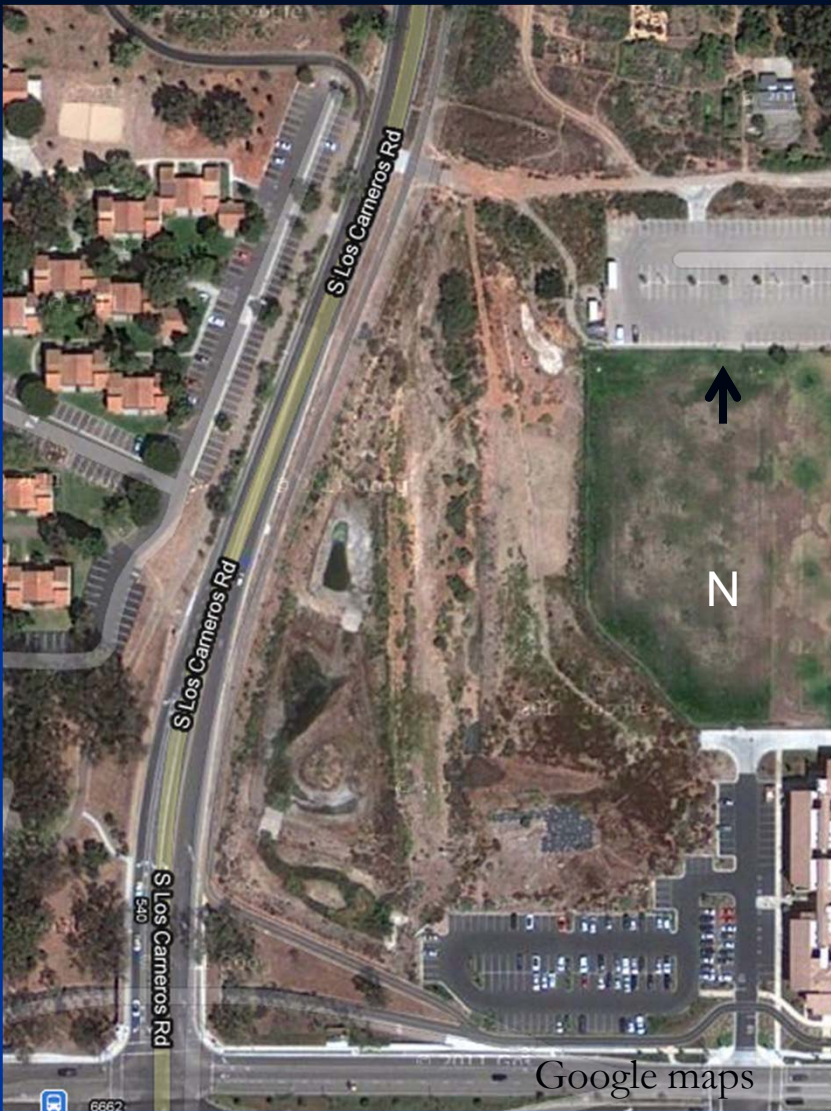




San Clemente

- 7 acre restoration project
- Mitigation Site for Southern Tarplant (*Centromadia parryi* ssp. *australis*) and Stormwater Runoff
- Features include:
 - Stormwater Management System
 - Bioswales
 - Preservation and monitoring of Southern Tarplant





San Clemente Aerial

Conventional Stormwater Treatment



Sediment Basin

San Clemente Project





Stormwater Management System (SMS)

- Designed for 25 year flood event
- Above standard of County of Santa Barbara Design BMP's



SMS redesign

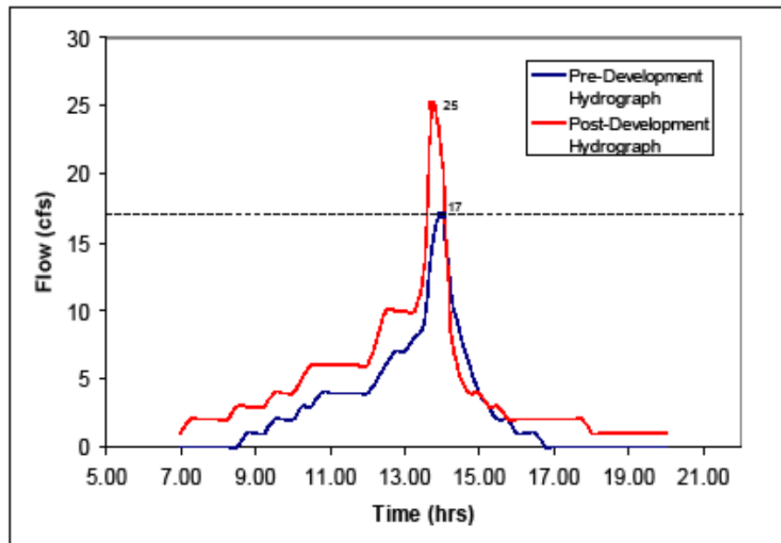
- Increased water levels and duration of inundation
- Greater topographical variance leads to increased diversity
- Larger amount of stormwater treated
- Successful establishment of wetland plant species



SMS: Project design criteria & parameters

COUNTY OF SANTA BARBARA DESIGN CRITERIA FOR TREATMENT BMPs		
Design Standard	Definition	Value
Volumetric	85 th percentile 24-hour runoff event determined as the maximized capture storm water volume for the area	1.2 inches
Flow-Based	85 th percentile hourly rainfall intensity for the area (with safety margin of 2)	0.30 inches

Pre-Development		Post-Development (without Mitigation)		Post-Development (with Mitigation)	
Peak Flow (cfs)	Volume (ac-ft)	Peak Flow (cfs)	Volume (ac-ft)	Peak Flow (cfs)	Volume (ac-ft)
17	3.1	25	5	16	4.1



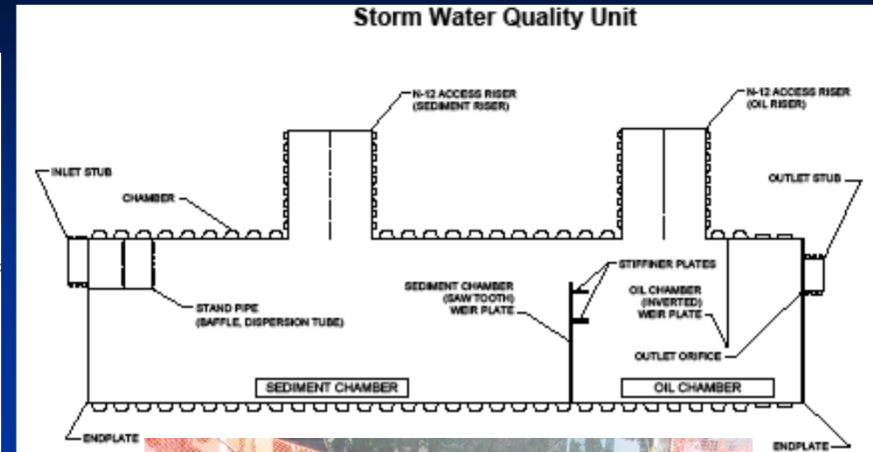
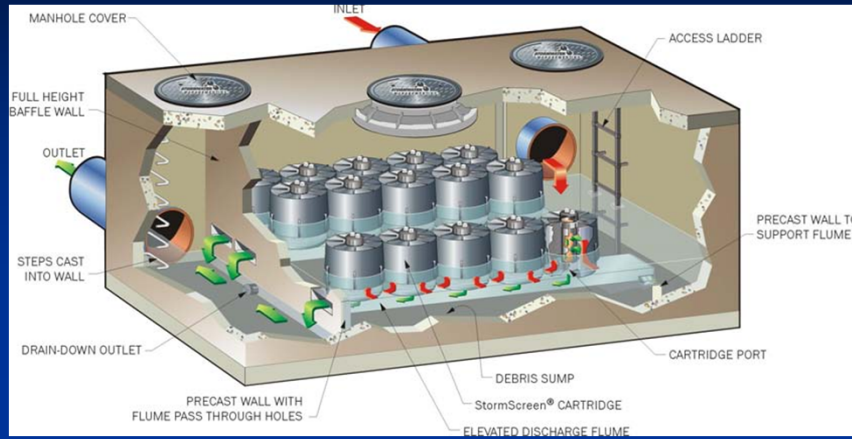
Pre-Development Volume:	3.1 ac-ft
Post-Development Volume: (without Mitigation)	5.0 ac-ft
Infiltration Loss: (during a 12-hr Peak Storm)	
<i>Rate :</i>	0.3 in /hr
<i>Basin Footprint :</i>	1.0 ac
<i>Ponding Time :</i>	36 hr
<i>Total Infiltration Volume :</i>	0.9 ac-ft
Post-Development Volume: (with Basin Mitigation)	4.1 ac-ft**

** Does not account for additional volume reduction through evaporation and evapotranspiration processes.

Parameter ⁷	Design Standard	Project Design	Acceptable
Residence Time	10 minutes minimum	21 minutes	Yes
Slope	<2%	<1%	Yes
Flow Velocity	<1 ft per sec	0.35 ft per sec	Yes
Flow Depth	4 inches	6 inches	Acceptable Variance*

* Vegetation height will be maintained at 8 to 10 inches within swale allowing for slightly deeper flow depths.

SMS: Prefiltration Devices



North Parcel Faculty Housing Water Quality Management Plan



LEGEND

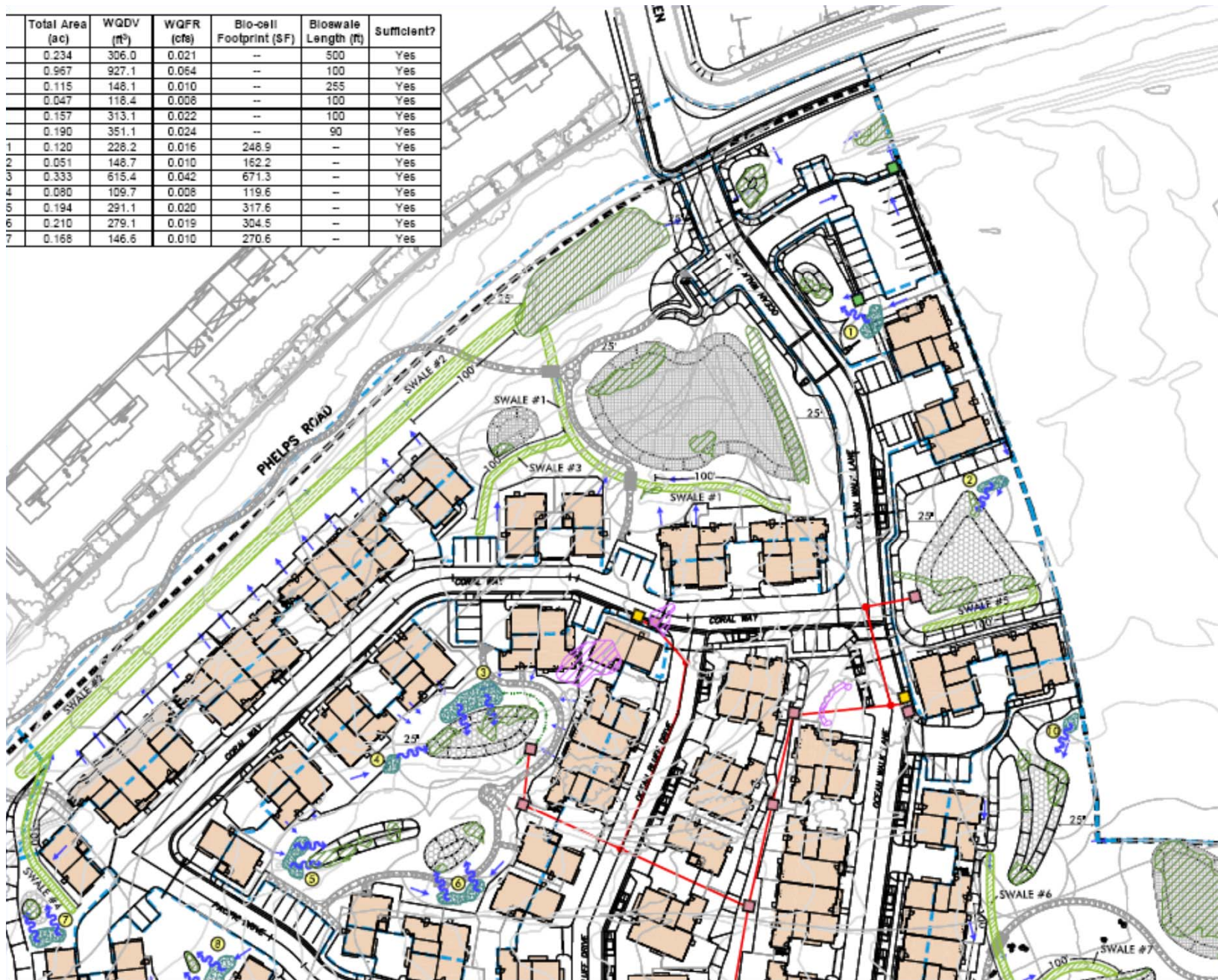
- | | | | | |
|------------------------------|-----------------|-------------------------------|------------------------|--------------------|
| PROJECT BOUNDARY | VERNAL POOL | STORM DRAIN | DIRECTION OF FLOW | PURPLE NEEDLEGRASS |
| EXISTING (PROTECTED) WETLAND | RIPARIAN BUFFER | 25' (AVERAGE) BUFFER | BIORETENTION CELL | ALKALINE RYE GRASS |
| WETLAND RESTORATION AREA | SWALE | 100' MINIMUM TREATMENT LENGTH | JURISDICTIONAL WETLAND | |



SITE
NORTH PARCEL
OCCE
UNIVERSITY
SANT

Scale: 1" = 160'
 Exhibit Date: 8-6-09

Total Area (ac)	WQDV (ft ²)	WQFR (cfs)	Bio-cell Footprint (SF)	Bioswale Length (ft)	Sufficient?
0.234	306.0	0.021	--	500	Yes
0.967	927.1	0.064	--	100	Yes
0.115	146.1	0.010	--	255	Yes
0.047	118.4	0.008	--	100	Yes
0.157	313.1	0.022	--	100	Yes
0.190	351.1	0.024	--	90	Yes
1	0.120	228.2	0.016	248.9	Yes
2	0.051	148.7	0.010	162.2	Yes
3	0.333	615.4	0.042	671.3	Yes
4	0.080	109.7	0.008	119.6	Yes
5	0.194	291.1	0.020	317.6	Yes
6	0.210	279.1	0.019	304.5	Yes
7	0.168	146.6	0.010	270.6	Yes



- ### LEGEND
- ■ ■ PROJECT BOUNDARY
 - ▨ EXISTING (PROTECTE
 - ▨ WETLAND RESTORAT
 - ▨ VERNAL POOL
 - ▨ RIPARIAN BUFFER
 - ▨ BIOSWALE
 - ▨ BIORETENTION CELL
 - SWALE
 - STORM DRAIN
 - ▨ BASIN / WETLAND D
 - ← DIRECTION OF FLOW
 - ▨ TREATED SUBDRAIN
 - 25' 25ft. (AVERAGE) BUF
 - 100' 100ft. MINIMUM TRE
 - FILTERRA FILTER UNIT
 - KRISTAR FILTER
 - KRISTAR SWALEGUA
 - BIORETENTION CELL
 - ▨ JURISDICTIONAL WE
 - ▨ PURPLE NEEDLEGRA
 - ▨ ALKALINE RYE GRAS

GRADING PLAN SOURCE: The Bridge Group (June 2009).
 ORTH CAMPUS FACULTY HOUSING PROJECT - WATER QUALITY MANAGEMENT PLAN



CCBER Innovations

- Designed flow-through wetland systems to filter and recharge natural watersheds
 - Functions
 - Conveyance of storm water and urban runoff
 - Biofiltration of pollutants
 - Groundwater and water table recharge
 - Slow down hydrologic cycle to natural rate
 - Sediment & trash traps
 - Landscape aesthetics
 - Habitats for plants and wildlife
 - Education and interpretation
 - Research

Collaborators

- CCBER
- UCSB Design and Construction Services
- UCSB Facilities Management
- UCSB Budget and Planning
- UCSB Housing & Residential Services
- Southern California Wetlands Recovery Project
- Coastal Fund
- True Nature & Suding Design Landscape Architects
- D Kal Engineering Contractors, Pro-West, Fuscoe, Penfield and Smith and more.