Conceptual Water Quality Management Plan (WQMP Priority)

Project Name:

REDA BIRCH MEDICAL OFFICE BUILDING

Prepared for:

REAL ESTATE DEVELOPMENT ASSOCIATES

4100 MACARTHUR BLVD. SUITE 120

NEWPORT BEACH, CA 92660

949-743-1463

Prepared by:

WALDEN & ASSOCIATES

2552 WHITE ROAD, SUITE B

IRVINE, CA 92614

949-660-0110

January 2015

Project Owner's Certification

Permit/Application No.		Grading Permit No.	
Tract/Parcel Map No.	T.P.M. No. 2014-171 & Tract No. 706	Building Permit No.	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract)			Portions of Lots (125-128)

This Water Quality Management Plan (WQMP) has been prepared for Real Estate Development Associates, LLC by Walden & Associates. This WQMP is intended to comply with the requirements of the local NPDES Stormwater Program requiring the preparation of the plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner:			
Title	Real Estate Development Associates Representative		
Company	Real Estate Development Associates		
Address	4100 Macarthur Blvd, Suite 120 Newport Beach, CA 92660		
Email			
Telephone #	(949) 743-1463		
Signature		Date	

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Attachments

Section I Discretionary Permit(s) and Water Quality Conditions

Project Infomation			
Permit/Application No.		Tract/Parcel Map No.	T.P.M. No. 2014-171 & Tract No. 706
Additional Information/ Comments:	Lots 125, 126, 127 and a portion of Lot 128 of Tract No. 706 in the City of Newport Beach, County of Orange State of California as shown on a map filed in Book 21, Page 25 of miscellaneous maps records of said county. 20352, 20354, 20362, 20372, 20382, 20392, 20402 & 20412 Birch Street A.P.N. 439-382-06, 07, 10, 26, 27, 31 & 34; 439-381-40		
Water Quality Conditions			
Water Quality Conditions (list verbatim)	City of Newport Beach, Policy L-22-Protection of Water Quality: Water Quality Management Plans for New Development and Redevelopment.		
Watershed-Based Plan Conditions			
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	No WIHMPs available at this time. TMDLS: Chlorpyrifos, Diazinon, Dieldrin, Chlordane, DDT, PCBs, Toxaphene, Pesticides, Selenium, Metals		

Section II Project Description

Description of Proposed Project				
Development Category (Verbatim from WQMP):	New development projects that create 10,000 square feet or more of impervious surface. This category includes commercial, industrial, residential housing subdivisions, mixed use, and public projects on private or public property that falls under the planning and building authority of the Permittees.			
Project Area (ft^2): 178,596	Number of Dwelling Units: 2		SIC Code: 8011 Medical Office	
Narrative Project Description:	The site is located south of the 73-freeway, at 20372, 20412, 20402, 20392 & 20382 SW Birch Street, near the Newport Beach Golf Course. It is located southeast of Birch Street between Orchard Drive and Mesa Drive, in Newport Beach, California. The site area encompasses approximately 4.1 acres. It is bounded by commercial property to the north, residential property to the south, and by Birch Street to the west. The project consists of two proposed medical office buildings and a parking lot. The site will not include any food preparation, cooking or eating areas. There are no loading docks. There will be no outdoor storage of any materials. There will be no outdoor activities routinely conducted other than going to and from vehicles in the parking lot. There will be no vehicle maintenance repair or any material processing in the project, including washing or cleaning. There will be no service bays, fueling islands or fuel pumps. The remainder of the site is mainly covered with asphaltic and concrete pavement and landscaping. The site will have asphaltic paved circulation lanes (96,930 sf), asphaltic paved parking areas (46,818 sf) and concrete paved trash pads. Landscaping will be provided along the perimeter of the site and within planter areas throughout the parking lot and frontage of each building. The general location of the site is illustrated on the Vicinity Map.			
Project Area	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	160,736	90	17,860	10
Post-Project Conditions	34,848	19.5	143,748	80.5

Drainage Patterns/Connections	The proposed development will not alter the existing drainage patterns. In the existing condition the majority of the site generally flows in a south-westerly direction. In the post-development condition, the site will surface flow in a westerly direction via concrete curb/gutter and v-gutter to 3 separate Filterra units, 2 biofiltration facilities, and 1 catch basin insert then conveyed via the on-site storm drain which will join the existing 33" storm drain at the southwest corner of the site. The 33" storm drain runs south prior to discharging to nearby Upper Newport Bay.

II.2 Potential Stormwater Pollutants

Pollutants of Concern			
Pollutant	Circle One: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	(E)	N	Driveways , rooftops and sidewalks
Nutrients	(E)	N	Fertilizers, Food waste
Heavy Metals	(E)	N	Cars
Pathogens (Bacteria/Virus)	(E)	N	Sources of pathogens include wild bird and pet waste, garbage.
Pesticides	(E)	N	Landscape Areas
Oil and Grease	(E)	N	Oil and grease are usually associated with fluid leaking vehicles in the parking lot.
Toxic Organic Compounds	(E)	N	Cars, Fertilizers
Trash and Debris	(E)	N	The major source for trash and debris in stormwater is poorly managed trash containers and parking lots.

II.3 Hydrologic Conditions of Concern

☐ No – Show map

☒ Yes – Describe applicable hydrologic conditions of concern below.

The City's MS4 Permit requires applicable development projects to implement a hydromodification control design to address Hydrologic Conditions of Concern (HCOCs) in the North Orange County Permit Area. Per Figure XVI.3 of the TGD, the project is located in an area which is potentially susceptible to hydromodification impacts (i.e. "Potential Areas of Erosion, Habitat & Physical Structure Susceptibility").

Per Section 5.3 of the TGD, HCOCs can be mitigated by managing runoff such that the post-development runoff volume for the 2-year, 24-hour storm event does not exceed that of the pre-development condition by more than 5%.

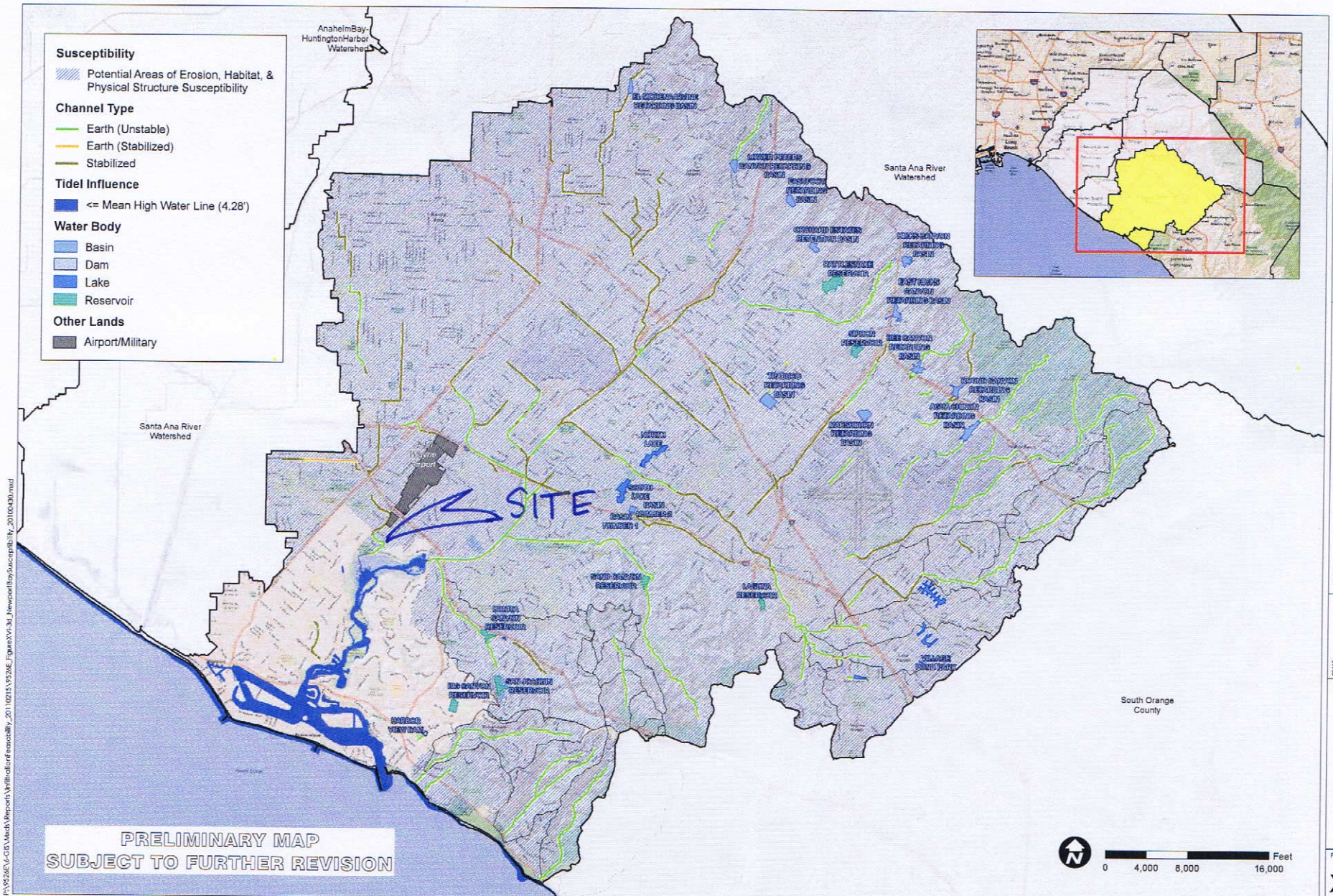
This can be expressed as:

$$\frac{V_{2\text{-}YR,POST}}{V_{2\text{-}YR,PRE}} \leq 1.05$$

For areas where retention is not feasible, the project must reduce post-development runoff 2-yr peak flow rate to no greater than 110% of the pre-development runoff 2-yr peak flow rate. This can be expressed as:

$$\frac{Q_{2\text{-}YR,POST}}{Q_{2\text{-}YR,PRE}} \leq 1.10$$

The hydrology study will determine if Hydrologic Conditions of Concern exist and demonstrate mitigation measures to address hydromodification. If any HCOCs exist the final hydrology and storm drain plan will be designed to mitigate and detain the required allowable post-development runoff for 2-year peak flow rate.



TITLE: SUSCEPTIBILITY ANALYS NEWPORT BAY-NEWPORT COASTAL STREAMS

ORANGE COUNTY WATERSHED MASTER PLANNING

ORANGE CO. CA

JOB

SCALE 1" = 4000'
DESIGNED TH
DRAWING TH
CHECKED EMP
DATE 04/30/10
JOB NO. 95.05-E

PACE Advanced Water Engineering

FIGURE XVI-3d

P:\95\05E\6-GIS\Mxds\Reports\Infiltration\Erosability_20110215\95206_Figure XVI-3d_Newportbay Susceptibility_20100430.mxd

II.4 Post Development Drainage Characteristics

In the post-development conditions, the most easterly portion of the site A-1 will surface flow in a northeasterly direction via concrete curb and gutters and into a vegetated swale before exiting into the 4' x 8' filterra which will treat area A-2. The flow will then be conveyed via a 12" PVC pipe towards the westerly corner of the site, towards the point of connection to the storm drain system running across Birch Street. Surface flow travelling westerly in area A-4 will be conveyed into a 6' x 6' filterra unit which includes an internal bypass. A-5 will capture the small area runoff via a catch basin inlet fitted with a treatment insert. Surface flow from area A-6 will travel in a northwesterly direction into a biotreatment facility. The remaining flow will continue in a westerly direction through area A-7 into a 6' x 6' filterra unit and catch basin, connecting to the 12" PVC pipe, to the point of connection. Surface flow from the southwesterly corner of the site will travel in a northwesterly direction through area A-8 into a biotreatment facility and exit into a catch basin, connecting to the existing storm drain system. Areas A-3 and A-9 consist of small negligible driveway areas which are not being treated.

II.5 Property Ownership/Management

The land referred in the WQMP is in the State of California, County of Orange and City of Newport Beach and is described hereon:

Parcel 171 in the City of Newport Beach, County of Orange, State of California as shown on map recorded in book 21, page 25 of miscellaneous maps, in the office of the county recorder of said county.

Ownership of the project will be held with Real Estate Development Associates. Long term maintenance will be the responsibility of the owner.

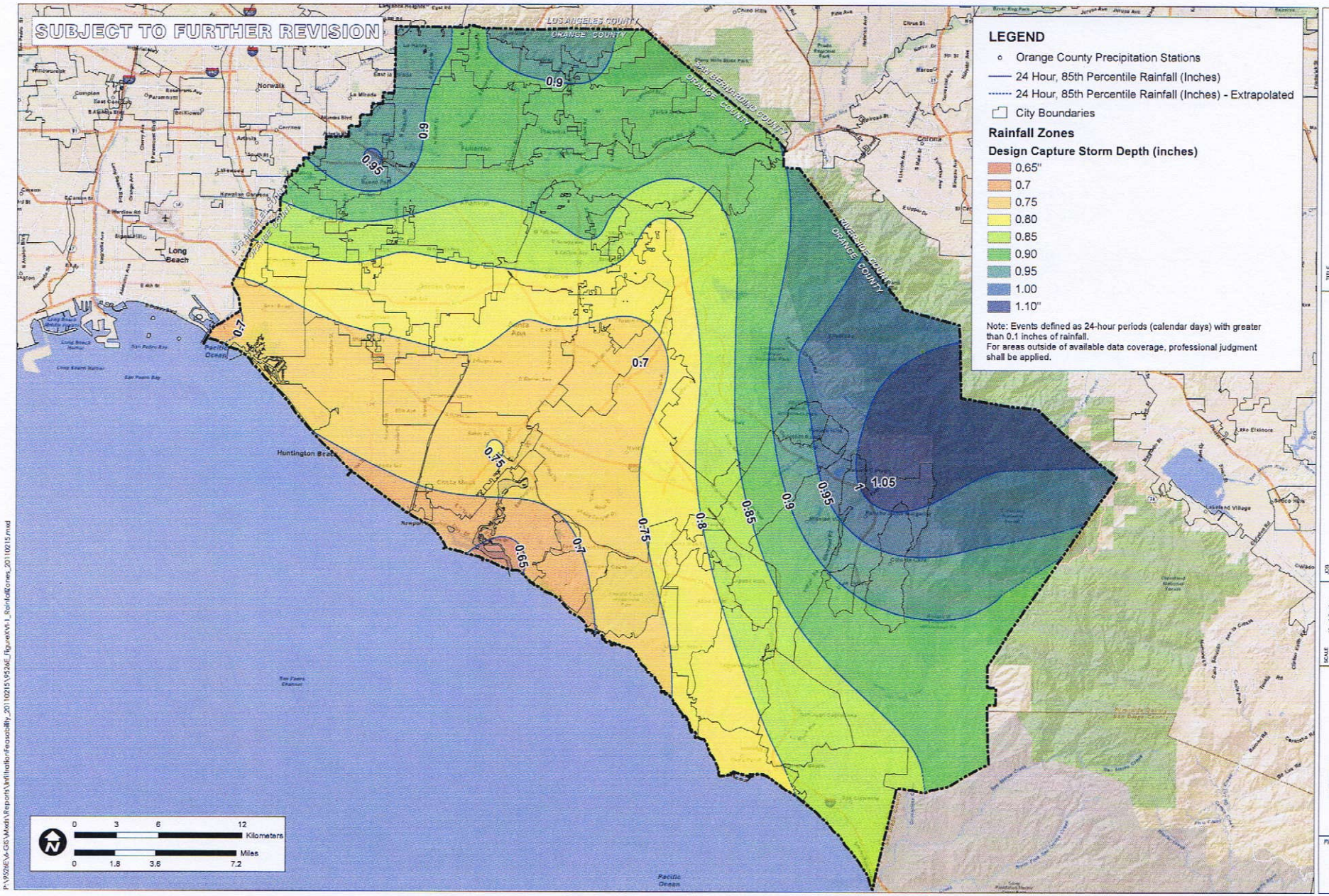
Section III Site Description

III.1 Physical Setting

Planning Area/ Community Name	7 – Park Newport – UP 1412, UP 1405
Location/Address	20352, 20354, 20362, 20372, 20382, 20392, 20402 & 20412 Birch Street
	Newport Beach, CA
Land Use	General Commercial Office
Zoning	Business Park SP-7
Acreage	4.1 Total
Predominant Soil Type	Soil Type D

III.2 Site Characteristics

Precipitation Zone	0.71″
Topography	Undeveloped with average ground cover with minimum slope for drainage.
Drainage Patterns/Connections	The site belongs to Newport Bay Watershed.
Soil Type, Geology, and Infiltration Properties	Topsoil consist of silty fine to medium sands with moderate organic content. Artificial soils consist of dense silty fine sands and extend to a depth of 3 feet. Native alluvial soils consist of medium dense to dense silty and clayey fine to medium sands as well as fine sandy silts found at ground surface, beneath topsoil, and beneath fill. Medium dense clayey fine sands and stiff to hard silty clays and clayey silts found between depths of 5 to 15 feet.



RAINFALL ZONES

TITLE

ORANGE COUNTY
TECHNICAL GUIDANCE
DOCUMENT

CA

ORANGE CO.

JOB

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/2010
JOB NO	9526.E

PACE
Advanced Water Engineering

FIGURE
XVI-1

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Site Characteristics (continued)	
Hydrogeologic (Groundwater) Conditions	Groundwater encountered approximately 31 feet below existing site grades.
Geotechnical Conditions (relevant to infiltration)	Based on soil type infiltration is not a feasible approach.
Off-Site Drainage	No off-site drainage.
Utility and Infrastructure Information	Not applicable.

III.3 Watershed Description

Receiving Waters	Upper Newport Bay
303(d) Listed Impairments	Indicator Bacteria, Chlordane, Copper, DDT, Metals, Nutrients, PCBs, Pesticides, Sediment Toxicity, Sedimentation/Siltation
Applicable TMDLs	PAHs, Hydrocarbons, Arsenic, Metals, Chlordane, DDT, Dieldrin, Indicator Bacteria, Lead, Mercury, Nickel, PCBs, Pesticides, Phenanthrene, Sediment Toxicity, Selenium, Silver
Pollutants of Concern for the Project	Metals, Pesticides, Nutrients, Sediment, Pathogens, Toxic Organic Compounds, Oil & Grease
Environmentally Sensitive and Special Biological Significant Areas	The project site does not discharge directly or within 200 feet of a receiving water body and therefore is not considered an Environmentally Sensitive Area. There are no Special Biological Significant Areas in proximity to the site.

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.		

Project Performance Criteria (continued)	
If HCOC exists, list applicable hydromodification control performance criteria	The evaluation of potential impacts is based on the following for a two-year frequency storm event: • Increases in runoff volume; • Changes in time of concentration; • Potential for increase in post development downstream erosions: and, • Potential for adverse downstream impacts of physical structure, aquatic and riparian habitat. If a hydrologic condition of concern (HCOC) exists, priority projects shall implement on-site or regional hydromodification controls such that: • Post-development runoff volume for the two-year frequency storm does not exceed that of the predevelopment condition by more than five percent, and; • Time of concentration of post-development runoff for the two-year storm event is not less than that for the predevelopment condition by more than five percent.
List applicable LID performance criteria	Priority projects must infiltrate, harvest and use, evapotranspire, or biotreat/biofilter the 85th percentile, 24-hour storm event (Design Capture Volume). A properly designed biotreatment system may only be considered if infiltration, harvest and use, and evapotransipiration (ET) cannot be feasibly implemented for the full design capture volume. In this case, infiltration, harvest and use, and ET practices must be implemented to the greatest extent feasible and biotreatment may be provided for the remaining design capture volume.
List applicable treatment control BMP performance criteria	Not applicable.

Calculate LID design storm capture volume for Project.	Area = 4.1 acres (tributary); Impervious Area Percentage = 81% C = (0.75 x imp) + 0.15 = 0.7575; I = 0.71 (Figure III.1) Vb = C * I * A * (1ft/12in) * (43,560 ft^2/acre) = 8,004 ft^3

IV.2. SITE DESIGN AND DRAINAGE PLAN

SITE CONSTRAINTS

The project site is located within a Class D soil type and within a HCOC.

EXISTING DRAINAGE PATTERNS

The proposed development will not alter the existing drainage patterns. In the existing condition, the majority of the site generally flows in a north-westerly direction into an existing storm drain towards the Birch Street cul-de-sac.

PROPOSED DRAINAGE PATTERNS

In the post-development conditions, the site will surface flow in a north-westerly direction via concrete curb/gutter and v-gutter to 2 separate biotreatment facilities and 3 separate Filterra units, then to catch basins which convey to a 12" PVC pipe which flows into a point of connection with the existing 33" storm drain system running directly across Birch Street.

Drainage Area	Design Capture Volume ($ft^{3)}$	BMP Type
A-1	3,217	BIO-1 Vegetated Swale
A-2	619	BIO-7 Filterra
A-3	113	No Treatment-Driveway
A-4	840	BIO-7 Filterra
A-5	140	TRT-2 Contech Insert
A-6	617	BIO-1 Biofiltration Facility
A-7	784	BIO-7 Filterra
A-8	1,561	BIO-1 Biofiltration Facility
A-9	113	No Treatment-Driveway
Total	8,004	

BMP GIS Coordinates	
BIO-1	33°39′22.06″N 117°52′41.83″ W
	33°39′20.81″N 117°52′43.57″ W
BIO-2	33°39′22.35″N 117°52′39.76″ W
BIO-7	33°39′21.90″N 117°52′44.10″ W
	33°39′22.24″N 117°52′42.54″ W
	33°39′22.65″N 117°52′40.40″ W

L.I.D. IMPLEMENTATION

In accordance with the County of Orange 2011 model WQMP, Low Impact Develoment (L.I.D.) BMPs are proposed as practical for the site conditions. Infiltration BMPs have not been included due to the class "D" soil type. Harvest and reuses does not have the required demand as needed.

As shown on the Grading plan and WQMP BMP exhibit, site design BMPs are intended to create a hydrologically functional project design that mimics the natural hydrologic regime. Site design concepts incorporated in the project include: biofiltration systems, vegetated swales, planting native California trees, maximizing landscape areas, and maintaining the landscape area along the perimeter of the site. Runoff from impervious areas is being dispersed to adjacent pervious areas where possible. Landscape buffers are provided between the right-of-way and street sidewalk. Pervious construction materials are not proposed for this project. There are no existing natural drainage systems to conserve.

Based on the information above the site is designed for the LID criteria and HCOC volume. According to the LID BMPs hierarchy, bioretention with underdrains, vegetated swales and proprietary biotreatment will satisfy the performance criteria set fourth within the Santa Ana Region (NOC). The site will detain stormwater runoff up the HCOC Volume. Curb openings will convey the low flows into the Filterra units equipped with a bypass inlet for high flows which will provide pre-treatment prior to ultimately discharging into the storm drain system.

IV.3 LID BMP SELECTION AND PROJECT CONFORMANCE ANALYSIS

IV.3.1 Hydrologic Source Controls

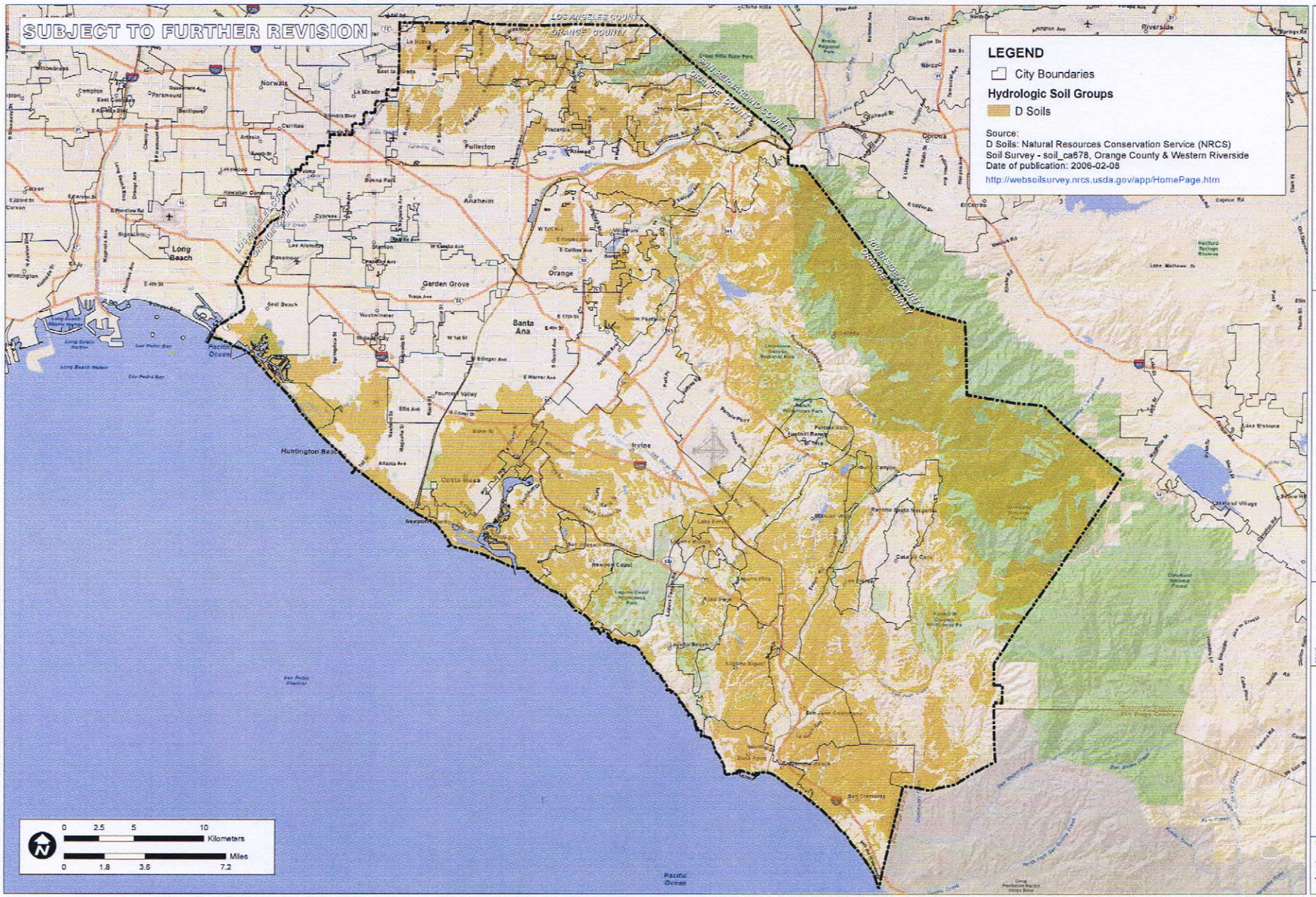
HSC's not required.

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

IV.3.2 Infiltration BMPs

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

Infiltration BMPs not allowed due to site having Type "D" soil. See attached worksheet.



TITLE
HYDROLOGIC SOIL GROUP
TYPE D NRCS SOIL SURVEY

ORANGE COUNTY
INFILTRATION STUDY
CA
ORANGE CO.

JOB	
SCALE	1" = 7.8 miles
DESIGNED	TH
DRAWN	TH
CHECKED	DMD
DATE	02/09/17
JOB NO.	9924-F

PACE
Advanced Water Engineering

FIGURE
XVI-2b

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IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☐
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

Evapotranspiration and Rainwater Harvesting cannot be implemented based on the low demand and lack of irrigated landscape areas other than small planter areas.

IV.3.4 Biotreatment BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, and/or evapotranspiration and rainwater harvesting BMPs, describe biotreatment BMPs. Include sections for selection, suitability, sizing, and infeasibility, as applicable.

Name	Included?
Bioretention with underdrains	☒
Stormwater planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☒
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☒
Wet extended detention basin	☐
Dry extended detention basins	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with infiltration, evapotranspiration, rainwater harvesting and/or biotreatment BMPs. If not document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with either of these BMPs categories.

See calculation worksheet.

Biotreatment BMP (BIO-2: Vegetated Swale)

Solution: (Area A-1=1.58, 85% Impervious)

Step 1: Determine Design Flow rate (Q)

Q_{LID} = [(0.75×0.85+0.15) × 0.27 in/hr × 1.58 ac]= 0.33 cfs

Step 2: Estimate the Swale Bottom Width

For shallow flow depths, channel side slopes can be ignored and the bottom width can be calculated using a simplified form of Manning"s formula:

$b = (Q \times n_{WQ}) / (1.49 \times y^{1.67} \times s^{0.5})$

Where:

b = estimated swale bottom width, ft = 2 ft

Q = design flowrate, cfs = 0.33 cfs

n_{WQ} = Manning"s roughness coefficient for shallow flow conditions, use 0.2 unless other information is available = 0.2

y = design flow depth, ft (not to exceed 4 inches or 0.33 ft) = 0.33 ft

s = longitudinal slope in flow direction, ft/ft (not to exceed 0.06) = 0.010 < 0.015 (underdrain required)

b = 2.8; use 3.5 ft

Step 3: Determine Design Flow Velocity

Calculate the design flow velocity using the following equation: $V_{WQ} = Q / A_{WQ}$ $V_{WQ} = 0.33 / 1.4817 = 0.22$ fps

Where:

V_{WQ} = design flow velocity, fps

Q = design flowrate, cfs = 0.33 cfs

$A_{WQ} = by + Zy^2$, cross sectional area of flow at design depth = $(3.5)(0.33) + (3)(0.33)^2 = 1.4817$

Z = side slope length per unit height = 3:1

Step 4: Calculate Swale Length

Calculate the swale length needed to achieve a minimum hydraulic residence time of 10 minutes using the following equation:

$L = 60 \times t_{HR} \times V_{WQ}$ $L = 60 \times 10 \times 0.22 = 132$ ft < 135 ft provided

Where:

L = swale length, ft

t_{HR} = hydraulic residence time, min (minimum 10 minutes)

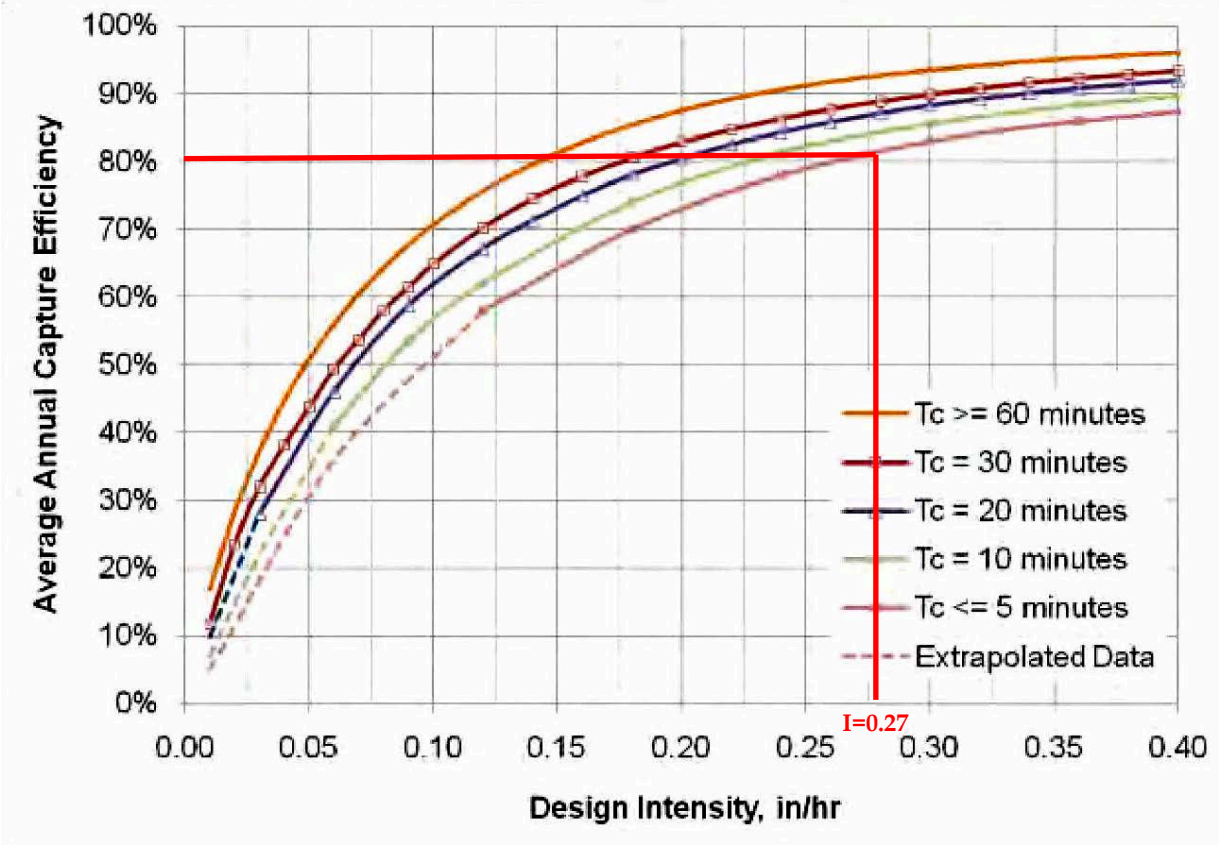
V_{WQ} = design flow velocity, fps = 0.22 fps

Solution: (Area A-2=0.32, 80% Impervious)

1) T_c = 5 minutes.
2) From **Figure III.6** I_1 = 0.27 in/hr
3) Capture efficiency achieved in upstream BMPs = 0 percent
4) From **Figure III.6** I_2 = 0.00 in/hr
5) $I_1 - I_2$ = design intensity = 0.27 in/hr
6) Q_{LID} = [(0.75×0.80+0.15) × 0.27 in/hr × 0.32 ac]= 0.0648 cfs
   Qbmp Filterra soil will treat 1.04 gpm/sf
   Qbmp = 4′ x 8′ = 32 sf > (0.0648 cfs. x 449 gpm/cfs)/(1.04 gpm/sf) = 27.97 sf

Graphical operations supporting solution:

Figure **III.6**
Graphical Operations Supporting **Example III.7**

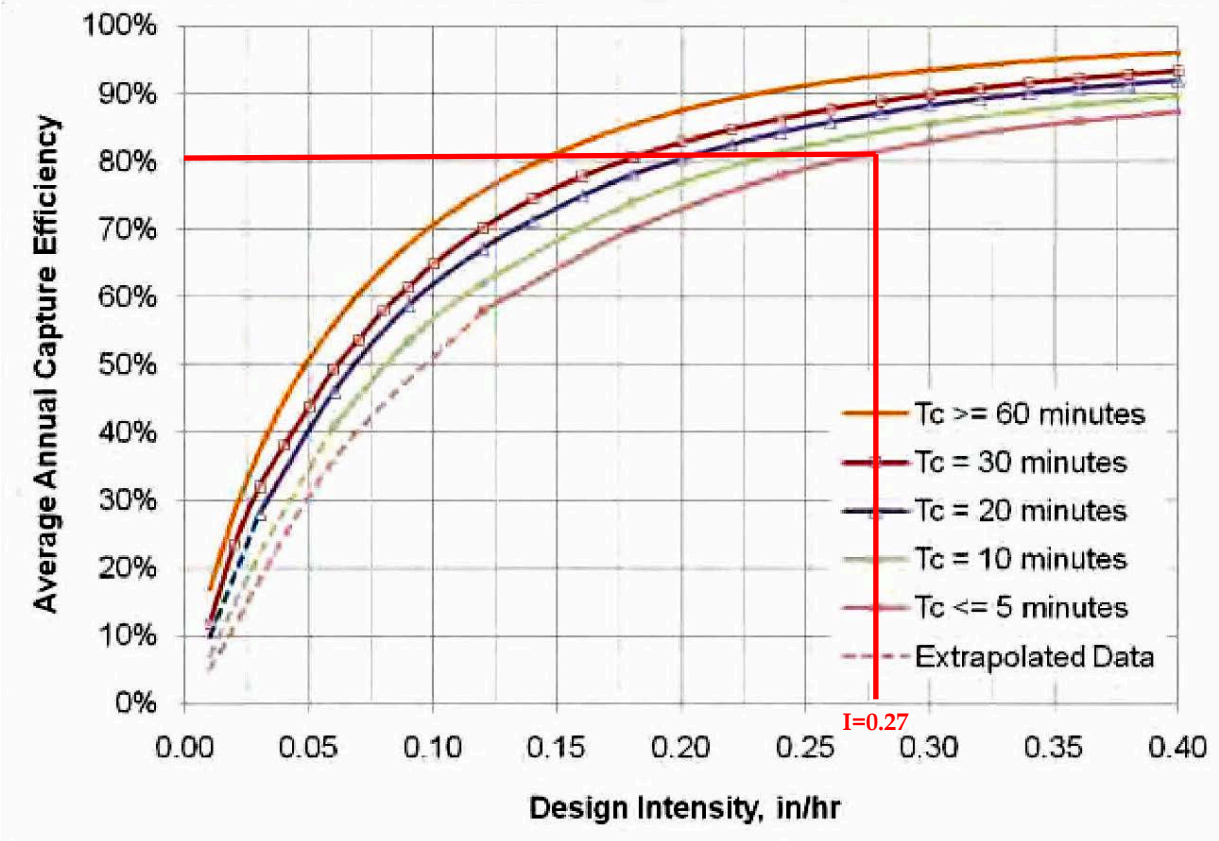


Solution: (Area A-4=0.37, 97% Impervious)

1) T_c = 5 minutes.
2) From **Figure III.6** I_1 = 0.27 in/hr
3) Capture efficiency achieved in upstream BMPs = 0 percent
4) From **Figure III.6** I_2 = 0.00 in/hr
5) $I_1 - I_2$ = design intensity = 0.27 in/hr
6) Q_{LID} = [(0.75×0.97+0.15) × 0.27 in/hr × 0.37 ac]= 0.0877 cfs
   Qbmp Filterra soil will treat 1.04 gpm/sf
   Qbmp = 6′ x 6′ = 36 sf < (0.0877 cfs. x 449 gpm/cfs)/(1.04 gpm/sf) = 37.86 sf

Graphical operations supporting solution:

Figure **III.6**
Graphical Operations Supporting **Example III.7**



Biotreatment BMP (BIO-1: Bioretention with underdrains)

Solution: (Area A-6=0.28, 94% Impervious)

CAPTURE EFFICIENCY METHOD FOR VOLUME-BASED, CONSTANT DRAWDOWN BMP'S

85TH percentile, 24-hr storm depth = 0.71 inches (Figure III.1)

BMP total ponding depth = 12 inches with 2.5 in/hr.

12 in/ 2.5 in/hr = 4.8 hour total drawdown

From Figure III.5 X1 = 0.3 (See Supporting Documents Section VI)

Capture efficiency achieved by HSCs = 0%

Fraction of 85th percentile, 24-storm depth required 0.71-0 = 0.71

Required design storm depth = 0.71*(0.3) = 0.21

Required storage depth = 0.28 ac. x 0.21 inches (0.75x0.94+.15) x 43,560 sf/ac x 1/12 in/ft = 185 cf

CAPTURE EFFICIENCY METHOD FOR BIORETENTION WITH UNDERDRAINS

Step 1: Determine the drawdown time associated with the selected basin geometry

DD = (dp / KDESIGN) × 12 in/ft Where: DD = (1.0/2.5) x 12 = 4.8 hrs

DD = time to completely drain infiltration basin ponding depth, hours

dP = bioretention ponding depth, ft (should be less than or equal to 1.5 ft); use 1.0

KDESIGN = design media infiltration rate, in/hr (assume 2.5 inches per hour)

Step 2: Determine the Required Adjusted DCV for this Drawdown Time

Use the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See Appendix III.3.2)

DCV = 185

Step 3: Determine the Basin Infiltrating Area Needed

A = Design Volume / dp Where: A = 185/1 = 185 sf

A = required infiltrating area, sq-ft (measured at the media surface)

Design Volume = fraction of DCV, adjusted for drawdown, cu-ft (see Step 2)

dp = ponding depth of water stored in bioretention area, ft (from Step 1)

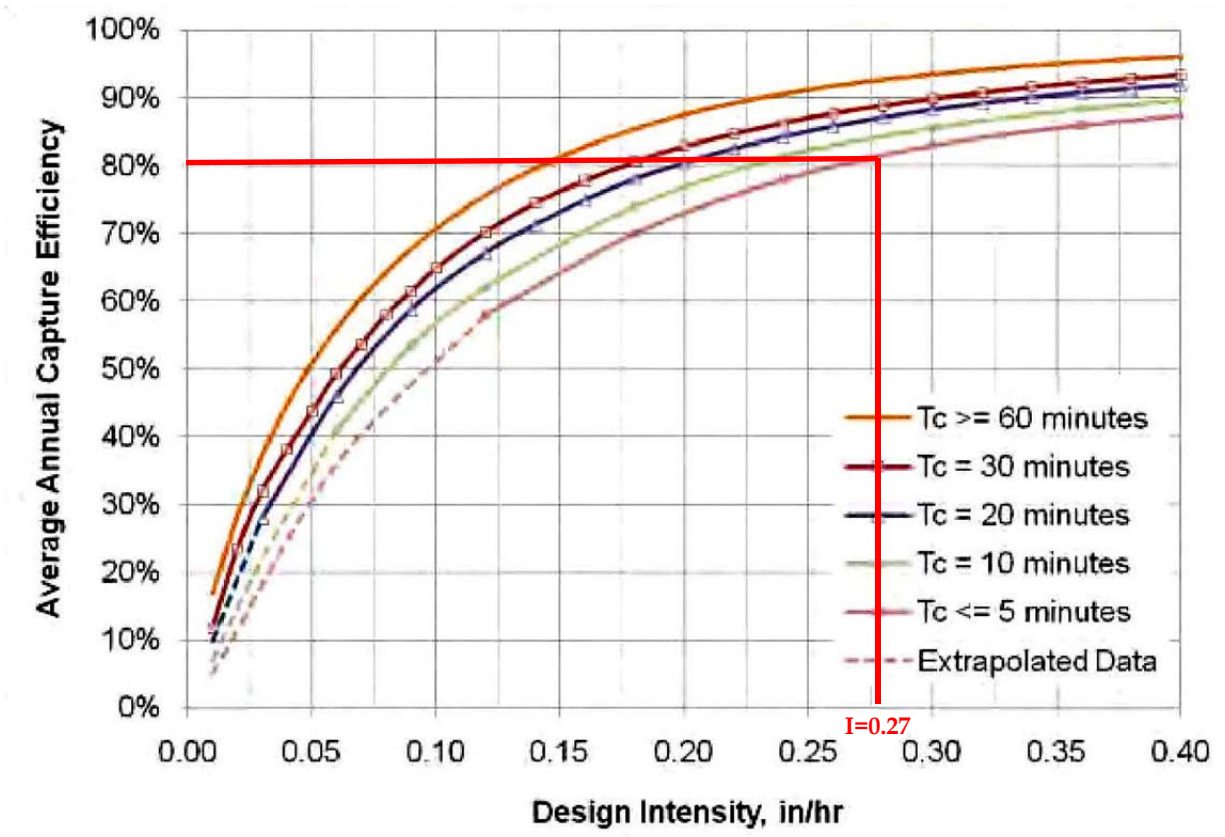
Area provided: 300 sf > 185 sf, therefore OK.

Solution: (Area A-7=0.34, 81.5% Impervious)

1) T_c = 5 minutes.
2) From **Figure III.6** I_1 = 0.27 in/hr
3) Capture efficiency achieved in upstream BMPs = 0 percent
4) From **Figure III.6** I_2 = 0.00 in/hr
5) $I_1 - I_2$ = design intensity = 0.27 in/hr
6) Q_{LID} = [(0.75×0.815+0.15) × 0.27 in/hr × 0.34 ac]= 0.0698 cfs
   Qbmp Filterra soil will treat 1.04 gpm/sf
   Qbmp = 6′ x 6′ = 36 sf > (0.0698 cfs. x 449 gpm/cfs)/(1.04 gpm/sf) = 30.2 sf

Graphical operations supporting solution:

Figure **III.6**
Graphical Operations Supporting **Example III.7**



Biotreatment BMP (BIO-1: Bioretention with underdrains)

Solution: (Area A-8=0.91, 75% Impervious)

CAPTURE EFFICIENCY METHOD FOR VOLUME-BASED, CONSTANT DRAWDOWN BMP'S

85TH percentile, 24-hr storm depth = 0.71 inches (Figure III.1)

BMP total depth = 12 inches with 2.5 in/hr.

12 in/ 2.5 in/hr = 4.8 hour total drawdown

From Figure III.5 X1 = 0.3 (See Supporting Documents Section VI)

Capture efficiency achieved by HSCs = 0%

Fraction of 85th percentile, 24-storm depth required 0.71-0 = 0.71

Required design storm depth = 0.71*(0.3) = 0.21

Required storage depth = 0.91 ac. x 0.21 inches (0.75x0.75+.15) x 43,560 sf/ac x 1/12 in/ft = 494 cf

CAPTURE EFFICIENCY METHOD FOR BIORETENTION WITH UNDERDRAINS

Step 1: Determine the drawdown time associated with the selected basin geometry

DD = (dp / KDESIGN) × 12 in/ft Where: DD = (1.0/2.5) x 12 = 4.8 hrs

DD = time to completely drain infiltration basin ponding depth, hours

dP = bioretention ponding depth, ft (should be less than or equal to 1.5 ft); use 1.0

KDESIGN = design media infiltration rate, in/hr (assume 2.5 inches per hour)

Step 2: Determine the Required Adjusted DCV for this Drawdown Time

Use the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See Appendix III.3.2)

DCV = 494

Step 3: Determine the Basin Infiltrating Area Needed

A = Design Volume / dp Where: A = 494/1 = 494 sf

A = required infiltrating area, sq-ft (measured at the media surface)

Design Volume = fraction of DCV, adjusted for drawdown, cu-ft (see Step 2)

dp = ponding depth of water stored in bioretention area, ft (from Step 1)

Area provided: 830 sf > 494 sf, therefore OK.

IV.3.5 Hydromodification Control BMPs

Describe hydromodification control BMPs. See Section 5 TGD. Include sections for selection, suitability, sizing, and infeasibility, as applicable. Detail compliance with Prior Conditions of Approval.

Hydromodification Control BMPs	
BMP Name	**BMP Description**

IV.3.6 Regional/Sub-Regional LID BMPs

Describe regional/sub-regional LID BMPs in which the project will participate. *Refer to Section 7.II-2.4.3.2 of the Model WQMP.*

Regional/Sub-Regional LID BMPs
Not applicable.

IV.3.7 Treatment Control BMPs

Treatment control BMPs can only be considered if the project conformance analysis indicates that it is not feasible to retain the full design capture volume with LID BMPs. Describe treatment control BMPs including sections for selection, sizing, and infeasibility, as applicable.

Treatment Control BMPs	
BMP Name	**BMP Description**

IV.3.8 Non-structural Source Control BMPs

Fill out non-structural source control check box forms or provide a brief narrative explaining if non-structural source controls were not used.

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☐	☒	No Association
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	
N6	Local Industrial Permit Compliance	☐	☒	No Industrial Permit
N7	Spill Contingency Plan	☒	☐	
N8	Underground Storage Tank Compliance	☐	☒	No Underground Tanks
N9	Hazardous Materials Disclosure Compliance	☒	☐	
N10	Uniform Fire Code Implementation	☒	☐	
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☐	☒	No Loading Docks
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	No Retail Gasoline Outlets

IV.3.9 Structural Source Control BMPs

Fill out structural source control check box forms or provide a brief narrative explaining if Structural source controls were not used.

Structural Source Control BMPs

Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	No Outdoor Storage
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☐	☒	No runoff over slopes
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☒	Not applicable
S6	Dock areas	☐	☒	No Dock areas
S7	Maintenance bays	☐	☒	No Maintenance bays
S8	Vehicle wash areas	☐	☒	No Vehicle wash areas
S9	Outdoor processing areas	☐	☒	No outdoor processing areas
S10	Equipment wash areas	☐	☒	No Equipment wash areas
S11	Fueling areas	☐	☒	No fueling areas
S12	Hillside landscaping	☐	☒	No Hillside landscaping
S13	Wash water control for food preparation areas	☐	☒	No Food Preparation Areas
S14	Community car wash racks	☐	☒	No Community car wash racks

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ✓ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING –

DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Spill Prevention, Control & Cleanup SC-11

Photo Credit: Geoff Brosseau

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Approach

Pollution Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Description of the facility, owner and address, activities and chemicals present
- Facility map
- Notification and evacuation procedures
- Cleanup instructions
- Identification of responsible departments
- Identify key spill response personnel

- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

Suggested Protocols (including equipment needs)

Spill Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- If consistent illegal dumping is observed at the facility:
  - Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
  - Landscaping and beautification efforts may also discourage illegal dumping.
  - Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.

- Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.

- If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.

- Routine maintenance:
  - Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
  - Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
  - Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

  - Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

- Label all containers according to their contents (e.g., solvent, gasoline).
- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).
- Identify key spill response personnel.

Spill Control and Cleanup Activities

- Follow the Spill Prevention Control and Countermeasure Plan.
- Clean up leaks and spills immediately.
- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).
- Report spills to local agencies, such as the fire department; they can assist in cleanup.
- Establish a system for tracking incidents. The system should be designed to identify the following:

  - Types and quantities (in some cases) of wastes

  - Patterns in time of occurrence (time of day/night, month, or year)

- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)

- Responsible parties

Training

- Educate employees about spill prevention and cleanup.

- Well-trained employees can reduce human errors that lead to accidental releases or spills:

  - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.

- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.

- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- A Spill Prevention Control and Countermeasure Plan (SPCC) is required for facilities that are subject to the oil pollution regulations specified in Part 112 of Title 40 of the Code of Federal Regulations or if they have a storage capacity of 10,000 gallons or more of petroleum. (Health and Safety Code 6.67)

- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.

- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

Requirements

Costs (including capital and operation & maintenance)

- Will vary depending on the size of the facility and the necessary controls.

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance (including administrative and staffing)

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from

tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
  - Cover fueling area if possible.
  - Use a perimeter drain or slope pavement inward with drainage to a sump.
  - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage "topping-off' of fuel tanks.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas

- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

Waste Handling & Disposal SC-34

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff.

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Approach

Pollution Prevention

- Accomplish reduction in the amount of waste generated using the following source controls:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

Suggested Protocols

General

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

Waste Collection

- Keep waste collection areas clean.
- Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc., may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

Good Housekeeping

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g., sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.

Chemical/Hazardous Wastes

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers and protect them from vandalism.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Stencil or demarcate storm drains on the facility's property with prohibitive message regarding waste disposal.

Run-on/Runoff Prevention

- Prevent stormwater run-on from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropyleneor hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

Inspection

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.

- Repair leaking equipment including valves, lines, seals, or pumps promptly.

Training

- Train staff in pollution prevention measures and proper disposal methods.
- Train employees and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Train employees and subcontractors in proper hazardous waste management.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment and trained personnel ready at all times to deal immediately with major spills
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.
- Ensure that vehicles transporting waste have spill prevention equipment that can prevent spills during transport. Spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

Other Considerations (Limitations and Regulations)

Hazardous waste cannot be reused or recycled; it must be disposed of by a licensed hazardous waste hauler.

Requirements

Costs

Capital and O&M costs for these programs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

Maintenance

- None except for maintaining equipment for material tracking program.

Supplemental Information

Further Detail of the BMP

Land Treatment System

Minimize runoff of polluted stormwater from land application by:

- Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, and there is a closed drainage system

- Avoiding application of waste to the site when it is raining or when the ground is saturated with water
- Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site
- Maintaining adequate barriers between the land application site and the receiving waters (planted strips are particularly good)
- Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins
- Performing routine maintenance to ensure the erosion control or site stabilization measures are working

Examples

The port of Long Beach has a state-of-the-art database for identifying potential pollutant sources, documenting facility management practices, and tracking pollutants.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety. Harvard University. 2002.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Building & Grounds Maintenance SC-41

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Building Repair and Construction SC-42

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Recycle

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Modifications are common particularly at large industrial sites. The activity may vary from minor and normal building repair to major remodeling, or the construction of new facilities. These activities can generate pollutants including solvents, paints, paint and varnish removers, finishing residues, spent thinners, soap cleaners, kerosene, asphalt and concrete materials, adhesive residues, and old asbestos installation. Protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants to stormwater from building repair, remodeling, and construction by using soil erosion controls, enclosing or covering building material storage areas, using good housekeeping practices, using safer alternative products, and training employees.

Approach

Pollution Prevention

- Recycle residual paints, solvents, lumber, and other materials to the maximum extent practical.
- Buy recycled products to the maximum extent practical.
- Inform on-site contractors of company policy on these matters and include appropriate provisions in their contract to ensure certain proper housekeeping and disposal practices are implemented.

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- Make sure that nearby storm drains are well marked to minimize the chance of inadvertent disposal of residual paints and other liquids.

Suggested Protocols

Repair & Remodeling

- Follow BMPs identified in Construction BMP Handbook.
- Maintain good housekeeping practices while work is underway.
- Keep the work site clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Cover materials of particular concern that must be left outside, particularly during the rainy season.
- Do not dump waste liquids down the storm drain.
- Dispose of wash water, sweepings, and sediments properly.
- Store materials properly that are normally used in repair and remodeling such as paints and solvents.
- Sweep out the gutter or wash the gutter and trap the particles at the outlet of the downspout if when repairing roofs, small particles have accumulated in the gutter. A sock or geofabric placed over the outlet may effectively trap the materials. If the downspout is tight lined, place a temporary plug at the first convenient point in the storm drain and pump out the water with a vactor truck, and clean the catch basin sump where you placed the plug.
- Properly store and dispose waste materials generated from construction activities. See Construction BMP Handbook.
- Clean the storm drain system in the immediate vicinity of the construction activity after it is completed.

Painting

- Enclose painting operations consistent with local air quality regulations and OSHA.
- Local air pollution regulations may, in many areas of the state, specify painting procedures which if properly carried out are usually sufficient to protect water quality.
- Develop paint handling procedures for proper use, storage, and disposal of paints.
- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint containers.
- Mix paint indoors before using so that any spill will not be exposed to rain. Do so even during dry weather because cleanup of a spill will never be 100% effective.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.

- Do not transfer or load paint near storm drain inlets.
- Plug nearby storm drain inlets prior to starting painting and remove plugs when job is complete when there is significant risk of a spill reaching storm drains.
- Cover nearby storm drain inlets prior to starting work if sand blasting is used to remove paint.
- Use a ground cloth to collect the chips if painting requires scraping or sand blasting of the existing surface. Dispose the residue properly.
- Cover or enclose painting operations properly to avoid drift.
- Clean the application equipment in a sink that is connected to the sanitary sewer if using water based paints.
- Capture all cleanup-water and dispose of properly.
- Dispose of paints containing lead or tributyl tin and considered a hazardous waste properly.
- Store leftover paints if they are to be kept for the next job properly, or dispose properly.
- Recycle paint when possible. Dispose of paint at an appropriate household hazardous waste facility.

Training

Proper education of off-site contractors is often overlooked. The conscientious efforts of well trained employees can be lost by unknowing off-site contractors, so make sure they are well informed about what they are expected to do.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Clean up spills immediately.
- Excavate and remove the contaminated (stained) soil if a spill occurs on dirt.

Limitations

- This BMP is for minor construction only. The State's General Construction Activity Stormwater Permit has more requirements for larger projects. The companion "Construction Best Management Practice Handbook" contains specific guidance and best management practices for larger-scale projects.
- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
- Be certain that actions to help stormwater quality are consistent with Cal- and Fed-OSHA and air quality regulations.

SC-42 Building Repair and Construction

Requirements

Costs

These BMPs are generally low to modest in cost.

Maintenance

N/A

Supplemental Information

Further Detail of the BMP

Soil/Erosion Control

If the work involves exposing large areas of soil, employ the appropriate soil erosion and control techniques. See the Construction Best Management Practice Handbook. If old buildings are being torn down and not replaced in the near future, stabilize the site using measures described in SC-40 Contaminated or Erodible Areas.

If a building is to be placed over an open area with a storm drainage system, make sure the storm inlets within the building are covered or removed, or the storm line is connected to the sanitary sewer. If because of the remodeling a new drainage system is to be installed or the existing system is to be modified, consider installing catch basins as they serve as effective "in-line" treatment devices. See Treatment Control Fact Sheet TC-20 Wet Pond/Basin in Section 5 of the New Development and Redevelopment Handbook regarding design criteria. Include in the catch basin a "turn-down" elbow or similar device to trap floatables.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Site Design & Landscape Planning SD-10

Design Objectives

- ✓ Maximize Infiltration
- ✓ Provide Retention
- ✓ Slow Runoff
- ✓ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

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Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Efficient Irrigation SD-12

Design Objectives

- ✓ Maximize Infiltration
- ✓ Provide Retention
- ✓ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

IV.4 ALTERNATIVE COMPLIANCE PLAN (IF APPLICABLE)

IV.4.1 Water Quality Credits

Determine if water quality credits are applicable for the project. *Refer to Section 3.1 of the Model WQMP for description of credits and Appendix VI of the TGD for calculation methods for applying water quality credits.*

<table>
<tr><th colspan="5">Description of Proposed Project</th></tr>
<tr><td colspan="5">Project Types that Qualify for Water Quality Credits (Select all that apply):</td></tr>
<tr><td colspan="2">☐Redevelopment projects that reduce the overall impervious footprint of the project site.</td><td colspan="2">☐Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.</td><td>☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).</td></tr>
<tr><td colspan="2">☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).</td><td colspan="2">☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned</td><td>☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).</td></tr>
<tr><td>☐Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.</td><td>☐ Developments in a city center area.</td><td>☐ Developments in historic districts or historic preservation areas.</td><td>☐ Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.</td><td>☐In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.</td></tr>
<tr><td>Calculation of Water Quality Credits
(if applicable)</td><td colspan="4">Not applicable</td></tr>
</table>

IV.4.2 Alternative Compliance Plan Information

Describe an alternative compliance plan (if applicable). Include alternative compliance obligations (i.e., gallons, pounds) and describe proposed alternative compliance measures. *Refer to Section 7.II 3.0 in the WQMP.*

Section V Inspection/Maintenance Responsibility for BMPs

BMP Inspection/Maintenance			
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Minimum Frequency of Activities**
Education for Property Owners, Tenants and Occupants	Real Estate Development Associates	Provide education information to new owners, Tenants and occupants as needed	Continuous
Common Area Landscape Management	Construction Superintendent during construction; Real Estate Development Associates during post-construction	Manage landscaping in accordance with County of Orange Water Conservation Ordinance No. 3802 and with Management Guidelines for Use of Fertilizers and Pesticides	Monthly during regular maintenance
BMP Maintenance.	Real Estate Development Associates	N/A	BMP table
Common Area Litter Control.	Construction Superintendent during construction; Real Estate Development Associates during post-construction.	Litter Maintenance	Continuous

Employee Training.	Real Estate Development Associates	Include the education materials contained in the approved Water Quality Management Plan.	Monthly for construction maintenance personnel and employees
Catch Basin Inspection	Real Estate Development Associates	Inspection	Catch Basins will be inspected after major rain events and immediately prior to the start of the rainy season on October 1st.
Street Sweeping Private Street and Parking Lot.	Real Estate Development Associates	Sweeping	Parking lot will be swept monthly at a minimum and immediately prior to the start of the rainy season on October 1st.
Storm Drain System Stenciling	Real Estate Development Associates	Repaint as necessary.	Annually
Trash and Waste Storage Areas	Construction Superintendent during construction; Real Estate Development Associates during post-construction.	Clean trash container area to prevent buildup of excess trash in area.	Monthly
Efficient Irrigation and Landscape Design	Real Estate Development Associates	Verify that runoff minimizing landscape design continues to function by checking that water sensors are functioning properly, that irrigation heads are adjusted properly to eliminate overspray to hardscape areas, and to verify that irrigation timing and cycle lengths are adjusted in	Once a week, in conjunction with maintenance activities.

		accordance with water demands, given time of year, weather and day or night time temperatures. Verify that plants continue to be grouped according to similar water requirements in order to reduce excess irrigation runoff.	
Biofiltration Facility/Vegetated Swale	Real Estate Development Associates	Repair damaged areas, mowing	Periodic
Filterra	Real Estate Development Associates	See Manufactures information sheet	See Manufactures information sheet

Section VI Site Plan and Drainage Plan

VI.1 SITE PLAN AND DRAINAGE PLAN

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural BMP locations
- Drainage delineations and flow information
- Drainage connections
- BMP details

VI.2 ELECTRONIC DATA SUBMITTAL

The minimum requirement is to provide submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open.

If the local jurisdiction requires specialized electronic document formats (CAD, GIS) to be submitted, this section will be used to describe the contents (e.g., layering, nomenclature, georeferencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

N

VICINITY MAP

NO SCALE

VI. - FIGURE 1

PROP. BUILDING #1
F.F.=59.00

PROP. BUILDING #2
F.F.=60.00

BIRCH STREET

BIRCH STREET

A-1 1.58

A-2 0.32

A-3 0.06

A-4 0.37

A-5 0.06

A-6 0.28

A-7 0.40

A-8 0.85

A-9 0.07

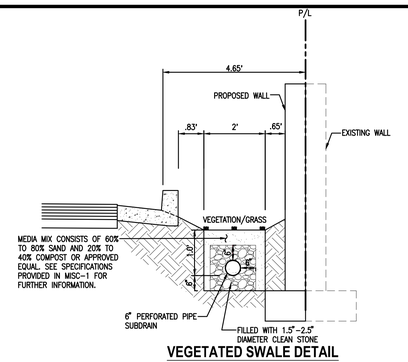
Subdrain

Point of Connection

SCALE: 1"=20'

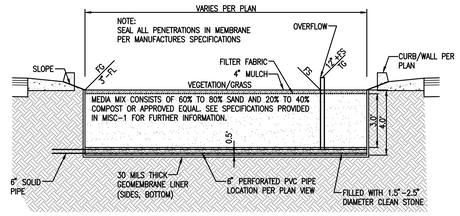
LEGEND

- Surface Drainage Pattern
- Stormdrain Flow Direction
- Indicates Pervious Area
- Catch Basin Stenciling
- Trash Container
- Filterra Unit (Bacterra Mix)
- Catchbasin Insert (Contech)
- Drainage Area Boundary
- Biofiltration Facility
- Vegetated Swale
- A-1 1.58 — Denotes Drainage Area Designation / Denotes Drainage Area in Acres



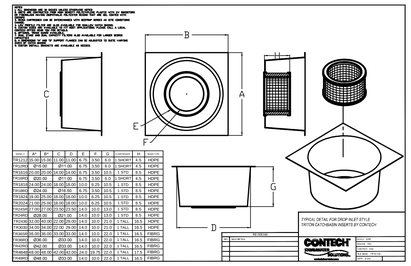
VEGETATED SWALE DETAIL

AREA (A-1)



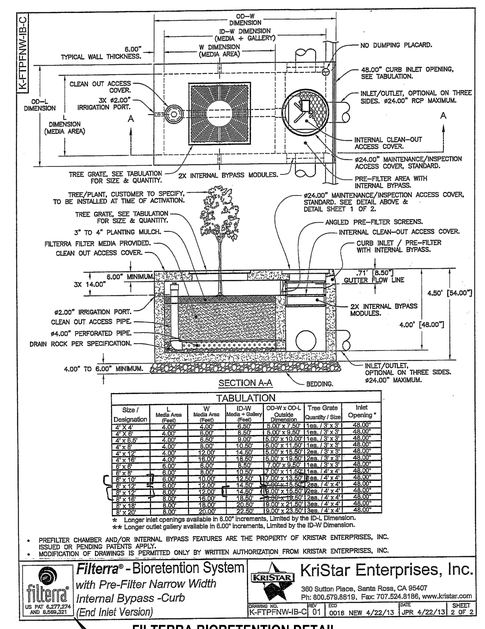
BIOFILTRATION FACILITY DETAIL

AREAS (A-6, A-8)



CATCH BASIN INSERTDETAIL

AREA (A-5)



TABULATION

Size / Designation	L Media Area	W Inside Area	ID-W Inside - Sides	OD-W x OD-L Outside	Tree Grate Quantity / Size	Inlet Opening *
2'X 4'	4.00'	6.00'	5.00'	6.00'W x 7.00'L	1 ea. / 2' x 3'	48.00"
2'X 6'	6.00'	8.00'	7.00'	8.00'W x 9.00'L	1 ea. / 2' x 3'	48.00"
2'X 8'	8.00'	10.00'	9.00'	10.00'W x 11.00'L	1 ea. / 2' x 3'	48.00"
4'X 4'	4.00'	8.00'	6.00'	8.00'W x 9.00'L	2 ea. / 2' x 3'	48.00"
4'X 6'	6.00'	10.00'	8.00'	10.00'W x 11.00'L	2 ea. / 2' x 3'	48.00"
4'X 8'	8.00'	12.00'	10.00'	12.00'W x 13.00'L	2 ea. / 2' x 3'	48.00"
4'X 10'	10.00'	14.00'	12.00'	14.00'W x 15.00'L	2 ea. / 2' x 3'	48.00"
4'X 12'	12.00'	16.00'	14.00'	16.00'W x 17.00'L	2 ea. / 2' x 3'	48.00"
6'X 4'	4.00'	10.00'	8.00'	10.00'W x 11.00'L	3 ea. / 2' x 3'	48.00"
6'X 6'	6.00'	12.00'	10.00'	12.00'W x 13.00'L	3 ea. / 2' x 3'	48.00"
6'X 8'	8.00'	14.00'	12.00'	14.00'W x 15.00'L	3 ea. / 2' x 3'	48.00"
6'X 10'	10.00'	16.00'	14.00'	16.00'W x 17.00'L	3 ea. / 2' x 3'	48.00"
6'X 12'	12.00'	18.00'	16.00'	18.00'W x 19.00'L	3 ea. / 2' x 3'	48.00"
6'X 14'	14.00'	20.00'	18.00'	20.00'W x 21.00'L	3 ea. / 2' x 3'	48.00"
6'X 16'	16.00'	22.00'	20.00'	22.00'W x 23.00'L	3 ea. / 2' x 3'	48.00"

* Longer inlet openings available in 6.00" increments, Limited by the ID-L Dimension.
** Longer outlet gallery available in 6.00" increments, Limited by the ID-W Dimension.

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filterra® US PAT. 6,277,274 AND 8,589,321

Filterra® - Bioretention System *with Pre-Filter Narrow Width Internal Bypass -Curb (End Inlet Version)*

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Ph: 800.579.8819, Fax: 707.524.8186, www.kristar.com

Drawing No. K-FTFPNW-IB-C | 01 | 0018 NEW 4/22/13 | JPR 4/22/13 | SHEET 2 OF 2

FILTERRA BIORETENTION DETAIL

AREAS (A-2, A-4, A7)

SITE PLAN
VI. - FIGURE 2
REDA Birch Medical Office Building
20412, 20402, 20392 & 203825 Birch Street
Newport Beach, CA

Section VII Educational Materials

Education Materials			
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**	**Business Material (http://www.ocwatersheds.com)**	**Check If Applicable**
The Ocean Begins at Your Front Door	☐	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☐	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☐	Proper Maintenance Practices for Your Business	☐
Household Tips	☐	**Other Material**	**Check If Attached**
Proper Disposal of Household Hazardous Waste	☐		
Recycle at Your Local Used Oil Collection Center (North County)	☐	County Urban Storm Water Pollution Prevention Program	☒
Recycle at Your Local Used Oil Collection Center (Central County)	☐	EPA: When it Rains it Drains	☒
Recycle at Your Local Used Oil Collection Center (South County)	☐	EPA: Preventing Pollution through Efficient Water Use	☒
Tips for Maintaining a Septic Tank System	☐	Solution to Pollution – Twenty Ways	☒
Responsible Pest Control	☐	County Ordinance No. 3802	☒
Sewer Spill	☐	County Ordinance No. 0-97-3987, Water Management and Urban Runoff	☒
Tips for the Home Improvement Projects	☐	Notice of Transfer of Responsibility Form	☒
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☐		☐
Tips for Pet Care	☐		☐
Tips for Pool Maintenance	☐		☐
Tips for Residential Pool, Landscape and Hardscape Drains	☐		☐
Tips for Projects Using Paint	☐		☐

Orange County Storm Water Program Participants:

Anaheim Public Works/Engineering	(714) 765-5176
Brea Engineering	(714) 990-7666
Buena Park Public Works	(714) 562-3655
Costa Mesa Public Services	(714) 754-5248
Cypress Public Works	(714) 229-6740
Dana Point Public Works	(949) 248-3562
Fountain Valley Public Works	(714) 593-4400 x347
Fullerton Engineering Dept	(714) 738-6853
Garden Grove Public Works	(714) 741-5554
Huntington Beach Public Works	(714) 536-5432
Irvine Public Works	(949) 724-6315
La Habra Public Services	(562) 905-9792
La Palma Public Works	(714) 690-3310
Laguna Beach Public Works	(949) 497-0330
Laguna Hills Engineering	(949) 707-2600
Laguna Niguel Public Works	(949) 362-4337
Laguna Woods Public Works	(949) 452-0600
Lake Forest Public Works	(949) 461-3480
Los Alamitos Community Dev	(562) 431-3538 x301
Mission Viejo Public Works	(949) 470-3095
Newport Beach Public Works	(949) 644-3311
Orange Public Works	(714) 744-5551
Placentia Engineering	(714) 993-8131
Rancho Santa Margarita Public Works	(949) 635-1800
San Clemente Engineering	(949) 361-6118
San Juan Capistrano Engineering	(949) 493-1171
Santa Ana Public Works	(714) 647-3380
Seal Beach Engineering	(562) 431-2527 x318
Stanton Public Works	(714) 379-9222 x204
Tustin Public Works Engineering	(714) 573-3150
Villa Park Engineering	(714) 998-1500
Westminster Public Works Eng.	(714) 898-3311 x229
Yorba Linda Engineering	(714) 961-7170 x174
O. C. Storm Water Program	(714) 567-6363
O. C. Urban Runoff Plan Review	(714) 834-3526
24 Hour Water Pollution Problem Reporting Hotline	(714) 567-6363 or E-mail information to ashbyk@pfrd.co.orange.ca.us
American Oceans Campaign	www.americanoceans.org

Other Important Phone Numbers:

For Additional Brochures **(714) 567-6363**

For Recycling Tips www.ciwmb.ca.gov/wmprog.htm

*O. C. Household Hazardous Waste Information (714) 834-6752 or www.oc.ca.gov/IWMD

Chemical and Hazardous Material Spill Emergencies 911

Information on locations that accept used motor oil, California Integrated Waste Management Board **(800) 553-2962 or www.CIWMB.ca.gov**

Information on agriculture chemicals, pesticides and possible alternatives, O.C. Agriculture Commissioner **(714) 447-7100**

Information for industries regarding Hazardous Waste And Underground Storage Tank Requirements: O.C. Health Care Agency / Environmental Health Division/ Hazardous Materials Management Section **(714) 667-3700**

Do You Know Where The Water In Your Storm Drain Goes?

To The Ocean...

Orange County Urban Storm Water Pollution Prevention Program

Even if you live miles from the Pacific Ocean you may be polluting it without knowing it.

How Does Orange County's Storm Drain System Work?

Unlike the sewer system, which carries water from your indoor drains to wastewater treatment plants, the storm drain system releases untreated water into channels, rivers and ultimately the ocean.

To insure the safety and enjoyment of our environment, everyone's help is needed to keep the storm drain system free from harmful pollutants...

Did you know that one pint of motor oil can produce an oil slick of approximately one acre on the surface of water?

COMMON STORM DRAIN POLLUTANTS

HOME MAINTENANCE

- **Detergents, Cleaners and Solvents**
- **Oil and Latex Paint**
- **Swimming Pool Chemicals**
- **Outdoor Trash and Litter**

LAWN AND GARDEN

- **Pet and Animal Waste**
- **Pesticides, Insecticides, and Herbicides**
- **Clippings, Leaves and Soil**
- **Fertilizer**

AUTOMOBILE

- **Oil and Grease**
- **Radiator Fluids and Antifreeze**
- **Cleaning Chemicals**
- **Brake pad dust**

Things You Can Do To Protect The Water In Your Storm Drain System

Did you know that dumping anything in the storm drain system is illegal and harmful to the environment?

Before you let anything go into the gutter or the storm drain, stop and think!

HOUSEHOLD

Some household products , such as cleaners, insect spray and weed killers, can cause pollution if allowed to drain into a storm drain. Buy household products labeled "nontoxic" whenever possible. Clean up spills with an absorbent material such as kitty litter and check with your disposal carrier or a *household hazardous waste collection center *, for disposal recommendations.*

PAINT AND SOLVENTS

Clean water-based paints from rollers, pans and brushes in sinks that go into the sewer system. Use paint thinner to remove oil-based paint from brushes and rollers, then take used thinner and left over paint to a *household hazardous waste collection center* *, or keep the paint for touch ups, or give it to a friend.

AUTOMOTIVE

Keep your autos in good repair and watch for possible leaks. Take left over or used fluids to your *household hazardous waste collection center* * . Clean up leaks and spills with an absorbent material such as kitty litter and check with your disposal carrier or a *household hazardous waste collection center * for disposal recommendations.*

Storm drain water goes directly into channels and creeks...

SWIMMING POOL AND SPA

Water containing chlorine is harmful to aquatic life. Whenever possible, drain water into the sewer system. There are established guidelines on the amount of residual chlorine, acceptable ph range, coloration, filter media and acid cleaning wastes when draining into the storm drain system, and some areas may require a permit. Check with your city or call the county at 714-567-6363 for a copy of the guidelines.

LAWN AND GARDEN

Use a broom or rake to clean up yard debris and place in trash bins; lawn clippings and leaves should be placed in recycling containers if available - or better yet, leave your grass clippings on the lawn. Follow directions carefully when using pesticides and fertilizers; don't over water or use before a rain. Pesticides and fertilizers may adversely impact our waterways.

TRASH

Place trash and litter that cannot be recycled or reused in trash cans, call your city to find out if your city has a recycling program. Whenever possible, turn trash into useful products and buy recycled products.

Remember: *Reduce - Reuse -Recycle*

PET CARE

Pick-up pet waste as soon as possible and put it in the trash. Pet waste has harmful bacteria that can get into our waterways. Also, follow label directions for disposal on pet care products like flea shampoo, they can be toxic.

...and through wetlands and bays...

...to the ocean.

This brochure has been developed as part of the Orange County Storm Water Management Program. Participants include the County of Orange, local cities, and agencies listed in this brochure. You may contact one of them for additional brochures and information.

It's Up To You

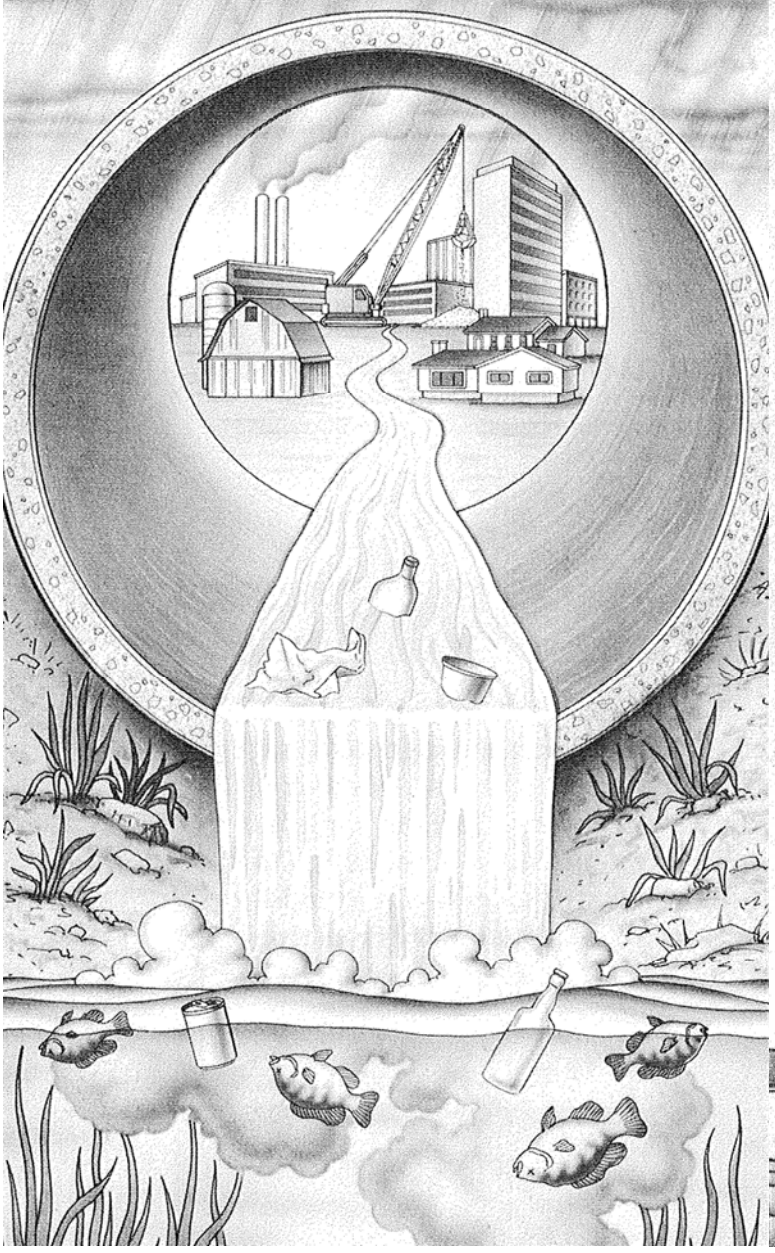
Together, you and your neighbors can make a difference to keep gutters, storm drains and waterways clean. To learn more, contact your city or one of the program participants listed in this brochure.

United States Environmental Protection Agency
August 1993
832-F-93-002
Office of Water
WH-547

EPA

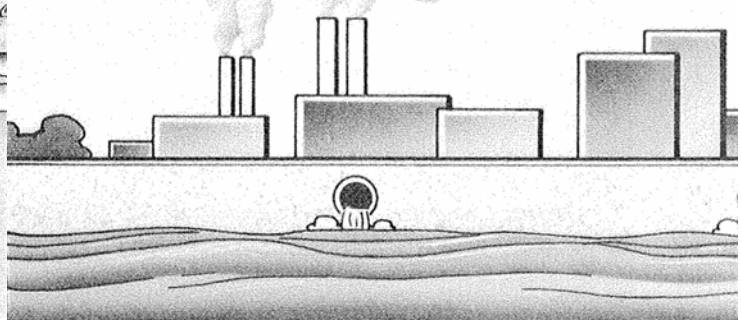
When It Rains, It Drains

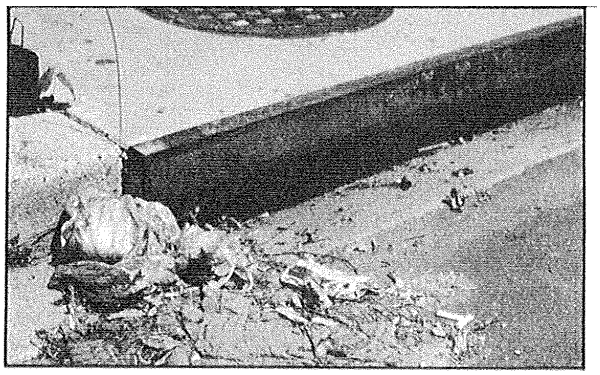
What Everyone Should Know About Storm Water



WHAT IS STORM WATER?

Storm water is water from precipitation that flows across the ground and pavement when it rains or when snow and ice melt. The water seeps into the ground or drains into what we call storm sewers. These are the drains you see at street corners or at low points on the sides of your streets. Collectively, the draining water is called storm water runoff and is a concern to us in commercial and industrial sites as well as your neighborhood because of the pollutants it carries.





Debris along street picked up by storm water.

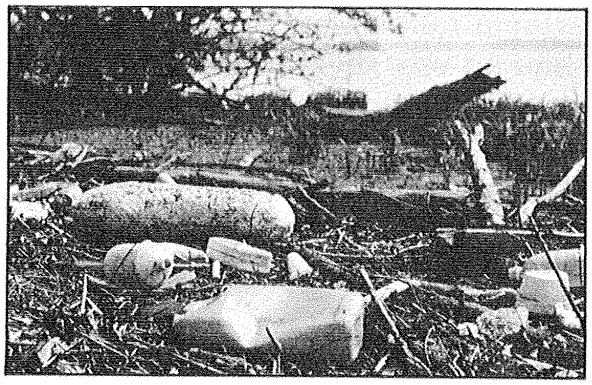
WHY IS STORM WATER A PROBLEM?

Storm water is a problem when it picks up debris, chemicals, and other pollutants as it flows or when it causes flooding and erosion of stream banks. The pollutants are deposited untreated into our waterways. The result can be the closing of our beaches; no swimming, fishing or boating; and injury to the plants and animals that live in or use the water.

WHAT ARE THESE POLLUTANTS? WHERE DO THEY COME FROM ? WHAT ARE SOME OF THEIR EFFECTS ON PLANTS, ANIMALS, AND HUMANS ?

The following information will answer these questions and let you know what you and your community can do to help recognize where there could be a problem and what to do to help solve it !

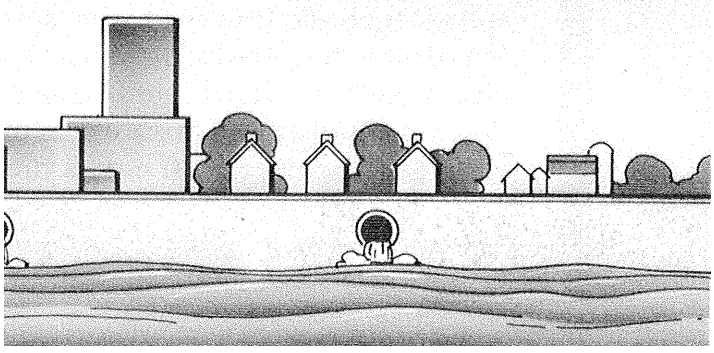
EPA has a storm water program that, with your help, can keep our rivers, lakes, streams, and oceans open to use and enjoyment, and healthy for plants and animals to live in.



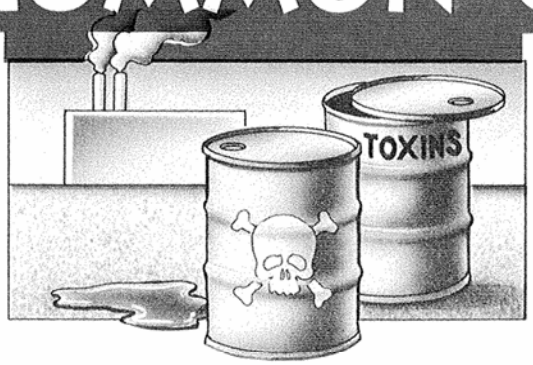
Debris washed up on the beach by storm water.

WHERE DOES THE STORM WATER GO AFTER IT DRAINS INTO STORM SEWERS?

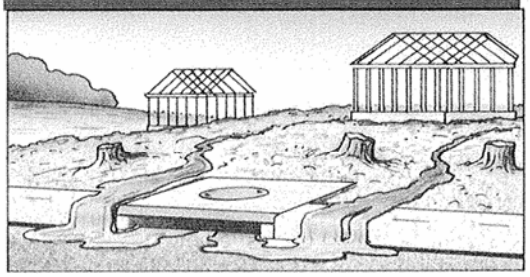
Storm water that does not seep into the ground, drains into systems of underground pipes or roadside ditches and may travel for many miles before being released into a lake, river, stream, wetland area, or coastal waters.



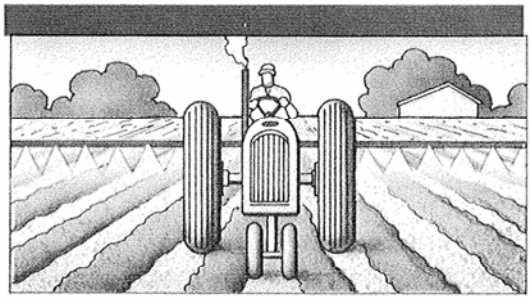
COMMON CONTRIBUTORS TO



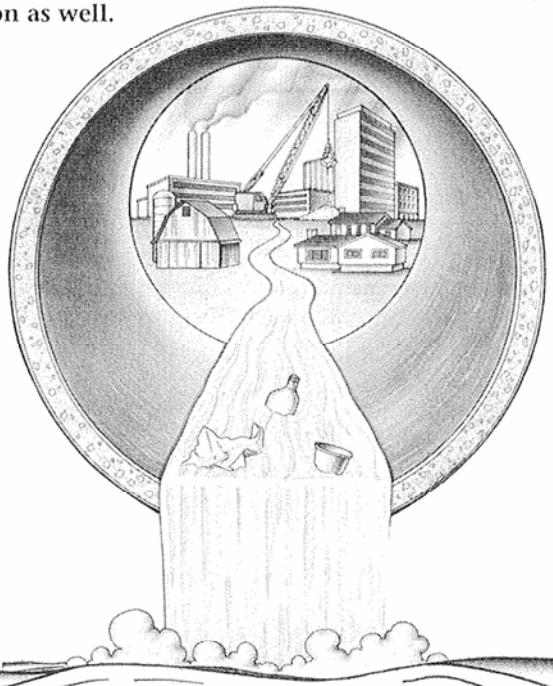
INDUSTRY – At industrial sites, chemical spills that contain toxic substances, smoke stacks that spew emissions, and uncovered or unprotected outdoor storage or waste areas can contribute pollutants to storm water runoff.



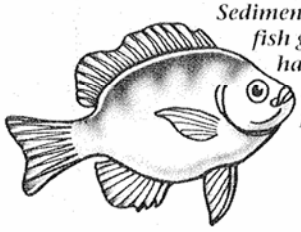
CONSTRUCTION – Waste from chemicals and materials used in construction can wash into our waterways during wet weather. Soil that erodes from construction sites can contribute to environmental degradation as well.



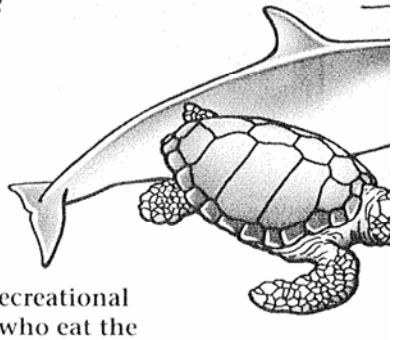
AGRICULTURE – Pesticides, fertilizers, and herbicides used in crop production can be toxic to aquatic life and can contribute to over-enrichment of the water, causing excess algae growth and oxygen depletion. Although storm water runoff from agricultural areas is not regulated under the EPA storm water permitting program, it is a nonpoint source of storm water pollution covered under other EPA programs.



WHAT ARE SOME OF THEIR EFFECTS ON PLANTS, ANIMALS, AND HUMANS?

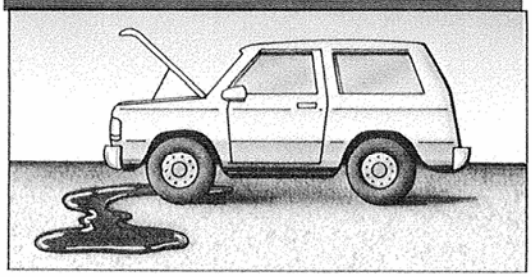


Sediment and other debris clog fish gills, damage fish habitat, and block the light needed for the plants to survive.

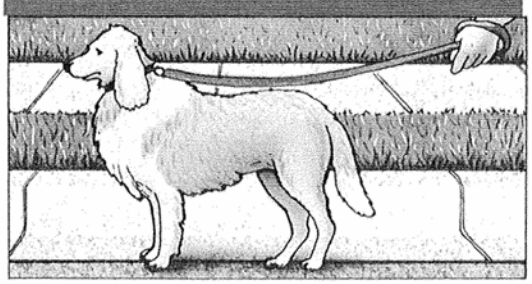


When polluted storm water runoff reaches our waterways, it can have many adverse effects on aquatic plant and animal life, other wildlife that use the water, humans who drink the water, use it for fishing, boating, swimming and other recreational activities, and on humans and animals who eat the contaminated fish and other seafood.

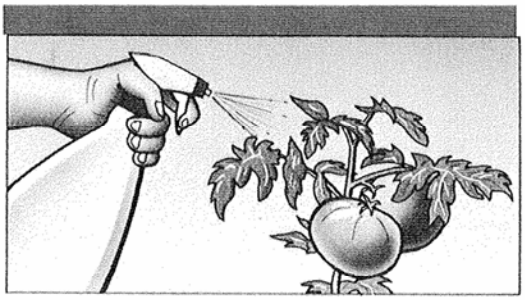
STORM WATER POLLUTION



HOUSEHOLD – Vehicles drip fluids (oil, grease, gasoline, antifreeze, brake fluids, etc.) onto paved areas where storm water runoff carries them through our storm drains and into our waterways.



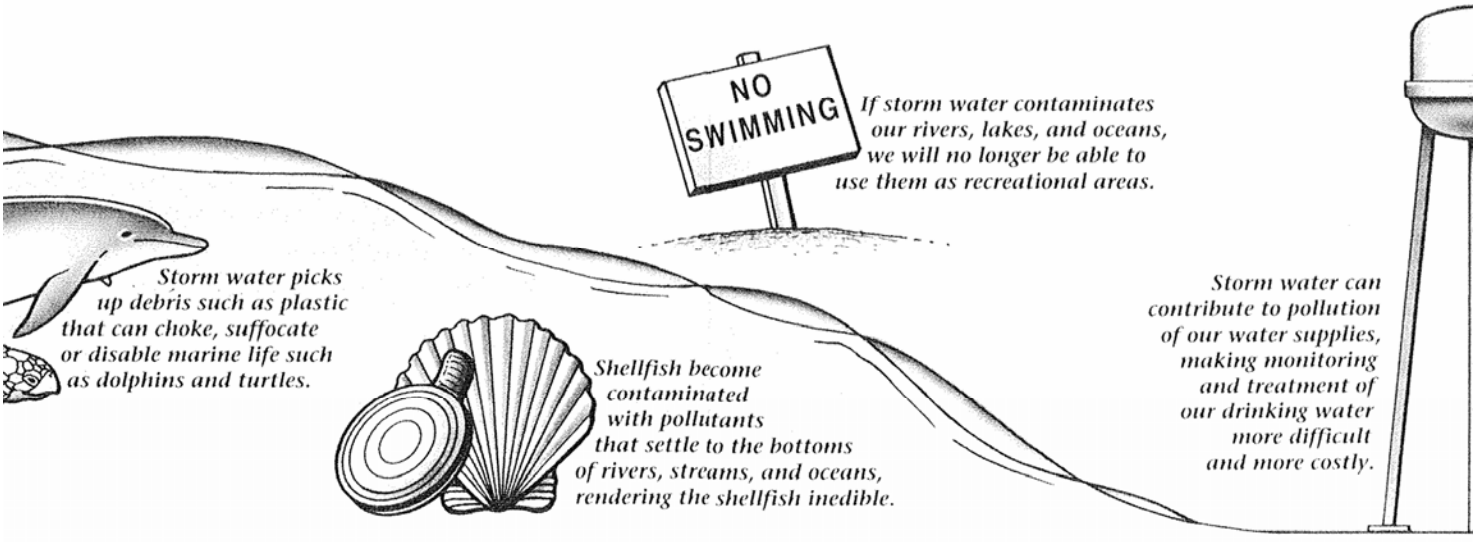
HOUSEHOLD – Pet wastes left on the ground get carried away by storm water, contributing harmful bacteria, parasites and viruses to our waterways.



HOUSEHOLD – Chemicals used to grow and maintain beautiful lawns and gardens, if not used properly, can run off into the storm drains when it rains or when we water our lawns and gardens.

OTHER COMMON HOUSEHOLD PRODUCTS THAT COULD CAUSE POLLUTION IF CARRIED OFF BY STORM WATER RUNOFF OR DUMPED DOWN STORM SEWERS:

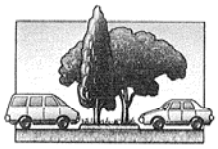
- Ammonia-based cleaners, drain cleaners
- Car care products such as detergents with phosphate and car waxes
- Paint, paint thinners, varnish, furniture refinishing products, paint brush cleaners
- Concrete or wood sealants
- Degreasers
- Chlorine bleaches and disinfectants (for swimming pools, etc.)



MUNICIPAL PROGRAM

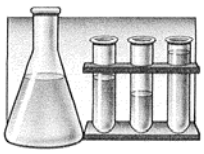
Here are some of the most important steps your community can take to control storm water pollution:

Prevent the release into the storm sewer system of hazardous substances such as used oil or household or yard chemicals

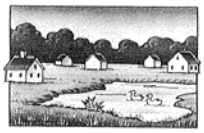


Make sure new commercial and residential developments include storm water management controls, such as reducing areas of paved surfaces to allow storm water to seep into the ground.

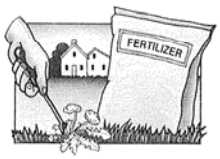
Promote practices such as street sweeping, limiting use of road salt, picking up litter, and disposing of leaves and yard wastes quickly.



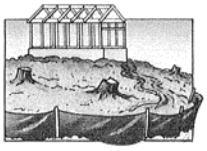
Collect samples of storm water from industrial sites to see whether pollutants are being released. If so, identify the type and quantity of pollutants being released.



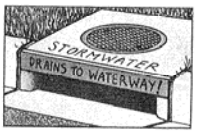
Design and institute flood control projects in a way that does not impair water quality.



Prevent runoff of excess pesticides, fertilizers, and herbicides by using them properly and efficiently. (Commercial, institutional, and residential landscapes can be designed to prevent pollution, conserve water, and look beautiful at the same time.)



Make sure that construction sites control the amount of soil that is washed off by rain into waterways.

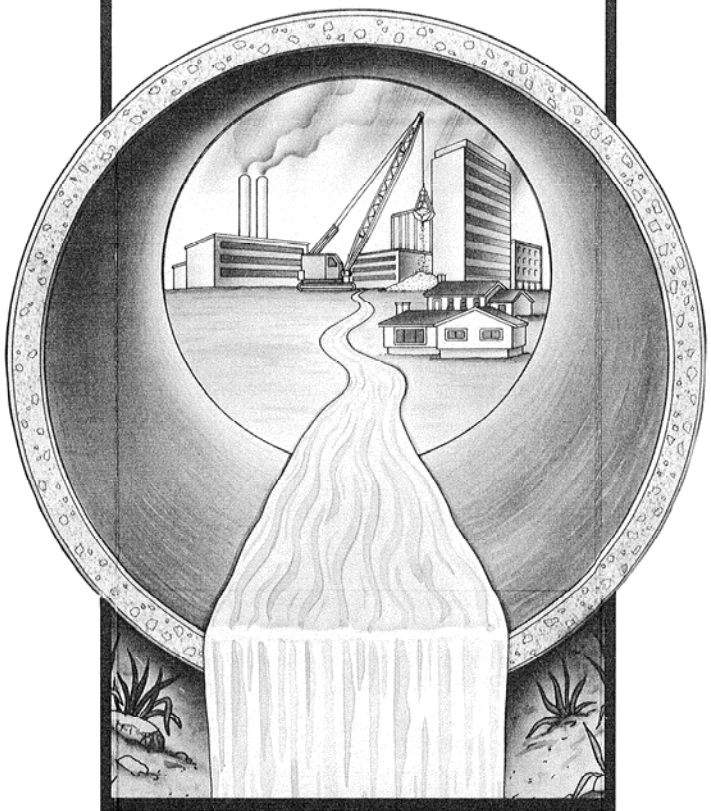


Promote citizen participation and public group activity to increase awareness and education at all levels. Encourage local collection pick-up days and recycling of household hazardous waste materials to prevent their disposal into storm drains.

MUNICIPAL SUCCESS STORY

A northwest city, recognizing the need for storm water management, set up a special water utility to oversee all local government storm water control activities and to raise the money for storm water projects. The city collects fees from citizens using the storm water sewer system and uses the funds to implement storm water programs. The program is still successfully providing funds for such varied purposes as flood control, maintenance of existing storm water controls, and public education.

We can agree that the best way to protect water quality is to avoid polluting it in the first place. EPA has a National Storm Water Permit Program that focuses on municipal and industrial pollution prevention to help control storm water pollution. This program involves issuing permits to certain municipalities and industries to control storm water pollution. Development of State and local storm water management programs can help to achieve the Clean Water Act goals of fishable and swimmable waters.



MUNICIPAL PROGRAM

Permits issued for municipal storm water systems allow communities to design storm water management programs that are suited for controlling pollutants in their own municipal systems. EPA hopes this flexibility will encourage community interest and participation in solving storm water runoff problems.

INDUSTRIAL PROGRAM

Most permits issued under the storm water program require development and use of a storm water pollution prevention plan. Such plans describe how the facility will prevent storm water from becoming polluted by making sure that:

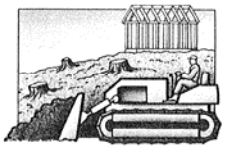
- Potential pollutants are not left outside uncovered
- Spills are prevented
- If spills occur, they are cleaned up right away
- There is no dumping of polluting substances into storm drains
- Grass and other vegetation is planted as quickly as possible after soils are disturbed

Some permits may require more extensive pollution control.

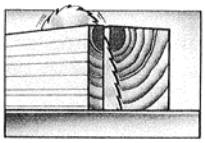
INDUSTRIAL PROGRAM

Storm water permits require many industrial facilities to prepare and implement storm water pollution prevention plans. Listed below are examples of industries and their pollution prevention activities.

Owners of construction sites that disturb 5 or more acres must develop a plan before beginning construction. The plan must limit the area of disturbed soil and provide controls — like sediment basins — to keep sediment from running off.

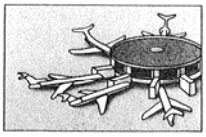


Operators of saw mills can reduce pollution by storing their materials and processing their products indoors; and removing any by-products from outdoor areas before these products come in contact with storm water runoff.

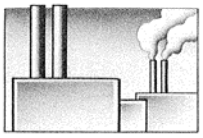


Operators of landfills should keep the storm water runoff from flowing over the pollutants and carrying them off the landfill site.

Airport employees can reduce storm water runoff pollution by using de-icing chemicals only in designated collection areas and by cleaning oil and grease spills from pavement immediately.

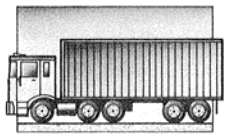


Chemical plant operators should develop spill prevention plans and use types of containers that do not rust or leak, eliminating exposure of materials to storm water runoff.

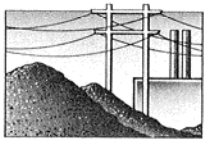


Owners of automobile junkyards should drain fluids from junked cars and properly dispose of hazardous chemicals.

Operators of trucking terminals should develop good housekeeping practices that clean up leaks and spills of oil and grease from the path of storm water runoff.



Power plant operators often store piles of coal and other fuels that have toxic components. Runoff from coal piles must be treated; other substances should be stored away from any possible contact with storm water runoff.



INDUSTRIAL SUCCESS STORY

A manufacturing facility located in a large midwestern city took an innovative approach to storm water management. Employees at a plant with a large fueling station noticed that during a rain storm, the runoff flowing into the city's storm sewer system had an oily sheen, caused by spilled fuel. To prevent future spills, the plant trained its drivers to avoid overfilling fuel tanks, laid down sawdust around the fueling station to absorb any accidental spills (the plant is careful not to wash the sawdust down the drain), and installed an oil/water separator to remove oil from the runoff before the runoff enters the storm drain.

WHAT CAN I DO TO HELP ?

First, become more aware of what may be causing storm water pollution in your area.

Second, help your municipality by:

1. Reporting to your local municipal officials -
   - Any dumping of inappropriate materials into storm water drains (such as oil, antifreeze).
   - Construction sites over 5 acres that do not have erosion or sediment controls.
2. Using good housekeeping practices with lawn care chemicals, oil, gasoline, pet wastes, etc.
3. Helping to start or participating in programs to recycle and safely dispose of used oil and household hazardous wastes and containers.
4. Telling others about pollution from storm water runoff and what they can do to help.

WHERE CAN I FIND OUT MORE INFORMATION?

Your EPA Regional Office
(Water Management Division)

1. EPA Region I (CT, ME, MA, NH, RI, VT)
   JFK Federal Bldg.; Boston, MA 02203
   617-565-3478
2. EPA Region II (NJ, NY, PR, VI)
   26 Federal Plaza; New York, NY 10278
   212-264-2513
3. EPA Region III (DE, MD, PA, VA, WV, DC)
   841 Chestnut Street; Philadelphia, PA 19107
   215-597-9410
4. EPA Region IV (AL, GA, FL, MS, NC, SC, TN, KY) 345 Courtland St., NE; Atlanta, GA 30365
   404-347-4450
5. EPA Region V (IL, IN, OH, MI, MN, WI)
   77 W. Jackson Blvd.; Chicago, IL 60604
   312-353-2145
6. EPA Region VI (AR, LA, OK, TX, NM)
   1445 Ross Ave., Suite 1200
   Dallas, TX 75202-2733
   214-655-7100
7. EPA Region VII (IA, KS, MO, NE)
   726 Minnesota Ave.; Kansas City, KS 66101
   913-551-7030
8. EPA Region VIII (CO, UT, WY, MT, ND, SD)
   999 18th St., Suite 500; Denver, CO 80202
   303-293-1542
9. EPA Region IX (AZ, CA, GM, HI, NV)
   75 Hawthorne Street; San Francisco, CA 94105
   415-744-2125
10. EPA Region X (AK, ID, OR, WA)
    1200 Sixth Ave.; Seattle, WA 98101
    206-553-1793

Other sources include:

- Storm Water Hotline (703) 821-4823
- State and Local Agencies

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April 1997
OW (4204)
OPPE (2164)

EPA

Preventing Pollution Through Efficient Water Use

EPA

For more information on what you and your community can do to use water more efficiently, contact:

U.S. Environmental Protection Agency
Office of Water
401 M Street, S.W.
Washington, D.C. 20460

For more information on pollution prevention programs at U.S. EPA, contact:

U.S. Environmental Protection Agency
Office of Pollution Prevention
401 M Street, S.W.
Washington, D.C. 20460

How Efficient Water Use Helps Prevent Pollution

Other Reasons to Use Water Wisely

What Individuals Can Do

What Communities Can Do

How Efficient Water Use Helps Prevent Pollution

Using water more efficiently can help prevent pollution as well as protect and conserve our finite water resources. More efficient water use by you and your community has many other benefits.

Fewer Pollutants

- Using less water reduces the amount of wastewater discharged into our lakes, streams, rivers, and marine waters.
- The amount of pollutants wastewater carries can also be reduced, as treatment efficiency improves.
- Recycled process water can reduce pollutants from industry.
- More efficient irrigation can minimize runoff of agricultural pollutants and reduce the use of fertilizers and pesticides.

Protection of Aquatic Habitats

- Building fewer and smaller new water projects can help preserve wetlands, which naturally treat pollutants.
- Diverting less water preserves more streamflow to maintain a healthy aquatic environment.

Protection of Drinking Water Sources

- Less pumping of groundwater lowers the chance that pollutants will be drawn into a water supply well.
- With less water use, septic system performance can improve, reducing the risk of groundwater contamination.
- Highest quality water sources are preserved for drinking water by using treated wastewater for other uses.

Energy Conservation

- Efficient water use means less power needed to pump and treat water and wastewater.
- Less water use reduces the amount of energy required for heating hot water.
- Less energy demand results in fewer harmful by-products from power plants.

Other Reasons to Use Water Wisely

Preventing pollution is only one reason why using water efficiently makes sense. Here are a few more:

Money Saved

- Less water use results in fewer pumping and treatment costs.
- Saving money on water and wastewater operations frees money for meeting water quality, public health and water treatment goals.
- Water saved is also energy, and money, saved for you and your community.

Improved Reliability

- Water conservation provides a hedge against drought impacts.
- Improving water efficiency may be quicker and cheaper than developing a new supply.
- Reduced water use may extend the life of your water or wastewater facility.
- Reduced water use may increase the efficiency of wastewater treatment, and reduce overflows during storms.
- Communities which use water efficiently are better prepared to cope with effects of possible future climate change.

What Individuals Can Do

More efficient water use begins with individuals, in the home and place of work. Taking these and other steps, and encouraging others to do so, makes good economic as well as environmental sense.

In The Home

- Install a toilet dam or plastic bottle in your toilet tank.
- Install a water-efficient showerhead (2.5 gallons or less per minute).
- When you buy a new toilet, purchase a low flow model (1.6 gallons or less per flush).

Outdoors

- Water in the morning or evening, to minimize evaporation.
- Install a drip-irrigation watering system for valuable plants.
- Use drought-tolerant plants and grasses for landscaping, and reduce grass-covered areas.

At Work or School

- Adopt the same water-saving habits that are effective at home.
- Ask about installing water-efficient equipment and reducing outdoor water use.
- Encourage employers to explore the use of recycled "gray-water" or reclaimed wastewater.

What Communities Can Do

A water supplier or wastewater system operator (public or private) has cost-effective options to process and deliver water more efficiently. A community can do the same, and can foster ways to use water wisely.

Not all of these steps are expensive. The best choices vary by region and by community; start by asking if these are appropriate where you live and work.

A Water Supplier or Wastewater Processor Can:

- ☞ Identify who uses water, and reduce unaccounted-for water use.
- ☞ Find and repair leaking pipes.
- ☞ Consider a new pricing scheme which encourages conservation.
- ☞ Reduce excess pressure in water lines.
- ☞ Explore the reuse of treated wastewater for uses other than drinking water.
- ☞ Charge hookup fees which encourage more efficient water use in new buildings.
- ☞ Build water efficiency into future demand projections, facility planning, and drought planning.

A Community Can:

- ☞ Adopt plumbing and building codes that require water-efficient equipment and practices.
- ☞ Adopt a water-efficient landscaping ordinance to reduce the water used for golf courses and commercial landscapes.
- ☞ Retrofit older buildings with water-efficient equipment, starting with public buildings.
- ☞ Reduce municipal water use for landscaping and other uses.
- ☞ Conduct a public education campaign.
- ☞ Require developers to build in water efficiency measures.

The Solution to Pollution - Begins with YOU!

Here are 20 WAYS that YOU can make a difference.

YOUR YARD

1. Apply pesticides and fertilizers carefully and sparingly. Do not apply chemicals if heavy rain is forecast.

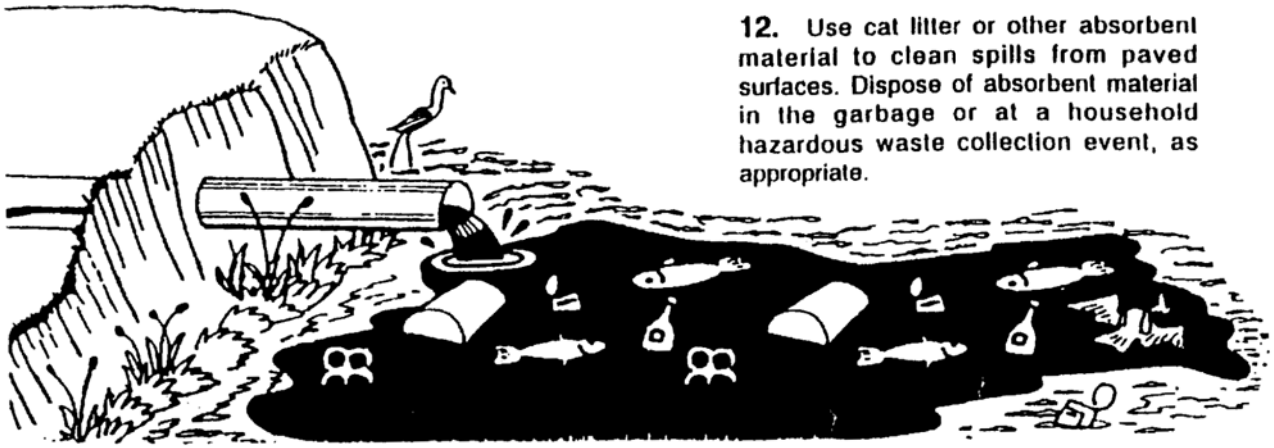
2. Use a broom, rather than a hose, to clean up garden clippings. Deposit leaves and clippings in a trash can or a compost pile.

3. Divert rainwater runoff from hard surfaces onto grass and permeable soil to help filter harmful substances.

4. Don't overwater your lawn and garden . . . water will only run into the street and storm drain.

5. Pick up animal waste and dispose of it in trash cans. Animal waste contains coliform bacteria and can spread serious diseases.

6. Control soil erosion. Prevent dirt and debris from washing into storm drains.



YOUR HOME

7. Use and dispose of household products carefully. Cleaning solutions and solvents often contain toxic elements.

8. Use non-hazardous cleaning substances such as baking soda, white vinegar or borax.

9. Take unwanted household hazardous materials to a Countywide Household Hazardous Waste collection event or other local collection programs.

10. When using water-based paints, clean brushes in a sink. Don't pour clean-up water down the storm drain. Dispose of oil-based products and solvents at a hazardous waste collection event.

11. Buy recycled products and recycle reusable materials. Many waste haulers provide curb-side service. Call yours for more information.

12. Use cat litter or other absorbent material to clean spills from paved surfaces. Dispose of absorbent material in the garbage or at a household hazardous waste collection event, as appropriate.

YOUR AUTO

13. Take used motor oil, antifreeze and other toxic solvents to collection centers.

14. Fix oil, radiator, and transmission leaks. Don't leave oil slicks to wash off in the rain.

15. Take your car to a car wash or wash your car on the grass. Don't just wash grimy road dirt down the driveway and into the storm drain.

16. Reduce polluting automotive emissions. Keep your car tuned, carpool, and use public transportation.

YOUR NEIGHBORHOOD

17. ***Never pour anything into a storm drain.***

18. Tell others how to prevent stormwater pollution. Don't let others pollute your water.

19. Report illegal dumping to local authorities.

20. Organize a stenciling campaign in your neighborhood. (Storm drain stencils remind us that there should be "only rain in the drain.") Call us for information on how to stencil.

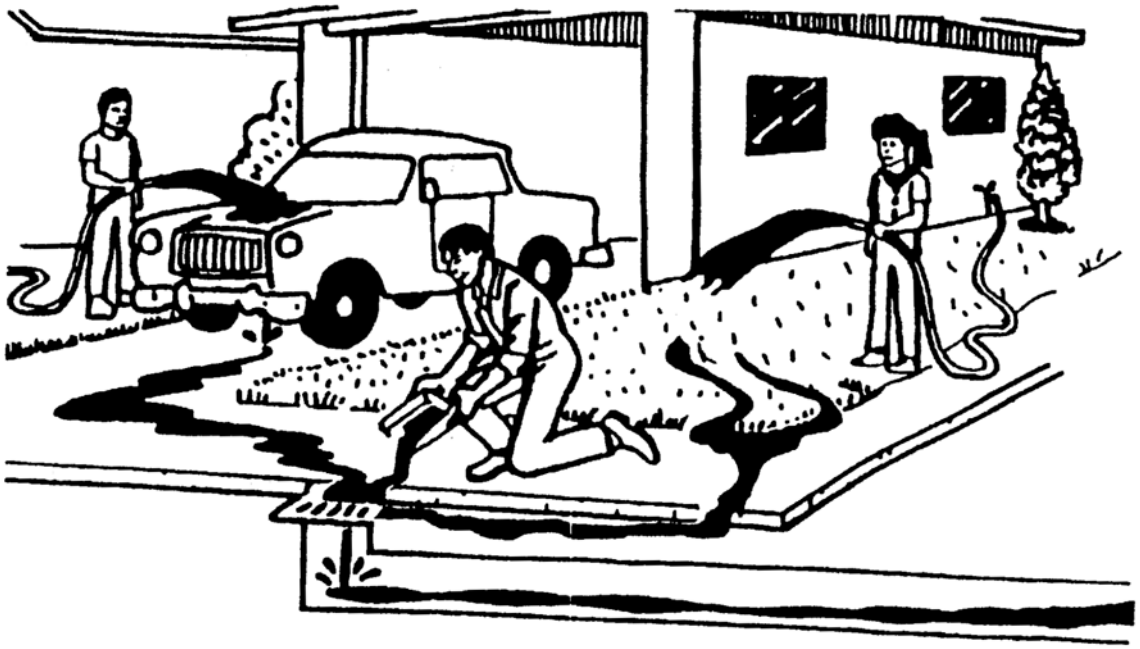
Twenty Ways to Protect Your Water

You Can Make A Difference!

Stormwater pollution . . . is fouling our water!

Every day, water from garden hoses, sprinklers and rainfall washes pollutants off roads and yards . . . right into neighborhood storm drains. Storm drains carry untreated water and pollutants ***directly*** *to our water resources.*

Some pollutants, such as grease and dirt from streets, reach the storm drains unintentionally. But, many pollutants like used motor oil, detergents, paints, and solvents, are carelessly dumped into the storm drains.



Polluted stormwater harms wildlife, jeopardizes the use of our rivers and lakes for recreation . . . and may eventually contaminate the water we drink!

ORDINANCE No. 3802

AN ORDINANCE OF THE COUNTY OF ORANGE, CALIFORNIA AMENDING VARIOUS PROVISIONS OF THE ZONING CODE REGARDING THE CONSERVATION OF WATER IN LANDSCAPING FOR COMMON AREAS OF MULTIFAMILY AND NON-RESIDENTIAL DEVELOPMENT

The Board of Supervisors of the County of Orange, California ordains as follows:

SECTION 1: Section 7-9-77.8(h) of the Codified Ordinances (R2 "Multifamily Dwellings" District Regulations) is hereby added to read as follows:

(h) Landscaping. For multifamily projects of five or more units and common areas of planned developments. Per section 7-9-132.2.

SECTION 2: Section 7-9-78.8(h) of the Codified Ordinances (R3 "Apartment" District Regulations) is hereby added to read as follows:

(h) Landscaping. For multifamily projects of five or more units and common areas of planned developments. Per section 7-9-132.2.

SECTION 3: Section 7-9-79.8(h) of the Codified Ordinances (R4 "Suburban Multifamily Residential" District Regulations) is hereby added to read as follows:

(h) Landscaping. For multifamily projects of five or more units and common areas of planned developments. Per section 7-9-132.2.

SECTION 4: Section 7-9-132.2 of the Codified Ordinances (Landscaping) is hereby amended to read as follows:

Section 7-9-132.2 Landscaping

Landscaping, consisting of trees, shrubs, vines, ground cover, turf or any combination thereof, shall be installed and maintained subject to the following standards:

(a) Boundary landscaping is required for a minimum depth equal to the required setback distance or ten (10) feet (whichever is less) along all property lines abutting streets except for the required street openings.

(b) Landscaping along all streets and boundaries shall be in compliance with Section 7-9-137.5, "Fences and walls."

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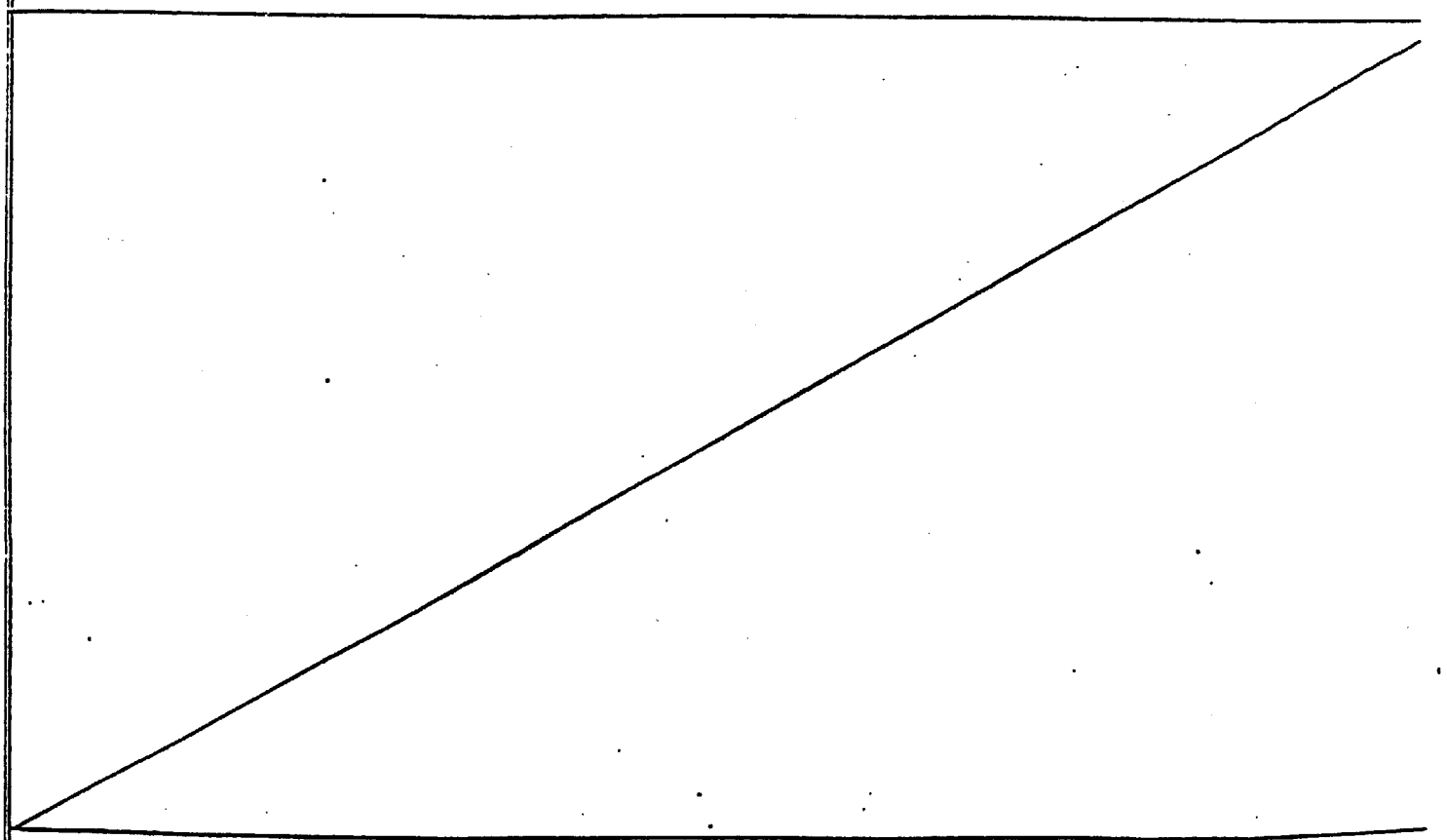
(c) Any landscaped area shall be separated from an adjacent parking or vehicular area by a wall or curb at least six (6) inches higher than the adjacent parking or vehicular area.

(d) Permanent watering facilities shall be provided for all landscaped areas.

(e) Required landscaping shall be maintained in a neat, clean and healthy condition. This shall include proper pruning, mowing of lawns, weeding, removal of litter, fertilizing and watering as needed and the replacement of plants when necessary.

(f) For projects with landscaping of more than one cumulative acre, a landscape and irrigation system plan shall be submitted and approved prior to the issuance of building permits (with implementation reports submitted and approved prior to the issuance of use and occupancy permits) to comply with criteria approved by Board of Supervisors' Water Conservation Resolution.

(g) In addition to other projects that may be subject to Section 7-9-132.2, the following projects shall be subject to these regulations regardless of the district, planned community or specific plan in which they are located: 1) Multifamily projects of five or more units; 2) Residential planned developments (common areas only); and 3) Commercial/Office/Industrial projects involving landscaping/irrigation of more than one cumulative acre.



SECTION 5. This Ordinance shall take effect and be in full force thirty (30) days from and after its passage and, before the expiration of fifteen (15) days after the passage thereof, shall be published once in the Saddleback Valley News, a newspaper published in the County of Orange, State of California, together with the names of the members of the Board of Supervisors voting for or against the same.

Chairman of the Board of Supervisors
of Orange County, California

SIGNED AND CERTIFIED THAT A COPY
OF THIS DOCUMENT HAS BEEN DELIVERED
TO THE CHAIRMAN OF THE BOARD

LINDA D. RUTH
Clerk of the Board of Supervisors
County of Orange, California

STATE OF CALIFORNIA)
) ss.
COUNTY OF ORANGE)

I, LINDA D. RUTH, Clerk of the Board of Supervisors, do hereby certify that at a regular meeting of the Board of Supervisors of Orange County, California, held on the 24th day of October, 19___, the foregoing ordinance containing five sections was passed and adopted by the following vote:

AYES: SUPERVISORS: HARRIETT M. WIEDER, GADDI H. VASQUEZ, ROGER R. STANTON, DON R. ROTH AND THOMAS F. RILEY

NOES: SUPERVISORS: NONE

ABSENT: SUPERVISORS NONE

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official seal of the Board of Supervisors of the County of Orange, State of California, this 26th day of October, 1990.

DATED: October 26, 1990
PUBLISH: Saddleback Valley News
November 2, 1990

LINDA D. RUTH
Clerk of the Board of Supervisors
of Orange County, California

RESOLUTION OF THE BOARD OF SUPERVISORS
OF ORANGE COUNTY CALIFORNIA
OCTOBER 24, 1990

On motion of Supervisor Wieder, duly seconded and carried, the following Resolution was adopted:

WHEREAS, the County of Orange has an adopted General Plan and Comprehensive Zoning Code; and

WHEREAS, on June 5, 1990 this Board received Guidelines for conserving water utilized in landscape irrigation from the Water Conservation Task Force; and

WHEREAS, this Board supports the goals of conserving water in landscaping irrigation as identified by the Water Conservation Task Force members; and

WHEREAS, the State of California has received less than normal levels of precipitation for the past four years resulting in a common need to conserve available potable waters and encourage utilization of reclaimed water; and

WHEREAS, this Board has complied with the California Environmental Quality Act (CEQA), the CEQA Guidelines and the County environmental procedures by revieving and considering Negative Declaration IP 90-40 and has determined that the proposed program will not have a significant effect on the environment; and

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Resolution No. 90-1341
Public Haring-Zoning Code Amendment No. 90-5, Water Conservation Implementation Program
:eb

WHEREAS, this Board has revieved the recommended criteria for the Water Conservation Implementation Program and has considered the EMA reports dated September 25, 1990 and the comments and responses received at the Planning Commission hearing.

NOW, THEREFORE, BE IT RESOLVED that this Board hereby approves this Resolution of Water Conservation Criteria for use in landscaping projects as identified in the Codified Ordinances of the County of Orange.

(1) Landscape and irrigation system plans required by Zoning Code section 7-9-132.2 shall be prepared and certified by a licensed landscape architect or licensed landscape contractor prior to the issuance of building permits and include but not be limited to:

(i) A site analysis study which includes evaluation of macro and micro climates, solar exposure, prevailing wind conditions, seasonal temperature patterns, soils and drainage, grade and slope analysis and street visibility;

(ii) utilization of the best available irrigation technology to maximize efficient use of water. This could include the use of historical evapo-transpiration rates, weather station (CIMIS) data, moisture sensors, rain shutoff devices, drip systems, multi-program electronic timers and matched output sprinkler heads;

(iii) project characteristics including visibility, adjacent development, activity and usage and focus area;

(iv) availability and special conditions for use of reclaimed water;

(v) consideration of planting zones or "hydrozones" to facilitate a zoned irrigation system;

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(vi) Landscaping plant palette selections utilizing potable water sources shall include low water using or drought-tolerant species.

(vii) A minimum of two inches (2") of mulched chip and fiber material shall be added to the soil surface after planting (slopes exceeding 25% from horizontal, 4 to 1, or areas planted with turf or full coverage ground cover are exempt).

(viii) The use of turf should not be included on slopes exceeding 25% (4 to 1) from horizontal or on areas where irrigation systems do not deliver 100% of their output to the turf and other landscape. Landscape project plans which include turf on slopes exceeding 25% shall include design features for the prevention of run-off.

(2) Implementation reports required by Zoning Code Section 7-9-132.2 shall include but not be limited to the submittal of the following prior to the issuance of use and occupancy permits:

(i) an Irrigation Management Report for each landscape irrigation system shall be prepared and certified by a licensed landscape architect or licensed landscape contractor prior to the issuance of final certificates of use and occupancy to identify appropriate long term use and maintenance of the system. This report shall include a watering schedule which incorporates the specific water needs of the plant material throughout the calendar year, a hardware component list for all materials used in the system and a recommendation of regular maintenance schedules for the irrigation system;

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(ii) certification by a licensed landscape architect or licensed landscape contractor that the irrigation system was installed in accordance with the certified plan and shall furnish said certification in writing prior to the issuance of final certificates of use and occupancy and the release of the financial security guaranteeing the landscape improvements to the Manager, Building Inspection Division;

(iii) a Certified Water Audit for the irrigation system prior to the issuance of final certificates of use and occupancy to verify that the irrigation design coverage and conservation goals are met. Subsequent water audits are recommended to be prepared each year.

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Chairman of the Board of Supervisors

SIGNED AND CERTIFIED THAT A COPY
OF THIS DOCUMENT HAS BEEN DELIVERED
TO THE CHAIRMAN OF THE BOARD

LINDA D. RUTH
Clerk of the Board of Supervisors
County of Orange, California

AYES: SUPERVISORS HARRIETT M. WIEDER, GADDI H. VASQUEZ, ROGER R STANTON, THOMAS F. RILEY, DON R. ROTH
NOES: SUPERVISORS NONE
ABSENT: SUPERVISORS NONE

STATE OF CALIFORNIA)
) ss.
COUNTY OF ORANGE)

I, LINDA D. RUTH, Clerk of the Board of Supervisors of Orange County, California, hereby certify that the above and foregoing Resolution was duly and regularly adopted by the said Board at a regular meeting thereof held on the 24th day of October , 1990 and passed by a unanimous vote of said Board.

IN WITNESS WHEREOF, I have hereunto set my hand and seal this 24th day of October, 1990.

LINDA D. RUTH
Clerk of the Board of Supervisors
of Orange County, California

ORDINANCE NO. O-97-3987

AN ORDINANCE ADDING DIVISION 13 TO TITLE 4 OF THE CODIFIED ORDINANCES OF THE COUNTY OF ORANGE RELATING TO STORM WATER MANAGEMENT AND URBAN RUNOFF

The Board of Supervisors of the County of Orange, California, does ordain as follows:

SECTION 1. Division 13 is hereby added to Title 4 of the Codified Ordinances of the County of Orange to read as follows:

Division 13

STORM WATER MANAGEMENT AND URBAN RUNOFF

ARTICLE 1. GENERAL PROVISIONS

Sec. 4-13-10. Adoption of the Water Quality Ordinance.

Pursuant to Article XI, Sec. 7 of the State Constitution, which authorizes the County to exercise the police power of the State by adopting regulations promoting the public health, public safety and general prosperity, and in compliance with the conditions of the National Pollution Discharge Elimination System Permit ("NPDES Permit"), there is hereby adopted a Water Quality Ordinance.

Sec. 4-13-20. Purpose.

The purpose of the Water Quality Ordinance is to prescribe regulations as mandated by the Clean Water Act [33 USC Sec. 1251 et seq., as amended] to effectively prohibit non-storm water discharges into the storm sewers and to reduce the discharge of pollutants. Human activities, such as agriculture, construction and the operation and maintenance of an urban infrastructure may result in undesirable discharges of pollutants and certain sediments, which may accumulate in local drainage channels and waterways and eventually may be deposited in the waters of the United States. This Ordinance will improve water quality by controlling the pollutants which enter the network of storm drains throughout Orange County.

Sec. 4-13-30. Definitions.

(a) "Authorized Inspector" shall mean the person designated by the Director of Public Facilities and Resources Department and persons designated by the Authorized Inspector as investigators and under his/her instruction and supervision, who are assigned to investigate compliance and detect violations of this Ordinance.

the amount of pollutants in such Discharge; and, Discharges authorized pursuant to federal or state laws or regulations.

In any action taken to enforce this Ordinance, the burden shall be on the Person who is the subject of such action to establish that a Discharge was within the scope of this Discharge Exception.

(h) "Domestic Sewage Exception" shall mean discharges which are exceptions to this Ordinance and excluded from the definition of Prohibited Discharge, as defined herein, including only:

Discharges composed entirely of accidental spills of untreated sanitary wastes (commonly called domestic sewage) and other wastes, but limited solely to wastes that are controlled by and are within publicly owned wastewater treatment system collection facilities, immediately prior to the accidental spill.

(i) "Enforcing Attorney" shall mean the District Attorney acting as counsel to the County or his/her designee, which person is authorized to take enforcement or other actions as described herein. For purposes of criminal prosecution, only the District Attorney or his/her designee shall act as the Enforcing Attorney.

(j) "EPA" shall mean the Environmental Protection Agency of the United States of America.

(k) "Hearing Officer" shall mean the person designated by the Director of the Public Facilities and Resources Department who shall preside at the administrative hearings authorized by this Ordinance and issue final decisions on matters raised therein.

(l) "Illicit Connection" shall mean any man-made conveyance or drainage system, pipeline, conduit, inlet or outlet, through which the Discharge of any Pollutant to the Storm Water Drainage System occurs or may occur. The term Illicit Connection shall not include Legal Nonconforming Connections or connections to the Storm Water Drainage System that are hereinafter authorized by the agency with jurisdiction over the system at the location at which the connection is made.

(m) "Invoice for Costs" shall mean the actual costs and expenses of the County, including but not limited to administrative overhead, salaries and other expenses recoverable under State law, incurred during any Inspection conducted pursuant to Article 2 of this Ordinance, or where a Notice of Noncompliance, Administrative Compliance Order or other enforcement option under Article 5 of this Ordinance is utilized to obtain compliance with this Ordinance.

(4) Petroleum and related hydrocarbons (such as fuels, lubricants, surfactants, waste oils, solvents, coolants and grease).

(5) Animal wastes (such as, Discharge from confinement facilities, kennels, pens, and recreational facilities, including, stables, show facilities, and polo fields).

(6) Substances having a pH less than 6.5 or greater than 8.6, or unusual coloration, turbidity or odor.

(7) Waste materials and wastewater generated on construction sites and by construction activities (such as painting and staining; use of sealants and glues; use of lime; use of wood preservatives and solvents; disturbance of asbestos fibers, paint flakes or stucco fragments; application of oils, lubricants, hydraulic, radiator or battery fluids; construction equipment washing, concrete pouring and cleanup; use of concrete detergents; steam cleaning or sand blasting; use of chemical degreasing or diluting agents; and use of super chlorinated water for potable water line flushing).

(8) Materials causing an increase in biochemical oxygen demand, chemical oxygen demand or total organic carbon.

(9) Materials which contain base/neutral or acid extractable organic compounds.

(10) Those pollutants defined in Sec. 1362(6) of the Federal Clean Water Act; and

(11) Any other constituent or material, including but not limited to pesticides, herbicides, fertilizers, fecal coliform, fecal streptococcus or enterococcus, or eroded soils, sediment and particulate materials, in quantities that will interfere with or adversely affect the beneficial uses of the receiving waters, flora or fauna of the State.

(t) "Prohibited Discharge" shall mean any Discharge, which contains any Pollutant, from public or private property to (i) the Storm Water Drainage System; (ii) any upstream flow, which is tributary to the Storm Water Drainage System; (iii) any groundwater, river, stream, creek, wash or dry weather arroyo, wetlands area, marsh, coastal slough, or (iv) any coastal harbor, bay, or the Pacific Ocean. The term Prohibited Discharge shall not include Discharges allowable under the Discharge Exception.

(u) "Significant Redevelopment" shall mean the rehabilitation or reconstruction of public or private residential (whether single family, multi-unit or planned unit development), industrial, commercial, retail, or other non-residential structures, for which

property, which states a Legal Nonconforming Connection has been identified. The notice of a Legal Nonconforming Connection shall state the date of expiration of use under this Ordinance.

A reasonable extension of use may be authorized by the Director of Public Facilities and Resources Department or the Authorized Inspector upon consideration of the following factors:

(1) The potential adverse effects of the continued use of the connection upon the beneficial uses of receiving waters;

(2) The economic investment of the discharger in the Legal Nonconforming Connection; and

(3) The financial effect upon the discharger of a termination of the Legal Nonconforming Connection.

(c) A civil or administrative violation of Section 4-13-40(a) shall occur irrespective of the negligence or intent of the violator to construct, maintain, operate or utilize an Illicit Connection or to cause, allow or facilitate any Prohibited Discharge.

(d) If an Authorized Inspector reasonably determines that a Discharge, which is otherwise within the Discharge Exception, may adversely affect the beneficial uses of receiving waters, then the Authorized Inspector may give written notice to the owner of the property or facility that the Discharge Exception shall not apply to the subject Discharge following expiration of the thirty (30) day period commencing upon delivery of the notice. Upon expiration of the thirty (30) day period any such discharge shall constitute a violation of 4-13-40(a).

(e) If a request for an extension of use is denied, the owner or occupant of property on which a Legal Nonconforming Connection exists may request an administrative hearing, pursuant to the procedures set forth in Sections 4-13-70(f) through(j), for an extension of the period allowed for continued use of the connection.

ARTICLE 3. CONTROLS FOR WATER QUALITY MANAGEMENT

Section 4-13-50. New Development and Significant Redevelopment.

(a) All New Development and Significant Redevelopment within the unincorporated area of the County shall be undertaken in accordance with the DAMP, including but not limited to the Development Project Guidance.

(b) Prior to the issuance by the County of a grading permit, building permit or Non-residential Plumbing Permit for any New Development or Significant Redevelopment, the Public Facilities and Resources Department and/or Planning and Development Services

Sec. 4-13-51. Cost Recovery

The County shall be reimbursed by the project applicant for all costs and expenses incurred by the Public Facilities and Resources Department and/or Planning and Development Services Department in the review of New Development or Significant Redevelopment projects for compliance with the DAMP. The Public Facilities and Resources Department and/or Planning and Development Services Department may elect to require a deposit of estimated costs and expenses, and the actual costs and expenses shall be deducted from the deposit, and the balance, if any, refunded to the project applicant.

Sec. 4-13-52. Litter Control

No Person shall discard any waste material including but not limited to common household rubbish or garbage of any kind (whether generated or accumulated at a residence, business or other location), upon any public property, whether occupied, open or vacant, including but not limited to any street, sidewalk, alley, right-of-way, open area or point of entry to the Storm Water Drainage System.

ARTICLE 4. INSPECTIONS

Sec. 4-13-60. Scope of Inspections

(a) Right to Inspect. Prior to commencing any inspection as hereinbelow authorized, the Authorized Inspector shall obtain either the consent of the owner or occupant of the property or shall obtain an administrative inspection warrant or criminal search warrant.

(b) Entry to Inspect. The Authorized Inspector may enter property to investigate the source of any Discharge to any public street, inlet, gutter, storm drain or the Storm Water Drainage System located within the jurisdiction of the County of Orange.

(c) Compliance Assessments. The Authorized Inspector may inspect property for the purpose of verifying compliance with this Ordinance, including but not limited to (i) identifying products produced, processes conducted, chemicals used and materials stored on or contained within the property, (ii) identifying point(s) of discharge of all wastewater, process water systems and Pollutants, (iii) investigating the natural slope at the location, including drainage patterns and man-made conveyance systems, (iv) establishing the location of all points of discharge from the property, whether by surface runoff or through a storm drain system, (v) locating any Illicit Connection or the source of Prohibited Discharge, (vi) evaluating compliance with any permit issued pursuant to Article 6 hereof, and (vii) investigating the condition of any Legal Nonconforming Connection.

additional enforcement actions against the owner, occupant and/or Person.

(2) The Notice of Noncompliance shall state a compliance date that must be met by the owner, occupant and/or Person; provided, however, that the compliance date may not exceed ninety (90) days unless the Authorized Inspector extends the compliance deadline an additional period not exceeding ninety (90) days where good cause exists for the extension.

(b) Administrative Compliance Orders.

(1) The Authorized Inspector may issue an Administrative Compliance Order. The Administrative Compliance Order shall be delivered in accordance with Section 4-13-70(e) of this Ordinance. The Administrative Compliance Order may be issued to:

a. The owner or occupant of any property requiring abatement of conditions on the property that cause or may cause a Prohibited Discharge or an Illicit Connection in violation of this Ordinance;

b. The owner of property subject to terms, conditions or requirements imposed on a project in accordance with Section 4-13-50(a) to ensure adherence to those terms, conditions and requirements.

c. A permittee subject to the requirements of any permit issued pursuant to Article 6 hereof to ensure compliance with the terms, conditions and requirements of the permit.

d. Any Person responsible for an Illicit Connection or Prohibited Discharge.

(2) The Administrative Compliance Order may include the following terms and requirements:

a. Specific steps and time schedules for compliance as reasonably necessary to eliminate an existing Prohibited Discharge or to prevent the imminent threat of a Prohibited Discharge, including but not limited to a Prohibited Discharge from any pond, pit, well, surface impoundment, holding or storage area;

b. Specific steps and time schedules for compliance as reasonably necessary to discontinue any Illicit Connection;

c. Specific requirements for containment, cleanup, removal, storage, installation of overhead

shall be delivered in accordance with Section 4-13-70(e) of this Ordinance. An Invoice for Costs shall be immediately due and payable to the County for the actual costs incurred by the County in issuing and enforcing any notice or order.

(1) If any owner or occupant, permittee or any other Person subject to an invoice for costs fails to either pay the Invoice for Costs or appeal successfully the Invoice for Costs in accordance with Section 4-13-70(f), then the Enforcing Attorney may institute collection proceedings.

(e) Delivery of Notice. Any Notice of Noncompliance, Administrative Compliance Order, Cease and Desist Order or Invoice of Costs to be delivered pursuant to the requirements of this Ordinance shall be subject to the following:

(1) The notice shall state that the recipient has a right to appeal the matter as set forth in Sections 4-13-70(f) through (j) of this Ordinance.

(2) Delivery shall be deemed complete upon (a) personal service to the recipient; (b) deposit in the U.S. mail, postage pre-paid for first class delivery; or (c) facsimile service with confirmation of receipt.

(3) Where the recipient of notice is the owner of the property, the address for notice shall be the address from the most recently issued equalized assessment roll for the property or as otherwise appears in the current records of the County.

(4) Where the owner or occupant of any property cannot be located after the reasonable efforts of the Authorized Inspector, a Notice of Noncompliance or Cease and Desist Order shall be deemed delivered after posting on the property for a period of ten (10) business days.

(f) Administrative Hearing for Notices of Noncompliance, Administrative Compliance Orders, Invoices for Costs and Adverse Determinations. Except as set forth in Section 4-13-70(h), any Person receiving a Notice of Noncompliance, Administrative Compliance Order, a notice of Legal Nonconforming Connection, an Invoice for Costs, or any Person who is subject to any adverse determination made pursuant to this Ordinance, may appeal the matter by requesting an administrative hearing. Notwithstanding the foregoing, these administrative appeal procedures shall not apply to criminal proceedings initiated to enforce this Ordinance.

(g) Request for Administrative Hearing. Any person appealing a Notice of Noncompliance, an Administrative Compliance Order, a notice of Legal Nonconforming Connection, an Invoice for Costs or an adverse determination shall, within thirty (30) days of receipt thereof, file a written request for an administrative hearing, accompanied by an administrative hearing fee as established by

such owner, operator, permittee or Person pursuant to this Ordinance, the Authorized Inspector may request the Enforcing Attorney to obtain an abatement warrant or other appropriate judicial authorization to enter the property, abate the condition and restore the area. Any costs incurred by the County in obtaining and carrying out an abatement warrant or other judicial authorization may be recovered pursuant to Section 4-13-71(d).

Sec. 4-13-71. Nuisance

Any condition in violation of the prohibitions of this Ordinance, including but not limited to the maintenance or use of any Illicit Connection or the occurrence of any Prohibited Discharge, shall constitute a threat to the public health, safety and welfare, and is declared and deemed a nuisance pursuant to Government Code Section 38771.

(a) Court Order to Enjoin or Abate. At the request of the Director, Public Facilities and Resources Department or his/her designee, the Enforcing Attorney may seek a court order to enjoin and/or abate the nuisance.

(b) Notice to Owner and Occupant. Prior to seeking any court order to enjoin or abate a nuisance or threatened nuisance, the Director, Public Facilities and Resources Department or his/her designee, shall provide notice of the proposed injunction or abatement to the owner and occupant, if any, of the property where the nuisance or threatened nuisance is occurring.

(c) Emergency Abatement. In the event the nuisance constitutes an imminent danger to public safety or the environment, the Authorized Inspector may enter the property from which the nuisance emanates, abate the nuisance and restore any property affected by the nuisance. To the extent reasonably practicable, informal notice shall be provided to the owner and occupant prior to abatement. If necessary to protect the public safety or the environment, abatement may proceed without prior notice to or consent from the owner or occupant thereof and without judicial warrant.

(1) An imminent danger shall include, but is not limited to, exigent circumstances created by the dispersal of Pollutants, where the same presents a significant and immediate threat to the public safety or the environment.

(2) Notwithstanding the authority of the County to conduct an emergency abatement action, an administrative hearing pursuant to Section 4-13-70(h) hereinabove shall follow the abatement action.

(d) Reimbursement of Costs. All costs incurred by the County in responding to any nuisance, all administrative expenses and all other expenses, recoverable under State law, shall be recoverable

the Authorized Inspector or Enforcing Attorney to seek cumulative remedies, except that multiple monetary fines or penalties shall not be available for any single violation of this Ordinance.

Sec. 4-13-75. Citations

Pursuant to Penal Code Section 836.5, the Authorized Inspector shall have the authority to cause the arrest of any Person committing a violation of this Ordinance. The Person shall be released and issued a citation to appear before a magistrate in accordance with Penal Code Sections 853.5, 853.6, and 853.9, unless the Person demands to be taken before a magistrate. Following issuance of any citation the Authorized Inspector shall refer the matter to the Enforcing Attorney.

Each citation to appear shall state the name and address of the violator, the provisions of this Ordinance violated, and the time and place of appearance before the court, which shall be at least ten (10) business days after the date of violation. The Person cited shall sign the citation giving his or her written promise to appear as stated therein. If the Person cited fails to appear, the Enforcing Attorney may request issuance of a warrant for the arrest of the Person cited.

Sec. 4-13-76. Violations of Other Laws.

Any Person acting in violation of this Ordinance also may be acting in violation of the Federal Clean Water Act or the State Porter-Cologne Act and other laws and also may be subject to sanctions including civil liability. Accordingly, the Enforcing Attorney is authorized to file a citizen suit pursuant to Federal Clean Water Act Section 505(a), seeking penalties, damages, and orders compelling compliance, and other appropriate relief. The Enforcing Attorney may notify EPA Region IX, the Santa Ana or San Diego Regional Water Quality Control Boards, or any other appropriate state or local agency, of any alleged violation of this Ordinance.

Sec. 4-13-77. Injunctions

At the request of the Director, Public Facilities and Resources Department or his/her designee, the Enforcing Attorney may cause the filing in a court of competent jurisdiction, of a civil action seeking an injunction against any threatened or continuing noncompliance with the provisions of this Ordinance.

(a) Order for Reimbursement. Any temporary, preliminary or permanent injunction issued pursuant hereto may include an order for reimbursement to the County of all costs incurred in enforcing this Ordinance, including costs of inspection, investigation and monitoring, the costs of abatement undertaken at the expense of the County, costs relating to restoration of the environment and all other expenses as authorized by law.

facilities located on the property, identification of equipment or processes to be used on-site and other information as may be requested in order to determine the constituents, and quantities thereof, which may be discharged if permission is granted.

(3) Permit Issuance. The permit shall be granted or denied by the Director, Public Facilities and Resources Department or his/her designee, no later than sixty (60) days following the completion and acceptance of the application as determined by the Director, Public Facilities and Resources Department or his/her designee.

a. The applicant shall be notified in Person or by first-class mail, postage prepaid, of the action taken.

(4) Permit Conditions. The permit may include terms, conditions and requirements to ensure compliance with the objectives of this Ordinance and as necessary to protect the receiving waters, including but not limited to:

a. Identification of the Discharge location on the property and the location at which the Discharge will enter the Storm Water Drainage System;

b. Identification of the constituents and quantities thereof to be discharged into the Storm Water Drainage System;

c. Specification of pollution prevention techniques and structural or non-structural control requirements as reasonably necessary to prevent the occurrence of potential Discharges in violation of this Ordinance;

d. Requirements for self-monitoring of any Discharge;

e. Requirements for submission of documents or data, such as technical reports, production data, Discharge reports, self-monitoring reports and waste manifests; and

f. Other terms and conditions appropriate to ensure compliance with the provisions of this Ordinance and the protection of receiving waters.

(5) General Permit. In the discretion of the Director, Public Facilities and Resources Department or his/her designee, the permit may, in accordance with the conditions identified in Section 4-13-80(a)(4) hereinabove, be prepared as a general permit applicable to a specific category of activities. If a general permit is issued, any Person intending to Discharge

d. Any regulatory agency, including EPA or a Regional Water Quality Control Board having jurisdiction over the Discharge, notifies the County that the Discharge should be terminated.

(2) The Director, Public Facilities and Resources Department or his/her designee, may modify any permit when it is determined that:

a. Federal or state law requirements have changed in a manner that necessitates a change in the permit; or

b. The Permittee's Discharge or the circumstances under which the Discharge occurs have changed so that it is appropriate to modify the permit's terms, conditions or requirements; or

c. A change to the permit is necessary to ensure compliance with the objectives of this Ordinance or to protect the quality of receiving waters.

The Permittee, or in the case of a general permit, each Person who has filed an application pursuant to Section 4-13-80(a)(5), shall be informed of any change in the permit terms and conditions at least sixty (60) days prior to the effective date of the modified permit. In the case of a general permit issued pursuant to Section 4-13-80(a)(5)(a), any charge in the permit terms and conditions shall be published in a newspaper of general circulation within the County at least sixty (60) days prior to the effective date of the modified permit.

(3) The determination that a permit shall be denied, suspended, revoked or modified may be appealed by a permittee pursuant to the same procedures applicable to appeal of an Administrative Compliance Order hereunder. In the absence of a judicial order to the contrary, the Permittee may continue to discharge pending issuance of the final administrative decision by the Hearing Officer.

(c) Permit Enforcement.

(1) Penalties. Any violation of the terms, conditions and requirements of any permit issued by the Director, Public Facilities and Resources Department or his/her designee, shall constitute a violation of this Ordinance and subject the violator to the administrative, civil and criminal remedies available under this Ordinance.

(d) Compliance. Compliance with the terms, conditions and requirements of a permit issued pursuant to this Ordinance shall not relieve the Permittee from compliance with all federal, state and local laws, regulations and

(c) Repeal of Prior Ordinance. The enactment of this Ordinance by County shall repeal the provisions of Article 3, Sections 4-3-148 through and including Section 4-3-190 of the Codified Ordinances of the County of Orange, enacted for the permitting of Discharges of industrial waste to ground or surface waters and no new Discharge permits shall be issued thereunder; provided however, that connection to Discharge under the terms and conditions of any individual Discharge permit issued prior to the date of enactment of the Water Quality Ordinance shall be allowed hereunder as a Legal Nonconforming Connection.

(d) Headings. Headings of the sections of this Ordinance are inserted for convenience only and shall have no effect in the application of this Ordinance.

ARTICLE 9. JUDICIAL REVIEW

Sec. 4-13-110. Procedure.

The provisions of Sections 1094.5 and 1094.6 of the Code of Civil Procedure set forth the procedure for judicial review of any act taken pursuant to this Ordinance. Parties seeking judicial review of any action taken pursuant to this Ordinance shall file such action within ninety (90) days of the occurrence of the event for which review is sought.

SECTION 2. This Ordinance shall take effect and be in full force thirty (30) days from and after its passage and, before the expiration of fifteen (15) days after the passage thereof, shall be published once in the Orange County Reporter, a newspaper published in the County of Orange, State of California, together with the names of the members of the Board of Supervisors voting for or against the same.

Water Quality Management Plan
Notice of Transfer of Responsibility

Tracking No. Assigned by the City of Newport Beach:_____

Submission of this Notice of Transfer of Responsibility constitutes notice to the City of Newport Beach that responsibility for the Water Quality Management Plan ("WQMP") for the subject property identified below, and implementation of that plan, is being transferred from the Previous Owner (and his/her agent) of the site (or a portion thereof) to the New Owner, as further described below.

I. Previous Owner/Previous Responsible Party Information

Company/Individual Name		Contact Person	
Street Address		Title	
City	State	Zip	Phone

II. Information about Site Transferred

Name of Project (if applicable)	
Title of WQMP Applicable to Site:	
Street Address of Site (if applicable)	
Planning Area (PA) and/or Tract Number(s) for Site	Lot Numbers (if Site is a portion of a tract)
Date WQMP Prepared (and revised if applicable)	

III. New Owner/New Responsible Party Information

Company/Individual Name		Contact Person	
Street Address		Title	
City	State	Zip	Phone

IV. Ownership Transfer Information

General Description of Site Transferred to New Owner	General Description of Portion of Project/Parcel Subject To WQMP Retained by Owner (if any)
Lot/Tract Numbers of Site Transferred to New Owner	
Remaining Lot/Tract Numbers Subject to WQMP Still Held by Owner (if any)	
Date of Ownership Transfer	

Note: When the Previous Owner is transferring a Site that is a portion of a larger project/parcel addresses by the WQMP, as opposed to the entire project/parcel addressed by the WQMP, the General Description of the Site transferred and the remainder of the project/parcel not transferred shall be set forth as maps attached to this notice. These maps shall show those portions of a project/parcel addressed by the WQMP that are transferred to the New Owner (the Transferred Site), those portions retained by the Previous Owner, and those portions previously transferred by Previous Owner. Those portions retained by Previous Owner shall be labeled "Previous Owner", and those portions previously transferred by Previous Owner shall be labeled as "Previously Transferred."

V. Purpose of Notice of Transfer

The purposes of this Notice of Transfer of Responsibility are: 1) to track transfer of responsibility for implementation and amendment of the WQMP when property to which the WQMP is applicable is transferred from the Previous Owner to the New Owner, and 2) to facilitate notification to a transferee of property subject to a WQMP that such New Owner is now the Responsible Party of record for the WQMP for those portions of the site that it owns.

VI. Certifications

A. Previous Owner

I certify under penalty of law that I am no longer the owner of the Transferred Site as described in Section II above. I have provided the New Owner with a copy of the WQMP applicable to the Transferred Site that the New Owner is acquiring from the Previous Owner.

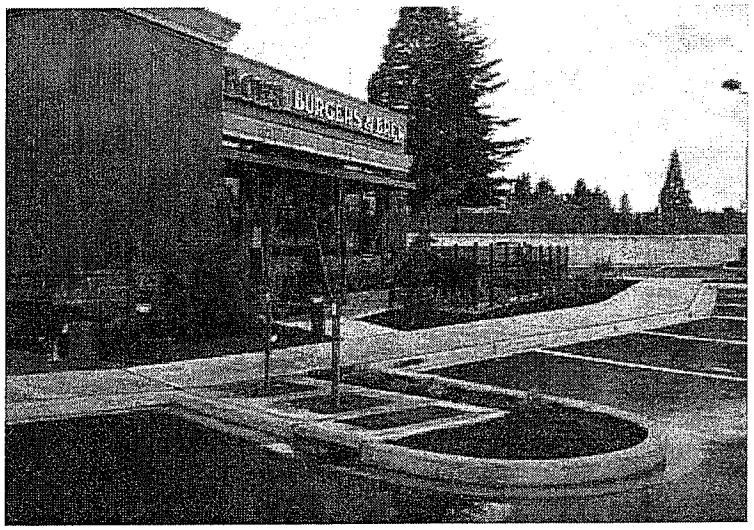
Printed Name of Previous Owner Representative	Title
Signature of Previous Owner Representative	Date

B. New Owner

I certify under penalty of law that I am the owner of the Transferred Site, as described in Section II above, that I have been provided a copy of the WQMP, and that I have informed myself and understand the New Owner's responsibilities related to the WQMP, its implementation, and Best Management Practices associated with it. I understand that by signing this notice, the New Owner is accepting all ongoing responsibilities for implementation and amendment of the WQMP for the Transferred site, which the New Owner has acquired from the Previous Owner.

Printed Name of New Owner Representative	Title
Signature	Date

Section VIII Filterra Model and Operation / Maintenance Requirements



filterra
Bioretention Systems
by KRISTAR

Filterra® Curb Inlet with Pre-Filter Chamber and Internal Bypass

Combining stormwater treatment with internal peak flow bypass in one packaged design.

Filterra® Curb Inlet with Pre-Filter Chamber and Internal Bypass

The Filterra Curb Inlet with Pre-Filter and Internal Bypass combines a unique pre-filtration chamber with the proven effectiveness of the Filterra bio-filtration system, enhancing system performance and simplifying maintenance procedures. The new pre-filter chamber incorporatees high flow bypass capabilities eliminating the need for separate bypass structures and allowing for installation on grade or within sag conditions.

Filterra Curb Inlet with Pre-Filter and Internal Bypass uses bio-filtration enhanced with pre-filter chamber to capture and immobilize pollutants of concern, such as: TSS, oil/grease, nutrients, metals, and trash/debris.

Initial runoff flows are conveyed internally from the Filterra pre-filter/bypass chamber into the Filterra media chamber. Runoff is then filtered and treated through engineered soil media and passes into the underdrain system, which then discharges into the internal bypass chamber. Higher peak flows bypass the biofiltration media chamber through the pre-filter/bypass chamber while retaining previosuly collected pollutants.

Features and Benefits

Best Value for High Density Areas.

- **Compact size**
- **Needs no external bypass**
- **Accepts flow from both directions**
- **Simple maintenance**
- **100% trash capture**
- **Pre-filtration of coarse sediment, debris, trash**

Versatile.

Filterra Curb Inlet with Pre-Filter Chamber and Internal Bypasss models can be used for:

- **New construction**
- **Retrofits**
- **Commercial or residential applications.**

Filterra Curb Inlet with Pre-Filter Chamber and Internal Bypass models can be placed:

- **At sidewalk locations**

Maintenance. Maintenance is simple and safe, and the first year is provided FREE with the purchase of every unit. The procedure is so easy you can perform it yourself.

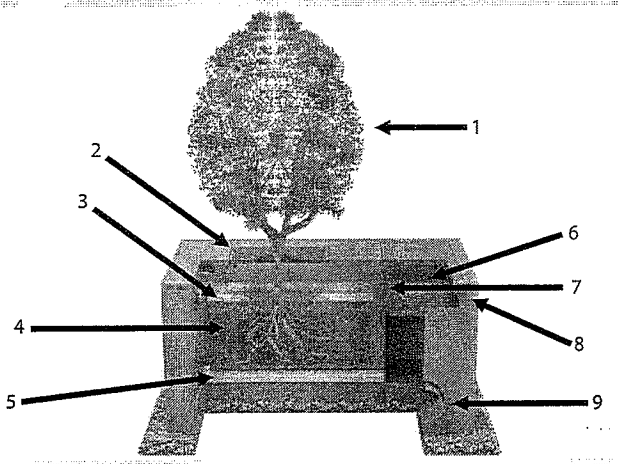
Expected Pollutant Removal

(Ranges Varying with Particle Size, Pollutant Loading and Site Conditions)

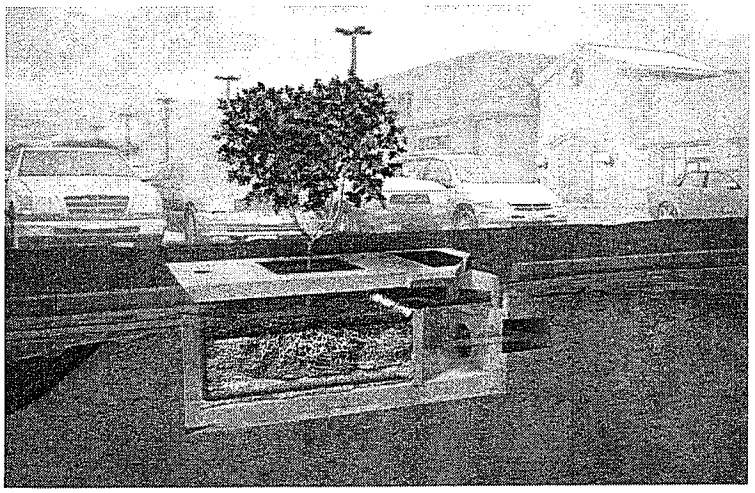
TSS Removal	85%
Phosphorus Removal	60% - 70%
Zinc Removal	> 66%
Copper Removal	>58%
Nitrogen Removal	42-45%
Oil & Grease	> 93%

Information on the pollutant removal efficiency of the filter soil/plant media is based on third party lab and field studies.

Filterra media has been TAPE and TARP tested and approved.



1. Native Tree or Shrubs (numerous plant choices available)
2. Cast Iron Tree Grate for Maintenance Access
3. Protective Mulch Layer
4. Filterra Engineered Soil Media
5. Perforated Underdrain Pipe
6. Pre-Filter Chamber
7. Pretreatment Screen
8. Curb Inlet Opening (variable widths available)
9. Outlet



filterra
Bioretention Systems
by KRISTAR

Filterra® Curb Inlet with Pre-Filter Chamber and Internal Bypass

Combining stormwater treatment with internal peak flow bypass in one packaged design.

Design Guidelines

1) Use the Filterra Curb Inlet with Pre-Treatment and Internal Bypass Design Guidelines as a reference, available from info@kristar.com.

2) Select the appropriate Filterra model size from your Regional Sizing Table, according to the drainage area and associated peak flow calculations.

3) Determine Filterra model placement on sidewalk, parking lot or street application.

4) Ensure the peak flow capacity from Filterra is "free-draining" at minimum 1% slope, or per local codes.

Placement Review

Because we want your project with Filterra to be a great success, we respectfully request that each Filterra Curb Inlet with Pre-Filter Chamber and Internal Bypass project be reviewed by our placement/ design staff. This review is mandatory, as proper placement ensures you of the most efficient and cost effective solution, as well as optimum performance and minimal maintenance.

Proper Placement

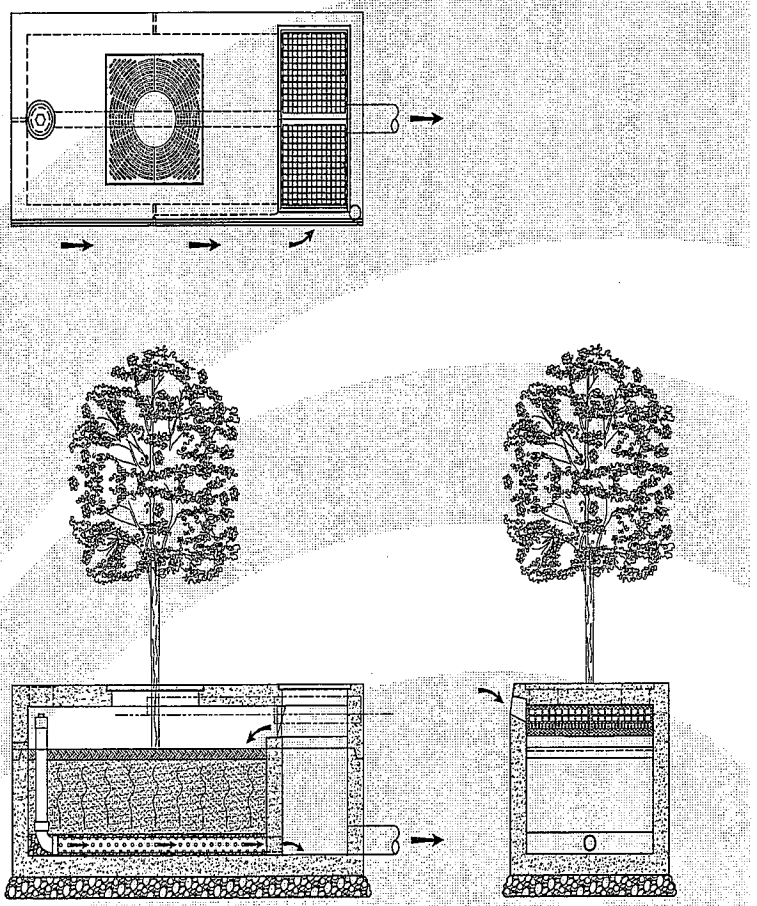
1) Determine an appropriate location for the Filterra Curb Inlet with Pre-Filter Chamber and Internal Bypass model based on curb and gutter elevations or site topography, and aesthetics.

2) The standard dimension from the top of the curb to the invert of the outlet pipe is 4'-0".

3) The system may be installed at up to 3-percent grade along the gutter line. The cross-slope, perpendicular to the gutter line, should be level.

4) Discharge piping may be connected to the bypass chamber at any one of thee three outside wall faces.

5) Send completed project information form along with plans to KriStar for placement and application review.



Filterra Curb with Pre-Filter Chamber and Internal Bypass combines biofiltration and an internal high flow bypass chamber into one single structure.

More Information

Visit **www.kristar.com** for more information including an animation of Filterra's features, operation and maintenance.

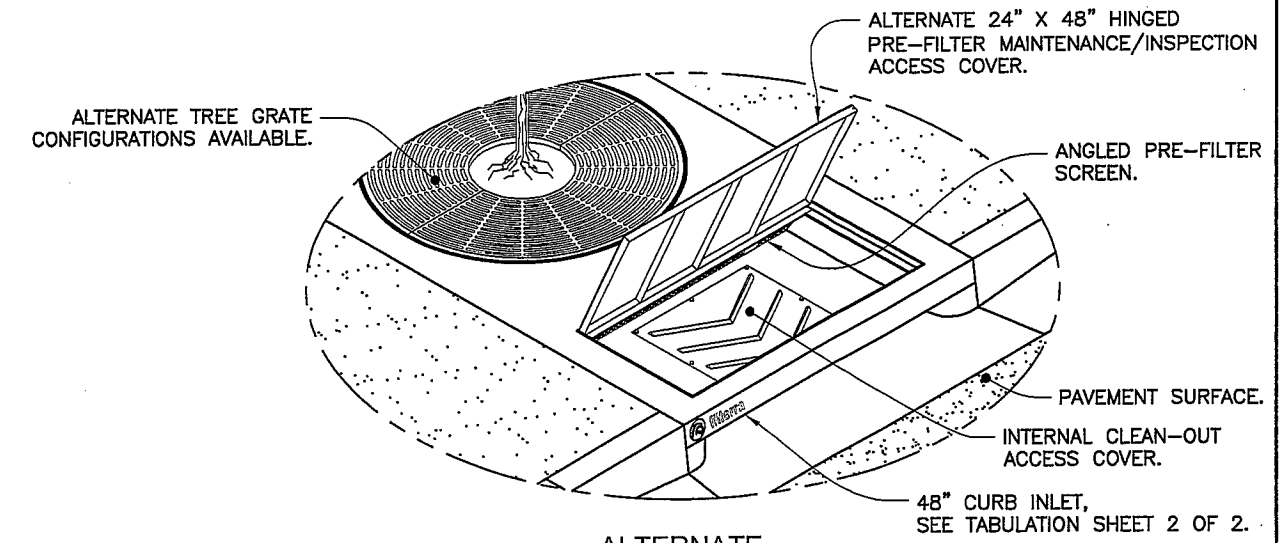
Western Region Support
34428 Yucaipa Blvd., Suite E-312
Yucaipa, CA 92399

KriStar Enterprises, Inc.
360 Sutton Place
Santa Rosa, CA 95407

Toll Free: (800) 579-8819 • F: (707) 524-8186

E-mail: info@kristar.com • Web: www.kristar.com

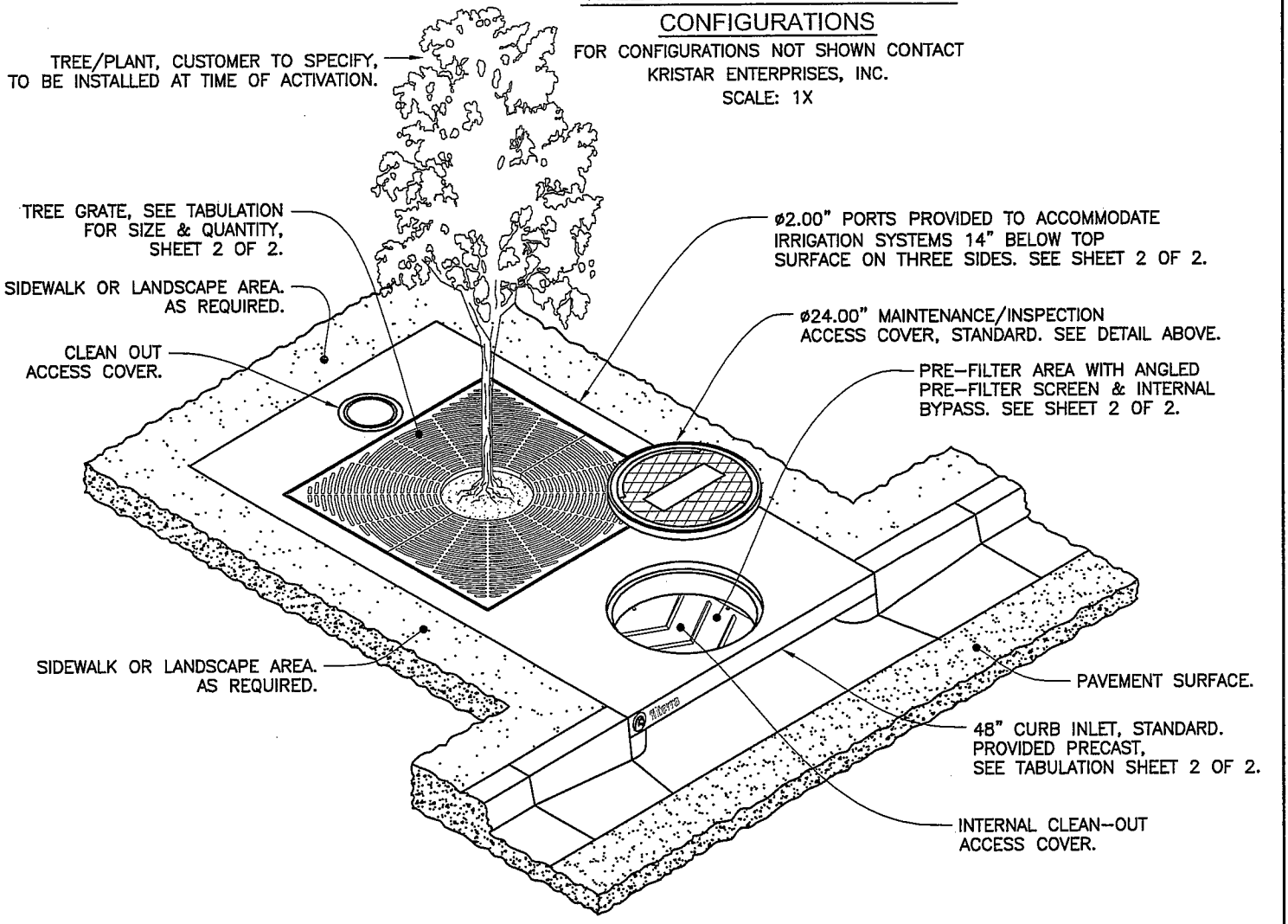
K-FTPFNW-IB-C



ALTERNATE TREE GRATE & ACCESS COVER CONFIGURATIONS

FOR CONFIGURATIONS NOT SHOWN CONTACT KRISTAR ENTERPRISES, INC.

SCALE: 1X



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US PAT 6,277,274 AND 6,569,321

Filterra® - Bioretention System

with Pre-Filter Narrow Width Internal Bypass -Curb (End Inlet Version)

KRISTAR

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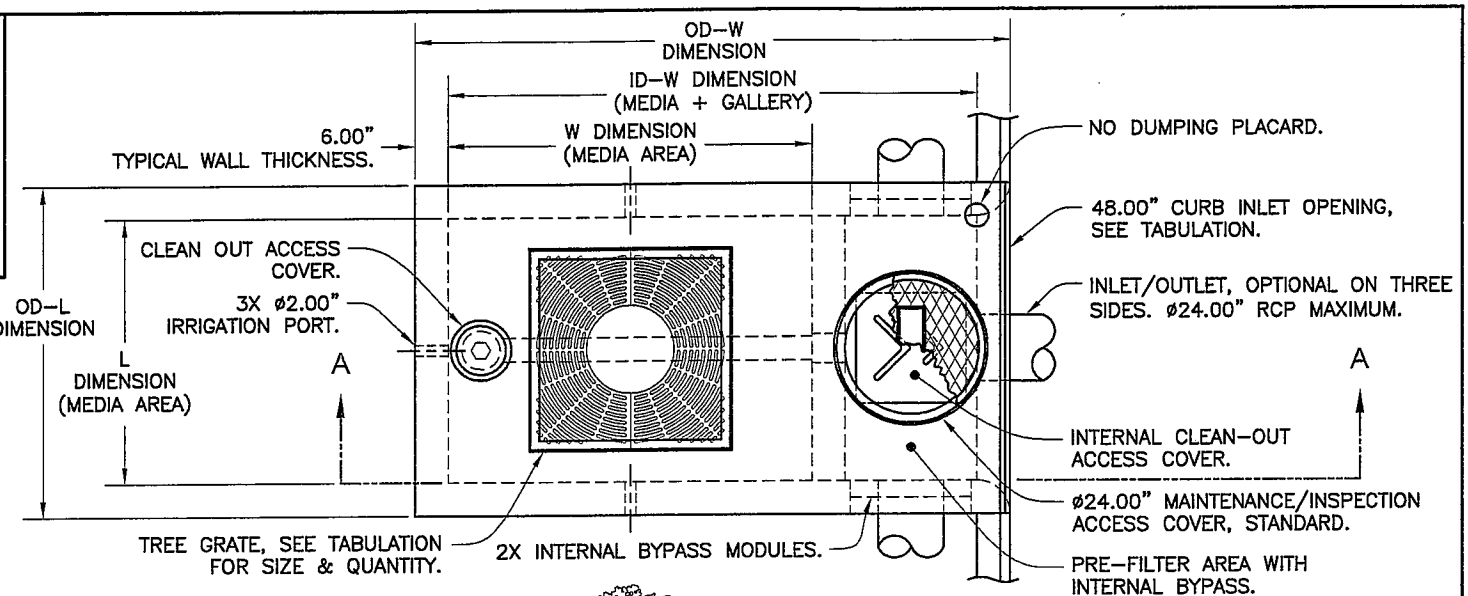
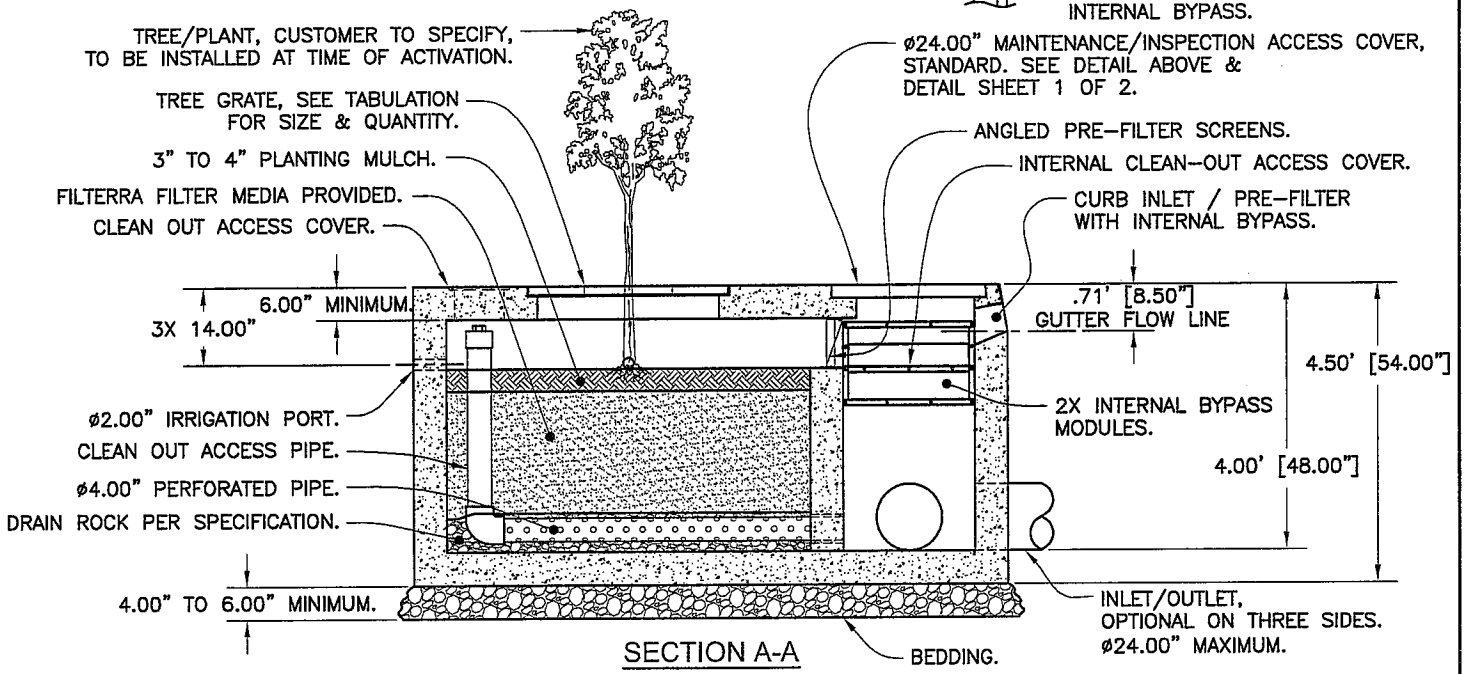
K-FTPFNW-IB-C





TABULATION

Size / Designation	L Media Area (Feet)	W Media Area (Feet)	ID-W Media + Gallery (Feet)	OD-W x OD-L Outside Dimension	Tree Grate Quantity / Size	Inlet Opening *
4' X 4'	4.00'	4.00'	6.50'	5.00' x 7.50'	1ea. / 3' x 3'	48.00"
4' X 6'	4.00'	6.00'	8.50'	5.00' x 9.50'	1ea. / 3' x 3'	48.00"
4' x 6.5'	4.00'	6.50'	9.00'	5.00' x 10.00'	1ea. / 3' x 3'	48.00"
4' x 8'	4.00'	8.00'	10.50'	5.00' x 11.50'	1ea. / 3' x 3'	48.00"
4' x 12'	4.00'	12.00'	14.50'	5.00' x 15.50'	2ea. / 3' x 3'	48.00"
4' x 16'	4.00'	16.00'	18.50'	5.00' x 19.50'	2ea. / 3' x 3'	48.00"
6' x 6'	6.00'	6.00'	8.50'	7.00' x 9.50'	1ea. / 3' x 3'	48.00"
6' x 8'	6.00'	8.00'	10.50'	7.00' x 11.50'	1ea. / 4' x 4'	48.00"
6' x 10'	6.00'	10.00'	12.50'	7.00' x 13.50'	1ea. / 4' x 4'	48.00"
6' x 12'	6.00'	12.00'	14.50'	7.00' x 15.50'	2ea. / 4' x 4'	48.00"
8' x 12'	8.00'	12.00'	14.50'	9.00' x 15.50'	2ea. / 4' x 4'	48.00"
8' x 16'	8.00'	16.00'	18.50'	9.00' x 19.50'	2ea. / 4' x 4'	48.00"
8' x 18'	8.00'	18.00'	20.50'	9.00' x 21.50'	3ea. / 4' x 4'	48.00"
8' x 20'	8.00'	20.00'	22.50'	9.00' x 23.50'	3ea. / 4' x 4'	48.00"

* Longer inlet openings available in 6.00" increments, Limited by the ID-L Dimension.
** Longer outlet gallery available in 6.00" increments, Limited by the ID-W Dimension.

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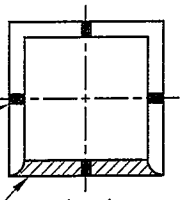
K-FTOPC

TYPICAL OUTLET PORT LOCATION
PVC COUPLING CAST MONOLITHIC.
INDICATED BY SOLID HATCHED AREA.

CURB INLET OPENING(S)
INDICATED BY HATCHED AREA.



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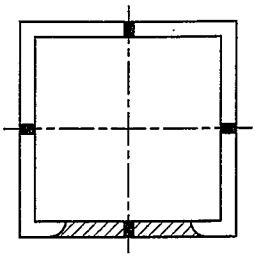

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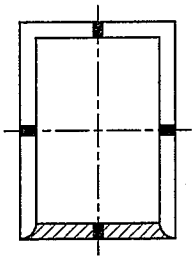
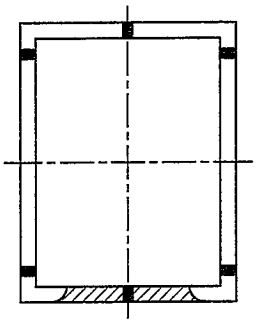


4x6
4x6.5
4x8
4x16



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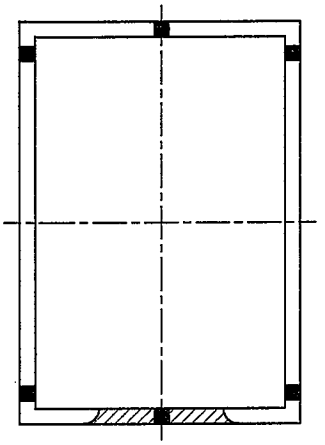

8x12
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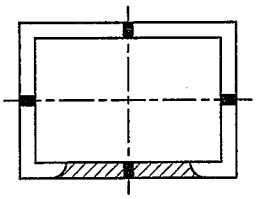

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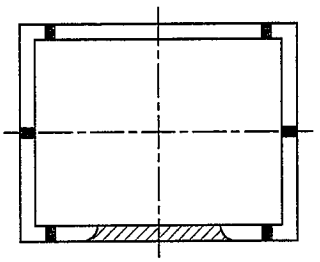

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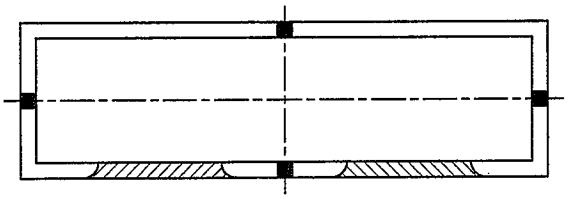

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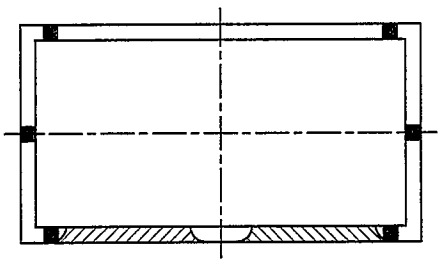
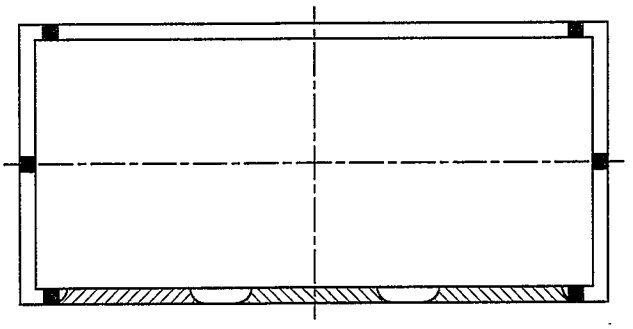


12x6, 12x8, 16x8



18x8, 20x8

TITLE

Filterra®

PVC Outlet Pipe Coupling Locations

KriStar Enterprises, Inc.
360 Sutton Place, Santa Rosa, CA 95407
Ph: 800.579.8819, Fax: 707.524.8186, www.kristar.com

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PRODUCTS

Filterra®
Filterra® Boxless™
Filterra® Internal Bypass
Filterra® Internal Bypass - Pipe
Filterra® BioPave™
Bacterra™
Washington GULD
Product Schematic
Options
Project Profiles
Maintenance
Plant Selections
Whitepaper
FAQ

Home Products Bacterra

Bacterra™ (BT)

Optimized Filterra® media blend for stormwater bacteria removal

Why Bacterra™?

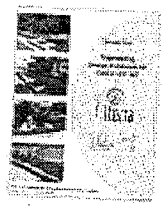
Adverse economic and public health impacts are on the rise due to increasing bacterial contamination of our swimmable and fishable waters from stormwater runoff. In response to this growing problem, Filterra Bioretention Systems has developed Bacterra media blend, an effective stormwater treatment technology available for removal of bacteria from urban runoff.

The Filterra bioretention BMP blend is currently designed to remove typical stormwater pollutants such as TSS, phosphorus, nitrogen and heavy metals. Through extensive studies Bacterra media blend has been optimized to capture and destroy bacteria such as fecal coliform, E.coli and enterococcus. Once the Bacterra media blend has matured it develops a complex natural microbological ecosystem that enhances predation, and other physical, chemical and biological processes that all contribute to the removal process.

Lab Findings

- Removal efficiencies ranging from 77% - 99%.

QUICK LINKS



Request Design Assistance Kit

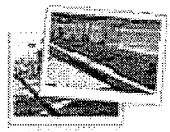
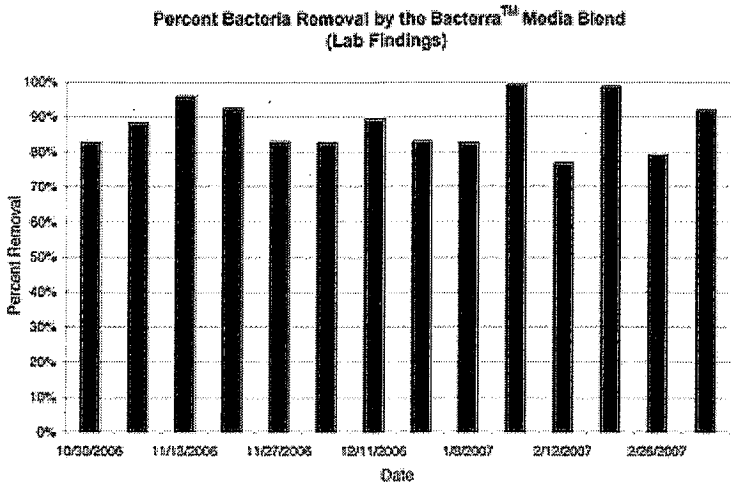


Photo Gallery

How Filterra Works
[Animation]

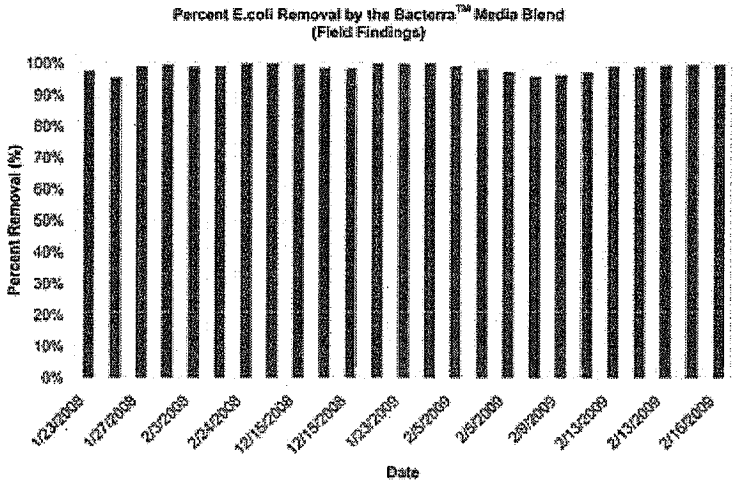
Search:

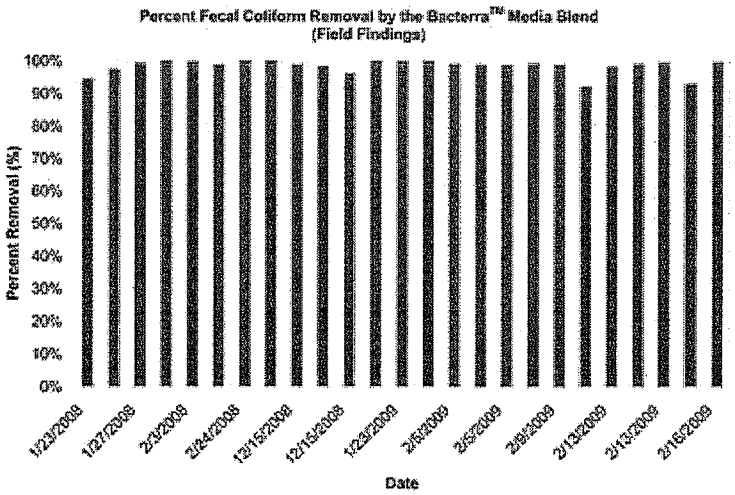
submit



Field Findings

- Removal efficiencies of 95% - 99% for fecal coliform, E.coli, and enterococcus.
- TSS removal efficiencies of 85%.





Based on lab and field data, Bacterra demonstrates a high flow rate media can achieve high bacteria removal efficiencies. Lab data showing removal rates of 77% - 99% has been supported by field results showing removal

rates of 95% - 99% for bacteria in stormwater.

All testing conducted using approved EPA methods. Field data obtained by third parties.

Features and Benefits

Water Quality. Achieve receiving water quality goals and reduce sources of bacteria to beaches and fisheries.

Best Value. The most cost effective stormwater treatment system available featuring low cost and easy installation and maintenance.

Aesthetics. Landscaping enhances the appearance of your site making it more attractive while removing pollutants.

Maintenance Support. Maintenance is safe and inexpensive. A one year maintenance agreement is included free with the purchase of every unit.

Versatility. May be used for new construction or as an urban retrofit device.

- Streetscapes
- Urban settings
- Parking lots
- Roof drains
- Highways
- Combined Sewer
- Industrial Settings Overflows (CSO)

Design Support. Our engineers can assist you with all aspects of each Bacterra application, including flora selection and sizing. *Contact us to request a sizing table for your region.

Adaptability. May be used alone or in combination with other BMPs.

Selection. Varying configurations to meet both standard and unique site conditions.

Expected Pollutant Removal

Like Filterra which removes typical stormwater pollutants, Bacterra media blend is expected to remove as much or more of those pollutants with higher bacteria removal. Bacterra media blend is recommended if higher bacteria removal is desired.

(Ranges Varying with Particle Size, Pollutant Loading and Site Conditions)

E.coli: 99%
Enterococcus: 95%
Predicted Phosphorus Removal: 60% - 70%
Predicted Nitrogen Removal: 43%

Fecal Coliform: 98%
TSS Removal: 85%
Predicted Heavy Metal Removal: 33% - 82%

Predicted Oil & Grease: 85%

Information on the pollutant removal efficiency of the Filterra soil/plant media is based on more than three-years of lab and field studies performed by the Civil Engineering Department at the University of Virginia. Bacteria pollutant removal efficiency for the Bacterra media blend is based on laboratory and field studies.

For more information see Bacterra E-Book (PDF, 1.9 MB)

Frequently Asked Questions

What is the difference between Bacterra and Filterra media blends?
Bacterra media blend has been designed to optimize the removal of pathogens using a high flow rate plant/soil media.

How does the Bacterra media blend prevent regrowth of bacteria downstream?
Bacterial regrowth downstream of treatment systems can be caused by increased nutrients and organics that serve as a food supply to stimulate bacteria regrowth. Bacterra helps prevent regrowth caused by nutrient overload by removing much of the nutrients and organics from stormwater runoff thus limiting regrowth.

How does the Bacterra media blend compare to other media filters?
While other sand filters or bioretention mixes show similar removal, Bacterra media blend demonstrates that much higher flow rates can achieve high bacteria removal efficiencies. As with Filterra, this allows larger drainage areas to be treated in a compact space; thus maximizing developable space.

How does Bacterra media blend remove bacteria from stormwater runoff?
Bacterra media blend uses several mechanisms for removal of bacteria including sorption, pH changes and predation by other organisms.

Could bacteria colonies re-establish themselves in the Bacterra media blend?
No. Microscopic examination of the Bacterra media shows no indication of regrowth. As long as the media is well maintained, well drained and stays aerobic the bacteria removal mechanisms prevent regrowth in the media.

CONTECH® ENGINEERED SOLUTIONS

Bacterra™ Advanced Bioretention Technology

A Best Management Practice

for Stand Alone Stormwater Treatment for Bacteria Removal

Dr. Robert F. Kelly[1] and Mindy Ruby[2,3]

filterra Bioretention Systems

1. Director of Degremont Technologies North America R&D Center, Richmond VA
2. Research and Development Manager, Filterra Bioretention Systems, Ashland, VA
3. Research Performed by Filterra Bioretention Systems R&D Group, Ashland, VA

INTRODUCTION

Municipalities throughout North America are faced with increasing environmental challenges. Treatment of urban stormwater runoff is among the most pressing as freshwater resources are increasingly strained from population growth and drought. Urban stormwater runoff is known to accumulate high pollutant loads, carrying sediment, nutrients and heavy metal contaminants for ultimate discharge into receiving water bodies. Perhaps even more concerning, untreated stormwater leads to further degradation of the aquatic environment through introduction of high levels of fecal coliform bacteria, indicators of associated bacterial pathogens, with concentrations as high as 15,000 to 20,000 MPN per 100 mL reported for untreated urban runoffs (Center for Watershed Protection, 1999). Field evaluations of Filterra's novel BACTERRA™ Technology at Marina Del Rey, California revealed influent stormwater fecal coliform concentrations greater than 200,000 MPN/100 mL.

In fact, the U.S. EPA's Impaired Waters Report or 303(d) list currently cites over 40,000 water bodies nationwide that are classified as impaired. The leading cause of impairment is the "pathogens" category - numbering over 10,000 citations, approximately 80% of which are due to fecal coliforms and related bacteria (U.S. Environmental Protection Agency, 2009).

In addition to the obvious public health concerns, the impairment of surface water resources has been well documented to exert a significant economic impact via damage to the recreation and tourism industries such as beach closings and impact to sport and commercial fishing reserves. Accordingly, municipalities are focused on identifying solutions to address protection of natural surface water resources with sustainable stormwater treatment practices.

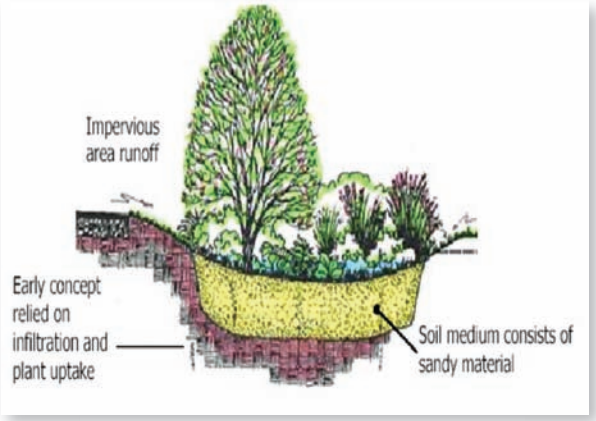


Figure 1. Prince George County Bioretention

Traditional stormwater treatment practices are designed to convey urban runoff from source areas to detention basins in order to reduce peak flows and control rate of discharge to the environment. The real challenge in delivering an efficient, sustainable stormwater treatment solution is the need to treat a large volume of flow at a high rate local to the source of origin.

Bioretention systems, simple plant and soil/sand-based units, are a sustainable,

low-impact, natural approach for direct stormwater treatment to reduce non-point source pollution in developed areas. Bioretention technology was introduced in 1993 with the original design from Prince George County, Maryland (Coffman, 1993). This early concept, illustrated in Figure 1, consisted of little more than a depression over porous soil / sand, covered with mulch and planted with a variety of vegetation. The design was focused primarily on minimizing surface water runoff volume by relying on infiltration and plant uptake to deliver water quality improvements.

Since the introduction of this original design, various bioretention approaches have been implemented to collect runoff from impervious areas including rain gardens, vegetated swales, trenches and infiltration basins. However, high failure rates were often observed due to use of old design standards, poor drainage, media variability, contractor error and requirement for high maintenance.

Figure 2. Filterra® / Bacterra™ Advanced Bioretention Technology

As the field and level of scientific knowledge have evolved, advanced bioretention designs have emerged which combine well-founded filtration principles from municipal wastewater treatment practices with the development of advanced media blends designed to enhance contaminant removal efficiency. The national stormwater program Section 402(p) of the Clean Water Act recommends Bioretention as a best management practice (BMP), and with mounting public pressure to deliver water quality improvements, bioretention practices have now been implemented at many urban development projects across the United States (U.S. Environmental Protection Agency, 1999).

However, despite regulatory and political pressures to encourage municipalities to adopt bioretention practices, the current standards for stormwater management continue to prevail (Morzaria-Luna et al., 2004). New technologies often have to meet existing treatment standards as well as address anticipated rules requiring infiltration. Accordingly, bioretention systems have generally supplemented, rather than replaced, traditional stormwater treatment practices such as wet or dry detention ponds.

Figure 3. Bacterra™ Advanced Bioretention Technology Installation for Urban Streetscape Retrofit Project in Marina Del Rey, CA.

Filterra, a division of Americast, Inc., was formed in 1997 with a specific focus to improve the field of bioretention by creating a technology that delivered optimized urban stormwater treatment performance at high flow rates. The Filterra® Stormwater Bioretention Filtration System (Figure 2) represented a major breakthrough in bioretention technology. The novel design emphasizes sustainable, low impact development while optimizing pollutant removal at high flow rates in order to provide the most efficient and cost effective approach to treatment of urban runoff. The Filterra® Technology was developed in association with the Civil Engineering Department at the University of Virginia through pursuit of an R&D Program designed to build upon the lessons learned from previous approaches to bioretention.

Beneficial features of the Filterra® Stormwater Bioretention Filtration System include its versatility for use in new construction or urban retrofit projects (Figure 3), quality construction, ease of installation and maintenance, and high aesthetic value with inclusion of suitable landscape plant. Additionally, Filterra offers design and engineering support and a no-fee first year maintenance plan with every unit sold (Figure 4).

Significant research efforts have focused on pollutant removal mechanisms associated with the performance of bioretention technologies. Multiple literature references cite an array of active mechanisms for pollutant removal within bioretention systems. The primary mechanisms are based upon physical-chemical processes such as such as absorption, adsorption, filtration, infiltration, ion exchange, organic complexation and sedimentation (Pitt et al., 2004; Rusciano & Obrupta, 2005). Based on results of studies conducted by other groups, the mulch layer is believed to be a key sink for heavy metals removal while the plants are very important with respect to root zone development which fosters infiltration, reduces the outflow load and prevents clogging (Muthanna et al., 2007; Gregory, 2006).

More recently, researchers have focused on the secondary pollutant removal mechanisms associated with bioretention technologies, and particularly the biological phenomena associated with bacterial removal. Dr. Allen Davis has published research findings which suggest that predation may be a key mechanism to enhance removal

Figure 4. Filterra® Stormwater Bioretention Filtration System Maintenance.

of fecal coliform bacterial populations (2007 Low Impact Development Proceedings).

In response to the growing need for bacteria removal from urban stormwater runoff, Filterra has now developed and introduced the Bacterra™ Advanced Bioretention Technology as a best management stormwater treatment practice. Founded upon the original Filterra® design platform, the Bacterra™ design basis is focused on delivering fundamental bioretention performance at high flow rates within a simple-to-construct, compact footprint available in standard size configurations.

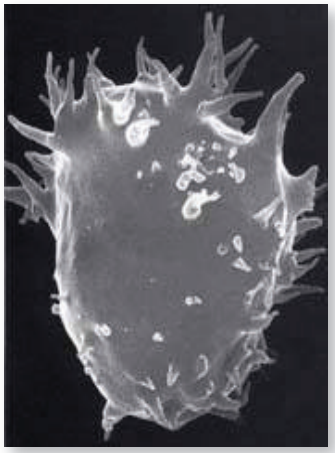
The Bacterra™ Advanced Bioretention Technology relies upon a proprietary blend of media that is subject to rigorous quality control standards and includes sand, silt, clay and organic content combined in unique ratios in order to optimize both flow rate and biofilm development to achieve efficient bacterial removal performance. Each component of the Bacterra™ Advanced Bioretention media is blended to optimize its role towards improving pollutant removal. The coarse sand filtration media provides both pore space and a high degree of surface area to support biofilm development. The complex organics support growth of an advanced biological population. The plants maintain soil porosity, encourage biological activity and take up specific pollutants (Davis et al., 2001), making adsorption sites available again; thus creating a sustainable design.

The Bacterra™ Advanced Bioretention Technology draws on multiple pollutant removal mechanisms including the full-range of primary and secondary mechanisms previously described. However, the Bacterra™ design is engineered to promote biofilm development and enhance the secondary pollutant removal mechanisms that occur between storm events such as biological decomposition, assimilation and predation in order to deliver an overall superior performance for removal of fecal coliforms and related bacteria. Microscopic examination of mulch and media samples from in-service Bacterra™ units reveals the presence of a dynamic and diverse microbial population including flagellates, ciliates and amoebae (Figure 5; Appendix 2). These results were notable for the high concentrations of protozoa, a higher order class of organisms that are known to prey upon bacterial populations as a primary food source.

Ciliate

The Bacterra™ Advanced Bioretention Technology uses a unique and sound analytical method to determine the appropriate media surface area needed to achieve the desired treatment levels. The key is to appropriately match the media's flow rate to the unique rainfall / runoff characteristics of the drainage area. This is achieved by matching the volume of runoff treated by the media to the volume of runoff generated by the drainage area based on actual rainfall intensity distributions for any given region. For example, in the Mid-Atlantic region, 50 years of rainfall data were analyzed from Reagan National Airport from which the probability and frequencies of all rainfall intensities (inches per hour) were determined. Knowing this and the flow characteristics of the Bacterra™ media, one can determine the annual volume of runoff that can be treated and the optimum surface area for any given drainage area. In the Mid-Atlantic region, the Bacterra™ Advanced Bioretention Technology is sized to treat approximately 90% of the total annual runoff volume while achieving maximum pollutant removal (Coffman & Siviter, 2008).

Flagellate



Amoeba

The objective of this paper is to highlight the performance testing conducted to demonstrate the advantages of the Bacterra™ Advanced Bioretention Technology in delivering optimized treatment of urban stormwater runoff, with a specific focus on bacterial removal.

Figure 5. Protozoan Classes Observed In Bacterra™ Units1

1. Photos courtesy www.blm.gov/nstc/soil/protozoa/index.html and www.tvt-bio.com/micro2.html

BACTERRA™ - EVALUATION of BACTERIAL REMOVAL PERFORMANCE

Pilot-Scale Studies

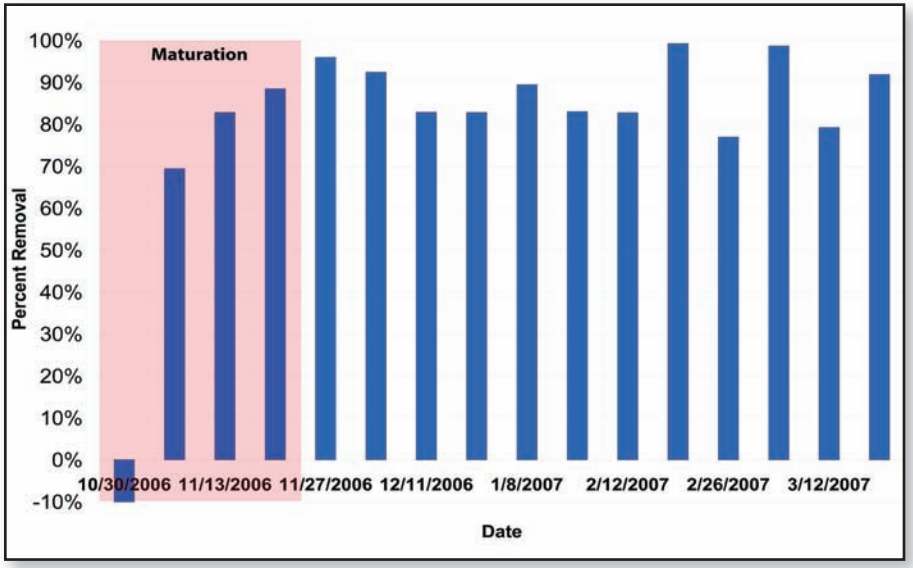


Figure 6. Effect of Time on Fecal Coliform Removal by the Bacterra™ Media Blend

The initial bacterial removal studies performed at Filterra's research center were conducted using pilot-scale filter columns having a media depth and configuration equivalent to the full-scale Bacterra™ design. The focus of the studies was to assess Bacterra™ performance for the removal of fecal coliform bacteria.

All test runs were analyzed according to EPA approved methodology, specifically HACH method 8368 using A-1 Medium Broth to perform multiple tube fermentations. Runs were designed to evaluate performance both under bypass and non-bypass flows.

The study results demonstrated that the Bacterra™ design achieved a 77 to 99% removal of fecal coliforms for non-bypass flows (Coffman & Ruby, 2007).

The results demonstrated that as the bioretention columns passed through a "maturation" period they exhibited greater fecal coliform removal efficiency (Figure 6).

The filter ripening process is essential towards optimization of the biological treatment phenomena via the establishment of a complex microbial community within the Bacterra™ Advanced Bioretention unit. This phenomenon was also observed by Clark & Pitt (1999) who reported that media filters develop a biofilm growth which promotes bacterial removal efficiency. The development of an advanced microbial community supports a hierarchy in which predation occurs as more developed organisms such as protozoa feed upon bacterial prey, further optimizing bacterial removal efficiency. Based upon in-field operating experience, this maturation period typically encompasses 4 to 6 storm events.

Studies conducted to evaluate the impact of the influent fecal coliform concentration revealed that the Bacterra™

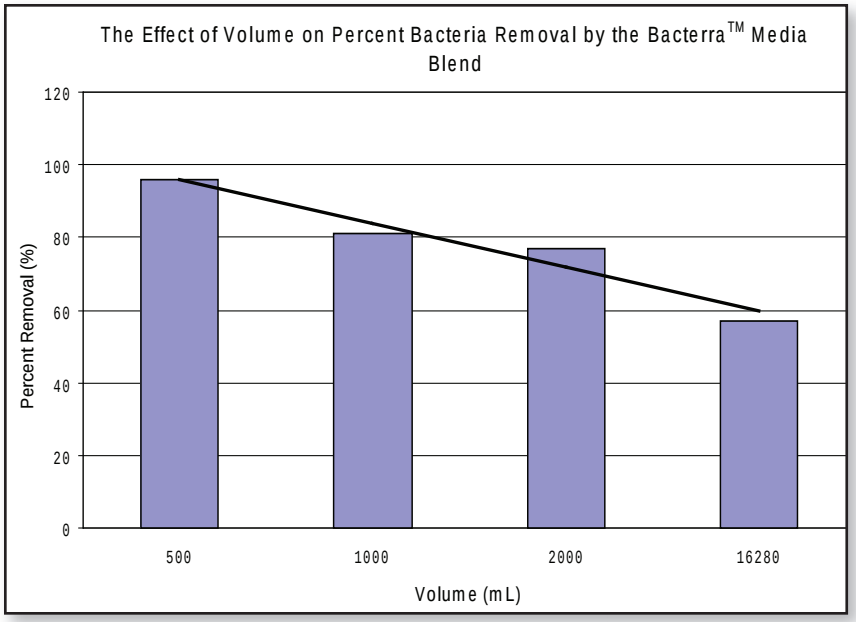


Figure 7. Effect of Simulated Rainfall Volume on Fecal Coliform Removal by the Bacterra™ Media Blend

Technology delivered greater than 80% fecal coliform removal over the wide range of influent concentrations tested (< 10,000 to 95,000 MPN / 100 mL).

Studies conducted to evaluate the impact of flow rate revealed that low volume / low intensity storms, as are typical for the majority of storm events, were found to yield the greatest removal efficiency (Figure 7).

Full-scale Field Studies

A full-scale Bacterra™ Advanced Bioretention unit was installed in Marina Del Rey (Los Angeles County, California) and has been in operation and receiving regular maintenance since January 2007. Pictured in Figure 8, this site is an urban streetscape retrofit in a densely populated area that was selected as an ideal location to perform event-based field testing of the Bacterra™ Advanced Bioretention Technology for bacteria removal performance.

Figure 8. Activated Bacterra™ - Marina Del Rey, CA

This site is particularly interesting based on Los Angeles County's need to implement stormwater treatment to address bacteria TMDL requirements imposed by the Los Angeles Regional Water Quality Control Board. The Marina Del Rey harbor is a popular tourist area and local attraction that is suffering from a variety of high pollutant

discharges from retail, commercial and residential activities.

All sampling and bacteriological testing were performed by CRG Marine Laboratories (Torrance, California), a state-certified third party laboratory. Sampling was conducted during qualifying storm events with replicate influent / effluent samples collected at 30 minute intervals. Bacterial enumeration for fecal coliforms was performed using the multiple tube fermentation technique (Standard Methods No. 9221E). Enumeration of Escherichia coli and Enterococcus spp. were performed using the Colilert™ and Enterolert™-E procedures, respectively (IDEXX Laboratories – Westbrook, Maine). Total Suspended Solids (TSS) analysis was performed using Standard Methods No. 2540 D.

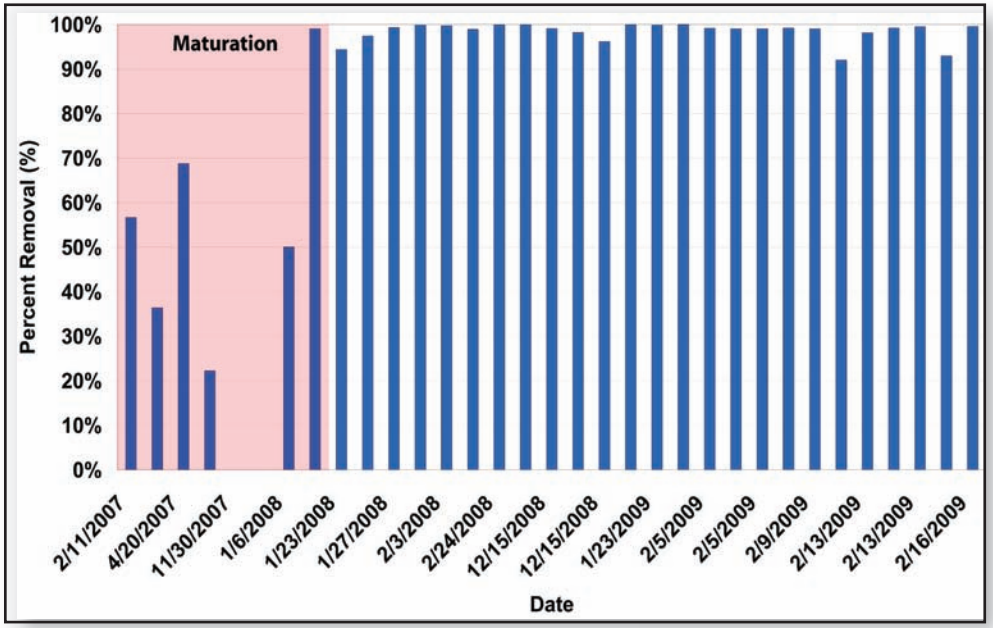


Figure 9. Effect of Time on Fecal Coliform Removal by the Bacterra™ Media Blend (Marina Del Rey Field Study)

The water quality data collected from this Bacterra™ unit during 11 monitored storm events since January 2008 confirms earlier findings from pilot-scale column studies that demonstrated the significant improvement in fecal coliform removal efficiency following an initial "maturation period". During normal operations, the Bacterra™ Advanced Bioretention Technology was found to yield average bacterial removals of 98% and 99% for fecal coliform and E. coli populations, respectively, for influent concentrations as high as 980,000 MPN/100 mL(Figures 9 & 10). Additionally, the Bacterra™ Advanced Bioretention Technology was found to deliver an average 95% removal of Enterococcus spp. for influent concentrations ranging from 1,990 to 396,800 MPN/100 mL.

Statistical analysis (ANOVA) was conducted to compare the variance of the influent and effluent concentrations for each of the pathogen indicator populations monitored (fecal coliforms, E. coli and Enterococcus spp.) demonstrating rejection of the null hypothesis at a 95% confidence level. Based on these data a Student's t-test was conducted to compare the mean values for these same populations ultimately demonstrating, at a 95% confidence level, that the Bacterra™ Advanced Bioretention Technology achieved a significant reduction in bacterial counts for

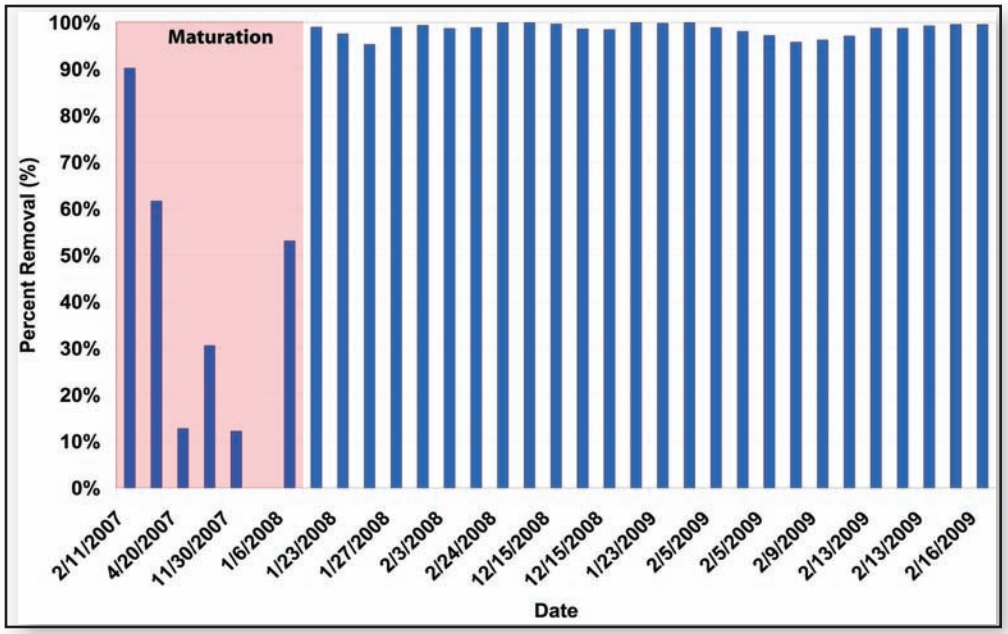


Figure 10. Effect of Time on E. coli Removal by the Bacterra™ Media Blend (Marina Del Rey Field Study)

all pathogen indicators monitored during this study.

These data confirm findings of research conducted by Dr. A. Davis who reported that bioretention facilities with well-developed microbial communities yielded >90% removal of fecal coliforms as compared to removal efficiencies ranging from 42 to 70% for less developed bioretention systems (Davis et al., 2003).

The results of the Marina Del Rey study compare very favorably with published literature accounts of bacterial removal both via conventional sand and dual media filters as well as various bioretention systems (Table 1).

As expected, there was a positive correlation between the TSS and fecal coliform removal efficiencies exhibited by the Bacterra™ Advanced Bioretention Technology. For the Bacterra™ systems to achieve the typical, long-term performance expected for TSS removal, it is critical that the filter units stabilize or ripen. This "maturation" process is a start-up phenomenon and is known to not have any long term effects on system performance. Effluent samples collected before this time may yield an unusually high effluent TSS concentration.

Statistical analysis (paired t-test) of the paired TSS inlet and outlet concentrations from previous studies was conducted in order to evaluate the minimum pollutant reduction achieved based on both mean and median influent and effluent concentrations. The TSS removal efficiency of the standard Filterra® unit was found to exhibit performance equivalent to or better than that of a conventional sand filter and significantly better as compared to several proprietary media filters, with an average TSS removal rate of 85% (Filterra, 2009).

The Bacterra™ Advanced Bioretention Technology exhibited an average TSS removal efficiency of 84.8% for samples collected during monitored storm events where influent TSS concentration was greater than 10 mg/L. Furthermore, the Bacterra™ Advanced Bioretention Technology produced a filtered effluent quality with an average TSS

TREATMENT TECHNOLOGY	FECAL COLIFORM REMOVAL	REFERENCE
Bacterra™ Advanced Bioretention	95%	
Peat-Sand Filter	90%	Galli, 1990
Bioretention	90%	Davis, 1998
Bioretention	88%	Rusciano & Obropta, 2005
Bioretention	71%	Hunt, 2006

Table 1. Bacteria Removal Comparison for Media Filtration

concentration of 3.9 mg/L.

The study also produced data useful towards validating system viability after extended dormant periods by illustrating effective performance under intermittent loading conditions.

CONCLUSIONS

With an alarming number of U.S. water bodies classified as impaired for fecal coliforms, treatment of urban stormwater runoff for bacteria removal is of growing interest. Bioretention practices are increasingly considered as a viable solution to stormwater treatment. Since the initial introduction of the bioretention concept, the field has evolved based on "lessons-learned" with past high failure rates attributed to the use of old design standards, poor drainage, media variability, contamination and high maintenance requirements.

A full-scale field evaluation of the Bacterra™ Advanced Bioretention Technology delivered greater than 95% removal of all key bacterial pathogen indicators analyzed, including fecal coliforms, E. coli and Enterococcus spp., following the filter maturation period. This performance is similar to or better than other media filters yet with the critical advantage of continued performance at very high flow rates, thereby allowing larger drainage areas to be treated within a very compact installed footprint.

Additionally, the Bacterra™ Advanced Bioretention Technology outperformed most stormwater best management practices in terms of TSS removal performance, yielding an average removal efficiency of 84.8% for samples

collected during monitored storm events where influent TSS concentration was greater than 10 mg/L. Furthermore, the Bacterra™ Advanced Bioretention Technology produced a high quality filtered effluent with an average TSS concentration of 3.9 mg/L.

Performance of the Bacterra™ Advanced Bioretention Technology has been proven to exceed conventional bioretention approaches, producing an excellent quality effluent that in some cases is suitable for receiving waters designated for human contact uses.

In conclusion, the Bacterra™ Advanced Bioretention Technology builds upon Filterra's history of delivering breakthrough technology to achieve sustainable water quality improvements via implementation of innovative bioretention solutions using standardized design configurations that are aesthetically pleasing, reliable, low cost and maintenance friendly.

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APPENDIX 1

STATISTICAL ANALYSIS – COMPARISON OF VARIANCES

	Fecal Coliforms		***Escherichia* coli**		**Enterococcus**	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
S_1	183,288		259,988		93,351	
$_2$		15,039		3,465		558
n_1	34		34		18	
n_2		34				18
F static		148.533		5,629.365		27,985.421
H0 equal variance	0.505 < F < 1.981		0.505 < F < 1.981		0.385 < F < 2.596	
H1 unequal variances	F < 0.505 or F < 1.981		F < 0.505 or F < 1.981		F < 0.385 or F < 2.596	
H0 Rejected for All Cases -- Variances Are Not Equal at 95% Confidence Level						

S_1 = Influent Standard Deviation
S_2 = Effluent Standard Deviation
n_1 = Influent Data Count
n_2 = Effluent Data Count

APPENDIX 2

Foodweb Analysis
Soil

Report prepared for:
Filterra
Mindy Ruby
11352 Virginia Precast Rd
Ashland, VA 23005-7920 USA
(804) 798-8400
mruby@filterra.com

Report Sent: 4/23/2009
Sample#: 01-107101 | Submission:01-019458
Unique ID: Media
Plant: Not Indicated
Invoice Number: 3710
Sample Received: 4/16/2009

For interpretation of this report please contact:
Soil Foodweb Oregon
info@oregonfoodweb.com
(541) 752-5066

Consulting fees may apply

Organism Biomass Data	Dry Weight	Active Bacteria (µg/g)	Total Bacteria (µg/g)	Active Fungi (µg/g)	Total Fungi (µg/g)	Hyphal Diameter (µm)
Results	**0.890**	14.7	119	4.34	422	2.85
Comments	Above Range	Below range	In range	Below range	Above range	
Expected Range Low	0.45	15	100	15	100	
Expected Range High	0.85	25	300	25	300	

	Protozoa (Numbers/g)			Total Nematodes #/g	Mycorrhizal Colonization (%)	
	Flagellates	Amoebae	Ciliates		ENDO	ECTO
Results	15519	**6441**	191	**0.29**	Not Ordered	Not Ordered
Comments	High	Low	High	Low		
Expected Range Low	10000	10000	50	20	40%	40%
Expected Range High			100	30	80%	80%

Organism Biomass Ratios	Total Fungi to Tot.Bacteria	Active to Total Fungi	Active to Total Bacteria	Active Fungi to Act.Bacteria	Plant Available N Supply (lbs/ac)	Actino Bacteria (µg/g)
Results	3.56	**0.01**	**0.12**	**0.29**	100-150	6.16
Comments	High	Low	Low	Low		
Expected Range Low	0.8	0.25	0.25	0.75		
Expected Range High	1.5	0.95	0.95	1.5		

Nematode detail (# per gram or # per mL)
Classified by type and identified to genus.
(If section is blank, no nematodes identified.)

Bacterial Feeders	
Metateratocephalus	0.02
Plectus	0.02
Prismatolaimus	0.02
Rhabditidae	0.10
Rhabdolaimus	0.04
Fungal Feeders	
Thonus	0.01
Tylencholaimus	0.01
Predatory	
Clarkus	0.02
Mononchoides	0.01

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(541) 752-5066 | info@oregonfoodweb.com

Filterra	Report Sent: 4/23/2009	For interpretation of this report please contact:
Mindy Ruby	Sample#: 01-107101 | Submission:01-019458	Soil Foodweb Oregon
11352 Virginia Precast Rd	Unique ID: Media	info@oregonfoodweb.com
Ashland, VA 23005-7920 USA	Plant: Not Indicated	(541) 752-5066
(804) 798-8400	Invoice Number: 3710	
mruby@filterra.com	Sample Received: 4/16/2009	***Consulting fees may apply***

Dry Weight:	Add organic matter to improve soil biology, build soil structure, increase water holding capacity.
Active Bacteria:	Aerobic bacteria not in growth mode; need to improve activity by adding simple, high energy sugar or amino-sugar source
Total Bacteria:	Aerobic bacterial biomass in normal range.
Active Fungi:	Need to improve active biomass; Add 2 to 4 gal/ ac of liquid humic acids, or 5 to 10 tons/ ac fungal compost or woody mulch, or 20 gal/ ac fungal compost tea
Total Fungi:	Fungal biomass and diversity above typical range.
Hyphal Diameter:	Good balance of disease suppressive and normal soil fungi
Protozoa:	Low amoebae numbers suggest lack of species diversity. Nutrient cycling will be limited. Need inoculum of protozoa to build populations, restore missing species.
Total Nematodes:	Low numbers, low diversity. Need to add beneficial nematodes, improve conditions to allow their survival.
Mycorrhizal Col.:	
TF/TB:	Fungal-dominated soil, best suited for shrubs and perennials.
AF/TF:	Low activity; need to add fungal foods to encourage fungi
AB/TB:	Low activity: add bacterial foods.
AF/AB:	Soil is fungal dominated, but becoming more bacterial; addition of fungal foods might re-align balance.

Interpretation Comments:

Actinobacteria Biomass = 6.16 ug/g
Good fungal diversity; hyphae diameter from 2.0 to 6.0 um.

Foodweb Analysis
Soil Amendment

Report prepared for:

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Report Sent: 4/23/2009
Sample#: 01-107100 | Submission:01-019458
Unique ID: Mulch
Plant:
Invoice Number: 3710
Sample Received: 4/16/2009

For interpretation of this report please contact:
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info@oregonfoodweb.com
(541) 752-5066

Consulting fees may apply

Organism Biomass Data	Dry Weight	Active Bacteria (µg/g)	Total Bacteria (µg/g)	Active Fungi (µg/g)	Total Fungi (µg/g)	Hyphal Diameter (µm)
Results	0.650	57.6	1108	48.4	1020	2.75
Comments	In Good Range	Above range	In range	Above range	Above range	
Expected Range Low	0.45	15	100	15	100	
Expected Range High	0.85	25	3000	25	300	

	Protozoa (Numbers/g)			Total Nematodes #/g	Mycorrhizal Colonization (%)	
	Flagellates	Amoebae	Ciliates		ENDO	ECTO
Results	70609	88201	424	**5.29**	Not Ordered	Not Ordered
Comments	High	High	High	Low		
Expected Range Low	10000	10000	50	20		
Expected Range High			100	30		

Organism Biomass Ratios	Total Fungi to Tot.Bacteria	Active to Total Fungi	Active to Total Bacteria	Active Fungi to Act.Bacteria	Plant Available N Supply (lbs/ac)	Actino Bacteria (µg/g)
Results	0.92	0.05	0.05	0.84	200+	37.9
Comments	Good	Good	Good	Good		
Expected Range Low	0.75	0.01	0.01	0.75		
Expected Range High	1.5	0.1	0.1	1.5		

Nematode detail (# per gram or # per mL)
Classified by type and identified to genus.
(If section is blank, no nematodes identified.)

Bacterial Feeders		
Butlerius		0.22
Cephalobus		0.33
Panagrolaimus		0.33
Plectus		0.05
Rhabditidae		1.15
Fungal/Root Feeders		
Aphelenchoides	Foliar nematode	0.22
Filenchus		0.05
Predatory		
Mononchoides		1.04
Seinura		0.05

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Report Sent: 4/23/2009
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Unique ID: Mulch
Plant:
Invoice Number: 3710
Sample Received: 4/16/2009

For interpretation of this report please contact:
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info@oregonfoodweb.com
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Consulting fees may apply

Dry Weight:	Within normal moisture levels for compost
Active Bacteria:	Bacterial activity above expected levels. Bacterial biomass will increase as long as nutrients are available
Total Bacteria:	Aerobic bacterial biomass in normal range for mature compost
Active Fungi:	Fungal activity above expected levels; fungal biomass will increase as long as nutrients are available
Total Fungi:	Fungal biomass and diversity above typical range for compost
Hyphal Diameter:	Good balance of disease suppressive and normal soil fungi
Protozoa:	High ciliate numbers indicate aggregates anaerobic internally, but aerobic outide based on excellent numbers of flagellates and amoebae. This means great diversity, good for soil functioning in all conditions.
Total Nematodes:	Low numbers, low diversity. Need to add beneficial nematodes. Nutrient cycling from fungi limited.
Mycorrhizal Col.:	
TF/TB:	Balanced biomass and diversity of bacteria and fungi. Good inoculum of both bacteria and fungi
AF/TF:	Activity in desired range for mature compost. Fungi will not compete with plants for nutrients.
AB/TB:	Activity in desired range for mature compost. Bacteria will not compete with plants for nutrients.
AF/AB:	Balanced compost is gradually becoming more bacterial; addition of foods for preferred dominance might speed balance.

Interpretation Comments:

Actinobacteria Biomass = 37.9 ug/g
Good fungal diversity; hyphae diameter from 2.0 to 5.0 um.

Operation & Maintenance (OM) Manual v01

filterra®

Bioretention Systems

A Growing Idea in Stormwater Filtration.

by KRISTAR

A Division of:

AMERICAST

Filterra® Stormwater Bioretention Filtration System

toll free: **800-579-8819** | fax: **707-524-8186** | drainageprotection.com | kristar.com

Table of Contents

Overview

Maintenance

Resources

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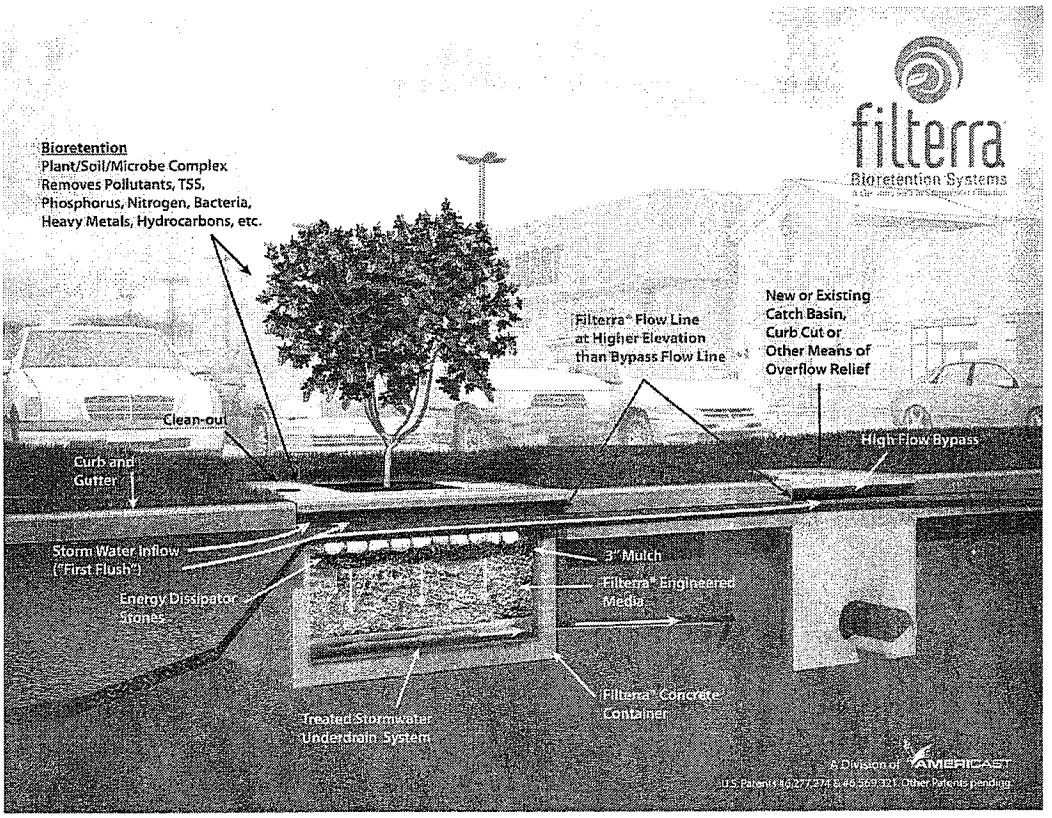
General Description

The following general specifications describe the general operations and maintenance requirements for the Americast stormwater bioretention filtration system, the Filterra®. The system utilizes physical, chemical and biological mechanisms of a soil, plant and microbe complex to remove pollutants typically found in urban stormwater runoff. The treatment system is a fully equipped, pre-constructed drop-in place unit designed for applications in the urban landscape to treat contaminated runoff.



Stormwater flows through a specially designed filter media mixture contained in a landscaped concrete container. The mixture immobilizes pollutants which are then decomposed, volatilized and incorporated into the biomass of the Filterra® system's micro/macro fauna and flora. Stormwater runoff flows through the media and into an underdrain system at the bottom of the container, where the treated water is discharged. Higher flows bypass the Filterra® to a downstream inlet or outfall.

Maintenance is a simple, inexpensive and safe operation that does not require confined space access, pumping or vacuum equipment or specialized tools. Properly trained landscape personnel can effectively maintain Filterra® Stormwater systems by following instructions in this manual.

filterra®
by KRISTAR

Basic Operations

Filterra® is a bioretention system in a concrete box. Contaminated stormwater runoff enters the filter box through the curb inlet spreading over the 3-inch layer of mulch on the surface of the filter media. As the water passes through the mulch layer, most of the larger sediment particles and heavy metals are removed through sedimentation and chemical reactions with the organic material in the mulch. Water passes through the soil media where the finer particles are removed and other chemical reactions take place to immobilize and capture pollutants in the soil media. The cleansed water passes into an underdrain and flows to a pipe system or other appropriate discharge point. Once the pollutants are in the soil, the bacteria begin to break down and metabolize the materials and the plants begin to uptake and metabolize the pollutants. Some pollutants such as heavy metals, which are chemically bound to organic particles in the mulch, are released over time as the organic matter decomposes to release the metals to the feeder roots of the plants and the cells of the bacteria in the soil where they remain and are recycled. Other pollutants such as phosphorus are chemically bound to the soil particles and released slowly back to the plants and bacteria and used in their metabolic processes. Nitrogen goes through a very complex variety of biochemical processes where it can ultimately end up in the plant/bacteria biomass, turned to nitrogen gas or dissolves back into the water column as nitrates depending on soil temperature, pH and the availability of oxygen. The pollutants ultimately are retained in the mulch, soil and biomass with some passing out of the system into the air or back into the water.

Design and Installation

Each project presents different scopes for the use of Filterra® systems. To ensure the safe and specified function of the stormwater BMP, Americast reviews each application before supply. Information and help may be provided to the design engineer during the planning process. Correct Filterra® box sizing (by rainfall region) is essential to predict pollutant removal rates for a given area. The engineer shall submit calculations for approval by the local jurisdiction. The contractor is responsible for the correct installation of Filterra units as shown in approved plans. A comprehensive installation manual is available at filterra.com.

Maintenance

Why Maintain?

All stormwater treatment systems require maintenance for effective operation. This necessity is often incorporated in your property's permitting process as a legally binding BMP maintenance agreement.

- Avoid legal challenges from your jurisdiction's maintenance enforcement program.
- Prolong the expected lifespan of your Filterra media.
- Avoid more costly media replacement.
- Help reduce pollutant loads leaving your property.

Simple maintenance of the Filterra® is required to continue effective pollutant removal from stormwater runoff before discharge into downstream waters. This procedure will also extend the longevity of the living biofilter system. The unit will recycle and accumulate pollutants within the biomass, but is also subjected to other materials entering the throat. This may include trash, silt and leaves etc. which will be contained within the void below the top grate and above the mulch layer. Too much silt may inhibit the Filterra's® flow rate, which is the reason for site stabilization before activation. Regular replacement of the mulch stops accumulation of such sediment.

filterra® by KRISTAR

When to Maintain?

Americast includes a 1-year maintenance plan with each system purchase. Annual included maintenance consists of a maximum of two (2) scheduled visits. Additional maintenance may be necessary depending on sediment and trash loading (by Owner or at additional cost). The start of the maintenance plan begins when the system is activated for full operation. Full operation is defined as the unit installed, curb and gutter and transitions in place and activation (by Supplier) when mulch and plant are added and temporary throat protection removed.

Activation cannot be carried out until the site is **fully** stabilized (full landscaping, grass cover, final paving and street sweeping completed). Maintenance visits are scheduled seasonally; the spring visit aims to clean up after winter loads including salts and sands. The fall visit helps the system by removing excessive leaf litter.

A first inspection to determine if maintenance is necessary should be performed at least twice annually after every major storm event of greater than (1) one inch total depth (subject to regional climate). Please refer to the maintenance checklist for specific conditions that indicate if maintenance is necessary.

It has been found that in regions which receive between 30-50 inches of annual rainfall, (2) two visits are generally required. Regions with less rainfall often only require (1) one visit per annum. Varying land uses can affect maintenance frequency; e.g. some fast food restaurants require more frequent trash removal. Contributing drainage areas which are subject to new development wherein the recommended erosion and sediment control measures have not been implemented require additional maintenance visits.

Some sites may be subjected to extreme sediment or trash loads, requiring more frequent maintenance visits. This is the reason for detailed notes of maintenance actions per unit, helping the Supplier and Owner predict future maintenance frequencies, reflecting individual site conditions.

Owners must promptly notify the (maintenance) Supplier of any damage to the plant(s), which constitute(s) an integral part of the bioretention technology. Owners should also advise other landscape or maintenance contractors to leave all maintenance to the Supplier (i.e. no pruning or fertilizing).

Exclusion of Services

It is the responsibility of the owner to provide adequate irrigation when necessary to the plant of the Filterra® system.

Clean up due to major contamination such as oils, chemicals, toxic spills, etc. will result in additional costs and are not covered under the Supplier maintenance contract. Should a major contamination event occur, the Owner must block off the outlet pipe of the Filterra® (where the cleaned runoff drains to, such as drop-inlet) and block off the throat of the Filterra®. The Supplier should be informed immediately.

Maintenance Visit Summary

Each maintenance visit consists of the following simple tasks (detailed instructions below).

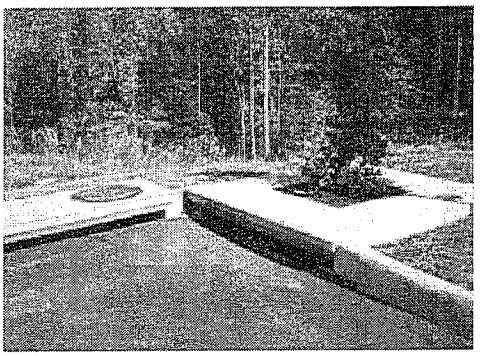
1. Inspection of Filterra® and surrounding area
2. Removal of tree grate and erosion control stones
3. Removal of debris, trash and mulch
4. Mulch replacement
5. Plant health evaluation and pruning or replacement as necessary
6. Clean area around Filterra®
7. Complete paperwork

Maintenance Tools, Safety Equipment and Supplies

Ideal tools include: camera, bucket, shovel, broom, pruners, hoe/rake, and tape measure. Appropriate Personal Protective Equipment (PPE) should be used in accordance with local or company procedures. This may include impervious gloves where the type of trash is unknown, high visibility clothing and barricades when working in close proximity to traffic and also safety hats and shoes. A T-Bar or crowbar should be used for moving the tree grates (up to 170 lbs ea.).

Most visits require only replacement mulch. Three bags of double shredded mulch are used per unit (on a standard 6x6' size). Some visits may require additional Filterra® engineered soil media available from the Supplier.

Maintenance Visit Procedure



1. Inspection of Filterra® and surrounding area

- Record individual unit **before** maintenance with photograph (numbered). Record on Maintenance Report (see example in this document) the following:

Record on Maintenance Report the following:

Standing Water	yes | no
Damage to Box Structure Damage	yes | no
to Grate	yes | no
Is Bypass Clear	yes | no

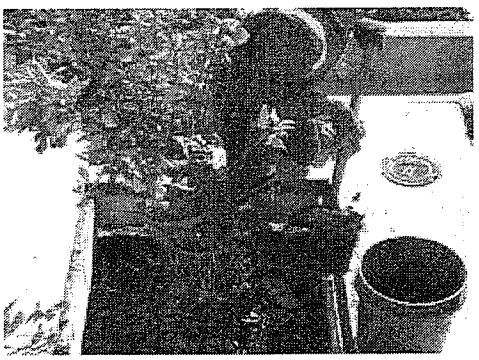
If yes answered to any of these observations, record with close-up photograph (numbered).

2. Removal of tree grate and erosion control stones

- Remove metal grates for access into Filterra® box.
- Dig out silt (if any) and mulch and remove trash & foreign items.

Record on Maintenance Report the following:

Silt/Clay	yes | no
Cups/ Bags	yes | no
Leaves	yes | no
# of Buckets Removed	



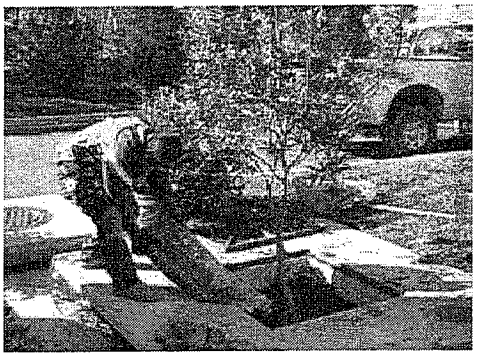
3. Removal of debris, trash and mulch

- After removal of mulch and debris, measure distance from the top of the Filterra® engineered media soil to the bottom of the top slab. If this distance is greater than 12", add Filterra® media (not top soil or other) to recharge to a 9" distance.

Record on Maintenance Report the following:

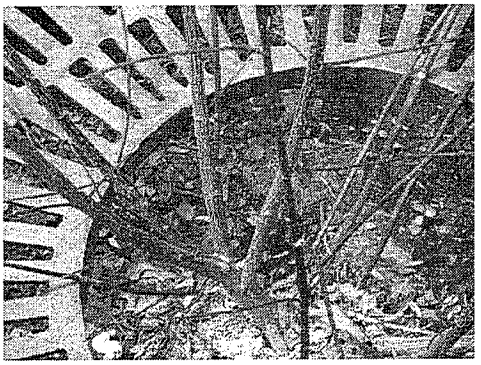
Distance to Bottom of Top Slab (inches)	
# of Buckets of Media Added	

filterra® by KRISTAR



4. Mulch replacement

- Please see mulch specifications.
- Add double shredded mulch evenly across the entire unit to a depth of 3".
- Ensure correct repositioning of erosion control stones by the Filterra® inlet to allow for entry of trash during a storm event.
- Replace Filterra® grates correctly using appropriate lifting or moving tools, taking care not to damage the plant.



5. Plant health evaluation and pruning or replacement as necessary

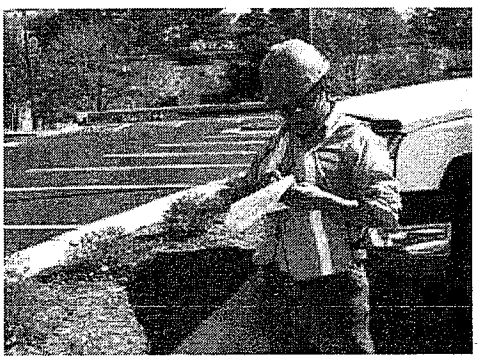
- Examine the plant's health and replace if dead.
- Prune as necessary to encourage growth in the correct directions

Record on Maintenance Report the following:

Height above Grate	(feet)
Width at Widest Point	(feet)
Health	alive | dead
Damage to Plant	yes | no
Plant Replaced	yes | no

6. Clean area around Filterra®

- Clean area around unit and remove all refuse to be disposed of appropriately.



7. Complete paperwork

- Deliver Maintenance Report and photographs to appropriate location (normally Americast during maintenance contract period).
- Some jurisdictions may require submission of maintenance reports in accordance with approvals. It is the responsibility of the Owner to comply with local regulations.

Maintenance Checklist

Drainage System Failure	Problem	Conditions to Check For	Conditions That Should Exist	Actions
Inlet	Excessive sediment or trash accumulation	Accumulated sediments or trash impair free flow of water into Filterra	Inlet should be free of obstructions allowing free distributed flow of water into Filterra.	Sediments and/or trash should be removed.
Mulch Cover	Trash and floatable debris accumulation	Excessive trash and/or debris accumulation.	Minimal trash or other debris on mulch cover.	Trash and debris should be removed and mulch cover raked level. Ensure bark nugget mulch is not used.
Mulch Cover	"Ponding" of water on mulch cover.	"Ponding" in unit could be indicative of clogging due to excessive fine sediment accumulation or spill of petroleum oils.	Stormwater should drain freely and evenly through mulch cover.	Recommend contact manufacturer and replace mulch as a minimum.
Vegetation	Plants not growing or in poor condition.	Soil/mulch too wet, evidence of spill. Incorrect plant selection. Pest infestation. Vandalism to plants.	Plants should be healthy and pest free.	Contact manufacturer for advice.
Vegetation	Plant growth excessive	Plants should be appropriate to the species and location of Filterra.		Trim/prune plants in accordance with typical landscaping and safety needs.
Structure	Structure has visible cracks	Cracks wider than ½ inch or evidence of soil particles entering the structure through the cracks.		Vault should be repaired.

Maintenance is ideally to be performed twice annually.
Inspection to be performed after every major storm event >1 inch total depth, subject to climate.

Filterra® Project Maintenance Order

Project	
Address	
Directions	
Project Owner	
Filterra Units on this Order	
Total Units on this Project	
Date of Maintenance	
Arrival Time	
Departure Time	
# of Workers	
Notes on Project	
Maintenance Supervisor	

Note : All maintenance debris, trash and mulch must go to landfill.

03/22/11

Filterra® Structure Maintenance Report

Project		**Structure Number**	
Plant Type		**Structure Size**	
Date		**GPS**	
		Pre Mtce Photo #	

Initial Observations

Standing Water	Y	N	Damage to Grate	Y	N
IF Yes, STOP NOW & call 888-950-8826			Is Bypass Clear	Y	N
			Notes		
Damage to Box Structure	Y	N			
If YES to any observation take close up photo					

Waste

Silt / Clay	Y	N	Buckets Removed (# of)	
Cups/Bags	Y	N	Notes	
Leaves	Y	N		
Other				

Media

Distance to Bottom of Top Slab (in.)		Notes
Buckets of Media Added (# of)		

Mulch

Netting Replaced	Y	N	Bags of Mulch Added (# of)	
Stones Replaced	Y	N	Notes	

Plant	#1	(#2)		#1	(#2)
Height above Grate (ft., in.)			Plant Replaced	Y / N	Y / N
Stem diameter/Caliper (in.)					
Width at Widest Point (ft., in.)			Notes		
Health	Alive/Dead	Alive/Dead			
Damage to Plant	Y / N	Y / N			
If YES to plant damage take close up photo					

Other Notes

(use back if necessary)

Filterra® Warranty

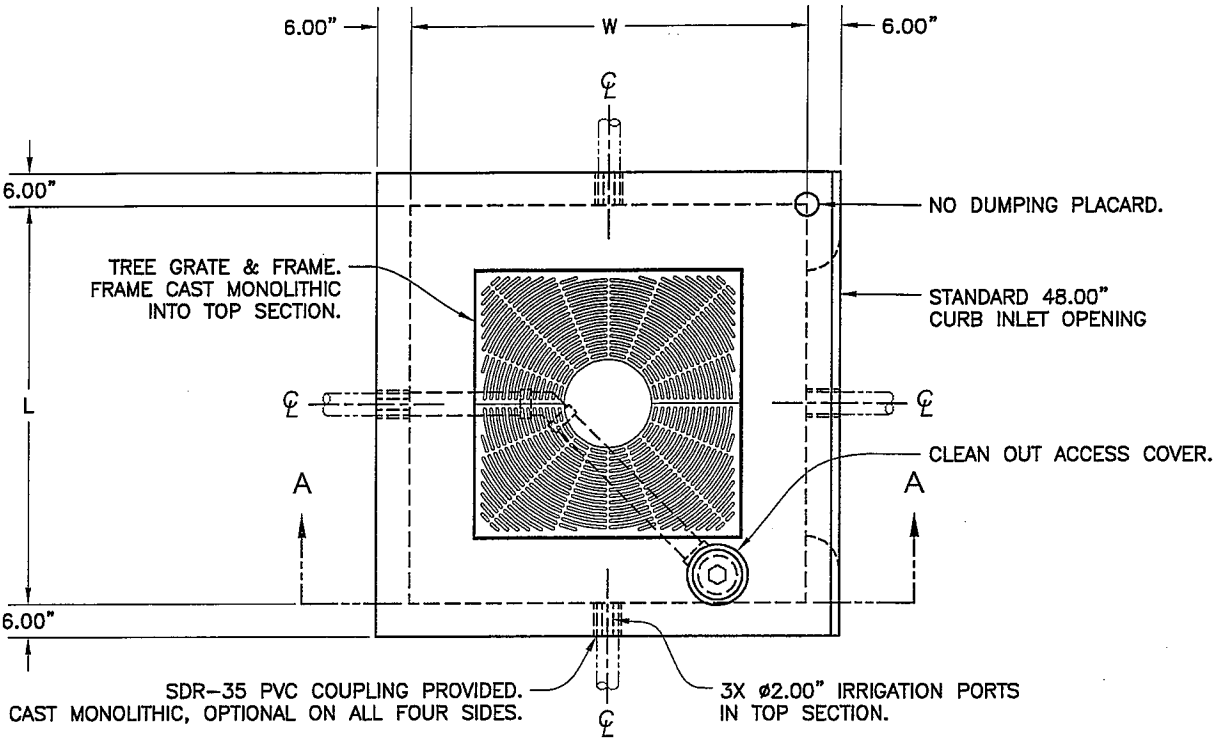
Seller warrants goods sold hereunder against defects in materials and workmanship only, for a period of (1) year from date the Seller activates the system into service. Seller makes no other warranties, expressed or implied.

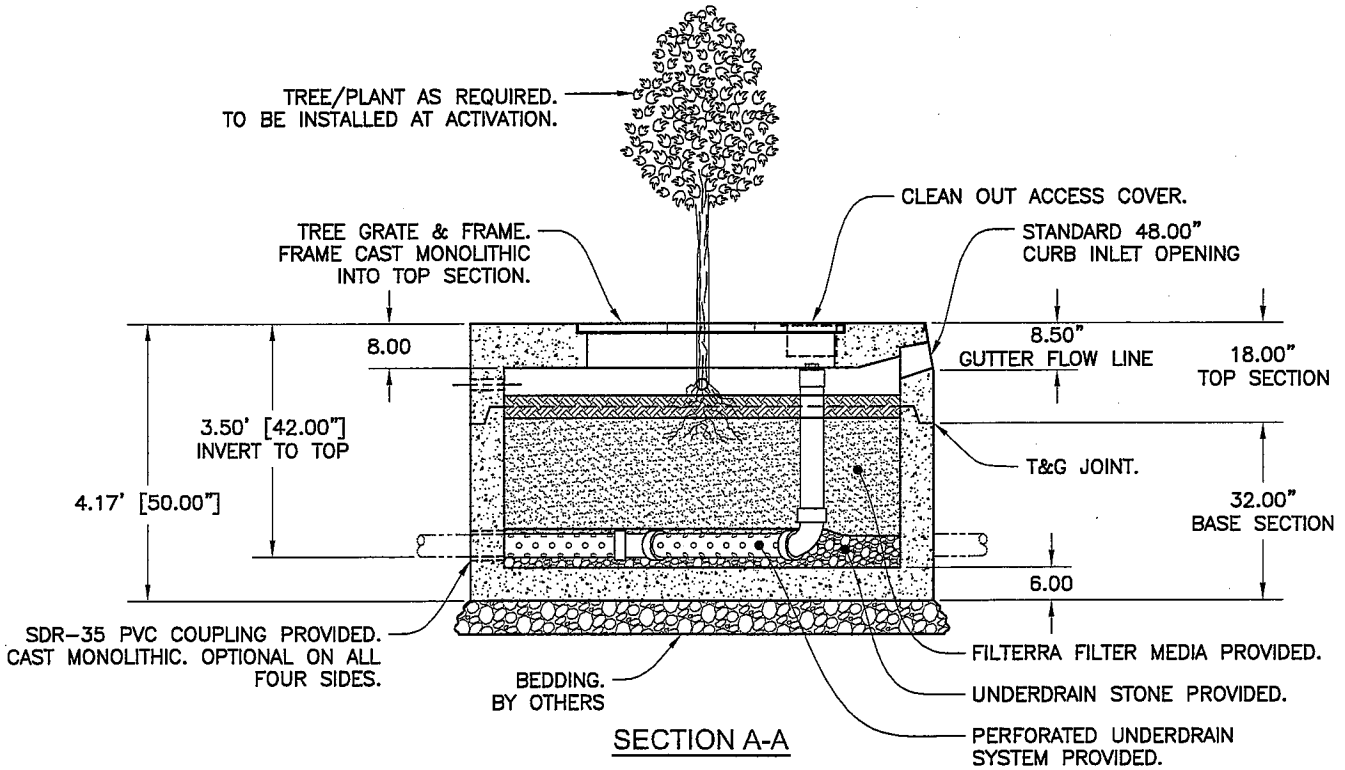
Seller's liability hereunder shall be conditioned upon the Buyer's installation, maintenance, and service of the goods in strict compliance with the written instructions and specifications provided by the Seller. Any deviation from Seller's instructions and specifications or any abuse or neglect shall void all warranties.

In the event of any claim upon Seller's warranty, the burden shall be upon the buyer to prove strict compliance with all instructions and specifications provided by the Seller.

Seller's liability hereunder shall be limited only to the cost or replacement of the goods. Buyer agrees that Seller shall not be liable for any consequential losses arising from the purchase, installation, and/or use of the goods.

WZ FTST-K-02





SECTION A-A

TABULATION				
Size / Designation	L (Feet)	W (Feet)	Tree Grate Quantity / Size	Outlet Pipe PVC SDR-35
4' x 4'	4.00'	4.00'	1Ea. / 3' x 3'	Ø4.00"
6' x 6'	6.00'	6.00'	1Ea. / 3' x 3'	Ø4.00"

TITLE

Precast Filterra® Unit

Standard Configuration (Square)

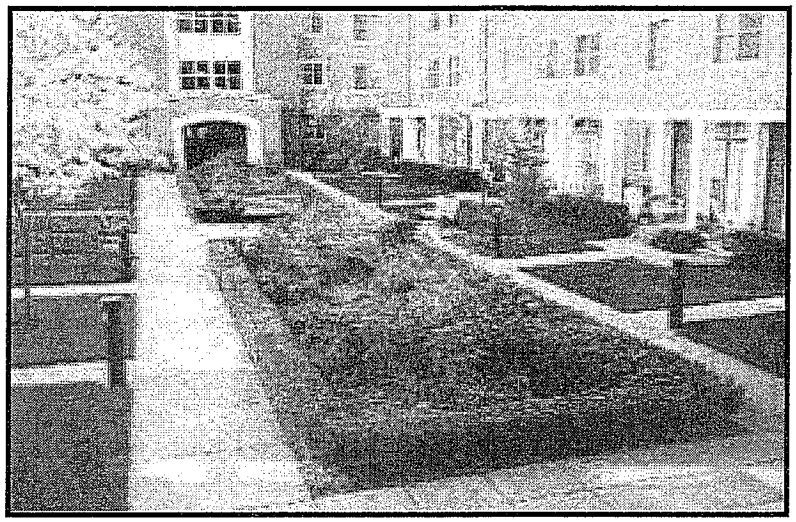
Western Zone

KriStar Enterprises, Inc.
360 Sutton Place, Santa Rosa, CA 95407
Ph: 800.579.8819, Fax: 707.524.8186, www.kristar.com

filterra® US PAT 6,277,274 AND 6,569,321

DRAWING NO.	REV	F-ECO	DATE
WZ FTST-K-01	02	0004 JPR 3/28/11	JPR 1/7/11

Bioretention TC-32



Design Considerations

- Soil for Infiltration
- Tributary Area
- Slope
- Aesthetics
- Environmental Side-effects

Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through buffer strip and subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

Targeted Constituents

✓	Sediment	■
✓	Nutrients	▲
✓	Trash	■
✓	Metals	■
✓	Bacteria	■
✓	Oil and Grease	■
✓	Organics	■

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

California Experience

None documented. Bioretention has been used as a stormwater BMP since 1992. In addition to Prince George's County, MD and Alexandria, VA, bioretention has been used successfully at urban and suburban areas in Montgomery County, MD; Baltimore County, MD; Chesterfield County, VA; Prince William County, VA; Smith Mountain Lake State Park, VA; and Cary, NC.

Advantages

- Bioretention provides stormwater treatment that enhances the quality of downstream water bodies by temporarily storing runoff in the BMP and releasing it over a period of four days to the receiving water (EPA, 1999).
- The vegetation provides shade and wind breaks, absorbs noise, and improves an area's landscape.

Limitations

- The bioretention BMP is not recommended for areas with slopes greater than 20% or where mature tree removal would

CASQA California Stormwater Quality Association

be required since clogging may result, particularly if the BMP receives runoff with high sediment loads (EPA, 1999).

- Bioretention is not a suitable BMP at locations where the water table is within 6 feet of the ground surface and where the surrounding soil stratum is unstable.
- By design, bioretention BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water.
- In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

Design and Sizing Guidelines

- The bioretention area should be sized to capture the design storm runoff.
- In areas where the native soil permeability is less than 0.5 in/hr an underdrain should be provided.
- Recommended minimum dimensions are 15 feet by 40 feet, although the preferred width is 25 feet. Excavated depth should be 4 feet.
- Area should drain completely within 72 hours.
- Approximately 1 tree or shrub per 50 ft^2 of bioretention area should be included.
- Cover area with about 3 inches of mulch.

Construction/Inspection Considerations

Bioretention area should not be established until contributing watershed is stabilized.

Performance

Bioretention removes stormwater pollutants through physical and biological processes, including adsorption, filtration, plant uptake, microbial activity, decomposition, sedimentation and volatilization (EPA, 1999). Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Thus, the infiltration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease. Pollutants removed by adsorption include metals, phosphorus, and hydrocarbons. Filtration occurs as runoff passes through the bioretention area media, such as the sand bed, ground cover, and planting soil.

Common particulates removed from stormwater include particulate organic matter, phosphorus, and suspended solids. Biological processes that occur in wetlands result in pollutant uptake by plants and microorganisms in the soil. Plant growth is sustained by the uptake of nutrients from the soils, with woody plants locking up these nutrients through the seasons. Microbial activity within the soil also contributes to the removal of nitrogen and organic matter. Nitrogen is removed by nitrifying and denitrifying bacteria, while aerobic bacteria are responsible for the decomposition of the organic matter. Microbial processes require oxygen and can result in depleted oxygen levels if the bioretention area is not adequately

aerated. Sedimentation occurs in the swale or ponding area as the velocity slows and solids fall out of suspension.

The removal effectiveness of bioretention has been studied during field and laboratory studies conducted by the University of Maryland (Davis et al, 1998). During these experiments, synthetic stormwater runoff was pumped through several laboratory and field bioretention areas to simulate typical storm events in Prince George's County, MD. Removal rates for heavy metals and nutrients are shown in Table 1.

Table 1 Laboratory and Estimated Bioretention Davis et al. (1998); PGDER (1993)

Pollutant	Removal Rate
Total Phosphorus	70-83%
Metals (Cu, Zn, Pb)	93-98%
TKN	68-80%
Total Suspended Solids	90%
Organics	90%
Bacteria	90%

Results for both the laboratory and field experiments were similar for each of the pollutants analyzed. Doubling or halving the influent pollutant levels had little effect on the effluent pollutants concentrations (Davis et al, 1998).

The microbial activity and plant uptake occurring in the bioretention area will likely result in higher removal rates than those determined for infiltration BMPs.

Siting Criteria

Bioretention BMPs are generally used to treat stormwater from impervious surfaces at commercial, residential, and industrial areas (EPA, 1999). Implementation of bioretention for stormwater management is ideal for median strips, parking lot islands, and swales. Moreover, the runoff in these areas can be designed to either divert directly into the bioretention area or convey into the bioretention area by a curb and gutter collection system.

The best location for bioretention areas is upland from inlets that receive sheet flow from graded areas and at areas that will be excavated (EPA, 1999). In order to maximize treatment effectiveness, the site must be graded in such a way that minimizes erosive conditions as sheet flow is conveyed to the treatment area. Locations where a bioretention area can be readily incorporated into the site plan without further environmental damage are preferred. Furthermore, to effectively minimize sediment loading in the treatment area, bioretention only should be used in stabilized drainage areas.

Additional Design Guidelines

The layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and drainage are considered (EPA, 1999). Sites with loamy sand soils are especially appropriate for bioretention because the excavated soil can be backfilled and used as the planting soil, thus eliminating the cost of importing planting soil.

The use of bioretention may not be feasible given an unstable surrounding soil stratum, soils with clay content greater than 25 percent, a site with slopes greater than 20 percent, and/or a site with mature trees that would be removed during construction of the BMP.

Bioretention can be designed to be off-line or on-line of the existing drainage system (EPA, 1999). The drainage area for a bioretention area should be between 0.1 and 0.4 hectares (0.25 and 1.0 acres). Larger drainage areas may require multiple bioretention areas. Furthermore, the maximum drainage area for a bioretention area is determined by the expected rainfall intensity and runoff rate. Stabilized areas may erode when velocities are greater than 5 feet per second (1.5 meter per second). The designer should determine the potential for erosive conditions at the site.

The size of the bioretention area, which is a function of the drainage area and the runoff generated from the area is sized to capture the water quality volume.

The recommended minimum dimensions of the bioretention area are 15 feet (4.6 meters) wide by 40 feet (12.2 meters) long, where the minimum width allows enough space for a dense, randomly-distributed area of trees and shrubs to become established. Thus replicating a natural forest and creating a microclimate, thereby enabling the bioretention area to tolerate the effects of heat stress, acid rain, runoff pollutants, and insect and disease infestations which landscaped areas in urban settings typically are unable to tolerate. The preferred width is 25 feet (7.6 meters), with a length of twice the width. Essentially, any facilities wider than 20 feet (6.1 meters) should be twice as long as they are wide, which promotes the distribution of flow and decreases the chances of concentrated flow.

In order to provide adequate storage and prevent water from standing for excessive periods of time the ponding depth of the bioretention area should not exceed 6 inches (15 centimeters). Water should not be left to stand for more than 72 hours. A restriction on the type of plants that can be used may be necessary due to some plants' water intolerance. Furthermore, if water is left standing for longer than 72 hours mosquitoes and other insects may start to breed.

The appropriate planting soil should be backfilled into the excavated bioretention area. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25 percent.

Generally the soil should have infiltration rates greater than 0.5 inches (1.25 centimeters) per hour, which is typical of sandy loams, loamy sands, or loams. The pH of the soil should range between 5.5 and 6.5, where pollutants such as organic nitrogen and phosphorus can be adsorbed by the soil and microbial activity can flourish. Additional requirements for the planting soil include a 1.5 to 3 percent organic content and a maximum 500 ppm concentration of soluble salts.

Soil tests should be performed for every 500 cubic yards (382 cubic meters) of planting soil, with the exception of pH and organic content tests, which are required only once per bioretention area (EPA, 1999). Planting soil should be 4 inches (10.1 centimeters) deeper than the bottom of the largest root ball and 4 feet (1.2 meters) altogether. This depth will provide adequate soil for the plants' root systems to become established, prevent plant damage due to severe wind, and provide adequate moisture capacity. Most sites will require excavation in order to obtain the recommended depth.

Planting soil depths of greater than 4 feet (1.2 meters) may require additional construction practices such as shoring measures (EPA, 1999). Planting soil should be placed in 18 inches or greater lifts and lightly compacted until the desired depth is reached. Since high canopy trees may be destroyed during maintenance the bioretention area should be vegetated to resemble a terrestrial forest community ecosystem that is dominated by understory trees. Three species each of both trees and shrubs are recommended to be planted at a rate of 2500 trees and shrubs per hectare (1000 per acre). For instance, a 15 foot (4.6 meter) by 40 foot (12.2 meter) bioretention area (600 square feet or 55.75 square meters) would require 14 trees and shrubs. The shrub-to-tree ratio should be 2:1 to 3:1.

Trees and shrubs should be planted when conditions are favorable. Vegetation should be watered at the end of each day for fourteen days following its planting. Plant species tolerant of pollutant loads and varying wet and dry conditions should be used in the bioretention area.

The designer should assess aesthetics, site layout, and maintenance requirements when selecting plant species. Adjacent non-native invasive species should be identified and the designer should take measures, such as providing a soil breach to eliminate the threat of these species invading the bioretention area. Regional landscaping manuals should be consulted to ensure that the planting of the bioretention area meets the landscaping requirements established by the local authorities. The designers should evaluate the best placement of vegetation within the bioretention area. Plants should be placed at irregular intervals to replicate a natural forest. Trees should be placed on the perimeter of the area to provide shade and shelter from the wind. Trees and shrubs can be sheltered from damaging flows if they are placed away from the path of the incoming runoff. In cold climates, species that are more tolerant to cold winds, such as evergreens, should be placed in windier areas of the site.

Following placement of the trees and shrubs, the ground cover and/or mulch should be established. Ground cover such as grasses or legumes can be planted at the beginning of the growing season. Mulch should be placed immediately after trees and shrubs are planted. Two to 3 inches (5 to 7.6 cm) of commercially-available fine shredded hardwood mulch or shredded hardwood chips should be applied to the bioretention area to protect from erosion.

Maintenance

The primary maintenance requirement for bioretention areas is that of inspection and repair or replacement of the treatment area's components. Generally, this involves nothing more than the routine periodic maintenance that is required of any landscaped area. Plants that are appropriate for the site, climatic, and watering conditions should be selected for use in the bioretention cell. Appropriately selected plants will aide in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural

soil horizon. These biologic and physical processes over time will lengthen the facility's life span and reduce the need for extensive maintenance.

Routine maintenance should include a biannual health evaluation of the trees and shrubs and subsequent removal of any dead or diseased vegetation (EPA, 1999). Diseased vegetation should be treated as needed using preventative and low-toxic measures to the extent possible. BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water. Routine inspections for areas of standing water within the BMP and corrective measures to restore proper infiltration rates are necessary to prevent creating mosquito and other vector habitat. In addition, bioretention BMPs are susceptible to invasion by aggressive plant species such as cattails, which increase the chances of water standing and subsequent vector production if not routinely maintained.

In order to maintain the treatment area's appearance it may be necessary to prune and weed. Furthermore, mulch replacement is suggested when erosion is evident or when the site begins to look unattractive. Specifically, the entire area may require mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas. Mulch replacement should be done prior to the start of the wet season.

New Jersey's Department of Environmental Protection states in their bioretention systems standards that accumulated sediment and debris removal (especially at the inflow point) will normally be the primary maintenance function. Other potential tasks include replacement of dead vegetation, soil pH regulation, erosion repair at inflow points, mulch replenishment, unclogging the underdrain, and repairing overflow structures. There is also the possibility that the cation exchange capacity of the soils in the cell will be significantly reduced over time. Depending on pollutant loads, soils may need to be replaced within 5-10 years of construction (LID, 2000).

Cost

Construction Cost

Construction cost estimates for a bioretention area are slightly greater than those for the required landscaping for a new development (EPA, 1999). A general rule of thumb (Coffman, 1999) is that residential bioretention areas average about $3 to $4 per square foot, depending on soil conditions and the density and types of plants used. Commercial, industrial and institutional site costs can range between $10 to $40 per square foot, based on the need for control structures, curbing, storm drains and underdrains.

Retrofitting a site typically costs more, averaging $6,500 per bioretention area. The higher costs are attributed to the demolition of existing concrete, asphalt, and existing structures and the replacement of fill material with planting soil. The costs of retrofitting a commercial site in Maryland, Kettering Development, with 15 bioretention areas were estimated at $111,600.

In any bioretention area design, the cost of plants varies substantially and can account for a significant portion of the expenditures. While these cost estimates are slightly greater than those of typical landscaping treatment (due to the increased number of plantings, additional soil excavation, backfill material, use of underdrains etc.), those landscaping expenses that would be required regardless of the bioretention installation should be subtracted when determining the net cost.

Perhaps of most importance, however, the cost savings compared to the use of traditional structural stormwater conveyance systems makes bioretention areas quite attractive financially. For example, the use of bioretention can decrease the cost required for constructing stormwater conveyance systems at a site. A medical office building in Maryland was able to reduce the amount of storm drain pipe that was needed from 800 to 230 feet - a cost savings of $24,000 (PGDER, 1993). And a new residential development spent a total of approximately $100,000 using bioretention cells on each lot instead of nearly $400,000 for the traditional stormwater ponds that were originally planned (Rappahanock,). Also, in residential areas, stormwater management controls become a part of each property owner's landscape, reducing the public burden to maintain large centralized facilities.

Maintenance Cost

The operation and maintenance costs for a bioretention facility will be comparable to those of typical landscaping required for a site. Costs beyond the normal landscaping fees will include the cost for testing the soils and may include costs for a sand bed and planting soil.

References and Sources of Additional Information

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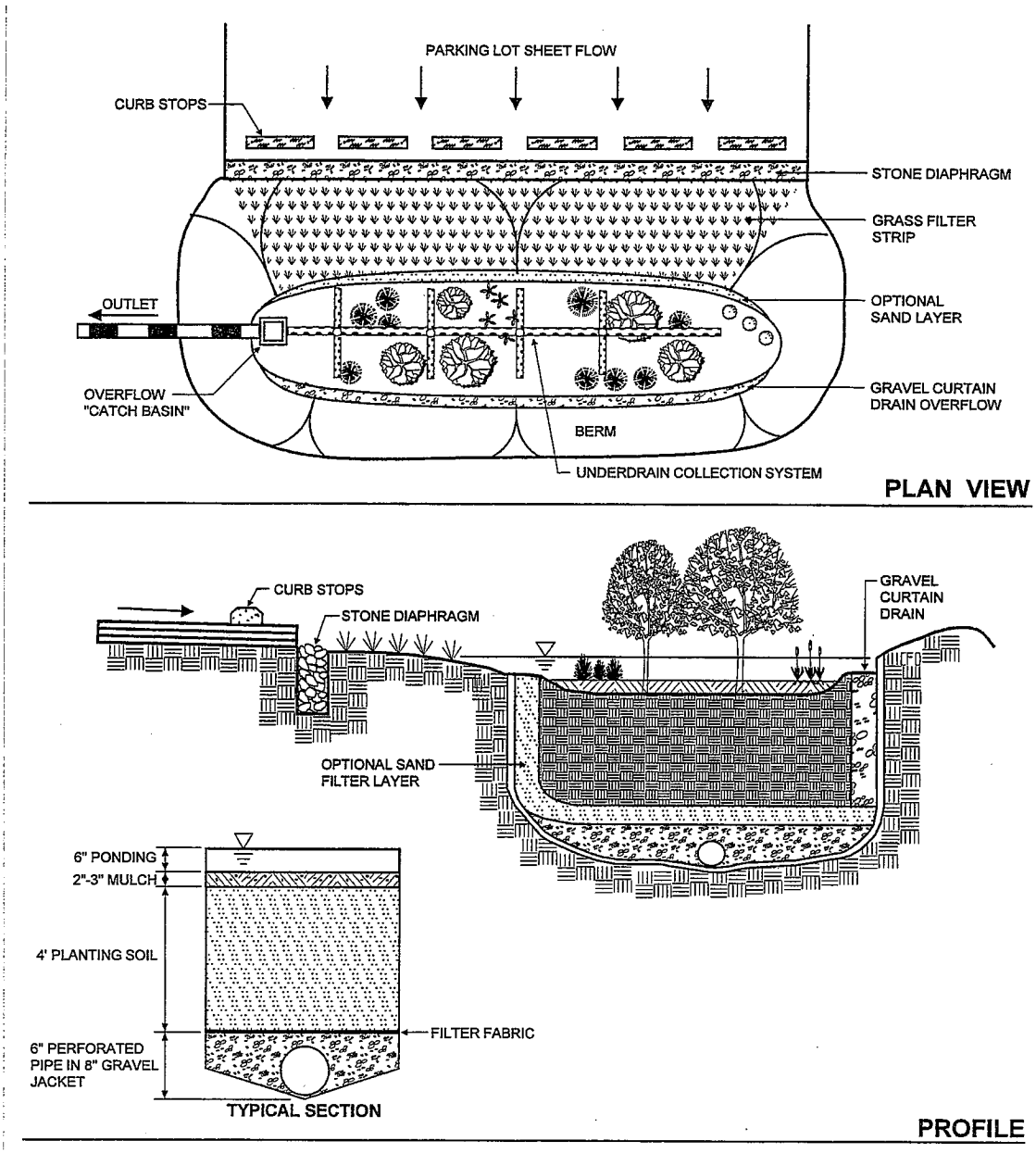
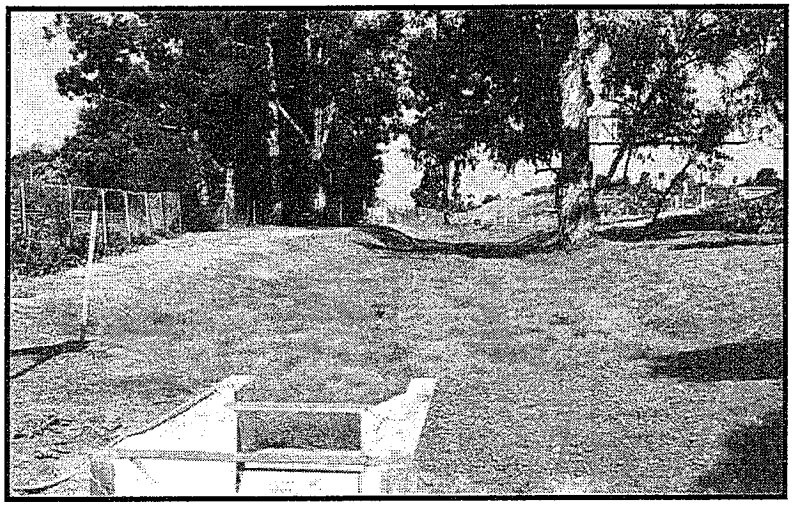
Weinstein, N. Davis, A.P. and Veeramachaneni, R. "Low Impact Development (LID) Stormwater Management Approach for the Control of Diffuse Pollution from Urban Roadways," *5th International Conference Diffuse/Nonpoint Pollution and Watershed Management Proceedings*, C.S. Melching and Emre Alp, Eds. 2001 International Water Association



Schematic of a Bioretention Facility (MDE, 2000)

Vegetated Swale TC-30



Design Considerations

- Tributary Area
- Area Required
- Slope
- Water Availability

Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems.

Targeted Constituents

✓	Sediment	▲
✓	Nutrients	●
✓	Trash	●
✓	Metals	▲
✓	Bacteria	●
✓	Oil and Grease	▲
✓	Organics	▲

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored six vegetated swales in southern California. These swales were generally effective in reducing the volume and mass of pollutants in runoff. Even in the areas where the annual rainfall was only about 10 inches/yr, the vegetation did not require additional irrigation. One factor that strongly affected performance was the presence of large numbers of gophers at most of the sites. The gophers created earthen mounds, destroyed vegetation, and generally reduced the effectiveness of the controls for TSS reduction.

Advantages

- If properly designed, vegetated, and operated, swales can serve as an aesthetic, potentially inexpensive urban development or roadway drainage conveyance measure with significant collateral water quality benefits.

CASQA California Stormwater Quality Association

- Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible.

Limitations

- Can be difficult to avoid channelization.
- May not be appropriate for industrial sites or locations where spills may occur
- Grassed swales cannot treat a very large drainage area. Large areas may be divided and treated using multiple swales.
- A thick vegetative cover is needed for these practices to function properly.
- They are impractical in areas with steep topography.
- They are not effective and may even erode when flow velocities are high, if the grass cover is not properly maintained.
- In some places, their use is restricted by law: many local municipalities require curb and gutter systems in residential areas.
- Swales are mores susceptible to failure if not properly maintained than other treatment BMPs.

Design and Sizing Guidelines

- Flow rate based design determined by local requirements or sized so that 85% of the annual runoff volume is discharged at less than the design rainfall intensity.
- Swale should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, which ever is less, at the design treatment rate.
- Longitudinal slopes should not exceed 2.5%
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equation using a value of 0.25 for Manning's n.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.
- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.
- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.
- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.
- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.

Performance

The literature suggests that vegetated swales represent a practical and potentially effective technique for controlling urban runoff quality. While limited quantitative performance data exists for vegetated swales, it is known that check dams, slight slopes, permeable soils, dense grass cover, increased contact time, and small storm events all contribute to successful pollutant removal by the swale system. Factors decreasing the effectiveness of swales include compacted soils, short runoff contact time, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities and discharge rates.

Conventional vegetated swale designs have achieved mixed results in removing particulate pollutants. A study performed by the Nationwide Urban Runoff Program (NURP) monitored three grass swales in the Washington, D.C., area and found no significant improvement in urban runoff quality for the pollutants analyzed. However, the weak performance of these swales was attributed to the high flow velocities in the swales, soil compaction, steep slopes, and short grass height.

Another project in Durham, NC, monitored the performance of a carefully designed artificial swale that received runoff from a commercial parking lot. The project tracked 11 storms and concluded that particulate concentrations of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. However, the swale proved largely ineffective for removing soluble nutrients.

The effectiveness of vegetated swales can be enhanced by adding check dams at approximately 17 meter (50 foot) increments along their length (See Figure 1). These dams maximize the retention time within the swale, decrease flow velocities, and promote particulate settling. Finally, the incorporation of vegetated filter strips parallel to the top of the channel banks can help to treat sheet flows entering the swale.

Only 9 studies have been conducted on all grassed channels designed for water quality (Table 1). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorus.

Table 1 Grassed swale pollutant removal efficiency data							
	Removal Efficiencies (% Removal)						
Study	TSS	TP	TN	NO_3	Metals	Bacteria	Type
Caltrans 2002	77	8	67	66	83-90	-33	dry swales
Goldberg 1993	67.8	4.5	-	31.4	42–62	-100	grassed channel
Seattle Metro and Washington Department of Ecology 1992	60	45	-	-25	2–16	-25	grassed channel
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	-25	46–73	-25	grassed channel
Wang et al., 1981	80	-	-	-	70–80	-	dry swale
Dorman et al., 1989	98	18	-	45	37–81	-	dry swale
Harper, 1988	87	83	84	80	88–90	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988.	81	17	40	52	37–69	-	wet swale
Koon, 1995	67	39	-	9	-35 to 6	-	wet swale

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although some swales appear to export soluble phosphorus (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils.

Siting Criteria

The suitability of a swale at a site will depend on land use, size of the area serviced, soil type, slope, imperviousness of the contributing watershed, and dimensions and slope of the swale system (Schueler et al., 1992). In general, swales can be used to serve areas of less than 10 acres, with slopes no greater than 5 %. Use of natural topographic lows is encouraged and natural drainage courses should be regarded as significant local resources to be kept in use (Young et al., 1996).

Selection Criteria (NCTCOG, 1993)

- Comparable performance to wet basins
- Limited to treating a few acres
- Availability of water during dry periods to maintain vegetation
- Sufficient available land area

Research in the Austin area indicates that vegetated controls are effective at removing pollutants even when dormant. Therefore, irrigation is not required to maintain growth during dry periods, but may be necessary only to prevent the vegetation from dying.

The topography of the site should permit the design of a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls. Recommendations for longitudinal slopes range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.

Additional Design Guidelines

Most of the design guidelines adopted for swale design specify a minimum hydraulic residence time of 9 minutes. This criterion is based on the results of a single study conducted in Seattle, Washington (Seattle Metro and Washington Department of Ecology, 1992), and is not well supported. Analysis of the data collected in that study indicates that pollutant removal at a residence time of 5 minutes was not significantly different, although there is more variability in that data. Therefore, additional research in the design criteria for swales is needed. Substantial pollutant removal has also been observed for vegetated controls designed solely for conveyance (Barrett et al, 1998); consequently, some flexibility in the design is warranted.

Many design guidelines recommend that grass be frequently mowed to maintain dense coverage near the ground surface. Recent research (Colwell et al., 2000) has shown mowing frequency or grass height has little or no effect on pollutant removal.

Summary of Design Recommendations

1) The swale should have a length that provides a minimum hydraulic residence time of at least 10 minutes. The maximum bottom width should not exceed 10 feet unless a dividing berm is provided. The depth of flow should not exceed 2/3rds the height of the grass at the peak of the water quality design storm intensity. The channel slope should not exceed 2.5%.

2) A design grass height of 6 inches is recommended.

3) Regardless of the recommended detention time, the swale should be not less than 100 feet in length.

4) The width of the swale should be determined using Manning's Equation, at the peak of the design storm, using a Manning's n of 0.25.

5) The swale can be sized as both a treatment facility for the design storm and as a conveyance system to pass the peak hydraulic flows of the 100-year storm if it is located "on-line." The side slopes should be no steeper than 3:1 (H:V).

6) Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible. If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.

7) Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation

establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials.

Maintenance

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.
- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.
- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.
- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.
- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Cost

Construction Cost

Little data is available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately $0.25 per ft^2. This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most stormwater management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately $0.50 per ft^2, which compares favorably with other stormwater management practices.

Table 2 Swale Cost Estimate (SEWRPC, 1991)

Component	Unit	Extent	Unit Cost			Total Cost		
			Low	Moderate	High	Low	Moderate	High
Mobilization / Demobilization-Light	Swale	1	$107	$274	$441	$107	$274	$441
Site Preparation								
Clearing[b]	Acre	0.5	$2,200	$3,800	$5,400	$1,100	$1,900	$2,700
Grubbing[c]	Acre	0.25	$3,800	$5,200	$8,600	$950	$1,300	$1,850
General Excavation[d]	Yd^3	372	$2.10	$3.70	$5.30	$781	$1,376	$1,972
Level and Till[e]	Yd^2	1,210	$0.20	$0.35	$0.50	$242	$424	$605
Sites Development								
Salvaged Topsoil Seed, and Mulch[f]	Yd^2	1,210	$0.40	$1.00	$1.60	$484	$1,210	$1,936
Sod[g]	Yd^2	1,210	$1.20	$2.40	$3.60	$1,452	$2,904	$4,356
Subtotal	--	--	--	--	--	$5,116	$9,388	$13,660
Contingencies	Swale	1	25%	25%	25%	$1,279	$2,347	$3,415
Total	--	--	--	--	--	$6,395	$11,735	$17,075

Source: (SEWRPC, 1991)

Note: Mobilization/demobilization refers to the organization and planning involved in establishing a vegetative swale.

[a] Swale has a bottom width of 1.0 foot, a top width of 10 feet with 1:3 side slopes, and a 1,000-foot length.

[b] Area cleared = (top width + 10 feet) x swale length.

[c] Area grubbed = (top width x swale length).

[d] Volume excavated = (0.67 x top width x swale depth) x swale length (parabolic cross-section).

[e] Area tilled = $\left(\text{top width} + \frac{8(\text{swale depth}^2)}{3(\text{top width})}\right)$ x swale length (parabolic cross-section).

[f] Area seeded = area cleared x 0.5.

[g] Area sodded = area cleared x 0.5.

Table 3 Estimated Maintenance Costs (SEWRPC, 1991)

Component	Unit Cost	Swale Size (Depth and Top Width)		Comment
		1.5 Foot Depth, One-Foot Bottom Width, 10-Foot Top Width	3-Foot Depth, 3-Foot Bottom Width, 21-Foot Top Width	
Lawn Mowing	$0.85 / 1,000 ft^2/ mowing	$0.14 / linear foot	$0.21 / linear foot	Lawn maintenance area=(top width + 10 feet) x length. Mow eight times per year
General Lawn Care	$9.00 / 1,000 ft^2/ year	$0.18 / linear foot	$0.28 / linear foot	Lawn maintenance area = (top width + 10 feet) x length
Swale Debris and Litter Removal	$0.10 / linear foot / year	$0.10 / linear foot	$0.10 / linear foot	--
Grass Reseeding with Mulch and Fertilizer	$0.30 / yd^2	$0.01 / linear foot	$0.01 / linear foot	Area revegetated equals 1% of lawn maintenance area per year
Program Administration and Swale Inspection	$0.15 / linear foot / year, plus $25 / inspection	$0.15 / linear foot	$0.15 / linear foot	Inspect four times per year
Total	--	$0.58 / linear foot	$ 0.75 / linear foot	--

Maintenance Cost

Caltrans (2002) estimated the expected annual maintenance cost for a swale with a tributary area of approximately 2 ha at approximately $2,700. Since almost all maintenance consists of mowing, the cost is fundamentally a function of the mowing frequency. Unit costs developed by SEWRPC are shown in Table 3. In many cases vegetated channels would be used to convey runoff and would require periodic mowing as well, so there may be little additional cost for the water quality component. Since essentially all the activities are related to vegetation management, no special training is required for maintenance personnel.

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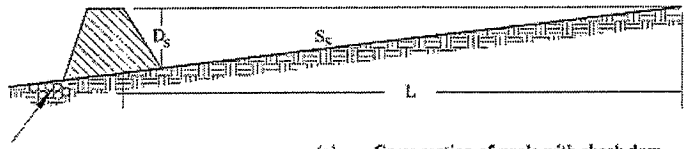
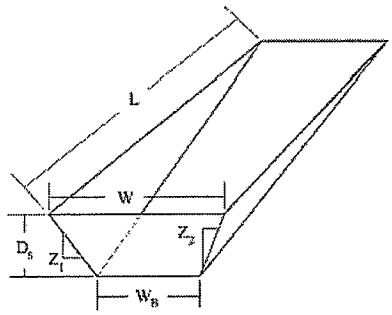


(a) Cross section of swale with check dam.

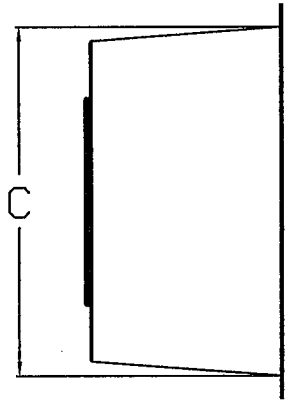


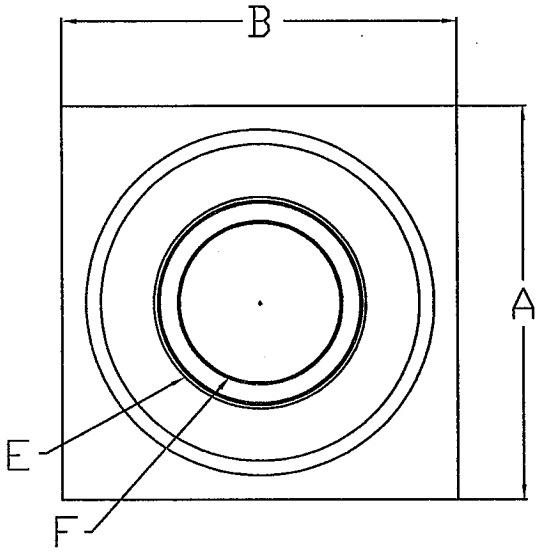
(b) Dimensional view of swale impoundment area.

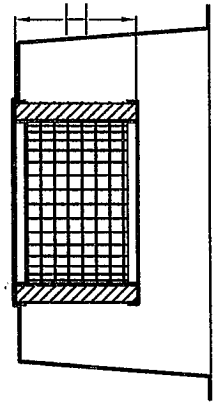
Notation:

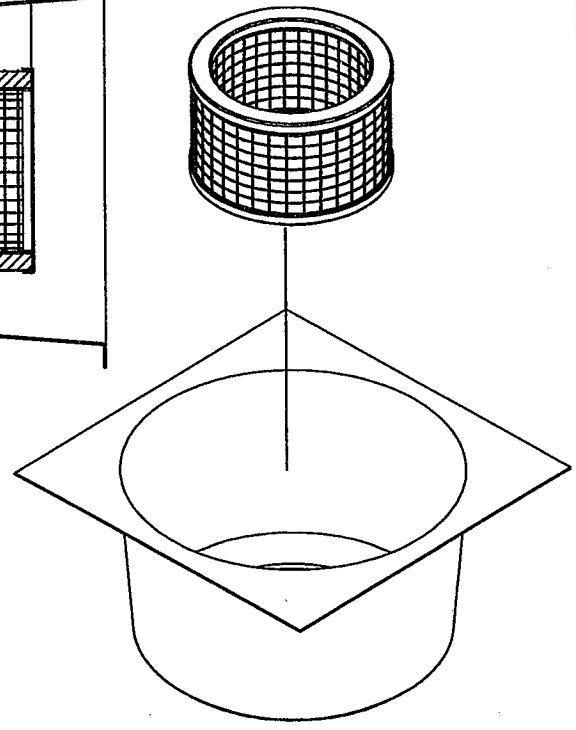
L = Length of swale impoundment area per check dam (ft)
D_S = Depth of check dam (ft)
S_S = Bottom slope of swale (ft/ft)
W = Top width of check dam (ft)
W_B = Bottom width of check dam (ft)
$Z_{1&2}$ = Ratio of horizontal to vertical change in swale side slope (ft/ft)

NOTES
1. ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE NOTED
2. UNITS ARE CONTRUCTED FROM HIGH DENSITY POLYETHYLENE PLASTIC WITH UV INHIBITORS OR FIBERGLASS HAVING ISOPHTHALIC POLYESTER RESINS THAT ARE GEL COATED WITH ISOTHPG
3. MEDIA CARTRIDGES CAN BE INTERCHANGED WITH GEOTRAP SERIES AS SITE CONDITIONS CHANGE.
4. LOW PROFILE FILTER ARE ALSO AVAILABLE FOR SHALLOW CATCH BASINS.
5. CUSTOM SIZES ARE AVAILABLE TO FIT MOST APPLICATIONS. PLEASE CALL A LOCAL CONTECH OFFICE NEAR YOU FOR DETAILS.
6. OPTIONAL TRASH GUARD AVAILABLE.
7. DUAL STAGE AND DUAL CAPACITY FILTERS ALSO AVAILABLE FOR LARGER DEBRIS CAPACITIES
8. IN DIMENSIONS "A" AND "B" SUPPORT FLANGES CAN BE ADJUSTED TO SUITE VARYING SIZES OF CATCH BASINS
9. CUSTOM INSTALL BRACKETS ARE AVAILABLE AS NEEDED.

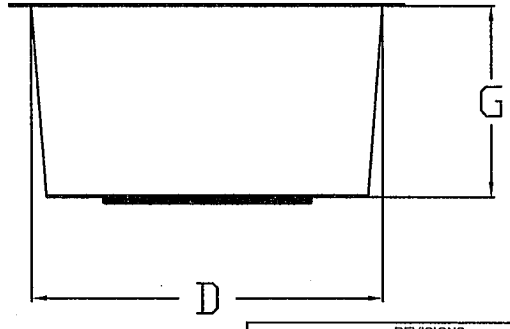








MODEL #	A*	B*	C	D	E	F	G	# CARTRIDGES	H	BASIN TYPE
TR1212	15.00	15.00	11.00	11.00	6.75	3.50	6.0	1 SHORT	4.5	HDPE
TR12RD	Ø15.00		Ø11.00		6.75	3.50	6.0	1 SHORT	4.5	HDPE
TR1616	20.00	20.00	14.00	14.00	6.75	3.50	10.5	1 STD	8.5	HDPE
TR16RD	Ø20.00		Ø11.00		6.75	3.50	6.0	1 SHORT	4.5	HDPE
TR1818	24.00	24.00	18.00	18.00	10.0	6.25	10.5	1 STD	8.5	HDPE
TR18RD	Ø24.00		Ø16.50		6.75	3.50	10.5	1 STD	8.5	HDPE
TR1824	19.00	25.00	18.00	18.00	10.0	6.25	10.5	1 STD	8.5	HDPE
TR2024	21.00	25.00	18.00	18.00	10.0	6.25	10.5	1 STD	8.5	HDPE
TR24SR	27.00	27.00	23.50	23.50	14.0	10.0	13.0	1 STD	8.5	HDPE
TR24RD	Ø28.00		Ø21.00		14.0	10.0	13.0	1 STD	8.5	HDPE
TR2436	32.00	40.00	22.00	29.00	14.0	10.0	21.0	1 TALL	16.5	HDPE
TR3030	34.00	34.00	22.00	29.00	14.0	10.0	21.0	1 TALL	16.5	HDPE
TR36SR	36.00	36.00	33.00	33.00	14.0	10.0	22.0	1 TALL	16.5	FIBRG
TR36RD	Ø36.00		Ø33.00		14.0	10.0	22.0	1 TALL	16.5	FIBRG
TR42RD	Ø42.00		Ø33.00		14.0	10.0	22.0	1 TALL	16.5	FIBRG
TR4848	48.00	48.00	42.00	42.00	24.0	19.75	22.0	1 TALL	17.5	FIBRG
TR48RD	Ø48.00		Ø33.00		14.0	10.0	22.0	1 TALL	16.5	FIBRG



TYPICAL DETAIL FOR DROP INLET STYLE
TRITON CATCHBASIN INSERTS BY CONTECH

REVISIONS	
REV	DESCRIPTION

CONTECH STORMWATER SOLUTIONS
contechstormwater.com

SCALE: NONE	
DRAWN: WSG	
CHECKED: WSG	
FILE NAME: TYPTBLTCBI	
DATE: 8/12/09	

Maintenance

The Triton catch basin inserts should be inspected at regular intervals and maintained when necessary to ensure optimum performance.

The useful life of the media-pak is based on the quantity of pollutants it collects. The media-pak with XSORB® media has the ability to repel water and absorb up to 500 percent of its own weight in oil when fully saturated. A typical TR24SR cartridge has the ability to absorb between 1 and 2 quarts of contaminants when fully saturated. On average we suggest three cleanouts of the cartridge basin and one change out or replacement of the media-pak per year. For Triton catch basin inserts placed in areas of greater pollutant loading the maintenance and change out frequency will be increase.

Life expectancy of the Triton catch basin inserts is anticipated to be excellent because of the materials of construction. The non-reactive high density polystyrene plastic with U.V. inhibitors and fiberglass housings provide excellent protection against damp and corrosive environments. The cartridge components including the stainless steel wire cage, geotextile polypropylene fabric are all considered durable and have good longevity in the environment.

On-site Procedures for Inspection and Maintenance

- Secure traffic and pedestrian traffic with cones, barrels, etc.
- Clean surface area immediate around each catch basin
- Remove grates and set aside
- Clean grates, remove litter and debris that may be trapped within the grate
- Inspect perimeter gasket system of the cartridge making sure no flows are bypassing the cartridge, repair as needed.
- Remove by vactor hose the debris that has been trapped in the trough area. Dispose of in accordance with local, state and federal regulatory agency requirements. Most debris that is captured in the trough or sump area will fall into the non-hazardous waste category.
- Visually inspect and chech the condition of the trough area.
- Inspect the media-pak condition in the wire mesh cartridge. When the normally white colored media turns black, the media should be changed. When service requires replacement of the cartridge media-pak please contact your local CONTECH Stormwater Solutions office.
- Replace grate and lockdown as needed.
- Secure and date weatherproof lock out tags.
- Report any concerns or improvements regarding the Triton insert on a service report.
- Un-secure traffic control area.
- Complete service report and submit to facility owner.

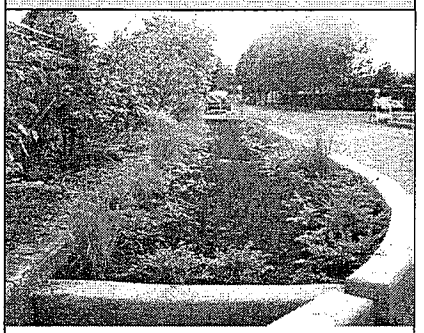
XIV.2. Miscellaneous BMP Design Element Fact Sheets (MISC)

MISC-1: Planting/Storage Media

Planting and storage media is a critical design element for several common BMP types, including bioretention, bioinfiltration, swales, filter strips, and greenroofs. This fact sheet is intended to be used as referenced from these fact sheets.

Also known as:

- *Bioretention soil media (BSM)*



Street-end biofiltration with planting/storage media
Source: City of Portland

General Design Criteria

- Planting/storage media should be designed to achieve the long term hydraulic design requirements associated with the design of the facility (i.e., design K_{sat}).
- The planting media shall be designed to address pollutants of concern at the design hydraulic capacity.
- Bioretention soil shall also support vigorous plant growth.
- Planting media should consist of 60 to 80% fine sand and 20 to 40% compost.
- Planting media for projects draining to nutrient sensitive receiving water should adhere to recommendations for nutrient sensitive planting media provided below.

Sand

- Sand should be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve size should be non-plastic. Sand for bioretention should be analyzed by an accredited lab using #200, #100, #40, #30, #16, #8, #4, and 3/8 sieves (ASTM D 422 or as approved by the local permitting authority) and meet the following gradation (Note: all sands complying with ASTM C33 for fine aggregate comply with the gradation requirements below):

Sieve Size (ASTM D422)	% Passing (by weight)	
	Minimum	Maximum
3/8 inch	100	100
#4	90	100
#8	70	100
#16	40	95
#30	15	70
#40	5	55
#100	0	15
#200	0	5

- Note: the gradation of the sand component of the media is believed to be a major factor in the hydraulic conductivity of the media mix. If the desired hydraulic conductivity of the media cannot be achieved within the specified proportions of sand and compost (#2), then it may be necessary to utilize sand at the coarser end of the range specified in the table above ("minimum" column).

Compost

Compost should be a well decomposed, stable, weed free organic matter source derived from waste materials including yard debris, wood wastes, or other organic materials not including manure or biosolids meeting standards developed by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program). Compost quality should be verified via a lab analysis to be:

- Feedstock materials shall be specified and include one or more of the following: landscape/yard trimmings, grass clippings, food scraps, and agricultural crop residues.
- Organic matter: 35-75% dry weight basis.
- Carbon and Nitrogen Ratio: 15:1 < C:N < 25:1
- Maturity/Stability: shall have dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell, containing recognizable grass or leaves, or is hot (120 F) upon delivery or rewetting is not acceptable.
- Toxicity: any one of the following measures is sufficient to indicate non-toxicity:
    - NH4:NH3 < 3
    - Ammonium < 500 ppm, dry weight basis
    - Seed Germination > 80% of control
    - Plant trials > 80% of control
- Solvita® > 5 index value
- Nutrient content:
    - Total Nitrogen content 0.9% or above preferred
    - Total Boron should be <80 ppm, soluble boron < 2.5 ppm
- Salinity: < 6.0 mmhos/cm
- pH between 6.5 and 8 (may vary with plant palette)
- Compost for bioretention should be analyzed by an accredited lab using #200, ¼ inch, ½ inch, and 1 inch sieves (ASTM D 422 or as approved by the local permitting authority) and meet the following gradation:

Sieve Size (ASTM D422)	% Passing (by weight)	
	Minimum	Maximum
1 inch	99	100
½ inch	90	100
¼ inch	40	90
#200	2	10

- Tests should be sufficiently recent to represent the actual material that is anticipated to be delivered to the site. If processes or sources used by the supplier have changed significantly since the most recent testing, new tests should be requested.
- Note: the gradation of compost used in bioretention media is believed to play an important role in the saturated hydraulic conductivity of the media. To achieve a higher saturated hydraulic conductivity, it may be necessary to utilize compost at the coarser end of this range ("minimum" column). The percent passing the #200 sieve (fines) is believed to be the most important factor in hydraulic conductivity. In addition, a coarser compost mix provides more heterogeneity of the bioretention media, which is believed to be advantageous for more rapid development of soil structure needed to support health biological processes. This may be an advantage for plant establishment with lower nutrient and water input.

Mulch

- Planting area should generally be covered with 2 to 4 inches (average 3 inches) of mulch at the start and an additional placement of 1 to 2 inches of mulch should be added annually. *The intention is that to help sustain the nutrient levels, suppress weeds, retain moisture, and maintain infiltration capacity.*
- For nutrient-sensitive planting/storage media design, inorganic mulch such as gravel, may be used.

Planting/Storage Media Design for Nutrient Sensitive Receiving Waters

Where the BMP discharges to receiving waters with nutrient impairments or nutrient TMDLs, the planting media placed should be designed with the specific goal of minimizing the potential for initial and long term leaching of nutrients from the media.

- In general, the potential for leaching of nutrients can be minimized by:
  - Utilizing stable, aged compost (as required of media mixes under all conditions).
  - Utilizing other sources of organic matter, as appropriate, that are safe, non-toxic, and have lower potential for nutrient leaching than compost.
  - Reducing the content of compost or other organic material in the media mix to the minimum amount necessary to support vigorous plant growth and healthy biological processes.
- A landscape architect should be consulted to assist in the design of planting/storage media to balance the interests of plant establishment, water retention capacity (irrigation demand), and the potential for nutrient leaching. The following practices should be considered in developing the media mix design:
  - The actual nutrient content and organic content of the selected compost source should be considered when specifying the proportions of compost and sand. The compost specification allows a range of organic content over approximately a factor of 2 and nutrient content may vary more widely. Therefore determining the actual organic content and nutrient content of the compost expected to be supplied is important in determining the proportion to be used for amendment.
  - A commitment to periodic soil testing for nutrient content and a commitment to adaptive management of nutrient levels can help reduce the amount of organic amendment that must be provided initially. Generally, nutrients can be added planting areas through the addition of organic mulch, but cannot be removed.
  - Plant palettes and the associated planting mix should be designed with native plants where possible. Native plants generally have a broader tolerance for nutrient content, and can be longer lived in leaner/lower nutrient soils. An additional benefit of lower nutrient levels is that native plants will generally have less competition from weeds.

- Nutrients are better retained in soils with higher cation exchange capacity (CEC). CEC can be increased through selection of organic material with naturally high CEC, such as peat, and/or selection of inorganic material with high CEC such as some sands or engineered minerals (e.g., low P-index sands, zeolites, rhyolites, etc). Including higher CEC materials would tend to reduce the net leaching of nutrients.
- Soil structure can be more important than nutrient content in plant survival and biologic health of the system. If a good soil structure can be created with very low amounts of compost, plants survivability should still be provided. Soil structure is loosely defined as the ability of the soil to conduct and store water and nutrients as well as the degree of aeration of the soil. While soil structure generally develops with time, planting/storage media can be designed to promote earlier development of soil structure. Soil structure is enhanced by the use of amendments with high hummus content (as found in well-aged organic material). In addition, soil structure can be enhanced through the use of compost/organic material with a distribution of particle sizes (i.e., a more heterogeneous mix). Finally, inorganic amendments such as polymer beads may be useful for promoting aeration and moisture retention associated with a good soil structure. An example of engineered soil to promote soil structure can be found here:

  http://www.hort.cornell.edu/uhi/outreach/pdfs/custructuralsoilwebpdf.pdf
- Younger plants are generally more tolerant of lower nutrient levels and tend to help develop soil structure as they grow. Starting plants from smaller transplants can help reduce the need for organic amendments and improve soil structure. The project should be able to accept a plant mortality rate that is somewhat higher than starting from larger plants and providing high organic content.

- With these considerations, it is anticipated that less than 10 percent compost amendment could be used, while still balancing plant survivability and water retention.

We wish to express our gratitude to following individuals for their feedback on the design of planting/storage media for nutrient sensitive receiving waters in Southern California.

Deborah Deets, City of Los Angeles Bureau of Sanitation

Drew Ready, LA and San Gabriel Rivers Watershed Council

Rick Fisher, ASLA, City of Los Angeles Bureau of Engineering

Dr. Garn Wallace, Wallace Laboratories

Glen Dake, GDML

Jason Schmidt, Tree People

The guidance provided herein does not reflect the individual opinions of any individual listed above and should not be cited or otherwise attributed to those listed.

Selecting Plants for Planting/Storage Media

- Plant materials should be tolerant of summer drought, ponding fluctuations, and saturated soil conditions for 48 to 96 hours.
- It is recommended that a minimum of three types of tree, shrubs, and/or herbaceous groundcover species be incorporated to protect against facility failure due to disease and insect infestations of a single species.
- Native plant species and/or hardy cultivars that are not invasive and do not require chemical inputs should be used to the maximum extent feasible.