WQ XX-XXXX

City of Newport Beach
Priority Project
Preliminary Water Quality Management Plan (WQMP)

Project Name: **Uptown Newport**

PLANNING APPLICATION NO.:	**PA2011-134**
TRACT / LOT NUMBER(S):	**TRACT 7953 / LOTS 1 AND 2**
ASSESSORS PARCEL NUMBER(S):	**445-131-02 AND 445-131-03**
PROJECT SITE ADDRESS:	**4311-4321 JAMBOREE ROAD NEWPORT BEACH, CA 92660**

Prepared for:

Uptown Newport, L.P.
2 Park Plaza, Suite 700
Irvine, CA 92614
(949) 417-1396

REGISTERED PROFESSIONAL ENGINEER
GAVIN D. POWELL
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Prepared: **Dec. 2011**

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Project Owner's Certification			
Planning Application No. (If applicable)	PA2011-134	Grading Permit No.	NA
Tract/Parcel Map and Lot(s) No.	Tract No. 7953 Lots 1 and 2	Building Permit No.	NA
Address of Project Site and APN (If no address, specify Tract/Parcel Map and Lot Numbers)			4311 - 4321 Jamboree Road, Newport Beach, CA 92660 APN(s): 445-131-02 445-131-03

This Water Quality Management Plan (WQMP) has been prepared for Uptown Newport, L.P. by Hall & Foreman, Inc. (HFI). The WQMP is intended to comply with the requirements of the City of Newport Beach 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 , including the ongoing operation and maintenance of all best management practices (BMPs), 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: Uptown Newport, L.P.			
Title	Brian Rupp / Director - Asset Management		
Company	The Shopoff Group		
Address	2 Park Plaza, Suite 700, Irvine, CA 92614		
Email	brupp@shopoff.com		
Telephone #	(949) 417-1396		
I understand my responsibility to implement the provisions of this WQMP including the ongoing operation and maintenance of the best management practices (BMPs) described herein.			
Owner Signature		Date	

Preparer (Engineer): Hall & Foreman, Inc.			
Title	Gavin Powell, P.E., LEED AP / Project Manager	PE Registration #	C 67187
Company	Hall & Foreman, Inc.		
Address	17782 E. 17th Street, Tustin, CA 92780		
Email	gpowell@hfinc.com		
Telephone #	(714) 665-4500		
I hereby certify that this Water Quality Management Plan is in compliance with, and meets the requirements set forth in, Order No. R8-2009-0030/NPDES No. CAS618030, of the Santa Ana Regional Water Quality Control Board.			
Preparer Signature	Gavin Powell	Date	12/19/2011
Place Stamp Here	REGISTERED PROFESSIONAL ENGINEER GAVIN D. POWELL No. 67187 Exp. 09-30-13 CIVIL STATE OF CALIFORNIA		

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Section I Permit(s) and Water Quality Conditions of Approval or Issuance

Provide discretionary or grading/building permit information and water quality conditions of approval, or permit issuance, applied to the project. If conditions are unknown, please request applicable conditions from staff. *Refer to Section 2.1 in the Technical Guidance Document (TGD) available on the OC Planning website (ocplanning.net).*

Project Infomation			
Permit/Application No. (If applicable)	PA2011-134	Grading or Building Permit No. (If applicable)	NA
Address of Project Site (or Tract Map and Lot Number if no address) and APN	4311-4321 Jamboree Road, Newport Beach, CA 92660		
Water Quality Conditions of Approval or Issuance			
Water Quality Conditions of Approval or Issuance applied to this project. (Please list verbatim.)	Not Applicable for Preliminary / Concept WQMP		
Conceptual WQMP			
Was a Conceptual Water Quality Management Plan previously approved for this project?	No, the enclosed document represents the Conceptual / Preliminary WQMP		

Watershed-Based Plan Conditions	
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	**WIHMP:** Not Applicable **303(d) Listed Impairments for San Diego Creek and Newport Bay:** Selenium, Toxaphene, Fecal Coliform, Metals, Copper, Sediment Toxicity, Chlordane, DDT, PCB's (Polychlorinated Biphenyls) **TMDL's for San Diego Creek and Newport Bay:** Bacteria Indicators/Pathogens, Metals, Nutrients, Pesticides, Turbidity/Siltation

Section II Project Description

II.1 Project Description

Provide a detailed project description including:

- Project areas;
- Land uses;
- Land cover;
- Design elements;
- A general description not broken down by drainage management areas (DMAs).

Include attributes relevant to determining applicable source controls. *Refer to Section 2.2 in the Technical Guidance Document (TGD) for information that must be included in the project description.*

Description of Proposed Project				
Development Category (From Model WQMP, Table 7.11-2; or -3):	**Category 8:** Significant Redevelopment Project			
Project Area (ac): 25.05	Number of Dwelling Units: 1,244		SIC Code: 59 (Misc. Retail)	
Project Area	Pervious		Impervious	
	Area (acres)	Percentage	Area (acres)	Percentage
Pre-Project Conditions	3.19	13%	21.86	87%
Post-Project Conditions	5.56	22%	19.49	78%
Drainage Patterns/Connections	The project will maintain the existing drainage pattern of the site and generally flows from the southeasterly property boundary to the northwesterly property boundary. Three (3) separate connections will be made to the existing storm drain system(s) at the northwesterly property boundary. The southernmost connection will join the existing 48-inch RCP that currently serves the site. The remaining two (2) connections will replace three (3) existing 18-inch RCP storm drain lines that currently service the site. These 18-inch storm drain lines ultimately join an existing 66-inch RCP located within the adjacent property to the northwest (Koll Site). There are no offsite flows anticipated to be received by the project.			

Narrative Project Description: (Use as much space as necessary.)	The Uptown Newport Planned Community Development Plan (Project), hereinafter referred to as "Uptown Newport" is a planned residential community located on the north side of Jamboree Road, between MacArthur Boulevard and Birch Street, in the City of Newport Beach, California. The street address is 4311-3421 Jamboree Road. The project site is bounded by Jamboree Road to the southeast, a fast food restaurant to the northeast, and by existing office developments within the Koll Center to the northwest and southwest. The property measures approximately 25 acres and is intended to be developed into 1,244 high-density residential units and 11,500 square feet of retail space. The project will incorporate streets, landscaping, parks, and development areas that provide a pedestrian friendly environment, with strong connectivity to adjacent commercial/office areas. Approximately six (6) of the twenty-five (25) acres will be landscaped or have a pervious surface. Two (2) parks are planned that represent approximately 1.5 acres of the pervious area while the remaining 4.5 acres consists of landscaping around buildings, walkways, streets, and slope areas. Of the remaining nineteen (19) acres, approximately 3.5-acres will be dedicated to roadway or parking areas that allow for vehicular traffic. These areas are anticipated to be paved with asphalt. The balance of the site will consist of either building footprints, sidewalks, or other hardscape feature. Anticipated pollutants for the proposed land uses include suspended-solids/sediments, nutrients, heavy metals, pathogens (bacteria/virus), pesticides, oil and grease, toxic organic compounds, and trash and debris. The project intends to join existing storm drain infrastructure at the downstream (northwest) side of the project. The existing storm drain infrastructure to be joined includes a 48-inch RCP and a 66-inch RCP storm drain line. These existing lines will discharge into a series of existing detention ponds before ultimately joining a 54-inch RCP storm drain system in MacArthur Boulevard. From there, storm flows continue to San Diego Creek before reaching Newport Bay and the Pacific Ocean. **<u>Existing (Pre-Developed) Hydrologic Conditions</u>:** The site was originally developed as part of the Koll Center, and has been used for manufacturing telecommunications equipment and computer chips since the 1970's. The property currently includes a single-story office building, and a two (2) and three (3) story semiconductor chip manufacturing facility. The remainder of the property consists of a large parking lot, drive aisle(s), and isolated areas of landscaping. Soil classification is largely comprised of 'D' type soils, a small percentage of 'B' type soils is located at the northwest tip of the project site. The reader is instructed to refer to the 'NRCS Hydrologic Soils Groups' Map (Figure XVI-2a from the Orange County Technical Guidance Document, Exhibit 7.III) included

in the appendix of this report.

Topography shows the site naturally drains from the southeast to the northwest end of the site. The site should be considered relatively flat with a maximum elevation drop of roughly 10-feet over a distance of approximately 650-feet.

The site currently utilizes a series of underground storm drain lines in order to provide drainage for the site. There are four (4) separate storm drain lines that ultimately connect with larger storm drain systems located in the adjacent property located to the northwest (Koll Center) of the Project site. The northernmost area of the site, which is comprised largely of a parking lot, has three (3) separate storm drain lines. These storm drain lines extend beyond the property limits and join a 66-inch RCP located within the drive aisle/parking lot of the adjacent property (Koll Center). The fourth (4th) storm drain line is a larger system that collects the storm flows from the remainder of the site. This system is further south and is ultimately taken through a 48-inch RCP storm drain before discharging into the detention pond(s) previously mentioned.

Developed (Post-Developed) Hydrologic Conditions:

As was previously described, the Uptown Newport Project proposes 1,244 high-density residential units and 11,500 square feet of retail space. It will also incorporate streets, landscaping, park areas, and development areas. Due to the addition of community parks and other landscape areas, under the post-developed condition it is estimated that an increase of almost 3-acres of pervious surface will result from development of the project.

Because the percentage of impervious surface will be decreased, runoff volumes will be reduced from the pre-developed condition and there are no hydrologic conditions of concern (HCOC) anticipated as a result of developing the project.

Topography under the developed condition will continue to be relatively flat. Because of the nature of the project, and the boundary conditions of the site, a series of 'bird-bath' or sump areas are proposed. This strategy will allow for minimum grades to be achieved while maintaining a relatively uniform elevation for the buildings proposed for the site. This will allow for easy access to and from buildings while providing the necessary grades to drain the site. The sump areas will be drained by catch basins and joined through a network of below ground storm drain lines.

The storm drain system under the developed condition will closely mimic that of the existing condition. Tributary areas and flow rates will be maintained relatively close to what exists today. One (1) of the three (3) connections made to the existing 66-inch RCP within the drive aisle/parking lot of the adjacent property (Koll Center) will be eliminated. The remaining connections will remain and operate much as they do today.

II.2 Potential Stormwater Pollutants

Determine and list expected stormwater pollutants based on land uses and site activities. *Refer to Section 2.2.2 and Table 2.1 in the Technical Guidance Document (TGD) for guidance.*

Pollutants of Concern			
Pollutant	Check One for each: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E ☒	N ☐	Attached Residential, Retail, Parking, and Street project components
Nutrients	E ☒	N ☐	Attached Residential, Retail, Parking, and Street project components
Heavy Metals	E ☒	N ☐	Retail, Parking and Street project components
Pathogens (Bacteria/Virus)	E ☒	N ☐	Attached Residential, Retail, Parking, and Street project components
Pesticides	E ☒	N ☐	Attached Residential, Retail, Parking, and Street project components
Oil and Grease	E ☒	N ☐	Attached Residential, Retail, Parking, and Street project components
Toxic Organic Compounds	E ☒	N ☐	Retail, Parking and Street project components
Trash and Debris	E ☒	N ☐	Attached Residential, Retail, Parking, and Street project components

II.3 Hydrologic Conditions of Concern

Determine if streams located downstream from the project area are potentially susceptible to hydromodification impacts. *Refer to Section 2.2.3.1 in the Technical Guidance Document (TGD) for North Orange County or Section 2.2.3.2 for South Orange County.*

☐ No – Show map

☒ Yes – Describe applicable hydrologic conditions of concern below. *Refer to Section 2.2.3 in the Technical Guidance Document (TGD).*

While streams located downstream of the project site are potentially susceptible to hydromodification impacts, there are no 'Hydrologic Conditions of Concern' (HCOC). Because of the increased pervious surface resulting from development of the project, the runoff volume produced by the site is reduced from the existing condition. Approximately 3.15 ac-ft of runoff volume is produced by a 2-year, 24-hour storm event under the post-developed condition. The same frequency and duration storm produces approximately 3.6 ac-ft in the pre-developed condition. This represents just over a 15% decrease in runoff volume. A summary of runoff volumes is provided in the following table. Hydrology calculations for the 2-year, 24-hour storm event are included in the Appendix of this report. Hydrology maps can be found in the projects Preliminary Hydrology Report dated December, 2011.

It should be noted that the tributary drainage area of the site measures slightly less than the overall property area of 25.05 acres. The tributary drainage area of the site measures 24.78 acres. The difference is attributed to that portion of the property adjacent to Jamboree Road that is tributary to Jamboree Road. It should be further noted that development of the project will result in an increase of 0.76 acres of tributary drainage area to Jamboree Road. This increase is considered less than significant.

Uptown Newport
Runoff Volume Summary
(2-year, 24-hour storm event)

Drainage Area	Pre-Developed Condition Runoff Volume (ac-ft)	Post-Developed Condition Runoff Volume (ac-ft)
Area A	2.6746	2.4023
Area B	0.9706	0.7437
Total	**3.6452**	**3.1460**

II.4 Post Development Drainage Characteristics

Describe post development drainage characteristics. *Refer to Section 2.2.4 in the Technical Guidance Document (TGD).*

The proposed storm drain system will largely maintain the same drainage pattern(s) and connectivity that exists today. Currently there are four (4) existing storm drain lines that exit the project site. Three (3) of these locations are 18-inch storm drain lines located in the northernmost parking area. These 18-inch storm drain lines drain to the northwest and leave the site before joining an existing 66-inch RCP storm drain line located within the parking area of the adjacent property (Koll Site). In the proposed condition, one (1) of these 18-inch storm drain lines is proposed to be eliminated. The other two (2) are proposed to remain, with the connection to the existing system being made near the northwesterly property boundary.

The fourth (4th) connection will be made further south and will join the existing 48-inch RCP storm drain line that currently serves the site. Again, the connection will be made near the northwesterly property boundary.

Both the existing 48-inch and 66-inch storm drain systems that receive the project storm flows discharge into an existing drainage pond to the northwest of the project site, along Von Karmen Avenue. This pond appears to operate as a detention facility before again entering an existing 54-inch RCP within MacArthur Boulevard. These flows discharge to San Diego Creek before ultimately reaching Newport Bay and the Pacific Ocean.

Because of the flat nature of the proposed site, a number of 'bird bath' or sump areas will be created in order to maintain the grades necessary to promote drainage. These sump areas will collect the storm drainage and route it through an underground storm drain system before ultimately joining the existing storm drain(s) located downstream of the project site.

Roofdrains, drains from buildings, and landscape drains shall be directed to the adjacent streets and discharge through openings in the curb(s). If during final design it is determined that it is not possible to outlet through curb openings due to insufficient grade differential, then said drains shall utilize a roofdrain stormwater treatment system (Filterra or appoved equal) prior to making a connection to the main storm drain system.

II.5 Property Ownership/Management

Describe property ownership/management. *Refer to Section 2.2.5 in the Technical Guidance Document (TGD).*

The property will be privately owned and maintained. This includes all street and storm drain improvements as well as all applicable site design, source control, and treatment control BMP's. A 'Homeowners Association' will be formed that will manage and be responsible for the maintenance obligations of the site.

Section III Site Description

III.1 Physical Setting

Fill out table with relevant information. *Refer to Section 2.3.1 in the Technical Guidance Document (TGD).*

Name of Planned Community/Planning Area (if applicable)	Uptown Newport
Location/Address	4311-4321 Jamboree Road, Newport Beach, CA 92660
	APN(s): 445-131-02 and 445-131-03
General Plan Land Use Designation	MU-HZ (Mixed Use Horizontal)
Zoning	PC (Planned Community)
Acreage of Project Site	25.05-acres
Predominant Soil Type	'D'

III.2 Site Characteristics

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.2 in the Technical Guidance Document (TGD).*

Site Characteristics	
Precipitation Zone	Between 0.7-inches and 0.75-inches (24-hour, 85th percentile rainfall) from Figure XVI-1 (Rainfall Zones) from the Orange County Technical Guidance Document.
Topography	The project site is flat with the maximum grade differential measuring approximately 10-feet over a distance of approximately 650-feet. Under the proposed condition, multiple sump-areas (bird baths) are proposed in order to facilitate drainage. Flow direction is to the northwest.

Drainage Patterns/Connections	The project will maintain the existing drainage pattern of the site and generally flows from the southeasterly property boundary to the northwesterly property boundary. Three (3) separate connections will be made to the existing storm drain systems at the northwesterly property boundary. The southernmost connection will join the existing 48-inch RCP that currently serves the site. The remaining two (2) connections will replace three (3) existing 18-inch RCP storm drain lines that currently service the site. These 18-inch storm drain lines ultimately join an existing 66-inch RCP located within the adjacent property to the northwest (Koll Site). There are no offsite flows anticipated to be received by the project site.
Soil Type, Geology, and Infiltration Properties	The site primarily consists of 'D' classified soils, with the northwest tip of the project site consisting of 'B' classified soils. This determination is based on Soil Map 'B' from the Orange County Hydrology Manual. The geologic units present within the site can be generally characterized as stiff to very stiff silty to sandy clay fill soils overlaying native sands, silts, clays and gravels of marine terrace deposits. Potential for infiltration is dependent on where within the project site infiltration is targeted, and the related soil strata and groundwater elevations at those locations. Further information in regards to soil type, geology, and infiltration properties can be seen in the *Preliminary Geologic and Geotechnical Engineering Investigation for Uptown Newport*, prepared by Ginter & Associates and dated November, 2011.
Hydrogeologic (Groundwater) Conditions	Groundwater monitoring wells were installed on the site in September of 1984. Since that time, the groundwater monitoring network has continually expanded. In general, the unsaturated zone extends from the surface down to the shallow water table surface which is generally encountered at depths approximately 15-30 feet below existing ground. The unsaturated zone is very heterogeneous and there is poor lateral correlation of specific layers between monitoring wells. Historically, water levels have not appeared to fluctuate seasonally to any significant degree. Over the last year, depth to groundwater has ranged from approximately 20 to 30 feet below finished ground. Additional information in regards to groundwater conditions can be seen in the *2010 Annual Groundwater Report and SVE Operations Progress Report* prepared by Jacob & Hefner Associates, Inc, dated May 2010. Excerpts from this report are included in the Appendix of the enclosed WQMP.
Geotechnical Conditions (relevant to infiltration)	The site generally consists of marine terrace and bay deposits to the depths up to 100 feet below finished ground. These sediments can range from fine to medium grained sands with minor gravels, silty

	sands, sandy clays, and clays. These soils are crudely stratified with lenses and pods interspersed indicative of terrace and backbay environments. A distinctive olive-green to olive-gray clay to silty clay horizon is present throughout the site and is commonly found at a depth of approximately 30 feet below existing ground. This is depicted in Section A-A from the *Preliminary Geologic and Geotechnical Engineering Investigation for Uptown Newport*, prepared by Ginter & Associates and dated November, 2011. Section A-A from this report is included in the Appendix of the enclosed WQMP.
Off-Site Drainage	No offsite drainage is anticipated to be received by the site. No comingling is anticipated of on-site and off-site drainage.
Utility and Infrastructure Information	Existing utilities are not anticipated to constrain site design in regards to implementing BMP strategies.

III.3 Watershed Description

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.3 in the Technical Guidance Document (TGD).*

Receiving Waters	**San Diego Creek (Reach 1)** **Newport Bay (Upper)** **Newport Bay (Lower)** **Pacific Ocean**
303(d) Listed Impairments	**San Diego Creek (Reach 1)** - Selenium, Toxaphene, Fecal Coliform **Newport Bay (Upper)** - Metals, Copper, Sediment Toxicity, Chlordane, DDT, PCB's (Polychlorinated Biphenyls) **Newport Bay (Lower)** - Copper, Sediment Toxicity, Chlordane, DDT, PCB's
Applicable TMDLs	**San Diego Creek (Reach 1)** - Metals, Nutrients, Pesticides, Turbidity/Siltation **Newport Bay (Upper)** - Bacteria Indicators/Pathogens, Metals, Nutrients, Pesticides, Turbidity/Siltation **Newport Bay (Lower)** - Bacteria Indicators/Pathogens, Metals, Nutrients, Pesticides, Turbidity/Siltation

Pollutants of Concern for the Project	**Primary Pollutants of Concern:** Suspended-Solid / Sediment, Nutrients, Heavy Metals, Pathogens (Bacteria/Virus), Pesticides, and Toxic Organic Compounds **Other Pollutants of Concern:** Oil and Grease, Trash and Debris
Environmentally Sensitive and Special Biological Significant Areas	**San Diego Creek (Reach 1)** **Newport Bay (Upper)** **Newport Bay (Lower)**

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

Describe project performance criteria. Several steps must be followed in order to determine what performance criteria will apply to a project. These steps include:

- If the project has an approved WIHMP or equivalent, then any watershed specific criteria must be used and the project can evaluate participation in the approved regional or sub-regional opportunities. (Please ask your assigned planner or plan checker regarding whether your project is part of an approved WIHMP or equivalent.)
- Determine applicable hydromodification control performance criteria. *Refer to Section 7.II-2.4.2.2 of the Model WQMP.*
- Determine applicable LID performance criteria. *Refer to Section 7.II-2.4.3 of the Model WQMP.*
- Determine applicable treatment control BMP performance criteria. *Refer to Section 7.II-3.2.2 of the Model WQMP.*
- Calculate the LID design storm capture volume for the project. *Refer to Section 7.II-2.4.3 of the Model WQMP.*

(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	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	Hydrologic Conditions of Concern (HCOC) do not exist.
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	Goal is to infiltrate, harvest and use, evapotranspire, or biotreat/biofilter, the 85th percentile, 24-hour storm event (Design Capture Volume). Due to limitations/constraints caused by the project site plan, land-uses, soil type, and drainage patterns; infiltration of the entire design capture volume is not possible. Harvest and use, and evapotranspiration are also not practical due to the proposed land-use and building densities. Underground infiltration is proposed where drainage patterns and grades are conducive to this strategy, pending the infiltration capacity of the underlying soils. This area is represented by 'BMP Drainage Area HS1 and IB1' as shown in the following table and on the BMP Site Plan included in this report. 8.65-acres resulting in 18,015 cubic-feet of the design capture volume is tributary to the proposed underground infiltration basin. If it is later determined that infiltration capacity of the underlying soils is insufficient, or groundwater elevations are higher than anticipated, then the water entering the underground detention basin shall be treated by an engineered filter media for treatment prior to entering an underlying perforated pipe system that will carry the treated water back to the primary storm drain system. The latter concept would effectively create a large bioretention system. The remaining areas will utilize the biotreat/biofilter strategy for treating the remaining design capture volume. The proposed biotreat/biofilter strategy consists of using proprietary biotreatment devices such as the Filterra Bioretention System, or approved equal. Tributary drainage areas and resulting design capture volumes shall be held within the treatment capacities of each biotreatment device. Distribution and location of the biotreatment devices can be seen on the BMP Site Plan included in this report. A small portion of the site, shown as drainage areas LS1, LS2, LS3, LS4, and LS5, represent drainage areas within landscaped portions of the site that are either not tributary to the main storm drain system, or are within slope areas where there is not adequate space available to utilize the aforementioned strategies. These areas shall provide catch basin (inlet) filter inserts at any inlet in order to collect any trash, leaves, sediment, or other debris from these areas. The design capture volume for these areas totals just 816 cubic-feet.

	Treatment of the design capture volume will take place on-site. The total calculated design capture volume for the site is 46,747 cubic-feet.
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	To achieve 'medium' or 'high' treatment levels for all pollutants of concern expected on the site. Treatment control BMP's are only proposed in the form of a hydrodynamic separator unit (HS1) used for pre-treatment of runoff prior to entering the proposed underground infiltration basin. Catch basin (inlet) filter inserts are also proposed in the aforementioned landscape areas (LS1, LS2, LS3, LS4, and LS5) where inlets are located. These areas are either isolated from the main storm drain system, or lack adequate space to provide any of the aforementioned LID BMP strategies. The total design capture volume tributary to these landscape areas represents just 816 of the total 46,747 cubic-feet of storm water.
Calculate LID design storm capture volume for Project.	The design storm capture volume has been summarized in the following table. Each 'BMP Area Designation' is shown on the WQMP Site Plan included with this report.

Design Capture Storm Volume Calculations				
BMP Area Designation	**Area (acres)**	**'i' (% impervious)**	**'C'**	**V (cu-ft)**
F1	0.52	0.50	0.525	743
F2	0.97	0.71	0.683	1,802
F3	1.00	0.64	0.630	1,715
F4	1.11	0.83	0.773	2,334
F5	0.93	0.85	0.788	1,994
F6	0.43	0.94	0.855	1,001
F7	0.29	0.28	0.360	284
F8	0.12	0.71	0.683	223
F9	0.64	0.92	0.840	1,464
F10	0.55	0.96	0.870	1,303
F11	1.22	0.75	0.713	2,367
F12	0.84	0.92	0.840	1,921
F13	0.98	0.14	0.255	680
F14	0.45	0.90	0.825	1,011
F15	0.46	0.91	0.833	1,043
F16	0.74	0.94	0.855	1,723
F17	0.53	0.84	0.780	1,125
F18	2.35	0.88	0.810	5,182
HS1	8.65	0.82	0.765	18,015
IB1	8.65	0.82	0.765	18,015
LS1	0.29	0.00	0.150	118
LS2	0.18	0.00	0.150	74
LS3	0.36	0.00	0.150	147
LS4	0.41	0.00	0.150	167
LS5	0.76	0.00	0.150	310
Entire Site	**24.78**	**0.72**	**0.693**	**46,747**

IV.2. Site Design and Drainage

Describe site design and drainage including

- A narrative of site design practices utilized or rationale for not using practices;
- A narrative of how site is designed to allow BMPs to be incorporated to the MEP
- A table of DMA characteristics and list of LID BMPs proposed in each DMA.
- Reference to the WQMP "BMP Exhibit."
- Calculation of Design Capture Volume (DCV) for each drainage area.
- A listing of GIS coordinates for LID and Treatment Control BMPs.

Refer to Section 2.4.2 in the Technical Guidance Document (TGD).

As was previously described, the Uptown Newport Project proposes 1,244 high-density residential units and 11,500 square feet of retail space. It will also incorporate streets, landscaping, park areas, and development areas. The site design incorporates two (2) parks that contribute to increasing the amount of pervious surface on the site. Due to the addition of the parks and other landscape areas, it is estimated that an increase of almost 3-acres (or roughly 9%) of pervious surface will result from development of the project.

The proposed parks have a large enough footprint where they provide an opportunity to pursue infiltration of the design capture volume. However, due to the proximity and elevations of these parks in relation to the surrounding areas, as well as the proposed storm drain system, it is not practical to direct the design capture volume for the entire site into the park areas. With that in mind, opportunities to provide infiltration have been proposed to the maximum extent practical for the site. It should be noted that infiltration capacity of the site is limited due to the fact the area exhibits 'D' classification soils. 'D' soils are generally not conducive to infiltration.

Harvest and re-use, and evapotranspiration strategies are not practical for the site due to the high building density and land use proposed for the project.

The treatment strategy for the remaining drainage areas is proposed to be provided by the use of proprietary bioretention systems (Filterra or approved equal). These systems will be located just upstream of all catch basins proposed on the roadways of the site.

The reader shall refer to the 'WQMP Site Plan' included in this report for additional information regarding the site design and drainage concept.

Calculations for the design capture volume and other drainage area characteristics are provided in the table in the previous sub-section of this report (IV.1 - Project Performance Criteria).

Topography under the developed condition will continue to be relatively flat. Because of the nature of the project, and the boundary conditions of the site, a series of 'bird-bath' or sump areas are proposed. This strategy will allow for minimum grades to be achieved while maintaining a relatively uniform elevation for the buildings proposed for the site. This will allow for easy access to and from buildings while providing the necessary grades to drain the site. The sump areas will be drained by catch basins and joined through a network of below ground storm drain lines.

The storm drain system under the developed condition will closely mimic that of the existing condition. Tributary areas and flow rates will be maintained relatively close to what exists today. This will minimize hydrologic impacts to the downstream receiving waters.

As eluded to earlier, treatment of the design capture volume will utilize multiple BMP strategies. For the 'BMP Area HS1 and IB1', treatment of the design capture volume will occur after the drainage from this area has been collected in the main storm drain system serving this area. A low-flow bypass system will then direct the design capture volume from this area through a hydrodynamic separator for pre-treatment, prior to entering an underground infiltration basin. The location of the hydrodynamic separator and underground infiltration basin is indicated on the 'WQMP Site Plan' included with this report. If it is later determined that infiltration capacity of the underlying soils is insufficient, or groundwater elevations are higher than anticipated, then the water entering the underground detention basin shall be treated by an engineered filter media for treatment prior to entering an underlying perforated pipe system that will carry the treated water back to the primary storm drain system. The latter concept would effectively create a large bioretention system.

For the remaining drainage areas outside of the 'BMP Area HS1 and IB1' drainage area, the design capture volume will be treated by a manufactured bioretention system (Filterra or approved equal). These systems will be located just upstream of each catch basin proposed for the main storm drain system. Because the storm water in these areas will be treated prior to entering the main storm drain system, rooftop and other landscape drain systems in these areas shall discharge through curb openings so that the water can be directed to, and treated by the bioretention systems prior to entering the main storm drain system. Direct connection of rooftop or other landscape drain systems to the main storm drain system shall not be allowed for any area outside of 'BMP Area HS1 and IB1'. If direct connection from a roof drain, building drain, or other landscape area drain is unavoidable, then said drains shall be equipped with a manufactured roof drain stormwater treatment system (Filterra or approved equal) prior to connecting to the main storm drain system.

As is shown on the 'WQMP Site Plan', a tributary drainage area increase of roughly 0.76-acres (BMP Drainage Area LS5) will occur along Jamboree Road as a result of the proposed development. This area is primarily within a landscaped area with a pervious surface. Because of this reason, and because the acreage is relatively small, the water quality and hydrologic impacts from the increased drainage area should be considered less than significant. It is recommended that a small berm be provided within the landscape area at the property boundary to further encourage the drainage from this area to be retained on site where it can be slowly infiltrated through the underlying soils.

Similar to the property boundary along Jamboree Road, the northwesterly project boundary is also surrounded by a landscape area that is isolated from the main storm drain system. These areas total 1.24-acres (BMP Drainage Areas LS1, LS2, LS3, and LS4). There is minimal opportunity for treatment of these areas due to the location of these areas in relation to the main storm drain. These areas will also be in areas where slopes are anticipated and will likely be bounded by retaining walls. Available space will be limited for implementing more effective BMP strategies. Because these areas display a largely pervious surface, and the relatively small size of these areas, water quality and hydrologic impacts from these areas shall be considered less than significant. Inlets located within these areas shall be equipped with catch basin (inlet) filter inserts (Kristar Flogard+Plus or approved equal) to remove trash , leaves, sediment, or other debris prior to entering the main storm drain system.

IV.3 LID BMP Selection and Project Conformance Analysis

Each sub-section below documents that the proposed design features conform to the applicable project performance criteria via check boxes, tables, calculations, narratives, and/or references to worksheets. *Refer to Section 2.4.2.3 in the Technical Guidance Document (TGD) for selecting LID BMPs and Section 2.4.3 in the Technical Guidance Document (TGD) for conducting conformance analysis with project performance criteria.*

IV.3.1 Hydrologic Source Controls (HSCs)

If required HSCs are included, fill out applicable check box forms. If the retention criteria are otherwise met with other LID BMPs, include a statement indicating HSCs 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:	☐

Because a reduction in the impervious area will be experienced as a result of developing the project, Hydrologic Conditions of Concern (HCOC) do not exist. Hydrologic Source Controls (HSCs) are not required. Treatment of the 'Design Capture Volume' is being met by the use of other LID BMP's.

IV.3.2 Infiltration BMPs

Identify infiltration BMPs to be used in project. If design volume cannot be met, state why.

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:	☐

Show calculations below to demonstrate if the LID Design Storm Capture Volume can be met with infiltration BMPs. If not, document how much can be met with infiltration and document why it is not feasible to meet the full volume with infiltration BMPs.

Most infiltration strategies were not considered due to the limitations of the surface area available for those infiltration strategies. These strategies include bioretention without underdrains, rain gardens, infiltration planters, retention swales, infiltration trenches, permeable asphalt, permeable concrete, and permeable concrete pavers. The area required to implement these strategies exceeds the space available on the site. Treatment using these strategies would not achieve the required performance criteria and their use would be inefficient.

The fact that the site sits in a region of predominantly 'D' classified soils also precludes the use of most infiltration strategies.

Because of the footprint provided by the park, there is adequate space available to house an underground infiltration basin. This strategy is considered viable despite unfavorable 'D' soil conditions. However, due to the projects phasing, utilizing the second park area (Park Area 2 from the BMP Site Plan) for a second underground infiltration basin was not considered practical.

Infiltration of the full 'Design Capture Volume' for the site is not feasible due to the constraints of the site. Infiltration of the design capture volumes has been recommended to the maximum extent practical based on the current site design, project phasing, and drainage path configurations. 'BMP Drainage Area HS1 and IB1' produces a design capture volume of 18,015 cubic feet (see table in sub-section 1V.1 - Project Performance Criteria). This represents the total design capture volume to be treated by use of Infiltration BMP's.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, describe any evapotranspiration and/or rainwater harvesting BMPs included.

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:	☐

Show calculations below to demonstrate if the LID Design Storm Capture Volume can be met with evapotranspiration and/or rainwater harvesting BMPs in combination with infiltration BMPs. If not, document below 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 these BMP categories.

Evapotranspiration and/or rainwater harvesting of the full 'Design Capture Volume' for the site is not feasible, nor is it practical due to the constraints of the site. The site design and high building densities to not provide for the surface area required to facilitate evapotranspiration effectively. Rainwater harvesting is also not practical due to the rainfall patterns in the area and the lack of a viable application for stormwater re-use. Evapotranspiration, Rainwater Harvesting BMP's contribute no treatment capacity of the Design Capture Volume. The total Design Capture Volume treated by Infiltration, Evapotrasnpiration, and Rainwater Harvesting BMP's is 18,015 cubic-feet.

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 included. 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 Storm 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 these BMP categories.

Because of the high building densities and limited space available, the use of compact proprietary vegetated biotreatment strategies is considered the ideal strategy to treat the remaining design capture volume. The required design capture volume for each biotreatment device can be seen in the table provided in sub-section IV.1 - Project Performance Criteria. BMP drainage areas are as shown on the BMP Site Plan included with this report. The total Design Capture Volume treated by Infiltration, Evapotrasnpiration, Rainwater Harvesting, and Biotreatment BMP's is 45,931 cubic-feet.

It should be noted that the remaining 816 cubic-feet of the Design Capture Volume for the entire site is located in the aforementioned landscape areas (LS1, LS2, LS3, LS4, and LS5). Because of the relative small size of these areas, and because they are largely pervious, these areas are considered to contribute pollutants at a less than significant level.

IV.3.5 Hydromodification Control BMPs

Describe hydromodification control BMPs. *See Section 5 of the Technical Guidance Document (TGD).* Include sections for selection, suitability, sizing, and infeasibility, as applicable. Detail compliance with Prior Conditions of Approval (if applicable).

There are no Hydrologic Condition of Concern (HCOC) on this project. Hydromodification Control BMP's are not proposed.

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 BMP's are not proposed for the majority of the site. However, pre-treatment shall be provided for the design capture volume tributary to the proposed underground infiltration basin. Similarly, in the small landscape areas (LS1, LS2, LS3, LS4, and LS5) where other BMP strategies are not viable then catch basin (inlet) filter inserts shall be provided.

A third possibility is presented only if during final design reveals that roof drains, building drains, or other landscape drains do not have the grade differential required to outlet through curb openings in the adjacent roadway(s). Under this scenario, manufactured roof drain stormwater systems (Filterra or approved equal) shall be provided prior to connecting to the main storm drain system.

Treatment Control BMPs	
BMP Name	**BMP Description**
Hydrodynamic Separator Device	Used for pre-treatment of the design capture volume tributary to the proposed underground infiltration basin. Unit shall be Contech CDS or approved equal.
Catch Basin Insert	To be used only when alternative BMP strategy is not possible. Anticipated locations are within the landscaped/slope areas of drainage areas LS1, LS2, LS3, LS4, and LS5 from the BMP Site Plan included with this report.
Propietary Roof Drain Stormwater Treatment Device (if applicable)	To be used only if final design reveals that roof drains, building drains, or other landscape drains do not have the grade differential required to outlet through curb openings in the adjacent roadway(s). Under this scenario, manufactured roof drain stormwater systems (Filterra or approved equal) shall be provided prior to connecting to the main storm drain system.

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	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	
N6	Local Industrial Permit Compliance	☐	☒	Not applicable for proposed land use.
N7	Spill Contingency Plan	☐	☒	Not applicable for proposed land use.
N8	Underground Storage Tank Compliance	☐	☒	Not applicable for proposed land use.
N9	Hazardous Materials Disclosure Compliance	☒	☐	
N10	Uniform Fire Code Implementation	☒	☐	
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☐	☒	Not applicable for proposed land use.
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	Not applicable for proposed land use.

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	☐	☒	Not applicable.
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	☒	☐	
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☒	☐	
S6	Dock areas	☐	☒	Not applicable.
S7	Maintenance bays	☐	☒	Not applicable.
S8	Vehicle wash areas	☐	☒	Not applicable.
S9	Outdoor processing areas	☐	☒	Not applicable.
S10	Equipment wash areas	☐	☒	Not applicable.
S11	Fueling areas	☐	☒	Not applicable.
S12	Hillside landscaping	☐	☒	Not applicable.
S13	Wash water control for food preparation areas	☒	☐	
S14	Community car wash racks	☐	☒	Not applicable.

IV.4 Alternative Compliance Plan (If Applicable)

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.*

Not 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 Technical Guidance Document (TGD) for calculation methods for applying water quality credits.*

Description of Proposed Project				
Project Types that Qualify for Water Quality Credits (Select all that apply):				
☐ Redevelopment projects that reduce the overall impervious footprint of the project site.	☐ 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.		☐ 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).	
☐ 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).		☐ 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		☐ 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).
☐ Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.	☐ Developments in a city center area.	☐ Developments in historic districts or historic preservation areas.	☐ 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.	☐ In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.

Calculation of Water Quality Credits (if applicable)	Not applicable.

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 Model WQMP.*

Not applicable.

Section V Inspection/Maintenance Responsibility for BMPs

Fill out information in table below. Prepare and attach an Operation and Maintenance Plan. Identify the funding mechanism through which BMPs will be maintained. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies. *Refer to Section 7.II 4.0 in the Model WQMP.*

BMP Inspection/Maintenance			
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Minimum Frequency of Activities**
Underground Infiltration Basin (Contech CMP Infiltration System or approved equal)	Home Owners Association	Per manufacturer recommendations	Per manufacturer recommendations.
Proprietary Biotreatment (Filterra or approved equal)	Home Owners Association	Per manufacturer recommendations.	Per manufacturer recommendations
Pre-Treatment Hydrodynamic Separator Device (Contech CDS or approved equal)	Home Owners Association	Per manufacturer recommendations.	Per manufacturer recommendations.
Catch Basin (Inlet) Filter Device (Kristar Flogard+Plus or approved equal)	Home Owners Association	Per manufacturer recommendations.	Per manufacturer recommendations.

Proprietary Roof Drain Stormwater Treatment System (Filterra or approved equal)	Home Owners Association	Per manufacturer recommendations.	Per manufacturer recommendations.

Section VI BMP Exhibit (Site Plan)

VI.1 BMP Exhibit (Site Plan)

Include a BMP Exhibit (Site Plan), at a size no less than 24" by 36," which includes the following minimum information:

- Insert in the title block (lower right hand corner) of BMP Exhibit: the WQMP Number (assigned by staff) and the grading/building or Planning Application permit numbers
- Project location (address, tract/lot number(s), etc.)
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural BMP locations
- Drainage delineations and flow information
- Delineate the area being treated by each structural BMP
- GIS coordinates for LID and Treatment Control BMPs
- Drainage connections
- BMP details
- Preparer name and stamp

Please do not include any areas outside of the project area or any information not related to drainage or water quality. The approved BMP Exhibit (Site Plan) shall be submitted as a plan sheet on all grading and building plan sets submitted for plan check review and approval. The BMP Exhibit shall be at the same size as the rest of the plan sheets in the submittal and shall have an approval stamp and signature prior to plan check submittal.

See Appendix A for WQMP Site Plan / BMP Exhibit.

VI.2 Submittal and Recordation of Water Quality Management Plan

Following approval of the Final Project-Specific WQMP, three copies of the approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) shall be submitted. In addition, these documents shall be submitted in a PDF format.

Each approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) shall be recorded in the Orange County Clerk-Recorder's Office, prior to close-out of grading and/or building permit. Educational Materials are not required to be included.

Section VII Educational Materials

Refer to the Orange County Stormwater Program (ocwatersheds.com) for a library of materials available. Please only attach the educational materials specifically applicable to this project. Other materials specific to the project may be included as well and must be attached.

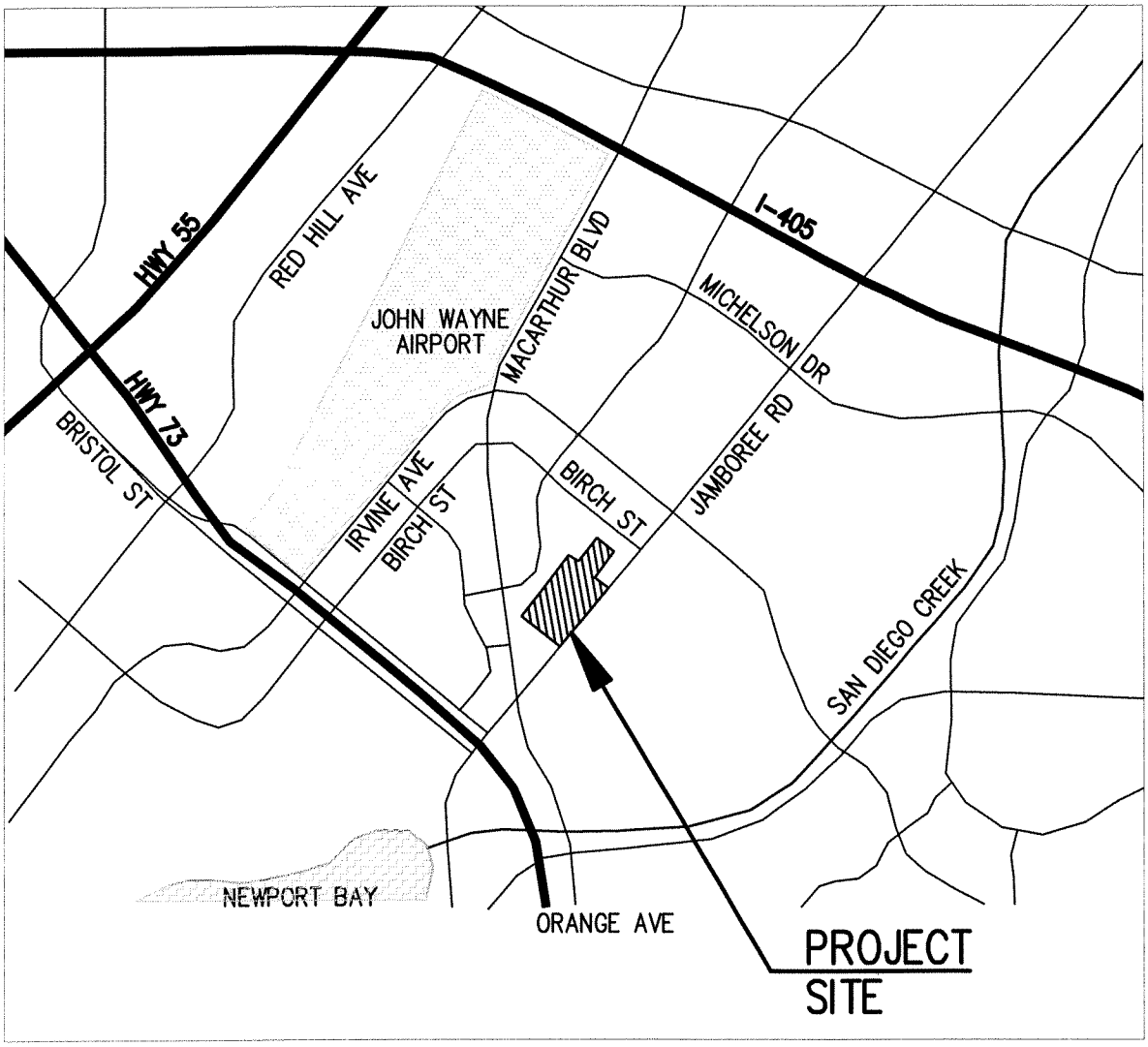
See Appendix E for Educational Materials.

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)	☒	Orange County Watersheds Brochure	☒
Recycle at Your Local Used Oil Collection Center (Central County)	☐	Stormwater General Information (reference City of Newport Beach)	☒
Recycle at Your Local Used Oil Collection Center (South County)	☐	How to Protect our Bay and Ocean (reference City of Newport Beach)	☒
Tips for Maintaining a Septic Tank System	☐	Pollution Reporting (reference City of Newport Beach)	☒
Responsible Pest Control	☒	Hazardous Waste and Oil Recycling (reference City of Newport Beach)	☒
Sewer Spill	☒	Commercial Trash Enclosure (reference San Bernardino County)	☒
Tips for the Home Improvement Projects	☒	Food and Restaurant Pollution Prevention (reference San Bernardino County)	☒
Tips for Horse Care	☐	Managing Fats, Oils, and Greases (reference San Bernardino County)	☒
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	☒		☐

Appendix A - Maps, Figures, and Exhibits

- **Vicinity Map**
- **Figure XVI-1: Orange County Rainfall Zones Map**
- **Figure XVI-2a: NRCS Hydrologic Soils Groups Map**
- **Figure XVI-3d: Susceptibility Analysis Newport Bay-Newport Coastal Streams**
- **WQMP Site Plan / BMP Exhibit**



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N.T.S.

UPTOWN NEWPORT PROJECT
VICINITY MAP

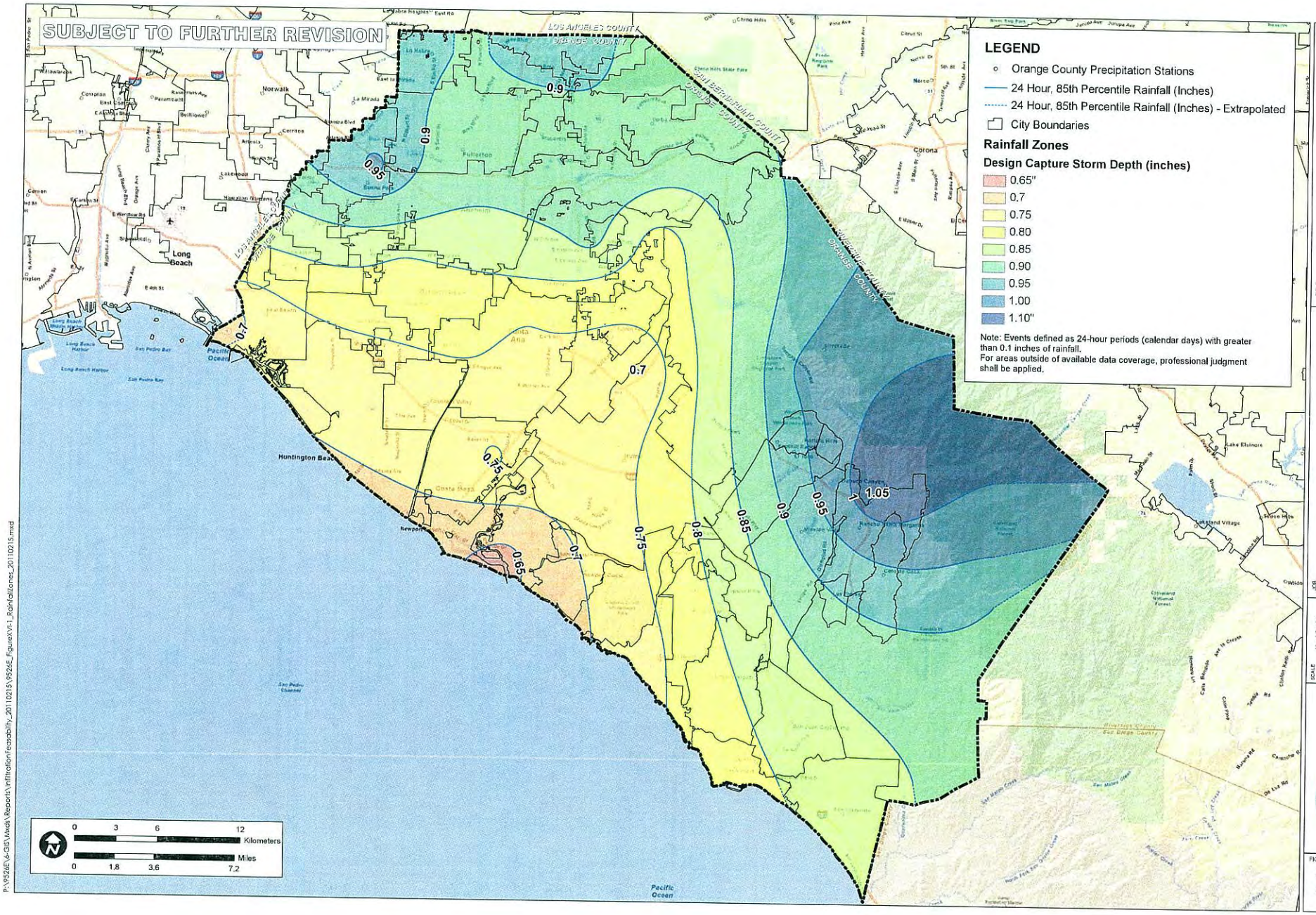
Hall & Foreman, Inc.

Engineering · Planning · Surveying

17782 17TH STREET, SUITE 200 · TUSTIN, CA 92780-1947 · 714-665-4500

Job Number:	II.100288.1000
Date:	NOV. 22, 2011
Scale:	N.T.S.
Sheet 1 of	1 Sheets

Drawing Name: S:\100288\Eng\100288-000\Hm\Hydrology Report\Appendix A - Vicinity Map\Vicinity Map.dwg
Last Opened: Nov 23, 2011 - 9:30am by: GPowell



TITLE
RAINFALL ZONES

JOB
ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT
ORANGE CO. CA

SCALE 1" = 1.8 miles
DESIGNED TH
DRAWING TH
CHECKED BMP
DATE 04/22/10
JOB NO. 9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-1

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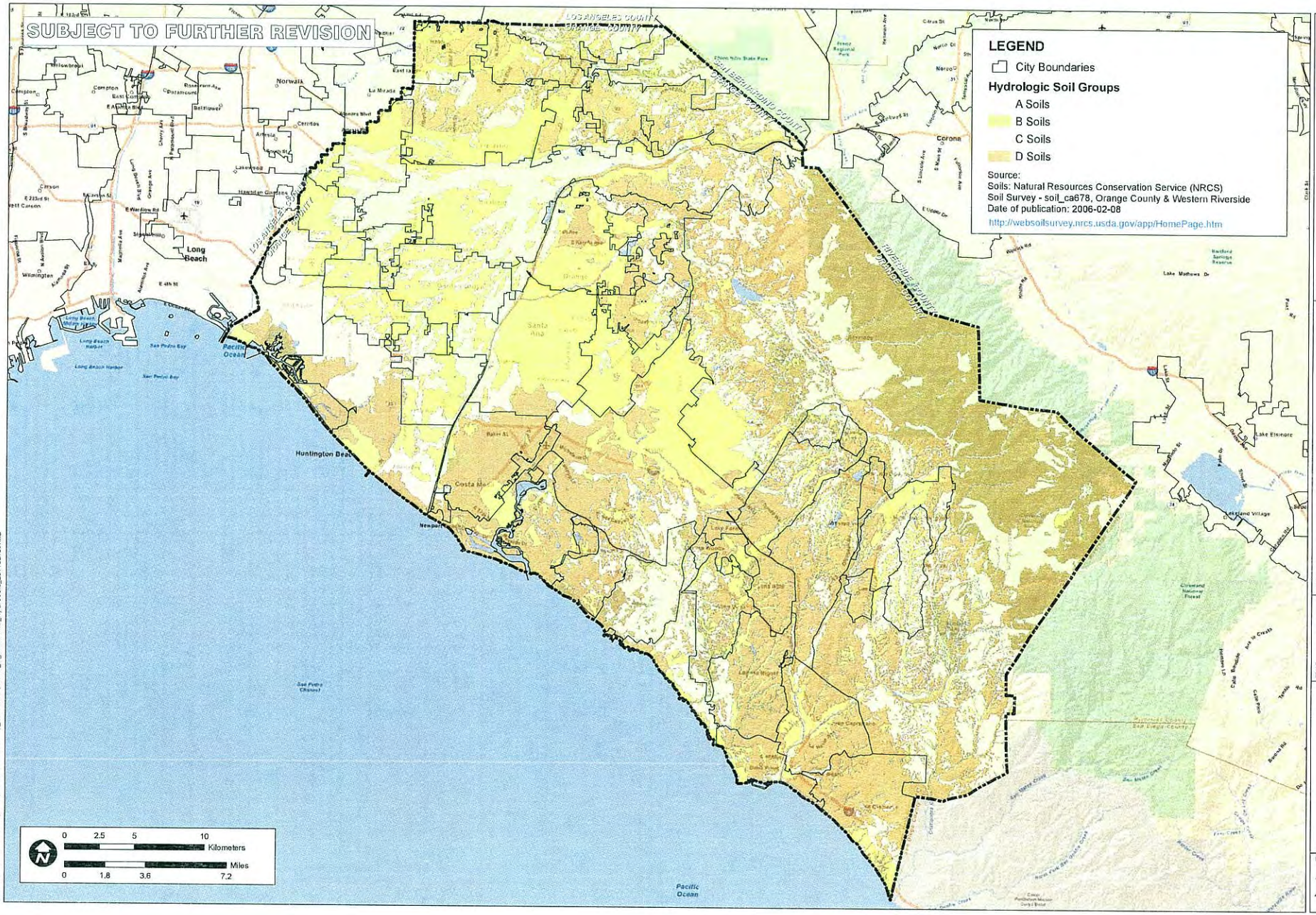

TITLE
NRCS HYDROLOGIC SOILS GROUPS

JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2a

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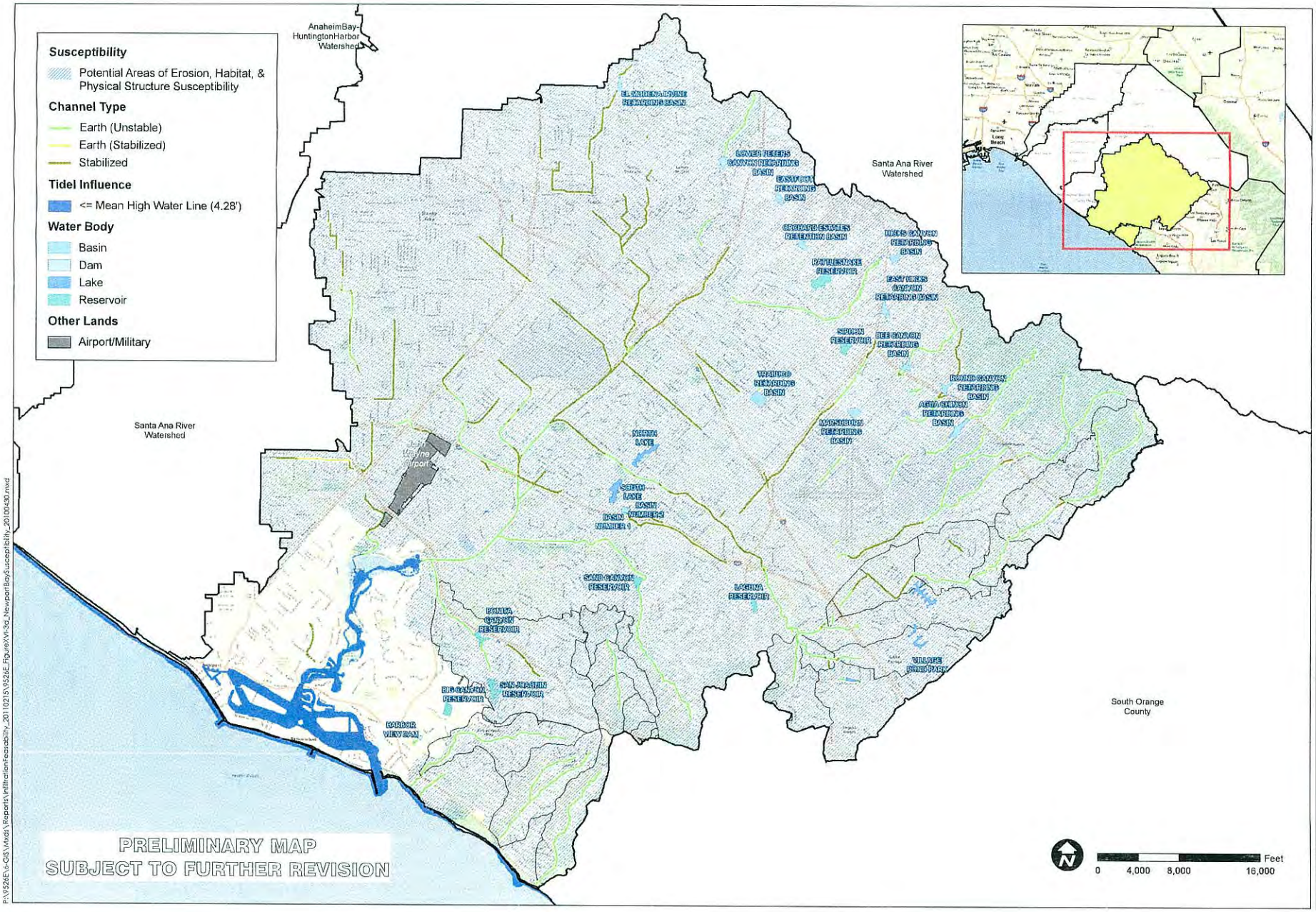

TITLE
SUSCEPTIBILITY ANALYIS
NEWPORT BAY-
NEWPORT COASTAL STREAMS

JOB
ORANGE COUNTY
WATERSHED
MASTER PLANNING
ORANGE CO. CA

SCALE	1" = 4000'
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/20/10
JOB NO	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-3d

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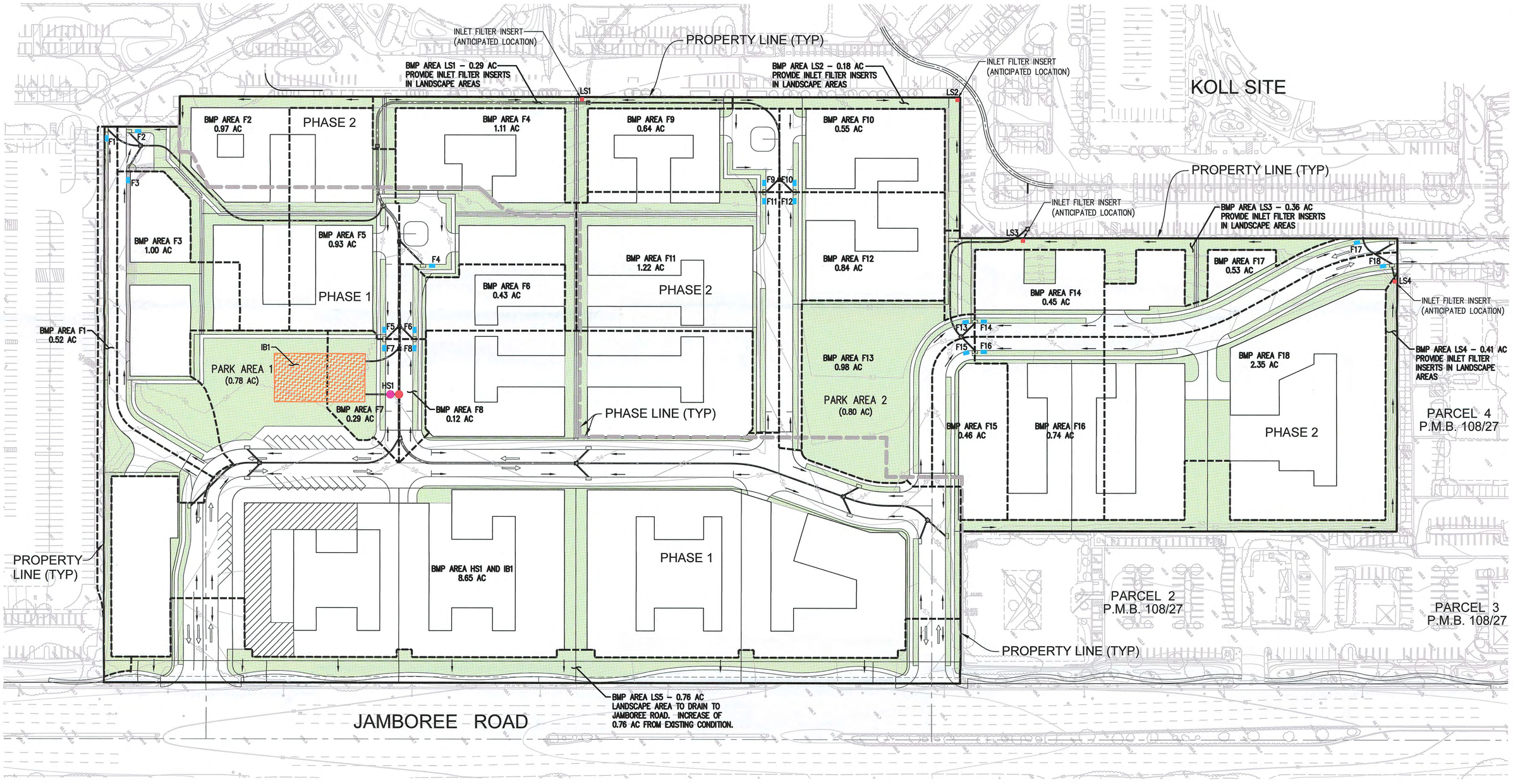


LEGEND:

BMP AREA F8 0.12 AC	BMP TRIBUTARY DRAINAGE AREA
F5	BMP DESIGNATION
●	LOW–FLOW BYPASS STRUCTURE
●	BMP – HYDRODYNAMIC SEPARATOR
▬	BMP – BIORETENTION SYSTEM (FILTERRA)
■	BMP – INLET FILTER INSERT (FLOGARD+PLUS)
	BMP – UNDERGROUND INFILTRATION BASIN
	LAND USE – LANDSCAPE AREA DESIGNATION
	LAND USE – IMPERVIOUS AREA (BUILDING OR PAVEMENT)
- - - - - -	BMP TRIBUTARY DRAINAGE AREA BOUNDARY
→	SURFACE FLOW DIRECTION
	CONSTRUCTION PHASE BOUNDARY LINE

60 0 60 120
scale 1"= 60' feet

TRACT NO. 7953, LOTS 1 AND 2

SITE ADDRESS:
4311–4321 JAMBOREE ROAD
NEWPORT BEACH, CA 92660

APN:
445–131–02
445–131–03

WQMP NO.: XX-XXXX
PLANNING APPLICATION NO.: PA2011-134

DIGALERT
DIAL BEFORE YOU DIG
TWO WORKING DAYS BEFORE YOU DIG
TOLL FREE 1–800–227–2600
A PUBLIC SERVICE BY UNDERGROUND SERVICE ALERT

NO.	DESCRIPTION	DATE	BY

REVISONS

REGISTERED PROFESSIONAL ENGINEER GAVIN D. POWELL NO. C67187 EXP. 09–30–12 CIVIL STATE OF CALIFORNIA

Hall & Foreman, Inc.
Engineering · Planning · Surveying
17782 17TH ST, SUITE 200 · TUSTIN, CA 92780–1947 · 714–665–4500
PREPARED UNDER THE SUPERVISION OF:
GAVIN D. POWELL R.C.E. 67187 DATE:

CITY OF NEWPORT BEACH
UPTOWN NEWPORT
PRELIMINARY WQMP
SITE PLAN / BMP EXHIBIT

DRAWN BY: GP
DESIGNED BY: GP
CHECKED BY: JH
APPROVED BY:
CITY ENGINEER DATE

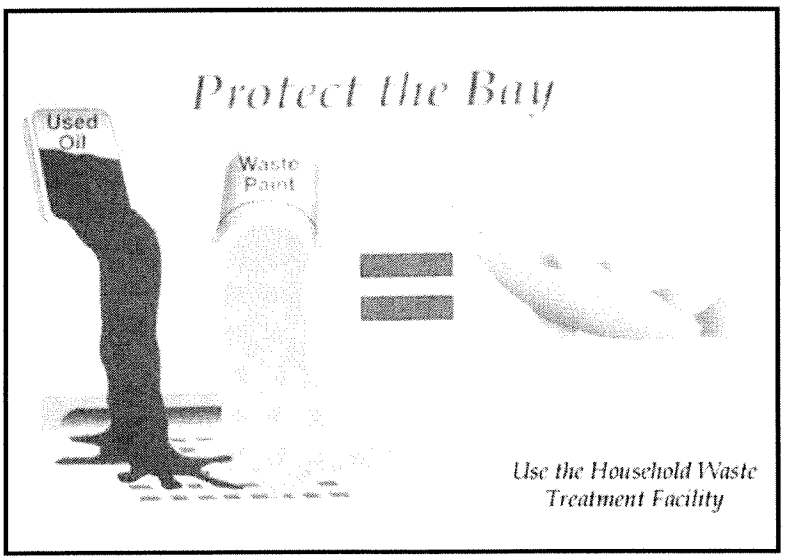
SCALE: 1"=60'
DATE: 11/30/2011
SHT NO.: 01 OF 01

Drawing Name: S:\10028B\Admin\Record\WQMP\Preliminary WQMP\01_100288ex01.dwg

Appendix B - BMP Fact Sheets

- **SC-10** Non-Stormwater Discharges
- **SC-11** Spill Prevention, Control & Cleanup
- **SC-34** Waste Handling & Disposal
- **SC-41** Building & Ground Maintenance
- **SC-42** Building Repair and Construction
- **SC-43** Parking/Storage Area Maintenance
- **SC-44** Drain System Maintenance
- **SC-60** Housekeeping Practices
- **SC-70** Road and Street Maintenance
- **SC-71** Plaza and Sidewalk Cleaning
- **SC-73** Landscape Maintenance
- **SC-74** Drainage System Maintenance
- **SC-75** Waste Handling and Disposal
- **SD-10** Site Design & Landscape Planning
- **SD-11** Roof Runoff Controls
- **SD-12** Efficient Irrigation
- **SD-13** Storm Drain Signage
- **SD-32** Trash Storage Areas
- **TC-11** Infiltration Basin
- **TC-32** Bioretention
- **MP-51** Vortex Separator
- **MP-52** Drain Inserts

Non-Stormwater Discharges SC-10



Objectives

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

Targeted Constituents

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

Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, air conditioner condensate, etc. However there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants into storm drains. They can generally be detected through a combination of detection and elimination. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges of pollutants on streets and into the storm drain system and creeks.

Approach

Initially the industry must make an assessment of non-stormwater discharges to determine which types must be eliminated or addressed through BMPs. The focus of the following approach is in the elimination of non-stormwater discharges.

CASQA
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Pollution Prevention

- Ensure that used oil, used antifreeze, and hazardous chemical recycling programs are being implemented. Encourage litter control.

Suggested Protocols

Recommended Complaint Investigation Equipment

- Field Screening Analysis
  - pH paper or meter
  - Commercial stormwater pollutant screening kit that can detect for reactive phosphorus, nitrate nitrogen, ammonium nitrogen, specific conductance, and turbidity
  - Sample jars
  - Sample collection pole
  - A tool to remove access hole covers
- Laboratory Analysis
  - Sample cooler
  - Ice
  - Sample jars and labels
  - Chain of custody forms
- Documentation
  - Camera
  - Notebook
  - Pens
  - Notice of Violation forms
  - Educational materials

General

- Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially those that are not classified as hazardous. These are often not responded to as effectively as they need to be.
- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled or demarcated next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.

- See SC44 Stormwater Drainage System Maintenance for additional information.

Illicit Connections

- Locate discharges from the industrial storm drainage system to the municipal storm drain system through review of "as-built" piping schematics.
- Isolate problem areas and plug illicit discharge points.
- Locate and evaluate all discharges to the industrial storm drain system.

Visual Inspection and Inventory

- Inventory and inspect each discharge point during dry weather.
- Keep in mind that drainage from a storm event can continue for a day or two following the end of a storm and groundwater may infiltrate the underground stormwater collection system. Also, non-stormwater discharges are often intermittent and may require periodic inspections.

Review Infield Piping

- A review of the "as-built" piping schematic is a way to determine if there are any connections to the stormwater collection system.
- Inspect the path of floor drains in older buildings.

Smoke Testing

- Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two systems.
- During dry weather the stormwater collection system is filled with smoke and then traced to sources. The appearance of smoke at the base of a toilet indicates that there may be a connection between the sanitary and the stormwater system.

Dye Testing

- A dye test can be performed by simply releasing a dye into either your sanitary or process wastewater system and examining the discharge points from the stormwater collection system for discoloration.

TV Inspection of Drainage System

- TV Cameras can be employed to visually identify illicit connections to the industrial storm drainage system.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- 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.

- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- 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.

Once a site has been cleaned:

- Post "No Dumping" signs with a phone number for reporting dumping and disposal.
- Landscaping and beautification efforts of hot spots may also discourage future dumping, as well as provide open space and increase property values.
- Lighting or barriers may also be needed to discourage future dumping.
- See fact sheet SC11 Spill Prevention, Control, and Cleanup.

Inspection

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Conduct field investigations of the industrial storm drain system for potential sources of non-stormwater discharges.
- Pro-actively conduct investigations of high priority areas. Based on historical data, prioritize specific geographic areas and/or incident type for pro-active investigations.

Reporting

- A database is useful for defining and tracking the magnitude and location of the problem.
- Report prohibited non-stormwater discharges observed during the course of normal daily activities so they can be investigated, contained, and cleaned up or eliminated.
- Document that non-stormwater discharges have been eliminated by recording tests performed, methods used, dates of testing, and any on-site drainage points observed.
- Document and report annually the results of the program.
- Maintain documentation of illicit connection and illegal dumping incidents, including significant conditionally exempt discharges that are not properly managed.

Training

- Training of technical staff in identifying and documenting illegal dumping incidents is required.
- Consider posting the quick reference table near storm drains to reinforce training.
- Train employees to identify non-stormwater discharges and report discharges to the appropriate departments.

- 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.
- Determine and implement appropriate outreach efforts to reduce non-permissible non-stormwater discharges.
- Conduct spill response drills annually (if no events occurred to evaluate your plan) in cooperation with other industries.
- When a responsible party is identified, educate the party on the impacts of his or her actions.

Spill Response and Prevention

- See SC11 Spill Prevention Control and Cleanup.

Other Considerations

- Many facilities do not have accurate, up-to-date schematic drawings.

Requirements

Costs (including capital and operation & maintenance)

- The primary cost is for staff time and depends on how aggressively a program is implemented.
- Cost for containment and disposal is borne by the discharger.
- Illicit connections can be difficult to locate especially if there is groundwater infiltration.
- Indoor floor drains may require re-plumbing if cross-connections to storm drains are detected.

Maintenance (including administrative and staffing)

- Illegal dumping and illicit connection violations requires technical staff to detect and investigate them.

Supplemental Information

Further Detail of the BMP

Illegal Dumping

- Substances illegally dumped on streets and into the storm drain systems and creeks include paints, used oil and other automotive fluids, construction debris, chemicals, fresh concrete, leaves, grass clippings, and pet wastes. All of these wastes cause stormwater and receiving water quality problems as well as clog the storm drain system itself.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots

- 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

One of the keys to success of reducing or eliminating illegal dumping is increasing the number of people at the facility who are aware of the problem and who have the tools to at least identify the incident, if not correct it. Therefore, train field staff to recognize and report the incidents.

What constitutes a "non-stormwater" discharge?

- Non-stormwater discharges to the stormwater collection system may include any water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

Permit Requirements

- Facilities subject to stormwater permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The State's General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility's SWPPP.

Performance Evaluation

- Review annually internal investigation results; assess whether goals were met and what changes or improvements are necessary.
- Obtain feedback from personnel assigned to respond to, or inspect for, illicit connections and illegal dumping incidents.

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/

Spill Prevention, Control & Cleanup SC-11

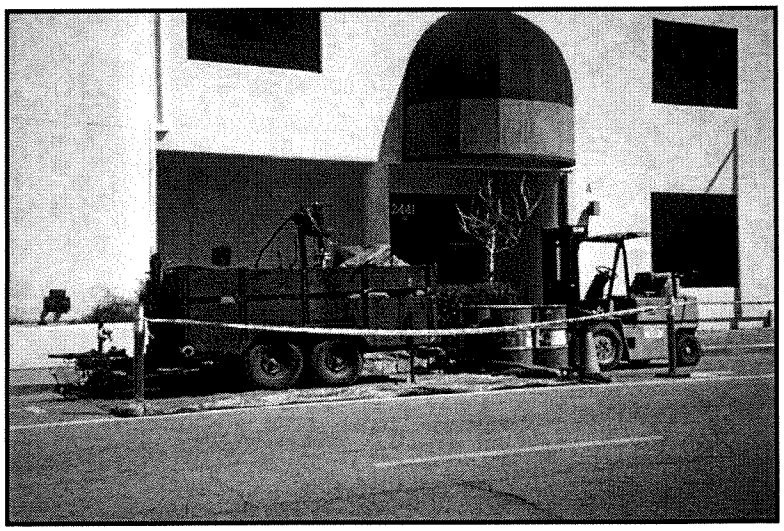

Photo Credit: Geoff Brosseau

Objectives

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

Targeted Constituents

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

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.

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:

- 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.

CASQA California Stormwater Quality Association

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, polyphosphates 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

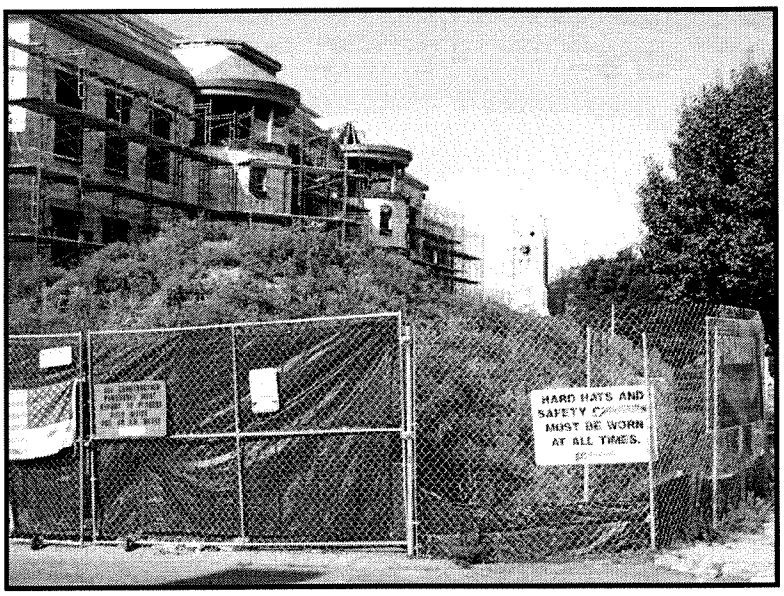
Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

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

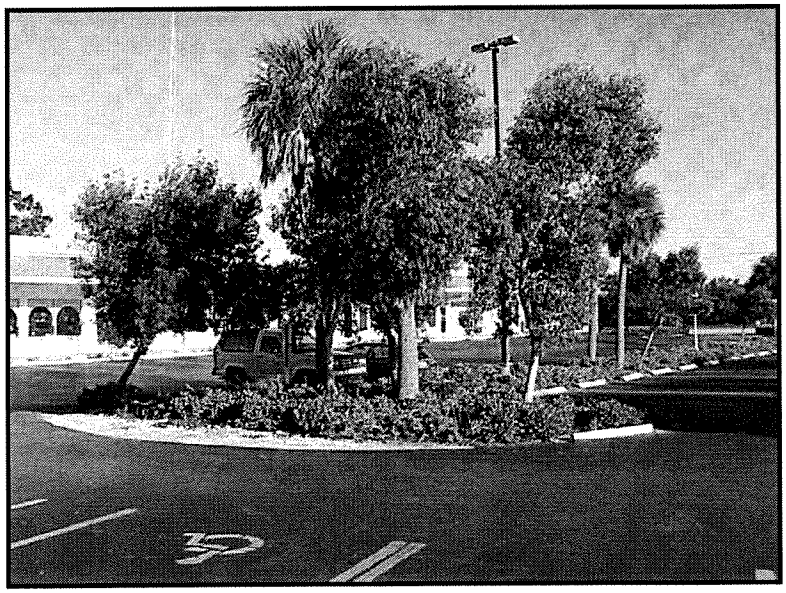
Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

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/

Parking/Storage Area Maintenance SC-43



Objectives

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

Targeted Constituents

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

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)
- Keep accurate maintenance logs to evaluate BMP implementation.

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SC-43 Parking/Storage Area Maintenance

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
  - Block the storm drain or contain runoff.
  - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
  - Clean oily spots with absorbent materials.
  - Use a screen or filter fabric over inlet, then wash surfaces.

- Do not allow discharges to the storm drain.
- Vacuum/pump discharges to a tank or discharge to sanitary sewer.
- Appropriately dispose of spilled materials and absorbents.

Surface Repair

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

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 or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

SC-43 Parking/Storage Area Maintenance

Requirements

Costs

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

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

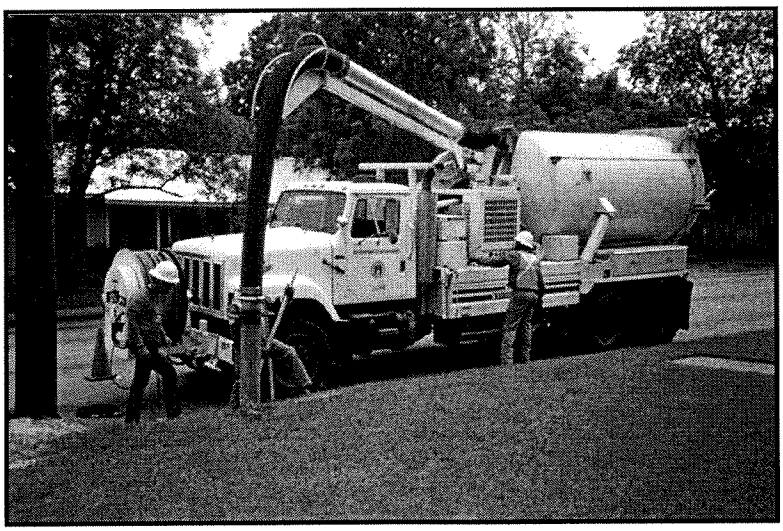
Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

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

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

Drainage System Maintenance SC-44



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Targeted Constituents

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

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - 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
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).
- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:
  - Purchase and installation of signs.
  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.
  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.
  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

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

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

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

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

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

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

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Housekeeping Practices SC-60

Description

Promote efficient and safe housekeeping practices (storage, use, and cleanup) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals. Related information is provided in BMP fact sheets SC-11 Spill Prevention, Control & Cleanup and SC-34 Waste Handling & Disposal.

Approach

Pollution Prevention

- Purchase only the amount of material that will be needed for foreseeable use. In most cases this will result in cost savings in both purchasing and disposal. See SC-61 Safer Alternative Products for additional information.
- Be aware of new products that may do the same job with less environmental risk and for less or the equivalent cost. Total cost must be used here; this includes purchase price, transportation costs, storage costs, use related costs, clean up costs and disposal costs.

Suggested Protocols

General

- Keep work sites clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Dispose of wash water, sweepings, and sediments, properly.
- Recycle or dispose of fluids properly.
- Establish a daily checklist of office, yard and plant areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy any problems found.
- Post waste disposal charts in appropriate locations detailing for each waste its hazardous nature (poison, corrosive, flammable), prohibitions on its disposal (dumpster, drain, sewer) and the recommended disposal method (recycle, sewer, burn, storage, landfill).
- Summarize the chosen BMPs applicable to your operation and post them in appropriate conspicuous places.

Objectives

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

Targeted Constituents

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

- Require a signed checklist from every user of any hazardous material detailing amount taken, amount used, amount returned and disposal of spent material.
- Do a before audit of your site to establish baseline conditions and regular subsequent audits to note any changes and whether conditions are improving or deteriorating.
- Keep records of water, air and solid waste quantities and quality tests and their disposition.
- Maintain a mass balance of incoming, outgoing and on hand materials so you know when there are unknown losses that need to be tracked down and accounted for.
- Use and reward employee suggestions related to BMPs, hazards, pollution reduction, work place safety, cost reduction, alternative materials and procedures, recycling and disposal.
- Have, and review regularly, a contingency plan for spills, leaks, weather extremes etc. Make sure all employees know about it and what their role is so that it comes into force automatically.

Training

- Train all employees, management, office, yard, manufacturing, field and clerical in BMPs and pollution prevention and make them accountable.
- Train municipal employees who handle potentially harmful materials in good housekeeping practices.
- Train personnel who use pesticides in the proper use of the pesticides. The California Department of Pesticide Regulation license pesticide dealers, certify pesticide applicators and conduct onsite inspections.
- Train employees and contractors in proper techniques for spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and Countermeasure (SPCC) plant up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- There are no major limitations to this best management practice.
- There are no regulatory requirements to this BMP. Existing regulations already require municipalities to properly store, use, and dispose of hazardous materials

Requirements

Costs

- Minimal cost associated with this BMP. Implementation of good housekeeping practices may result in cost savings as these procedures may reduce the need for more costly BMPs.

Maintenance

- Ongoing maintenance required to keep a clean site. Level of effort is a function of site size and type of activities.

Supplemental Information

Further Detail of the BMP

- The California Integrated Waste Management Board's Recycling Hotline, 1-800-553-2962, provides information on household hazardous waste collection programs and facilities.

Examples

There are a number of communities with effective programs. The most pro-active include Santa Clara County and the City of Palo Alto, the City and County of San Francisco, and the Municipality of Metropolitan Seattle (Metro).

References and Resources

British Columbia Lake Stewardship Society. Best Management Practices to Protect Water Quality from Non-Point Source Pollution. March 2000.
http://www.nalms.org/bclss/bmphome.html#bmp

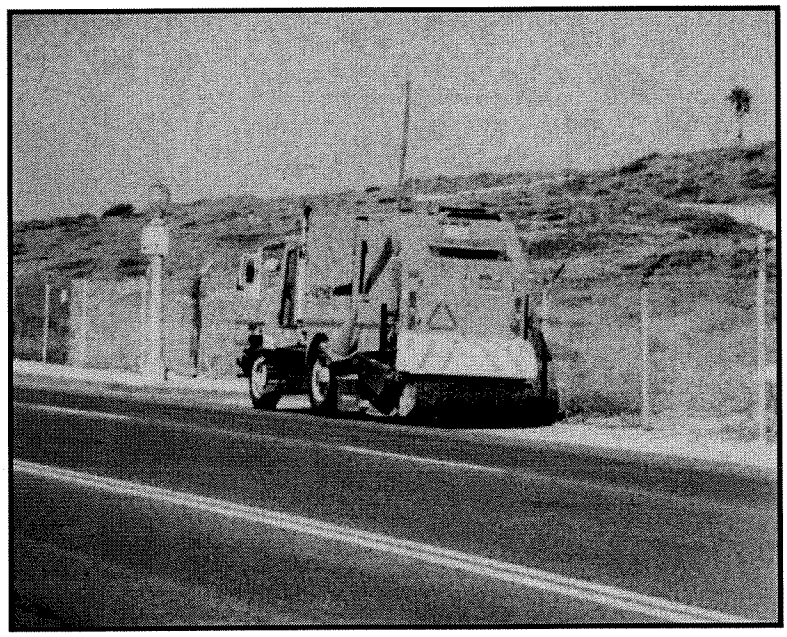
King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities, Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July, 1998, Revised by California Coastal Commission, February 2002.

Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Mateo STOPPP - (http://stoppp.tripod.com/bmp.html)

Road and Street Maintenance SC-70



Objectives

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

Targeted Constituents

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

Description

Streets, roads, and highways are significant sources of pollutants in stormwater discharges, and operation and maintenance (O&M) practices, if not conducted properly, can contribute to the problem. Stormwater pollution from roadway and bridge maintenance should be addressed on a site-specific basis. Use of the procedures outlined below, that address street sweeping and repair, bridge and structure maintenance, and unpaved roads will reduce pollutants in stormwater.

Approach

Pollution Prevention

- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal)
- Recycle paint and other materials whenever possible.
- Enlist the help of citizens to keep yard waste, used oil, and other wastes out of the gutter.

Suggested Protocols

Street Sweeping and Cleaning

- Maintain a consistent sweeping schedule. Provide minimum monthly sweeping of curbed streets.
- Perform street cleaning during dry weather if possible.

- Avoid wet cleaning or flushing of street, and utilize dry methods where possible.
- Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc. For example:
  - Increase the sweeping frequency for streets with high pollutant loadings, especially in high traffic and industrial areas.
  - Increase the sweeping frequency just before the wet season to remove sediments accumulated during the summer.
  - Increase the sweeping frequency for streets in special problem areas such as special events, high litter or erosion zones.
- Maintain cleaning equipment in good working condition and purchase replacement equipment as needed. Old sweepers should be replaced with new technologically advanced sweepers (preferably regenerative air sweepers) that maximize pollutant removal.
- Operate sweepers at manufacturer requested optimal speed levels to increase effectiveness.
- To increase sweeping effectiveness consider the following:
  - Institute a parking policy to restrict parking in problematic areas during periods of street sweeping.
  - Post permanent street sweeping signs in problematic areas; use temporary signs if installation of permanent signs is not possible.
  - Develop and distribute flyers notifying residents of street sweeping schedules.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- If available use vacuum or regenerative air sweepers in the high sediment and trash areas (typically industrial/commercial).
- Keep accurate logs of the number of curb-miles swept and the amount of waste collected.
- Dispose of street sweeping debris and dirt at a landfill.
- Do not store swept material along the side of the street or near a storm drain inlet.
- Keep debris storage to a minimum during the wet season or make sure debris piles are contained (e.g. by berming the area) or covered (e.g. with tarps or permanent covers).

Street Repair and Maintenance

Pavement marking

- Schedule pavement marking activities for dry weather.

- Develop paint handling procedures for proper use, storage, and disposal of paints.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.
- Provide drop cloths and drip pans in paint mixing areas.
- Properly maintain application equipment.
- Street sweep thermoplastic grindings. Yellow thermoplastic grindings may require special handling as they may contain lead.
- Paints containing lead or tributyltin are considered a hazardous waste and must be disposed of properly.
- Use water based paints whenever possible. If using water based paints, clean the application equipment in a sink that is connected to the sanitary sewer.
- Properly store leftover paints if they are to be kept for the next job, or dispose of properly.

Concrete installation and repair

- Schedule asphalt and concrete activities for dry weather.
- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place san bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- When making saw cuts in pavement, use as little water as possible and perform during dry weather. Cover each storm drain inlet completely with filter fabric or plastic during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site. Alternatively, a small onsite vacuum may be used to pick up the slurry as this will prohibit slurry from reaching storm drain inlets.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

Patching, resurfacing, and surface sealing

- Schedule patching, resurfacing and surface sealing for dry weather.
- Stockpile materials away from streets, gutter areas, storm drain inlets or watercourses. During wet weather, cover stockpiles with plastic tarps or berm around them if necessary to prevent transport of materials in runoff.
- Pre-heat, transfer or load hot bituminous material away from drainage systems or watercourses.
- Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and maintenance holes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from covered maintenance holes and storm drain inlets when the job is complete.
- Prevent excess material from exposed aggregate concrete or similar treatments from entering streets or storm drain inlets. Designate an area for clean up and proper disposal of excess materials.
- Use only as much water as necessary for dust control, to avoid runoff.
- Sweep, never hose down streets to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Equipment cleaning maintenance and storage

- Inspect equipment daily and repair any leaks. Place drip pans or absorbent materials under heavy equipment when not in use.
- Perform major equipment repairs at the corporation yard, when practical.
- If refueling or repairing vehicles and equipment must be done onsite, use a location away from storm drain inlets and watercourses.
- Clean equipment including sprayers, sprayer paint supply lines, patch and paving equipment, and mud jacking equipment at the end of each day. Clean in a sink or other area (e.g. vehicle wash area) that is connected to the sanitary sewer.

Bridge and Structure Maintenance

Paint and Paint Removal

- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- Do not transfer or load paint near storm drain inlets or watercourses.

- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint container.
- Plug nearby storm drain inlets prior to starting painting where there is significant risk of a spill reaching storm drains. Remove plugs when job is completed.
- If sand blasting is used to remove paint, cover nearby storm drain inlets prior to starting work.
- Perform work on a maintenance traveler or platform, or use suspended netting or tarps to capture paint, rust, paint removing agents, or other materials, to prevent discharge of materials to surface waters if the bridge crosses a watercourse. If sanding, use a sander with a vacuum filter bag.
- Capture all clean-up water, and dispose of properly.
- Recycle paint when possible (e.g. paint may be used for graffiti removal activities). Dispose of unused paint at an appropriate household hazardous waste facility.

Graffiti Removal

- Schedule graffiti removal activities for dry weather.
- Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.
- When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal above.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a landscaped or dirt area. If such an area is not available, filter runoff through an appropriate filtering device (e.g. filter fabric) to keep sand, particles, and debris out of storm drains.
- If a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound), plug nearby storm drains and vacuum/pump wash water to the sanitary sewer.
- Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).

Repair Work

- Prevent concrete, steel, wood, metal parts, tools, or other work materials from entering storm drains or watercourses.
- Thoroughly clean up the job site when the repair work is completed.
- When cleaning guardrails or fences follow the appropriate surface cleaning methods (depending on the type of surface) outlined in SC-71 Plaza & Sidewalk Cleaning fact sheet.

- If painting is conducted, follow the painting and paint removal procedures above.
- If graffiti removal is conducted, follow the graffiti removal procedures above.
- If construction takes place, see the Construction Activity BMP Handbook.
- Recycle materials whenever possible.

Unpaved Roads and Trails

- Stabilize exposed soil areas to prevent soil from eroding during rain events. This is particularly important on steep slopes.
- For roadside areas with exposed soils, the most cost-effective choice is to vegetate the area, preferably with a mulch or binder that will hold the soils in place while the vegetation is establishing. Native vegetation should be used if possible.
- If vegetation cannot be established immediately, apply temporary erosion control mats/blankets; a comma straw, or gravel as appropriate.
- If sediment is already eroded and mobilized in roadside areas, temporary controls should be installed. These may include: sediment control fences, fabric-covered triangular dikes, gravel-filled burlap bags, biobags, or hay bales staked in place.

Non-Stormwater Discharges

Field crews should be aware of non-stormwater discharges as part of their ongoing street maintenance efforts.

- Refer to SC-10 Non-Stormwater Discharges
- Identify location, time and estimated quantity of discharges.
- Notify appropriate personnel.

Training

- Train employees regarding proper street sweeping operation and street repair and maintenance.
- Instruct employees and subcontractors to ensure that measures to reduce the stormwater impacts of roadway/bridge maintenance are being followed.
- Require engineering staff and/or consulting A/E firms to address stormwater quality in new bridge designs or existing bridge retrofits.
- Use a training log or similar method to document training.
- Train employees on proper spill containment and clean up, and in identifying non-stormwater discharges.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Densely populated areas or heavily used streets may require parking regulations to clear streets for cleaning.
- No currently available conventional sweeper is effective at removing oil and grease. Mechanical sweepers are not effective at removing finer sediments.
- Limitations may arise in the location of new bridges. The availability and cost of land and other economic and political factors may dictate where the placement of a new bridge will occur. Better design of the bridge to control runoff is required if it is being placed near sensitive waters.

Requirements

Costs

- The maintenance of local roads and bridges is already a consideration of most community public works or transportation departments. Therefore, the cost of pollutant reducing management practices will involve the training and equipment required to implement these new practices.
- The largest expenditures for street sweeping programs are in staffing and equipment. The capital cost for a conventional street sweeper is between $60,000 and $120,000. Newer technologies might have prices approaching $180,000. The average useful life of a conventional sweeper is about four years, and programs must budget for equipment replacement. Sweeping frequencies will determine equipment life, so programs that sweep more often should expect to have a higher cost of replacement.
- A street sweeping program may require the following.
  - Sweeper operators, maintenance, supervisory, and administrative personnel are required.
  - Traffic control officers may be required to enforce parking restrictions.
  - Skillful design of cleaning routes is required for program to be productive.
  - Arrangements must be made for disposal of collected wastes.

- If investing in newer technologies, training for operators must be included in operation and maintenance budgets. Costs for public education are small, and mostly deal with the need to obey parking restrictions and litter control. Parking tickets are an effective reminder to obey parking rules, as well as being a source of revenue.

Maintenance

- Not applicable

Supplemental Information

Further Detail of the BMP

Street sweeping

There are advantages and disadvantages to the two common types of sweepers. The best choice depends on your specific conditions. Many communities find it useful to have a compliment of both types in their fleet.

Mechanical Broom Sweepers - More effective at picking up large debris and cleaning wet streets. Less costly to purchase and operate. Create more airborne dust.

Vacuum Sweepers - More effective at removing fine particles and associated heavy metals. Ineffective at cleaning wet streets. Noisier than mechanical broom sweepers which may restrict areas or times of operation. May require an advance vehicle to remove large debris.

Street Flushers - Not affected by biggest interference to cleaning, parked cars. May remove finer sediments, moving them toward the gutter and stormwater inlets. For this reason, flushing fell out of favor and is now used primarily after sweeping. Flushing may be effective for combined sewer systems. Presently street flushing is not allowed under most NPDES permits.

Cross-Media Transfer of Pollutants

The California Air Resources Board (ARB) has established state ambient air quality standards including a standard for respirable particulate matter (less than or equal to 10 microns in diameter, symbolized as PM10). In the effort to sweep up finer sediments to remove attached heavy metals, municipalities should be aware that fine dust, that cannot be captured by the sweeping equipment and becomes airborne, could lead to issues of worker and public safety.

Bridges

Bridges that carry vehicular traffic generate some of the more direct discharges of runoff to surface waters. Bridge scupper drains cause a direct discharge of stormwater into receiving waters and have been shown to carry relatively high concentrations of pollutants. Bridge maintenance also generates wastes that may be either directly deposited to the water below or carried to the receiving water by stormwater. The following steps will help reduce the stormwater impacts of bridge maintenance:

- Site new bridges so that significant adverse impacts to wetlands, sensitive areas, critical habitat, and riparian vegetation are minimized.

- Design new bridges to avoid the use of scupper drains and route runoff to land for treatment control. Existing scupper drains should be cleaned on a regular basis to avoid sediment/debris accumulation.
- Reduce the discharge of pollutants to surface waters during maintenance by using suspended traps, vacuums, or booms in the water to capture paint, rust, and paint removing agents. Many of these wastes may be hazardous. Properly dispose of this waste by referring to CA21 (Hazardous Waste Management) in the Construction Handbook.
- Train employees and subcontractors to reduce the discharge of wastes during bridge maintenance.

De-icing

- Do not over-apply deicing salt and sand, and routinely calibrate spreaders.
- Near reservoirs, restrict the application of deicing salt and redirect any runoff away from reservoirs.
- Consider using alternative deicing agents (less toxic, biodegradable, etc.).

References and Resources

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 2001. Fresh Concrete and Mortar Application Best Management Practices for the Construction Industry. June.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 2001. Roadwork and Paving Best Management Practices for the Construction Industry. June.

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Roadway and Bridge Maintenance. On-line
http://www.epa.gov/npdes/menuofbmps/poll_13.htm

Plaza and Sidewalk Cleaning SC-71

Objectives

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

Targeted Constituents

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

Description

Pollutants on sidewalks and other pedestrian traffic areas and plazas are typically due to littering and vehicle use. This fact sheet describes good housekeeping practices that can be incorporated into the municipality's existing cleaning and maintenance program.

Approach

Pollution Prevention

- Use dry cleaning methods whenever practical for surface cleaning activities.
- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal).

Suggested Protocols

Surface Cleaning

- Regularly broom (dry) sweep sidewalk, plaza and parking lot areas to minimize cleaning with water.
- Dry cleanup first (sweep, collect, and dispose of debris and trash) when cleaning sidewalks or plazas, then wash with or without soap.
- Block the storm drain or contain runoff when cleaning with water. Discharge wash water to landscaping or collect water and pump to a tank or discharge to sanitary sewer if allowed. (Permission may be required from local sanitation district.)

- Block the storm drain or contain runoff when washing parking areas, driveways or drive-throughs. Use absorbents to pick up oil; then dry sweep. Clean with or without soap. Collect water and pump to a tank or discharge to sanitary sewer if allowed. Street Repair and Maintenance.

Graffiti Removal

- Avoid graffiti abatement activities during rain events.
- Implement the procedures under Painting and Paint Removal in SC-70 Roads, Streets, and Highway Operation and Maintenance fact sheet when graffiti is removed by painting over.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a dirt or landscaped area after treating with an appropriate filtering device.
- Plug nearby storm drain inlets and vacuum/pump wash water to the sanitary sewer if authorized to do so if a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound). Ensure that a non-hazardous cleaning compound is used or dispose as hazardous waste, as appropriate.

Surface Removal and Repair

- Schedule surface removal activities for dry weather if possible.
- Avoid creating excess dust when breaking asphalt or concrete.
- Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up as much material as possible.
- Designate an area for clean up and proper disposal of excess materials.
- Remove and recycle as much of the broken pavement as possible to avoid contact with rainfall and stormwater runoff.
- When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet completely with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site.
- Always dry sweep first to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Wash water should be directed to landscaping or collected and pumped to the sanitary sewer if allowed.

Concrete Installation and Repair

- Schedule asphalt and concrete activities for dry weather.

- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place san bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- Protect applications of fresh concrete from rainfall and runoff until the material has dried.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow.
- Clean parking lots on a regular basis with a street sweeper.

Training

- Provide regular training to field employees and/or contractors regarding surface cleaning and proper operation of equipment.
- Train employee and contractors in proper techniques for spill containment and cleanup.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Limitations related to sweeping activities at large parking facilities may include current sweeper technology to remove oil and grease.
- Surface cleaning activities that require discharges to the local sewering agency will require coordination with the agency.
- Arrangements for disposal of the swept material collected must be made, as well as accurate tracking of the areas swept and the frequency of sweeping.

Requirements

Costs

- The largest expenditures for sweeping and cleaning of sidewalks, plazas, and parking lots are in staffing and equipment. Sweeping of these areas should be incorporated into street sweeping programs to reduce costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Community education, such as informing residents about their options for recycling and waste disposal, as well as the consequences of littering, can instill a sense of citizen responsibility and potentially reduce the amount of maintenance required by the municipality.

Additional BMPs that should be considered for parking lot areas include:

- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Structural BMPs such as storm drain inlet filters can be very effective in reducing the amount of pollutants discharged from parking facilities during periods of rain.

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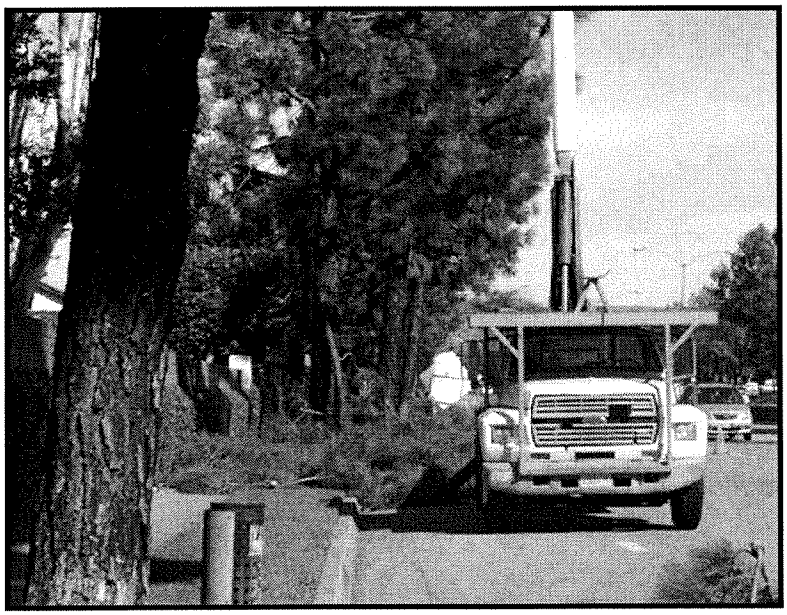
Landscape Maintenance SC-73



Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

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

Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.
- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).
- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- 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 pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

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.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a know in location
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

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Drainage System Maintenance SC-74

Photo Credit: Geoff Brosseau

Objectives

- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

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

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff that may contain certain pollutants. Maintaining catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis will remove pollutants, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Approach

Suggested Protocols

Catch Basins/Inlet Structures

- Municipal staff should regularly inspect facilities to ensure the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC-75 Waste Handling and Disposal).
- Clean catch basins, storm drain inlets, and other conveyance structures in high pollutant load areas just before the wet season to remove sediments and debris accumulated during the summer.

- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Record the amount of waste collected.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream.
- Except for small communities with relatively few catch basins that may be cleaned manually, most municipalities will require mechanical cleaners such as eductors, vacuums, or bucket loaders.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect flushed effluent and pump to the sanitary sewer for treatment.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge from cleaning a storm drain pump station or other facility to reach the storm drain system.
- Conduct quarterly routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.
- Sample collected sediments to determine if landfill disposal is possible, or illegal discharges in the watershed are occurring.

Open Channel

- Consider modification of storm channel characteristics to improve channel hydraulics, to increase pollutant removals, and to enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies

(SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS

Illicit Connections and Discharges

- During routine maintenance of conveyance system and drainage structures field staff should look for evidence of illegal discharges or illicit connections:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections
  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of up gradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
  - Once the origin of flow is established, require illicit discharger to eliminate the discharge.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - 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
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).
- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Only properly trained individuals are allowed to handle hazardous materials/wastes.
- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.
- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.
- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

Spill Response and Prevention

- Refer to SC-11, Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.
- Private property access rights may be needed to track illegal discharges up gradient.

- Requirements of municipal ordinance authority for suspected source verification testing for illicit connections necessary for guaranteed rights of entry.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget. A careful study of cleaning effectiveness should be undertaken before increased cleaning is implemented. Catch basin cleaning costs are less expensive if vacuum street sweepers are available; cleaning catch basins manually can cost approximately twice as much as cleaning the basins with a vacuum attached to a sweeper.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary. Encouraging reporting of illicit discharges by employees can offset costs by saving expense on inspectors and directing resources more efficiently. Some programs have used funds available from "environmental fees" or special assessment districts to fund their illicit connection elimination programs.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.

- Identifying illicit discharges requires teams of at least two people (volunteers can be used), plus administrative personnel, depending on the complexity of the storm sewer system.

- Arrangements must be made for proper disposal of collected wastes.

- Requires technical staff to detect and investigate illegal dumping violations, and to coordinate public education.

Supplemental Information

Further Detail of the BMP

Storm Drain flushing

Sanitary sewer flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in sanitary sewer systems. The same principles that make sanitary sewer flushing effective can be used to flush storm drains. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as to an open channel, to another point where flushing will be initiated, or over to the sanitary sewer and on to the treatment facilities, thus preventing re-suspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. The deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to

cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce the impacts of stormwater pollution, a second inflatable device, placed well downstream, may be used to re-collect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to re-collect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75 percent for organics and 55-65 percent for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm drain flushing.

Flow Management

Flow management has been one of the principal motivations for designing urban stream corridors in the past. Such needs may or may not be compatible with the stormwater quality goals in the stream corridor.

Downstream flood peaks can be suppressed by reducing through flow velocity. This can be accomplished by reducing gradient with grade control structures or increasing roughness with boulders, dense vegetation, or complex banks forms. Reducing velocity correspondingly increases flood height, so all such measures have a natural association with floodplain open space. Flood elevations laterally adjacent to the stream can be lowered by increasing through flow velocity.

However, increasing velocity increases flooding downstream and inherently conflicts with channel stability and human safety. Where topography permits, another way to lower flood elevation is to lower the level of the floodway with drop structures into a large but subtly excavated bowl where flood flows we allowed to spread out.

Stream Corridor Planning

Urban streams receive and convey stormwater flows from developed or developing watersheds. Planning of stream corridors thus interacts with urban stormwater management programs. If local programs are intended to control or protect downstream environments by managing flows delivered to the channels, then it is logical that such programs should be supplemented by management of the materials, forms, and uses of the downstream riparian corridor. Any proposal for steam alteration or management should be investigated for its potential flow and stability effects on upstream, downstream, and laterally adjacent areas. The timing and rate of flow from various tributaries can combine in complex ways to alter flood hazards. Each section of channel is unique, influenced by its own distribution of roughness elements, management activities, and stream responses.

Flexibility to adapt to stream features and behaviors as they evolve must be included in stream reclamation planning. The amenity and ecology of streams may be enhanced through the landscape design options of 1) corridor reservation, 2) bank treatment, 3) geomorphic restoration, and 4) grade control.

Corridor reservation - Reserving stream corridors and valleys to accommodate natural stream meandering, aggradation, degradation, and over bank flows allows streams to find their own form and generate less ongoing erosion. In California, open stream corridors in recent urban developments have produced recreational open space, irrigation of streamside plantings, and the aesthetic amenity of flowing water.

Bank treatment - The use of armoring, vegetative cover, and flow deflection may be used to influence a channel's form, stability, and biotic habitat. To prevent bank erosion, armoring can be done with rigid construction materials, such as concrete, masonry, wood planks and logs, riprap, and gabions. Concrete linings have been criticized because of their lack of provision of biotic habitat. In contrast, riprap and gabions make relatively porous and flexible linings. Boulders, placed in the bed reduce velocity and erosive power.

Riparian vegetation can stabilize the banks of streams that are at or near a condition of equilibrium. Binding networks of roots increase bank shear strength. During flood flows, resilient vegetation is forced into erosion-inhibiting mats. The roughness of vegetation leads to lower velocity, further reducing erosive effects. Structural flow deflection can protect banks from erosion or alter fish habitat. By concentrating flow, a deflector causes a pool to be scoured in the bed.

Geomorphic restoration – Restoration refers to alteration of disturbed streams so their form and behavior emulate those of undisturbed streams. Natural meanders are retained, with grading to gentle slopes on the inside of curves to allow point bars and riffle-pool sequences to develop. Trees are retained to provide scenic quality, biotic productivity, and roots for bank stabilization, supplemented by plantings where necessary.

A restorative approach can be successful where the stream is already approaching equilibrium. However, if upstream urbanization continues new flow regimes will be generated that could disrupt the equilibrium of the treated system.

Grade Control - A grade control structure is a level shelf of a permanent material, such as stone, masonry, or concrete, over which stream water flows. A grade control structure is called a sill, weir, or drop structure, depending on the relation of its invert elevation to upstream and downstream channels.

A sill is installed at the preexisting channel bed elevation to prevent upstream migration of nick points. It establishes a firm base level below which the upstream channel can not erode.

A weir or check dam is installed with invert above the preexisting bed elevation. A weir raises the local base level of the stream and causes aggradation upstream. The gradient, velocity, and erosive potential of the stream channel are reduced. A drop structure lowers the downstream invert below its preexisting elevation, reducing downstream gradient and velocity. Weirs and drop structure control erosion by dissipating energy and reducing slope velocity.

When carefully applied, grade control structures can be highly versatile in establishing human and environmental benefits in stabilized channels. To be successful, application of grade control structures should be guided by analysis of the stream system both upstream and downstream from the area to he reclaimed.

Examples

The California Department of Water Resources began the Urban Stream Restoration Program in 1985. The program provides grant funds to municipalities and community groups to implement stream restoration projects. The projects reduce damages from streambank aid watershed instability arid floods while restoring streams' aesthetic, recreational, and fish and wildlife values.

In Buena Vista Park, upper floodway slopes are gentle and grassed to achieve continuity of usable park land across the channel of small boulders at the base of the slopes.

The San Diego River is a large, vegetative lined channel, which was planted in a variety of species to support riparian wildlife while stabilizing the steep banks of the floodway.

References and Resources

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

Los Angeles County Stormwater Quality. Public Agency Activities Model Program. On-line: http://ladpw.org/wmd/npdes/public_TC.cfm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

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http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) Municipal Activities Model Program Guidance. 2001. Project Clean Water. November.

United States Environmental Protection Agency (USEPA). 1999. Stormwater Management Fact Sheet Non-stormwater Discharges to Storm Sewers. EPA 832-F-99-022. Office of Water, Washington, D.C. September.

United States Environmental Protection Agency (USEPA). 1999. Stormwater O&M Fact Sheet Catch Basin Cleaning. EPA 832-F-99-011. Office of Water, Washington, D.C. September.

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Illegal Dumping Control. On line: http://www.epa.gov/npdes/menuofbmps/poll_7.htm

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line: http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Waste Handling and Disposal SC-75

Objectives

- Cover
- Contain
- Educate
- Reduce/Reuse

Targeted Constituents

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

Description

It is important to control litter to eliminate trash and other materials in stormwater runoff. Waste reduction is a major component of waste management and should be encouraged through training and public outreach. Management of waste once it is collected may involve reuse, recycling, or proper disposal.

Approach

Pollution Prevention

- Reuse products when possible.
- Encourage recycling programs with recycling bins, used oil collection, etc.

Suggested Protocols

Solid Waste Collection

- Implement procedures, where applicable, to collect, transport, and dispose of solid waste at appropriate disposal facilities in accordance with applicable federal, state, and local laws and regulations.
- Include properly designed trash storage areas. If feasible provide cover over trash storage areas.
- Regularly inspect solid waste containers for structural damage. 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.
- Refer to SC-34 Waste Handling and Disposal for more information regarding solid waste facilities.

Waste Reduction and Recycling

- Recycle wastes whenever possible. Many types of waste can be recycled, recycling options for each waste type are limited. All gasoline, antifreeze, waste oil, and lead-acid batteries can be recycled. Latex and oil-based paint can be reused, as well as recycled. Materials that cannot be reused or recycled should either be incinerated or disposed of at a properly permitted landfill.
- Recycling is always preferable to disposal of unwanted materials.
- Recycling bins for glass, metal, newspaper, plastic bottles and other recyclable household solid wastes should be provided at public facilities and/or for residential curbside collection.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- Clean out and cover litter receptacles frequently to prevent spillage.

Illegal Dumping

Substances illegally dumped on streets and into the storm drain system and creeks include paints, used oil and other automotive fluids, construction debris, chemicals, fresh concrete, leaves, grass clipping, and pet wastes.

- Post "No Dumping" signs with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Landscaping and beautification efforts of hot spots might also discourage future dumping.
- See SC-74 Drainage System Maintenance, and SC-10 Non-Stormwater Discharges.

Requirements

Costs

- The costs for a solid waste source control program vary depending on the type of method. The cost of a community education program or a plan to increase the number of trash receptacles can be very minimal. Costs for structural controls such as trash racks, bar screens, and silt traps can be quite costly ranging from $250,000 to $900,000.

- A collection facility or curbside collection for used oil may result in significant costs. Commercial locations (automobile service stations, quick oil change centers, etc.) as collection points eliminate hauling and recycling costs.

- Collection and disposal of hazardous waste can be very expensive and requires trained operators; laboratory and detection equipment; and extensive record keeping including dates, types, and quantities.

- Use of volunteer work forces can lower storm drain stenciling program costs. Stenciling kits require procurement of durable/disposable items. The stenciling program can aid in the cataloging of the storm drain system. One municipality from the state of Washington has estimated that stenciling kits cost approximately $50 each. Stencils may cost about $8 each including the die cost on an order of 1,000. Re-orders cost about $1/stencil. Stencil designs may be available from other communities. Stencil kits should be provided on a loan basis to volunteer groups free of charge with the understanding that kit remnants are to be returned.

Maintenance

- The primary staff demand for stenciling programs is for program setup to provide marketing and training. Ongoing/follow-up staff time is minimal because of volunteer services.

- Staffing requirements are minimal for oil recycling programs if collection/recycling is contracted out to a used oil hauler/recycler or required at commercial locations.

- Staff requirements for maintaining good housekeeping BMPs at waste handling sites is minimal.

Supplemental Information

Further Detail of the BMP

Waste Reduction

An approach to reduce stormwater pollution from waste handling and disposal is to assess activities and reduce waste generation. The assessment is designed to find situations where waste can be eliminated or reduced and emissions and environmental damage can be minimized. The assessment involves collecting process specific information, setting pollution prevention targets, and developing, screening and selecting waste reduction options for further study. Starting a waste reduction program is economically beneficial because of reduced raw material purchases and lower waste disposal fees.

References and Resources

Best Management Practices Program for Pollution Prevention, City and County of San Francisco, Uribe & Associates, Oakland, California, 1990.

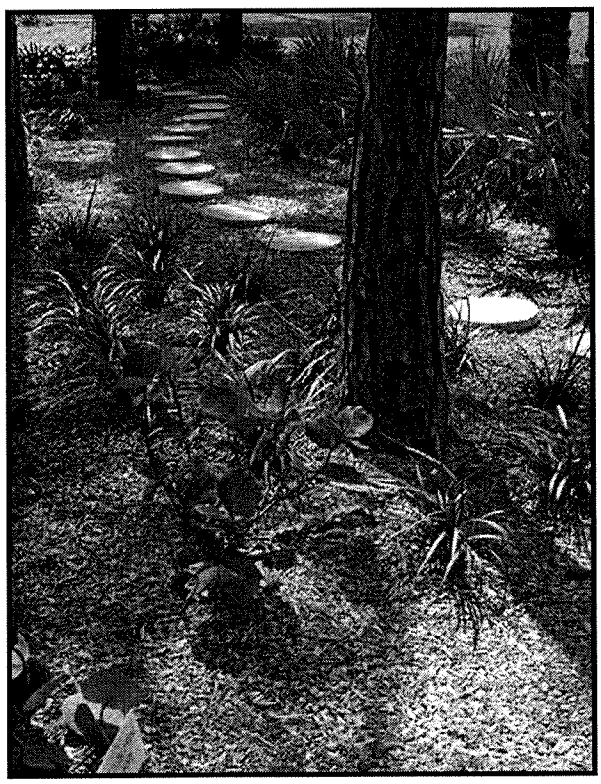
Harvard University. 2002. Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety.

Model Urban Runoff Program: A How-To-Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July 1998. (Revised February 2002 by the California Coastal Commission).

Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

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.

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.

Roof Runoff Controls SD-11

Rain Garden

Design Objectives

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

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

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

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

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.

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

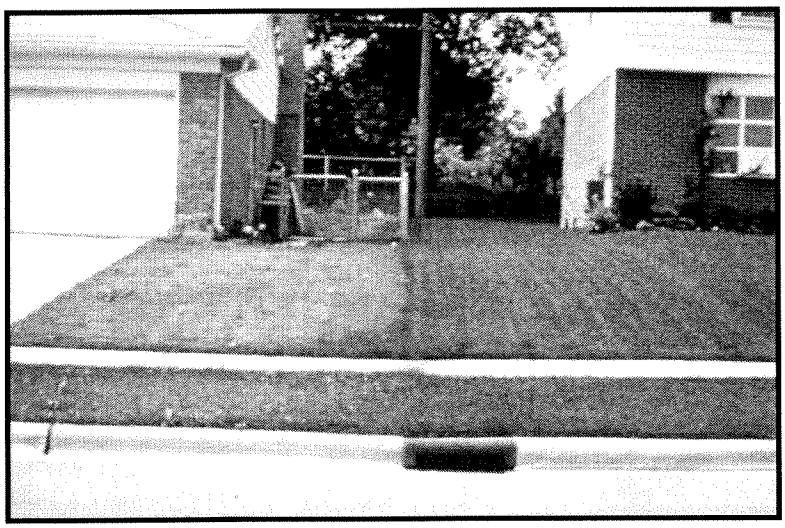
Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

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

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.

- 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

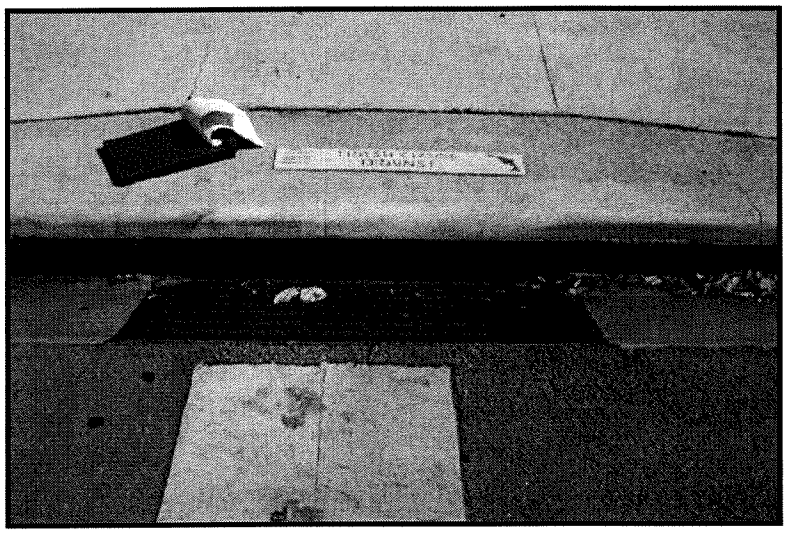
A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

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.

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.

Trash Storage Areas SD-32

Design Objectives

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

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

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

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

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.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

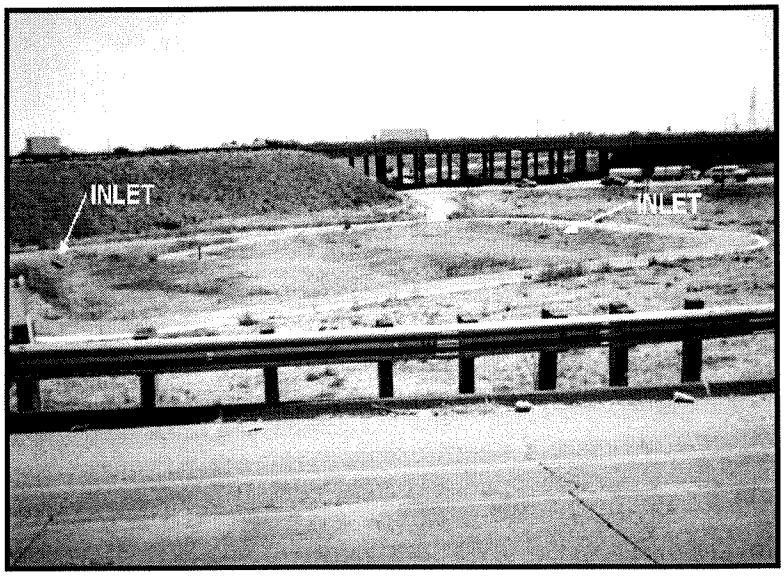
A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

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.

Infiltration Basin TC-11



Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

Targeted Constituents

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

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

Description

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually exfiltrates through the soil and eventually into the water table. This practice has high pollutant removal efficiency and can also help recharge groundwater, thus helping to maintain low flows in stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated.

Advantages

- Provides 100% reduction in the load discharged to surface waters.
- The principal benefit of infiltration basins is the approximation of pre-development hydrology during which a

significant portion of the average annual rainfall runoff is infiltrated and evaporated rather than flushed directly to creeks.

- If the water quality volume is adequately sized, infiltration basins can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

Limitations

- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.
- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- Upstream drainage area must be completely stabilized before construction.
- Difficult to restore functioning of infiltration basins once clogged.

Design and Sizing Guidelines

- Water quality volume determined by local requirements or sized so that 85% of the annual runoff volume is captured.
- Basin sized so that the entire water quality volume is infiltrated within 48 hours.
- Vegetation establishment on the basin floor may help reduce the clogging rate.

Construction/Inspection Considerations

- Before construction begins, stabilize the entire area draining to the facility. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction or remove the top 2 inches of soil after the site is stabililized. Stabilize the entire contributing drainage area, including the side slopes, before allowing any runoff to enter once construction is complete.
- Place excavated material such that it can not be washed back into the basin if a storm occurs during construction of the facility.
- Build the basin without driving heavy equipment over the infiltration surface. Any equipment driven on the surface should have extra-wide ("low pressure") tires. Prior to any construction, rope off the infiltration area to stop entrance by unwanted equipment.
- After final grading, till the infiltration surface deeply.
- Use appropriate erosion control seed mix for the specific project and location.

Performance

As water migrates through porous soil and rock, pollutant attenuation mechanisms include precipitation, sorption, physical filtration, and bacterial degradation. If functioning properly, this approach is presumed to have high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Actual pollutant removal in the subsurface would be expected to vary depending upon site-specific soil types. This technology eliminates discharge to surface waters except for the very largest storms; consequently, complete removal of all stormwater constituents can be assumed.

There remain some concerns about the potential for groundwater contamination despite the findings of the NURP and Nightingale (1975; 1987a,b,c; 1989). For instance, a report by Pitt et al. (1994) highlighted the potential for groundwater contamination from intentional and unintentional stormwater infiltration. That report recommends that infiltration facilities not be sited in areas where high concentrations are present or where there is a potential for spills of toxic material. Conversely, Schroeder (1995) reported that there was no evidence of groundwater impacts from an infiltration basin serving a large industrial catchment in Fresno, CA.

Siting Criteria

The key element in siting infiltration basins is identifying sites with appropriate soil and hydrogeologic properties, which is critical for long term performance. In one study conducted in Prince George's County, Maryland (Galli, 1992), all of the infiltration basins investigated clogged within 2 years. It is believed that these failures were for the most part due to allowing infiltration at sites with rates of less than 0.5 in/hr, basing siting on soil type rather than field infiltration tests, and poor construction practices that resulted in soil compaction of the basin invert.

A study of 23 infiltration basins in the Pacific Northwest showed better long-term performance in an area with highly permeable soils (Hilding, 1996). In this study, few of the infiltration basins had failed after 10 years. Consequently, the following guidelines for identifying appropriate soil and subsurface conditions should be rigorously adhered to.

- Determine soil type (consider RCS soil type 'A, B or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30% clay or more than 40% of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.

- Groundwater separation should be at least 3 m from the basin invert to the measured ground water elevation. There is concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.

- Location away from buildings, slopes and highway pavement (greater than 6 m) and wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15% should not be considered.

- Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.

- Base flow should not be present in the tributary watershed.

Secondary Screening Based on Site Geotechnical Investigation

- At least three in-hole conductivity tests shall be performed using USBR 7300-89 or Bouwer-Rice procedures (the latter if groundwater is encountered within the boring), two tests at different locations within the proposed basin and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.

- The minimum acceptable hydraulic conductivity as measured in any of the three required test holes is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.

- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.

- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Additional Design Guidelines

(1) Basin Sizing - The required water quality volume is determined by local regulations or sufficient to capture 85% of the annual runoff.

(2) Provide pretreatment if sediment loading is a maintenance concern for the basin.

(3) Include energy dissipation in the inlet design for the basins. Avoid designs that include a permanent pool to reduce opportunity for standing water and associated vector problems.

(4) Basin invert area should be determined by the equation:

$$A = \frac{WQV}{kt}$$

where A = Basin invert area (m^2)

WQV = water quality volume (m^3)

k = 0.5 times the lowest field-measured hydraulic conductivity (m/hr)

t = drawdown time (48 hr)

(5) The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).

Maintenance

Regular maintenance is critical to the successful operation of infiltration basins. Recommended operation and maintenance guidelines include:

- Inspections and maintenance to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.
- Observe drain time for the design storm after completion or modification of the facility to confirm that the desired drain time has been obtained.
- Schedule semiannual inspections for beginning and end of the wet season to identify potential problems such as erosion of the basin side slopes and invert, standing water, trash and debris, and sediment accumulation.
- Remove accumulated trash and debris in the basin at the start and end of the wet season.
- Inspect for standing water at the end of the wet season.
- Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of the basin.
- If erosion is occurring within the basin, revegetate immediately and stabilize with an erosion control mulch or mat until vegetation cover is established.
- To avoid reversing soil development, scarification or other disturbance should only be performed when there are actual signs of clogging, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a very light tractor.

Cost

Infiltration basins are relatively cost-effective practices because little infrastructure is needed when constructing them. One study estimated the total construction cost at about $2 per ft (adjusted for inflation) of storage for a 0.25-acre basin (SWRPC, 1991). As with other BMPs, these published cost estimates may deviate greatly from what might be incurred at a specific site. For instance, Caltrans spent about $18/ft^3 for the two infiltration basins constructed in southern California, each of which had a water quality volume of about 0.34 ac.-ft. Much of the higher cost can be attributed to changes in the storm drain system necessary to route the runoff to the basin locations.

Infiltration basins typically consume about 2 to 3% of the site draining to them, which is relatively small. Additional space may be required for buffer, landscaping, access road, and fencing. Maintenance costs are estimated at 5 to 10% of construction costs.

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time.

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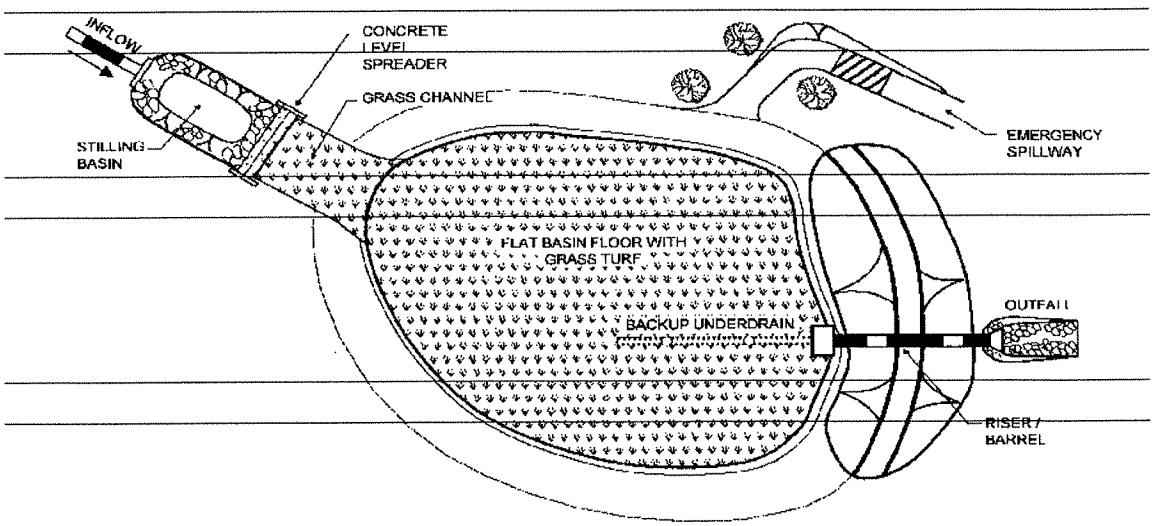
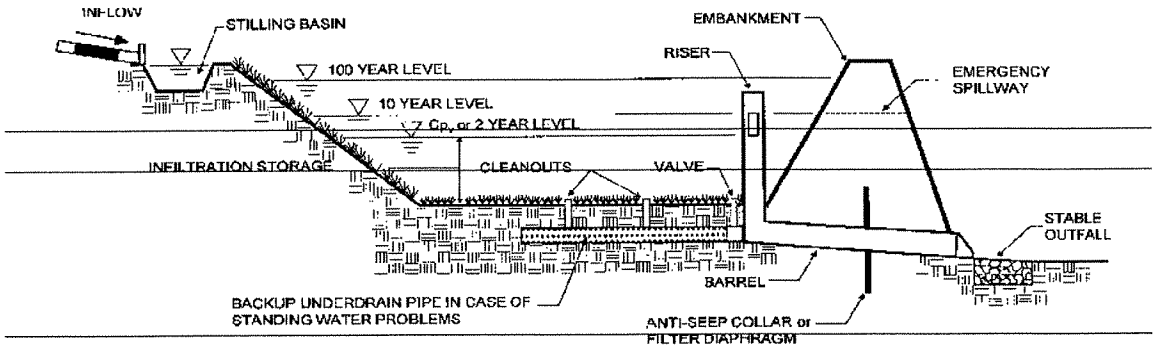


PLAN VIEW



PROFILE

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

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.

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Hsieh, C.-h. and Davis, A.P. "Engineering Bioretention for Treatment of Urban Stormwater Runoff," *Watersheds 2002, Proceedings on CDROM Research Symposium*, Session 15, Ft. Lauderdale, FL, Feb. 2002.

Prince George's County Department of Environmental Resources (PGDER), 1993. Design Manual for Use of *Bioretention in Stormwater Management*. Division of Environmental Management, Watershed Protection Branch. Landover, MD.

U.S. EPA Office of Water, 1999. Stormwater Technology Fact Sheet: Bioretention. EPA 832-F-99-012.

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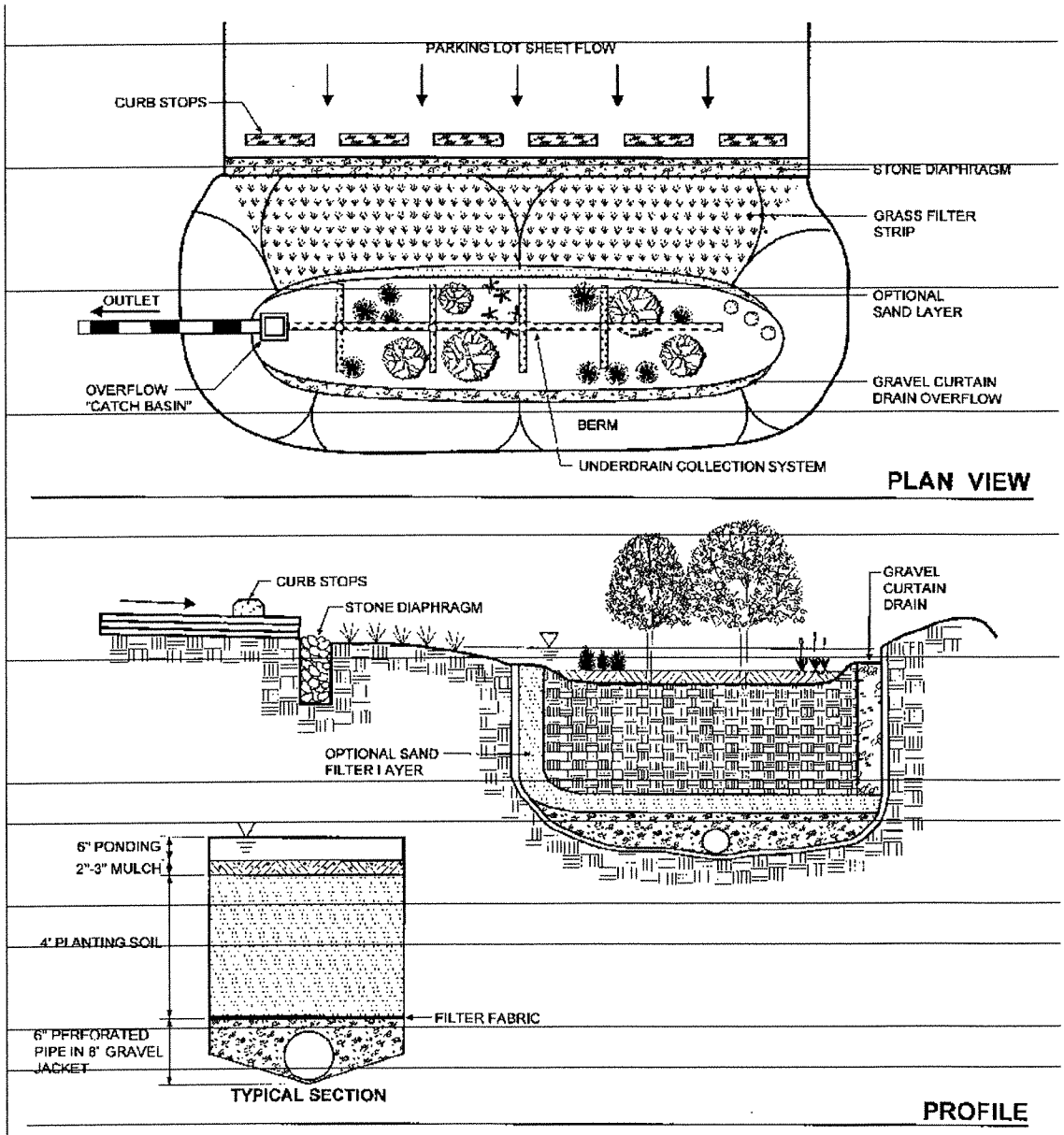

Schematic of a Bioretention Facility (MDE, 2000)

Vortex Separator MP-51

General Description

Vortex separators: (alternatively, swirl concentrators) are gravity separators, and in principle are essentially wet vaults. The difference from wet vaults, however, is that the vortex separator is round, rather than rectangular, and the water moves in a centrifugal fashion before exiting. By having the water move in a circular fashion, rather than a straight line as is the case with a standard wet vault, it is possible to obtain significant removal of suspended sediments and attached pollutants with less space. Vortex separators were originally developed for combined sewer overflows (CSOs), where it is used primarily to remove coarse inorganic solids. Vortex separation has been adapted to stormwater treatment by several manufacturers.

Inspection/Maintenance Considerations

As some of the systems have standing water that remains between storms, there is concern about mosquito breeding. Also, a loss of dissolved pollutants may occur as accumulated organic matter (e.g., leaves) decomposes in the units.

Inspection Activities	Suggested Frequency
■ Inspect for accumulated sediment/debris.	As needed
Maintenance Activities	**Suggested Frequency**
■ Remove of accumulated material with an eductor truck. It may be necessary to remove and dispose the floatables separately due to the presence of petroleum product.	Annual, or more frequent as needed

Maintenance Concerns, Objectives, and Goals

- Sediment/Debris Removal
- Vector Control

Targeted Constituents

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

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

CASQA California Stormwater Quality Association

Drain Inserts MP-52

Description

Drain inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris. There are a multitude of inserts of various shapes and configurations, typically falling into one of three different groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are one box; that is, the setting area and filtration through media occur in the same box. Some products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon.

California Experience

The number of installations is unknown but likely exceeds a thousand. Some users have reported that these systems require considerable maintenance to prevent plugging and bypass.

Advantages

- Does not require additional space as inserts as the drain inlets are already a component of the standard drainage systems.
- Easy access for inspection and maintenance.
- As there is no standing water, there is little concern for mosquito breeding.
- A relatively inexpensive retrofit option.

Limitations

Performance is likely significantly less than treatment systems that are located at the end of the drainage system such as ponds and vaults. Usually not suitable for large areas or areas with trash or leaves than can plug the insert.

Design and Sizing Guidelines

Refer to manufacturer's guidelines. Drain inserts come any many configurations but can be placed into three general groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are

Design Considerations

- Use with other BMPs
- Fit and Seal Capacity within Inlet

Targeted Constituents

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

Removal Effectiveness

See New Development and Redevelopment Handbook-Section 5.

one box; that is, the setting area and filtration through media occurs in the same box. One manufacturer has a double-box. Stormwater enters the first box where setting occurs. The stormwater flows into the second box where the filter media is located. Some products consist of one or more trays or mesh grates. The trays can hold different types of media. Filtration media vary with the manufacturer: types include polypropylene, porous polymer, treated cellulose, and activated carbon.

Construction/Inspection Considerations

Be certain that installation is done in a manner that makes certain that the stormwater enters the unit and does not leak around the perimeter. Leakage between the frame of the insert and the frame of the drain inlet can easily occur with vertical (drop) inlets.

Performance

Few products have performance data collected under field conditions.

Siting Criteria

It is recommended that inserts be used only for retrofit situations or as pretreatment where other treatment BMPs presented in this section area used.

Additional Design Guidelines

Follow guidelines provided by individual manufacturers.

Maintenance

Likely require frequent maintenance, on the order of several times per year.

Cost

- The initial cost of individual inserts ranges from less than $100 to about $2,000. The cost of using multiple units in curb inlet drains varies with the size of the inlet.
- The low cost of inserts may tend to favor the use of these systems over other, more effective treatment BMPs. However, the low cost of each unit may be offset by the number of units that are required, more frequent maintenance, and the shorter structural life (and therefore replacement).

References and Sources of Additional Information

Hrachovec, R., and G. Minton, 2001, Field testing of a sock-type catch basin insert, Planet CPR, Seattle, Washington

Interagency Catch Basin Insert Committee, Evaluation of Commercially-Available Catch Basin Inserts for the Treatment of Stormwater Runoff from Developed Sites, 1995

Larry Walker Associates, June 1998, NDMP Inlet/In-Line Control Measure Study Report

Manufacturers literature

Santa Monica (City), Santa Monica Bay Municipal Stormwater/Urban Runoff Project - Evaluation of Potential Catch basin Retrofits, Woodward Clyde, September 24, 1998

Woodward Clyde, June 11, 1996, Parking Lot Monitoring Report, Santa Clara Valley Nonpoint Source Pollution Control Program.

Appendix C - Proprietary Product Data Sheets

- **Filterra - Bioretention Systems**
- **Contech - UrbanGreen Metal Detention and Infiltration Products**
- **Contech - UrbanGreen Hydrodynamic Separation Products**
- **Kristar - Flogard+Plus Filter Catch Basin Insert Filter**
- **Filterra - Roofdrain Stormwater Treatment System (if applicable)**

Filterra Bioretention Systems

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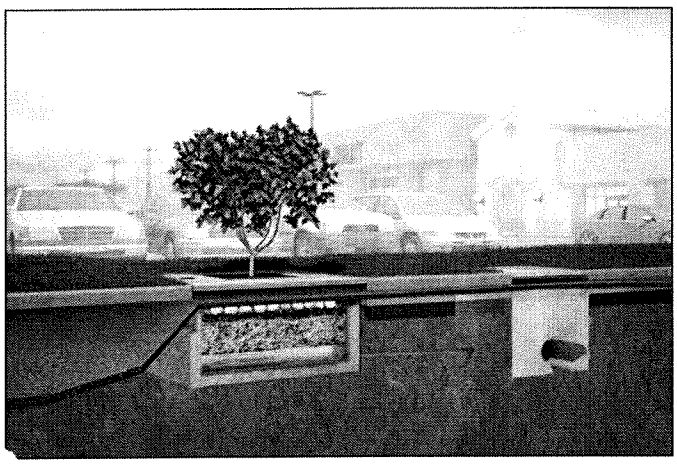
Low Impact Development Solutions for Stormwater Runoff

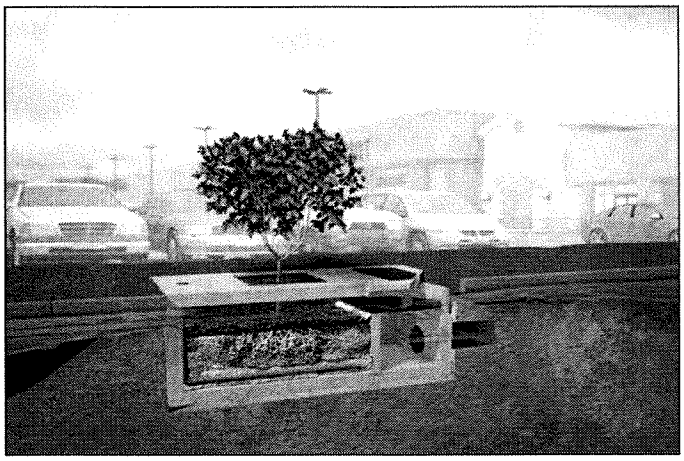
Filterra Bioretention Systems is the leading provider of stormwater biofiltration systems for the treatment of stormwater runoff generated from parking lots, roadways, commercial and residential developments. The Filterra System can be built in a variety of sizes, models and configurations. Filterra's compact size makes it ideal for both urban retrofits and space-constrained new developments. Filterra is easy to install, simple to maintain, and is approved by over 500 local, regional and state agencies.

Standard Filterra® System



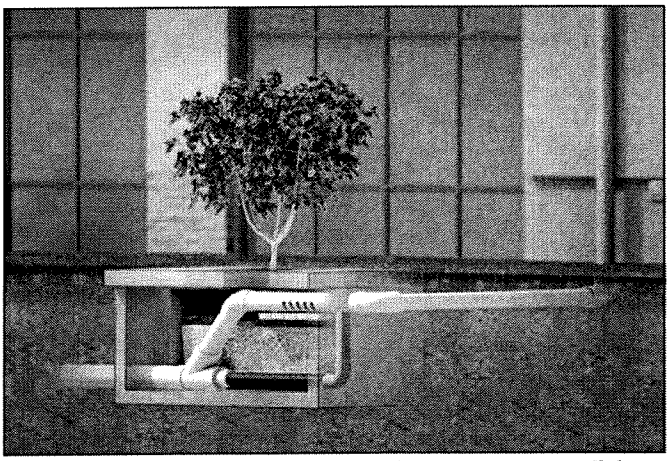
The standard Filterra System is similar in concept to "raingardens" in its function and application but has been optimized for high volume/flow treatment and high pollutant removal.

Filterra® Curb Inlet with Internal Bypass System



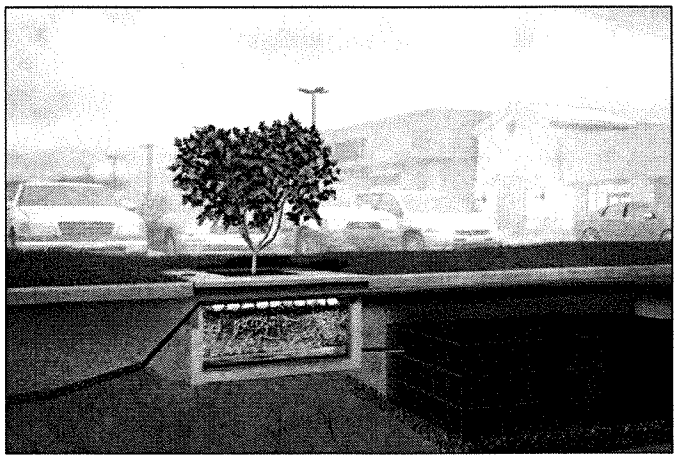
The Filterra Curb Inlet with Internal Bypass system incorporates biofiltration and an internal high flow bypass chamber into one single structure. This system eliminates the need and cost of installing a separate bypass structure and enables placement on grade or at low points.

Filterra® Roofdrain System



The Filterra Roofdrain System treats "Piped-In" stormwater runoff from rooftops and area drains. Using biofiltration, the system captures and immobilizes pollutants of concern such as: TSS, nutrients, oils, greases, metals and bacteria.

Filterra® combined with Underground Storage



Filterra combined with underground storage provides complete stormwater capture, treatment and storage in one packaged system. Surface flows can be conveyed into the Filterra and discharged to any underground storage system for detention, retention and re-use applications including landscape irrigation systems.

Filterra is protected by U.S. Patents #6,277,274 , #6,569,321 , #7,425,261 , #7,625,485 , #12,379,338. Other patents pending. Filterra is a division of AMERICAST

Filterra Bioretention Systems

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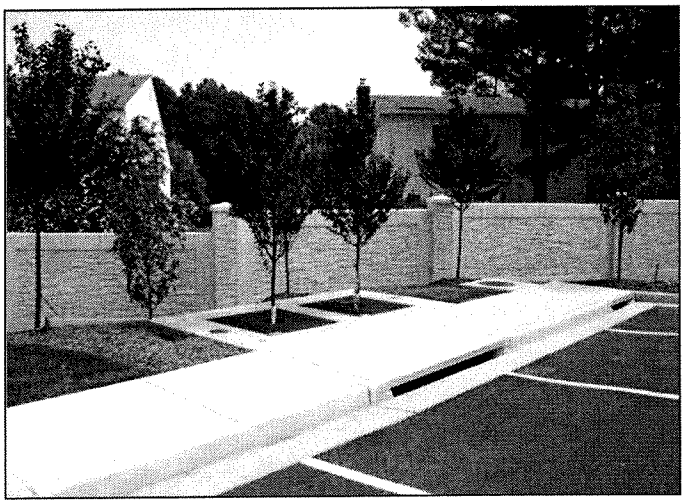

Standard Filterra System
Richmond, VA

Standard Filterra System
Independence, WA

Filterra Roofdrain System
Salem, VA

Filterra Curb Inlet with Internal Bypass
Everett, WA

Standard Filterra System with Modified Recessed Top
Charlottesville, VA

Standard Filterra System Linear/ROW Application
Mill Creek, WA

Filterra is protected by U.S. Patents #6,277,274 , #6,569,321 , #7,425,261 , #7,625,485 , #12,379,338. Other patents pending. Filterra is a division of AMERICAST

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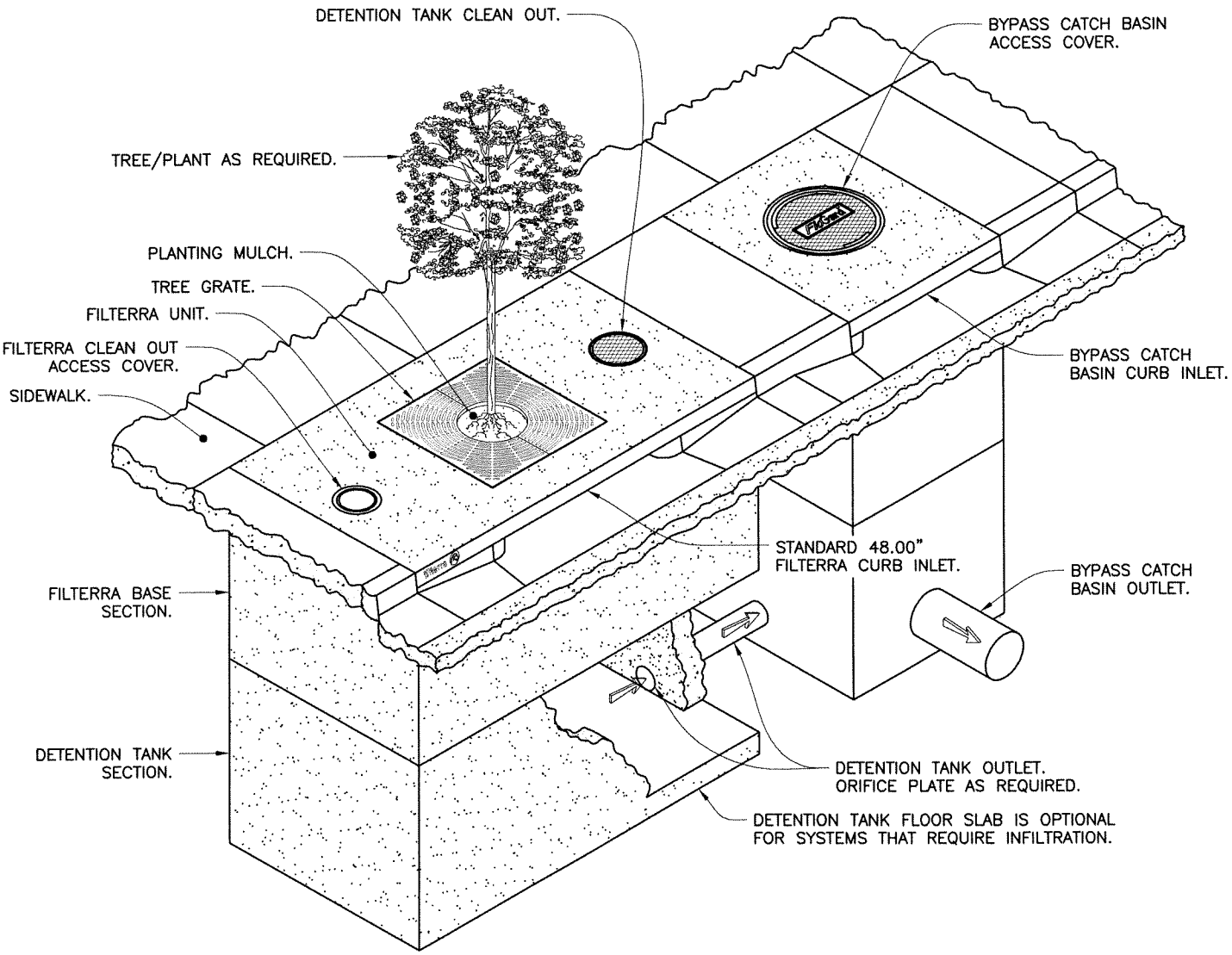

NOTES:

1. 8.00' X 4.00' FILTERRA SHOWN, UNITS CAN BE SIZED TO MEET SITE SPECIFIC REQUIREMENTS.
2. TREATED OUTLET FROM DETENTION TANK CAN BE LOCATED ON ANY SIDE.
3. DETENTION TANK FLOOR SLAB IS OPTIONAL FOR SYSTEMS THAT REQUIRE INFILTRATION.

MODIFICATION OF DRAWINGS IS PERMITTED ONLY BY WRITTEN AUTHORIZATION FROM KRISTAR ENTERPRISES, INC.

TITLE

filterra®

Hydromod System

By Kristar

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

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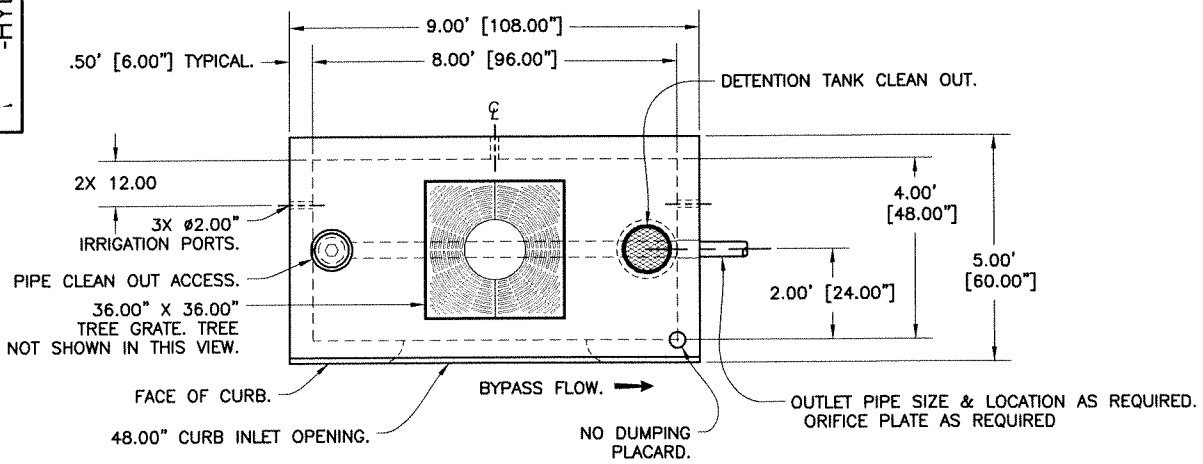

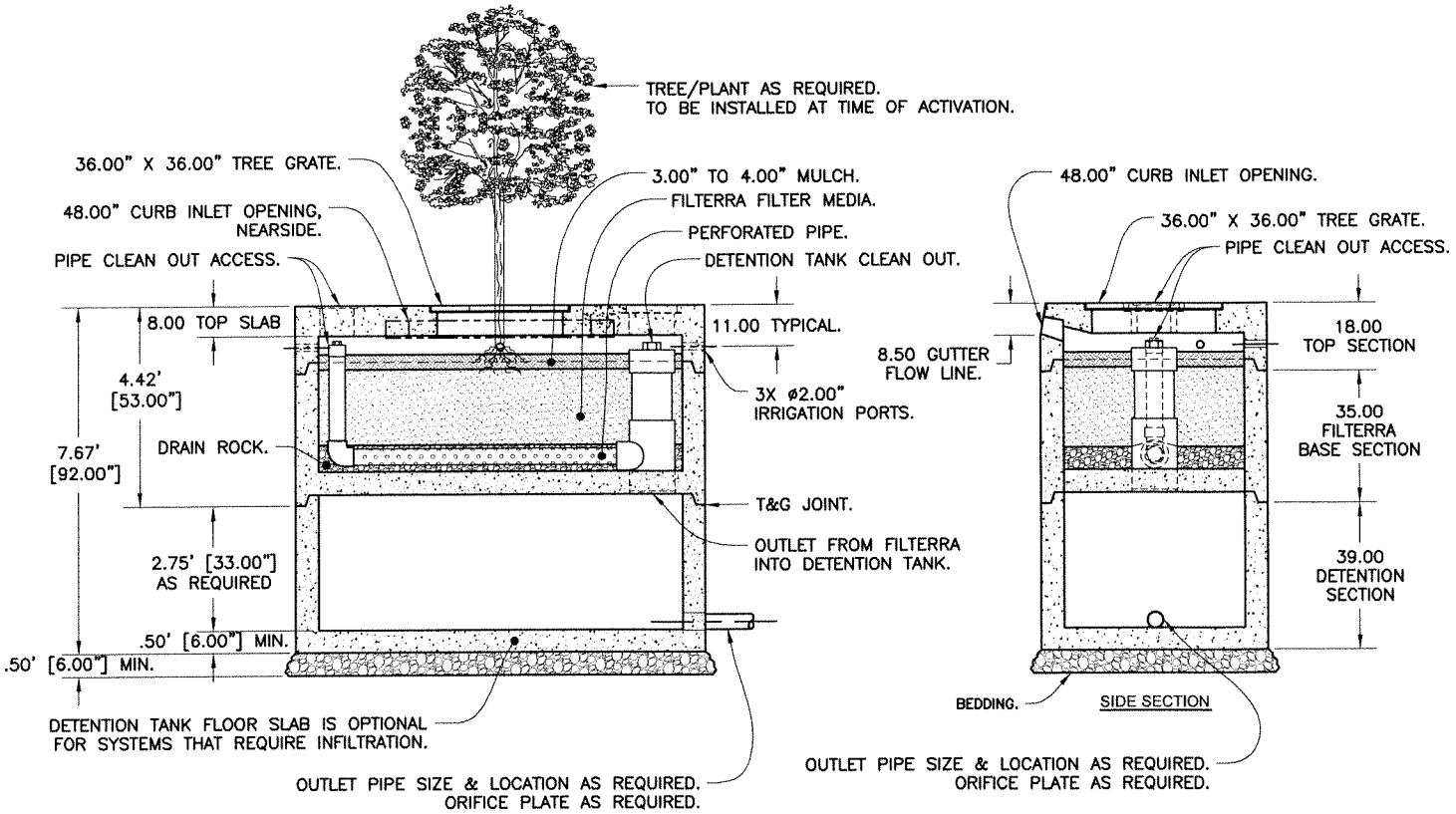

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filterra®

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

DRAWING NO.	REV	F-ECO	DATE	
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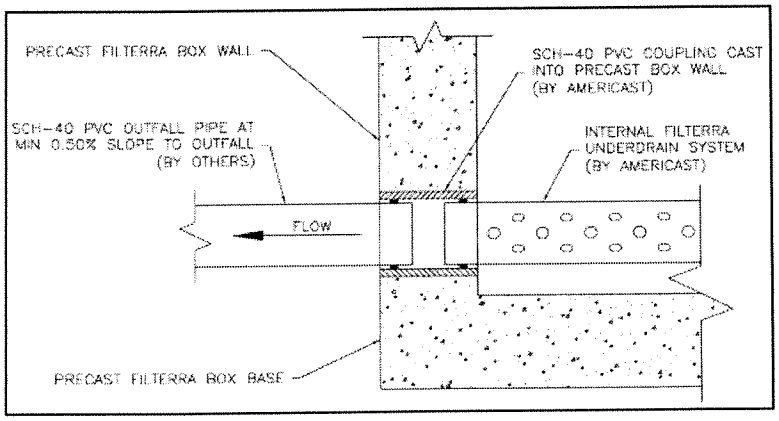
Filterra® Piping Technical Details

Filterra® is supplied with an internal underdrain system that exits a wall in a perpendicular direction. Most efficient drainage is accomplished when the drain exits on the lower side of the Filterra®, i.e. nearest the overflow bypass. This is more important when using the larger sized Filterra® Systems.



Drawing DP1:
Section View through Filterra Precast Box Wall at Outfall Pipe Connection

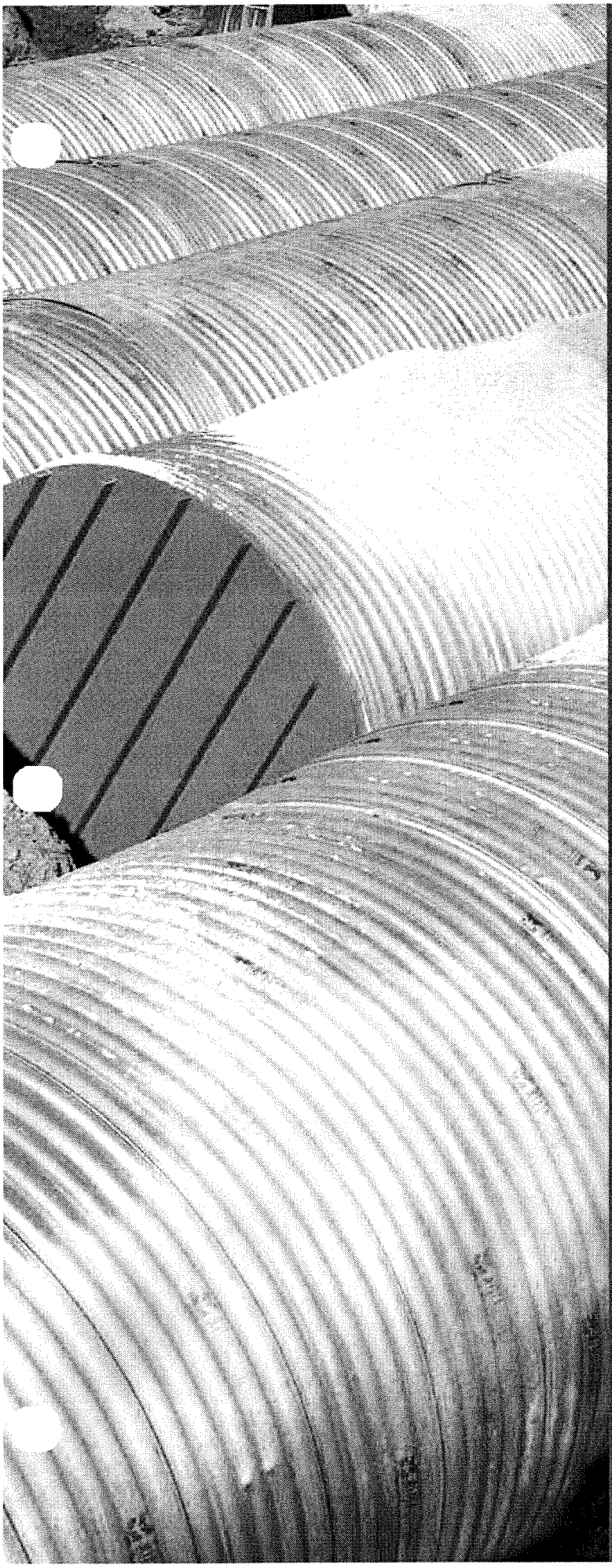
All units are supplied with the drainage pipe coupling precast into the wall, at a depth of 3.50 feet (INV to TC). Drawing DP1 is a detail of the coupling. The coupling used is SCH-40 PVC.

Typically, a minimum slope of 0.5% is adequate to accommodate the flow of treated water from the Filterra®, but each site may present unique conditions based on routing of the outfall pipe (elbows). The pipe must not be a restricting point for the successful operation of Filterra®. All connecting pipes must accommodate freefall flow. Table 3 lists WA DOE approved treatment sizing flow rates of the various size Filterra® units. A safety factor of at least two should be used to size piping from the Filterra based on these conservative approved treatment flow rates.

Table 3: Filterra Flow Rates & Pipe Details

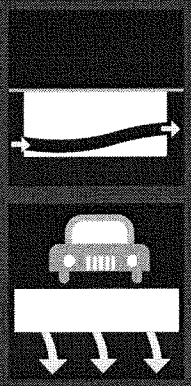
Important Note: Actual flow rate may be more than double rates below.

Filterra® Size (feet)	Expected Flow Rate (cubic feet/second)	Connecting Drainage Pipe
4x4	0.037	4" SCH-40 PVC
4 x 6 or 6 x 4	0.061	4" SCH-40 PVC
4x6.5 or 6.5x4	0.061	4" SCH-40 PVC
4 x 8 or 8 x 4	0.075	4" SCH-40 PVC
4x16 or 16x4	0.150	6" SCH-40 PVC
6 x 6	0.084	4" SCH-40 PVC
6 x 8 or 8 x 6	0.112	4" SCH-40 PVC
6 x 10 or 10 x 6	0.140	6" SCH-40 PVC
6 x 12 or 12 x 6	0.168	6" SCH-40 PVC
8x12 or 12x8	0.224	6" SCH-40 PVC
8x16 or 16x8	0.229	6" SCH-40 PVC
8x18 or 18x8	0.337	6" SCH-40 PVC
8x20 or 20x8	0.374	6" SCH-40 PVC



UrbanGreen™

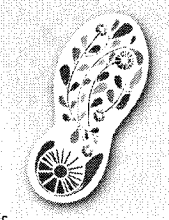
Metal Detention and Infiltration Products



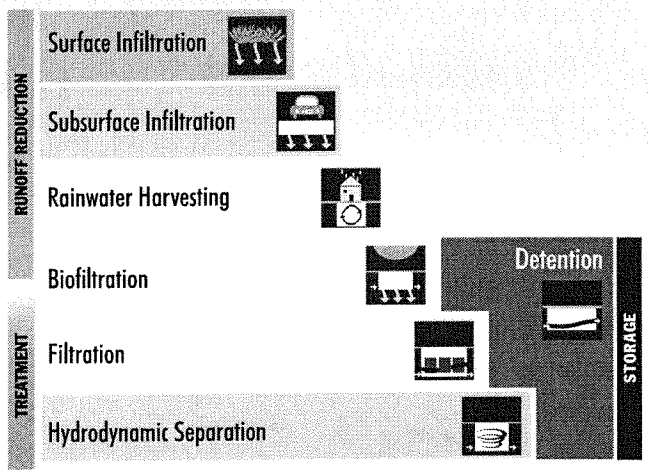
CONTECH®
CONSTRUCTION PRODUCTS INC.

Corrugated Metal Pipe for Stormwater Detention and Infiltration

Selecting the right stormwater solution just got easier...



It's simple to choose the right low impact development (LID) solution to achieve your runoff reduction goals with the CONTECH UrbanGreen Staircase. First, select the runoff reduction practices that are most appropriate for your site, paying particular attention to pretreatment needs. If the entire design storm cannot be retained, select a treatment best management practice (BMP) for the balance. Finally, select a detention system to address any outstanding downstream erosion.



Learn more about our low impact development at www.contech-cpi.com/lid

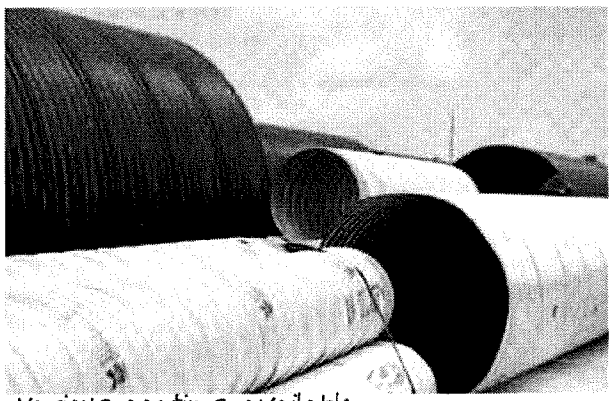
Meet your stormwater quantity and runoff reduction requirements with ease.

CONTECH's corrugated metal pipe (CMP) underground detention/infiltration systems can be sized and shaped to meet your site-specific needs. The versatile material provides almost limitless opportunities to match individual site requirements while lowering site development costs.

Durable

- Proven service life — Exceeds 100-years with proper specification that meets all AASHTO and ASTM pipe specifications
- Handles fill heights in excess of 100 feet – steel gains strength from soil
- 100% traceable material — maintains performance even when recycled
- Homogenous material — eliminates failures due to stress cracks, shrinkage cracks and air voids
- Various coatings available with predictable service life
  - Aluminized Steel™ Type 2
  - Galvanized
  - CORLIX®
  - TRENCHCOAT®

Learn more about our available coatings at www.contech-cpi/cmp



Various coatings available

Versatile

- Wide range of shapes and sizes – round and pipe-arch in diameters from 6 to 144 inches
- Variety of layouts – rectangular, L-shape and staggered cells are frequently used
- Array of fittings – tees, wyes, elbow, saddle branches, manifolds, reducers and custom fabrication available

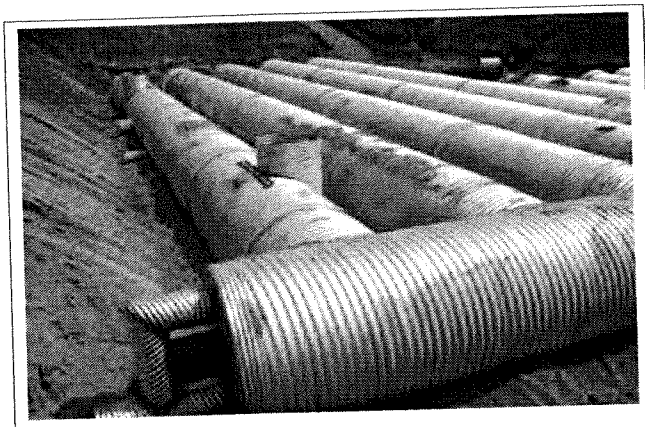
Sustainable

- World's most recycled content – can count towards LEED® credits
- Requires less energy and materials to produce – lowers carbon footprint

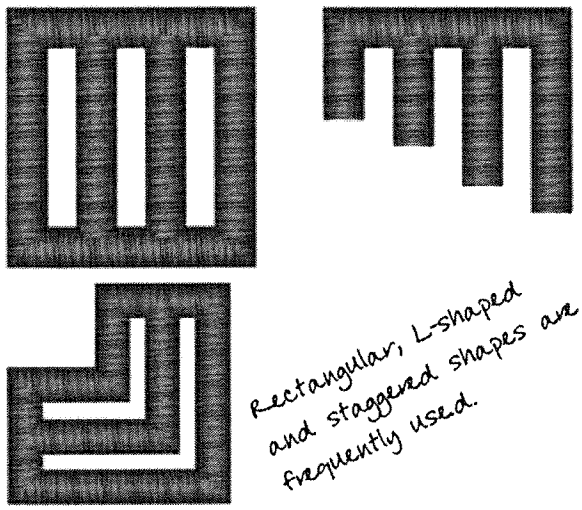
Learn how CONTECH products can help contribute to LEED credits at www.contech-cpi.com/LEED

Easy to Install and Maintain

- Flexible and forgiving during installation
- Lightweight for easy handling
- Quick assembly shortens site development time
- Integrated outlet control structure eliminates need for downstream control structure
- Manhole riser sections, complete with ladders facilitate any access and scheduled maintenance

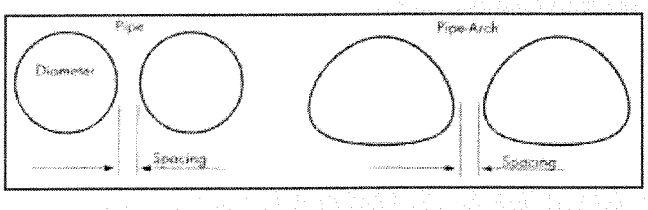


Tees, wyes, elbows, saddle branches, manifolds and reducers are available



Rectangular, L-shaped and staggered shapes are frequently used.

Typical Spacing for Multiple Barrels



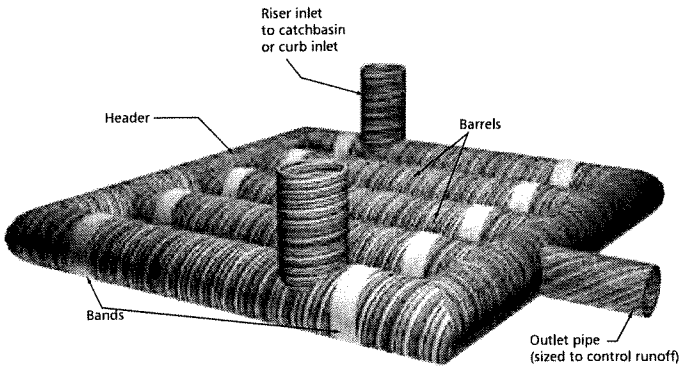
Diameter	Spacing*	Pipe-Arch Span	Spacing*
Up to 24"	12"	Up to 36"	12"
24" to 72"	1/2 Diameter of Pipe	36" to 108"	1/3 Span of Pipe-Arch
72" +	36"	108" to 189"	36"

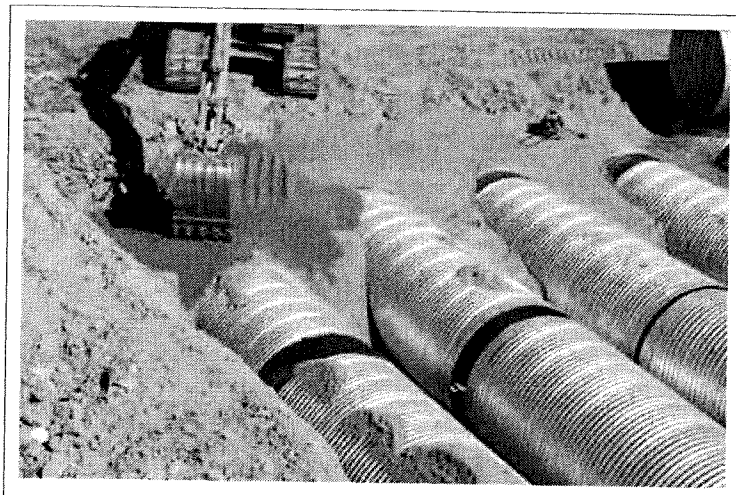
* Spacing shown provides room for proper backfill to enable the structure to develop adequate side support. Spacing with AASHTO M-145, A-1, A-2, A-3 granular fill. Closer spacing is possible depending on quality of backfill and placing and compaction methods.

Applications

Detention

CONTECH CMP detention systems store stormwater runoff exceeding a site's allowable discharge rate and release it slowly over time. Installed belowgrade, the systems maximize property usage and meet your specific water quantity requirements. CMP detention systems are available in all AASHTO M-36 Types. For larger systems, the Optimizer™ flow control device can reduce required storage volume.





CMP detention system

High Volume Storage

CONTECH plate systems allow for high volume stormwater storage in small footprint areas. The systems are offered in a wide variety of shapes and sizes in both aluminum and galvanized steel. Full-pipe systems and three-sided structures with open bottoms can be used for infiltration.

Typically, CONTECH plate systems are used on high vertical rise applications or in areas where the smallest possible footprint is of the greatest concern. The systems are bolted together in the field, which reduces the number of freight loads. Remote sites or projects with challenging accessibility often utilize plate systems.

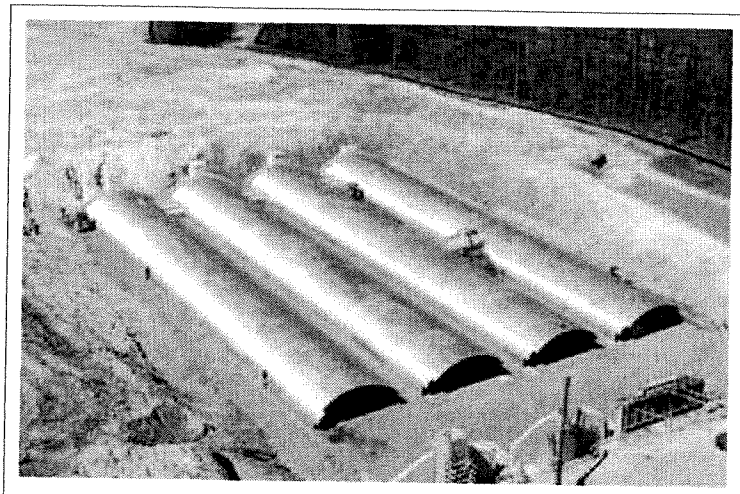
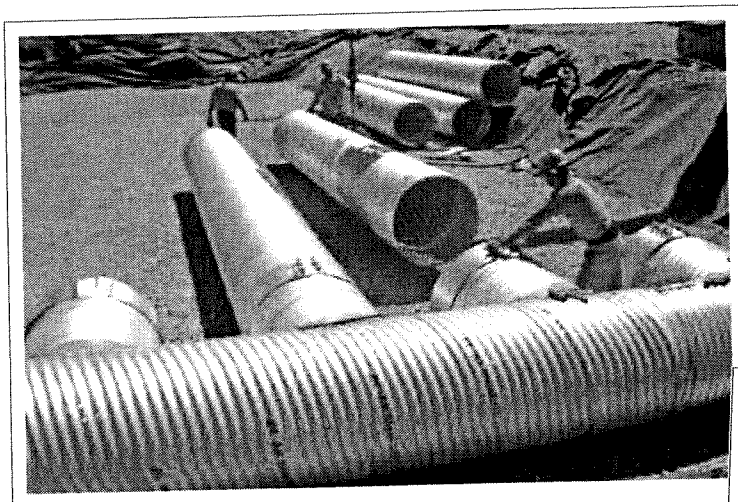


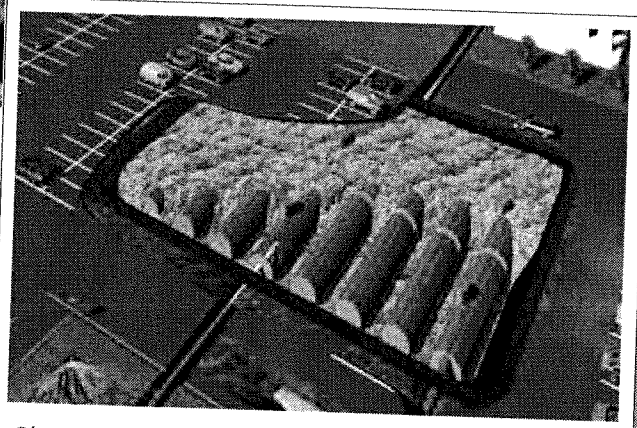
Plate system for high volume storage



CMP infiltration system

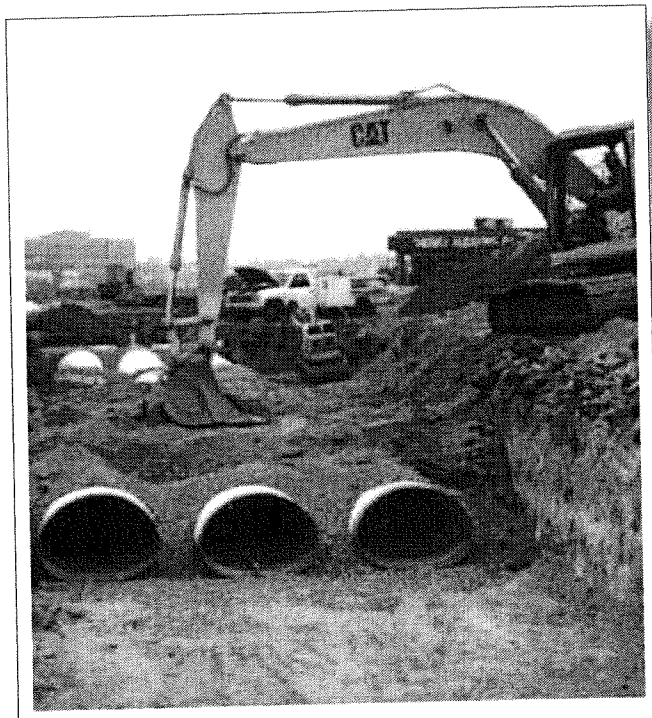
Infiltration

CMP pipe and pipe-arch is available fully or partially perforated to meet your Low Impact Development (LID) requirements. Standard pipe-wall perforations (3/8" diameter holes meeting AASHTO M-36, Class 2) provide approximately 2.5% open area. Subsurface perforated CMP infiltration systems store stormwater runoff in the pipe and surrounding stone during a storm until it can be slowly released into the surrounding native soil.



Stormwater runoff is stored in the pipe and surrounding stone

Meet Your Low Impact Development Requirements



Pipe-arch for low profile application.

Low Profile

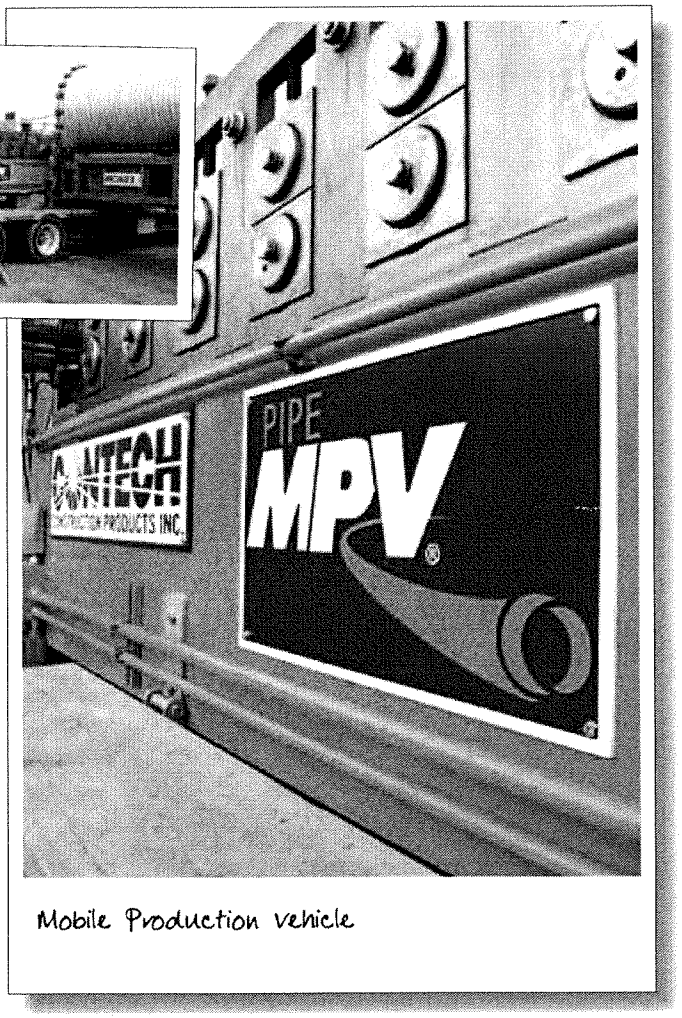
When vertical space must be maximized, the CMP can be utilized in a pipe-arch shape. The low, wide pipe-arch design allows for greater storage in a shallow profile than typical round pipe without losing any structural integrity. Like our round pipe, pipe arch is produced in six wall thicknesses including 18, 16, 14, 12, 10 and 8 gage, which are available with either helical or annular corrugations.

Applications

On-Site Manufacturing

If your job site is remote or you have limited storage space or restricted traffic patterns, take advantage of our Mobile Production Vehicle (MPV) for fast and cost effective on-site steel pipe manufacturing. The PIPE MPV® is designed to be a self-supporting factory that can be quickly deployed and put into production. Once on site, pipe manufacturing progresses quickly enough to allow pipe installation within four hours.

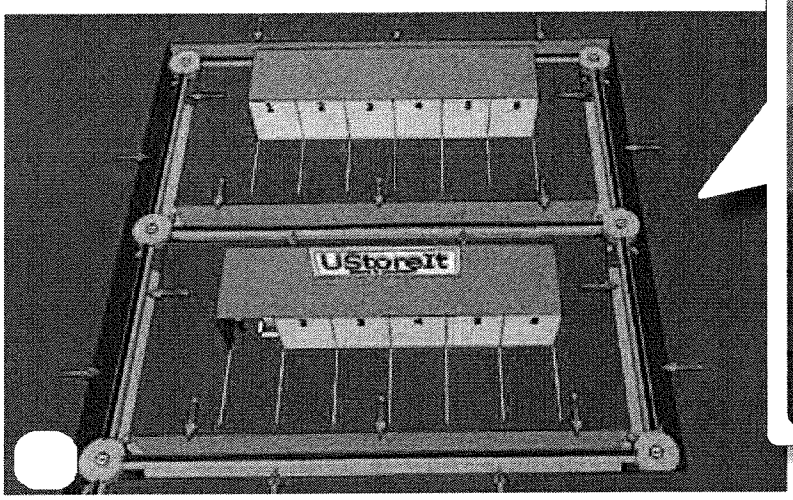
The PIPE MPV can produce corrugated metal pipe in a variety of sizes. Diameters from 36" — 192" and lengths up to 35' can be accommodated. This pipe meets the same levels of quality construction as does all CONTECH manufactured pipe, with high coil feedrate speeds and the same lock-seem edge process used in conventional pipe manufacturing.

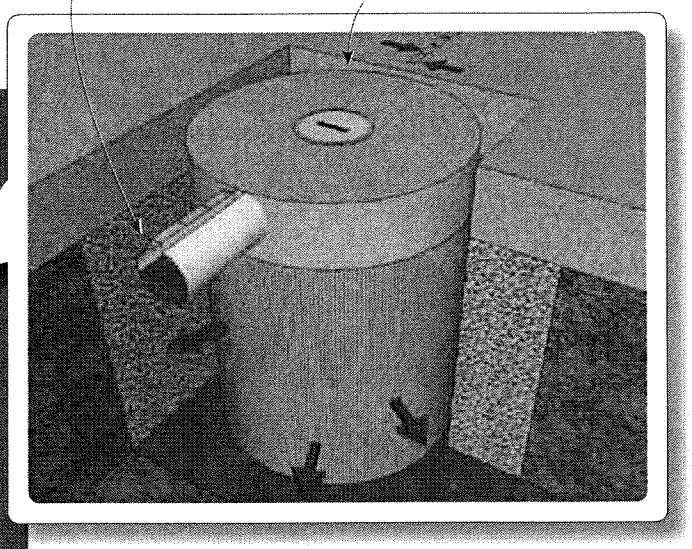


Mobile Production vehicle

Innovative Solutions for Challenging Sites

The flexibility of CMP allows you to create innovative solutions when dealing with challenging sites. For example, when trying to meet runoff reduction requirements, your site may be mostly impervious or you may have a thin, shallow clay layer just below the surface, limiting the infiltration capacity of surface BMPs. One solution is to utilize CMP infiltration wells. First, collect the site runoff using our Slotted Drain™ around the perimeter of each drive isle. The Slotted Drain then directs water into vertical lengths of perforated CMP. The vertical perforated CMP is long enough to penetrate the clay layer and infiltrate the stormwater into a highly permeable alluvial layer about 12'-14' belowground. This allows the developer to meet the LID requirements and eliminate the need for the extended detention basin.





Sizing

Round Pipe - CMP and Plate (CMP → 12-in to 144-in; Plate → 60-in to 240-in)

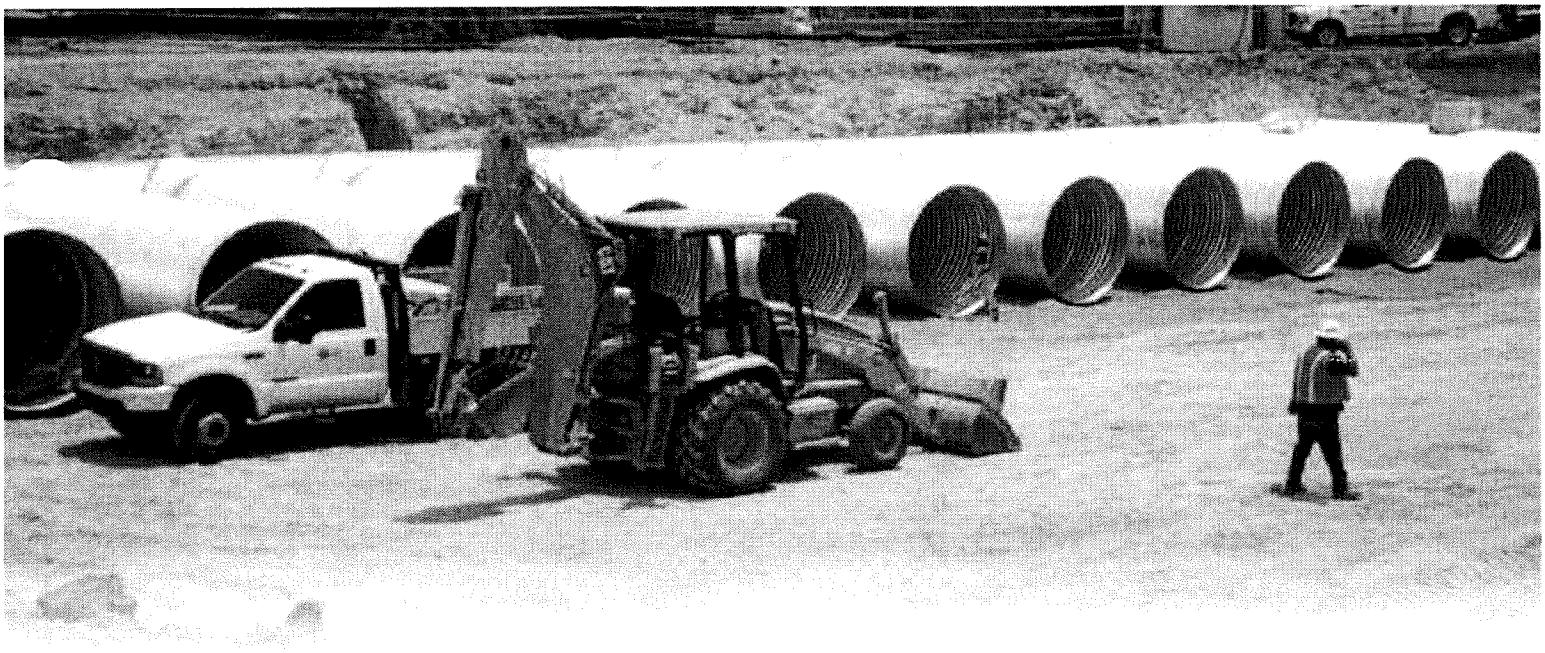
Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height	Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height	Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height	Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height
12	.78	12"	60	19.6	12"	120	78.5	18"	180	176	24"
15	1.22	12"	66	23.7	12"	126	86.5	18"	186	188	24"
18	1.76	12"	72	28.2	12"	132	95.0	18"	192	201	24"
21	2.40	12"	78	33.1	12"	138	103.8	18"	198	213	30"
24	3.14	12"	84	38.4	12"	144	113.1	18"	204	227	30"
30	4.9	12"	90	44.1	12"	150	122	24"	210	240	30"
36	7.0	12"	96	50.2	12"	156	132	24"	216	254	30"
42	9.6	12"	102	56.7	18"	162	143	24"	222	268	30"
48	12.5	12"	108	63.6	18"	168	153	24"	228	283	30"
54	15.9	12"	114	70.8	18"	174	165	24"	234	298	30"

Pipe-Arch - CMP

1/2" Deep Corrugations											
Shape (inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (inches)	Volume (ft^3/ft)	Min. Cover Height
17 x 13	1.1	12"	28 x 20	2.9	12"	49 x 33	8.9	12"	71 x 47	18.1	12"
21 x 15	1.6	12"	35 x 24	4.5	12"	57 x 38	11.6	12"	77 x 52	21.9	12"
24 x 18	2.2	12"	42 x 29	6.5	12"	64 x 43	14.7	12"	83 x 57	26.0	12"
1" Deep Corrugations											
60 x 46	15.6	15"	81 x 59	27.4	18"	103 x 71	42.4	18"	128 x 83	60.5	24"
66 x 51	19.3	15"	87 x 63	32.1	18"	112 x 75	48.0	21"	137 x 87	67.4	24"
73 x 55	23.2	18"	95 x 67	37.0	18"	117 x 79	54.2	21"	142 x 91	74.5	24"

Pipe-Arch - Multi Plate

2" Deep Corrugations												
	Shape (ft-in.)	Volume (ft^3/ft)	Min. Cover Height	Shape (Inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (Inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (Inches)	Volume (ft^3/ft)	Min. Cover Height
18-in Corner Radius (Rc)	6-1 x 4-7	22	12"	8-7 x 5-11	41	18"	8-7 x 5-11	41	18"	14-1 x 8-9	97	24"
	6-4 x 4-9	24	12"	8-10 x 6-1	43	18"	8-10 x 6-1	43	18"	14-3 x 8-11	101	24"
	6-9 x 4-11	26	12"	9-4 x 6-3	46	18"	9-4 x 6-3	46	18"	14-10 x 9-1	105	24"
	7-0 x 5-1	29	12"	9-6 x 6-5	49	18"	9-6 x 6-5	49	18"	15-4 x 9-3	109	24"
	7-3 x 5-3	31	12"	9-9 x 6-7	52	18"	9-9 x 6-7	52	18"	15-6 x 9-5	114	24"
	7-8 x 5-5	33	12"	10-3 x 6-9	55	18"	10-3 x 6-9	55	18"	15-8 x 9-7	118	24"
	7-11 x 5-7	36	12"	10-8 x 6-11	58	18"	10-8 x 6-11	58	18"	15-10 x 9-10	122	24"
	8-2 x 5-9	38	18"	10-11 x 7-1	61	18"	10-11 x 7-1	61	18"	16-5 x 9-11	126	30"
							13-11 x 8-7	93	24"	16-7 x 10-1	131	30"
31-in Corner Radius (Rc)	13-3 x 9-4	98	24"	15-4 x 10-4	124	24"	17-2 x 11-4	153	30"	19-3 x 12-4	185	30"
	13-6 x 9-6	102	24"	15-7 x 10-6	129	24"	17-5 x 11-6	158	30"	19-6 x 12-6	191	30"
	14-0 x 9-8	106	24"	15-10 x 10-8	134	24"	17-11 x 11-8	163	30"	19-8 x 12-8	196	30"
	14-2 x 9-10	111	24"	16-3 x 10-10	138	30"	18-1 x 11-10	168	30"	19-11 x 12-10	202	30"
	14-5 x 10-0	115	24"	16-6 x 11-0	143	30"	18-7 x 12-0	174	30"	20-5 x 13-0	208	36"
	14-11 x 10-2	120	24"	17-0 x 11-2	148	30"	18-9 x 12-2	179	30"	20-7 x 13-2	214	36"



Next Steps

Learn more

Read our white paper, *Economic Optimization of Infiltration Systems*, to learn more. You'll receive free PDH credits for completing a quick quiz. Available at **www.contech-cpi.com/cmp**

Connect with us

We're always available to make your job easier. Search for your local rep at **www.contech-cpi.com.** While you're there, be sure to check out our upcoming seminar schedule or request an in-house technical presentation.

Start a Project

If you are ready to begin a project, check out our DYODS calculator available for adjustable and rectangular CMP systems. Download at **www.contech-cpi.com/cmp**.

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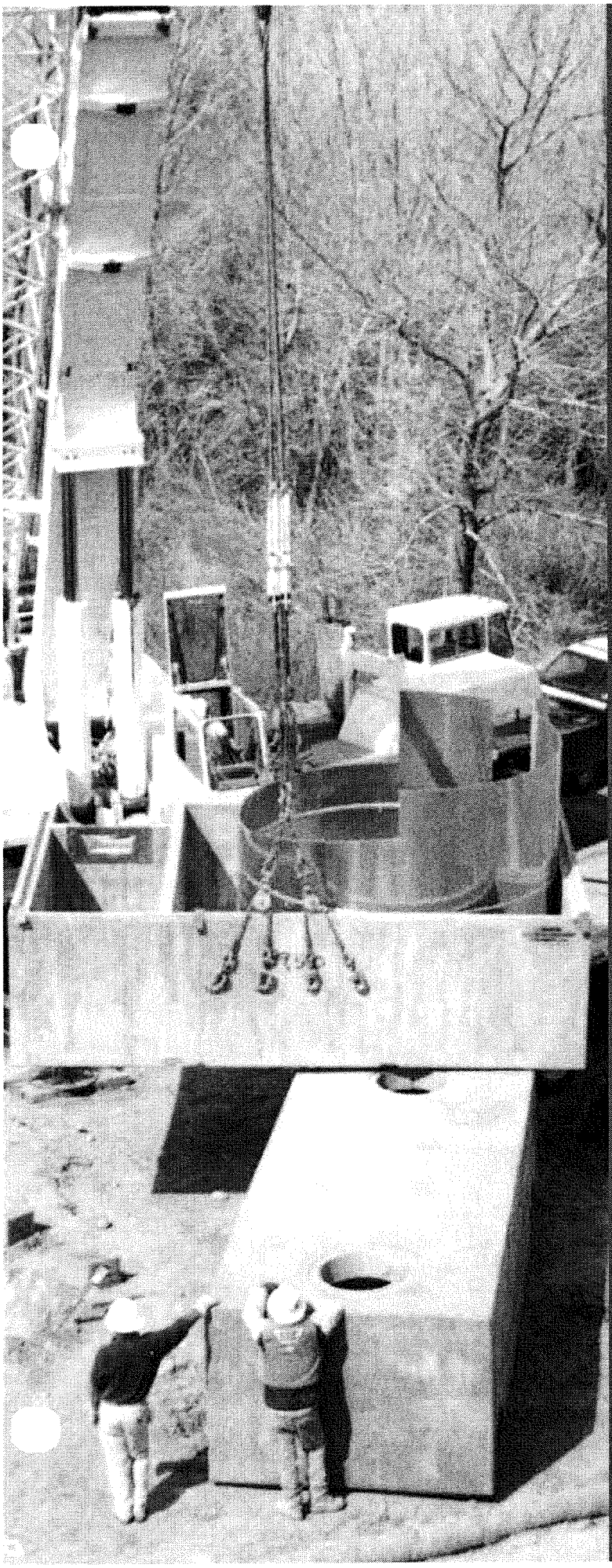
CMP Detention-Infiltration SM 01/11 MC



URBANGREEN™

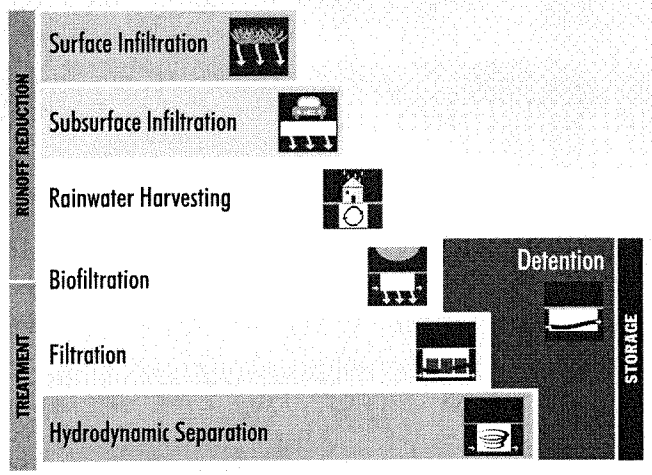
Hydrodynamic Separation Products

CONTECH®
CONSTRUCTION PRODUCTS INC.

Hydrodynamic Separation

Selecting the right stormater solution just got easier...

It's simple to choose the right low impact development (LID) solution to achieve your runoff reduction goals with the CONTECH UrbanGreen Staircase. First, select the runoff reduction practices that are most appropriate for your site, paying particular attention to pretreatment needs. If the entire design storm cannot be retained, select a treatment best management practice (BMP) for the balance. Finally, select a detention system to address any outstanding downstream erosion.



Removing Pollutants with Hydrodynamic Separation

Hydrodynamic separators are some of the first technologies to be developed for treating stormwater. Our hydrodynamic separation (HDS) products have been providing reliable stormwater treatment solutions for more than 20 years. With performance proven in the lab and in the field at sites across the country, these systems are widely accepted for effective solids removal. They are an optimal choice for pretreatment systems, especially efficient on gross solids, trash and debris, while also removing total suspended solids (TSS).

Fundamentals of HDS

- Create a low velocity vortex action to:
  - Increase efficiency by increasing length of flow path and eliminating short circuiting
  - Concentrate solids in staple, low velocity flow field
- Incorporate flow controls to:
  - Minimize turbulence and velocity
  - Prevent flow surges and resuspension
  - Retain floating pollutants
- Provide easy access to captured pollutants to make maintenance easy

Learn more about hydrodynamic separation at www.contech-cpi/stormwater

> Our hydrodynamic separation products have been providing reliable stormwater treatment solutions for more than 20 years ❖❖❖

Applications

HDS products work well as standalone or end-of-pipe treatment systems and can easily be implemented in a retrofit scenario. They are particularly effective at removal of solids, trash and debris – and can help you meet TMDL requirements for these pollutants. HDS systems are also optimal pretreatment systems – and an important building block in a low impact development (LID) design. By removing solids, trash and debris prior to detention, infiltration or re-use systems, you can significantly increase their service life.

Water Quality

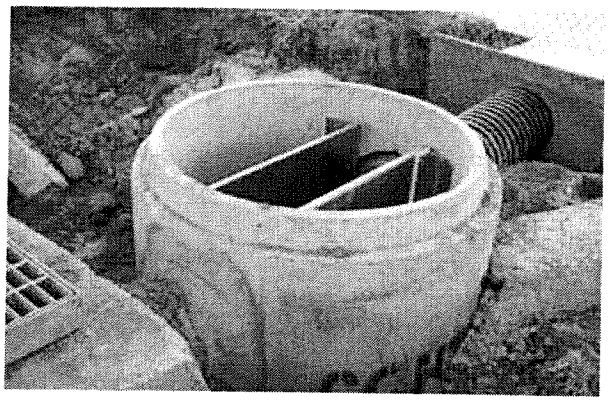
HDS products provide high-performance stormwater pollutant removal. These systems are effective in removing solids to meet water quality goals and can be designed to achieve site treatment goals for TSS or oil.

Pretreatment for Low Impact Development (LID) Designs

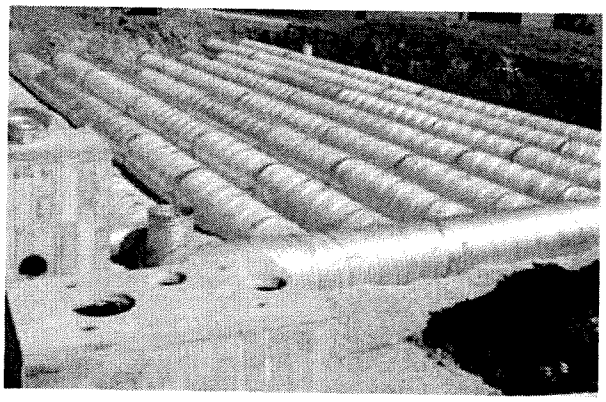
Hydrodynamic separation systems installed as pretreatment reduce downstream loading to reduce maintenance

Inlet and Outlet Pollution Control

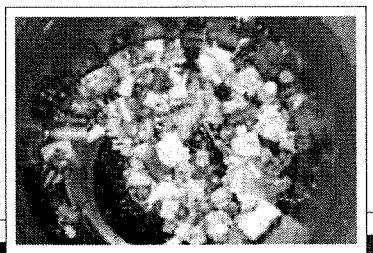
Our HDS products are especially effective for solids and trash and debris. They can be installed at either the inlet or outlet of a drainage system to prevent pollutants from being discharged into lakes, streams or the ocean.

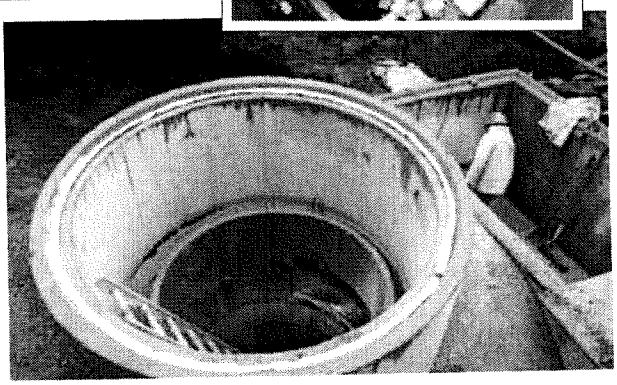


VortSentry HS is an effective option where space is limited



A Vortechs protects detention system from sediment build-up and reduces maintenance

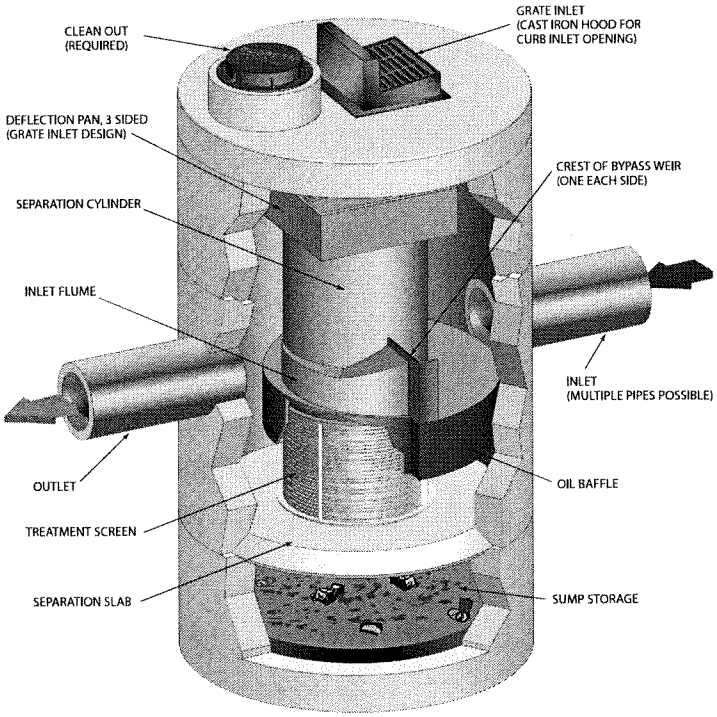




CDS unit installed to remove trash before entering Lake Meritt in Oakland, CA

CDS®

The CDS is a swirl concentrator hybrid technology that provides continuous deflective separation – a combination of swirl concentration and patented indirect screening – into a uniquely capable product. It effectively screens, separates and traps debris, sediment and oil from stormwater runoff and is an ideal system to meet trash Total Maximum Daily Load (TMDL) requirements.



Features & Benefits

One-of-a-Kind Screening Technology

- Captures and retains 100% of floatables and neutrally buoyant debris 2.4mm or larger
- Effectively removes solids down to 100μm
- Self-cleaning screen – the only non-blocking screening technology available
- Water velocities within the swirl chamber continually shear debris off the screen to keep it clean
- Various screening apertures available

Proven Performance

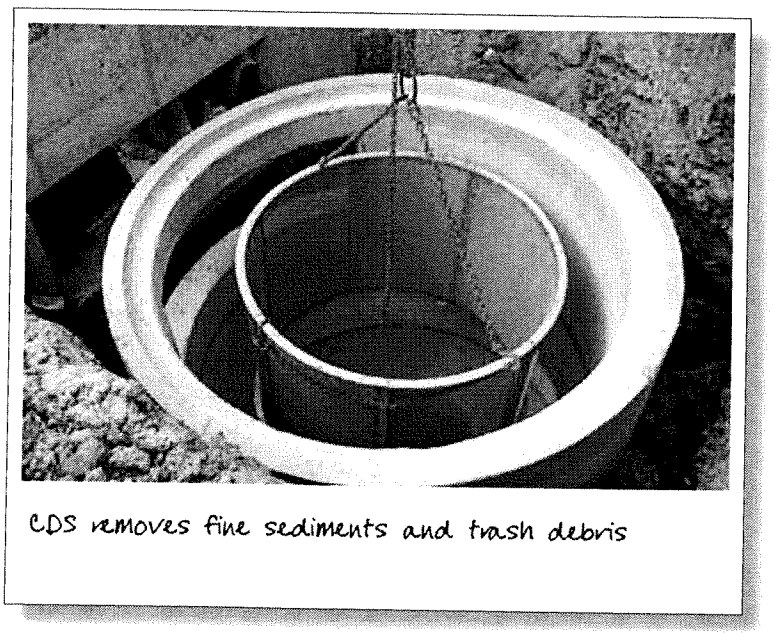
- Performance verified by NJ CAT and WA Ecology

Excellent Pollutant Retention

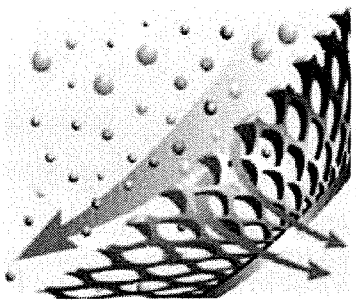
- Isolated Storage Sump eliminates scour potential
- Oil Baffle improves hydrocarbon removal

Multiple Options to Meet Site-Specific Needs

- Inline, offline, grate inlet and drop inlet configuration
- Accepts multiple pipe inlets and 90-180º angles – eliminate the need for junction manholes
- Internal and external peak bypass options available
- High treatment flow capacity – up to 300 cfs



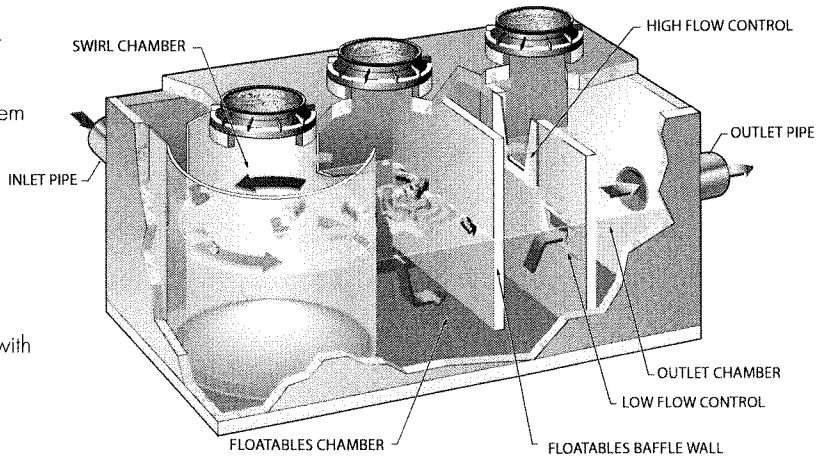
CDS removes fine sediments and trash debris



Continuous deflective separation — water velocities within the swirl chamber continually shear debris off the screen to keep it clean

Vortechs®

The Vortechs system's swirl concentrator and flow controls work together to create a low energy environment, ideal for capturing and storing fine particles and other pollutants of concern. With comprehensive lab and field testing, the system delivers proven results and site-specific solutions.



Features & Benefits

Shallow Profile

- Easy and cost-effective installation, especially on sites with high groundwater or bedrock
- Typical invert only 3 feet below pipe

Effective Fine Solids Removal

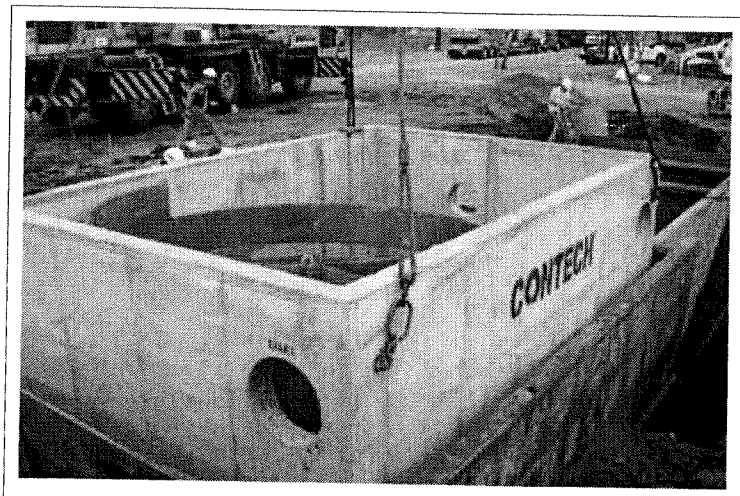
- Large swirl chamber – Enhances very fine particle removal (down to 50 microns)
- Flow controls reduce inflow velocity and increase residence time
- Largest treatment zone surface area of any swirl concentrator system available

Easy Maintenance

- Unobstructed access to stored pollutants
- Sealed swirl chamber decreases clean-out volume

Proven Performance

- Performance verified by NJ CAT and WA Ecology



Large diameter swirl chamber for enhancement of sediment removal in a low profile unit

Our systems are widely accepted for effective solids removal ❖❖❖

VortSentry® HS

The VortSentry HS hydrodynamic separator has a small footprint making it an effective pretreatment or treatment option for projects where space is at a premium.

Helical Flow Pattern

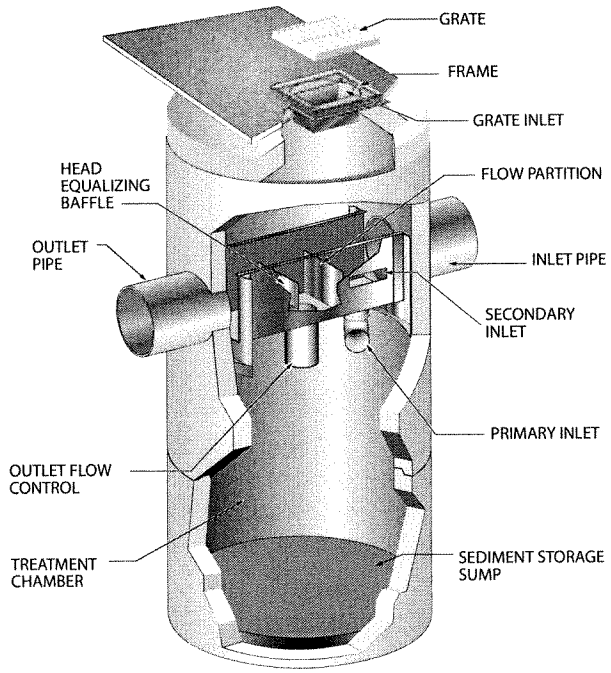
- Enhances trapping and containment of pollutants
- Provides effective removal of settleable solids and floating contaminants

Unique Internal Bypass

- Accepts a wide range of pipe sizes to treat and convey a wide range of flows
- Higher flows can be diverted without the use of external bypass structures
- Secondary inlet enhances floatable debris capture

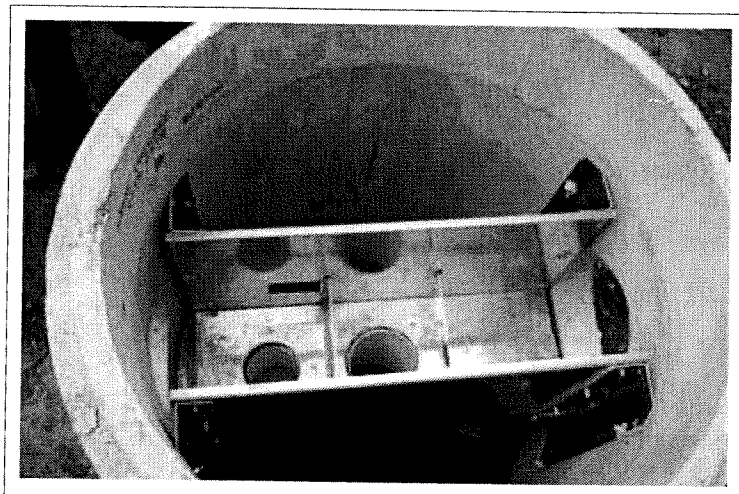
Flexible, Compact Design

- Small manhole footprint
- Inlet and grated inlet configuration available



VortSentry®

Similar to the VortSentry HS, the VortSentry is a compact manhole hydrodynamic separator; however it does not have the same treatment flow routing components/controls as the VortSentry HS does. This limits the flow rate and pipe sizes the system can accept. The VortSentry has received approval and is accepted by many municipalities, and is currently available in only those areas. Please see www.contech-cpi.com/vortsentry for more information.



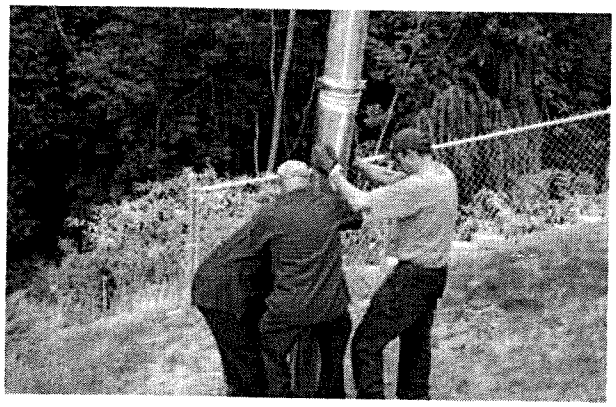
VSHS unique internal bypass design treats high flows and bypasses peak flow, eliminating washout

Maintenance

All stormwater treatment systems – whether natural or manufactured –should be maintained regularly. Despite the widespread implementation of BMPs, water quality goals will not be met if the treatment structures are not properly cleaned and maintained.

Systems vary in their maintenance needs, and the selection of a cost-effective and easy-to-access treatment system can mean a huge difference in maintenance expenses for years to come.

We design our products to minimize maintenance and make it as easy and inexpensive as possible to keep our systems working properly.



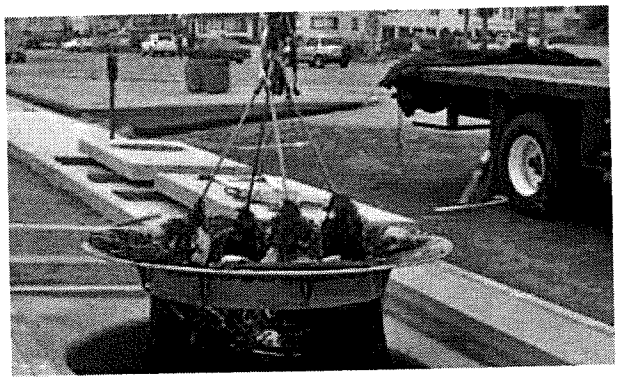
A vacuum truck excavates pollutants from the systems

Inspection

Inspection is the key to effective maintenance. Pollutant deposition and transport may vary from year to year and site to site. Semi-annual inspections will help ensure that the system is cleaned out at the appropriate time. Inspections should be performed more frequently where site conditions may cause rapid accumulation of pollutants.

Vortechs, VortSentry and VortSentry HS

These systems should be cleaned out when sediment has accumulated to a specific depth (refer to the respective maintenance guidelines for details). Maintaining these systems is easiest when there is no flow entering the system. A vacuum truck is generally the most effective and convenient method of excavating pollutants from the systems.

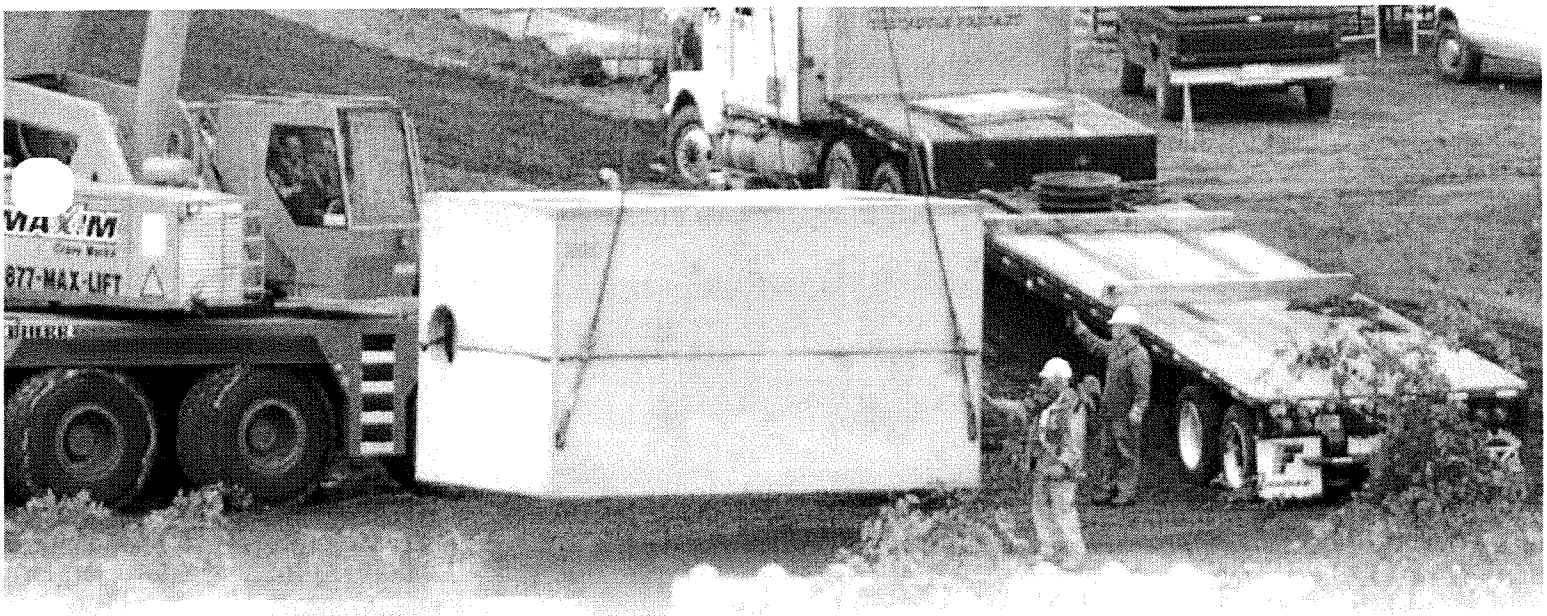


A CDS unit can be easily cleaned out in less than 30 minutes

CDS

The recommended cleanout of solids within the CDS unit's sump should occur at 75% of the sump capacity. Access to the CDS unit is typically achieved through two manhole access covers – one allows inspection and cleanout of the separation chamber and sump, and another allows inspection and cleanout of sediment captured and retained behind the screen. A vacuum truck is recommended for cleanout of the CDS unit and can be easily accomplished in less than 30 minutes for most installations.

All stormwater systems should be maintained regularly ❖ ❖ ❖



Next Steps

Learn more

See our HDS systems in action. Flash animations available at **www.contech-cpi.com/hds**

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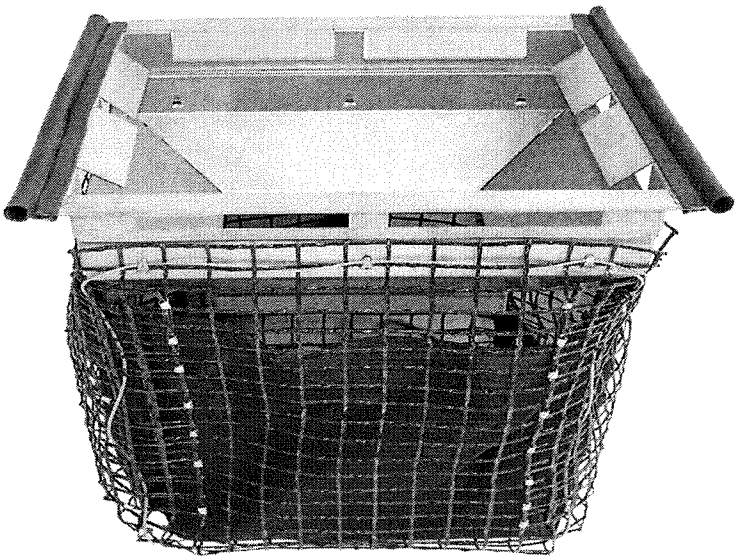


KRISTAR

FloGard® +PLUS

Catch Basin Insert Filter

FloGard®+PLUS Catch Basin Insert Filter

GENERAL FILTER CONFIGURATION

FloGard®+PLUS catch basin insert filter shall provide solids filtration through a filter screen or filter liner, and hydrocarbon capture shall be effected using a non-leaching absorbent material contained in a pouch or similar removable restraint. Hydrocarbon absorbent shall not be placed at an exposed location at the entry to the filter that would allow blinding by debris and sediment without provision for self-cleaning in operation.

Filter shall conform to the dimensions of the inlet in which it is applied, allow removal and replacement of all internal components, and allow complete inspection and cleaning in the field.

FLOW CAPACITY

Filter shall provide two internal high-flow bypass locations that in total exceed the inlet peak flow capacity. Filter shall provide filtered flow capacity in excess of the required "first flush" treatment flow. Unit shall not impede flow into or through the catch basin when properly sized and installed.

MATERIALS

Filter support frame shall be constructed of type 304 stainless steel. Filter screen, when used in place of filter liner, shall be type 304 or 316 stainless steel, with an apparent opening size of not less than 4 U.S. mesh. Filter liner, when used in place of filter screen, shall be woven polypropylene geotextile fabric liner with an apparent opening size (AOS) of not less than 40 U.S. mesh as determined by ASTM D 4751. Filter liner shall include a support basket of polypropylene geogrid with stainless steel cable reinforcement.

Filter frame shall be rated at a minimum 25-year service life. All other materials, with the exception of the hydrocarbon absorbent, shall have a rated service life in excess of 2 years.

FloGard®+PLUS TEST RESULTS SUMMARY

Testing Agency	% TSS Removal	% Oil and Grease Removal	% PAH Removal
UCLA	80	70 to 80	
U of Auckland Tonking & Taylor Ltd. (for city of Auckland)	78 to 95		
U of Hawaii (for city of Honolulu)	80		20 to 40

FEATURES

- Easy to install, inspect and maintain
- Can be retrofitted to existing drain catch basins – or used in new projects
- Economical and efficient
- Catches pollutants where they are easiest to catch (at the inlet)
- No standing water – minimizes vector, bacteria and odor problems
- Can be incorporated as part of a "Treatment Train"

BENEFITS

- Lower installation, inspection and maintenance costs
- Versatile installation applications
- Higher return on investment
- Allows for installation on small and confined sites
- Minimizes vector, bacteria and odor problems
- Allows user to target specific pollutants

Innovative stormwater management products

FloGard® +PLUS

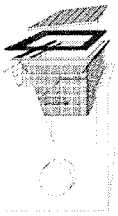
Catch Basin Insert Filter

INSTALLATION AND MAINTENANCE

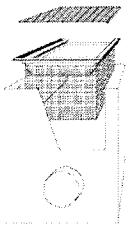
Filter shall be installed and maintained in accordance with manufacturer's general instructions and recommendations.

PERFORMANCE

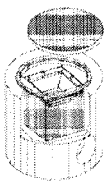
Filter shall provide 80% removal of total suspended solids (TSS) from treated flow with a particle size distribution consistent with typical urban street deposited sediments. Filter shall capture at least 70% of oil and grease and 40% of total phosphorus (TP) associated with organic debris from treated flow. Unit shall provide for isolation of trapped pollutants, including debris, sediments, and floatable trash and hydrocarbons, from bypass flow such that re-suspension and loss of pollutants is minimized during peak flow events.



FloGard+PLUS Combination Inlet



FloGard+PLUS Flat Grate



FloGard+PLUS Round Gated Inlet

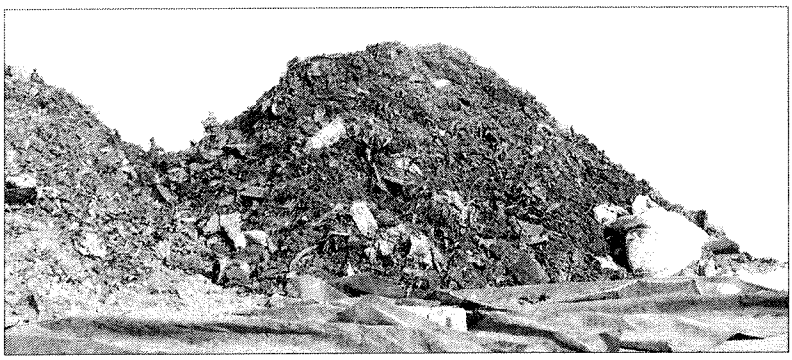
FloGard®+PLUS COMPETITIVE FEATURE COMPARISON

Evaluation of FloGard+PLUS Units (Based on flow-comparable units) (Scale 1-10, 10 being best)	**FloGard+PLUS**	**Other Insert Filter Types****
Flow Rate	10	7
Removal Efficiency*	80%	45%
Capacity – Sludge and Oil	7	7
Service Life	10	3
Installation – Ease of Handling / Installation	8	6
Ease of Inspections & Maintenance	7	7
Value	**10**	**2**

*approximate, based on field sediment removal testing in urban street application **average

Long-Term Cost Comparison (Scale 1-10, 10 being lowest cost, higher number being best)	**FloGard+PLUS**	**Other Insert Filter Types**
Unit cost — initial ($/cfs treated)	10	4
Installation cost ($/cfs treated)	10	7
Adsorbent replacement (annual avg $/cfs treated)	10	2
Unit materials replacement (annual avg $/cfs treated)	10	10
Maintenance cost (annual avg $/cfs treated)	10	7
Total first yr ($/cfs treated)	10	5
Total Annual Avg ($/cfs treated, avg over 20 yrs)*	**10**	**5**

*assumes 3% annual inflation



Captured debris from FloGard+PLUS, Dana Point, CA

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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FGP-T 05.19.09.1M

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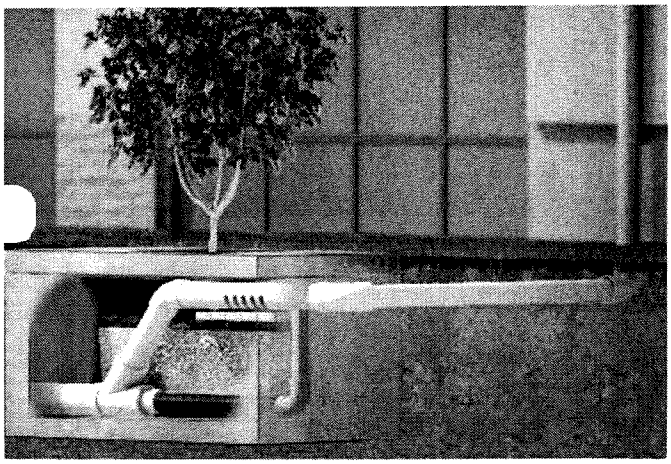


filterra
Bioretention Systems
by KRISTAR

Filterra® Roofdrain Stormwater Treatment System

A Greenroof at Ground Level™

Filterra® Roofdrain System

The Filterra Roofdrain System treats piped in stormwater runoff from rooftops. Using bioretention filtration the system captures and immobilizes pollutants of concern such as: TSS, nutrients and metals.

Stormwater continues to flow through the media and into the underdrain system, where treated water is discharged. Higher flows bypass the bioretention treatment via an overflow/bypass pipe design.

Features and Benefits

Best Value for Rooftop Treatment.

- **compact size**
- **needs no external bypass**
- **easy installation**
- **simple maintenance**

Versatile.
Filterra Roofdrain can be used for:

- **new construction**
- **retrofits**
- **commercial or residential applications.**

Filterra Roofdrain can be placed:

- **At grade**
- **Above grade with effluent below grade to meet elevation challenges of high water tables**
- **Install next to or away from your building**

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

Protection. The Filterra Roofdrain's hydraulic configuration was tested by the Colorado State University Hydraulics Laboratory.

Below grade treatment using Filterra Roofdrain avoids the slipping hazard liabilities of daylighted roofdrains during freezing weather.

otect from erosion with Filterra's monolithic water tight design.

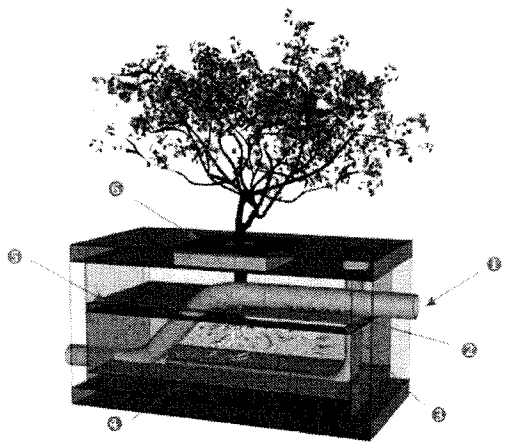
Expected Pollutant Removal

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

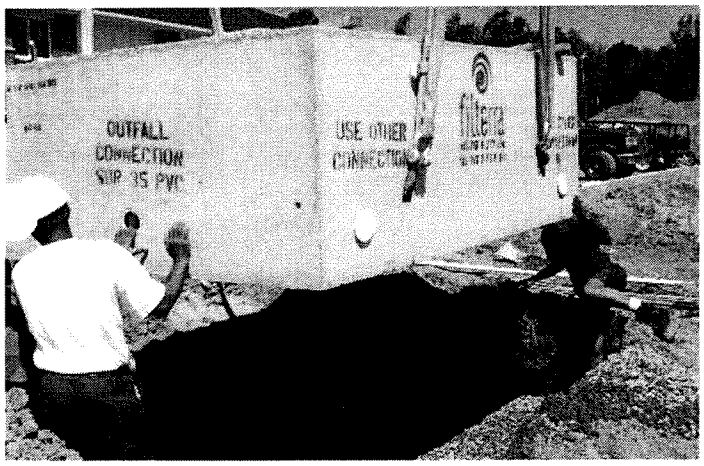
TSS Removal	85%
Phosphorus Removal	60% - 70%
Zinc Removal	> 66%
Copper Removal	>58%
Nitrogen Removal	43%
Oil & Grease	> 93%

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. Influent Pipe from Roof Leader
2. Pipe slots allow treatment flow to media surface
3. Erosion Control
4. Perforated Underdrain for Treatment Flows
5. Protective Mulch Layer
6. Cast Iron Tree Grate for Maintenance Access



filterra
Bioretention Systems
by KRISTAR

Filterra® Roofdrain Stormwater Treatment System

A Greenroof at Ground Level™

Design Guidelines

1) Use the Filterra Roofdrain Design Guidance as a reference available from info@kristar.com.

2) Select Filterra Roofdrain model according to your Regional Sizing Table, and according to the building's roof drainage area and associated roof drain pipe sizes.

3) Determine Filterra Roofdrain placement next to a building, or away from your building.

4) Ensure piping to and from Filterra Roofdrain system 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 require that each Filterra Roofdrain 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) Pipe flow of the Filterra Roofdrain System eliminates the cross-linear flow requirements necessary with standard Filterra.

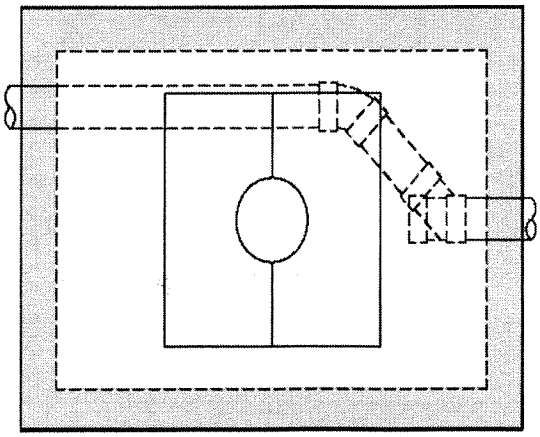
2) Filterra Roofdrain Systems should only receive piped in runoff.

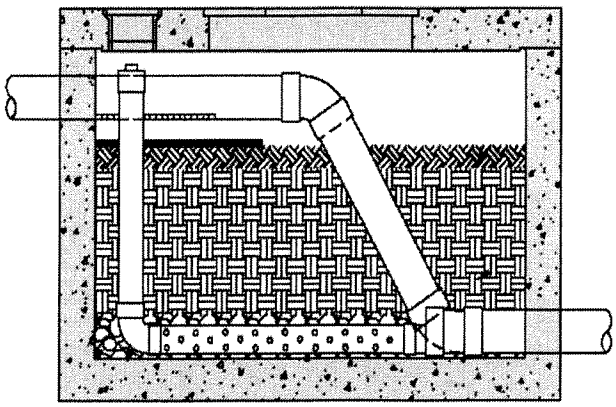
3) Rooftop drainage should still be designed with emergency bypass relief prior to the Filterra Roofdrain System (e.g.: rooftop scuppers, etc.)

Always follow local plumbing codes for roof drainage requirements.

The Filterra System is not a substitute for rooftop overflow/bypass.

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





Filterra Roofdrain System
One pipe in, one pipe out, with internal high-flow bypass.

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

Filterra® is protected by U.S. Patents #6,277,274, #6,569,321 & #7,625,485. Other patents pending.
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Appendix D - Inspection and Maintenance Guidelines

- **Filterra - Bioretention Systems Maintenance Services Guide**
- **Contech - Underground Detention and Infiltration Maintenance Guide**
- **Contech - CDS Inspection and Maintenance Guide**
- **Kristar - Flogard+Plus Maintenance Guide**

filterra

Maintenance Services

for

Filterra® Stormwater Bioretention Filtration Systems

- Extended Maintenance Service
- Maintenance Training for your Landscape Contractor or Local DPW

filterra

Corporate Headquarters
11352 Virginia Precast Road
Ashland, VA 23005
Toll Free: (866) 349-3458
Fax: (804) 798-8400

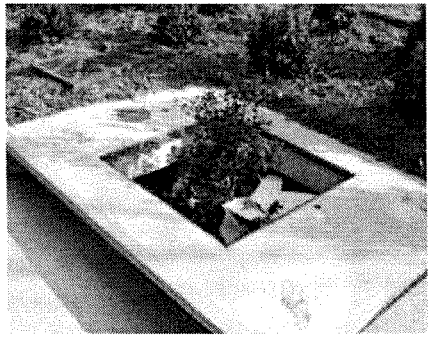
E-mail: design@filterra.com
www.filterra.com

Filterra® is a division of AMERICAST
Filterra® is protected by
U.S. Patents # 6,277,274 & 6,569,321

Filterra® - Americast
11352 Virginia Precast Road
Ashland, VA 23005

Why M tain?

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.



Maint ance Includes

Filterra maintenance includes:

- Unit inspection
- Debris, trash & mulch removal & disposal
- Filter media evaluation
- Plant health evaluation
- Replacement of mulch
- Updated and stored records of performed maintenance

- **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.**

Why use Filterra Services?

- As the manufacturer we have performed 1,000's of maintenance visits.
- Filterra will schedule visits and keep maintenance records for you.
- Cost effective, multi-year plans available.
- Backed by Filterra's technical department.
- Use only Filterra approved materials.

Training Includes

- Site visit by Filterra personnel.
- Full maintenance demonstration on a single unit.
- Instructional DVD.
- *Maintenance Instruction Manual* complete with color photos.
- Maintenance forms for keeping your own records.

Please complete all sections, detach and return to Filterra® or call 866-349-3458

Project Name: _____

Site Address: _____

☐ Owner
☐ Owner Representative
☐ Current Occupant
☐ Home Owner Association

Contact Information:

Name: _____

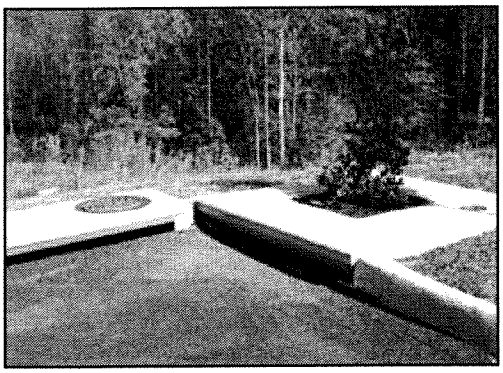
Company Name (if applicable): _____

Phone: _____ E-mail: _____

I am interested in:

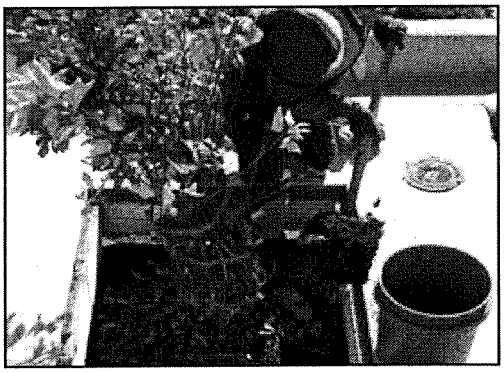
☐ Extended Maintenance
☐ Maintentance Training

Filterra® Maintenance Steps



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. Clean area around Filterra

6. Complete paperwork and record plant height and width

For additional information please contact your local Filterra sales representative.
Eastern Zone: 866-349-3458, Western Zone: 877-345-1450.

© 2007 Filterra

Maintenance

Underground storm water detention and retention systems should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size or configuration of the system.

Inspection

Inspection is the key to effective maintenance and is easily performed. CONTECH recommends ongoing quarterly inspections of the accumulated sediment. Sediment deposition and transport may vary from year to year and quarterly inspections will help insure that systems are cleaned out at the appropriate time. Inspections should be performed more often in the winter months in climates where sanding operations may lead to rapid accumulations, or in equipment washdown areas. It is very useful to keep a record of each inspection. A sample inspection log is included for your use.

Systems should be cleaned when inspection reveals that accumulated sediment or trash is clogging the discharge orifice. CONTECH suggests that all systems be designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.

Cleaning

Maintaining an underground detention or retention system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.

Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities.

CONTECH STORMWATER SOLUTIONS

Inspection & Maintenance Log

__" Diameter System			Location: Anywhere, USA		
Date	**Depth of Sediment**	**Accumulated Trash**	**Maintenance Performed**	**Maintenance Personnel**	**Comments**
12/01/99	2"	None	Removed Sediment	B. Johnson	Installed
03/01/00	1"	Some	Removed Sediment and Trash	B. Johnson	Swept parking lot
06/01/00	0"	None	None		
09/01/00	0"	Heavy	Removed Trash	S. Riley	
12/01/00	1"	None	Removed Sediment	S. Riley	
4/01/01	0"	None	None	S. Riley	
04/15/01	2"	Some	Removed Sediment and Trash	ACE Environmental Services	

SAMPLE

CONTECH®
CONSTRUCTION PRODUCTS INC.

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

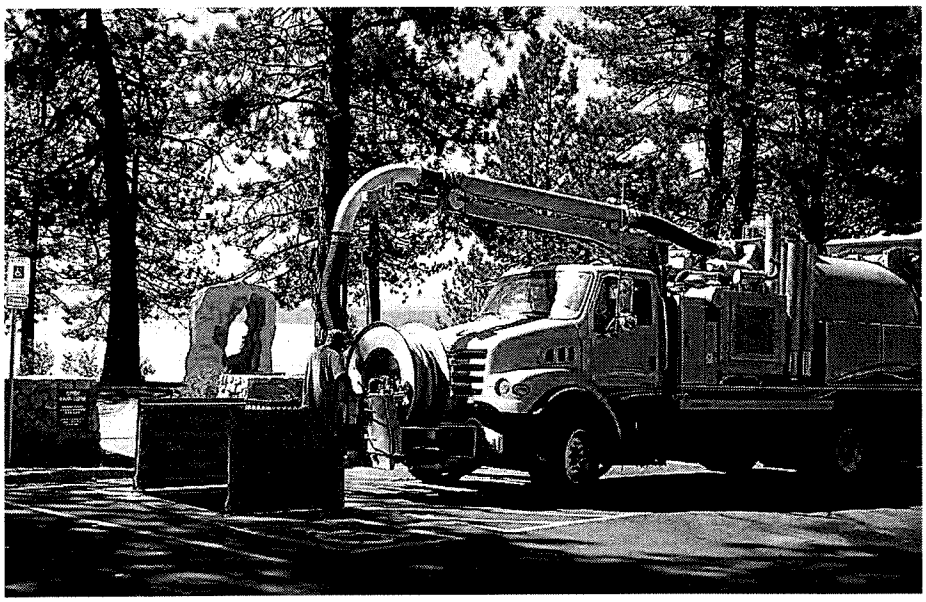
Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.5	0.4
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities



Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

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CONTECH Construction Products Inc. provides site solutions for the civil engineering industry. CONTECH's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other CONTECH division offerings, visit contech-cpi.com or call 800.338.1122

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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; 7,517,450 related foreign patents or other patents pending.

CONTECH CONSTRUCTION PRODUCTS INC.
800.925.5240
contechstormwater.com

CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than eighteen inches the system should be cleaned out. **Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

GENERAL SPECIFICATIONS FOR MAINTENANCE OF
***FLO-GARD+PLUS®* CATCH BASIN INSERT FILTERS**

SCOPE:

Federal, State and Local Clean Water Act regulations and those of insurance carriers require that stormwater filtration systems be maintained and serviced on a recurring basis. The intent of the regulations is to ensure that the systems, on a continuing basis, efficiently remove pollutants from stormwater runoff thereby preventing pollution of the nation's water resources. These specifications apply to the FloGard+Plus® Catch Basin Insert Filter.

RECOMMENDED FREQUENCY OF SERVICE:

Drainage Protection Systems (DPS) recommends that installed Flo-Gard+Plus® Catch Basin Insert Filters be serviced on a recurring basis. Ultimately, the frequency depends on the amount of runoff, pollutant loading and interference from debris (leaves, vegetation, cans, paper, etc.); however, it is recommended that each installation be serviced a minimum of three times per year, with a change of filter medium once per year. DPS technicians are available to do an on-site evaluation, upon request.

RECOMMENDED TIMING OF SERVICE:

DPS guidelines for the timing of service are as follows:

1. For areas with a definite rainy season: Prior to, during and following the rainy season.
2. For areas subject to year-round rainfall: On a recurring basis (at least three times per year).
3. For areas with winter snow and summer rain: Prior to and just after the snow season and during the summer rain season.
4. For installed devices not subject to the elements (washracks, parking garages, etc.): On a recurring basis (no less than three times per years).

SERVICE PROCEDURES:

1. The catch basin grate shall be removed and set to one side. The catch basin shall be visually inspected for defects and possible illegal dumping. If illegal dumping has occurred, the proper authorities and property owner representative shall be notified as soon as practicable.
2. Using an industrial vacuum, the collected materials shall be removed from the liner. (Note: DPS uses a truck-mounted vacuum for servicing Flo-Gard+Plus® catch basin inserts.)
3. When all of the collected materials have been removed, the filter medium pouches shall be removed by unsnapping the tether from the D-ring and set to one side. The filter liner, gaskets, stainless steel frame and mounting brackets, etc. shall be inspected for continued serviceability. Minor damage or defects found shall be corrected on-the-spot and a notation made on the Maintenance Record. More extensive deficiencies that affect the efficiency of the filter (torn liner, etc.), if approved by the customer representative, will be corrected and an invoice submitted to the representative along with the Maintenance Record.
4. The filter medium pouches shall be inspected for defects and continued serviceability and replaced as necessary and the pouch tethers re-attached to the liner's D-ring. See below.
5. The grate shall be replaced.

REPLACEMENT AND DISPOSAL OF EXPOSED FILTER MEDIUM AND COLLECTED DEBRIS

The frequency of filter medium pouch exchange will be in accordance with the existing DPS-Customer Maintenance Contract. DPS recommends that the medium be changed at least once per year. During the appropriate service, or if so determined by the service technician during a non-scheduled service, the filter medium pouches will be replaced with new pouches. Once the exposed pouches and debris have been removed, DPS has possession and must dispose of it in accordance with local, state and federal agency requirements.

DPS also has the capability of servicing all manner of catch basin inserts and catch basins without inserts, underground oil/water separators, stormwater interceptors and other such devices. All DPS personnel are highly qualified technicians and are confined space trained and certified. Call us at (888) 950-8826 for further information and assistance.

Appendix E - Educational Materials

- The Ocean Begins at your Front Door
- Homeowners Guide for Sustainable Water Use
- Household Tips
- Proper Disposal of Household Hazardous Waste
- Recycle at Your Local Used Oil Collection Center (North Orange County)
- Responsible Pest Control
- Sewer Spill
- Tips for the Home Improvement Projects
- Tips for Landscaping and Gardening
- Tips for Pet Care
- Tips for Using Concrete and Mortar
- Tips for the Food Service Industry
- Proper Maintenance Practices for your Business
- Orange County Watersheds Brochure
- Stormwater General Information
- How to Protect Your Bay and Ocean
- Pollution Reporting
- Hazardous Waste and Oil Recycling
- Commercial Trash Enclosure
- Food and Restaurant Pollution Prevention
- Managing Fats, Oils, and Greases
- Tips for Projects Using Paint

The Ocean Begins at Your Front Door

Even if you live miles from the Pacific Ocean, you may be unknowingly polluting it.

Dumping one quart of motor oil into a storm drain can contaminate 250,000 gallons of water.

Did You Know?

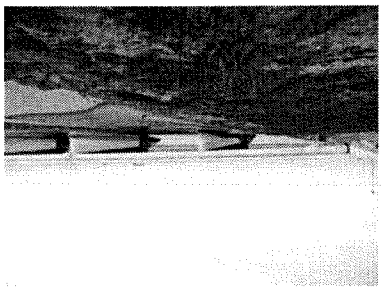
- Most people believe that the largest source of water pollution in urban areas comes from specific sources such as factories and sewage treatment plants. In fact, the largest source of water pollution comes from city streets, neighborhoods, construction sites and parking lots. This type of pollution is sometimes called "non-point source" pollution.
- There are two types of non-point source pollution: stormwater and urban runoff pollution.
- Stormwater runoff results from rainfall. When rainstorms cause large volumes of water to rinse the urban landscape, picking up pollutants along the way.
- Urban runoff can happen any time of the year when excessive water use from irrigation, vehicle washing and other sources carries trash, lawn clippings and other urban pollutants into storm drains.

Where Does It Go?

- Anything we use outside homes, vehicles and businesses – like motor oil, paint, pesticides, fertilizers and cleaners – can be blown or washed into storm drains.
- A little water from a garden hose or rain can also send materials into storm drains.
- Storm drains are separate from our sanitary sewer systems; unlike water in sanitary sewers (from sinks or toilets), water in storm drains is not treated before entering our waterways.

Sources of Non-Point Source Pollution

- Automotive leaks and spills.
- Improper disposal of used oil and other engine fluids.
- Metals found in vehicle exhaust, weathered paint, rust, metal plating and tires.
- Pesticides and fertilizers from lawns, gardens and farms.
- Improper disposal of cleaners, paint and paint removers.
- Soil erosion and dust debris from landscape and construction activities.
- Litter, lawn clippings, animal waste, and other organic matter.
- Oil stains on parking lots and paved surfaces.

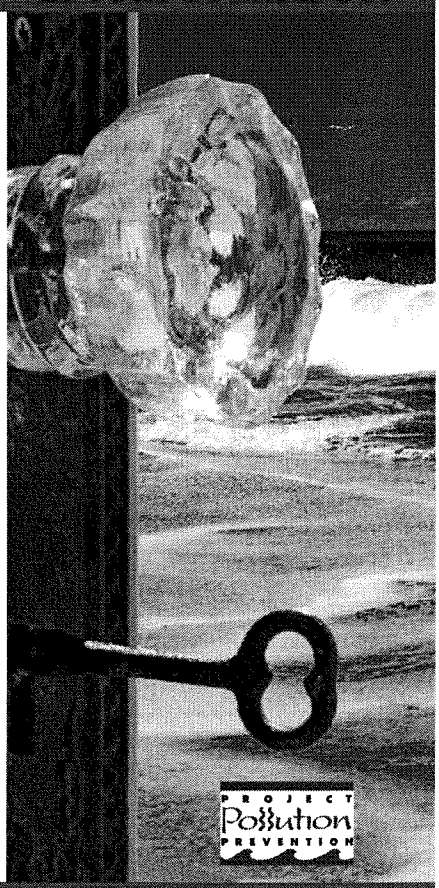


The Effect on the Ocean

Non-point source pollution can have a serious impact on water quality in Orange County. Pollutants from the storm drain system can harm marine life as well as coastal and wetland habitats. They can also degrade recreation areas such as beaches, harbors and bays.

Stormwater quality management programs have been developed throughout Orange County to educate and encourage the public to protect water quality, monitor runoff in the storm drain system, investigate illegal dumping and maintain storm drains.

Support from Orange County residents and businesses is needed to improve water quality and reduce urban runoff pollution. Proper use and disposal of materials will help stop pollution before it reaches the storm drain and the ocean.



For More Information

California Environmental Protection Agency
www.calepa.ca.gov

- **Air Resources Board**
  www.arb.ca.gov
- **Department of Pesticide Regulation**
  www.cdpr.ca.gov
- **Department of Toxic Substances Control**
  www.dtsc.ca.gov
- **Integrated Waste Management Board**
  www.ciwmb.ca.gov
- **Office of Environmental Health Hazard Assessment**
  www.oehha.ca.gov
- **State Water Resources Control Board**
  www.waterboards.ca.gov

Earth 911 - Community-Specific Environmental Information 1-800-cleanup or visit www.1800cleanup.org

Health Care Agency's Ocean and Bay Water Closure and Posting Hotline
(714) 433-6400 or visit www.ocbeachinfo.com

Integrated Waste Management Dept. of Orange County (714) 834-6752 or visit www.oclandfills.com for information on household hazardous waste collection centers, recycling centers and solid waste collection

O.C. Agriculture Commissioner
(714) 447-7100 or visit www.ocagcomm.com

Stormwater Best Management Practice Handbook
Visit www.cabmphandbooks.com

UC Master Gardener Hotline
(714) 708-1646 or visit www.uccemg.com

The Orange County Stormwater Program has created and moderates an electronic mailing list to facilitate communications, take questions and exchange ideas among its users about issues and topics related to stormwater and urban runoff and the implementation of program elements. To join the list, please send an email to ocstormwaterinfo-join@list.ocwatersheds.com

Orange County Stormwater Program

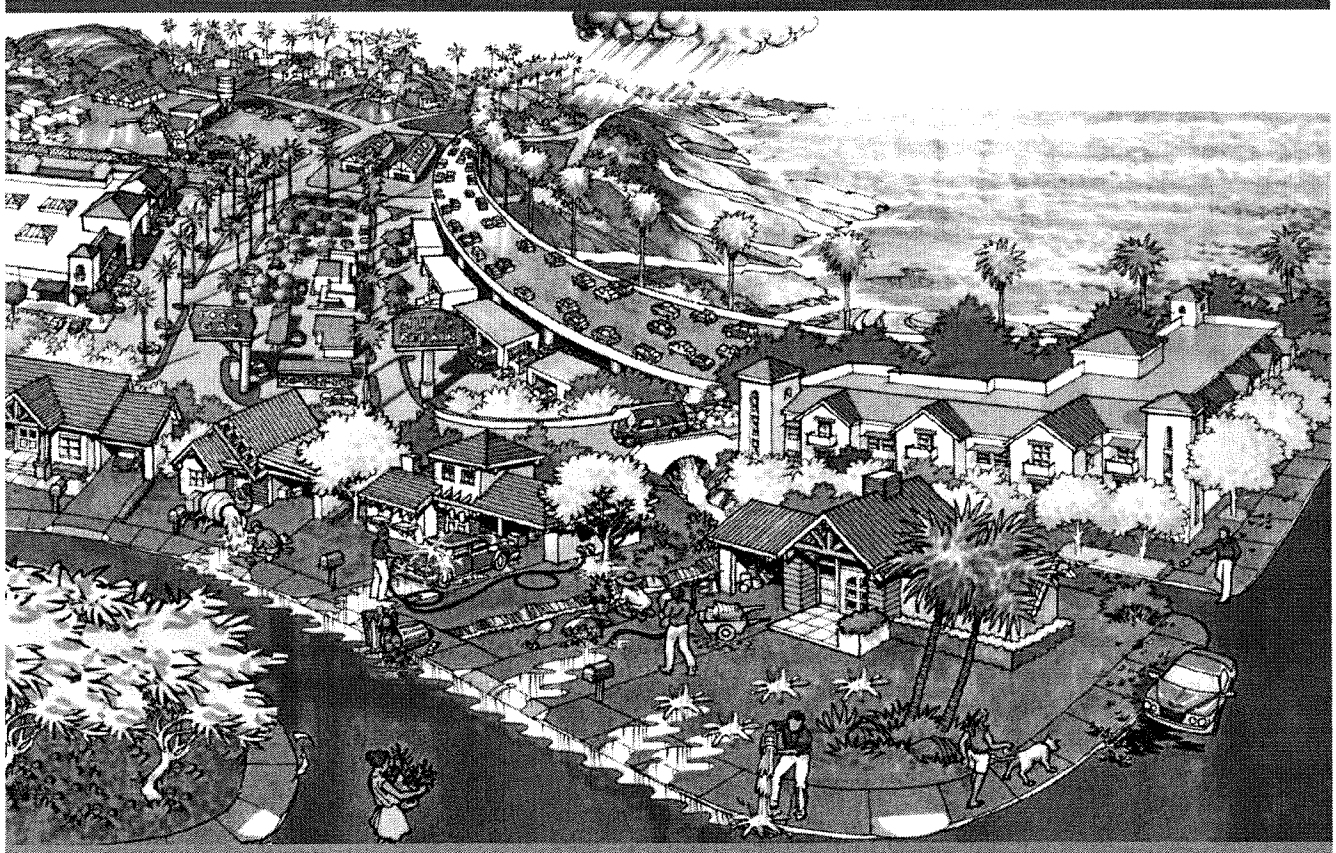
Aliso Viejo	(949)	425-2535
Anaheim Public Works Operations	(714)	765-6860
Brea Engineering	(714)	990-7666
Buena Park Public Works	(714)	562-3655
Costa Mesa Public Services	(714)	754-5323
Cypress Public Works	(714)	229-6740
Dana Point Public Works	(949)	248-3584
Fountain Valley Public Works	(714)	593-4441
Fullerton Engineering Dept.	(714)	738-6853
Garden Grove Public Works	(714)	741-5956
Huntington Beach Public Works	(714)	536-5431
Irvine Public Works	(949)	724-6315
La Habra Public Services	(562)	905-9792
La Palma Public Works	(714)	690-3310
Laguna Beach Water Quality	(949)	497-0378
Laguna Hills Public Services	(949)	707-2650
Laguna Niguel Public Works	(949)	362-4337
Laguna Woods Public Works	(949)	639-0500
Lake Forest Public Works	(949)	461-3480
Los Alamitos Community Dev.	(562)	431-3538
Mission Viejo Public Works	(949)	470-3056
Newport Beach, Code & Water Quality Enforcement	(949)	644-3215
Orange Public Works	(714)	532-6480
Placentia Public Works	(714)	993-8245
Rancho Santa Margarita	(949)	635-1800
San Clemente Environmental Programs	(949)	361-6143
San Juan Capistrano Engineering	(949)	234-4413
Santa Ana Public Works	(714)	647-3380
Seal Beach Engineering	(562)	431-2527 x317
Stanton Public Works	(714)	379-9222 x204
Tustin Public Works/Engineering	(714)	573-3150
Villa Park Engineering	(714)	998-1500
Westminster Public Works/Engineering	(714)	898-3311 x446
Yorba Linda Engineering	(714)	961-7138
Orange County Stormwater Program	(877)	897-7455

Orange County 24-Hour
Water Pollution Problem Reporting Hotline
1-877-89-SPILL (1-877-897-7455)

On-line Water Pollution Problem Reporting Form
www.ocwatersheds.com

Printed on Recycled Paper

The Ocean Begins at Your Front Door



Never allow pollutants to enter the street, gutter or storm drain!

Follow these simple steps to help reduce water pollution:

Household Activities

- Do not rinse spills with water. Use dry cleanup methods such as applying cat litter or another absorbent material, sweep and dispose of in the trash. Take items such as used or excess batteries, oven cleaners, automotive fluids, painting products and cathode ray tubes, like TVs and computer monitors, to a Household Hazardous Waste Collection Center (HHWCC).
- For a HHWCC near you call (714) 834-6752 or visit www.ocl.andfills.com.
- Do not hose down your driveway, sidewalk or patio to the street, gutter or storm drain. Sweep up debris and dispose of it in the trash.

Automotive

- Take your vehicle to a commercial car wash whenever possible. If you wash your vehicle at home, choose soaps, cleaners, or detergents labeled non-toxic, phosphate- free or biodegradable. Vegetable and citrus-based products are typically safest for the environment.
- Do not allow washwater from vehicle washing to drain into the street, gutter or storm drain. Excess washwater should be disposed of in the sanitary sewer (through a sink or toilet) or onto an absorbent surface like your lawn.
- Monitor your vehicles for leaks and place a pan under leaks. Keep your vehicles well maintained to stop and prevent leaks.
- Never pour oil or antifreeze in the street, gutter or storm drain. Recycle these substances at a service station, a waste oil collection center or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.1800cleanup.org.

Pool Maintenance

- Pool and spa water must be dechlorinated and free of excess acid, alkali or color to be allowed in the street, gutter or storm drain.
- When it is not raining, drain dechlorinated pool and spa water directly into the sanitary sewer.
- Some cities may have ordinances that do not allow pool water to be disposed of in the storm drain. Check with your city.

Landscape and Gardening

- Do not over-water. Water your lawn and garden by hand to control the amount of water you use or set irrigation systems to reflect seasonal water needs. If water flows off your yard onto your driveway or sidewalk, your system is over-watering. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of waste by composting, hauling it to a permitted landfill, or as green waste through your city's recycling program.
- Follow directions on pesticides and fertilizer, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Take unwanted pesticides to a HHWCC to be recycled. For locations and hours of HHWCC, call (714) 834-6752 or visit www.ocl.andfills.com.

Trash

- Place trash and litter that cannot be recycled in securely covered trash cans.
- Whenever possible, buy recycled products.
- Remember: Reduce, Reuse, Recycle.

Pet Care

- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash. Pet waste, if left outdoors, can wash into the street, gutter or storm drain.
- If possible, bathe your pets indoors. If you must bathe your pet outside, wash it on your lawn or another absorbent/permeable surface to keep the washwater from entering the street, gutter or storm drain.
- Follow directions for use of pet care products and dispose of any unused products at a HHWCC.

Common Pollutants

Home Maintenance
- Detergents, disinfectants and polishes
- Oil and lacquer paint
- Swimming pool chemicals
- Outdoor trash and litter

Lawn and Garden
- Pet and animal waste
- Pesticides
- Clippings, leaves and soil
- Fertilizer

Automobile
- Oil and grease
- Radiator fluids and antifreeze
- Cleaning chemicals
- Brake pad dust

The Pollution Solution

Several important activities can result in water pollution. Allowing fertilizers to run off during watering and hosing off driveways and walkways. Pollution also can occur when we are not careful in our daily lives. Water conservation methods described in this pamphlet will prevent pollution and conserve water. By taking part in a commercial car wash and by cleaning drainage inlets/catch basins, you can further protect the transport of pollution to Orange County waterways. Here are some of the common pollutants and what you can do to take part in the solution.

1 Pesticides and Fertilizers

Pollution: [illegible]

Solution: [illegible]

2 Detergent Substances

Pollution: [illegible]

Solution: [illegible]

3 Oil

Pollution: [illegible]

Solution: [illegible]

DID YOU KNOW?

[illegible]

4 Pet Waste

Pollution: [illegible]

Solution: [illegible]

5 Trash and Debris

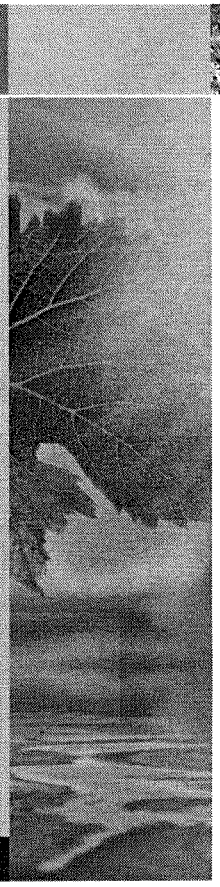
Pollution: [illegible]

Solution: [illegible]

6 Washing Of Vehicle Fluids

Pollution: [illegible]

Solution: [illegible]



A TEAM EFFORT

The Orange County Stormwater Program has teamed with the Municipal Water District of Orange County (MWDOC) and the University of California Cooperative Extension Program (UCCE) to develop this pamphlet.

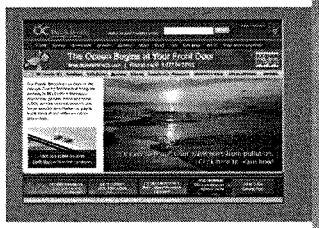
Low Impact Development (LID) and sustainable water use prevents water pollution and conserves water for drinking and reuse. Reducing your water use and the amount of water flowing from your home protects the environment and saves you money.

Thank you for making water protection a priority!

For more information, please visit www.ocwatersheds.com/publiced/

www.mwdoc.com

www.uccamg.com



To report a spill, call the Orange County 24-Hour Water Pollution Prevention Reporting Hotline at 1-877-89-SPILL (1-877-897-7455)

Special Thanks to
The City of Los Angeles Stormwater Program for the use of its artwork

The Metropolitan Water District of Southern California for the use of the California-Friendly Plant and Native Habitat photos

Homeowners Guide for Sustainable Water Use

Low Impact Development, Water Conservation & Pollution Prevention

The Ocean Begins at Your Front Door

RUNOFF, RAINWATER AND REUSE

Where Does Water Runoff Go?

Stormwater, or water from rainfall events, and runoff from outdoor water use such as sprinklers and hoses flows from homes directly into catch basins and the storm drain system. After entering the storm drain, the water flows untreated into streams, rivers, bays and ultimately the Pacific Ocean. Runoff can come from lawns, gardens, driveways, sidewalks and roofs. As it flows over hard, impervious surfaces, it picks up pollutants. Some pollutants carried by the water runoff include trash, pet waste, pesticides, fertilizer, motor oil and more.

Water Conservation

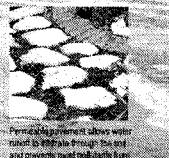
Pollution not only impairs the water quality for habitat and recreation, it can also reduce the water available for reuse. Runoff allowed to soak into the ground is cleaned as it percolates through the soil, replenishing depleted groundwater supplies. Groundwater provides at least 50% of the total water for drinking and other indoor household activities in north and central Orange County. When land is covered with roads, parking lots, homes, etc., there is less land to take in the water and more hard surfaces over which the water can flow.

In Orange County, 60-70% of water used by residents and businesses goes to irrigation and other outdoor uses. Reusing rainwater to irrigate our lawn not only reduces the impact of water pollution from runoff, but it also is a great way to conserve our precious water resources and replenish our groundwater basin.

What is Low Impact Development (LID)?

Low Impact Development (LID) is a method of development that seeks to maintain the natural hydrologic character of an area. LID provides a more sustainable and pollution-preventative approach to water management.

New water quality regulations require implementation of LID in large new developments and encourage implementation of LID and other sustainable practices in ongoing redevelopment. Implementing modifications to your lawn or garden can reduce pollution in our environment, conserve water and reduce your water bill.



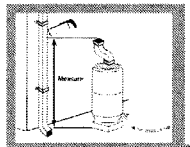
Permeable pavement allows water runoff to filtrate through the soil and prevents most pollutants from reaching the storm drain system.

OPTIONS FOR RAINWATER HARVESTING AND REUSE

Rainwater harvesting is a great way to save money, prevent pollution, and reduce potable water use. To harvest your rainwater, simply redirect the runoff from roofs and downspouts to rain barrels. Rain gardens are another option, these reduce runoff as well as encourage infiltration.

Downspout Disconnection/Redirection

Disconnecting downspouts from pipes leading to the gutter prevents runoff from transporting pollutants to the storm drain. Once disconnected, downspouts can be redirected to rain gardens or other vegetated areas, or be connected to a rain barrel.



Rain Barrels

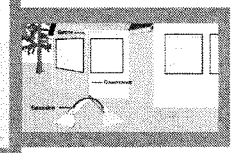
Rain barrels capture rainwater flow from roofs for reuse in landscape irrigation. Capacity of rain barrels needed for your home will depend on the amount of roof area and rainfall received. When purchasing your rain barrel make sure it includes a screen, a spigot to siphon water for use, an overflow tube to allow for excess water to run out and a connector if you wish to connect multiple barrels to add capacity of water storage.

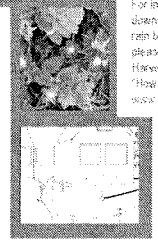
Mosquito growth prevention is very important when installing a rain barrel. The best way to prevent mosquito breeding is to eliminate entry points by ensuring all openings are sealed tightly. If these methods are unsuccessful, products are available to kill mosquito larvae, but that are harmless to animals and humans. Regular application of these products is essential. Please visit the Orange County Vector Control website for more information at www.orange-county.com/vector.org

Rain Gardens

Rain gardens allow runoff to be directed from your roof downspout into a landscaped area. Vegetation and rocks in the garden will slow the flow of water to allow for infiltration into the soil. Plants and soil particles will absorb pollutants from the roof runoff. By utilizing a native plant palette, rain gardens can be maintained all year with minimal additional irrigation. These plants are adapted to the semi-arid climate of Southern California, require less water and can reduce your water bill.

Before modifying your yard to install a rain garden, please consult your local building and/or planning departments to ensure your garden plan follows pertinent building codes and ordinances. Besides codes and ordinances, some home owner associations also have guidelines for yard modifications. If your property is in hill areas or includes engineered slopes, please seek professional advice before proceeding with changes.





For information on how to disconnect a downspout or to install and maintain a rain barrel or rain garden at your home, please see the Los Angeles Rainwater Harvesting Program, A Homeowner's "How-To" Guide, November 2000 at www.lacitysd.com/rainwater.asp

OTHER WATER CONSERVATION AND POLLUTION PREVENTION TECHNIQUES

Native Vegetation and Maintenance

"California Friendly" plants or native vegetation can significantly reduce water use. These plants often require far less fertilizers and pesticides, which are two significant pollutants found in Orange County waterways. Replacing water "thirsty" plants and grass types with water efficient native or a great way to save water and reduce the need for potentially harmful pesticides and fertilizer.

Please see the California Friendly Garden Guide produced by the Metropolitan Water District of Southern California and associated Southern California Water Agencies for a catalog of California friendly plants and other garden resources at www.bewaterwise.com/landscape.html

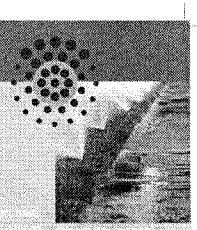
Weed Free Yards

Weeds are water thieves. They often reproduce quickly and rob your yard of both water and nutrients. Weed your yard by hand if possible. If you use herbicides to control the weeds, use only the amount recommended on the label and never use it if rain is forecast within the next 48 hours.

Soil Amendments

Soil amendments such as green waste (e.g. grass clippings compost, etc.) can be a significant source of nutrients and can help keep the soil near the roots of plants moist. However, they can cause algal blooms if they get into our waterways, which reduces the amount of oxygen in the water and impacts most aquatic organisms. It is important to apply soil amendments more than 48 hours prior to predicted rainfall.

IRRIGATE EFFICIENTLY



Set a timer for your sprinklers

Water at Sunrise

Water by hand

Fix leaks

Do your part to prevent water pollution in our creeks, rivers, bays and ocean.

Clean beaches and healthy creeks, rivers, bays, and ocean are important to Orange County. However, many common household activities can lead to water pollution if you're not careful.

REMEMBER THE WATER IN YOUR STORM DRAIN IS NOT TREATED BEFORE IT ENTERS OUR WATERWAYS

Litter, oil, chemicals and other substances that are left on your yard or driveway can be blown or washed into storm drains that flow to the ocean. Over-watering your lawn and washing your car can also flush materials into the storm drains. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated.

You would never pour soap, fertilizers or oil into the ocean, so don't let them enter streets, gutters or storm drains. Follow the easy tips in this brochure to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

To report a spill,
call the
Orange County 24-Hour Water Pollution Problem Reporting Hotline
1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

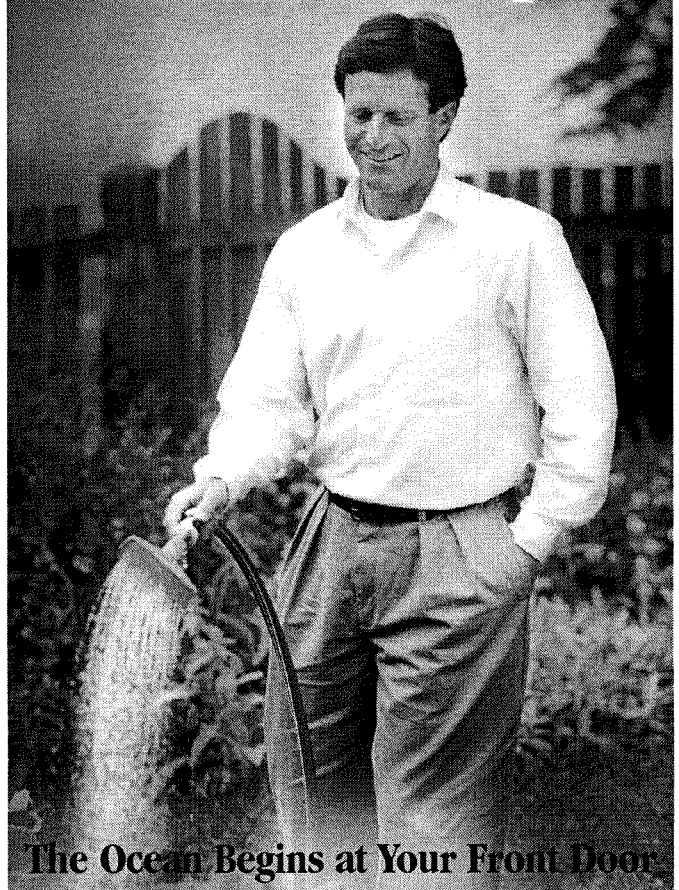
The tips contained in this brochure provide useful information to help prevent water pollution while performing everyday household activities. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

GENUINE RECYCLED PAPER
50% PRE-CONSUMER AND 15% POST-CONSUMER

RECYCLE USED OIL

Help Prevent Ocean Pollution:

Household Tips



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Pollution Prevention

Household Activities

- **Do not rinse spills with water!** Sweep outdoor spills and dispose of in the trash. For wet spills like oil, apply cat litter or another absorbent material, then sweep and bring to a household hazardous waste collection center (HHWCC).
- Securely cover trash cans.
- Take household hazardous waste to a household hazardous waste collection center.
- Store household hazardous waste in closed, labeled containers inside or under a cover.
- Do not hose down your driveway, sidewalk or patio. Sweep up debris and dispose of in trash.
- Always pick up after your pet. Flush waste down the toilet or dispose of in the trash.
- Bathe pets indoors or have them professionally groomed.

Household Hazardous Wastes include:

- ▲ **Batteries**
- ▲ **Paint thinners, paint strippers and removers**
- ▲ **Adhesives**
- ▲ **Drain openers**
- ▲ **Oven cleaners**
- ▲ **Wood and metal cleaners and polishes**
- ▲ **Herbicides and pesticides**
- ▲ **Fungicides/wood preservatives**
- ▲ **Automotive fluids and products**
- ▲ **Grease and rust solvents**
- ▲ **Thermometers and other products containing mercury**
- ▲ **Fluorescent lamps**
- ▲ **Cathode ray tubes, e.g. TVs, computer monitors**
- ▲ **Pool and spa chemicals**

Gardening Activities

- Follow directions on pesticides and fertilizers, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Water your lawn and garden by hand to control the amount of water you use. Set irrigation systems to reflect seasonal water needs. If water flows off your yard and onto your driveway or sidewalk, your system is over-watering.
- Mulch clippings or leave them on the lawn. If necessary, dispose in a green waste container.
- Cultivate your garden often to control weeds.

Washing and Maintaining Your Car

- Take your car to a commercial car wash whenever possible.
- Choose soaps, cleaners, or detergents labeled "non-toxic," "phosphate free" or "biodegradable." Vegetable and citrus-based products are typically safest for the environment, **but even these should not be allowed into the storm drain.**
- Shake floor mats into a trash can or vacuum to clean.
- Do not use acid-based wheel cleaners and "hose off" engine degreasers at home. They can be used at a commercial facility, which can properly process the washwater.
- **Do not dump washwater onto your driveway, sidewalk, street, gutter or storm drain.** Excess washwater should be disposed of in the sanitary sewers (through a sink, or toilet) or onto an absorbent surface like your lawn.
- Use a nozzle to turn off water when not actively washing down automobile.
- Monitor vehicles for leaks and place pans under leaks. Keep your car well maintained to stop and prevent leaks.
- Use cat litter or other absorbents and sweep to remove any materials deposited by vehicles. Contain sweepings and dispose of at a HHWCC.
- Perform automobile repair and maintenance under a covered area and use drip pans or plastic sheeting to keep spills and waste material from reaching storm drains.
- **Never pour oil or antifreeze in the street, gutter or storm drains.** Recycle these substances at a service station, HHWCC, or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.ciwmb.ca.gov/UsedOil.

For locations and hours of Household Hazardous Waste Collection Centers in Anaheim, Huntington Beach, Irvine and San Juan Capistrano, call (714)834-6752 or visit www.oclandfills.com.

Do your part to prevent water pollution in our creeks, rivers, bays and ocean.

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, not properly disposing of household hazardous waste can lead to water pollution. Batteries, electronics, paint, oil, gardening chemicals, cleaners and other hazardous materials cannot be thrown in the trash. They also must never be poured or thrown into yards, sidewalks, driveways, gutters or streets. Rain or other water could wash the materials into the storm drain and eventually into our waterways and the ocean. In addition, hazardous waste must not be poured in the sanitary sewers (sinks and toilets).

NEVER DISPOSE OF HOUSEHOLD HAZARDOUS WASTE IN THE TRASH, STREET, GUTTER, STORM DRAIN OR SEWER.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

To Report Illegal Dumping of Household Hazardous Waste call 1-800-69-TOXIC

To report a spill,
call the
Orange County 24-Hour Water Pollution Problem Reporting Hotline
1-877-89-SPILL (1-877-897-7455).

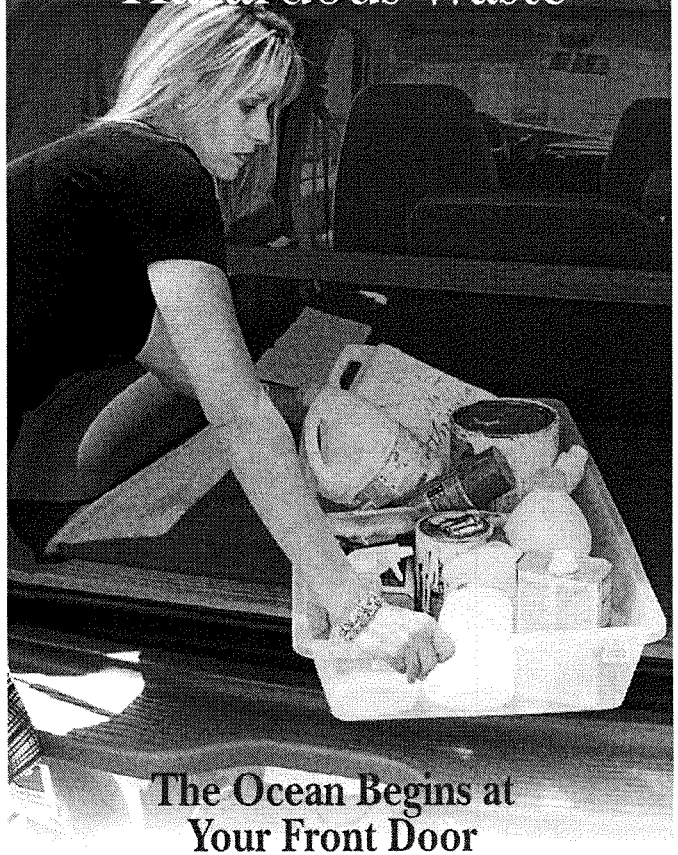
For emergencies, dial 911.

RECYCLE USED OIL

Printed on Recycled Paper

Help Prevent Ocean Pollution:

Proper Disposal of Household Hazardous Waste



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

ORANGE COUNTY

Pollution Prevention

Leftover household products that contain corrosive, toxic, ignitable, or reactive ingredients are considered to be "household hazardous waste" or "HHW." HHW can be found throughout your home, including the bathroom, kitchen, laundry room and garage.

WHEN POSSIBLE, USE NON-HAZARDOUS OR LESS-HAZARDOUS PRODUCTS.

Disposal of HHW down the drain, on the ground, into storm drains, or in the trash is illegal and unsafe.

Proper disposal of HHW is actually easy. Simply drop them off at a Household Hazardous Waste Collection Center (HHWCC) for free disposal and recycling. Many materials including anti-freeze, latex-based paint, motor oil and batteries can be recycled. Some centers have a "Stop & Swap" program that lets you take partially used home, garden, and automobile products free of charge. There are four HHWCCs in Orange County:

Anaheim:.....1071 N. Blue Gum St
Huntington Beach:.....17121 Nichols St
Irvine:.....6411 Oak Canyon
San Juan Capistrano:... 32250 La Pata Ave

Centers are open Tuesday-Saturday, 9 a.m.-3 p.m. Centers are closed on rainy days and major holidays. For more information, call **(714) 834-6752** or visit **www.oclandfills.com.**

Common household hazardous wastes

- Batteries
- Paint and paint products
- Adhesives
- Drain openers
- Household cleaning products
- Wood and metal cleaners and polishes
- Pesticides
- Fungicides/wood preservatives
- Automotive products (antifreeze, motor oil, fluids)
- Grease and rust solvents
- Fluorescent lamps
- Mercury (thermometers & thermostats)
- All forms of electronic waste including computers and microwaves
- Pool & spa chemicals
- Cleaners
- Medications
- Propane (camping & BBQ)
- Mercury-containing lamps
- Television & monitors (CRTs, flatscreens)

Tips for household hazardous waste

- Never dispose of HHW in the trash, street, gutter, storm drain or sewer.
- Keep these materials in closed, labeled containers and store materials indoors or under a cover.
- When possible, use non-hazardous products.
- Reuse products whenever possible or share with family and friends.
- Purchase only as much of a product as you'll need. Empty containers may be disposed of in the trash.
- HHW can be harmful to humans, pets and the environment. Report emergencies to 911.

Did you know that just one quart of oil can pollute 250,000 gallons of water?

A clean ocean and healthy creeks, rivers, bays and beaches are important to Orange County. However, not properly disposing of used oil can lead to water pollution. If you pour or drain oil onto driveways, sidewalks or streets, it can be washed into the storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering the ocean. Help prevent water pollution by taking your used oil to a used oil collection center.

Included in this brochure is a list of locations that will accept up to five gallons of used motor oil at no cost. Many also accept used oil filters. Please contact the facility before delivering your used oil. This listing of companies is for your reference and does not constitute a recommendation or endorsement of the company.

Please note that used oil filters may not be disposed of with regular household trash. They must be taken to a household hazardous waste collection or recycling center in Anaheim, Huntington Beach, Irvine or San Juan Capistrano. For information about these centers, visit www.oclandfills.com.

Please do not mix your oil with other substances!

For more information, please call the Orange County Stormwater Program at 1-877-89-SPILL (1-877-897-7455) **or visit www.watersheds.com.**

For information about the proper disposal of household hazardous waste, call the Household Waste Hotline at (714) 834-6752 or visit www.oclandfills.com.

RECYCLE USED OIL

For additional information about the nearest oil recycling center, call the Used Oil Program at 1-800-CLEANUP or visit www.cleanup.org.

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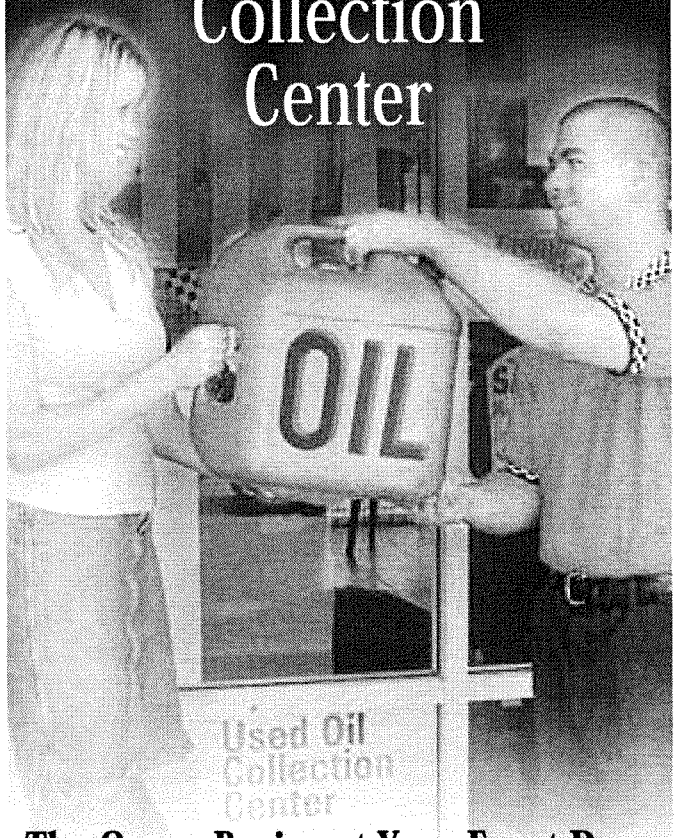
Help Prevent Ocean Pollution:

Recycle at Your Local Used Oil Collection Center



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

NORTH COUNTY

Used Oil Collection Centers

Anaheim

All Seasons Tire and Auto Center, Inc.
817 S Brookhurst St., Anaheim, CA 92804
(714)772-6090( )
CIWMB#: 30-C-03177

AutoZone #3317
423 N Anaheim Blvd., Anaheim, CA 92805
(714)776-0787( )
CIWMB#: 30-C-05263

AutoZone #5226
2145 W Lincoln Ave., Anaheim, CA 92801
(714)533-6599( )
CIWMB#: 30-C-04604

Bedard Automotive
3601 E Miraloma Ave., Anaheim, CA 92806
(714)528-1380( )
CIWMB#: 30-C-02205

Classic Chevrolet
1001 Weir Canyon Rd., Anaheim, CA 92807
(714)283-5400( )
CIWMB#: 30-C-05223

Econo Lube N' Tune #4
3201 W Lincoln Ave., Anaheim, CA 92801
(714)821-0128( )
CIWMB#: 30-C-01485

EZ Lube Inc - Savi Ranch #43
985 N Weir Canyon Rd., Anaheim, CA 92807
(714)556-1312( )
CIWMB#: 30-C-06011

Firestone Store #71C7
1200 S Magnolia Ave., Anaheim, CA 92804
(949)598-5520( )
CIWMB#: 30-C-05743

Great Western Lube Express
125 N Brookhurst St., Anaheim, CA 92801
(714)254-1300( )
CIWMB#: 30-C-05542

HR Pro Auto Service Center
3180 W Lincoln Ave., Anaheim, CA 92801
(714)761-4343( )
CIWMB#: 30-C-05927

Ira Newman Automotive Services
1507 N State College Blvd., Anaheim, CA 92806
(714)635-2392( )
CIWMB#: 30-C-01482

Jiffy Lube #1028
2400 W Ball Rd., Anaheim, CA 92804
(714)761-5211( )
CIWMB#: 30-C-00870

Jiffy Lube #1903
2505 E Lincoln Ave., Anaheim, CA 92806
(714)772-4000( )
CIWMB#: 30-C-05511

Jiffy Lube #2340
2181 W Lincoln Ave., Anaheim, CA 92801
(714)533-1000( )
CIWMB#: 30-C-04647

Kragen Auto Parts #1303
1088 N State College Blvd., Anaheim, CA 92806
(714)956-7351( )
CIWMB#: 30-C-03438

Kragen Auto Parts #1399
2245 W Ball Rd., Anaheim, CA 92804
(714)490-1274( )
CIWMB#: 30-C-04094

Kragen Auto Parts #1565
2072 Lincoln Ave., Anaheim, CA 92806
(714)502-6992( )
CIWMB#: 30-C-04078

Kragen Auto Parts #1582
3420 W Lincoln Ave., Anaheim, CA 92801
(714)828-7977( )
CIWMB#: 30-C-04103

Pep Boys #613
10912 Katella Ave., Anaheim, CA 92804
(714)638-0863( )
CIWMB#: 30-C-01756

Pep Boys #663
3030 W Lincoln Anaheim, CA 92801
(714)826-4810( )
CIWMB#: 30-C-03417

Pep Boys #809
8205 E Santa Ana Cyn Rd., Anaheim, CA 92808
(714)974-0105( )
CIWMB#: 30-C-03443

Pick Your Part
1235 S Beach Blvd., Anaheim, CA 92804
(714)527-1645( )
CIWMB#: 30-C-03744

PK Auto Performance
3106 W. Lincoln Ave., Anaheim, CA 92801
(714)826-2141( )
CIWMB#: 30-C-05628

Quick Change Lube and Oil
2731 W Lincoln Ave., Anaheim, CA 92801
(714)821-4464( )
CIWMB#: 30-C-04363

Saturn of Anaheim
1380 S Auto Center Dr., Anaheim, CA 92806
(714)648-2444( )
CIWMB#: 30-C-06332

Sun Tech Auto Service
105 S State College Blvd., Anaheim, CA 92806
(714)956-1389( )
CIWMB#: 30-C-06455

Vonic Truck Services
515 S Rose St., Anaheim, CA 92805
(714)533-3333( )
CIWMB#: 30-C-01142

Anaheim Hills

Anaheim Hills Car Wash & Lube
5810 E La Palma Ave., Anaheim Hills, CA 92807
(714)777-6605( )
CIWMB#: 30-C-01387

Brea

Firestone Store #27A9
891 E Imperial Hwy., Brea, CA 92821
(714)529-8404( )
CIWMB#: 30-C-01221

Oil Can Henry's
230 N Brea Blvd., Brea, CA 92821
(714)990-1900( )
CIWMB#: 30-C-04273

Buena Park

Firestone Store #71F7
6011 Orangethorpe Buena Park, CA 90620
(714)670-7912( )
CIWMB#: 30-C-01218

Firestone Store #71T8
8600 Beach Blvd., Buena Park, CA 90620
(714)827-5300( )
CIWMB#: 30-C-02121

Kragen Auto Parts #1204
5303 Beach Blvd., Buena Park, CA 90621
(714)994-1320( )
CIWMB#: 30-C-02623

Cypress

AutoZone #5521
5471 Lincoln Ave., Cypress, CA 90630
(714)995-4644( )
CIWMB#: 30-C-00836

Big O Tires
6052 Cerritos Ave., Cypress, CA 90630
(714)826-6334( )
CIWMB#: 30-C-04245

Econo Lube N' Tune #213
5497 Cerritos Ave., Cypress, CA 90630
(714)761-0456( )
CIWMB#: 30-C-06240

Jiffy Lube #851
4942 Lincoln Ave., Cypress, CA 90630
(626)965-9689( )
CIWMB#: 30-C-06182

M & N Coastline Auto & Tire Service
4005 Ball Rd., Cypress, CA 90630
(714)826-1001( )
CIWMB#: 30-C-04387

Masterlube #103
5904 Lincoln Cypress, CA 90630
(714)826-2323( )
CIWMB#: 30-C-01071

Masterlube #104
5971 Ball Rd., Cypress, CA 90630
(714)220-1555( )
CIWMB#: 30-C-04682

Metric Motors of Cypress
6042 Cerritos Ave., Cypress, CA 90630
(714)821-4702( )
CIWMB#: 30-C-05157

Fullerton

AutoZone #2898
146 N. Raymond Ave., Fullerton, CA 92831
(714)870-9772( )
CIWMB#: 30-C-04488

AutoZone #5522
1801 Orangethorpe W. Fullerton, CA 92833
(714)870-8286( )
CIWMB#: 30-C-06062

AutoZone #5523
102 N Euclid Fullerton, CA 92832
(714)870-8286( )
CIWMB#: 30-C-04755

EZ Lube #17
4002 N Harbor Blvd., Fullerton, CA 92835
(714)871-9980( )
CIWMB#: 30-C-03741

Firestone Store #27EH
1933 N Placentia Ave., Fullerton, CA 92831
(714)993-7100( )
CIWMB#: 30-C-02122

Fox Service Center
1018 W Orangethorpe Fullerton, CA 92833
(714)879-1430( )
CIWMB#: 30-C-02318

Fullerton College Automotive Technology
321 E Chapman Ave., Fullerton, CA 92832
(714)992-7275( )
CIWMB#: 30-C-03165

Kragen Auto Parts #0731
2978 Yorba Linda Fullerton, CA 92831
(714)996-4780( )
CIWMB#: 30-C-02628

Kragen Auto Parts #4133
904 W Orangethorpe Ave., Fullerton, CA 92832
(714)526-3570( )
CIWMB#: 30-C-06256

Pep Boys #642
1530 S Harbor Blvd., Fullerton, CA 92832
(714)870-0700( )
CIWMB#: 30-C-01755

Sunnyside 76 Car Care Center
2701 N Brea Blvd., Fullerton, CA 92835
(714)256-0773( )
CIWMB#: 30-C-01381

Garden Grove

76 Pro Lube Plus
9001 Trask Ave., Garden Grove, CA 92844
(714)393-0590( )
CIWMB#: 30-C-05276

AutoZone #5527
13190 Harbor Blvd., Garden Grove, CA 92843
(714)636-5665( )
CIWMB#: 30-C-04760

David Murray Shell
12571 Vly View St., Garden Grove, CA 92845
(714)898-0170( )
CIWMB#: 30-C-00547

Express Lube & Wash
8100 Lampson Ave., Garden Grove, CA 92841
(909)316-8261( )
CIWMB#: 30-C-06544

Firestone Store #7180
10081 Chapman Ave., Garden Grove, CA 92840
(714)530-4630( )
CIWMB#: 30-C-01224

Firestone Store #71W3
13961 Brookhurst St., Garden Grove, CA 92843
(714)590-2741( )
CIWMB#: 30-C-03690

Jiffy Lube #1991
13970 Harbor Blvd., Garden Grove, CA 92843
(714)554-0610( )
CIWMB#: 30-C-05400

Kragen Auto Parts #1251
13933 N Harbor Blvd., Garden Grove, CA 92843
(714)554-3780( )
CIWMB#: 30-C-02663

Kragen Auto Parts #1555
9851 Chapman Ave., Garden Grove, CA 92841
(714)741-8030( )
CIWMB#: 30-C-04079

Nissan of Grarden Grove
9670 Trask Ave., Garden Grove, CA 92884
(714)537-0900( )
CIWMB#: 30-C-06553

Toyota of Garden Grove
9444 Trask Ave., Garden Grove, CA 92844
(714)895-5595( )
CIWMB#: 30-C-06555

La Habra

AutoZone #5532
1200 W Imperial Hwy., La Habra, CA 90631
(562)694-5337( )
CIWMB#: 30-C-04784

Burch Ford
201 N Harbor Blvd., La Habra, CA 90631
(562)691-3225( )
CIWMB#: 30-C-05179

Firestone Store #2736
1071 S Beach Blvd., La Habra, CA 90631
(562)691-1731( )
CIWMB#: 30-C-01169

Kragen Auto Parts #1569
1621 W Whittier Blvd., La Habra, CA 90631
(562)905-2538( )
CIWMB#: 30-C-04076

Pep Boys #997
125 W Imperial Hwy., La Habra, CA 90631
(714)447-0601( )
CIWMB#: 30-C-04026

SpeeDee Oil Change & Tune-Up
1580 W Imperial Hwy., La Habra, CA 90631
(562)697-3513( )

Los Alamitos

Jiffy Lube #1740
3311 Katella Ave., Los Alamitos, CA 90720
(562)596-1827( )
CIWMB#: 30-C-03529

Midway City

Bolsa Transmission
8331 Bolsa Ave., Midway City, CA 92655
(714)799-6158( )
CIWMB#: 30-C-05768

Placentia

Advanced Auto & Diesel
144 S Bradford Placentia, CA 92870
(714)996-8222( )
CIWMB#: 30-C-06242

Castner's Auto Service
214 S. Bradford Ave., Placentia, CA 92870
(714)528-1311( )
CIWMB#: 30-C-06452

Econo Lube N' Tune
100 W Chapman Ave., Placentia, CA 92870
(714)524-0424( )
CIWMB#: 30-C-06454

Fairway Ford
1350 E Yorba Linda Blvd., Placentia, CA 92870
(714)524-1200( )
CIWMB#: 30-C-01863

Seal Beach

M & N Coastline Auto & Tire Service
12239 Seal Beach Blvd., Seal Beach, CA 90740
(714)826-1001( )
CIWMB#: 30-C-04433

Seal Beach Chevron
12541 Seal Beach Blvd., Seal Beach, CA 90740
(949)495-0774(14)
CIWMB#: 30-C-06425

Stanton

AutoZone #2806
11320 Beach Blvd., Stanton, CA 90680
(714)895-7665( )
CIWMB#: 30-C-04563

Joe's Auto Clinic
11763 Beach Blvd., Stanton, CA 90680
(714)891-7715( )
CIWMB#: 30-C-03253

Kragen Auto Parts #1742
11951 Beach Blvd., Stanton, CA 90680
(714)799-7574( )
CIWMB#: 30-C-05231

Scher Tire #20
7000 Katella Ave., Stanton, CA 90680
(714)892-9924( )
CIWMB#: 30-C-05907

USA 10 Minute Oil Change
8100 Lampson Ave., Stanton, CA 92841
(714)373-4432( )
CIWMB#: 30-C-05909

Westminster

AutoZone #5543
6611 Westminster Blvd., Westminster, CA 92683
(714)898-2898( )
CIWMB#: 30-C-04964

AutoZone #5544
8481 Westminster Blvd., Westminster, CA 92683
(714)891-3511( )
CIWMB#: 30-C-04966

City of Westminster Corporate Yard
14381 Olive St., Westminster, CA 92683
(714)895-2876(292)
CIWMB#: 30-C-02008

Honda World
13600 Beach Blvd., Westminster, CA 92683
(714)890-8900( )
CIWMB#: 30-C-03639

Jiffy Lube #1579
6011 Westminster Blvd., Westminster, CA 92683
(714)899-2727( )
CIWMB#: 30-C-02745

John's Brake & Auto Repair
13050 Hoover St., Westminster, CA 92683
(714)379-2088( )
CIWMB#: 30-C-05617

Kragen Auto Parts #0752
6562 Westminster Blvd., Westminster, CA 92683
(714)898-0810( )
CIWMB#: 30-C-02590

Midway City Sanitary District
14451 Cedarwood St., Westminster, CA 92683
(714)893-3553( )
CIWMB#: 30-C-01626

Pep Boys #653
15221 Beach Blvd., Westminster, CA 92683
(714)893-8544( )
CIWMB#: 30-C-03415

Yorba Linda

AutoZone #5545
18528 Yorba Linda Blvd., Yorba Linda, CA 92886
(714)970-8933( )
CIWMB#: 30-C-04971

Econo Lube N' Tune
22270 La Palma Ave., Yorba Linda, CA 92887
(714)692-8394( )
CIWMB#: 30-C-06513

EZ Lube Inc. #41
17511 Yorba Linda Blvd., Yorba Linda, CA 92886
(714)556-1312( )
CIWMB#: 30-C-05739

Firestone Store #27T3
18500 Yorba Linda Blvd., Yorba Linda, CA 92886
(714)779-1966( )
CIWMB#: 30-C-01222

Jiffy Lube #1532
16751 Yorba Linda Blvd., Yorba Linda, CA 92886
(714)528-2800( )
CIWMB#: 30-C-03777

Mike Schultz Import Service
4832 Eureka Ave., Yorba Linda, CA 92886
(714)528-4411( )
CIWMB#: 30-C-04313

This information was provided by the County of Orange Integrated Waste Management Department and the California Integrated Waste Management Board (CIWMB).

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities such as pest control can lead to water pollution if you're not careful. Pesticide treatments must be planned and applied properly to ensure that pesticides do not enter the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump pesticides into the ocean, so don't let it enter the storm drains. Pesticides can cause significant damage to our environment if used improperly. If you are thinking of using a pesticide to control a pest, there are some important things to consider.

For more information,
please call
University of California Cooperative
Extension Master Gardeners at
(714) 708-1646
or visit these Web sites:
www.uccemg.org
www.ipm.ucdavis.edu

For instructions on collecting a specimen sample visit the Orange County Agriculture Commissioner's website at:
http://www.ocagcomm.com/ser_lab.asp

To report a spill, call the
Orange County 24-Hour Water Pollution Problem Reporting Hotline at 1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

Information From:
Cheryl Wilen, Area IPM Advisor; Darren Haver, Watershed Management Advisor; Mary Louise Flint, IPM Education and Publication Director; Pamela M. Geisel, Environmental Horticulture Advisor; Carolyn L. Unruh, University of California Cooperative Extension staff writer. Photos courtesy of the UC Statewide IPM Program and Darren Haver.

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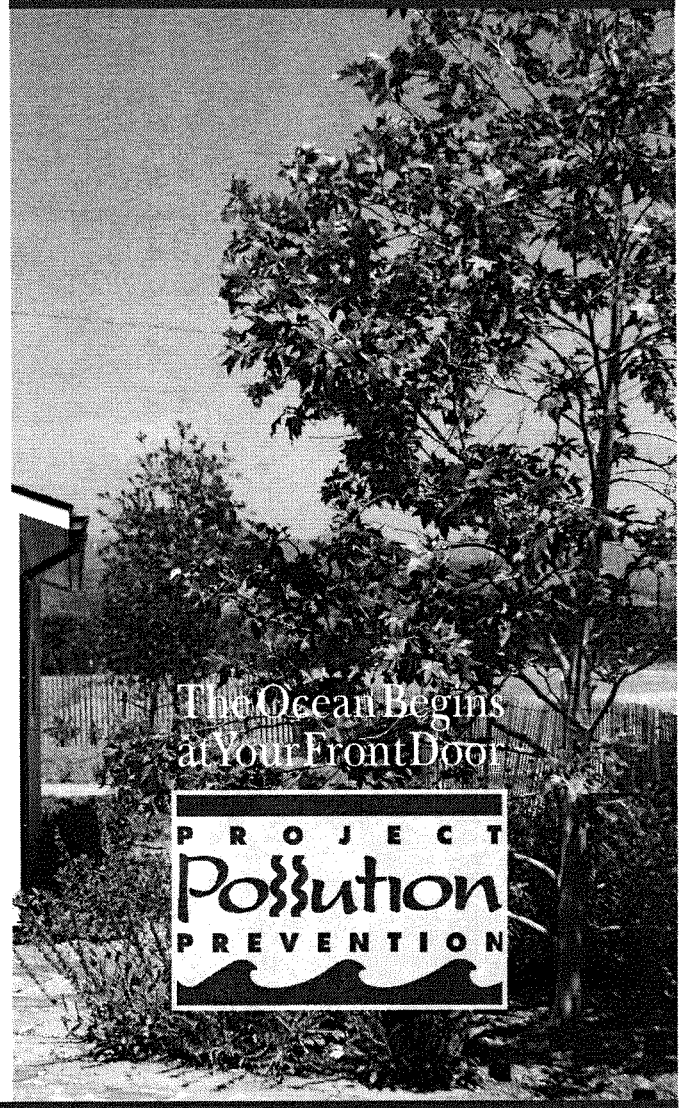
Help Prevent Ocean Pollution:

Responsible Pest Control



Tips for Pest Control

Key Steps to Follow:

Step 1: **Correctly identify the pest (insect, weed, rodent, or disease) and verify that it is actually causing the problem.**

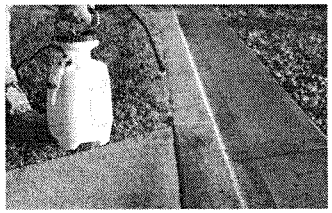
Three life stages of the common lady beetle, a beneficial insect.

This is important because beneficial insects are often mistaken for pests and sprayed with pesticides needlessly.

Consult with a Certified Nursery Professional at a local nursery or garden center or send a sample of the pest to the Orange County Agricultural Commissioner's Office.

Determine if the pest is still present – even though you see damage, the pest may have left.

Step 2: **Determine how many pests are present and causing damage.**



Small pest populations may be controlled more safely using non-pesticide techniques. These include removing food sources, washing off leaves with a strong stream of water, blocking entry into the home using caulking and replacing problem plants with ones less susceptible to pests.

Integrated Pest Management (IPM) usually combines several least toxic pest control methods for long-term prevention and management of pest problems without harming you, your family, or the environment.

UC CE University of California Cooperative Extension

Step 3: **If a pesticide must be used, choose the least toxic chemical.**

Obtain information on the least toxic pesticides that are effective at controlling the target pest from the UC Statewide Integrated Pest Management (IPM) Program's Web site at www.ipm.ucdavis.edu.

Seek out the assistance of a Certified Nursery Professional at a local nursery or garden center when selecting a pesticide. Purchase the smallest amount of pesticide available.

Apply the pesticide to the pest during its most vulnerable life stage. This information can be found on the pesticide label.

Step 4: **Wear appropriate protective clothing.**

Follow pesticide labels regarding specific types of protective equipment you should wear. Protective clothing should always be washed separately from other clothing.

Step 5: **Continuously monitor external conditions when applying pesticides such as weather, irrigation, and the presence of children and animals.**

Never apply pesticides when rain is predicted within the next 48 hours. Also, do not water after applying pesticides unless the directions say it is necessary.

Apply pesticides when the air is still; breezy conditions may cause the spray or dust to drift away from your targeted area.

In case of an emergency call 911 and/or the regional poison control number at (714) 634-5988 or (800) 544-4404 (CA only).

For general questions you may also visit www.calpoison.org.

Step 6: **In the event of accidental spills, sweep up or use an absorbent agent to remove any excess pesticides. Avoid the use of water.**

Be prepared. Have a broom, dust pan, or dry absorbent material, such as cat litter, newspapers or paper towels, ready to assist in cleaning up spills.

Contain and clean up the spill right away. Place contaminated materials in a doubled plastic bag. All materials used to clean up the spill should be properly disposed of according to your local Household Hazardous Waste Disposal site.

Step 7: **Properly store and dispose of unused pesticides.**

Purchase Ready-To-Use (RTU) products to avoid storing large concentrated quantities of pesticides.

Store unused chemicals in a locked cabinet.

Unused pesticide chemicals may be disposed of at a Household Hazardous Waste Collection Center.

Empty pesticide containers should be triple rinsed prior to disposing of them in the trash.

Household Hazardous Waste Collection Center
(714) 834-6752
www.oclandfills.com

PROJECT Pollution PREVENTION

Sewage Spill Regulatory Requirements

Allowing sewage to discharge to a gutter or storm drain may subject you to penalties and/or out-of-pocket costs to reimburse cities or public agencies for clean-up efforts.

Here are the pertinent codes, fines, and agency contact information that apply.

Orange County Stormwater Program

24 Hour Water Pollution Reporting Hotline
1-877-89-SPILL (1-877-897-7455)

- County and city water quality ordinances prohibit discharges containing pollutants.

Orange County Health Care Agency Environmental Health

(714) 433-6419

California Health and Safety Code, Sections 5410-5416

- No person shall discharge raw or treated sewage or other waste in a manner that results in contamination, pollution or a nuisance.
- Any person who causes or permits a sewage discharge to any state waters:
  - must immediately notify the local health agency of the discharge.
  - shall reimburse the local health agency for services that protect the public's health and safety (water-contact receiving waters).
  - who fails to provide the required notice to the local health agency is guilty of a misdemeanor and shall be punished by a fine (between $500–$1,000) and/or imprisonment for less than one year.

Regional Water Quality Control Board

Santa Ana Region (951) 782-4130
San Diego Region (858) 467-2952

- Requires the prevention, mitigation, response to and reporting of sewage spills.

California Office of Emergency Services

(800) 852-7550

California Water Code, Article 4, Chapter 4, Sections 13268-13271
California Code of Regulations, Title 23, Division 3, Chapter 9.2, Article 2, Sections 2250-2260

- Any person who causes or permits sewage in excess of 1,000 gallons to be discharged to state waters **shall immediately notify the Office of Emergency Services.**
- Any person who fails to provide the notice required by this section is **guilty of a misdemeanor** and shall be punished by a fine (less than $20,000) and/or imprisonment for not more than one year.

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Sewage Spill

Reference Guide

Your Responsibilities as a Private Property Owner

Residences
Businesses
Homeowner/Condominium Associations
Federal and State Complexes
Military Facilities

Orange County Sanitation District

Health Care Agency
Environmental Health

PROJECT Pollution PREVENTION

www.ocwatersheds.com

This brochure was designed courtesy of the Orange County Sanitation District (OCSD).
For additional information, call (714) 962-2411, or visit their website at www.ocsd.com

What is a Sewage Spill?

Sewage spills occur when the wastewater being transported via underground pipes overflows through a manhole, cleanout or broken pipe. Sewage spills can cause health hazards, damage to homes and businesses, and threaten the environment, local waterways and beaches.

Common Causes of Sewage Spills

Grease builds up inside and eventually blocks sewer pipes. Grease gets into the sewer from food establishments, household drains, as well as from poorly maintained commercial grease traps and interceptors.

Structure problems caused by tree roots in the lines, broken/cracked pipes, missing or broken cleanout caps or undersized sewers can cause blockages.

Infiltration and inflow (I/I) impacts pipe capacity and is caused when groundwater or rainwater enters the sewer system through pipe defects and illegal connections.

You Are Responsible for a Sewage Spill Caused by a Blockage or Break in Your Sewer Lines!

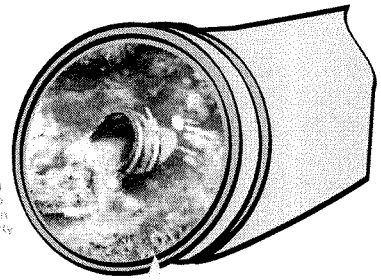
Time is of the essence in dealing with sewage spills. You are required to **immediately**:

Control and minimize the spill. Keep spills contained on private property and out of gutters, storm drains and public waterways by shutting off or not using the water.

Use sandbags, dirt and/or plastic sheeting to prevent sewage from entering the storm drain system.

Clear the sewer blockage. Always wear gloves and wash your hands. It is recommended that a plumbing professional be called for clearing blockages and making necessary repairs.

Always notify your city sewer/public works department or public sewer district of sewage spills. If the spill enters the storm drains also notify the Health Care Agency. In addition, if it exceeds 1,000 gallons notify the Office of Emergency Services. Refer to the numbers listed in this brochure.



Overflowing cleanout pipe located on private property

You Could Be Liable

Allowing sewage from your home, business or property to discharge to a gutter or storm drain may subject you to penalties and/or out-of-pocket costs to reimburse cities or public agencies for clean-up and enforcement efforts. See Regulatory Codes & Fines section for pertinent codes and fines that apply.

What to Look For

Sewage spills can be a very noticeable gushing of water from a manhole or a slow water leak that may take time to be noticed. Don't dismiss unaccounted-for wet areas.

Look for:

- Drain backups inside the building.
- Wet ground and water leaking around manhole lids onto your street.
- Leaking water from cleanouts or outside drains.
- Unusual odorous wet areas: sidewalks, external walls or ground/landscape around a building.

Caution

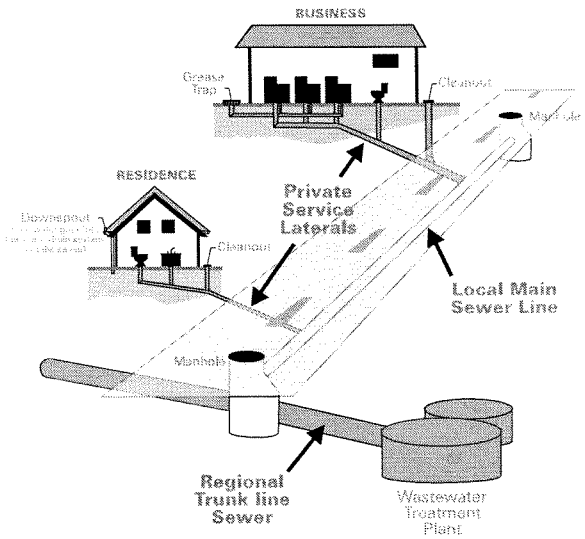
Keep people and pets away from the affected area. Untreated sewage has high levels of disease-causing viruses and bacteria. Call your local health care agency listed on the back for more information.

If You See a Sewage Spill Occurring, Notify Your City Sewer/Public Works Department or Public Sewer District IMMEDIATELY!

How a Sewer System Works

A property owner's sewer pipes are called service laterals and are connected to larger local main and regional trunk lines. Service laterals run from the connection at the home to the connection with the public sewer (including the area under the street). These laterals are the responsibility of the property owner and must be maintained by the property owner. Many city agencies have adopted ordinances requiring maintenance of service laterals. Check with your city sewer/local public works department for more information.

Operation and maintenance of **local and regional sewer lines** are the responsibility of the city sewer/public works departments and public sewer districts.



How You Can Prevent Sewage Spills

1. **Never put grease down garbage disposals, drains or toilets.**
2. **Perform periodic cleaning to eliminate grease, debris and roots in your service laterals.**
3. **Repair any structural problems in your sewer system and eliminate any rainwater infiltration/inflow leaks into your service laterals.**

Preventing Grease Blockages

The drain is not a dump! Recycle or dispose of grease properly and never pour grease down the drain.

Homeowners should mix fats, oils and grease with absorbent waste materials such as paper, coffee grounds, or kitty litter and place it in the trash. Wipe food scraps from plates and pans and dump them in the trash.

Restaurants and commercial food service establishments should always use "Kitchen Best Management Practices." These include:

- Collecting all cooking grease and liquid oil from pots, pans and fryers in covered grease containers for recycling.
- Scraping or dry-wiping excess food and grease from dishes, pots, pans and fryers into the trash.
- Installing drain screens on all kitchen drains.
- Having spill kits readily available for cleaning up spills.
- Properly maintaining grease traps or interceptors by having them serviced regularly. Check your local city codes.

Orange County Agency Responsibilites

- **City Sewer/Public Works Departments—** Responsible for protecting city property and streets, the local storm drain system, sewage collection system and other public areas.
- **Public Sewer/Sanitation District—** Responsible for collecting, treating and disposing of wastewater.
- **County of Orange Health Care Agency—** Responsible for protecting public health by closing ocean/bay waters and may close food-service businesses if a spill poses a threat to public health.
- **Regional Water Quality Control Boards—** Responsible for protecting State waters.
- **Orange County Stormwater Program—** Responsible for preventing harmful pollutants from being discharged or washed by stormwater runoff into the municipal storm drain system, creeks, bays and the ocean.

You Could Be Liable for Not Protecting the Environment

Local and state agencies have legal jurisdiction and enforcement authority to ensure that sewage spills are remedied.

They may respond and assist with containment, relieving pipe blockages, and/or clean-up of the sewage spill, especially if the spill is flowing into storm drains or onto public property.

A property owner may be charged for costs incurred by these agencies responding to spills from private properties.

Report Sewage Spills!

City Sewer/Public Works Departments

Aliso Viejo	(949) 425-2500
Anaheim	(714) 765-6860
Brea	(714) 990-7691
Buena Park	(714) 562-3655
Costa Mesa	(949) 645-8400
Cypress	(714) 229-6760
Dana Point	(949) 248-3562
Fountain Valley	(714) 593-4600
Fullerton	(714) 738-6897
Garden Grove	(714) 741-5375
Huntington Beach	(714) 536-5921
Irvine	(949) 453-5300
Laguna Beach	(949) 497-0765
Laguna Hills	(949) 707-2650
Laguna Niguel	(949) 362-4337
Laguna Woods	(949) 639-0500
La Habra	(562) 905-9792
Lake Forest	(949) 461-3480
La Palma	(714) 690-3310
Los Alamitos	(562) 431-3538
Mission Viejo	(949) 831-2500
Newport Beach	(949) 644-3011
Orange	(714) 532-6480
Orange County	(714) 567-6363
Placentia	(714) 993-8245
Rancho Santa Margarita	(949) 635-1800
San Clemente	(949) 366-1553
San Juan Capistrano	(949) 443-6363
Santa Ana	(714) 647-3380
Seal Beach	(562) 431-2527
Stanton	(714) 379-9222
Tustin	(714) 962-2411
Villa Park	(714) 998-1500
Westminster	(714) 893-3553
Yorba Linda	(714) 961-7170

Public Sewer/Water Districts

Costa Mesa Sanitary District	(714) 393-4433/ (949) 645-8400
El Toro Water District	(949) 837-0660
Emerald Bay Service District	(949) 494-8571
Garden Grove Sanitary District	(714) 741-5375
Irvine Ranch Water District	(949) 453-5300
Los Alamitos/Rossmoor Sewer District	(562) 431-2223
Midway City Sanitary District (Westminster)	(714) 893-3553
Moulton Niguel Water District	(949) 831-2500
Orange County Sanitation District	(714) 962-2411
Santa Margarita Water District	(949) 459-6420
South Coast Water District	(949) 499-4555
South Orange County Wastewater Authority	(949) 234-5400
Sunset Beach Sanitary District	(562) 493-9932
Trabuco Canyon Sanitary District	(949) 858-0277
Yorba Linda Water District	(714) 777-3018

Other Agencies

Orange County Health Care Agency	(714) 433-6419
Office of Emergency Services	(800) 852-7550

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Home improvement projects and work sites must be maintained to ensure that building materials do not enter the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump building materials into the ocean, so don't let them enter the storm drains. Follow these tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

To report a spill,
call the
Orange County 24-Hour Water Pollution Problem Reporting Hotline
at **1-877-89-SPILL** (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while performing home improvement projects. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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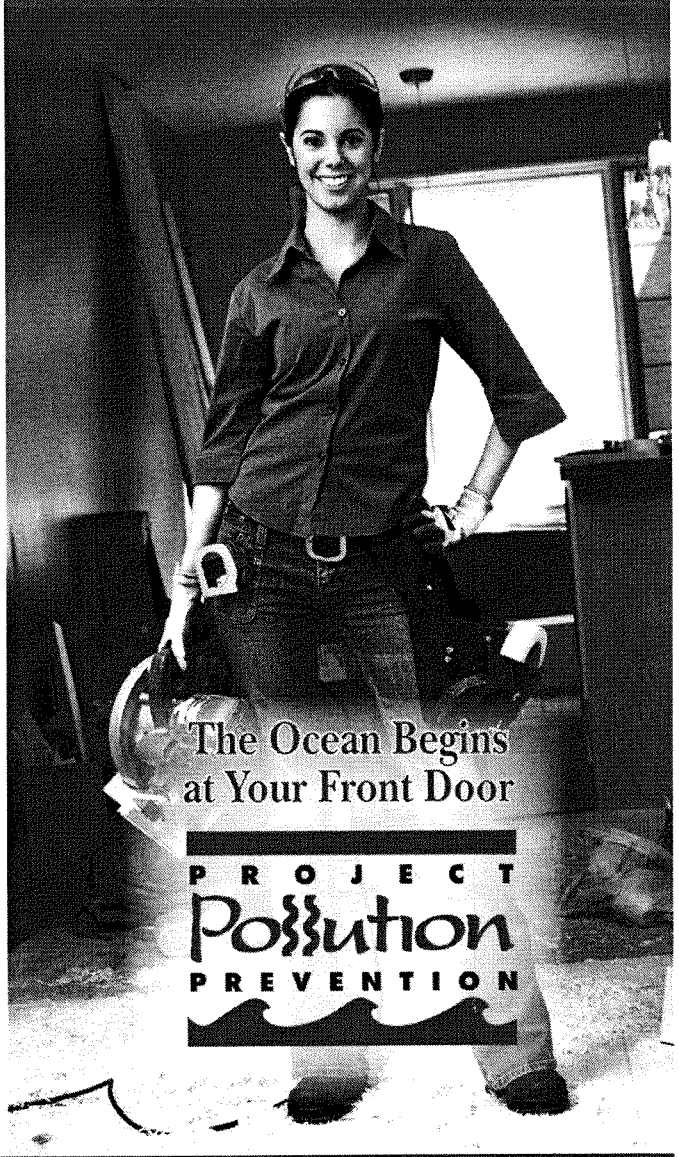
Help Prevent Ocean Pollution:

Tips for Home Improvement Projects



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Tips for Home Improvement Projects

Home improvement projects can cause significant damage to the environment. Whether you hire a contractor or work on the house yourself, it is important to follow these simple tips while renovating, remodeling or improving your home:

General Construction

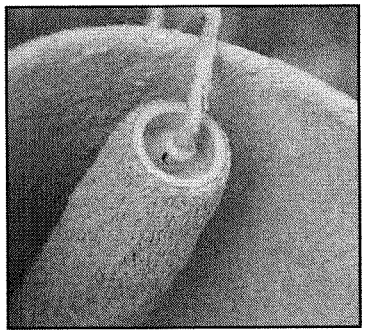
- Schedule projects for dry weather.
- Keep all construction debris away from the street, gutter and storm drain.
- Store materials under cover with temporary roofs or plastic sheets to eliminate or reduce the possibility that rainfall, runoff or wind will carry materials from the project site to the street, storm drain or adjacent properties.

Building Materials

- Never hose materials into a street, gutter or storm drain.
- Exposed piles of construction material should not be stored on the street or sidewalk.
- Minimize waste by ordering only the amount of materials needed to complete the job.
- Do not mix more fresh concrete than is needed for each project.
- Wash concrete mixers and equipment in a designated washout area where the water can flow into a containment area or onto dirt.
- Dispose of small amounts of dry excess materials in the trash. Powdery waste, such as dry concrete, must be properly contained within a box or bag prior to disposal. Call your local trash hauler for weight and size limits.

Paint

- Measure the room or object to be painted, then buy only the amount needed.
- Place the lid on firmly and store the paint can upside-down in a dry location away from the elements.
- Tools such as brushes, buckets and rags should never be washed where excess water can drain into the street, gutter or storm drain. All tools should be rinsed in a sink connected to the sanitary sewer.
- When disposing of paint, never put wet paint in the trash.
- Dispose of water-based paint by removing the lid and letting it dry in the can. Large amounts must be taken to a Household Hazardous Waste Collection Center (HHWCC).



- Oil-based paint is a household hazardous waste. All leftover paint should be taken to a HHWCC.
- For HHWCC locations and hours, call **(714) 834-6752** or visit **www.oclandfills.com**.

Erosion Control

- Schedule grading and excavation projects for dry weather.
- When temporarily removing soil, pile it in a contained, covered area where it cannot spill into the street, or obtain the required temporary encroachment or street closure permit and follow the conditions instructed by the permit.
- When permanently removing large quantities of soil, a disposal location must be found prior to excavation. Numerous businesses are available to handle disposal needs. For disposal options, visit **www.ciwmb.ca.gov/SWIS**.
- Prevent erosion by planting fast-growing annual and perennial grasses. They will shield and bind the soil.

Recycle

- Use a construction and demolition recycling company to recycle lumber, paper, cardboard, metals, masonry (bricks, concrete, etc.), carpet, plastic, pipes (plastic, metal and clay), drywall, rocks, dirt and green waste.
- For a listing of construction and demolition recycling locations in your area, visit **www.ciwmb.ca.gov/recycle.**

Spills

- Clean up spills immediately by using an absorbent material such as cat litter, then sweep it up and dispose of it in the trash.
- Immediately report spills that have entered the street, gutter or storm drain to the County's 24-Hour Water Pollution Problem Reporting Hotline at **(714) 567-6363** or visit **www.ocwatersheds.com** to fill out an incident reporting form.

PROJECT Pollution PREVENTION

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Fertilizers, pesticides and other chemicals that are left on yards or driveways can be blown or washed into storm drains that flow to the ocean. Overwatering lawns can also send materials into storm drains. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never pour gardening products into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

UCCE Master Gardener Hotline:
(714) 708-1646

To report a spill,
call the
Orange County 24-Hour
Water Pollution Problem
Reporting Hotline
1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while landscaping or gardening. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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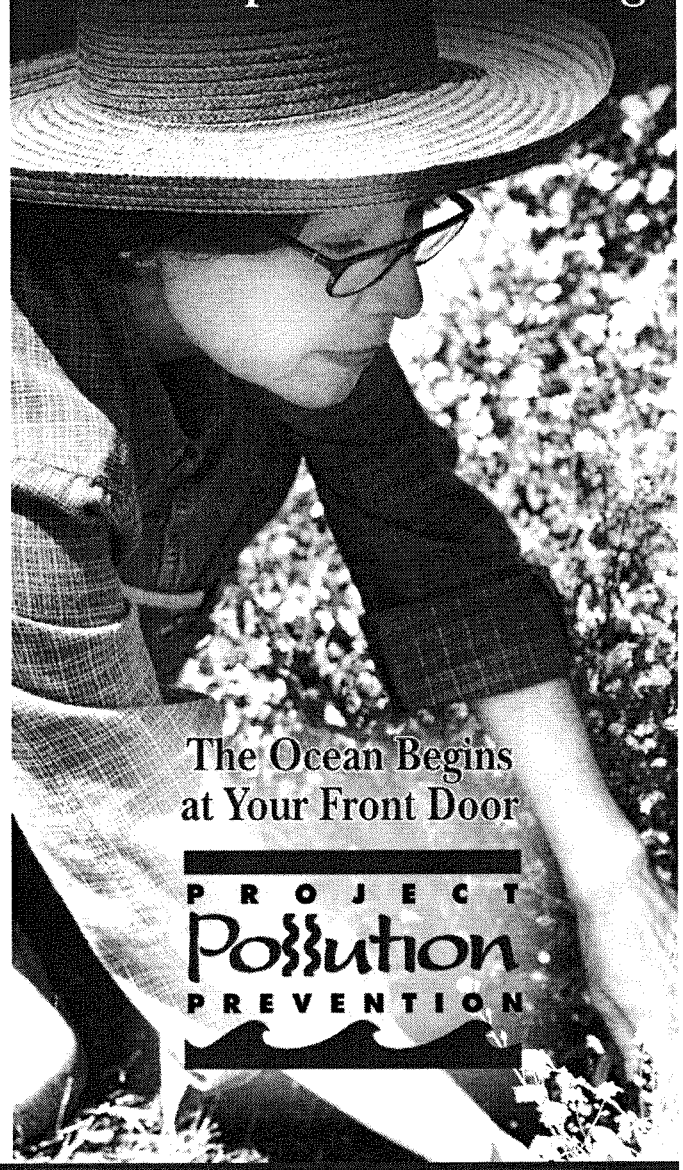
Help Prevent Ocean Pollution:

Tips for Landscape & Gardening



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Tips for Landscape & Gardening

Never allow gardening products or polluted water to enter the street, gutter or storm drain.

General Landscaping Tips

- Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting.

- Prevent erosion of slopes by planting fast-growing, dense ground covering plants. These will shield and bind the soil.

- Plant native vegetation to reduce the amount of water, fertilizers, and pesticide applied to the landscape.

- Never apply pesticides or fertilizers when rain is predicted within the next 48 hours.

Garden & Lawn Maintenance

- Do not overwater. Use irrigation practices such as drip irrigation, soaker hoses or micro spray systems. Periodically inspect and fix leaks and misdirected sprinklers.

- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of green waste by composting, hauling it to a permitted landfill, or recycling it through your city's program.

- Use slow-release fertilizers to minimize leaching, and use organic fertilizers.

- Read labels and use only as directed. Do not over-apply pesticides or fertilizers. Apply to spots as needed, rather than blanketing an entire area.

- Store pesticides, fertilizers and other chemicals in a dry covered area to prevent exposure that may result in the deterioration of containers and packaging.

- Rinse empty pesticide containers and re-use rinse water as you would use the product. Do not dump rinse water down storm drains. Dispose of empty containers in the trash.

- When available, use non-toxic alternatives to traditional pesticides, and use pesticides specifically designed to control the pest you are targeting. For more information, visit **www.ipm.ucdavis.edu**.

- If fertilizer is spilled, sweep up the spill before irrigating. If the spill is liquid, apply an absorbent material such as cat litter, and then sweep it up and dispose of it in the trash.

- Take unwanted pesticides to a Household Hazardous Waste Collection Center to be recycled. Locations are provided below.

Household Hazardous Waste Collection Centers

Anaheim:	1071 N. Blue Gum St.
Huntington Beach:	17121 Nichols St.
Irvine:	6411 Oak Canyon
San Juan Capistrano:	32250 La Pata Ave.

For more information, call (714) 834-6752 or visit www.oclandfills.com

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Pet waste and pet care products can be washed into the storm drains that flow to the ocean. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never put pet waste or pet care products into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

To report a spill,
call the
Orange County 24-Hour Water Pollution Problem Reporting Hotline
1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while caring for your pet. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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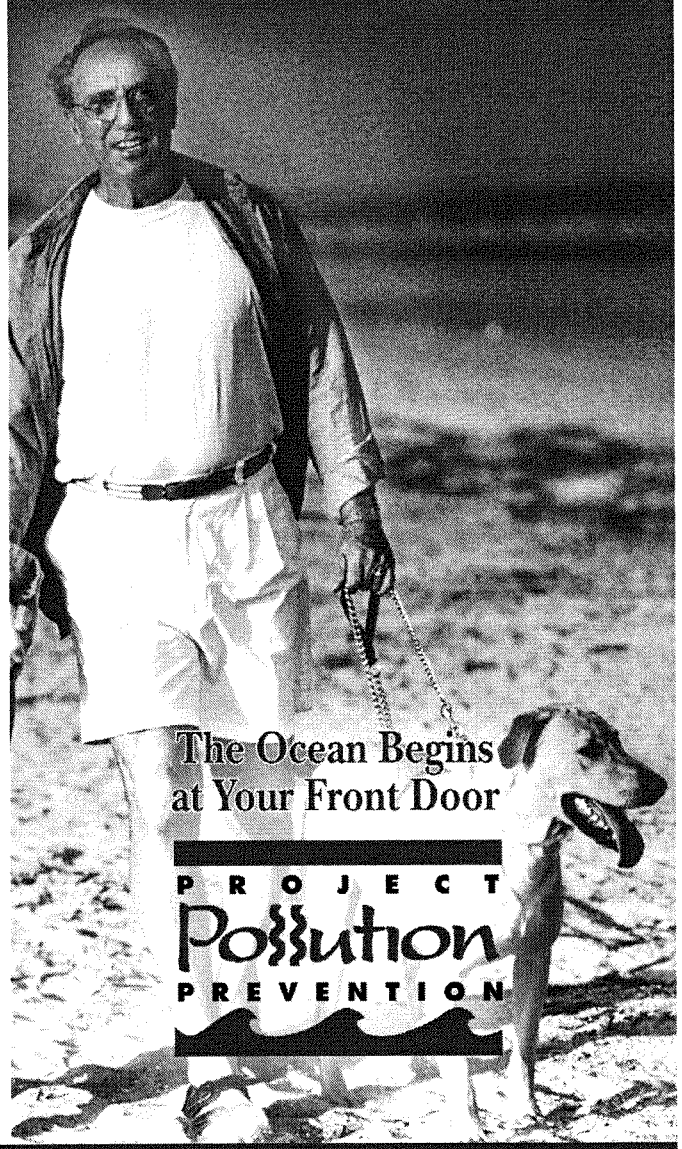
Help Prevent Ocean Pollution:

Tips for Pet Care



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Tips for Pet Care

Never let any pet care products or washwater run off your yard and into the street, gutter or storm drain.

Washing Your Pets

Even biodegradable soaps and shampoos can be harmful to marine life and the environment.

- If possible, bathe your pets indoors using less-toxic shampoos or have your pet professionally groomed. Follow instructions on the products and clean up spills.

- If you bathe your pet outside, wash it on your lawn or another absorbent/ permeable surface to keep the washwater from running into the street, gutter or storm drain.

Flea Control

- Consider using oral or topical flea control products.

- If you use flea control products such as shampoos, sprays or collars, make sure to dispose of any unused products at a Household Hazardous Waste Collection Center. For location information, call **(714) 834-6752**.

Why You Should Pick Up After Your Pet

It's the law! Every city has an ordinance requiring you to pick up after your pet. Besides being a nuisance, pet waste can lead to water pollution, even if you live inland. During rainfall, pet waste left outdoors can wash into storm drains. This waste flows directly into our waterways and the ocean where it can harm human health, marine life and the environment.

As it decomposes, pet waste demands a high level of oxygen from water. This decomposition can contribute to killing marine life by reducing the amount of dissolved oxygen available to them.

Have fun with your pets, but please be a responsible pet owner by taking care of them and the environment.

- Take a bag with you on walks to pick up after your pet.

- Dispose of the waste in the trash or in a toilet.

PROJECT Pollution PREVENTION

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities such as painting can lead to water pollution if you're not careful. Paint must be used, stored and disposed of properly to ensure that it does not enter the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump paint into the ocean, so don't let it enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

To report a spill,
call the
Orange County 24-Hour Water Pollution Problem Reporting Hotline
at **1-877-89-SPILL** (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while using, storing and disposing of paint. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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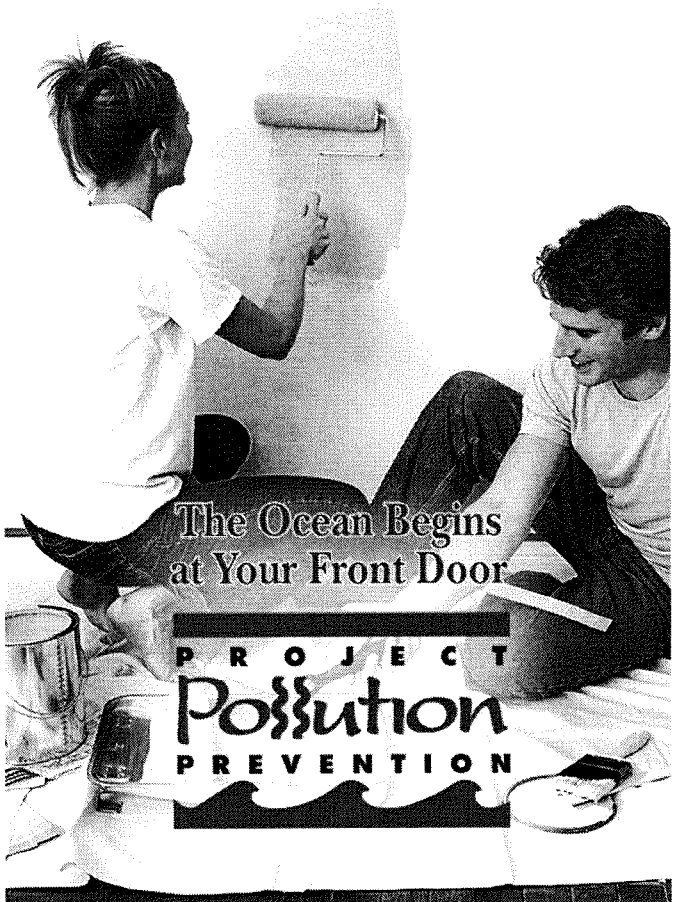
Help Prevent Ocean Pollution:

Tips for Projects Using Paint



Tips for Projects Using Paint

Paint can cause significant damage to our environment. Whether you hire a contractor or do it yourself, it is important to follow these simple tips when purchasing, using, cleaning, storing and disposing of paint.

Purchasing Paint

- Measure the room or object to be painted, then buy only the amount needed.
- Whenever possible, use water-based paint since it usually does not require hazardous solvents such as paint thinner for cleanup.

Painting

- Use only one brush or roller per color of paint to reduce the amount of water needed for cleaning.
- Place open paint containers or trays on a stable surface and in a position that is unlikely to spill.
- Always use a tarp under the area or object being painted to collect paint drips and contain spills.

Cleaning

- Never clean brushes or rinse paint containers in the street, gutter or storm drain.
- For oil-based products, use as much of the paint on the brushes as possible. Clean brushes with thinner. To reuse thinner, pour it through a fine filter (e.g. nylon, metal gauze or filter paper) to remove solids such as leftover traces of paint.
- For water-based products, use as much of the paint on the brushes as possible, then rinse in the sink.
- Collect all paint chips and dust. Chips and dust from marine paints or paints containing lead, mercury or tributyl tin are hazardous waste. Sweep up and dispose of at a Household Hazardous Waste Collection Center (HHWCC).

Storing Paint

- Store paint in a dry location away from the elements.
- Store leftover water-based paint, oil-based paint and solvents separately in original or clearly marked containers.
- Avoid storing paint cans directly on cement floors. The bottom of the can will rust much faster on cement.
- Place the lid on firmly and store the paint can upside-down to prevent air from entering. This will keep the paint usable longer. Oil-based paint is usable for up to 15 years. Water-based paint remains usable for up to 10 years.

Alternatives to Disposal

- Use excess paint to apply another coat, for touch-ups, or to paint a closet, garage, basement or attic.
- Give extra paint to friends or family. Extra paint can also be donated to a local theatre group, low-income housing program or school.
- Take extra paint to an exchange program such as the **"Stop & Swap"** that allows you to drop off or pick up partially used home care products free of charge. **"Stop & Swap"** programs are available at most HHWCCs.
- For HHWCC locations and hours, call **(714) 834-6752** or visit **www.oclandfills.com**.

Disposing of Paint

- Never put wet paint in the trash.

For water-based paint:

- If possible, brush the leftover paint on cardboard or newspaper. Otherwise, allow the paint to dry in the can with the lid off in a well-ventilated area protected from the elements, children and pets. Stirring the paint every few days will speed up the drying.
- Large quantities of extra paint should be taken to a HHWCC.
- Once dried, paint and painted surfaces may be disposed of in the trash. When setting a dried paint can out for trash collection, leave the lid off so the collector will see that the paint has dried.

For oil-based paint:

- Oil-based paint is a household hazardous waste. All leftover paint should be taken to a HHWCC.

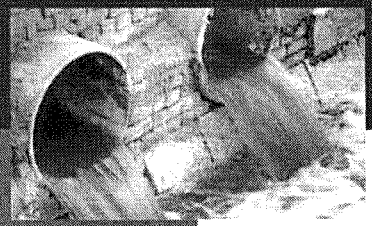
Aerosol paint:

- Dispose of aerosol paint cans at a HHWCC.

Spills

- Never hose down pavement or other impermeable surfaces where paint has spilled.
- Clean up spills immediately by using an absorbent material such as cat litter. Cat litter used to clean water-based paint spills can be disposed of in the trash. When cleaning oil-based paint spills with cat litter, it must be taken to a HHWCC.
- Immediately report spills that have entered the street, gutter or storm drain to the County's 24-Hour Water Pollution Problem Reporting Hotline at **(714) 567-6363** or visit **www.ocwatersheds.com** to fill out an incident reporting form.

PROJECT Pollution PREVENTION



Clean beaches and healthy creeks, rivers, bays, and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Materials and excess concrete or mortar can be blown or washed into the storm drains that flow to the ocean. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never throw building materials into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.

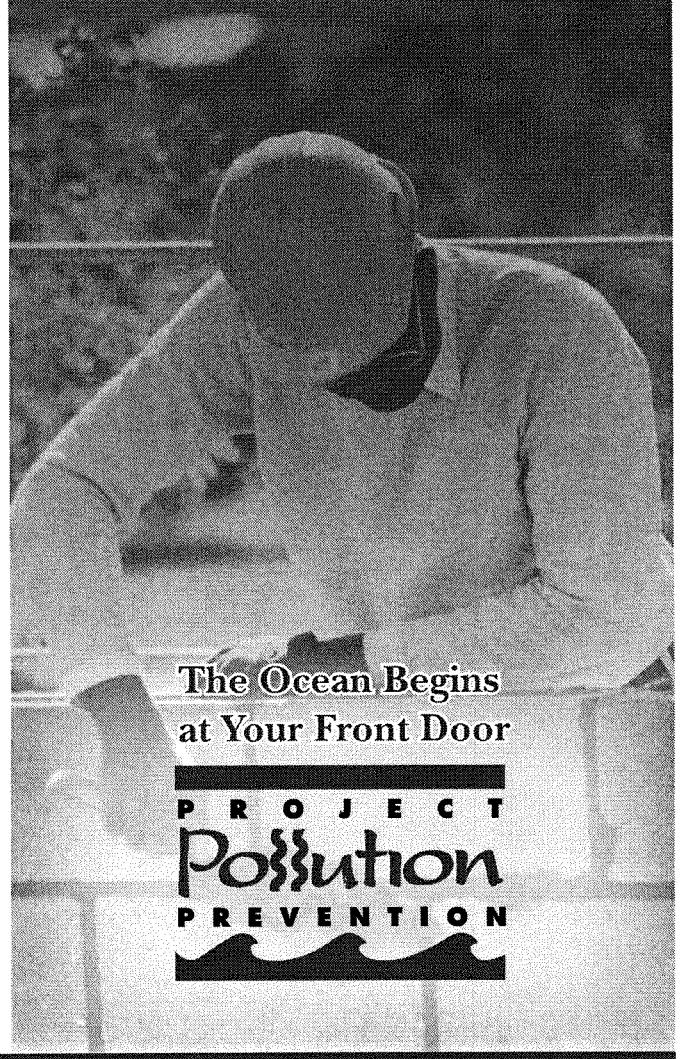
For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com.

To report a spill,
call the
Orange County 24-Hour
Water Pollution Reporting Hotline
at **1-877-89-SPILL** (1-877-897-7455).

For emergencies, dial 911.

The Tips contained in this brochure provide useful information about how you can keep materials and washwater from entering the storm drain system. If you have other suggestions for how water and materials may be contained, please contact your city's stormwater representative or call the Orange County Stormwater Program.

Tips for Using Concrete and Mortar



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Tips for Using Concrete and Mortar

Never allow materials or washwater to enter the street or storm drain.

Before the Project

- Schedule projects for dry weather.
- Store materials under cover, with temporary roofs or plastic sheets, to eliminate or reduce the possibility that the materials can be carried from the project site to streets, storm drains or adjacent properties via rainfall, runoff or wind.
- Minimize waste by ordering only the amount of materials needed to complete the job.
- Take measures to block nearby storm drain inlets.

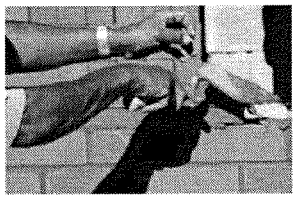
During the Project

- Set up and operate small mixers on tarps or heavy drop cloths.
- Do not mix more fresh concrete or cement than is needed for the job.

- When breaking up pavement, pick up all chunks and pieces and recycle them at a local construction and demolition recycling company. (See information to the right)
- When making saw cuts in pavement, protect nearby storm drain inlets during the saw-cutting operation and contain the slurry. Collect the slurry residue from the pavement or gutter and remove from the site.

Clean-Up

- Dispose of small amounts of dry concrete, grout or mortar in the trash.
- Never hose materials from exposed aggregate concrete, asphalt or similar treatments into a street, gutter, parking lot, or storm drain.
- Wash concrete mixers and equipment in designated washout areas where the water can flow into a containment area or onto dirt. Small amounts of dried material can be disposed of in the trash. Large amounts should be recycled at a local construction and demolition recycling company. (See information below)



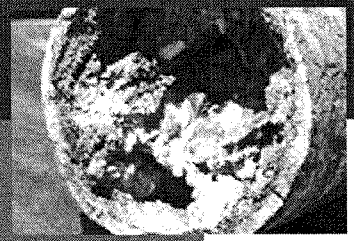
- Recycle cement wash water by pumping it back into cement mixers for reuse.

Spills

- Never hose down pavement or impermeable surfaces where fluids have spilled. Use an absorbent material such as cat litter to soak up a spill, then sweep and dispose in the trash.
- Clean spills on dirt areas by digging up and properly disposing of contaminated dry soil in trash.
- Immediately report significant spills to the County's 24-Hour Water Pollution Problem Reporting Hotline at 714-567-6363 or log onto the County's website at www.ocwatersheds.com and fill out an incident reporting form.

For a list of construction and demolition recycling locations in your area visit www.ciwmb.ca.gov/Recycle/.

For additional information on how to control, prevent, remove, and reduce pollution refer to the Stormwater Best Management Practice Handbook, available on-line at www.cabmphandbooks.com.



Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. Fats, oils and grease from restaurants and food service facilities can cause sewer line blockages that may result in sewage overflow into your facility and into storm drains. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways and should never contain washwater, trash, grease or other materials.

You would never dump oil and trash into the ocean, so don't let it enter the storm drains. Follow these tips to help prevent water pollution.

For more information, please call the **Orange County Stormwater Program** at **1-877-89-SPILL** (1-877-897-7455) or visit **www.ocwatersheds.com**

Report sewage spills and discharges that are not contained to your site to the **Orange County 24-Hour Water Pollution Problem Reporting Hotline** at **1-877-89-SPILL** (1-877-897-7455)

For emergencies, dial 911.

CALIFORNIA Restaurant ASSOCIATION SINCE 1906

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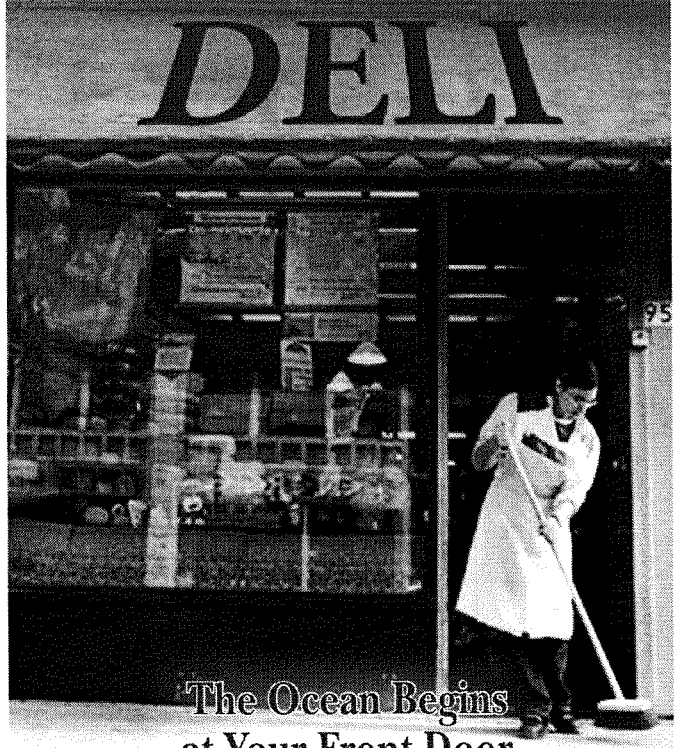
Help Prevent Ocean Pollution:

Tips for the Food Service Industry



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

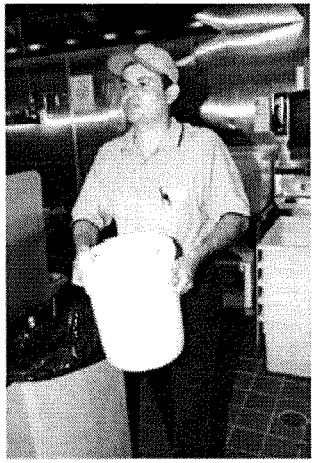
Best Kitchen Practices

Food Waste Disposal

- Scrape food waste off of plates, utensils, pots, food preparation and cooking areas and dispose of it in the trash.
- Never put food waste down the drain. Food scraps often contain grease, which can clog sewer pipes and result in sewage backups and overflows.

Grease & Oil Disposal

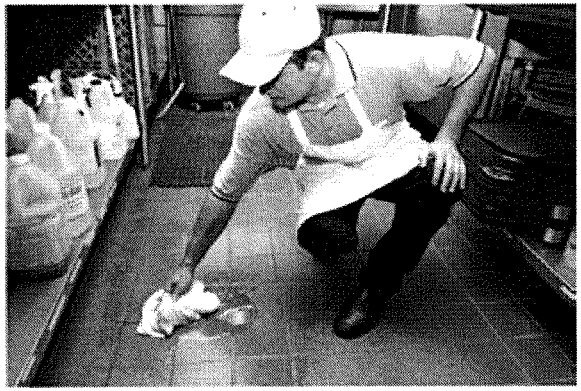
- Never put oil or grease down the drain. Contain grease and oil by using covered grease storage containers or installing a grease interceptor.
- Never overfill your grease storage container or transport it without a cover.
- Grease control devices must be emptied and cleaned by permitted companies.
- Keep maintenance records on site.



- For a list of oil/grease recycling companies, contact the CIWMB at **www.ciwmb.ca.gov/foodwaste/render.htm** or contact your local sanitation district.

Minor Spill Cleanup

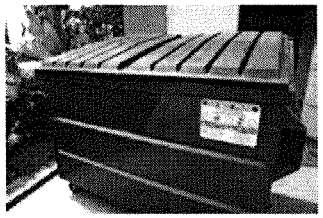
- Always use dry cleanup methods, such as a rag, damp mop or broom.
- Never hose a spill into the street, gutter or storm drain.



Major Spill Cleanup

- Have spill containment and clean-up kits readily available, and train all employees on how to use them.
- Immediately contain and clean the spill using dry methods.
- If the spill leaves your site, call **(714) 567-6363**.

Dumpster Cleanup



- Pick up all debris around the dumpster.
- Always keep the lid on the dumpster closed.
- Never pour liquids into the dumpster or hose it out.

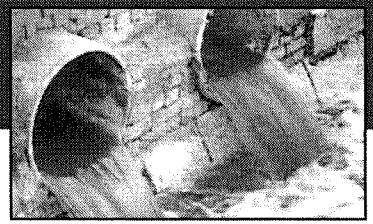
Floor Mat Cleaning

- Sweep the floor mats regularly, discarding the debris into the trash.
- Hose off the mats in a mop sink, at a floor drain, or in an outdoor area that can contain the water.
- Never hose the mats in an area where the wastewater can flow to the street, gutter or storm drain.

Washwater Disposal

- Dispose of washwater in a mop sink or an area with a floor drain.
- Never dispose of washwater in the street, gutter or storm drain.

PROJECT Pollution PREVENTION



Preventing water pollution at your commercial/industrial site

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many landscape and building maintenance activities can lead to water pollution if you're not careful. Paint, chemicals, plant clippings and other materials can be blown or washed into storm drains that flow to the ocean. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never pour soap or fertilizers into the ocean, so why would you let them enter the storm drains? Follow these easy tips to help prevent water pollution.

Some types of industrial facilities are required to obtain coverage under the State General Industrial Permit. For more information visit: **www.swrcb.ca.gov/stormwater/industrial.html**

For more information, please call the **Orange County Stormwater Program** at **1-877-89-SPILL** (1-877-897-7455) or visit **www.ocwatersheds.com**

To report a spill, call the **Orange County 24-Hour Water Pollution Problem Reporting Hotline** at **1-877-89-SPILL** (1-877-897-7455).

For emergencies, dial 911.

RECYCLE USED OIL

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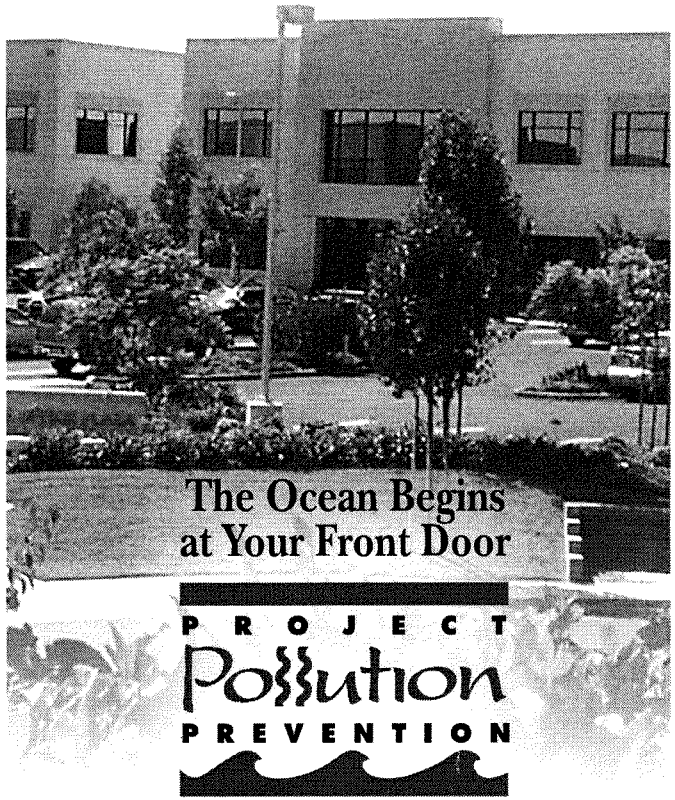
Help Prevent Ocean Pollution:

Proper Maintenance Practices for Your Business



Proper Maintenance Practices for your Business

Landscape Maintenance

- Compost grass clippings, leaves, sticks and other vegetation, or dispose of it at a permitted landfill or in green waste containers. Do not dispose of these materials in the street, gutter or storm drain.
- Irrigate slowly and inspect the system for leaks, overspraying and runoff. Adjust automatic timers to avoid overwatering.
- Follow label directions for the use and disposal of fertilizers and pesticides.
- Do not apply pesticides or fertilizers if rain is expected within 48 hours or if wind speeds are above 5 mph.
- Do not spray pesticides within 100 feet of waterways.
- Fertilizers should be worked into the soil rather than dumped onto the surface.
- If fertilizer is spilled on the pavement or sidewalk, sweep it up immediately and place it back in the container.

Building Maintenance

- Never allow washwater, sweepings or sediment to enter the storm drain.
- Sweep up dry spills and use cat litter, towels or similar materials to absorb wet spills. Dispose of it in the trash.
- If you wash your building, sidewalk or parking lot, you **must** contain the water. Use a shop vac to collect the water and contact your city or sanitation agency for proper disposal information. Do not let water enter the street, gutter or storm drain.
- Use drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of materials in the trash.
- Use a ground cloth or oversized tub for mixing paint and cleaning tools.
- Use a damp mop or broom to clean floors.
- Cover dumpsters to keep insects, animals, rainwater and sand from entering. Keep the area around the dumpster clear of trash and debris. Do not overfill the dumpster.
- Call your trash hauler to replace leaking dumpsters.
- Do not dump any toxic substance or liquid waste on the pavement, the ground, or near a storm drain. Even materials that seem harmless such as latex paint or biodegradable cleaners can damage the environment.

NEVER DISPOSE OF ANYTHING IN THE STORM DRAIN.

- Recycle paints, solvents and other materials. For more information about recycling and collection centers, visit **www.oclandfills.com**.
- Store materials indoors or under cover and away from storm drains.
- Use a construction and demolition recycling company to recycle lumber, paper, cardboard, metals, masonry, carpet, plastic, pipes, drywall, rocks, dirt, and green waste. For a listing of construction and demolition recycling locations in your area, visit **www.ciwmb.ca.gov/recycle.**
- Properly label materials. Familiarize employees with Material Safety Data Sheets.

PROJECT Pollution PREVENTION

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, if we are not careful, our daily activities can lead directly to water pollution problems. Water that drains through your watershed can pick up pollutants which are then transported to our waterways and beautiful ocean.

You can prevent water pollution by taking personal action and by working with members of your watershed community to prevent urban runoff from entering your waterway.

For more information,
please call the
Orange County Stormwater Program
at **1.877.89.SPILL**
or visit
www.ocwatersheds.com

To report a spill,
call the
Orange County 24-Hour Water Pollution Problem Reporting Hotline
at **1.877.89.SPILL.**

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help protect your watershed. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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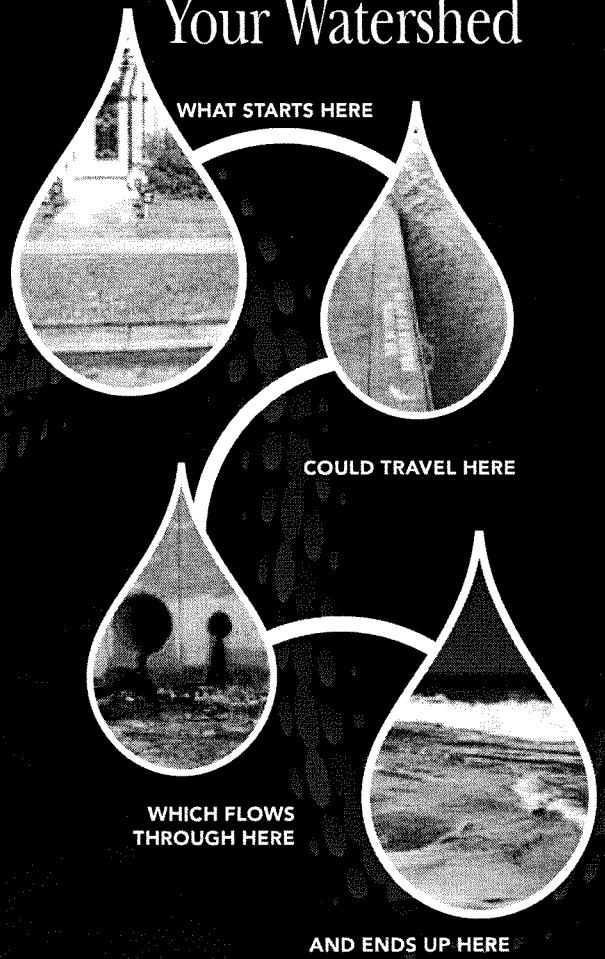
Help Prevent Ocean Pollution: Tips For Protecting Your Watershed



The Ocean Begins at Your Front Door

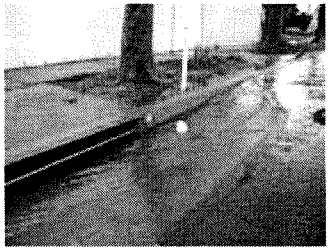
PROJECT Pollution PREVENTION

Tips for Protecting Your Watershed

My Watershed. Our Ocean.

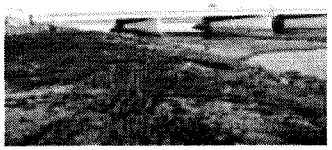
Water + shed, *noun: A region of land within which water flows down into a specified water body, such as a river, lake, sea, or ocean; a drainage basin or catchment basin.*

Orange County is comprised of 11 major watersheds into which most of our water flows, connecting all of Orange County to the Pacific Ocean.



As water from rain (stormwater) or sprinklers and hoses (urban runoff) runs down your driveway and into your neighborhood streets, sidewalks and gutters, it flows into storm drains that lead to waterways within your watershed. The waterways from other cities merge as they make their way through our watersheds until all the runoff water in Orange County meets at the Pacific Ocean. The water that reaches our ocean is not pure. As it flows through the watershed, it picks up pollutants such as litter, cigarette butts, fertilizer, pesticides, pet waste, motor oil and lawn clippings. Unlike water that enters the sewer (from sinks and toilets), water that enters the storm drain is not treated before it flows, ultimately, to the ocean.

Water quality can be improved by "Adopting Your Watershed." Through this effort, we are challenging citizens and organizations to join the Orange County Stormwater Program and others who are working to protect and restore our creeks, rivers, bays and ocean.

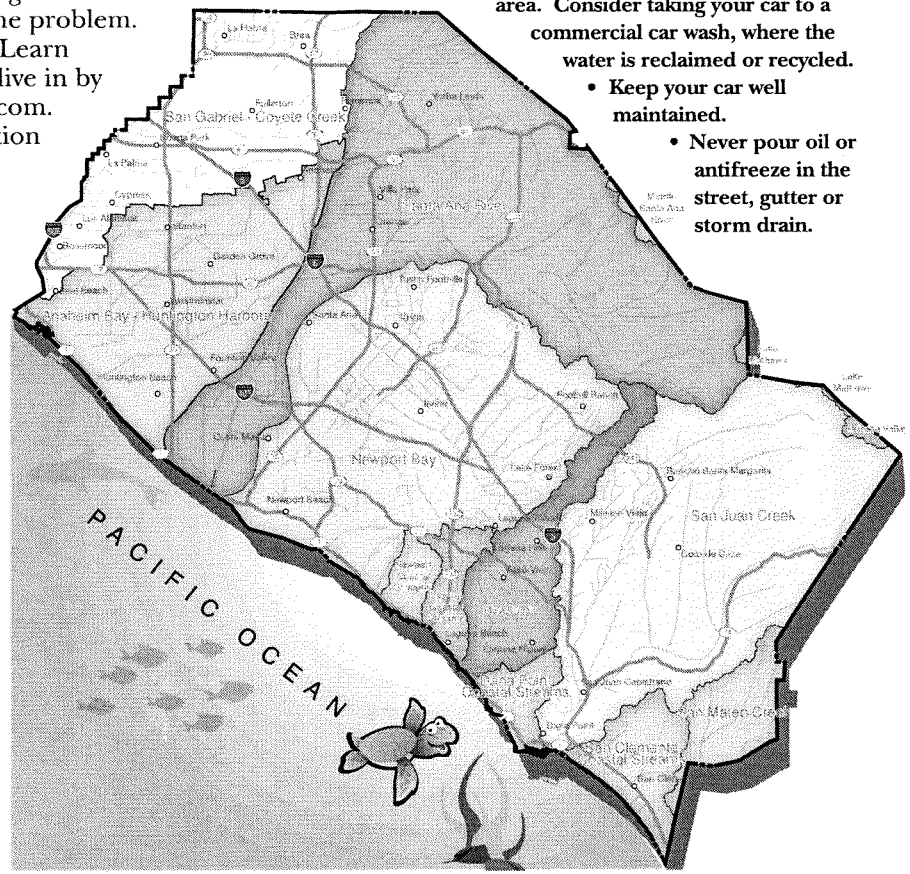


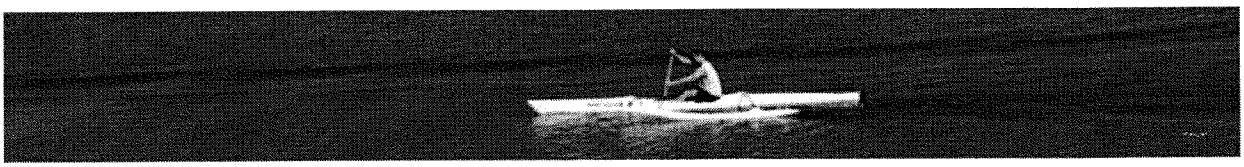
There are many opportunities to get involved:

- Appreciate your watershed - explore the creeks, trails and ocean and make observations about its conditions. If you see anything abnormal (such as dead fish, oil spills, leaking barrels, and other pollution) contact the Orange County 24-hour water pollution problem reporting hotline at 1.877.89.SPILL to report the problem.
- Research your watershed. Learn about what watershed you live in by visiting www.ocwatersheds.com.
- Find a watershed organization in your community and volunteer to help. If there are no active groups, consider starting your own.
- Visit EPA's Adopt Your Watershed's Catalog of Watershed Groups at www.epa.gov/adopt to locate groups in your community.
- Organize or join in a creek, river, bay or ocean cleanup event such as Coastal & Inner Coastal Cleanup Day that takes place the 3rd Saturday of every September. For more information visit www.coast4u.org.

Follow these simple tips to protect . water quality of your watershed:

- **Sweep up debris and dispose of it in the trash. Do not hose down driveways or sidewalks into the street or gutter.**
- **Use dry cleanup methods such as cat litter to absorb spills and sweep up residue.**
- **Set your irrigation systems to reflect seasonal water needs or use weather-based controllers. Inspect for runoff regularly.**
- **Cover trashcans securely.**
- **Take hazardous waste to a household hazardous waste collection center. (For example, paint, batteries and petroleum products)**
- **Pick up after your pet.**
- **Follow application and disposal directions for pesticides and fertilizers.**
- **If you wash your car at home, wash it on your lawn or divert the runoff onto a landscaped area. Consider taking your car to a commercial car wash, where the water is reclaimed or recycled.**
- **Keep your car well maintained.**
- **Never pour oil or antifreeze in the street, gutter or storm drain.**





GENERAL INFORMATION

THE PROBLEM: WHAT IS STORMWATER POLLUTION?

Stormwater pollution is urban runoff water that has picked up pollutants as it flows through the storm drain system (a network of channels, gutters and pipes that collect runoff from city streets, neighborhoods, farms, construction sites and parking lots) and empties directly into local waterways.

Unlike sewage, which goes to treatment plants, urban runoff flows untreated through the storm drain system. Anything thrown, swept or poured into the street, gutter or a catch basin (the curbside openings that lead into the storm drain system) can flow directly into our channels, creeks, bays and ocean. This includes pollutants like trash, pet waste, cigarette butts, motor oil, anti-freeze, runoff from pesticides and fertilizers, paint from brushes and containers rinsed in the gutter and toxic household chemicals.

How Stormwater Pollution Affects Newport Beach Residents

Contaminated urban runoff is an uncontrolled nonpoint source of pollution into local waters, and often contributes to beach closures. Litter, leaves and other debris clog catch basins, causing flooding when it rains.

How Stormwater Pollution Affects Newport Beach Businesses

Stormwater pollution contributes to beach closures, which hurt local businesses, tourism and Newport Beach's image as a desirable place to live and work. It is illegal for businesses without a permit to discharge wastewater or other materials into the storm drain system.

The Answer: Preventing Stormwater Pollution

Everyone in Newport Beach can help prevent stormwater pollution. It is often caused by everyday behavior that you may not realize contributes to the problem. Simple behavior changes are all it takes to prevent stormwater pollution, if we all do our part. Find out how.

- How Residents Can Prevent Stormwater Pollution
- How Businesses Can Prevent Stormwater Pollution

REGULATORY INFORMATION

The Federal Water Pollution Control Act prohibits the discharge of any pollutant to navigable waters from a point source unless the discharge is authorized by a National Pollutant Discharge Elimination System (NPDES) permit. The 1987 passage of the Water Quality Act established NPDES permit requirements for discharges of stormwater. The NPDES permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

Industrial facilities and construction sites are regulated by the State Water Resources Control Board, through general stormwater permits. Cities and counties are regulated through permits issued by the Regional Water Quality Control Boards. Since 1990, operators of large storm drain systems such as Newport Beach's have been required to:

- Develop a stormwater management program designed to prevent harmful pollutants from being dumped or washed by stormwater runoff, into the stormwater system, then discharged into local waterbodies; and
- Obtain a National Pollutant Discharge Elimination System (NPDES) permit.

The NPDES permit programs in California are administered by the State Water Resources Control Board and by nine regional boards that issue NPDES permits and enforce regulations within their respective region.

Newport Beach lies within the jurisdiction of the Santa Ana Region. This regional board issues permits to the Orange County Permittees, which includes the County of Orange, Orange County Flood Control District and incorporated cities of Orange County. Since the program's inception, the County of Orange has served as the principal permittee.

DOCUMENTS AND REPORTS

The following documents describe the regulations and programs for water quality in Orange County.

Basin Plans

The document for each region of the State Water Quality Board's jurisdiction, Santa Ana and San Diego, is the Water Quality Control Plan, commonly referred to as the Basin Plan. It is the foundation for the regulatory programs of each regional board. The Basin Plan documents the beneficial uses of the region's ground and surface waters, existing water quality conditions, problems, and goals, and actions by the regional board and others that are necessary to achieve and maintain water quality standards.

- Water Control Plan for the Santa Ana River Basin

WATER QUALITY MANAGEMENT PLANS (WQMPs)

Quick Downloads

2011 Model WQMP [PDF]
WQMP Template [MS Word]
Technical Guidance Document [PDF]
Non Priority Projects [MS Word]

In response to permit requirements from the SARWQCB, the County of Orange has prepared a 2011 Model WQMP to assist with project development in North and Central Orange County. Consistent with the 2011 Model WQMP, a Project WQMP may include:

Site design measures
Low Impact Development (LID) Best Management Practices (BMPs)
Participation in sub regional/regional BMPs
Hydromodification BMPs
Use of alternative programs or treatment control BMPs, and
Applicable source control BMPs

This updated 2011 Model WQMP was approved by the SARWQCB on May 19, 2011 and becomes effective on August 17, 2011. To assist with compliance with the SARWQCB permit requirements and to explain aspects of the Model WQMP, a Technical Guidance Document is available for project proponents.

The Orange County Stormwater Program has developed this Non-Priority Project Water Quality Plan (NPP) for new development / significant redevelopment projects that do not meet the criteria for Priority Projects as defined within the County's Model Water Quality Management Plan (see Model WQMP Sections 1.3 and 1.4) but that qualify as Non-Priority Projects as defined in the Drainage Area Management Plan (DAMP).

Municipal National Pollutant Discharge Elimination System (NPDES) Permits

The permits of each region outline additional steps for a storm water management program and specify requirements to help protect the beneficial uses of the receiving waters. They require permittees to develop and implement Best Management Practices (BMPs) to control/reduce the discharge of pollutants to waters of the United States to the maximum extent practicable (MEP).

- Santa Ana Regional Water Quality Control Board Municipal NPDES Permit Order No. R8-2009-0030

- San Diego Regional Water Quality Control Board Municipal NPDES Permit Order No. R9-2002-0001

Orange County Stormwater Program Annual Report

The Annual Report is a requirement of the National Pollution Discharge Elimination Systems (NPDES) permit for submittal to the Regional Boards and United States Environmental Protection Agency.

Annual Report
City of Newport Beach Local Implementation Plan

The City of Newport Beach has developed an LIP, which provides a written account of the activities that the City has undertaken and the City is undertaking to meet the requirements of Third Term Permit and make a meaningful improvement in urban water quality. In developing this LIP, the City has utilized the 2003 DAMP as the foundation for its program development and the LIP, as a result, contains numerous references to it and the two, in effect, act as companion parts of the City's compliance program. The LIP is intended to serve as the basis for city compliance during the five-year life of the Third Term Permit, but is subject to updating and modification as the City determines necessary, or as directed by the Regional Board.

Below is a copy of the City of Newport Beach's Local Implementation Plan (LIP). To make it easier to view and download, this document has been broken down into fourteen Adobe Acrobat Reader files (.pdf).

- Cover Page
- Table of Contents
- Section A-1.0: Introduction
- Section A-2.0: Program Management
- Section A-3.0: Plan Development
- Section A-4.0: Legal Authority
- Section A-5.0: Municipal Activities
- Section A-6.0: Public Education
- Section A-7.0: New Development/Significant Redevelopment
- Section A-8.0: Construction
- Section A-9.0: Existing Development
- Section A-10.0: Illegal Discharges/Illicit Connections
- Section A-11.0: Water Quality Monitoring
- Section A-12.0: Watersheds

Additional City of Newport Beach Water Quality Documents:

- City of Newport Beach's Water Quality Ordinance NBMC 14.36.030
- City of Newport Beach's Council Policies L-18 & L-22
- Planning Department Environmental Applications and Forms

Commercial & Industrialrunoff

All non-stormwater discharges are prohibited from entering a storm drain system.

The following list contains examples of prohibited discharges that are **not allowed** to enter a storm drain:

- Wash water from concrete, plaster, sand or any waste water from cleaning tools
- Jobsite sediment
- Trash and debris around dumpsters, leakage from dumpsters
- Cleaning and rinsing of mop water in a drain other than the sewer
- Wash water from the commercial washing of vehicles. Reclaim the contaminated water, don't let it enter the gutter
- Over-irrigation where sediment and pollutants enter the storm drain
- Washing out paint and paint equipment
- High pressure washing of buildings, driveways, and parking areas
- Swimming pool discharges (unless chlorine is reduced to non-detectable levels)
- Fluids leaking from equipment/vehicles
- Runoff from mobile animal grooming, carpet cleaning and pressure washing

Constructionrunoff

All construction projects regardless of size are required, at a minimum, to implement an effective combination of erosion and sediment controls and waste and materials management.

Dry Season Requirements *(May – September)*

- Dust Control
- Sediment control
- Off-site tracking

Constructionrunoff - *continued*

- Materials pollution control
- Waste management and pollutant control
- Install permanent sediment control devices on completed slopes
- Employ a "weather triggered" action plan within 48hrs of predicted storm

Wet Season Requirements *(October – April)*

- Sediment control should be in place along perimeter of job site
- Physical or vegetative (temporary or permanent) erosion control should be established
- Have sufficient materials needed to install and replace sediment controls

For a comprehensive understanding of sediment controls please visit www.ocwatersheds.com

Webresources

Newport Beach
www.cleanwaternewport.com
www.city.newport-beach.ca.us
Orange County
www.ocwatersheds.com
www.cabmphandbooks.com
www.erasethewaste.com
www.ocbeachinfo.com
www.ocpfrd.com
www.swrcb.ca.gov
www.bewaterwise.com
Environmental Groups
www.coastkeeper.org
www.surfrider.org
www.earthresource.org
www.trails4all.org

How to Protect Our Bay and Ocean

... at your home
...at your business
... around town

PROJECT Pollution PREVENTION

Office of the City Manager
Code and Water Quality
Enforcement Division
949.644.3215
www.cleanwaternewport.com
Recycling Center
714.834.6752

Residentialrunoff

A new Stormwater law, issued by the Regional Water Quality Control Board has gone into effect. This law mandates that the City of Newport Beach along with other Orange County region jurisdictions control the amount of pollutants flowing into our storm drains into creeks and ultimately to our bay and ocean.

Help us improve the quality of our water and quality of life.

There are ways to prevent storm water pollution:

- Do not use a hose to wash off yard debris and sand. It helps to conserve our water and reduces runoff.
- Don't dump waste in storm drains.
- Inspect and maintain your car regularly to prevent oil and antifreeze leaks.
- Take motor oil, antifreeze, pesticides, fertilizers, weed killers and paints to a recycling center.
- Use kitty litter to clean up leaks and spills.
- Never hose spills into the gutter. Sweep driveways clean.
- Dispose of household chemicals properly.
- Take unused oil-based paint, paint thinner, varnishes and solvents to a recycling center. (714.834.6752)
- Clean water-based paint brushes in the sink.
- Buy household and garden products that are environmentally safe (phosphate free). Buy only the amount you will use.
- Apply all household and garden products sparingly and follow instructions. Do not apply lawn or garden products when rain is imminent.
- Shovel and bag pet waste and it throw away in the garbage.

Quickfacts

A sewer system and a storm drain system are not the same.

These two systems are different. The water that goes down a sink or toilet flows to a wastewater treatment plant where it is treated and filtered. Water that flows down driveways into streets and the gutter flows directly to our bay or the ocean. This water may pick up pollutants along the way and is not treated.

There are many pollutants that enter storm drains.

Some common contaminants include: cigarette butts, yard debris, motor oil, pesticides, brake dust, pet waste, paint and household chemicals. Rain takes oil and grit left by cars and sprinklers wash pesticides, fertilizers and weed killers from our gardens and lawns into the stormdrain. Detergents, oils and grease from washing the car can make runoff dirty.

The effects of pollutants on our water can be harmful.

This polluted runoff can have harmful effects on drinking water supplies, recreational use and wildlife. Our beaches and bay have been closed occasionally because of contaminated storm water. It is important to keep runoff free from pollutants.

Urban runoff flows into storm drains located in the streets. In most cases, it goes directly to our bay and ocean.

Urbanrunoff**Myths**

- **Storm drains lead to the sewer.** *They don't.* Storm drains lead straight to bodies of water. Keep gutters clean by sweeping rather than using the hose.
- **Biodegradable soap is safe.** *It's not.* Some have phosphates allowing the algae population to explode, leading to the death of aquatic plants and starving fish of oxygen. Degreasers strip fish of oils causing scales to break apart.
- **Pet waste is natural to the environment.** *It's not.* Pet waste contains nitrates and bacteria, if leached into surface water it reduces oxygen and changes nutrient levels endangering aquatic life.
- **Yard clippings are natural and degrade in water.** *Not true.* Contamination from pesticides and nitrates on the clippings can contaminate rivers, and beaches. Pipes become clogged and can cause local flooding.
- **Cigarette butts biodegrade.** *They don't.* Cigarette butts are not biodegradable. They harm our ecosystem and contain over 165 chemicals. On November 15, 2003 in a two hour period an estimated 10,000 cigarette butts were collected on the beaches of Newport.

Citationissuance

Any discharge into the storm drain (curb, gutter, catch basins and pipes) is illegal, with a few exceptions. The City of Newport Beach will issue citations if it is warranted at the time of the illegal discharge

POLLUTION REPORTING

HOW TO REPORT STORMWATER POLLUTION OR STREET DRAIN PROBLEMS

Thank you for being a part of the solution to stormwater pollution. Reporting incidents of water pollution problems such as illegal dumping or discharges helps keep our channels, creeks, bays and the ocean clean. You can also report street drain problems, including clogged catch basins and faded or missing storm drain stencils.

To Report

Chemical Spill Emergencies

call **911.**

Durring Business Hours
City of Newport Beach
Code & Water Quality Enforcement Division
(949) 644-3215

After Hours

WaterPollutionHotline
1-877-89SPILL

877-897-7455 or
Email Your Complaint

HAZARDOUS WASTE & OIL RECYCLING

Toxic household materials like motor oil and oil filters, anti-freeze, paints, solvents, cleaners and old batteries are too hazardous to throw in the trash. Once in a landfill, they can contaminate ground water and pollute our creeks, channels, bays and the ocean.

Take your unwanted household hazardous waste to one of Orange County's four convenient collection centers. You can also recycle used motor oil and oil filters at one of the many certified collection centers throughout the City, including most auto parts stores and gas stations.

DISPOSAL OF HOUSEHOLD HAZARDOUS WASTE

Orange County has one of the most extensive and efficient household hazardous waste collection programs in Southern California. With four permanent collection facilities open five days a week, including Saturdays, and offering fast drive-up and drop-off service, a quick and convenient way to safely dispose of your household hazardous waste is right around the corner. Just follow these directions:

- A maximum of 15 gallons or 125 pounds may be transported per vehicle, per trip.
- Materials should be in original containers, except motor oil, fuels and antifreeze.
- Place your items in a sturdy box, preferably in their original, labeled containers. All containers should have lids, not leak and be protected from breakage.
- Do not combine types of waste, or mix oil-based paint with latex paint.
- If you want a container returned, like oil containers and boxes or crates used to transport materials, please notify the collection attendant in advance. Some containers may not be returnable.

Accepted Materials:

- Automotive fluids (antifreeze, motor oil)
- Paint products
- Batteries (home and car)
- Personal care products
  Computer monitors and televisions
- Consumer electronic devices

- Cosmetics
  Fluorescent lamps
- Pesticides
- Herbicides
- Hobby supplies
  mercury thermometers & thermostats
- Pool and spa chemicals
- Household cleaners
- Propane barbecues tanks
- Fuels
- Unused road flares
- Medicines
- Wood preservatives

Unacceptable Materials:

- Ammunition
- Explosives
- Asbestos
- Radioactive materials
- Biological materials
- Compressed gas cylinders
- Business-generated materials

COLLECTION LOCATIONS

The following locations are open Tuesday through Saturday, 9:00 a.m. to 3:00 p.m., except for rainy days and major holidays, including 4th of July, Thanksgiving, Christmas and New Years Day. For more information, call (714) 834-6752.

Anaheim:

Stop and Swap Location
1071 N. Blue Gum Street
Between the 91 and 57 Freeways on the corner of La Palma and Blue Gum.
Additional Information and Map

The Stop and Swap is a unique and free program that allows you to drop off household, yard, and car care products you no longer need and pick up others you can use.

Huntington Beach:

Rainbow Recycling and Disposal
17121 Nichols Street
Between Beach Boulevard and Gothard Street, off Warner Avenue at Rainbow Recycling and Disposal. Use Gate 6.
Additional Information and Map

Irvine:

Stop and Swap Location
6411 Oak Canyon
Between the 5 and 405 freeways, next to the City Corporate Yard and Animal Shelter.
Additional Information and Map

San Juan Capistrano:

Prima Descha Landfill
32250 La Pata Avenue, San Juan Capistrano, CA 92675
From the 55 Freeway, Exit Ortega highway,go east to La Pata and turn right.
Additional Information and Map

For more information about Orange County's landfills and household hazardous waste collection programs, see O.C. Integrated Waste Management Department.

USED OIL RECYCLING

You can recycle used motor oil and oil filters at one of the many certified collection centers throughout the City, including most auto parts stores and gas stations.

At the California Integrated Waste Management Board's web site , you can get a list of used oil collection centers in your city just by entering your zip code.

For more information, call the City of Newport Beach's Water Quality Division at (949) 644-3215.

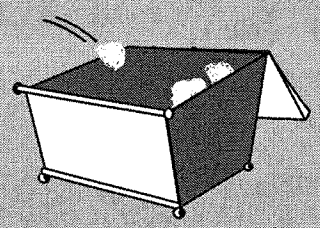
COMMERCIAL TRASH ENCLOSURES

FOLLOW THESE **REQUIREMENTS** TO **KEEP OUR WATERWAYS CLEAN**

Trash enclosures, such as those found in commercial and apartment complexes, typically contain materials that are intended to find their way to a landfill or a recycling facility. **These materials are NOT meant to go into our local lakes and rivers.**

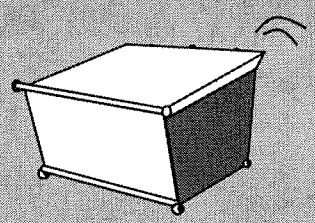
PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

PUT TRASH INSIDE



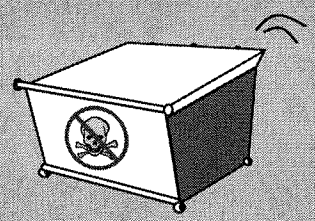
Place trash inside the bin (preferably in sealed bags)

CLOSE THE LID



Prevent rain from entering the bin in order to avoid leakage of polluted water runoff

KEEP TOXICS OUT



- Paint
- Grease, fats and used oils
- Batteries, electronics and fluorescent lights

SOME ADDITIONAL GUIDELINES, INCLUDE

✓ SWEEP FREQUENTLY

Sweep trash enclosure areas frequently, instead of hosing them down, to prevent polluted water from flowing into the streets and storm drains.

✓ FIX LEAKS

Address trash bin leaks immediately by using dry clean up methods and report to your waste hauler to receive a replacement.

✓ CONSTRUCT ROOF

Construct a solid cover roof over the existing trash enclosure structure to prevent rainwater from coming into contact with trash and garbage. Check with your local City/County for Building Codes.

In San Bernardino County, stormwater pollution is caused by food waste, landscape waste, chemicals and other debris that are washed into storm drains and end up in our waterways - untreated! You can be part of the solution by maintaining a water-friendly trash enclosure.

THANK YOU FOR HELPING TO KEEP SAN BERNARDINO COUNTY CLEAN AND HEALTHY!

San Bernardino County STORMWATER PROGRAM

To report illegal dumping **(877-WASTE18)** or
to find a household hazardous waste facility (800-OILY CAT): **sbcountystormwater.org**
To dispose of hazardous waste call the San Bernardino County Fire Dept. - CUPA Program **(909) 386-8401**

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga
Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

STORMWATER Pollution Prevention

FOOD AND RESTAURANT

Food waste, grease, cleaning fluids, mop water and trash from restaurant operations often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Recycle Oil & Grease

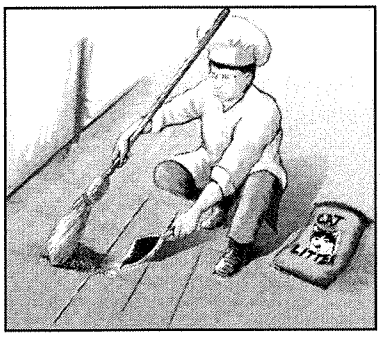
Oil and grease wastes can be recycled. Look in the yellow pages for rendering companies, or call (909) 386-8401 for disposal information. Don't pour oil or grease into sinks, floor drains or onto a parking lot or street. Keep grease bins covered and contained. Keep your grease interceptor maintained to prevent sewer overflows or backups and keep records of grease waste hauling.

Dumpster Areas

Keep dumpster lids closed and the areas around them clean. Do not fill with liquid waste or hose them out. Call your trash hauler to replace any dumpsters that are damaged or leak.

Cleaning & Maintenance

Clean equipment, floor mats, filters and garbage cans in a mop sink, wash rack or floor drain connected to the sewer through a grease trap. Don't wash them or pour wash water in a parking lot, alley, sidewalk or street. Sweep outside areas and put the debris in the garbage, instead of sweeping or hosing it into the parking lot or street.



Managing Spills

Clean food spills in loading and trash areas by using absorbent materials and sweeping then mopping, and discharge mop water into the sewer through a grease interceptor. Have spill containment and cleanup kits available. To report serious toxic spills, call 911.

Handling Toxic Chemicals

Dispose of all unwanted toxics materials like cleaners, solvents and detergents through a hazardous waste hauler. These items are not trash. For information on hazardous waste pickup, call (909) 386-8401. Use non-toxic cleaning products whenever possible.

To report illegal dumping or for more information on stormwater pollution prevention, call:

1 (800) CLEANUP

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

Managing , OIL and GREASE

"It's Easier than YOU Think!"

THE WRONG WAY
La Forma Incorrecta

Do not pour cooking residue directly into the drain.

No vierta residuos de cocinar directamente en el desague.

Do not dispose of food waste into the garbage disposal.

No ponga desperdicios de comida en el triturador de comida.

Do not pour waste oil directly into the drain.

No ponga desperdicio de aceite directamente en el desague.

Do not wash floor mats where water will run off directly into the storm drain.

No lave tapetes de piso en un lugar donde el agua corra hacia el desague.

THE RIGHT WAY
La Forma Correcta

1

Wipe pots, pans, and work areas prior to washing.

Limpie con una toallita las ollas, cazuelas, y areas de trabajo antes de lavarlos.

2

Dispose of food waste directly into the trash.

Deseche los desperdicios de comida en el bote de basura.

3

Collect waste oil and store for recycling.

Junte el desperdicio de aceite y guardelo para que sea reciclado.

4

Clean mats inside over a utility sink.

Limpie los tapetes de piso detro de un lavabo o fregador.

Appendix F - BMP Sizing Worksheets

- **BMP Sizing (Volume and Flow) Calculations**
- **Figure III.4 - Capture Efficiency Nomograph for Off-Line Flow-based Systems in Orange County**

UPTOWN NEWPORT - PA2011-134

Preliminary Water Quality Management Plan (WQMP)

BMP Sizing (Volume and Flow) Calculations						
BMP Area Designation	Area (acres)	'i' (% impervious)	'C'	V_{LID} (cu-ft)	Q_{LID} (cfs)	BMP
F1	0.52	0.50	0.525	743	0.07	Bioretention (Filterra)
F2	0.97	0.71	0.683	1,802	0.18	Bioretention (Filterra)
F3	1.00	0.64	0.630	1,715	0.17	Bioretention (Filterra)
F4	1.11	0.83	0.773	2,334	0.23	Bioretention (Filterra)
F5	0.93	0.85	0.788	1,994	0.20	Bioretention (Filterra)
F6	0.43	0.94	0.855	1,001	0.10	Bioretention (Filterra)
F7	0.29	0.28	0.360	284	0.03	Bioretention (Filterra)
F8	0.12	0.71	0.683	223	0.02	Bioretention (Filterra)
F9	0.64	0.92	0.840	1,464	0.14	Bioretention (Filterra)
F10	0.55	0.96	0.870	1,303	0.13	Bioretention (Filterra)
F11	1.22	0.75	0.713	2,367	0.23	Bioretention (Filterra)
F12	0.84	0.92	0.840	1,921	0.19	Bioretention (Filterra)
F13	0.98	0.14	0.255	680	0.07	Bioretention (Filterra)
F14	0.45	0.90	0.825	1,011	0.10	Bioretention (Filterra)
F15	0.46	0.91	0.833	1,043	0.10	Bioretention (Filterra)
F16	0.74	0.94	0.855	1,723	0.17	Bioretention (Filterra)
F17	0.53	0.84	0.780	1,125	0.11	Bioretention (Filterra)
F18	2.35	0.88	0.810	5,182	0.51	Bioretention (Filterra)
HS1	8.65	0.82	0.765	18,015	1.77	Hydrodynamic Separator
IB1	8.65	0.82	0.765	18,015	1.77	CMP Underground Infiltration Basin
LS1	0.29	0.00	0.150	118	0.01	Inlet Filter Insert(s)
LS2	0.18	0.00	0.150	74	0.01	Inlet Filter Insert(s)
LS3	0.36	0.00	0.150	147	0.01	Inlet Filter Insert(s)
LS4	0.41	0.00	0.150	167	0.02	Inlet Filter Insert(s)
LS5	0.76	0.00	0.150	310	0.03	None
Entire Site	**24.78**	**0.72**	**0.693**	**46,747**	**4.59**	

V_{LID} = Design Capture Storm Volume = 'C' * d * A * 43,560 sf/ac * 1/12 in/ft

'C' = runoff coefficient = 0.75 * 'i' + 0.15

'i' = % impervious per table

d = storm depth (inches) = 0.75

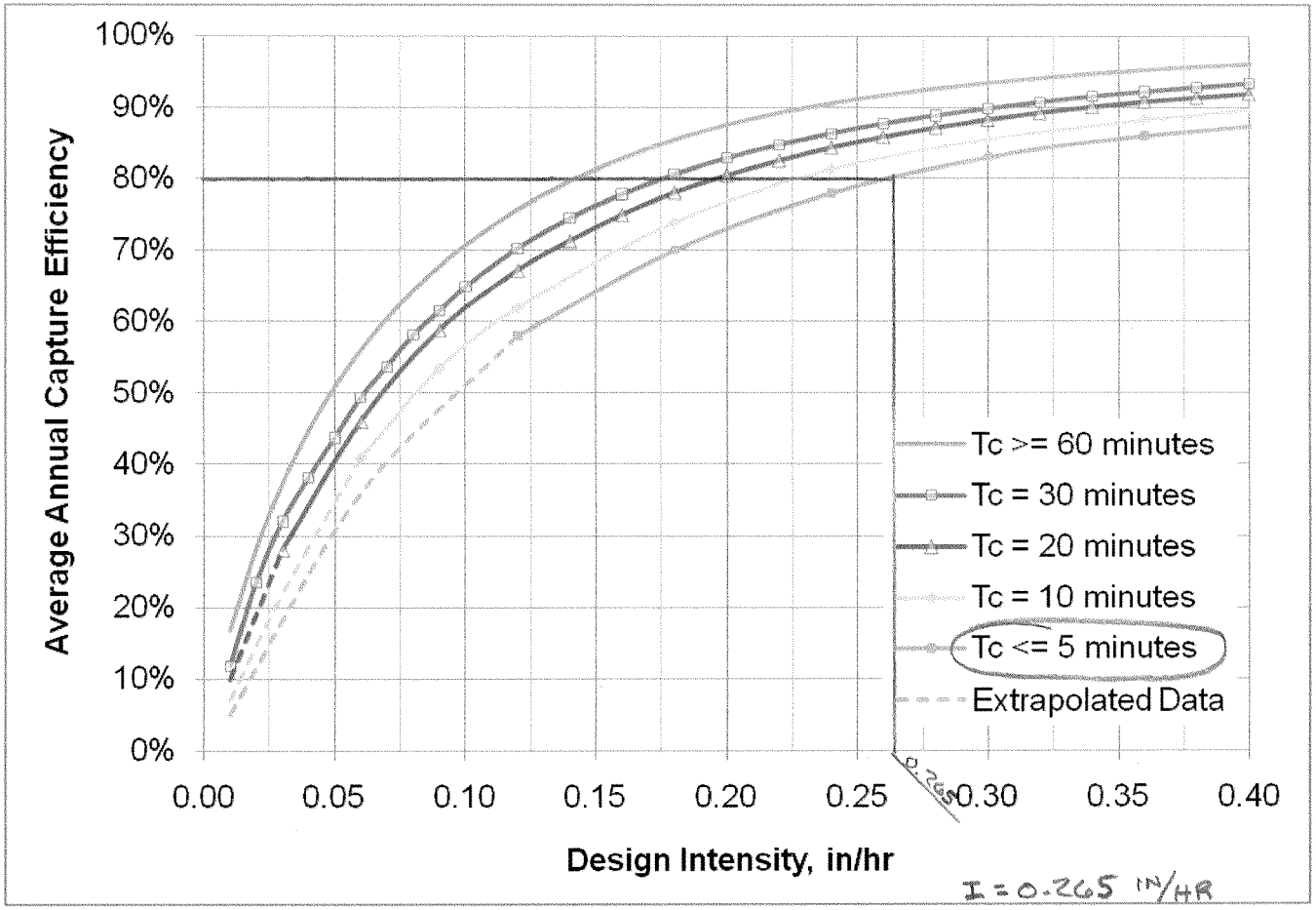
A = tributary area (acres)

Tc = 5-min (assumed)

I = 0.265 inches/hour = design intensity from Figure III.4

Q_{LID} = BMP Design Flowrate = 'C' * I * A * 43,560 sf/ac * 1/12 in/ft * 1/60 hr/min * 1/60 min/sec

Figure III.4. Capture Efficiency Nomograph for Off-line Flow-based Systems in Orange County



Appendix G - Supporting Hydrologic Calculations

- **Existing Condition Drainage Area A: 2-Year Storm Rational Method Analysis**
- **Existing Condition Drainage Area A: 2-Year, 24-Hour Unit Hydrograph Analysis**
- **Existing Condition Drainage Area B: 2-Year Storm Rational Method Analysis**
- **Existing Condition Drainage Area B: 2-Year, 24-Hour Unit Hydrograph Analysis**
- **Developed Condition Drainage Area A: 2-Year Storm Rational Method Analysis**
- **Developed Condition Drainage Area A: 2-Year, 24-Hour Unit Hydrograph Analysis**
- **Developed Condition Drainage Area B: 2-Year Storm Rational Method Analysis**
- **Developed Condition Drainage Area B: 2-Year, 24-Hour Unit Hydrograph Analysis**

```
                    Orange County Rational Hydrology Program

                 (Hydrology Manual Date(s) October 1986 & November
1996)

       CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2004
Version 8.0
            Rational Hydrology Study, Date: 11/23/11  File Name:
100288exa2.roc
      ------------------------------------------------------------------
------
      UPTOWN NEWPORT
      HFI JOB NO.  II.100288.0000
      EXISTING CONDITION
      AREA A
      ------------------------------------------------------------------
------


      Program License Serial Number 4014

      ------------------------------------------------------------------
------
       *********   Hydrology Study Control Information **********

      ------------------------------------------------------------------
------

      Rational hydrology study storm event year is     2.0

      Decimal fraction of study above 2000 ft., 600M  =     0.0000
      English Units Used for input data


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      100.000 to Point/Station
101.000
      **** INITIAL AREA EVALUATION ****
      ___________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   420.000(Ft.)
      Top (of initial area) elevation =    56.600(Ft.)
      Bottom (of initial area) elevation =    48.400(Ft.)
      Difference in elevation =     8.200(Ft.)
      Slope =    0.01952  s(%)=       1.95
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    7.483 min.
      NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
      for this Development Type
      Rainfall intensity =      1.796(In/Hr) for a     2.0 year storm
```

```
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
      Subarea runoff =       4.412(CFS)
      Total initial stream area =        2.760(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      101.000 to Point/Station
102.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
_____
      Upstream point/station elevation =    45.100(Ft.)
      Downstream point/station elevation =    43.700(Ft.)
      Pipe length  =   290.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     4.412(CFS)
      Nearest computed pipe diameter  =     15.00(In.)
      Calculated individual pipe flow  =     4.412(CFS)
      Normal flow depth in pipe =   12.07(In.)
      Flow top width inside pipe =   11.90(In.)
      Critical Depth =   10.21(In.)
      Pipe flow velocity =      4.17(Ft/s)
      Travel time through pipe =    1.16 min.
      Time of concentration (TC) =     8.64 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      101.000 to Point/Station
102.000
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
_____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Time of concentration =     8.64 min.
      Rainfall intensity =      1.654(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.889
      Subarea runoff =      0.616(CFS) for    0.660(Ac.)
      Total runoff =      5.028(CFS)      Total area =        3.42(Ac.)
      Area averaged Fm value =    0.020(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      101.000 to Point/Station
102.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
_____
      Along Main Stream number: 1 in normal stream number 1
      Stream flow area =      3.420(Ac.)
      Runoff from this stream =      5.028(CFS)
```

```
      Time of concentration =    8.64 min.
      Rainfall intensity =     1.654(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      102.100 to Point/Station
102.200
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   390.000(Ft.)
      Top (of initial area) elevation =    56.600(Ft.)
      Bottom (of initial area) elevation =    49.600(Ft.)
      Difference in elevation =     7.000(Ft.)
      Slope =    0.01795  s(%)=       1.79
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    7.387 min.
      NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
      for this Development Type
      Rainfall intensity =      1.809(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
      Subarea runoff =      6.152(CFS)
      Total initial stream area =        3.820(Ac.)

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      102.200 to Point/Station
102.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    47.500(Ft.)
      Downstream point/station elevation =    43.700(Ft.)
      Pipe length  =   265.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     6.152(CFS)
      Nearest computed pipe diameter  =     15.00(In.)
      Calculated individual pipe flow  =     6.152(CFS)
      Normal flow depth in pipe =   10.10(In.)
      Flow top width inside pipe =   14.07(In.)
      Critical Depth =   12.02(In.)
      Pipe flow velocity =      7.00(Ft/s)
      Travel time through pipe =    0.63 min.
      Time of concentration (TC) =     8.02 min.

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      102.200 to Point/Station
```

```
102.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ____________________________________________________________________________
____
      Along Main Stream number: 1 in normal stream number 2
      Stream flow area =      3.820(Ac.)
      Runoff from this stream =      6.152(CFS)
      Time of concentration =    8.02 min.
      Rainfall intensity =     1.726(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000
      Summary of stream data:

      Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
       No.    (Ac.)   (CFS)       (min) (In/Hr)     (In/Hr)


      1      3.42     5.028      8.64    0.020      1.654
      2      3.82     6.152      8.02    0.020      1.726
      Qmax(1) =
               1.000 *    1.000 *     5.028) +
               0.957 *    1.000 *     6.152) + =      10.918
      Qmax(2) =
               1.044 *    0.928 *     5.028) +
               1.000 *    1.000 *     6.152) + =      11.024

      Total of 2 streams to confluence:
      Flow rates before confluence point:
             5.028       6.152
      Maximum flow rates at confluence using above data:
             10.918       11.024
      Area of streams before confluence:
              3.420        3.820
      Effective area values after confluence:
              7.240        6.993
      Results of confluence:
      Total flow rate =     11.024(CFS)
      Time of concentration =     8.019 min.
      Effective stream area after confluence =      6.993(Ac.)
      Study area average Pervious fraction(Ap) =  0.100
      Study area average soil loss rate(Fm) =    0.020(In/Hr)
      Study area total (this main stream) =       7.24(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      102.000 to Point/Station
103.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ____________________________________________________________________________
____
      Upstream point/station elevation =    43.700(Ft.)
      Downstream point/station elevation =    43.200(Ft.)
      Pipe length  =    95.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    11.024(CFS)
      Nearest computed pipe diameter  =     21.00(In.)
      Calculated individual pipe flow  =    11.024(CFS)
      Normal flow depth in pipe =   16.49(In.)
      Flow top width inside pipe =   17.25(In.)
      Critical Depth =   14.85(In.)
      Pipe flow velocity =      5.44(Ft/s)
```

```
      Travel time through pipe =    0.29 min.
      Time of concentration (TC) =     8.31 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      102.000 to Point/Station
103.000
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
_____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Time of concentration =     8.31 min.
      Rainfall intensity =      1.691(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.889
      Subarea runoff =      1.630(CFS) for    1.420(Ac.)
      Total runoff =     12.654(CFS)      Total area =        8.41(Ac.)
      Area averaged Fm value =    0.020(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      103.000 to Point/Station
104.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
_____
      Upstream point/station elevation =    43.200(Ft.)
      Downstream point/station elevation =    37.900(Ft.)
      Pipe length  =   235.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    12.654(CFS)
      Nearest computed pipe diameter  =     18.00(In.)
      Calculated individual pipe flow  =    12.654(CFS)
      Normal flow depth in pipe =   12.20(In.)
      Flow top width inside pipe =   16.82(In.)
      Critical Depth =   16.07(In.)
      Pipe flow velocity =      9.92(Ft/s)
      Travel time through pipe =    0.39 min.
      Time of concentration (TC) =     8.70 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      103.000 to Point/Station
104.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
_____
      Along Main Stream number: 1 in normal stream number 1
      Stream flow area =      8.413(Ac.)
      Runoff from this stream =     12.654(CFS)
      Time of concentration =    8.70 min.
```

```
      Rainfall intensity =     1.647(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      104.100 to Point/Station
104.200
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   315.000(Ft.)
      Top (of initial area) elevation =    54.700(Ft.)
      Bottom (of initial area) elevation =    49.600(Ft.)
      Difference in elevation =     5.100(Ft.)
      Slope =    0.01619  s(%)=       1.62
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    6.924 min.
      Rainfall intensity =      1.878(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
      Subarea runoff =      2.475(CFS)
      Total initial stream area =        1.480(Ac.)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++++
      Process from Point/Station      104.200 to Point/Station
104.300
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    42.800(Ft.)
      Downstream point/station elevation =    41.500(Ft.)
      Pipe length  =   255.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     2.475(CFS)
      Nearest computed pipe diameter  =     12.00(In.)
      Calculated individual pipe flow  =     2.475(CFS)
      Normal flow depth in pipe =    9.55(In.)
      Flow top width inside pipe =    9.67(In.)
      Critical Depth =    8.09(In.)
      Pipe flow velocity =      3.69(Ft/s)
      Travel time through pipe =    1.15 min.
      Time of concentration (TC) =     8.08 min.


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++++
      Process from Point/Station      104.200 to Point/Station
104.300
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
```

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____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Time of concentration =     8.08 min.
      Rainfall intensity =      1.719(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.890
      Subarea runoff =      1.425(CFS) for    1.070(Ac.)
      Total runoff =      3.900(CFS)      Total area =        2.55(Ac.)
      Area averaged Fm value =    0.020(In/Hr)


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++++
      Process from Point/Station      104.300 to Point/Station
104.400
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    41.500(Ft.)
      Downstream point/station elevation =    40.400(Ft.)
      Pipe length  =   225.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     3.900(CFS)
      Nearest computed pipe diameter  =     15.00(In.)
      Calculated individual pipe flow  =     3.900(CFS)
      Normal flow depth in pipe =   10.75(In.)
      Flow top width inside pipe =   13.51(In.)
      Critical Depth =    9.57(In.)
      Pipe flow velocity =      4.14(Ft/s)
      Travel time through pipe =    0.91 min.
      Time of concentration (TC) =     8.98 min.


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++++
      Process from Point/Station      104.300 to Point/Station
104.400
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Time of concentration =     8.98 min.
      Rainfall intensity =      1.617(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.889
      Subarea runoff =      1.520(CFS) for    1.220(Ac.)
```

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      Total runoff =      5.420(CFS)      Total area =        3.77(Ac.)
      Area averaged Fm value =    0.020(In/Hr)


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++++
      Process from Point/Station      104.400 to Point/Station
104.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    40.400(Ft.)
      Downstream point/station elevation =    37.900(Ft.)
      Pipe length  =   225.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     5.420(CFS)
      Nearest computed pipe diameter  =     15.00(In.)
      Calculated individual pipe flow  =     5.420(CFS)
      Normal flow depth in pipe =   10.11(In.)
      Flow top width inside pipe =   14.06(In.)
      Critical Depth =   11.32(In.)
      Pipe flow velocity =      6.16(Ft/s)
      Travel time through pipe =    0.61 min.
      Time of concentration (TC) =     9.59 min.


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++++
      Process from Point/Station      104.400 to Point/Station
104.000
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Time of concentration =     9.59 min.
      Rainfall intensity =      1.558(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.888
      Subarea runoff =      1.499(CFS) for    1.230(Ac.)
      Total runoff =      6.919(CFS)      Total area =        5.00(Ac.)
      Area averaged Fm value =    0.020(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      104.400 to Point/Station
104.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 1 in normal stream number 2
      Stream flow area =      5.000(Ac.)
      Runoff from this stream =      6.919(CFS)
      Time of concentration =    9.59 min.
```

```
Rainfall intensity =     1.558(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)      (In/Hr)


1      8.41    12.654      8.70    0.020      1.647
2      5.00     6.919      9.59    0.020      1.558
Qmax(1) =
         1.000 *    1.000 *    12.654) +
         1.058 *    0.908 *     6.919) + =      19.298
Qmax(2) =
         0.945 *    1.000 *    12.654) +
         1.000 *    1.000 *     6.919) + =      18.881

Total of 2 streams to confluence:
Flow rates before confluence point:
      12.654       6.919
Maximum flow rates at confluence using above data:
       19.298       18.881
Area of streams before confluence:
        8.413        5.000
Effective area values after confluence:
       12.952       13.413
Results of confluence:
Total flow rate =     19.298(CFS)
Time of concentration =     8.704 min.
Effective stream area after confluence =     12.952(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =      13.41(Ac.)


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++++
Process from Point/Station      104.000 to Point/Station
105.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
____
Upstream point/station elevation =    37.900(Ft.)
Downstream point/station elevation =    37.700(Ft.)
Pipe length  =    35.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    19.298(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    19.298(CFS)
Normal flow depth in pipe =   18.68(In.)
Flow top width inside pipe =   24.93(In.)
Critical Depth =   18.44(In.)
Pipe flow velocity =      6.58(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =     8.79 min.


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++++
Process from Point/Station      104.000 to Point/Station
105.000
```

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**** CONFLUENCE OF MAIN STREAMS ****
____________________________________________________________________________
____
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     12.952(Ac.)
Runoff from this stream =     19.298(CFS)
Time of concentration =    8.79 min.
Rainfall intensity =     1.637(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 2


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++++
Process from Point/Station      105.100 to Point/Station
105.200
**** INITIAL AREA EVALUATION ****
____________________________________________________________________________
____
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   210.000(Ft.)
Top (of initial area) elevation =    52.300(Ft.)
Bottom (of initial area) elevation =    51.700(Ft.)
Difference in elevation =     0.600(Ft.)
Slope =    0.00286  s(%)=       0.29
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.329 min.
Rainfall intensity =      1.689(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
Subarea runoff =      0.706(CFS)
Total initial stream area =        0.470(Ac.)


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++++
Process from Point/Station      105.200 to Point/Station
105.300
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
____________________________________________________________________________
____
Upstream point/station elevation =    49.700(Ft.)
Downstream point/station elevation =    49.100(Ft.)
Pipe length  =   125.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.706(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     0.706(CFS)
Normal flow depth in pipe =    5.11(In.)
Flow top width inside pipe =    8.92(In.)
Critical Depth =    4.59(In.)
Pipe flow velocity =      2.73(Ft/s)
Travel time through pipe =    0.76 min.
```

```
      Time of concentration (TC) =     9.09 min.

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.200 to Point/Station
105.300
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
_____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Time of concentration =     9.09 min.
      Rainfall intensity =      1.606(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.889
      Subarea runoff =      0.636(CFS) for    0.470(Ac.)
      Total runoff =      1.342(CFS)      Total area =        0.94(Ac.)
      Area averaged Fm value =    0.020(In/Hr)

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++++
      Process from Point/Station      105.300 to Point/Station
105.400
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
_____
      Upstream point/station elevation =    49.100(Ft.)
      Downstream point/station elevation =    48.600(Ft.)
      Pipe length  =   100.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     1.342(CFS)
      Nearest computed pipe diameter  =     12.00(In.)
      Calculated individual pipe flow  =     1.342(CFS)
      Normal flow depth in pipe =    6.23(In.)
      Flow top width inside pipe =   11.99(In.)
      Critical Depth =    5.88(In.)
      Pipe flow velocity =      3.26(Ft/s)
      Travel time through pipe =    0.51 min.
      Time of concentration (TC) =     9.60 min.

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.300 to Point/Station
105.400
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
_____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
```

```
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Time of concentration =     9.60 min.
      Rainfall intensity =      1.556(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.888
      Subarea runoff =      0.608(CFS) for    0.470(Ac.)
      Total runoff =      1.950(CFS)      Total area =        1.41(Ac.)
      Area averaged Fm value =    0.020(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.400 to Point/Station
105.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    48.600(Ft.)
      Downstream point/station elevation =    37.700(Ft.)
      Pipe length  =   120.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     1.950(CFS)
      Nearest computed pipe diameter  =      9.00(In.)
      Calculated individual pipe flow  =     1.950(CFS)
      Normal flow depth in pipe =    3.91(In.)
      Flow top width inside pipe =    8.92(In.)
      Critical Depth =    7.63(In.)
      Pipe flow velocity =     10.59(Ft/s)
      Travel time through pipe =    0.19 min.
      Time of concentration (TC) =     9.79 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.400 to Point/Station
105.000
      **** CONFLUENCE OF MAIN STREAMS ****
      ______________________________________________________________________
____
      The following data inside Main Stream is listed:
      In Main Stream number: 2
      Stream flow area =      1.410(Ac.)
      Runoff from this stream =      1.950(CFS)
      Time of concentration =    9.79 min.
      Rainfall intensity =     1.539(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000
      Program is now starting with Main Stream No. 3


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.100 to Point/Station
105.500
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
```

```
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   210.000(Ft.)
      Top (of initial area) elevation =    52.300(Ft.)
      Bottom (of initial area) elevation =    51.700(Ft.)
      Difference in elevation =     0.600(Ft.)
      Slope =    0.00286  s(%)=       0.29
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    8.329 min.
      Rainfall intensity =      1.689(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
      Subarea runoff =      0.706(CFS)
      Total initial stream area =        0.470(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.500 to Point/Station
105.600
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    49.700(Ft.)
      Downstream point/station elevation =    49.100(Ft.)
      Pipe length  =   110.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     0.706(CFS)
      Nearest computed pipe diameter  =      9.00(In.)
      Calculated individual pipe flow  =     0.706(CFS)
      Normal flow depth in pipe =    4.91(In.)
      Flow top width inside pipe =    8.96(In.)
      Critical Depth =    4.59(In.)
      Pipe flow velocity =      2.87(Ft/s)
      Travel time through pipe =    0.64 min.
      Time of concentration (TC) =     8.97 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.500 to Point/Station
105.600
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Time of concentration =     8.97 min.
      Rainfall intensity =      1.619(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.889
```

```
      Subarea runoff =       0.647(CFS) for    0.470(Ac.)
      Total runoff =       1.352(CFS)       Total area =         0.94(Ac.)
      Area averaged Fm value =    0.020(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.600 to Point/Station
105.700
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
_____
      Upstream point/station elevation =    49.100(Ft.)
      Downstream point/station elevation =    48.600(Ft.)
      Pipe length  =   100.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     1.352(CFS)
      Nearest computed pipe diameter  =     12.00(In.)
      Calculated individual pipe flow  =     1.352(CFS)
      Normal flow depth in pipe =    6.26(In.)
      Flow top width inside pipe =   11.99(In.)
      Critical Depth =    5.90(In.)
      Pipe flow velocity =      3.26(Ft/s)
      Travel time through pipe =    0.51 min.
      Time of concentration (TC) =     9.48 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.600 to Point/Station
105.700
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
_____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Time of concentration =     9.48 min.
      Rainfall intensity =      1.568(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.889
      Subarea runoff =      0.612(CFS) for    0.470(Ac.)
      Total runoff =      1.964(CFS)       Total area =         1.41(Ac.)
      Area averaged Fm value =    0.020(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.700 to Point/Station
105.800
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
_____
      Upstream point/station elevation =    48.600(Ft.)
      Downstream point/station elevation =    46.200(Ft.)
      Pipe length  =   105.00(Ft.)   Manning's N = 0.013
```

```
      No. of pipes = 1  Required pipe flow  =     1.964(CFS)
      Nearest computed pipe diameter  =      9.00(In.)
      Calculated individual pipe flow  =     1.964(CFS)
      Normal flow depth in pipe =    6.01(In.)
      Flow top width inside pipe =    8.48(In.)
      Critical Depth =    7.66(In.)
      Pipe flow velocity =      6.27(Ft/s)
      Travel time through pipe =    0.28 min.
      Time of concentration (TC) =     9.76 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.700 to Point/Station
105.800
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
_____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.900
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.100
      SCS curve number for soil(AMC 2)  = 57.90
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.290(In/Hr)
      Max Catchment Loss (Fm) =     0.029(In/Hr)
      Time of concentration =     9.76 min.
      Rainfall intensity =      1.542(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.886
      Subarea runoff =      1.206(CFS) for    0.910(Ac.)
      Total runoff =      3.171(CFS)      Total area =        2.32(Ac.)
      Area averaged Fm value =    0.024(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.800 to Point/Station
105.900
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
_____
      Upstream point/station elevation =    46.200(Ft.)
      Downstream point/station elevation =    44.200(Ft.)
      Pipe length  =   400.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     3.171(CFS)
      Nearest computed pipe diameter  =     15.00(In.)
      Calculated individual pipe flow  =     3.171(CFS)
      Normal flow depth in pipe =    9.20(In.)
      Flow top width inside pipe =   14.61(In.)
      Critical Depth =    8.60(In.)
      Pipe flow velocity =      4.02(Ft/s)
      Travel time through pipe =    1.66 min.
      Time of concentration (TC) =    11.42 min.


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++++
      Process from Point/Station      105.800 to Point/Station
105.900
```

```
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.370
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.630
      SCS curve number for soil(AMC 2)  = 67.97
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.237(In/Hr)
      Max Catchment Loss (Fm) =     0.024(In/Hr)
      Time of concentration =    11.42 min.
      Rainfall intensity =      1.409(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.885
      Subarea runoff =      0.708(CFS) for    0.790(Ac.)
      Total runoff =      3.879(CFS)      Total area =        3.11(Ac.)
      Area averaged Fm value =    0.024(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.900 to Point/Station
105.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    44.200(Ft.)
      Downstream point/station elevation =    37.700(Ft.)
      Pipe length  =    25.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     3.879(CFS)
      Nearest computed pipe diameter  =      9.00(In.)
      Calculated individual pipe flow  =     3.879(CFS)
      Normal flow depth in pipe =    4.29(In.)
      Flow top width inside pipe =    8.99(In.)
      Critical depth could not be calculated.
      Pipe flow velocity =     18.69(Ft/s)
      Travel time through pipe =    0.02 min.
      Time of concentration (TC) =    11.44 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.900 to Point/Station
105.000
      **** CONFLUENCE OF MAIN STREAMS ****
      ______________________________________________________________________
____
      The following data inside Main Stream is listed:
      In Main Stream number: 3
      Stream flow area =      3.110(Ac.)
      Runoff from this stream =      3.879(CFS)
      Time of concentration =   11.44 min.
      Rainfall intensity =     1.408(In/Hr)
      Area averaged loss rate (Fm) =    0.0236(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000
      Summary of stream data:

      Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
       No.    (Ac.)   (CFS)       (min)  (In/Hr)     (In/Hr)
```

```
1      12.95    19.298      8.79    0.020      1.637
2       1.41     1.950      9.79    0.020      1.539
3       3.11     3.879     11.44    0.024      1.408
Qmax(1) =
          1.000 *    1.000 *    19.298) +
          1.065 *    0.898 *     1.950) +
          1.166 *    0.769 *     3.879) + =      24.638
Qmax(2) =
          0.939 *    1.000 *    19.298) +
          1.000 *    1.000 *     1.950) +
          1.095 *    0.856 *     3.879) + =      23.713
Qmax(3) =
          0.858 *    1.000 *    19.298) +
          0.914 *    1.000 *     1.950) +
          1.000 *    1.000 *     3.879) + =      22.220

Total of 3 main streams to confluence:
Flow rates before confluence point:
      20.298       2.950       4.879
Maximum flow rates at confluence using above data:
       24.638       23.713       22.220
Area of streams before confluence:
       12.952        1.410        3.110
Effective area values after confluence:
       16.609       17.024       17.472


Results of confluence:
Total flow rate =     24.638(CFS)
Time of concentration =     8.793 min.
Effective stream area after confluence  =     16.609(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.021(In/Hr)
Study area total =      17.47(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
Process from Point/Station      105.000 to Point/Station
106.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
____
Upstream point/station elevation =    37.700(Ft.)
Downstream point/station elevation =    37.400(Ft.)
Pipe length  =    60.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    24.638(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    24.638(CFS)
Normal flow depth in pipe =   21.24(In.)
Flow top width inside pipe =   27.28(In.)
Critical Depth =   20.27(In.)
Pipe flow velocity =      6.63(Ft/s)
Travel time through pipe =    0.15 min.
Time of concentration (TC) =     8.94 min.
End of computations, total study area =           18.18 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
```

effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number (AMC 2) = 73.8

U n i t H y d r o g r a p h A n a l y s i s

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Study date 11/23/11 File Name 100288exa2uh.out

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Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996

Program License Serial Number 4014

UPTOWN NEWPORT
HFI JOB NO. II.100288.0000
EXISTING CONDITION
AREA A

Storm Event Year = 2

Antecedent Moisture Condition = 1

English (in-lb) Input Units Used

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	Area (Ac.)	Area Fraction	Soil Group	Fp (In/Hr)	Ap (dec.)	Fm (In/Hr)
73.8	18.2	1.00	D	0.200	0.100	0.020

Area-averaged adjusted loss rate Fm (In/Hr) = 0.020

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC1)	S	Pervious Yield Fr
1.82	0.100	73.8	55.6	8.00	0.012
16.36	0.900	98.0	98.0	0.20	0.890

Area-averaged catchment yield fraction, Y = 0.802
Area-averaged low loss fraction, Yb = 0.198

++

User entry of time of concentration = 0.149 (hours)
Watershed area = 18.18(Ac.)
Catchment Lag time = 0.119 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 69.9105
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.020(In/Hr)
Average low loss rate fraction (Yb) = 0.198 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.190(In)
Computed peak 30-minute rainfall = 0.400(In)
Specified peak 1-hour rainfall = 0.530(In)
Computed peak 3-hour rainfall = 0.890(In)
Specified peak 6-hour rainfall = 1.220(In)

Specified peak 24-hour rainfall = 2.050(In)

Rainfall depth area reduction factors:
Using a total area of 18.18(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999 Adjusted rainfall = 0.190(In)
30-minute factor = 0.999 Adjusted rainfall = 0.400(In)
1-hour factor = 0.999 Adjusted rainfall = 0.530(In)
3-hour factor = 1.000 Adjusted rainfall = 0.890(In)
6-hour factor = 1.000 Adjusted rainfall = 1.220(In)
24-hour factor = 1.000 Adjusted rainfall = 2.050(In)

U n i t H y d r o g r a p h

++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
	(K = 219.86 (CFS))	
1	8.755	19.250
2	53.373	98.099
3	89.259	78.899
4	97.900	19.000
5	99.455	3.419
6	100.000	1.197

Total soil rain loss = 0.28(In)
Total effective rainfall = 1.77(In)
Peak flow rate in flood hydrograph = 25.02(CFS)

++

24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	7.5	15.0	22.5	30.0
0+ 5	0.0003	0.04	Q				
0+10	0.0020	0.25	Q				
0+15	0.0049	0.42	Q				
0+20	0.0081	0.46	Q				
0+25	0.0113	0.47	Q				
0+30	0.0146	0.48	Q				
0+35	0.0179	0.48	Q				
0+40	0.0212	0.48	Q				
0+45	0.0245	0.48	Q				
0+50	0.0278	0.48	Q				
0+55	0.0312	0.48	Q				
1+ 0	0.0345	0.49	Q				
1+ 5	0.0379	0.49	Q				
1+10	0.0412	0.49	Q				
1+15	0.0446	0.49	Q				
1+20	0.0480	0.49	Q				
1+25	0.0514	0.49	Q				
1+30	0.0548	0.50	Q				
1+35	0.0582	0.50	Q				
1+40	0.0617	0.50	Q				
1+45	0.0651	0.50	Q				
1+50	0.0686	0.50	QV				
1+55	0.0720	0.50	QV				

```
2+ 0        0.0755       0.51  QV          |          |          |          |
2+ 5        0.0790       0.51  QV          |          |          |          |
2+10        0.0825       0.51  QV          |          |          |          |
2+15        0.0861       0.51  QV          |          |          |          |
2+20        0.0896       0.51  QV          |          |          |          |
2+25        0.0932       0.52  QV          |          |          |          |
2+30        0.0967       0.52  QV          |          |          |          |
2+35        0.1003       0.52  QV          |          |          |          |
2+40        0.1039       0.52  QV          |          |          |          |
2+45        0.1075       0.52  QV          |          |          |          |
2+50        0.1111       0.53  QV          |          |          |          |
2+55        0.1148       0.53  QV          |          |          |          |
3+ 0        0.1184       0.53  QV          |          |          |          |
3+ 5        0.1221       0.53  QV          |          |          |          |
3+10        0.1258       0.53  QV          |          |          |          |
3+15        0.1295       0.54  QV          |          |          |          |
3+20        0.1332       0.54  QV          |          |          |          |
3+25        0.1369       0.54  Q V         |          |          |          |
3+30        0.1406       0.54  Q V         |          |          |          |
3+35        0.1444       0.55  Q V         |          |          |          |
3+40        0.1482       0.55  Q V         |          |          |          |
3+45        0.1520       0.55  Q V         |          |          |          |
3+50        0.1558       0.55  Q V         |          |          |          |
3+55        0.1596       0.55  Q V         |          |          |          |
4+ 0        0.1634       0.56  Q V         |          |          |          |
4+ 5        0.1673       0.56  Q V         |          |          |          |
4+10        0.1711       0.56  Q V         |          |          |          |
4+15        0.1750       0.56  Q V         |          |          |          |
4+20        0.1789       0.57  Q V         |          |          |          |
4+25        0.1828       0.57  Q V         |          |          |          |
4+30        0.1868       0.57  Q V         |          |          |          |
4+35        0.1907       0.57  Q V         |          |          |          |
4+40        0.1947       0.58  Q V         |          |          |          |
4+45        0.1987       0.58  Q V         |          |          |          |
4+50        0.2027       0.58  Q  V        |          |          |          |
4+55        0.2067       0.58  Q  V        |          |          |          |
5+ 0        0.2108       0.59  Q  V        |          |          |          |
5+ 5        0.2148       0.59  Q  V        |          |          |          |
5+10        0.2189       0.59  Q  V        |          |          |          |
5+15        0.2230       0.60  Q  V        |          |          |          |
5+20        0.2271       0.60  Q  V        |          |          |          |
5+25        0.2313       0.60  Q  V        |          |          |          |
5+30        0.2355       0.60  Q  V        |          |          |          |
5+35        0.2396       0.61  Q  V        |          |          |          |
5+40        0.2438       0.61  Q  V        |          |          |          |
5+45        0.2481       0.61  Q  V        |          |          |          |
5+50        0.2523       0.62  Q  V        |          |          |          |
5+55        0.2566       0.62  Q  V        |          |          |          |
6+ 0        0.2609       0.62  Q  V        |          |          |          |
6+ 5        0.2652       0.63  Q  V        |          |          |          |
6+10        0.2695       0.63  Q   V       |          |          |          |
6+15        0.2739       0.63  Q   V       |          |          |          |
6+20        0.2783       0.64  Q   V       |          |          |          |
6+25        0.2827       0.64  Q   V       |          |          |          |
6+30        0.2871       0.64  Q   V       |          |          |          |
6+35        0.2915       0.65  Q   V       |          |          |          |
6+40        0.2960       0.65  Q   V       |          |          |          |
6+45        0.3005       0.65  Q   V       |          |          |          |
6+50        0.3050       0.66  Q   V       |          |          |          |
6+55        0.3096       0.66  Q   V       |          |          |          |
7+ 0        0.3142       0.66  Q   V       |          |          |          |
7+ 5        0.3188       0.67  Q   V       |          |          |          |
7+10        0.3234       0.67  Q   V       |          |          |          |
7+15        0.3281       0.68  Q   V       |          |          |          |
7+20        0.3327       0.68  Q   V       |          |          |          |
7+25        0.3374       0.68  Q    V      |          |          |          |
```

```
 7+30       0.3422      0.69  Q    V    |         |         |         |
 7+35       0.3470      0.69  Q    V    |         |         |         |
 7+40       0.3518      0.70  Q    V    |         |         |         |
 7+45       0.3566      0.70  Q    V    |         |         |         |
 7+50       0.3614      0.71  Q    V    |         |         |         |
 7+55       0.3663      0.71  Q    V    |         |         |         |
 8+ 0       0.3712      0.71  Q    V    |         |         |         |
 8+ 5       0.3762      0.72  Q    V    |         |         |         |
 8+10       0.3812      0.72  Q    V    |         |         |         |
 8+15       0.3862      0.73  Q    V    |         |         |         |
 8+20       0.3912      0.73  Q    V    |         |         |         |
 8+25       0.3963      0.74  Q    V    |         |         |         |
 8+30       0.4014      0.74  Q     V   |         |         |         |
 8+35       0.4066      0.75  Q     V   |         |         |         |
 8+40       0.4118      0.75  |Q    V   |         |         |         |
 8+45       0.4170      0.76  |Q    V   |         |         |         |
 8+50       0.4222      0.76  |Q    V   |         |         |         |
 8+55       0.4275      0.77  |Q    V   |         |         |         |
 9+ 0       0.4329      0.77  |Q    V   |         |         |         |
 9+ 5       0.4383      0.78  |Q    V   |         |         |         |
 9+10       0.4437      0.79  |Q    V   |         |         |         |
 9+15       0.4491      0.79  |Q    V   |         |         |         |
 9+20       0.4546      0.80  |Q    V   |         |         |         |
 9+25       0.4602      0.80  |Q    V   |         |         |         |
 9+30       0.4657      0.81  |Q    V   |         |         |         |
 9+35       0.4714      0.82  |Q     V  |         |         |         |
 9+40       0.4770      0.82  |Q     V  |         |         |         |
 9+45       0.4827      0.83  |Q     V  |         |         |         |
 9+50       0.4885      0.84  |Q     V  |         |         |         |
 9+55       0.4943      0.84  |Q     V  |         |         |         |
10+ 0       0.5002      0.85  |Q     V  |         |         |         |
10+ 5       0.5061      0.86  |Q     V  |         |         |         |
10+10       0.5120      0.87  |Q     V  |         |         |         |
10+15       0.5181      0.87  |Q     V  |         |         |         |
10+20       0.5241      0.88  |Q     V  |         |         |         |
10+25       0.5302      0.89  |Q     V  |         |         |         |
10+30       0.5364      0.90  |Q      V |         |         |         |
10+35       0.5426      0.90  |Q      V |         |         |         |
10+40       0.5489      0.91  |Q      V |         |         |         |
10+45       0.5553      0.92  |Q      V |         |         |         |
10+50       0.5617      0.93  |Q      V |         |         |         |
10+55       0.5682      0.94  |Q      V |         |         |         |
11+ 0       0.5747      0.95  |Q      V |         |         |         |
11+ 5       0.5813      0.96  |Q      V |         |         |         |
11+10       0.5880      0.97  |Q      V |         |         |         |
11+15       0.5948      0.98  |Q      V |         |         |         |
11+20       0.6016      0.99  |Q      V |         |         |         |
11+25       0.6085      1.00  |Q       V|         |         |         |
11+30       0.6154      1.01  |Q       V|         |         |         |
11+35       0.6225      1.02  |Q       V|         |         |         |
11+40       0.6296      1.04  |Q       V|         |         |         |
11+45       0.6368      1.05  |Q       V|         |         |         |
11+50       0.6441      1.06  |Q       V|         |         |         |
11+55       0.6515      1.07  |Q       V|         |         |         |
12+ 0       0.6590      1.09  |Q       V|         |         |         |
12+ 5       0.6667      1.12  |Q       V|         |         |         |
12+10       0.6753      1.24  |Q        V         |         |         |
12+15       0.6845      1.34  |Q        V         |         |         |
12+20       0.6940      1.38  |Q        V         |         |         |
12+25       0.7037      1.40  |Q        V         |         |         |
12+30       0.7134      1.42  |Q        V         |         |         |
12+35       0.7233      1.44  |Q        V         |         |         |
12+40       0.7334      1.46  |Q        V         |         |         |
12+45       0.7435      1.48  |Q        |V        |         |         |
12+50       0.7539      1.50  |Q        |V        |         |         |
12+55       0.7643      1.52  | Q       |V        |         |         |
```

```
13+ 0        0.7750       1.55  | Q        |V         |          |          |
13+ 5        0.7859       1.58  | Q        |V         |          |          |
13+10        0.7970       1.61  | Q        |V         |          |          |
13+15        0.8082       1.64  | Q        | V        |          |          |
13+20        0.8197       1.67  | Q        | V        |          |          |
13+25        0.8314       1.70  | Q        | V        |          |          |
13+30        0.8434       1.74  | Q        | V        |          |          |
13+35        0.8556       1.77  | Q        | V        |          |          |
13+40        0.8681       1.81  | Q        | V        |          |          |
13+45        0.8808       1.85  | Q        |  V       |          |          |
13+50        0.8939       1.89  | Q        |  V       |          |          |
13+55        0.9072       1.94  | Q        |  V       |          |          |
14+ 0        0.9209       1.99  | Q        |  V       |          |          |
14+ 5        0.9350       2.04  | Q        |  V       |          |          |
14+10        0.9497       2.14  | Q        |   V      |          |          |
14+15        0.9651       2.23  | Q        |   V      |          |          |
14+20        0.9809       2.30  |  Q       |   V      |          |          |
14+25        0.9972       2.37  |  Q       |   V      |          |          |
14+30        1.0140       2.44  |  Q       |    V     |          |          |
14+35        1.0313       2.51  |  Q       |    V     |          |          |
14+40        1.0492       2.60  |  Q       |    V     |          |          |
14+45        1.0677       2.68  |  Q       |    V     |          |          |
14+50        1.0868       2.78  |  Q       |     V    |          |          |
14+55        1.1067       2.89  |  Q       |     V    |          |          |
15+ 0        1.1274       3.01  |   Q      |     V    |          |          |
15+ 5        1.1491       3.14  |   Q      |      V   |          |          |
15+10        1.1717       3.29  |   Q      |      V   |          |          |
15+15        1.1955       3.45  |   Q      |      V   |          |          |
15+20        1.2206       3.65  |   Q      |       V  |          |          |
15+25        1.2469       3.81  |    Q     |       V  |          |          |
15+30        1.2730       3.80  |    Q     |        V|          |          |
15+35        1.2997       3.87  |    Q     |        V|          |          |
15+40        1.3287       4.22  |    Q     |        V|          |          |
15+45        1.3612       4.71  |     Q    |         V          |          |
15+50        1.3991       5.50  |      Q   |         V          |          |
15+55        1.4445       6.60  |       Q  |          |V         |          |
16+ 0        1.5041       8.66  |          |Q         | V        |          |
16+ 5        1.6000      13.92  |          |       Q  |  V       |          |
16+10        1.7723      25.02  |          |          |     V    |  Q       |
16+15        1.9117      20.24  |          |          |     Q V  |          |
16+20        1.9767       9.44  |          | Q        |        V|          |
16+25        2.0148       5.53  |      Q   |          |         V          |
16+30        2.0455       4.46  |    Q     |          |         V          |
16+35        2.0722       3.88  |    Q     |          |         V          |
16+40        2.0962       3.48  |   Q      |          |          |V         |
16+45        2.1180       3.16  |   Q      |          |          |V         |
16+50        2.1380       2.91  |  Q       |          |          |V         |
16+55        2.1566       2.70  |  Q       |          |          | V        |
17+ 0        2.1740       2.52  |  Q       |          |          | V        |
17+ 5        2.1903       2.37  |  Q       |          |          | V        |
17+10        2.2054       2.20  | Q        |          |          | V        |
17+15        2.2196       2.05  | Q        |          |          |  V       |
17+20        2.2330       1.95  | Q        |          |          |  V       |
17+25        2.2457       1.86  | Q        |          |          |  V       |
17+30        2.2580       1.78  | Q        |          |          |  V       |
17+35        2.2697       1.70  | Q        |          |          |  V       |
17+40        2.2810       1.64  | Q        |          |          |   V      |
17+45        2.2919       1.58  | Q        |          |          |   V      |
17+50        2.3024       1.53  | Q        |          |          |   V      |
17+55        2.3126       1.48  |Q         |          |          |   V      |
18+ 0        2.3225       1.44  |Q         |          |          |   V      |
18+ 5        2.3320       1.38  |Q         |          |          |   V      |
18+10        2.3406       1.24  |Q         |          |          |    V     |
18+15        2.3484       1.13  |Q         |          |          |    V     |
18+20        2.3558       1.08  |Q         |          |          |    V     |
18+25        2.3630       1.05  |Q         |          |          |    V     |
```

```
18+30      2.3701     1.02  |Q        |         |         |    V    |
18+35      2.3770     1.00  |Q        |         |         |    V    |
18+40      2.3837     0.98  |Q        |         |         |    V    |
18+45      2.3903     0.96  |Q        |         |         |    V    |
18+50      2.3968     0.94  |Q        |         |         |    V    |
18+55      2.4032     0.92  |Q        |         |         |    V    |
19+ 0      2.4094     0.91  |Q        |         |         |     V   |
19+ 5      2.4155     0.89  |Q        |         |         |     V   |
19+10      2.4215     0.87  |Q        |         |         |     V   |
19+15      2.4274     0.86  |Q        |         |         |     V   |
19+20      2.4333     0.84  |Q        |         |         |     V   |
19+25      2.4390     0.83  |Q        |         |         |     V   |
19+30      2.4446     0.82  |Q        |         |         |     V   |
19+35      2.4501     0.80  |Q        |         |         |     V   |
19+40      2.4556     0.79  |Q        |         |         |     V   |
19+45      2.4610     0.78  |Q        |         |         |     V   |
19+50      2.4663     0.77  |Q        |         |         |     V   |
19+55      2.4715     0.76  |Q        |         |         |     V   |
20+ 0      2.4767     0.75  Q         |         |         |      V  |
20+ 5      2.4817     0.74  Q         |         |         |      V  |
20+10      2.4868     0.73  Q         |         |         |      V  |
20+15      2.4917     0.72  Q         |         |         |      V  |
20+20      2.4966     0.71  Q         |         |         |      V  |
20+25      2.5014     0.70  Q         |         |         |      V  |
20+30      2.5062     0.69  Q         |         |         |      V  |
20+35      2.5109     0.68  Q         |         |         |      V  |
20+40      2.5156     0.68  Q         |         |         |      V  |
20+45      2.5202     0.67  Q         |         |         |      V  |
20+50      2.5247     0.66  Q         |         |         |      V  |
20+55      2.5292     0.65  Q         |         |         |      V  |
21+ 0      2.5337     0.65  Q         |         |         |      V  |
21+ 5      2.5381     0.64  Q         |         |         |      V  |
21+10      2.5424     0.63  Q         |         |         |       V |
21+15      2.5467     0.63  Q         |         |         |       V |
21+20      2.5510     0.62  Q         |         |         |       V |
21+25      2.5552     0.61  Q         |         |         |       V |
21+30      2.5594     0.61  Q         |         |         |       V |
21+35      2.5636     0.60  Q         |         |         |       V |
21+40      2.5677     0.60  Q         |         |         |       V |
21+45      2.5717     0.59  Q         |         |         |       V |
21+50      2.5758     0.58  Q         |         |         |       V |
21+55      2.5798     0.58  Q         |         |         |       V |
22+ 0      2.5837     0.57  Q         |         |         |       V |
22+ 5      2.5876     0.57  Q         |         |         |       V |
22+10      2.5915     0.56  Q         |         |         |       V |
22+15      2.5954     0.56  Q         |         |         |       V |
22+20      2.5992     0.55  Q         |         |         |       V |
22+25      2.6030     0.55  Q         |         |         |       V |
22+30      2.6067     0.55  Q         |         |         |       V |
22+35      2.6105     0.54  Q         |         |         |        V|
22+40      2.6142     0.54  Q         |         |         |        V|
22+45      2.6178     0.53  Q         |         |         |        V|
22+50      2.6215     0.53  Q         |         |         |        V|
22+55      2.6251     0.52  Q         |         |         |        V|
23+ 0      2.6286     0.52  Q         |         |         |        V|
23+ 5      2.6322     0.52  Q         |         |         |        V|
23+10      2.6357     0.51  Q         |         |         |        V|
23+15      2.6392     0.51  Q         |         |         |        V|
23+20      2.6427     0.50  Q         |         |         |        V|
23+25      2.6462     0.50  Q         |         |         |        V|
23+30      2.6496     0.50  Q         |         |         |        V|
23+35      2.6530     0.49  Q         |         |         |        V|
23+40      2.6564     0.49  Q         |         |         |        V|
23+45      2.6597     0.49  Q         |         |         |        V|
23+50      2.6630     0.48  Q         |         |         |        V|
23+55      2.6664     0.48  Q         |         |         |        V|
```

```
   24+ 0       2.6696      0.48  Q          |          |          |          V|
   24+ 5       2.6726      0.43  Q          |          |          |          V|
   24+10       2.6741      0.22  Q          |          |          |          V|
   24+15       2.6745      0.05  Q          |          |          |          V|
   24+20       2.6746      0.01  Q          |          |          |          V|
   24+25       2.6746      0.00  Q          |          |          |          V|
-------------------------------------------------------------------------------
```

```
                    Orange County Rational Hydrology Program

                 (Hydrology Manual Date(s) October 1986 & November
1996)

       CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2004
Version 8.0
            Rational Hydrology Study, Date: 11/23/11  File Name:
100288exb2.roc
      ------------------------------------------------------------------
------
      UPTOWN NEWPORT
      HFI JOB NO.  II.100288.0000
      EXISTING CONDITION
      AREA B
      ------------------------------------------------------------------
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      Program License Serial Number 4014

      ------------------------------------------------------------------
------
       *********   Hydrology Study Control Information **********

      ------------------------------------------------------------------
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      Rational hydrology study storm event year is     2.0

      Decimal fraction of study above 2000 ft., 600M  =     0.0000
      English Units Used for input data


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      200.000 to Point/Station
201.000
      **** INITIAL AREA EVALUATION ****
      ___________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   170.000(Ft.)
      Top (of initial area) elevation =    49.600(Ft.)
      Bottom (of initial area) elevation =    48.300(Ft.)
      Difference in elevation =     1.300(Ft.)
      Slope =    0.00765  s(%)=       0.76
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    6.286 min.
      Rainfall intensity =      1.985(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
      Subarea runoff =      1.203(CFS)
```

```
      Total initial stream area =        0.680(Ac.)

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      201.000 to Point/Station
202.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    44.800(Ft.)
      Downstream point/station elevation =    43.300(Ft.)
      Pipe length  =   240.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     1.203(CFS)
      Nearest computed pipe diameter  =      9.00(In.)
      Calculated individual pipe flow  =     1.203(CFS)
      Normal flow depth in pipe =    6.80(In.)
      Flow top width inside pipe =    7.74(In.)
      Critical Depth =    6.05(In.)
      Pipe flow velocity =      3.36(Ft/s)
      Travel time through pipe =    1.19 min.
      Time of concentration (TC) =     7.48 min.

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      201.000 to Point/Station
202.000
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.440
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.560
      SCS curve number for soil(AMC 2)  = 66.64
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.244(In/Hr)
      Max Catchment Loss (Fm) =     0.024(In/Hr)
      Time of concentration =     7.48 min.
      Rainfall intensity =      1.797(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.889
      Subarea runoff =      0.970(CFS) for    0.680(Ac.)
      Total runoff =      2.172(CFS)      Total area =        1.36(Ac.)
      Area averaged Fm value =    0.022(In/Hr)

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++++
      Process from Point/Station      202.000 to Point/Station
203.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    43.300(Ft.)
      Downstream point/station elevation =    42.700(Ft.)
      Pipe length  =   130.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     2.172(CFS)
      Nearest computed pipe diameter  =     12.00(In.)
```

```
      Calculated individual pipe flow  =     2.172(CFS)
      Normal flow depth in pipe =    8.88(In.)
      Flow top width inside pipe =   10.53(In.)
      Critical Depth =    7.57(In.)
      Pipe flow velocity =      3.49(Ft/s)
      Travel time through pipe =    0.62 min.
      Time of concentration (TC) =     8.10 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      203.000 to Point/Station
204.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    42.700(Ft.)
      Downstream point/station elevation =    41.500(Ft.)
      Pipe length  =   245.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     2.172(CFS)
      Nearest computed pipe diameter  =     12.00(In.)
      Calculated individual pipe flow  =     2.172(CFS)
      Normal flow depth in pipe =    8.67(In.)
      Flow top width inside pipe =   10.75(In.)
      Critical Depth =    7.57(In.)
      Pipe flow velocity =      3.58(Ft/s)
      Travel time through pipe =    1.14 min.
      Time of concentration (TC) =     9.24 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      203.000 to Point/Station
204.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 1 in normal stream number 1
      Stream flow area =      1.360(Ac.)
      Runoff from this stream =      2.172(CFS)
      Time of concentration =    9.24 min.
      Rainfall intensity =     1.591(In/Hr)
      Area averaged loss rate (Fm) =    0.0222(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000


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++++
      Process from Point/Station      200.000 to Point/Station
204.100
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
```

```
      Initial subarea data:
      Initial area flow distance =   170.000(Ft.)
      Top (of initial area) elevation =    49.600(Ft.)
      Bottom (of initial area) elevation =    48.100(Ft.)
      Difference in elevation =     1.500(Ft.)
      Slope =    0.00882  s(%)=       0.88
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    6.108 min.
      Rainfall intensity =      2.018(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
      Subarea runoff =      1.834(CFS)
      Total initial stream area =        1.020(Ac.)


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++++
      Process from Point/Station      204.100 to Point/Station
204.200
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    44.600(Ft.)
      Downstream point/station elevation =    43.400(Ft.)
      Pipe length  =   240.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     1.834(CFS)
      Nearest computed pipe diameter  =     12.00(In.)
      Calculated individual pipe flow  =     1.834(CFS)
      Normal flow depth in pipe =    7.60(In.)
      Flow top width inside pipe =   11.57(In.)
      Critical Depth =    6.92(In.)
      Pipe flow velocity =      3.50(Ft/s)
      Travel time through pipe =    1.14 min.
      Time of concentration (TC) =     7.25 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      204.100 to Point/Station
204.200
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.580
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.420
      SCS curve number for soil(AMC 2)  = 63.98
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.258(In/Hr)
      Max Catchment Loss (Fm) =     0.026(In/Hr)
      Time of concentration =     7.25 min.
      Rainfall intensity =      1.829(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.889
      Subarea runoff =      1.400(CFS) for    0.970(Ac.)
      Total runoff =      3.234(CFS)      Total area =        1.99(Ac.)
      Area averaged Fm value =    0.023(In/Hr)


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++++
Process from Point/Station 204.200 to Point/Station
204.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 43.400(Ft.)
Downstream point/station elevation = 41.500(Ft.)
Pipe length = 130.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.234(CFS)
Nearest computed pipe diameter = 12.00(In.)
Calculated individual pipe flow = 3.234(CFS)
Normal flow depth in pipe = 7.76(In.)
Flow top width inside pipe = 11.47(In.)
Critical Depth = 9.23(In.)
Pipe flow velocity = 6.02(Ft/s)
Travel time through pipe = 0.36 min.
Time of concentration (TC) = 7.61 min.

++
++++
Process from Point/Station 204.200 to Point/Station
204.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 1.990(Ac.)
Runoff from this stream = 3.234(CFS)
Time of concentration = 7.61 min.
Rainfall intensity = 1.779(In/Hr)
Area averaged loss rate (Fm) = 0.0228(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream No.	Area (Ac.)	Flow rate (CFS)	TC (min)	Fm (In/Hr)	Rainfall Intensity (In/Hr)
1	1.36	2.172	9.24	0.022	1.591
2	1.99	3.234	7.61	0.023	1.779

Qmax(1) =
1.000 * 1.000 * 2.172) +
0.893 * 1.000 * 3.234) + = 5.061
Qmax(2) =
1.119 * 0.824 * 2.172) +
1.000 * 1.000 * 3.234) + = 5.237

Total of 2 streams to confluence:
Flow rates before confluence point:
2.172 3.234
Maximum flow rates at confluence using above data:
5.061 5.237
Area of streams before confluence:
1.360 1.990
Effective area values after confluence:
3.350 3.110
Results of confluence:
Total flow rate = 5.237(CFS)
Time of concentration = 7.611 min.

```
      Effective stream area after confluence =       3.110(Ac.)
      Study area average Pervious fraction(Ap) =  0.100
      Study area average soil loss rate(Fm) =    0.023(In/Hr)
      Study area total (this main stream) =       3.35(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      204.000 to Point/Station
205.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
_____
      Upstream point/station elevation =    41.500(Ft.)
      Downstream point/station elevation =    40.500(Ft.)
      Pipe length  =   200.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     5.237(CFS)
      Nearest computed pipe diameter  =     18.00(In.)
      Calculated individual pipe flow  =     5.237(CFS)
      Normal flow depth in pipe =   11.15(In.)
      Flow top width inside pipe =   17.48(In.)
      Critical Depth =   10.57(In.)
      Pipe flow velocity =      4.55(Ft/s)
      Travel time through pipe =    0.73 min.
      Time of concentration (TC) =     8.34 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      204.000 to Point/Station
205.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
_____
      Along Main Stream number: 1 in normal stream number 1
      Stream flow area =      3.110(Ac.)
      Runoff from this stream =      5.237(CFS)
      Time of concentration =    8.34 min.
      Rainfall intensity =     1.687(In/Hr)
      Area averaged loss rate (Fm) =    0.0226(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      205.100 to Point/Station
205.200
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
_____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   465.000(Ft.)
      Top (of initial area) elevation =    56.600(Ft.)
```

```
      Bottom (of initial area) elevation =    48.600(Ft.)
      Difference in elevation =     8.000(Ft.)
      Slope =    0.01720  s(%)=       1.72
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    7.993 min.
      NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
      for this Development Type
      Rainfall intensity =      1.729(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
      Subarea runoff =      3.092(CFS)
      Total initial stream area =        2.010(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      205.200 to Point/Station
205.300
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    45.400(Ft.)
      Downstream point/station elevation =    43.900(Ft.)
      Pipe length  =   300.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     3.092(CFS)
      Nearest computed pipe diameter  =     15.00(In.)
      Calculated individual pipe flow  =     3.092(CFS)
      Normal flow depth in pipe =    9.04(In.)
      Flow top width inside pipe =   14.68(In.)
      Critical Depth =    8.50(In.)
      Pipe flow velocity =      4.00(Ft/s)
      Travel time through pipe =    1.25 min.
      Time of concentration (TC) =     9.24 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      205.200 to Point/Station
205.300
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.330
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.670
      SCS curve number for soil(AMC 2)  = 68.73
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.233(In/Hr)
      Max Catchment Loss (Fm) =     0.023(In/Hr)
      Time of concentration =     9.24 min.
      Rainfall intensity =      1.591(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.888
      Subarea runoff =      1.499(CFS) for    1.240(Ac.)
      Total runoff =      4.591(CFS)      Total area =        3.25(Ac.)
      Area averaged Fm value =    0.021(In/Hr)


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```
      Process from Point/Station      205.300 to Point/Station
205.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    43.900(Ft.)
      Downstream point/station elevation =    40.500(Ft.)
      Pipe length  =    70.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     4.591(CFS)
      Nearest computed pipe diameter  =     12.00(In.)
      Calculated individual pipe flow  =     4.591(CFS)
      Normal flow depth in pipe =    6.59(In.)
      Flow top width inside pipe =   11.94(In.)
      Critical Depth =   10.72(In.)
      Pipe flow velocity =     10.39(Ft/s)
      Travel time through pipe =    0.11 min.
      Time of concentration (TC) =     9.36 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      205.300 to Point/Station
205.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 1 in normal stream number 2
      Stream flow area =      3.250(Ac.)
      Runoff from this stream =      4.591(CFS)
      Time of concentration =    9.36 min.
      Rainfall intensity =     1.580(In/Hr)
      Area averaged loss rate (Fm) =    0.0213(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000
      Summary of stream data:

      Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
       No.    (Ac.)   (CFS)       (min)  (In/Hr)     (In/Hr)


      1      3.11     5.237      8.34    0.023      1.687
      2      3.25     4.591      9.36    0.021      1.580
      Qmax(1) =
               1.000 *    1.000 *     5.237) +
               1.069 *    0.892 *     4.591) + =       9.613
      Qmax(2) =
               0.935 *    1.000 *     5.237) +
               1.000 *    1.000 *     4.591) + =       9.490

      Total of 2 streams to confluence:
      Flow rates before confluence point:
             5.237       4.591
      Maximum flow rates at confluence using above data:
              9.613        9.490
      Area of streams before confluence:
              3.110        3.250
      Effective area values after confluence:
              6.008        6.360
      Results of confluence:
      Total flow rate =      9.613(CFS)
      Time of concentration =     8.343 min.
      Effective stream area after confluence =      6.008(Ac.)
```

```
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.022(In/Hr)
Study area total (this main stream) =       6.36(Ac.)
End of computations, total study area =            6.60 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number (AMC 2) =  71.3
```

U n i t   H y d r o g r a p h   A n a l y s i s

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Study date 11/23/11   File Name 100288exb2uh.out

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Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996

Program License Serial Number 4014

UPTOWN NEWPORT
HFI JOB NO. II.100288.0000
EXISTING CONDITION
AREA B

Storm Event Year = 2

Antecedent Moisture Condition = 1

English (in-lb) Input Units Used
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******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	Area (Ac.)	Area Fraction	Soil Group	Fp (In/Hr)	Ap (dec.)	Fm (In/Hr)
71.3	6.6	1.00	D	0.200	0.100	0.020

Area-averaged adjusted loss rate Fm (In/Hr) = 0.020

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC1)	S	Pervious Yield Fr
0.66	0.100	71.3	52.6	9.03	0.003
5.94	0.900	98.0	98.0	0.20	0.890

Area-averaged catchment yield fraction, Y = 0.801
Area-averaged low loss fraction, Yb = 0.199
++
User entry of time of concentration = 0.139 (hours)
Watershed area = 6.60(Ac.)
Catchment Lag time = 0.111 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 74.9400
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.020(In/Hr)
Average low loss rate fraction (Yb) = 0.199 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.190(In)
Computed peak 30-minute rainfall = 0.400(In)
Specified peak 1-hour rainfall = 0.530(In)
Computed peak 3-hour rainfall = 0.890(In)
Specified peak 6-hour rainfall = 1.220(In)

Specified peak 24-hour rainfall = 2.050(In)

Rainfall depth area reduction factors:
Using a total area of 6.60(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.190(In)
30-minute factor = 1.000 Adjusted rainfall = 0.400(In)
1-hour factor = 1.000 Adjusted rainfall = 0.530(In)
3-hour factor = 1.000 Adjusted rainfall = 0.890(In)
6-hour factor = 1.000 Adjusted rainfall = 1.220(In)
24-hour factor = 1.000 Adjusted rainfall = 2.050(In)

U n i t H y d r o g r a p h

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Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
	(K = 79.82 (CFS))	
1	9.992	7.976
2	58.716	38.891
3	91.969	26.542
4	98.461	5.182
5	100.000	1.228

Total soil rain loss = 0.28(In)
Total effective rainfall = 1.77(In)
Peak flow rate in flood hydrograph = 9.52(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0001	0.02	Q				
0+10	0.0008	0.10	Q				
0+15	0.0019	0.16	Q				
0+20	0.0031	0.17	Q				
0+25	0.0042	0.17	Q				
0+30	0.0054	0.17	Q				
0+35	0.0066	0.17	Q				
0+40	0.0078	0.17	Q				
0+45	0.0090	0.17	Q				
0+50	0.0102	0.17	Q				
0+55	0.0114	0.18	Q				
1+ 0	0.0126	0.18	Q				
1+ 5	0.0139	0.18	Q				
1+10	0.0151	0.18	Q				
1+15	0.0163	0.18	Q				
1+20	0.0175	0.18	Q				
1+25	0.0188	0.18	Q				
1+30	0.0200	0.18	Q				
1+35	0.0212	0.18	Q				
1+40	0.0225	0.18	Q				
1+45	0.0237	0.18	Q				
1+50	0.0250	0.18	QV				
1+55	0.0263	0.18	QV				
2+ 0	0.0275	0.18	QV				

2+ 5	0.0288	0.18	QV				
2+10	0.0301	0.19	QV				
2+15	0.0313	0.19	QV				
2+20	0.0326	0.19	QV				
2+25	0.0339	0.19	QV				
2+30	0.0352	0.19	QV				
2+35	0.0365	0.19	QV				
2+40	0.0378	0.19	QV				
2+45	0.0391	0.19	QV				
2+50	0.0404	0.19	QV				
2+55	0.0418	0.19	QV				
3+ 0	0.0431	0.19	QV				
3+ 5	0.0444	0.19	QV				
3+10	0.0457	0.19	QV				
3+15	0.0471	0.19	QV				
3+20	0.0484	0.20	QV				
3+25	0.0498	0.20	Q V				
3+30	0.0511	0.20	Q V				
3+35	0.0525	0.20	Q V				
3+40	0.0539	0.20	Q V				
3+45	0.0552	0.20	Q V				
3+50	0.0566	0.20	Q V				
3+55	0.0580	0.20	Q V				
4+ 0	0.0594	0.20	Q V				
4+ 5	0.0608	0.20	Q V				
4+10	0.0622	0.20	Q V				
4+15	0.0636	0.20	Q V				
4+20	0.0650	0.21	Q V				
4+25	0.0665	0.21	Q V				
4+30	0.0679	0.21	Q V				
4+35	0.0693	0.21	Q V				
4+40	0.0708	0.21	Q V				
4+45	0.0722	0.21	Q V				
4+50	0.0737	0.21	Q V				
4+55	0.0751	0.21	Q V				
5+ 0	0.0766	0.21	Q V				
5+ 5	0.0781	0.21	Q V				
5+10	0.0795	0.22	Q V				
5+15	0.0810	0.22	Q V				
5+20	0.0825	0.22	Q V				
5+25	0.0840	0.22	Q V				
5+30	0.0855	0.22	Q V				
5+35	0.0871	0.22	Q V				
5+40	0.0886	0.22	Q V				
5+45	0.0901	0.22	Q V				
5+50	0.0917	0.22	Q V				
5+55	0.0932	0.22	Q V				
6+ 0	0.0948	0.23	Q V				
6+ 5	0.0963	0.23	Q V				
6+10	0.0979	0.23	Q V				
6+15	0.0995	0.23	Q V				
6+20	0.1011	0.23	Q V				
6+25	0.1027	0.23	Q V				
6+30	0.1043	0.23	Q V				
6+35	0.1059	0.23	Q V				
6+40	0.1075	0.24	Q V				
6+45	0.1091	0.24	Q V				
6+50	0.1108	0.24	Q V				
6+55	0.1124	0.24	Q V				
7+ 0	0.1141	0.24	Q V				
7+ 5	0.1158	0.24	Q V				
7+10	0.1175	0.24	Q V				
7+15	0.1191	0.25	Q V				
7+20	0.1208	0.25	Q V				
7+25	0.1225	0.25	Q V				
7+30	0.1243	0.25	Q V				

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 7+35      0.1260      0.25  |Q   V    |         |         |         |
 7+40      0.1277      0.25  |Q   V    |         |         |         |
 7+45      0.1295      0.25  |Q   V    |         |         |         |
 7+50      0.1313      0.26  |Q   V    |         |         |         |
 7+55      0.1330      0.26  |Q   V    |         |         |         |
 8+ 0      0.1348      0.26  |Q   V    |         |         |         |
 8+ 5      0.1366      0.26  |Q   V    |         |         |         |
 8+10      0.1384      0.26  |Q   V    |         |         |         |
 8+15      0.1402      0.26  |Q   V    |         |         |         |
 8+20      0.1421      0.27  |Q   V    |         |         |         |
 8+25      0.1439      0.27  |Q   V    |         |         |         |
 8+30      0.1458      0.27  |Q    V   |         |         |         |
 8+35      0.1476      0.27  |Q    V   |         |         |         |
 8+40      0.1495      0.27  |Q    V   |         |         |         |
 8+45      0.1514      0.28  |Q    V   |         |         |         |
 8+50      0.1533      0.28  |Q    V   |         |         |         |
 8+55      0.1552      0.28  |Q    V   |         |         |         |
 9+ 0      0.1572      0.28  |Q    V   |         |         |         |
 9+ 5      0.1591      0.28  |Q    V   |         |         |         |
 9+10      0.1611      0.29  |Q    V   |         |         |         |
 9+15      0.1631      0.29  |Q    V   |         |         |         |
 9+20      0.1651      0.29  |Q    V   |         |         |         |
 9+25      0.1671      0.29  |Q    V   |         |         |         |
 9+30      0.1691      0.29  |Q    V   |         |         |         |
 9+35      0.1711      0.30  |Q     V  |         |         |         |
 9+40      0.1732      0.30  |Q     V  |         |         |         |
 9+45      0.1753      0.30  |Q     V  |         |         |         |
 9+50      0.1774      0.30  |Q     V  |         |         |         |
 9+55      0.1795      0.31  |Q     V  |         |         |         |
10+ 0      0.1816      0.31  |Q     V  |         |         |         |
10+ 5      0.1838      0.31  |Q     V  |         |         |         |
10+10      0.1859      0.31  |Q     V  |         |         |         |
10+15      0.1881      0.32  |Q     V  |         |         |         |
10+20      0.1903      0.32  |Q     V  |         |         |         |
10+25      0.1925      0.32  |Q     V  |         |         |         |
10+30      0.1948      0.33  |Q      V |         |         |         |
10+35      0.1970      0.33  |Q      V |         |         |         |
10+40      0.1993      0.33  |Q      V |         |         |         |
10+45      0.2016      0.33  |Q      V |         |         |         |
10+50      0.2039      0.34  |Q      V |         |         |         |
10+55      0.2063      0.34  |Q      V |         |         |         |
11+ 0      0.2087      0.34  |Q      V |         |         |         |
11+ 5      0.2111      0.35  |Q      V |         |         |         |
11+10      0.2135      0.35  |Q      V |         |         |         |
11+15      0.2159      0.36  |Q      V |         |         |         |
11+20      0.2184      0.36  |Q       V|         |         |         |
11+25      0.2209      0.36  |Q       V|         |         |         |
11+30      0.2234      0.37  |Q       V|         |         |         |
11+35      0.2260      0.37  |Q       V|         |         |         |
11+40      0.2286      0.38  |Q       V|         |         |         |
11+45      0.2312      0.38  |Q       V|         |         |         |
11+50      0.2339      0.38  |Q       V|         |         |         |
11+55      0.2365      0.39  |Q       V|         |         |         |
12+ 0      0.2393      0.39  |Q       V|         |         |         |
12+ 5      0.2421      0.41  |Q       V|         |         |         |
12+10      0.2452      0.46  |Q        V         |         |         |
12+15      0.2486      0.49  |Q        V         |         |         |
12+20      0.2520      0.50  | Q       V         |         |         |
12+25      0.2555      0.51  | Q       V         |         |         |
12+30      0.2591      0.52  | Q       V         |         |         |
12+35      0.2627      0.52  | Q       V         |         |         |
12+40      0.2663      0.53  | Q       V         |         |         |
12+45      0.2700      0.54  | Q       |V        |         |         |
12+50      0.2738      0.54  | Q       |V        |         |         |
12+55      0.2776      0.55  | Q       |V        |         |         |
13+ 0      0.2815      0.56  | Q       |V        |         |         |
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13+ 5      0.2854     0.57  | Q       |V        |         |         |
13+10      0.2894     0.58  | Q       |V        |         |         |
13+15      0.2935     0.60  | Q       | V       |         |         |
13+20      0.2977     0.61  | Q       | V       |         |         |
13+25      0.3020     0.62  | Q       | V       |         |         |
13+30      0.3063     0.63  | Q       | V       |         |         |
13+35      0.3108     0.64  | Q       | V       |         |         |
13+40      0.3153     0.66  | Q       | V       |         |         |
13+45      0.3200     0.67  | Q       |  V      |         |         |
13+50      0.3247     0.69  | Q       |  V      |         |         |
13+55      0.3296     0.70  | Q       |  V      |         |         |
14+ 0      0.3345     0.72  | Q       |  V      |         |         |
14+ 5      0.3397     0.74  | Q       |  V      |         |         |
14+10      0.3450     0.78  |  Q      |   V     |         |         |
14+15      0.3506     0.81  |  Q      |   V     |         |         |
14+20      0.3564     0.84  |  Q      |   V     |         |         |
14+25      0.3623     0.86  |  Q      |   V     |         |         |
14+30      0.3684     0.89  |  Q      |    V    |         |         |
14+35      0.3747     0.91  |  Q      |    V    |         |         |
14+40      0.3812     0.95  |  Q      |    V    |         |         |
14+45      0.3880     0.98  |  Q      |    V    |         |         |
14+50      0.3949     1.01  |   Q     |     V   |         |         |
14+55      0.4022     1.05  |   Q     |     V   |         |         |
15+ 0      0.4097     1.10  |   Q     |     V   |         |         |
15+ 5      0.4176     1.14  |   Q     |      V  |         |         |
15+10      0.4259     1.20  |   Q     |      V  |         |         |
15+15      0.4345     1.26  |    Q    |      V  |         |         |
15+20      0.4437     1.33  |    Q    |       V |         |         |
15+25      0.4533     1.39  |    Q    |       V |         |         |
15+30      0.4628     1.38  |    Q    |        V|         |         |
15+35      0.4725     1.41  |    Q    |        V|         |         |
15+40      0.4831     1.55  |     Q   |        V|         |         |
15+45      0.4950     1.73  |     Q   |         V         |         |
15+50      0.5090     2.03  |       Q |         V         |         |
15+55      0.5258     2.44  |        Q|         |V        |         |
16+ 0      0.5481     3.23  |         | Q       | V       |         |
16+ 5      0.5845     5.29  |         |         |Q  V     |         |
16+10      0.6501     9.52  |         |         |    V    |         Q
16+15      0.6981     6.98  |         |         |     QV  |         |
16+20      0.7195     3.11  |         | Q       |      V|         |
16+25      0.7329     1.95  |      Q  |         |       V         |
16+30      0.7435     1.53  |     Q   |         |       V         |
16+35      0.7531     1.39  |    Q    |         |        |V       |
16+40      0.7617     1.25  |   Q     |         |        |V       |
16+45      0.7695     1.14  |   Q     |         |        |V       |
16+50      0.7767     1.05  |   Q     |         |         V       |
16+55      0.7834     0.97  |  Q      |         |         V       |
17+ 0      0.7896     0.91  |  Q      |         |         V       |
17+ 5      0.7955     0.85  |  Q      |         |         V       |
17+10      0.8010     0.79  |  Q      |         |          V      |
17+15      0.8061     0.74  | Q       |         |          V      |
17+20      0.8109     0.70  | Q       |         |          V      |
17+25      0.8155     0.67  | Q       |         |          V      |
17+30      0.8199     0.64  | Q       |         |          V      |
17+35      0.8242     0.62  | Q       |         |          V      |
17+40      0.8283     0.59  | Q       |         |           V     |
17+45      0.8322     0.57  | Q       |         |           V     |
17+50      0.8360     0.55  | Q       |         |           V     |
17+55      0.8397     0.53  | Q       |         |           V     |
18+ 0      0.8433     0.52  | Q       |         |           V     |
18+ 5      0.8467     0.50  |Q        |         |           V     |
18+10      0.8498     0.44  |Q        |         |            V    |
18+15      0.8525     0.41  |Q        |         |            V    |
18+20      0.8552     0.39  |Q        |         |            V    |
18+25      0.8578     0.38  |Q        |         |            V    |
18+30      0.8604     0.37  |Q        |         |            V    |
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18+35      0.8629      0.36  |Q         |         |         |    V    |
18+40      0.8653      0.35  |Q         |         |         |    V    |
18+45      0.8677      0.35  |Q         |         |         |    V    |
18+50      0.8701      0.34  |Q         |         |         |    V    |
18+55      0.8724      0.33  |Q         |         |         |    V    |
19+ 0      0.8746      0.33  |Q         |         |         |     V   |
19+ 5      0.8768      0.32  |Q         |         |         |     V   |
19+10      0.8790      0.32  |Q         |         |         |     V   |
19+15      0.8812      0.31  |Q         |         |         |     V   |
19+20      0.8833      0.31  |Q         |         |         |     V   |
19+25      0.8853      0.30  |Q         |         |         |     V   |
19+30      0.8874      0.30  |Q         |         |         |     V   |
19+35      0.8894      0.29  |Q         |         |         |     V   |
19+40      0.8914      0.29  |Q         |         |         |     V   |
19+45      0.8933      0.28  |Q         |         |         |     V   |
19+50      0.8952      0.28  |Q         |         |         |     V   |
19+55      0.8971      0.27  |Q         |         |         |     V   |
20+ 0      0.8990      0.27  |Q         |         |         |      V  |
20+ 5      0.9008      0.27  |Q         |         |         |      V  |
20+10      0.9026      0.26  |Q         |         |         |      V  |
20+15      0.9044      0.26  |Q         |         |         |      V  |
20+20      0.9062      0.26  |Q         |         |         |      V  |
20+25      0.9079      0.25  |Q         |         |         |      V  |
20+30      0.9097      0.25  |Q         |         |         |      V  |
20+35      0.9114      0.25  Q          |         |         |      V  |
20+40      0.9131      0.24  Q          |         |         |      V  |
20+45      0.9147      0.24  Q          |         |         |      V  |
20+50      0.9164      0.24  Q          |         |         |      V  |
20+55      0.9180      0.24  Q          |         |         |      V  |
21+ 0      0.9196      0.23  Q          |         |         |      V  |
21+ 5      0.9212      0.23  Q          |         |         |      V  |
21+10      0.9228      0.23  Q          |         |         |       V |
21+15      0.9244      0.23  Q          |         |         |       V |
21+20      0.9259      0.22  Q          |         |         |       V |
21+25      0.9274      0.22  Q          |         |         |       V |
21+30      0.9290      0.22  Q          |         |         |       V |
21+35      0.9305      0.22  Q          |         |         |       V |
21+40      0.9319      0.22  Q          |         |         |       V |
21+45      0.9334      0.21  Q          |         |         |       V |
21+50      0.9349      0.21  Q          |         |         |       V |
21+55      0.9363      0.21  Q          |         |         |       V |
22+ 0      0.9378      0.21  Q          |         |         |       V |
22+ 5      0.9392      0.21  Q          |         |         |       V |
22+10      0.9406      0.20  Q          |         |         |       V |
22+15      0.9420      0.20  Q          |         |         |       V |
22+20      0.9434      0.20  Q          |         |         |       V |
22+25      0.9447      0.20  Q          |         |         |       V |
22+30      0.9461      0.20  Q          |         |         |       V |
22+35      0.9474      0.20  Q          |         |         |        V|
22+40      0.9488      0.19  Q          |         |         |        V|
22+45      0.9501      0.19  Q          |         |         |        V|
22+50      0.9514      0.19  Q          |         |         |        V|
22+55      0.9527      0.19  Q          |         |         |        V|
23+ 0      0.9540      0.19  Q          |         |         |        V|
23+ 5      0.9553      0.19  Q          |         |         |        V|
23+10      0.9566      0.19  Q          |         |         |        V|
23+15      0.9579      0.18  Q          |         |         |        V|
23+20      0.9591      0.18  Q          |         |         |        V|
23+25      0.9604      0.18  Q          |         |         |        V|
23+30      0.9616      0.18  Q          |         |         |        V|
23+35      0.9629      0.18  Q          |         |         |        V|
23+40      0.9641      0.18  Q          |         |         |        V|
23+45      0.9653      0.18  Q          |         |         |        V|
23+50      0.9665      0.18  Q          |         |         |        V|
23+55      0.9677      0.17  Q          |         |         |        V|
24+ 0      0.9689      0.17  Q          |         |         |        V|
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   24+ 5       0.9700      0.15  Q          |          |          |         V|
   24+10       0.9704      0.07  Q          |          |          |         V|
   24+15       0.9705      0.01  Q          |          |          |         V|
   24+20       0.9706      0.00  Q          |          |          |          V
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                    Orange County Rational Hydrology Program

                 (Hydrology Manual Date(s) October 1986 & November
1996)

       CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2004
Version 8.0
            Rational Hydrology Study, Date: 11/14/11  File Name:
100288PRA2.roc
      ------------------------------------------------------------------
------
      UPTOWN NEWPORT
      HFI JOB NO.  II.100288.0000
      DEVELOPED CONDITION
      AREA A
      ------------------------------------------------------------------
------


      Program License Serial Number 4014

      ------------------------------------------------------------------
------
       *********   Hydrology Study Control Information **********

      ------------------------------------------------------------------
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      Rational hydrology study storm event year is     2.0

      Decimal fraction of study above 2000 ft., 600M  =     0.0000
      English Units Used for input data


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      100.000 to Point/Station
101.000
      **** INITIAL AREA EVALUATION ****
      ___________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   290.000(Ft.)
      Top (of initial area) elevation =    56.500(Ft.)
      Bottom (of initial area) elevation =    55.000(Ft.)
      Difference in elevation =     1.500(Ft.)
      Slope =    0.00517  s(%)=       0.52
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    8.416 min.
      Rainfall intensity =      1.679(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
      Subarea runoff =      0.836(CFS)
```

```
      Total initial stream area =        0.560(Ac.)

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      Process from Point/Station      101.000 to Point/Station
102.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    51.000(Ft.)
      Downstream point/station elevation =    50.400(Ft.)
      Pipe length  =   115.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     0.836(CFS)
      Nearest computed pipe diameter  =      9.00(In.)
      Calculated individual pipe flow  =     0.836(CFS)
      Normal flow depth in pipe =    5.55(In.)
      Flow top width inside pipe =    8.75(In.)
      Critical Depth =    5.01(In.)
      Pipe flow velocity =      2.93(Ft/s)
      Travel time through pipe =    0.65 min.
      Time of concentration (TC) =     9.07 min.

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++++
      Process from Point/Station      101.000 to Point/Station
102.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 1 in normal stream number 1
      Stream flow area =      0.560(Ac.)
      Runoff from this stream =      0.836(CFS)
      Time of concentration =    9.07 min.
      Rainfall intensity =     1.608(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000

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++++
      Process from Point/Station      102.100 to Point/Station
102.200
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   430.000(Ft.)
      Top (of initial area) elevation =    57.200(Ft.)
      Bottom (of initial area) elevation =    55.000(Ft.)
      Difference in elevation =     2.200(Ft.)
      Slope =    0.00512  s(%)=       0.51
```

```
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.873 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      1.532(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.888
Subarea runoff =      1.878(CFS)
Total initial stream area =        1.380(Ac.)


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Process from Point/Station      102.200 to Point/Station
102.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
____
Upstream point/station elevation =    51.000(Ft.)
Downstream point/station elevation =    50.400(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.878(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.878(CFS)
Normal flow depth in pipe =    5.72(In.)
Flow top width inside pipe =    8.66(In.)
Critical Depth =    7.51(In.)
Pipe flow velocity =      6.34(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =     9.94 min.


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Process from Point/Station      102.200 to Point/Station
102.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
____
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.380(Ac.)
Runoff from this stream =      1.878(CFS)
Time of concentration =    9.94 min.
Rainfall intensity =     1.526(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      102.300 to Point/Station
102.400
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
____
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
```

```
Max Catchment Loss (Fm) =     0.170(In/Hr)
Initial subarea data:
Initial area flow distance =   175.000(Ft.)
Top (of initial area) elevation =    57.000(Ft.)
Bottom (of initial area) elevation =    55.000(Ft.)
Difference in elevation =     2.000(Ft.)
Slope =    0.01143  s(%)=       1.14
TC = k(0.483)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.323 min.
Rainfall intensity =      1.583(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.803
Subarea runoff =      1.056(CFS)
Total initial stream area =        0.830(Ac.)


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Process from Point/Station      102.400 to Point/Station
102.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
____
Upstream point/station elevation =    51.000(Ft.)
Downstream point/station elevation =    50.400(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.056(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.056(CFS)
Normal flow depth in pipe =    4.02(In.)
Flow top width inside pipe =    8.95(In.)
Critical Depth =    5.66(In.)
Pipe flow velocity =      5.52(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     9.40 min.


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Process from Point/Station      102.400 to Point/Station
102.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
____
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      0.830(Ac.)
Runoff from this stream =      1.056(CFS)
Time of concentration =    9.40 min.
Rainfall intensity =     1.576(In/Hr)
Area averaged loss rate (Fm) =    0.1700(In/Hr)
Area averaged Pervious ratio (Ap) = 0.8500
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)      (In/Hr)


1       0.56     0.836      9.07    0.020       1.608
2       1.38     1.878      9.94    0.020       1.526
3       0.83     1.056      9.40    0.170       1.576
Qmax(1) =
         1.000 *    1.000 *     0.836) +
```

```
          1.055 *    0.913 *     1.878) +
          1.023 *    0.965 *     1.056) + =       3.685
Qmax(2) =
          0.948 *    1.000 *     0.836) +
          1.000 *    1.000 *     1.878) +
          0.965 *    1.000 *     1.056) + =       3.689
Qmax(3) =
          0.980 *    1.000 *     0.836) +
          1.033 *    0.946 *     1.878) +
          1.000 *    1.000 *     1.056) + =       3.709

Total of 3 streams to confluence:
Flow rates before confluence point:
       0.836       1.878       1.056
Maximum flow rates at confluence using above data:
        3.685       3.689       3.709
Area of streams before confluence:
        0.560       1.380       0.830
Effective area values after confluence:
        2.620       2.770       2.695
Results of confluence:
Total flow rate =      3.709(CFS)
Time of concentration =     9.399 min.
Effective stream area after confluence =      2.695(Ac.)
Study area average Pervious fraction(Ap) =  0.325
Study area average soil loss rate(Fm) =    0.065(In/Hr)
Study area total (this main stream) =       2.77(Ac.)


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Process from Point/Station      102.000 to Point/Station
103.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =    50.400(Ft.)
Downstream point/station elevation =    46.200(Ft.)
Pipe length  =   205.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.709(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     3.709(CFS)
Normal flow depth in pipe =    7.59(In.)
Flow top width inside pipe =   11.57(In.)
Critical Depth =    9.84(In.)
Pipe flow velocity =      7.08(Ft/s)
Travel time through pipe =    0.48 min.
Time of concentration (TC) =     9.88 min.


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Process from Point/Station      102.000 to Point/Station
103.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      2.695(Ac.)
Runoff from this stream =      3.709(CFS)
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```
      Time of concentration =    9.88 min.
      Rainfall intensity =     1.531(In/Hr)
      Area averaged loss rate (Fm) =    0.0649(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.3247
      Program is now starting with Main Stream No. 2


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      Process from Point/Station      150.000 to Point/Station
151.000
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
_____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   100.000(Ft.)
      Top (of initial area) elevation =    57.000(Ft.)
      Bottom (of initial area) elevation =    54.500(Ft.)
      Difference in elevation =     2.500(Ft.)
      Slope =    0.02500  s(%)=       2.50
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    4.011 min.
      Rainfall intensity =      2.569(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
      Subarea runoff =      0.206(CFS)
      Total initial stream area =        0.090(Ac.)


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      Process from Point/Station      151.000 to Point/Station
152.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
_____
      Upstream point/station elevation =    50.500(Ft.)
      Downstream point/station elevation =    50.200(Ft.)
      Pipe length  =    40.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     0.206(CFS)
      Nearest computed pipe diameter  =      6.00(In.)
      Calculated individual pipe flow  =     0.206(CFS)
      Normal flow depth in pipe =    2.73(In.)
      Flow top width inside pipe =    5.98(In.)
      Critical Depth =    2.73(In.)
      Pipe flow velocity =      2.37(Ft/s)
      Travel time through pipe =    0.28 min.
      Time of concentration (TC) =     4.29 min.


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      Process from Point/Station      151.000 to Point/Station
152.000
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**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________
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Along Main Stream number: 2 in normal stream number 1
Stream flow area =      0.090(Ac.)
Runoff from this stream =      0.206(CFS)
Time of concentration =    4.29 min.
Rainfall intensity =     2.471(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      152.200 to Point/Station
152.100
**** INITIAL AREA EVALUATION ****
____________________________________________________________________
____
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   100.000(Ft.)
Top (of initial area) elevation =    57.000(Ft.)
Bottom (of initial area) elevation =    54.500(Ft.)
Difference in elevation =     2.500(Ft.)
Slope =    0.02500  s(%)=       2.50
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    4.011 min.
Rainfall intensity =      2.569(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff =      0.344(CFS)
Total initial stream area =        0.150(Ac.)


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Process from Point/Station      152.100 to Point/Station
152.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
____________________________________________________________________
____
Upstream point/station elevation =    50.500(Ft.)
Downstream point/station elevation =    50.200(Ft.)
Pipe length  =    45.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.344(CFS)
Nearest computed pipe diameter  =      6.00(In.)
Calculated individual pipe flow  =     0.344(CFS)
Normal flow depth in pipe =    3.88(In.)
Flow top width inside pipe =    5.74(In.)
Critical Depth =    3.57(In.)
Pipe flow velocity =      2.56(Ft/s)
Travel time through pipe =    0.29 min.
Time of concentration (TC) =     4.30 min.
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Process from Point/Station      152.100 to Point/Station
152.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
____
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.150(Ac.)
Runoff from this stream =      0.344(CFS)
Time of concentration =    4.30 min.
Rainfall intensity =     2.467(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)      (In/Hr)


1      0.09     0.206      4.29    0.020      2.471
2      0.15     0.344      4.30    0.020      2.467
Qmax(1) =
         1.000 *    1.000 *     0.206) +
         1.002 *    0.997 *     0.344) + =       0.550
Qmax(2) =
         0.998 *    1.000 *     0.206) +
         1.000 *    1.000 *     0.344) + =       0.550

Total of 2 streams to confluence:
Flow rates before confluence point:
       0.206       0.344
Maximum flow rates at confluence using above data:
        0.550        0.550
Area of streams before confluence:
        0.090        0.150
Effective area values after confluence:
        0.240        0.240
Results of confluence:
Total flow rate =      0.550(CFS)
Time of concentration =     4.304 min.
Effective stream area after confluence =      0.240(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       0.24(Ac.)


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Process from Point/Station      152.000 to Point/Station
153.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
____
Upstream point/station elevation =    50.200(Ft.)
Downstream point/station elevation =    49.300(Ft.)
Pipe length  =   110.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.550(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     0.550(CFS)
```

```
      Normal flow depth in pipe =    3.78(In.)
      Flow top width inside pipe =    8.88(In.)
      Critical Depth =    4.03(In.)
      Pipe flow velocity =      3.13(Ft/s)
      Travel time through pipe =    0.59 min.
      Time of concentration (TC) =     4.89 min.


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++++
      Process from Point/Station      152.000 to Point/Station
153.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 2 in normal stream number 1
      Stream flow area =      0.240(Ac.)
      Runoff from this stream =      0.550(CFS)
      Time of concentration =    4.89 min.
      Rainfall intensity =     2.293(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000


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      Process from Point/Station      153.100 to Point/Station
153.200
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   310.000(Ft.)
      Top (of initial area) elevation =    56.100(Ft.)
      Bottom (of initial area) elevation =    53.500(Ft.)
      Difference in elevation =     2.600(Ft.)
      Slope =    0.00839  s(%)=       0.84
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    7.847 min.
      Rainfall intensity =      1.748(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
      Subarea runoff =      1.399(CFS)
      Total initial stream area =        0.900(Ac.)


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++++
      Process from Point/Station      153.200 to Point/Station
153.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    49.500(Ft.)
```

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      Downstream point/station elevation =    49.300(Ft.)
      Pipe length  =    25.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     1.399(CFS)
      Nearest computed pipe diameter  =      9.00(In.)
      Calculated individual pipe flow  =     1.399(CFS)
      Normal flow depth in pipe =    6.97(In.)
      Flow top width inside pipe =    7.52(In.)
      Critical Depth =    6.54(In.)
      Pipe flow velocity =      3.81(Ft/s)
      Travel time through pipe =    0.11 min.
      Time of concentration (TC) =     7.96 min.


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      Process from Point/Station      153.200 to Point/Station
153.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 2 in normal stream number 2
      Stream flow area =      0.900(Ac.)
      Runoff from this stream =      1.399(CFS)
      Time of concentration =    7.96 min.
      Rainfall intensity =     1.734(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000


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      Process from Point/Station      153.400 to Point/Station
153.500
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =    90.000(Ft.)
      Top (of initial area) elevation =    55.500(Ft.)
      Bottom (of initial area) elevation =    53.500(Ft.)
      Difference in elevation =     2.000(Ft.)
      Slope =    0.02222  s(%)=       2.22
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    3.937 min.
      Rainfall intensity =      2.596(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
      Subarea runoff =      0.301(CFS)
      Total initial stream area =        0.130(Ac.)


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      Process from Point/Station      153.500 to Point/Station
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153.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    49.500(Ft.)
      Downstream point/station elevation =    49.300(Ft.)
      Pipe length  =    25.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     0.301(CFS)
      Nearest computed pipe diameter  =      6.00(In.)
      Calculated individual pipe flow  =     0.301(CFS)
      Normal flow depth in pipe =    3.35(In.)
      Flow top width inside pipe =    5.96(In.)
      Critical Depth =    3.33(In.)
      Pipe flow velocity =      2.67(Ft/s)
      Travel time through pipe =    0.16 min.
      Time of concentration (TC) =     4.09 min.


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++++
      Process from Point/Station      153.500 to Point/Station
153.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 2 in normal stream number 3
      Stream flow area =      0.130(Ac.)
      Runoff from this stream =      0.301(CFS)
      Time of concentration =    4.09 min.
      Rainfall intensity =     2.539(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000
      Summary of stream data:

      Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
       No.    (Ac.)   (CFS)       (min)  (In/Hr)     (In/Hr)


      1      0.24     0.550      4.89    0.020      2.293
      2      0.90     1.399      7.96    0.020      1.734
      3      0.13     0.301      4.09    0.020      2.539
      Qmax(1) =
               1.000 *    1.000 *     0.550) +
               1.326 *    0.615 *     1.399) +
               0.902 *    1.000 *     0.301) + =       1.963
      Qmax(2) =
               0.754 *    1.000 *     0.550) +
               1.000 *    1.000 *     1.399) +
               0.680 *    1.000 *     0.301) + =       2.019
      Qmax(3) =
               1.108 *    0.837 *     0.550) +
               1.470 *    0.514 *     1.399) +
               1.000 *    1.000 *     0.301) + =       1.870

      Total of 3 streams to confluence:
      Flow rates before confluence point:
             0.550       1.399       0.301
      Maximum flow rates at confluence using above data:
              1.963        2.019        1.870
      Area of streams before confluence:
              0.240        0.900        0.130
```

```
Effective area values after confluence:
        0.923        1.270        0.794
Results of confluence:
Total flow rate =      2.019(CFS)
Time of concentration =     7.956 min.
Effective stream area after confluence =      1.270(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       1.27(Ac.)


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++++
Process from Point/Station      153.000 to Point/Station
154.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =    49.300(Ft.)
Downstream point/station elevation =    47.500(Ft.)
Pipe length  =   360.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.019(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.019(CFS)
Normal flow depth in pipe =    8.13(In.)
Flow top width inside pipe =   11.22(In.)
Critical Depth =    7.28(In.)
Pipe flow velocity =      3.57(Ft/s)
Travel time through pipe =    1.68 min.
Time of concentration (TC) =     9.64 min.


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Process from Point/Station      153.000 to Point/Station
154.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      1.270(Ac.)
Runoff from this stream =      2.019(CFS)
Time of concentration =    9.64 min.
Rainfall intensity =     1.553(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      154.100 to Point/Station
154.200
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
```

```
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   460.000(Ft.)
      Top (of initial area) elevation =    56.300(Ft.)
      Bottom (of initial area) elevation =    54.000(Ft.)
      Difference in elevation =     2.300(Ft.)
      Slope =    0.00500  s(%)=       0.50
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =   10.190 min.
      NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
      for this Development Type
      Rainfall intensity =      1.504(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.888
      Subarea runoff =      3.794(CFS)
      Total initial stream area =        2.840(Ac.)


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++++
      Process from Point/Station      154.200 to Point/Station
154.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    49.500(Ft.)
      Downstream point/station elevation =    47.500(Ft.)
      Pipe length  =    25.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     3.794(CFS)
      Nearest computed pipe diameter  =      9.00(In.)
      Calculated individual pipe flow  =     3.794(CFS)
      Normal flow depth in pipe =    6.15(In.)
      Flow top width inside pipe =    8.37(In.)
      Critical depth could not be calculated.
      Pipe flow velocity =     11.80(Ft/s)
      Travel time through pipe =    0.04 min.
      Time of concentration (TC) =    10.23 min.


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      Process from Point/Station      154.200 to Point/Station
154.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 2 in normal stream number 2
      Stream flow area =      2.840(Ac.)
      Runoff from this stream =      3.794(CFS)
      Time of concentration =   10.23 min.
      Rainfall intensity =     1.501(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000


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      Process from Point/Station      154.300 to Point/Station
154.400
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
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COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   365.000(Ft.)
Top (of initial area) elevation =    55.300(Ft.)
Bottom (of initial area) elevation =    53.500(Ft.)
Difference in elevation =     1.800(Ft.)
Slope =    0.00493  s(%)=       0.49
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.315 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      1.584(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
Subarea runoff =      2.491(CFS)
Total initial stream area =        1.770(Ac.)


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Process from Point/Station      154.400 to Point/Station
154.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________

Upstream point/station elevation =    49.500(Ft.)
Downstream point/station elevation =    47.500(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.491(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     2.491(CFS)
Normal flow depth in pipe =    4.67(In.)
Flow top width inside pipe =    8.99(In.)
Critical Depth =    8.30(In.)
Pipe flow velocity =     10.76(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =     9.35 min.


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Process from Point/Station      154.400 to Point/Station
154.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________

Along Main Stream number: 2 in normal stream number 3
Stream flow area =      1.770(Ac.)
Runoff from this stream =      2.491(CFS)
Time of concentration =    9.35 min.
Rainfall intensity =     1.580(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:
```

```
Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min)  (In/Hr)     (In/Hr)


1      1.27     2.019      9.64    0.020      1.553
2      2.84     3.794     10.23    0.020      1.501
3      1.77     2.491      9.35    0.020      1.580
Qmax(1) =
         1.000 *    1.000 *     2.019) +
         1.035 *    0.943 *     3.794) +
         0.983 *    1.000 *     2.491) + =       8.169
Qmax(2) =
         0.966 *    1.000 *     2.019) +
         1.000 *    1.000 *     3.794) +
         0.950 *    1.000 *     2.491) + =       8.111
Qmax(3) =
         1.018 *    0.970 *     2.019) +
         1.053 *    0.915 *     3.794) +
         1.000 *    1.000 *     2.491) + =       8.140

Total of 3 streams to confluence:
Flow rates before confluence point:
       2.019       3.794       2.491
Maximum flow rates at confluence using above data:
        8.169       8.111       8.140
Area of streams before confluence:
        1.270       2.840       1.770
Effective area values after confluence:
        5.717       5.880       5.600
Results of confluence:
Total flow rate =      8.169(CFS)
Time of concentration =     9.639 min.
Effective stream area after confluence =      5.717(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       5.88(Ac.)


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Process from Point/Station      154.000 to Point/Station
103.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
____
Upstream point/station elevation =    47.500(Ft.)
Downstream point/station elevation =    46.200(Ft.)
Pipe length  =   265.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     8.169(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     8.169(CFS)
Normal flow depth in pipe =   13.39(In.)
Flow top width inside pipe =   20.19(In.)
Critical Depth =   12.71(In.)
Pipe flow velocity =      5.04(Ft/s)
Travel time through pipe =    0.88 min.
Time of concentration (TC) =    10.51 min.


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      Process from Point/Station      154.000 to Point/Station
103.000
      **** CONFLUENCE OF MAIN STREAMS ****
      ____________________________________________________________________
____
      The following data inside Main Stream is listed:
      In Main Stream number: 2
      Stream flow area =      5.717(Ac.)
      Runoff from this stream =      8.169(CFS)
      Time of concentration =   10.51 min.
      Rainfall intensity =     1.477(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000
      Summary of stream data:

      Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
       No.    (Ac.)   (CFS)       (min) (In/Hr)     (In/Hr)


      1      2.69     3.709      9.88    0.065      1.531
      2      5.72     8.169     10.51    0.020      1.477
      Qmax(1) =
               1.000 *    1.000 *     3.709) +
               1.037 *    0.940 *     8.169) + =      11.668
      Qmax(2) =
               0.963 *    1.000 *     3.709) +
               1.000 *    1.000 *     8.169) + =      11.742

      Total of 2 main streams to confluence:
      Flow rates before confluence point:
             4.709       9.169
      Maximum flow rates at confluence using above data:
            11.668      11.742
      Area of streams before confluence:
              2.695       5.717
      Effective area values after confluence:
              8.068       8.412


      Results of confluence:
      Total flow rate =     11.742(CFS)
      Time of concentration =    10.515 min.
      Effective stream area after confluence  =      8.412(Ac.)
      Study area average Pervious fraction(Ap) =  0.172
      Study area average soil loss rate(Fm) =    0.034(In/Hr)
      Study area total =       8.41(Ac.)


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      Process from Point/Station      103.000 to Point/Station
104.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ____________________________________________________________________
____
      Upstream point/station elevation =    46.200(Ft.)
      Downstream point/station elevation =    45.500(Ft.)
      Pipe length  =   145.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    11.742(CFS)
      Nearest computed pipe diameter  =     24.00(In.)
```

```
      Calculated individual pipe flow  =    11.742(CFS)
      Normal flow depth in pipe =   15.46(In.)
      Flow top width inside pipe =   22.98(In.)
      Critical Depth =   14.76(In.)
      Pipe flow velocity =      5.49(Ft/s)
      Travel time through pipe =    0.44 min.
      Time of concentration (TC) =    10.96 min.


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++++
      Process from Point/Station      103.000 to Point/Station
104.000
      **** CONFLUENCE OF MAIN STREAMS ****
      ______________________________________________________________________
____
      The following data inside Main Stream is listed:
      In Main Stream number: 1
      Stream flow area =      8.412(Ac.)
      Runoff from this stream =     11.742(CFS)
      Time of concentration =   10.96 min.
      Rainfall intensity =     1.443(In/Hr)
      Area averaged loss rate (Fm) =    0.0344(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1720
      Program is now starting with Main Stream No. 2


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      Process from Point/Station      104.100 to Point/Station
104.200
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      PARK subarea
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.170(In/Hr)
      Initial subarea data:
      Initial area flow distance =   160.000(Ft.)
      Top (of initial area) elevation =    56.000(Ft.)
      Bottom (of initial area) elevation =    53.500(Ft.)
      Difference in elevation =     2.500(Ft.)
      Slope =    0.01563  s(%)=       1.56
      TC = k(0.483)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    8.450 min.
      Rainfall intensity =      1.675(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.809
      Subarea runoff =      0.393(CFS)
      Total initial stream area =        0.290(Ac.)


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++++
      Process from Point/Station      104.100 to Point/Station
104.200
      **** CONFLUENCE OF MINOR STREAMS ****
```

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____________________________________________________________________________
      Along Main Stream number: 2 in normal stream number 1
      Stream flow area =       0.290(Ac.)
      Runoff from this stream =       0.393(CFS)
      Time of concentration =    8.45 min.
      Rainfall intensity =     1.675(In/Hr)
      Area averaged loss rate (Fm) =    0.1700(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.8500


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++++
      Process from Point/Station      104.300 to Point/Station
104.200
      **** INITIAL AREA EVALUATION ****
____________________________________________________________________________
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   420.000(Ft.)
      Top (of initial area) elevation =    57.200(Ft.)
      Bottom (of initial area) elevation =    53.500(Ft.)
      Difference in elevation =     3.700(Ft.)
      Slope =    0.00881  s(%)=       0.88
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    8.774 min.
      NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
      for this Development Type
      Rainfall intensity =      1.639(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
      Subarea runoff =      1.355(CFS)
      Total initial stream area =        0.930(Ac.)


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++++
      Process from Point/Station      104.300 to Point/Station
104.200
      **** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________________
      Along Main Stream number: 2 in normal stream number 2
      Stream flow area =       0.930(Ac.)
      Runoff from this stream =       1.355(CFS)
      Time of concentration =    8.77 min.
      Rainfall intensity =     1.639(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000
      Summary of stream data:

      Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
       No.    (Ac.)   (CFS)       (min)  (In/Hr)     (In/Hr)
```

```
1       0.29      0.393       8.45     0.170       1.675
2       0.93      1.355       8.77     0.020       1.639
Qmax(1) =
          1.000 *     1.000 *      0.393) +
          1.022 *     0.963 *      1.355) + =        1.727
Qmax(2) =
          0.976 *     1.000 *      0.393) +
          1.000 *     1.000 *      1.355) + =        1.739

Total of 2 streams to confluence:
Flow rates before confluence point:
        0.393        1.355
Maximum flow rates at confluence using above data:
         1.727        1.739
Area of streams before confluence:
         0.290        0.930
Effective area values after confluence:
         1.186        1.220
Results of confluence:
Total flow rate =       1.739(CFS)
Time of concentration =      8.774 min.
Effective stream area after confluence =       1.220(Ac.)
Study area average Pervious fraction(Ap) =  0.278
Study area average soil loss rate(Fm) =    0.056(In/Hr)
Study area total (this main stream) =       1.22(Ac.)


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++++
Process from Point/Station      104.200 to Point/Station
104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
_____
Upstream point/station elevation =    49.500(Ft.)
Downstream point/station elevation =    45.500(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.739(CFS)
Nearest computed pipe diameter  =      6.00(In.)
Calculated individual pipe flow  =     1.739(CFS)
Normal flow depth in pipe =    3.97(In.)
Flow top width inside pipe =    5.68(In.)
Critical depth could not be calculated.
Pipe flow velocity =     12.62(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     8.81 min.


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++++
Process from Point/Station      104.200 to Point/Station
104.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
_____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      1.220(Ac.)
Runoff from this stream =      1.739(CFS)
Time of concentration =    8.81 min.
```

```
      Rainfall intensity =     1.636(In/Hr)
      Area averaged loss rate (Fm) =    0.0557(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.2783
      Program is now starting with Main Stream No. 3


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      Process from Point/Station      104.400 to Point/Station
104.500
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   160.000(Ft.)
      Top (of initial area) elevation =    56.000(Ft.)
      Bottom (of initial area) elevation =    53.500(Ft.)
      Difference in elevation =     2.500(Ft.)
      Slope =    0.01563  s(%)=       1.56
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    5.318 min.
      Rainfall intensity =      2.185(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
      Subarea runoff =      0.234(CFS)
      Total initial stream area =        0.120(Ac.)


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      Process from Point/Station      104.400 to Point/Station
104.500
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 3 in normal stream number 1
      Stream flow area =      0.120(Ac.)
      Runoff from this stream =      0.234(CFS)
      Time of concentration =    5.32 min.
      Rainfall intensity =     2.185(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000


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      Process from Point/Station      104.600 to Point/Station
104.500
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
```

```
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   265.000(Ft.)
Top (of initial area) elevation =    55.800(Ft.)
Bottom (of initial area) elevation =    53.500(Ft.)
Difference in elevation =     2.300(Ft.)
Slope =    0.00868  s(%)=       0.87
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.319 min.
Rainfall intensity =      1.819(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
Subarea runoff =      0.696(CFS)
Total initial stream area =        0.430(Ac.)


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Process from Point/Station      104.600 to Point/Station
104.500
**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________________
____
Along Main Stream number: 3 in normal stream number 2
Stream flow area =      0.430(Ac.)
Runoff from this stream =      0.696(CFS)
Time of concentration =    7.32 min.
Rainfall intensity =     1.819(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)      (In/Hr)


1      0.12     0.234      5.32    0.020      2.185
2      0.43     0.696      7.32    0.020      1.819
Qmax(1) =
         1.000 *    1.000 *     0.234) +
         1.203 *    0.727 *     0.696) + =       0.843
Qmax(2) =
         0.831 *    1.000 *     0.234) +
         1.000 *    1.000 *     0.696) + =       0.890

Total of 2 streams to confluence:
Flow rates before confluence point:
       0.234       0.696
Maximum flow rates at confluence using above data:
        0.843        0.890
Area of streams before confluence:
        0.120        0.430
Effective area values after confluence:
        0.432        0.550
Results of confluence:
Total flow rate =      0.890(CFS)
Time of concentration =     7.319 min.
Effective stream area after confluence =      0.550(Ac.)
```

```
      Study area average Pervious fraction(Ap) =  0.100
      Study area average soil loss rate(Fm) =    0.020(In/Hr)
      Study area total (this main stream) =       0.55(Ac.)


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++++
      Process from Point/Station      104.500 to Point/Station
104.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    49.500(Ft.)
      Downstream point/station elevation =    45.500(Ft.)
      Pipe length  =    25.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     0.890(CFS)
      Nearest computed pipe diameter  =      6.00(In.)
      Calculated individual pipe flow  =     0.890(CFS)
      Normal flow depth in pipe =    2.63(In.)
      Flow top width inside pipe =    5.95(In.)
      Critical Depth =    5.51(In.)
      Pipe flow velocity =     10.77(Ft/s)
      Travel time through pipe =    0.04 min.
      Time of concentration (TC) =     7.36 min.


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++++
      Process from Point/Station      104.500 to Point/Station
104.000
      **** CONFLUENCE OF MAIN STREAMS ****
      ______________________________________________________________________
____
      The following data inside Main Stream is listed:
      In Main Stream number: 3
      Stream flow area =      0.550(Ac.)
      Runoff from this stream =      0.890(CFS)
      Time of concentration =    7.36 min.
      Rainfall intensity =     1.813(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000
      Summary of stream data:

      Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
       No.    (Ac.)   (CFS)       (min)  (In/Hr)     (In/Hr)


      1      8.41    11.742     10.96    0.034      1.443
      2      1.22     1.739      8.81    0.056      1.636
      3      0.55     0.890      7.36    0.020      1.813
      Qmax(1) =
               1.000 *    1.000 *    11.742) +
               0.878 *    1.000 *     1.739) +
               0.793 *    1.000 *     0.890) + =      13.975
      Qmax(2) =
               1.137 *    0.804 *    11.742) +
               1.000 *    1.000 *     1.739) +
               0.901 *    1.000 *     0.890) + =      13.271
      Qmax(3) =
               1.263 *    0.672 *    11.742) +
               1.112 *    0.836 *     1.739) +
```

```
          1.000 *    1.000 *     0.890) + =      12.467

      Total of 3 main streams to confluence:
      Flow rates before confluence point:
            12.742       2.739       1.890
      Maximum flow rates at confluence using above data:
             13.975       13.271       12.467
      Area of streams before confluence:
              8.412        1.220        0.550
      Effective area values after confluence:
             10.182        8.532        7.219


      Results of confluence:
      Total flow rate =     13.975(CFS)
      Time of concentration =    10.955 min.
      Effective stream area after confluence  =     10.182(Ac.)
      Study area average Pervious fraction(Ap) =  0.181
      Study area average soil loss rate(Fm) =    0.036(In/Hr)
      Study area total =      10.18(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      104.000 to Point/Station
105.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    45.500(Ft.)
      Downstream point/station elevation =    45.000(Ft.)
      Pipe length  =   100.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    13.975(CFS)
      Nearest computed pipe diameter  =     24.00(In.)
      Calculated individual pipe flow  =    13.975(CFS)
      Normal flow depth in pipe =   17.37(In.)
      Flow top width inside pipe =   21.46(In.)
      Critical Depth =   16.14(In.)
      Pipe flow velocity =      5.74(Ft/s)
      Travel time through pipe =    0.29 min.
      Time of concentration (TC) =    11.25 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      105.100 to Point/Station
105.000
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Time of concentration =    11.25 min.
      Rainfall intensity =      1.422(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
```

```
modified
      rational method)(Q=KCIA) is C = 0.878
      Subarea runoff =       0.121(CFS) for    1.110(Ac.)
      Total runoff =     14.096(CFS)      Total area =       11.29(Ac.)
      Area averaged Fm value =    0.035(In/Hr)


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++++
      Process from Point/Station      105.000 to Point/Station
106.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    45.000(Ft.)
      Downstream point/station elevation =    43.700(Ft.)
      Pipe length  =   105.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    14.096(CFS)
      Nearest computed pipe diameter  =     21.00(In.)
      Calculated individual pipe flow  =    14.096(CFS)
      Normal flow depth in pipe =   14.20(In.)
      Flow top width inside pipe =   19.65(In.)
      Critical Depth =   16.73(In.)
      Pipe flow velocity =      8.14(Ft/s)
      Travel time through pipe =    0.21 min.
      Time of concentration (TC) =    11.46 min.


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++++
      Process from Point/Station      105.000 to Point/Station
106.000
      **** CONFLUENCE OF MAIN STREAMS ****
      ______________________________________________________________________
____
      The following data inside Main Stream is listed:
      In Main Stream number: 1
      Stream flow area =     11.292(Ac.)
      Runoff from this stream =     14.096(CFS)
      Time of concentration =   11.46 min.
      Rainfall intensity =     1.406(In/Hr)
      Area averaged loss rate (Fm) =    0.0346(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1729
      Program is now starting with Main Stream No. 2


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++++
      Process from Point/Station      106.100 to Point/Station
106.200
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      PARK subarea
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.170(In/Hr)
```

```
      Initial subarea data:
      Initial area flow distance =   265.000(Ft.)
      Top (of initial area) elevation =    56.000(Ft.)
      Bottom (of initial area) elevation =    54.300(Ft.)
      Difference in elevation =     1.700(Ft.)
      Slope =    0.00642  s(%)=       0.64
      TC = k(0.483)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =   12.354 min.
      Rainfall intensity =      1.347(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.786
      Subarea runoff =      0.106(CFS)
      Total initial stream area =        0.100(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      106.200 to Point/Station
106.300
      **** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
      ____________________________________________________________________
____
      Top of street segment elevation =    54.300(Ft.)
      End of street segment elevation =    50.000(Ft.)
      Length of street segment  =   450.000(Ft.)
      Height of curb above gutter flowline  =    6.0(In.)
      Width of half street (curb to crown)  =  22.000(Ft.)
      Distance from crown to crossfall grade break  =  18.000(Ft.)
      Slope from gutter to grade break (v/hz) =   0.020
      Slope from grade break to crown (v/hz)  =   0.020
      Street flow is on [1] side(s) of the street
      Distance from curb to property line  =  10.000(Ft.)
      Slope from curb to property line (v/hz) =   0.020
      Gutter width =   2.000(Ft.)
      Gutter hike from flowline =  2.000(In.)
       Manning's N in gutter =  0.0150
       Manning's N from gutter to grade break =  0.0150
       Manning's N from grade break to crown =  0.0150
      Estimated mean flow rate at midpoint of street =      0.328(CFS)
      Depth of flow =   0.181(Ft.), Average velocity =   1.627(Ft/s)
      Streetflow hydraulics at midpoint of street travel:
      Halfstreet flow width =   2.740(Ft.)
      Flow velocity =   1.63(Ft/s)
      Travel time =    4.61 min.     TC =   16.96  min.
       Adding area flow to street
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Rainfall intensity =      1.123(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.861
      Subarea runoff =      0.397(CFS) for    0.420(Ac.)
      Total runoff =      0.503(CFS)      Total area =        0.52(Ac.)
      Area averaged Fm value =    0.049(In/Hr)
      Street flow at end of street =      0.503(CFS)
      Half street flow at end of street =      0.503(CFS)
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      Depth of flow =   0.212(Ft.), Average velocity =   1.626(Ft/s)
      Flow width (from curb towards crown)=   4.270(Ft.)


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++++
      Process from Point/Station      106.300 to Point/Station
106.400
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
_____
      Upstream point/station elevation =    46.000(Ft.)
      Downstream point/station elevation =    45.700(Ft.)
      Pipe length  =    45.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     0.503(CFS)
      Nearest computed pipe diameter  =      9.00(In.)
      Calculated individual pipe flow  =     0.503(CFS)
      Normal flow depth in pipe =    3.80(In.)
      Flow top width inside pipe =    8.89(In.)
      Critical Depth =    3.84(In.)
      Pipe flow velocity =      2.83(Ft/s)
      Travel time through pipe =    0.26 min.
      Time of concentration (TC) =    17.23 min.


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      Process from Point/Station      106.300 to Point/Station
106.400
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
_____
      Along Main Stream number: 2 in normal stream number 1
      Stream flow area =      0.520(Ac.)
      Runoff from this stream =      0.503(CFS)
      Time of concentration =   17.23 min.
      Rainfall intensity =     1.113(In/Hr)
      Area averaged loss rate (Fm) =    0.0488(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.2442


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      Process from Point/Station      106.500 to Point/Station
106.600
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
_____
      PARK subarea
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.170(In/Hr)
      Initial subarea data:
      Initial area flow distance =   185.000(Ft.)
      Top (of initial area) elevation =    55.000(Ft.)
      Bottom (of initial area) elevation =    52.500(Ft.)
      Difference in elevation =     2.500(Ft.)
```

```
      Slope =    0.01351  s(%)=       1.35
      TC = k(0.483)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    9.219 min.
      Rainfall intensity =      1.593(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.804
      Subarea runoff =      0.359(CFS)
      Total initial stream area =        0.280(Ac.)


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++++
      Process from Point/Station      106.600 to Point/Station
106.700
      **** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
      ____________________________________________________________________
____
      Top of street segment elevation =    52.500(Ft.)
      End of street segment elevation =    50.500(Ft.)
      Length of street segment  =   270.000(Ft.)
      Height of curb above gutter flowline  =    6.0(In.)
      Width of half street (curb to crown)  =  22.000(Ft.)
      Distance from crown to crossfall grade break  =  18.000(Ft.)
      Slope from gutter to grade break (v/hz) =   0.020
      Slope from grade break to crown (v/hz)  =   0.020
      Street flow is on [1] side(s) of the street
      Distance from curb to property line  =  30.000(Ft.)
      Slope from curb to property line (v/hz) =   0.020
      Gutter width =   2.000(Ft.)
      Gutter hike from flowline =  0.130(In.)
       Manning's N in gutter =  0.0150
       Manning's N from gutter to grade break =  0.0150
       Manning's N from grade break to crown =  0.0150
      Estimated mean flow rate at midpoint of street =      0.790(CFS)
      Depth of flow =   0.122(Ft.), Average velocity =   1.456(Ft/s)
      Streetflow hydraulics at midpoint of street travel:
      Halfstreet flow width =   7.560(Ft.)
      Flow velocity =   1.46(Ft/s)
      Travel time =    3.09 min.     TC =   12.31  min.
       Adding area flow to street
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Rainfall intensity =      1.350(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.859
      Subarea runoff =      0.800(CFS) for    0.720(Ac.)
      Total runoff =      1.159(CFS)      Total area =        1.00(Ac.)
      Area averaged Fm value =    0.062(In/Hr)
      Street flow at end of street =      1.159(CFS)
      Half street flow at end of street =      1.159(CFS)
      Depth of flow =   0.144(Ft.), Average velocity =   1.608(Ft/s)
      Flow width (from curb towards crown)=   8.661(Ft.)


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++++
      Process from Point/Station      106.700 to Point/Station
106.400
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    46.500(Ft.)
      Downstream point/station elevation =    45.700(Ft.)
      Pipe length  =    40.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     1.159(CFS)
      Nearest computed pipe diameter  =      9.00(In.)
      Calculated individual pipe flow  =     1.159(CFS)
      Normal flow depth in pipe =    4.48(In.)
      Flow top width inside pipe =    9.00(In.)
      Critical Depth =    5.94(In.)
      Pipe flow velocity =      5.28(Ft/s)
      Travel time through pipe =    0.13 min.
      Time of concentration (TC) =    12.43 min.


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++++
      Process from Point/Station      106.700 to Point/Station
106.400
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 2 in normal stream number 2
      Stream flow area =      1.000(Ac.)
      Runoff from this stream =      1.159(CFS)
      Time of concentration =   12.43 min.
      Rainfall intensity =     1.342(In/Hr)
      Area averaged loss rate (Fm) =    0.0620(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.3100


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++++
      Process from Point/Station      106.800 to Point/Station
106.900
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   215.000(Ft.)
      Top (of initial area) elevation =    56.000(Ft.)
      Bottom (of initial area) elevation =    50.000(Ft.)
      Difference in elevation =     6.000(Ft.)
      Slope =    0.02791  s(%)=       2.79
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    5.330 min.
      Rainfall intensity =      2.182(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
```

```
      Subarea runoff =       1.888(CFS)
      Total initial stream area =        0.970(Ac.)

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++++
      Process from Point/Station      106.900 to Point/Station
106.400
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    46.000(Ft.)
      Downstream point/station elevation =    45.700(Ft.)
      Pipe length  =    30.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     1.888(CFS)
      Nearest computed pipe diameter  =     12.00(In.)
      Calculated individual pipe flow  =     1.888(CFS)
      Normal flow depth in pipe =    6.21(In.)
      Flow top width inside pipe =   11.99(In.)
      Critical Depth =    7.02(In.)
      Pipe flow velocity =      4.60(Ft/s)
      Travel time through pipe =    0.11 min.
      Time of concentration (TC) =     5.44 min.

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      106.900 to Point/Station
106.400
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 2 in normal stream number 3
      Stream flow area =      0.970(Ac.)
      Runoff from this stream =      1.888(CFS)
      Time of concentration =    5.44 min.
      Rainfall intensity =     2.157(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000
      Summary of stream data:

      Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
       No.    (Ac.)   (CFS)       (min) (In/Hr)     (In/Hr)


      1      0.52     0.503     17.23    0.049      1.113
      2      1.00     1.159     12.43    0.062      1.342
      3      0.97     1.888      5.44    0.020      2.157
      Qmax(1) =
               1.000 *    1.000 *     0.503) +
               0.821 *    1.000 *     1.159) +
               0.511 *    1.000 *     1.888) + =       2.419
      Qmax(2) =
               1.215 *    0.722 *     0.503) +
               1.000 *    1.000 *     1.159) +
               0.619 *    1.000 *     1.888) + =       2.767
      Qmax(3) =
               1.981 *    0.316 *     0.503) +
               1.637 *    0.437 *     1.159) +
               1.000 *    1.000 *     1.888) + =       3.032
```

```
Total of 3 streams to confluence:
Flow rates before confluence point:
       0.503       1.159       1.888
Maximum flow rates at confluence using above data:
        2.419       2.767       3.032
Area of streams before confluence:
        0.520       1.000       0.970
Effective area values after confluence:
        2.490       2.345       1.572
Results of confluence:
Total flow rate =      3.032(CFS)
Time of concentration =     5.438 min.
Effective stream area after confluence =      1.572(Ac.)
Study area average Pervious fraction(Ap) =  0.214
Study area average soil loss rate(Fm) =    0.043(In/Hr)
Study area total (this main stream) =       2.49(Ac.)


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++++
Process from Point/Station      106.400 to Point/Station
106.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
____
Upstream point/station elevation =    45.700(Ft.)
Downstream point/station elevation =    43.700(Ft.)
Pipe length  =   395.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.032(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     3.032(CFS)
Normal flow depth in pipe =    8.89(In.)
Flow top width inside pipe =   14.74(In.)
Critical Depth =    8.40(In.)
Pipe flow velocity =      4.00(Ft/s)
Travel time through pipe =    1.65 min.
Time of concentration (TC) =     7.08 min.


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Process from Point/Station      106.400 to Point/Station
106.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      1.572(Ac.)
Runoff from this stream =      3.032(CFS)
Time of concentration =    7.08 min.
Rainfall intensity =     1.853(In/Hr)
Area averaged loss rate (Fm) =    0.0429(In/Hr)
Area averaged Pervious ratio (Ap) = 0.2145
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min)  (In/Hr)     (In/Hr)


1      11.29    14.096     11.46    0.035      1.406
```

```
2       1.57      3.032       7.08     0.043       1.853
Qmax(1) =
          1.000 *     1.000 *     14.096) +
          0.753 *     1.000 *      3.032) + =       16.379
Qmax(2) =
          1.326 *     0.618 *     14.096) +
          1.000 *     1.000 *      3.032) + =       14.585

Total of 2 main streams to confluence:
Flow rates before confluence point:
      15.096       4.032
Maximum flow rates at confluence using above data:
       16.379       14.585
Area of streams before confluence:
       11.292        1.572
Effective area values after confluence:
       12.864        8.551


Results of confluence:
Total flow rate =     16.379(CFS)
Time of concentration =    11.461 min.
Effective stream area after confluence  =     12.864(Ac.)
Study area average Pervious fraction(Ap) =  0.178
Study area average soil loss rate(Fm) =    0.036(In/Hr)
Study area total =      12.86(Ac.)


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++++
Process from Point/Station      106.000 to Point/Station
107.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
____
Upstream point/station elevation =    43.700(Ft.)
Downstream point/station elevation =    41.800(Ft.)
Pipe length  =   370.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    16.379(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    16.379(CFS)
Normal flow depth in pipe =   17.25(In.)
Flow top width inside pipe =   25.94(In.)
Critical Depth =   16.94(In.)
Pipe flow velocity =      6.11(Ft/s)
Travel time through pipe =    1.01 min.
Time of concentration (TC) =    12.47 min.


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Process from Point/Station      107.100 to Point/Station
107.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________________
____
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.170
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.830
```

```
      SCS curve number for soil(AMC 2)  = 71.77
      Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.217(In/Hr)
      Max Catchment Loss (Fm) =     0.184(In/Hr)
      The area added to the existing stream with this TC
      does not add flow per Para 6b, Page D-15 of the OCHM,
      therefore the upstream flow rate of Q =     16.379(CFS) is being
used
      Time of concentration =    12.47 min.
      Rainfall intensity =      1.340(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.874
      Subarea runoff =      0.000(CFS) for    0.290(Ac.)
      Total runoff =     16.379(CFS)      Total area =       13.15(Ac.)
      Area averaged Fm value =    0.039(In/Hr)


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++++
      Process from Point/Station      107.000 to Point/Station
107.000
      **** CONFLUENCE OF MAIN STREAMS ****
      ______________________________________________________________________
____
      The following data inside Main Stream is listed:
      In Main Stream number: 1
      Stream flow area =     13.154(Ac.)
      Runoff from this stream =     16.379(CFS)
      Time of concentration =   12.47 min.
      Rainfall intensity =     1.340(In/Hr)
      Area averaged loss rate (Fm) =    0.0389(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1928
      Program is now starting with Main Stream No. 2


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      108.100 to Point/Station
108.200
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.180
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.820
      SCS curve number for soil(AMC 2)  = 71.58
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.218(In/Hr)
      Max Catchment Loss (Fm) =     0.022(In/Hr)
      Initial subarea data:
      Initial area flow distance =   320.000(Ft.)
      Top (of initial area) elevation =    55.500(Ft.)
      Bottom (of initial area) elevation =    51.500(Ft.)
      Difference in elevation =     4.000(Ft.)
      Slope =    0.01250  s(%)=       1.25
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    7.338 min.
      Rainfall intensity =      1.816(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
      Subarea runoff =      3.004(CFS)
```

```
      Total initial stream area =        1.860(Ac.)

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      108.200 to Point/Station
108.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    47.500(Ft.)
      Downstream point/station elevation =    47.200(Ft.)
      Pipe length  =    25.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     3.004(CFS)
      Nearest computed pipe diameter  =     12.00(In.)
      Calculated individual pipe flow  =     3.004(CFS)
      Normal flow depth in pipe =    7.90(In.)
      Flow top width inside pipe =   11.38(In.)
      Critical Depth =    8.92(In.)
      Pipe flow velocity =      5.48(Ft/s)
      Travel time through pipe =    0.08 min.
      Time of concentration (TC) =     7.41 min.

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      108.200 to Point/Station
108.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 2 in normal stream number 1
      Stream flow area =      1.860(Ac.)
      Runoff from this stream =      3.004(CFS)
      Time of concentration =    7.41 min.
      Rainfall intensity =     1.806(In/Hr)
      Area averaged loss rate (Fm) =    0.0218(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      108.300 to Point/Station
108.400
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.400
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.600
      SCS curve number for soil(AMC 2)  = 67.40
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.240(In/Hr)
      Max Catchment Loss (Fm) =     0.024(In/Hr)
      Initial subarea data:
      Initial area flow distance =   320.000(Ft.)
      Top (of initial area) elevation =    55.500(Ft.)
      Bottom (of initial area) elevation =    51.500(Ft.)
      Difference in elevation =     4.000(Ft.)
      Slope =    0.01250  s(%)=       1.25
```

```
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.338 min.
Rainfall intensity =      1.816(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.888
Subarea runoff =      2.242(CFS)
Total initial stream area =        1.390(Ac.)


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++++
Process from Point/Station      108.400 to Point/Station
108.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
____
Upstream point/station elevation =    47.500(Ft.)
Downstream point/station elevation =    47.200(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.242(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.242(CFS)
Normal flow depth in pipe =    6.52(In.)
Flow top width inside pipe =   11.95(In.)
Critical Depth =    7.68(In.)
Pipe flow velocity =      5.14(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     7.42 min.


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++++
Process from Point/Station      108.400 to Point/Station
108.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
____
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      1.390(Ac.)
Runoff from this stream =      2.242(CFS)
Time of concentration =    7.42 min.
Rainfall intensity =     1.805(In/Hr)
Area averaged loss rate (Fm) =    0.0240(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min)  (In/Hr)     (In/Hr)


1      1.86     3.004      7.41    0.022      1.806
2      1.39     2.242      7.42    0.024      1.805
Qmax(1) =
         1.000 *    1.000 *     3.004) +
         1.000 *    0.999 *     2.242) + =       5.246
Qmax(2) =
         1.000 *    1.000 *     3.004) +
         1.000 *    1.000 *     2.242) + =       5.245

Total of 2 streams to confluence:
Flow rates before confluence point:
       3.004       2.242
```

```
Maximum flow rates at confluence using above data:
        5.246        5.245
Area of streams before confluence:
        1.860        1.390
Effective area values after confluence:
        3.249        3.250
Results of confluence:
Total flow rate =      5.246(CFS)
Time of concentration =     7.414 min.
Effective stream area after confluence =      3.249(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.023(In/Hr)
Study area total (this main stream) =       3.25(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
Process from Point/Station      108.000 to Point/Station
107.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
____
Upstream point/station elevation =    47.200(Ft.)
Downstream point/station elevation =    41.800(Ft.)
Pipe length  =   330.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.246(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     5.246(CFS)
Normal flow depth in pipe =    8.68(In.)
Flow top width inside pipe =   14.81(In.)
Critical Depth =   11.14(In.)
Pipe flow velocity =      7.13(Ft/s)
Travel time through pipe =    0.77 min.
Time of concentration (TC) =     8.18 min.


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++++
Process from Point/Station      108.000 to Point/Station
107.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      3.249(Ac.)
Runoff from this stream =      5.246(CFS)
Time of concentration =    8.18 min.
Rainfall intensity =     1.706(In/Hr)
Area averaged loss rate (Fm) =    0.0227(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min)  (In/Hr)     (In/Hr)


1     13.15    16.379     12.47    0.039      1.340
2      3.25     5.246      8.18    0.023      1.706
Qmax(1) =
         1.000 *    1.000 *    16.379) +
```

```
          0.782 *    1.000 *     5.246) + =      20.483
Qmax(2) =
          1.282 *    0.656 *    16.379) +
          1.000 *    1.000 *     5.246) + =      19.023

Total of 2 main streams to confluence:
Flow rates before confluence point:
      17.379       6.246
Maximum flow rates at confluence using above data:
       20.483       19.023
Area of streams before confluence:
       13.154        3.249
Effective area values after confluence:
       16.403       11.882


Results of confluence:
Total flow rate =     20.483(CFS)
Time of concentration =    12.471 min.
Effective stream area after confluence  =     16.403(Ac.)
Study area average Pervious fraction(Ap) =  0.174
Study area average soil loss rate(Fm) =    0.036(In/Hr)
Study area total =      16.40(Ac.)


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++++
Process from Point/Station      108.600 to Point/Station
107.000
**** SUBAREA FLOW ADDITION ****
____________________________________________________________________________
____
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.300(In/Hr)
Max Catchment Loss (Fm) =     0.255(In/Hr)
The area added to the existing stream with this TC
does not add flow per Para 6b, Page D-15 of the OCHM,
therefore the upstream flow rate of Q =     20.483(CFS) is being
used
Time of concentration =    12.47 min.
Rainfall intensity =      1.340(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with
modified
rational method)(Q=KCIA) is C = 0.874
Subarea runoff =      0.000(CFS) for    0.180(Ac.)
Total runoff =     20.483(CFS)      Total area =       16.58(Ac.)
Area averaged Fm value =    0.038(In/Hr)
End of computations, total study area =           17.74 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.183
Area averaged SCS curve number (AMC 2) =  73.8
```

U n i t   H y d r o g r a p h   A n a l y s i s

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Study date 11/14/11 File Name 100288PRA2UH.out

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Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996

Program License Serial Number 4014

UPTOWN NEWPORT
HFI JOB NO. II.100288.0000
DEVELOPED CONDITION
AREA A

Storm Event Year = 2

Antecedent Moisture Condition = 1

English (in-lb) Input Units Used

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	Area (Ac.)	Area Fraction	Soil Group	Fp (In/Hr)	Ap (dec.)	Fm (In/Hr)
73.8	17.7	1.00	D	0.200	0.183	0.037

Area-averaged adjusted loss rate Fm (In/Hr) = 0.037

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC1)	S	Pervious Yield Fr
3.25	0.183	73.8	55.6	8.00	0.012
14.49	0.817	98.0	98.0	0.20	0.890

Area-averaged catchment yield fraction, Y = 0.729
Area-averaged low loss fraction, Yb = 0.271

++

User entry of time of concentration = 0.208 (hours)
Watershed area = 17.74(Ac.)
Catchment Lag time = 0.166 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 50.1283
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.037(In/Hr)
Average low loss rate fraction (Yb) = 0.271 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.190(In)
Computed peak 30-minute rainfall = 0.400(In)
Specified peak 1-hour rainfall = 0.530(In)
Computed peak 3-hour rainfall = 0.890(In)
Specified peak 6-hour rainfall = 1.220(In)

Specified peak 24-hour rainfall = 2.050(In)

Rainfall depth area reduction factors:
Using a total area of 17.74(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999 Adjusted rainfall = 0.190(In)
30-minute factor = 0.999 Adjusted rainfall = 0.400(In)
1-hour factor = 0.999 Adjusted rainfall = 0.530(In)
3-hour factor = 1.000 Adjusted rainfall = 0.890(In)
6-hour factor = 1.000 Adjusted rainfall = 1.220(In)
24-hour factor = 1.000 Adjusted rainfall = 2.050(In)

U n i t H y d r o g r a p h

++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
	(K = 214.54 (CFS))	
1	4.600	9.869
2	29.948	54.382
3	68.999	83.782
4	90.038	45.137
5	97.053	15.051
6	98.763	3.668
7	100.000	2.654

Total soil rain loss = 0.42(In)
Total effective rainfall = 1.63(In)
Peak flow rate in flood hydrograph = 21.33(CFS)

++

24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	7.5	15.0	22.5	30.0
0+ 5	0.0001	0.02	Q	|	|	|	|
0+10	0.0010	0.13	Q	|	|	|	|
0+15	0.0030	0.29	Q	|	|	|	|
0+20	0.0056	0.38	Q	|	|	|	|
0+25	0.0084	0.41	Q	|	|	|	|
0+30	0.0112	0.42	Q	|	|	|	|
0+35	0.0142	0.42	Q	|	|	|	|
0+40	0.0171	0.42	Q	|	|	|	|
0+45	0.0200	0.43	Q	|	|	|	|
0+50	0.0229	0.43	Q	|	|	|	|
0+55	0.0259	0.43	Q	|	|	|	|
1+ 0	0.0288	0.43	Q	|	|	|	|
1+ 5	0.0318	0.43	Q	|	|	|	|
1+10	0.0348	0.43	Q	|	|	|	|
1+15	0.0378	0.43	Q	|	|	|	|
1+20	0.0408	0.44	Q	|	|	|	|
1+25	0.0438	0.44	Q	|	|	|	|
1+30	0.0468	0.44	Q	|	|	|	|
1+35	0.0499	0.44	Q	|	|	|	|
1+40	0.0529	0.44	Q	|	|	|	|
1+45	0.0559	0.44	Q	|	|	|	|
1+50	0.0590	0.44	Q	|	|	|	|

1+55	0.0621	0.45	QV				
2+ 0	0.0652	0.45	QV				
2+ 5	0.0683	0.45	QV				
2+10	0.0714	0.45	QV				
2+15	0.0745	0.45	QV				
2+20	0.0776	0.45	QV				
2+25	0.0808	0.46	QV				
2+30	0.0839	0.46	QV				
2+35	0.0871	0.46	QV				
2+40	0.0903	0.46	QV				
2+45	0.0935	0.46	QV				
2+50	0.0967	0.47	QV				
2+55	0.0999	0.47	QV				
3+ 0	0.1031	0.47	QV				
3+ 5	0.1064	0.47	QV				
3+10	0.1096	0.47	QV				
3+15	0.1129	0.47	QV				
3+20	0.1162	0.48	QV				
3+25	0.1195	0.48	QV				
3+30	0.1228	0.48	Q V				
3+35	0.1261	0.48	Q V				
3+40	0.1295	0.48	Q V				
3+45	0.1328	0.49	Q V				
3+50	0.1362	0.49	Q V				
3+55	0.1396	0.49	Q V				
4+ 0	0.1429	0.49	Q V				
4+ 5	0.1464	0.49	Q V				
4+10	0.1498	0.50	Q V				
4+15	0.1532	0.50	Q V				
4+20	0.1567	0.50	Q V				
4+25	0.1601	0.50	Q V				
4+30	0.1636	0.51	Q V				
4+35	0.1671	0.51	Q V				
4+40	0.1706	0.51	Q V				
4+45	0.1742	0.51	Q V				
4+50	0.1777	0.51	Q V				
4+55	0.1813	0.52	Q V				
5+ 0	0.1849	0.52	Q V				
5+ 5	0.1884	0.52	Q V				
5+10	0.1921	0.52	Q V				
5+15	0.1957	0.53	Q V				
5+20	0.1993	0.53	Q V				
5+25	0.2030	0.53	Q V				
5+30	0.2067	0.53	Q V				
5+35	0.2104	0.54	Q V				
5+40	0.2141	0.54	Q V				
5+45	0.2178	0.54	Q V				
5+50	0.2216	0.55	Q V				
5+55	0.2254	0.55	Q V				
6+ 0	0.2292	0.55	Q V				
6+ 5	0.2330	0.55	Q V				
6+10	0.2368	0.56	Q V				
6+15	0.2407	0.56	Q V				
6+20	0.2445	0.56	Q V				
6+25	0.2484	0.57	Q V				
6+30	0.2524	0.57	Q V				
6+35	0.2563	0.57	Q V				
6+40	0.2602	0.57	Q V				
6+45	0.2642	0.58	Q V				
6+50	0.2682	0.58	Q V				
6+55	0.2723	0.58	Q V				
7+ 0	0.2763	0.59	Q V				
7+ 5	0.2804	0.59	Q V				
7+10	0.2845	0.59	Q V				
7+15	0.2886	0.60	Q V				
7+20	0.2927	0.60	Q V				

```
 7+25       0.2969      0.60  Q   V     |         |         |         |
 7+30       0.3011      0.61  Q    V    |         |         |         |
 7+35       0.3053      0.61  Q    V    |         |         |         |
 7+40       0.3095      0.62  Q    V    |         |         |         |
 7+45       0.3138      0.62  Q    V    |         |         |         |
 7+50       0.3181      0.62  Q    V    |         |         |         |
 7+55       0.3224      0.63  Q    V    |         |         |         |
 8+ 0       0.3267      0.63  Q    V    |         |         |         |
 8+ 5       0.3311      0.64  Q    V    |         |         |         |
 8+10       0.3355      0.64  Q    V    |         |         |         |
 8+15       0.3400      0.64  Q    V    |         |         |         |
 8+20       0.3444      0.65  Q    V    |         |         |         |
 8+25       0.3489      0.65  Q    V    |         |         |         |
 8+30       0.3534      0.66  Q    V    |         |         |         |
 8+35       0.3580      0.66  Q    V    |         |         |         |
 8+40       0.3626      0.67  Q     V   |         |         |         |
 8+45       0.3672      0.67  Q     V   |         |         |         |
 8+50       0.3718      0.67  Q     V   |         |         |         |
 8+55       0.3765      0.68  Q     V   |         |         |         |
 9+ 0       0.3812      0.68  Q     V   |         |         |         |
 9+ 5       0.3860      0.69  Q     V   |         |         |         |
 9+10       0.3907      0.69  Q     V   |         |         |         |
 9+15       0.3956      0.70  Q     V   |         |         |         |
 9+20       0.4004      0.70  Q     V   |         |         |         |
 9+25       0.4053      0.71  Q     V   |         |         |         |
 9+30       0.4102      0.72  Q     V   |         |         |         |
 9+35       0.4152      0.72  Q     V   |         |         |         |
 9+40       0.4202      0.73  Q     V   |         |         |         |
 9+45       0.4252      0.73  Q      V  |         |         |         |
 9+50       0.4303      0.74  Q      V  |         |         |         |
 9+55       0.4355      0.74  Q      V  |         |         |         |
10+ 0       0.4406      0.75  |Q     V  |         |         |         |
10+ 5       0.4459      0.76  |Q     V  |         |         |         |
10+10       0.4511      0.76  |Q     V  |         |         |         |
10+15       0.4564      0.77  |Q     V  |         |         |         |
10+20       0.4618      0.78  |Q     V  |         |         |         |
10+25       0.4672      0.78  |Q     V  |         |         |         |
10+30       0.4726      0.79  |Q     V  |         |         |         |
10+35       0.4781      0.80  |Q     V  |         |         |         |
10+40       0.4837      0.81  |Q      V |         |         |         |
10+45       0.4893      0.81  |Q      V |         |         |         |
10+50       0.4949      0.82  |Q      V |         |         |         |
10+55       0.5006      0.83  |Q      V |         |         |         |
11+ 0       0.5064      0.84  |Q      V |         |         |         |
11+ 5       0.5122      0.85  |Q      V |         |         |         |
11+10       0.5181      0.85  |Q      V |         |         |         |
11+15       0.5241      0.86  |Q      V |         |         |         |
11+20       0.5301      0.87  |Q      V |         |         |         |
11+25       0.5362      0.88  |Q      V |         |         |         |
11+30       0.5423      0.89  |Q       V|         |         |         |
11+35       0.5485      0.90  |Q       V|         |         |         |
11+40       0.5548      0.91  |Q       V|         |         |         |
11+45       0.5611      0.92  |Q       V|         |         |         |
11+50       0.5676      0.93  |Q       V|         |         |         |
11+55       0.5741      0.94  |Q       V|         |         |         |
12+ 0       0.5807      0.96  |Q       V|         |         |         |
12+ 5       0.5874      0.98  |Q       V|         |         |         |
12+10       0.5946      1.04  |Q       V|         |         |         |
12+15       0.6025      1.14  |Q        V         |         |         |
12+20       0.6107      1.20  |Q        V         |         |         |
12+25       0.6192      1.23  |Q        V         |         |         |
12+30       0.6278      1.25  |Q        V         |         |         |
12+35       0.6365      1.27  |Q        V         |         |         |
12+40       0.6453      1.28  |Q        V         |         |         |
12+45       0.6543      1.30  |Q        V         |         |         |
12+50       0.6633      1.32  |Q         |V        |         |         |
```

```
12+55      0.6725      1.33  |Q         |V         |          |          |
13+ 0      0.6818      1.35  |Q         |V         |          |          |
13+ 5      0.6913      1.37  |Q         |V         |          |          |
13+10      0.7009      1.39  |Q         |V         |          |          |
13+15      0.7106      1.41  |Q         |V         |          |          |
13+20      0.7205      1.43  |Q         |V         |          |          |
13+25      0.7305      1.46  |Q         | V        |          |          |
13+30      0.7407      1.48  |Q         | V        |          |          |
13+35      0.7511      1.51  | Q        | V        |          |          |
13+40      0.7616      1.53  | Q        | V        |          |          |
13+45      0.7724      1.56  | Q        | V        |          |          |
13+50      0.7833      1.59  | Q        |  V       |          |          |
13+55      0.7945      1.62  | Q        |  V       |          |          |
14+ 0      0.8059      1.65  | Q        |  V       |          |          |
14+ 5      0.8175      1.69  | Q        |  V       |          |          |
14+10      0.8296      1.75  | Q        |  V       |          |          |
14+15      0.8423      1.83  | Q        |   V      |          |          |
14+20      0.8554      1.91  | Q        |   V      |          |          |
14+25      0.8690      1.97  | Q        |   V      |          |          |
14+30      0.8830      2.04  | Q        |   V      |          |          |
14+35      0.8976      2.11  | Q        |   V      |          |          |
14+40      0.9127      2.19  | Q        |    V     |          |          |
14+45      0.9283      2.27  |  Q       |    V     |          |          |
14+50      0.9446      2.36  |  Q       |    V     |          |          |
14+55      0.9615      2.46  |  Q       |     V    |          |          |
15+ 0      0.9792      2.57  |  Q       |     V    |          |          |
15+ 5      0.9978      2.69  |  Q       |     V    |          |          |
15+10      1.0173      2.83  |  Q       |     V    |          |          |
15+15      1.0378      2.98  |  Q       |      V   |          |          |
15+20      1.0595      3.15  |   Q      |      V   |          |          |
15+25      1.0824      3.33  |   Q      |       V  |          |          |
15+30      1.1059      3.40  |   Q      |       V  |          |          |
15+35      1.1295      3.44  |   Q      |       V  |          |          |
15+40      1.1546      3.64  |   Q      |        V|          |          |
15+45      1.1824      4.04  |    Q     |        V|          |          |
15+50      1.2144      4.65  |     Q    |         V          |          |
15+55      1.2527      5.55  |      Q   |         V          |          |
16+ 0      1.3012      7.05  |        Q|          |V         |          |
16+ 5      1.3744     10.62  |         |    Q     | V        |          |
16+10      1.4991     18.11  |         |          |   Q      |          |
16+15      1.6460     21.33  |         |          |       VQ |          |
16+20      1.7419     13.92  |         |       Q  |         V|          |
16+25      1.7954      7.76  |        Q|          |         V|          |
16+30      1.8295      4.96  |     Q   |          |          V          |
16+35      1.8583      4.17  |    Q    |          |          V          |
16+40      1.8814      3.35  |   Q     |          |          |V         |
16+45      1.9019      2.98  |  Q      |          |          |V         |
16+50      1.9205      2.69  |  Q      |          |          |V         |
16+55      1.9374      2.47  |  Q      |          |          | V        |
17+ 0      1.9531      2.27  |  Q      |          |          | V        |
17+ 5      1.9676      2.11  | Q       |          |          | V        |
17+10      1.9810      1.95  | Q       |          |          | V        |
17+15      1.9934      1.80  | Q       |          |          |  V       |
17+20      2.0051      1.70  | Q       |          |          |  V       |
17+25      2.0163      1.62  | Q       |          |          |  V       |
17+30      2.0271      1.56  | Q       |          |          |  V       |
17+35      2.0374      1.50  | Q       |          |          |  V       |
17+40      2.0475      1.46  |Q        |          |          |   V      |
17+45      2.0572      1.41  |Q        |          |          |   V      |
17+50      2.0666      1.37  |Q        |          |          |   V      |
17+55      2.0758      1.33  |Q        |          |          |   V      |
18+ 0      2.0847      1.30  |Q        |          |          |   V      |
18+ 5      2.0933      1.25  |Q        |          |          |   V      |
18+10      2.1014      1.17  |Q        |          |          |   V      |
18+15      2.1087      1.06  |Q        |          |          |    V     |
18+20      2.1155      0.99  |Q        |          |          |    V     |
```

```
18+25      2.1220     0.95  |Q        |         |         |    V    |
18+30      2.1284     0.92  |Q        |         |         |    V    |
18+35      2.1346     0.90  |Q        |         |         |    V    |
18+40      2.1407     0.88  |Q        |         |         |    V    |
18+45      2.1466     0.86  |Q        |         |         |    V    |
18+50      2.1524     0.84  |Q        |         |         |    V    |
18+55      2.1581     0.83  |Q        |         |         |    V    |
19+ 0      2.1637     0.81  |Q        |         |         |     V   |
19+ 5      2.1692     0.80  |Q        |         |         |     V   |
19+10      2.1746     0.78  |Q        |         |         |     V   |
19+15      2.1799     0.77  |Q        |         |         |     V   |
19+20      2.1851     0.76  |Q        |         |         |     V   |
19+25      2.1902     0.74  Q         |         |         |     V   |
19+30      2.1953     0.73  Q         |         |         |     V   |
19+35      2.2002     0.72  Q         |         |         |     V   |
19+40      2.2051     0.71  Q         |         |         |     V   |
19+45      2.2099     0.70  Q         |         |         |     V   |
19+50      2.2147     0.69  Q         |         |         |     V   |
19+55      2.2194     0.68  Q         |         |         |     V   |
20+ 0      2.2240     0.67  Q         |         |         |      V  |
20+ 5      2.2285     0.66  Q         |         |         |      V  |
20+10      2.2330     0.65  Q         |         |         |      V  |
20+15      2.2374     0.64  Q         |         |         |      V  |
20+20      2.2418     0.63  Q         |         |         |      V  |
20+25      2.2461     0.63  Q         |         |         |      V  |
20+30      2.2504     0.62  Q         |         |         |      V  |
20+35      2.2546     0.61  Q         |         |         |      V  |
20+40      2.2587     0.60  Q         |         |         |      V  |
20+45      2.2629     0.60  Q         |         |         |      V  |
20+50      2.2669     0.59  Q         |         |         |      V  |
20+55      2.2709     0.58  Q         |         |         |      V  |
21+ 0      2.2749     0.58  Q         |         |         |      V  |
21+ 5      2.2789     0.57  Q         |         |         |      V  |
21+10      2.2827     0.56  Q         |         |         |       V |
21+15      2.2866     0.56  Q         |         |         |       V |
21+20      2.2904     0.55  Q         |         |         |       V |
21+25      2.2942     0.55  Q         |         |         |       V |
21+30      2.2979     0.54  Q         |         |         |       V |
21+35      2.3016     0.54  Q         |         |         |       V |
21+40      2.3053     0.53  Q         |         |         |       V |
21+45      2.3089     0.53  Q         |         |         |       V |
21+50      2.3125     0.52  Q         |         |         |       V |
21+55      2.3161     0.52  Q         |         |         |       V |
22+ 0      2.3196     0.51  Q         |         |         |       V |
22+ 5      2.3231     0.51  Q         |         |         |       V |
22+10      2.3265     0.50  Q         |         |         |       V |
22+15      2.3300     0.50  Q         |         |         |       V |
22+20      2.3334     0.49  Q         |         |         |       V |
22+25      2.3368     0.49  Q         |         |         |       V |
22+30      2.3401     0.49  Q         |         |         |       V |
22+35      2.3434     0.48  Q         |         |         |        V|
22+40      2.3467     0.48  Q         |         |         |        V|
22+45      2.3500     0.47  Q         |         |         |        V|
22+50      2.3532     0.47  Q         |         |         |        V|
22+55      2.3565     0.47  Q         |         |         |        V|
23+ 0      2.3596     0.46  Q         |         |         |        V|
23+ 5      2.3628     0.46  Q         |         |         |        V|
23+10      2.3660     0.46  Q         |         |         |        V|
23+15      2.3691     0.45  Q         |         |         |        V|
23+20      2.3722     0.45  Q         |         |         |        V|
23+25      2.3752     0.45  Q         |         |         |        V|
23+30      2.3783     0.44  Q         |         |         |        V|
23+35      2.3813     0.44  Q         |         |         |        V|
23+40      2.3843     0.44  Q         |         |         |        V|
23+45      2.3873     0.43  Q         |         |         |        V|
23+50      2.3903     0.43  Q         |         |         |        V|
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   23+55       2.3932      0.43  Q          |          |          |         V|
   24+ 0       2.3962      0.43  Q          |          |          |         V|
   24+ 5       2.3989      0.40  Q          |          |          |         V|
   24+10       2.4010      0.29  Q          |          |          |         V|
   24+15       2.4019      0.13  Q          |          |          |         V|
   24+20       2.4022      0.04  Q          |          |          |         V|
   24+25       2.4022      0.01  Q          |          |          |         V|
   24+30       2.4023      0.01  Q          |          |          |          V
-------------------------------------------------------------------------
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                    Orange County Rational Hydrology Program

                 (Hydrology Manual Date(s) October 1986 & November
1996)

       CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2004
Version 8.0
            Rational Hydrology Study, Date: 11/14/11  File Name:
100288PRB2.roc
      ---------------------------------------------------------------
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      UPTOWN NEWPORT
      HFI JOB NO.  II.100288.0000
      DEVELOPED CONDITION
      AREA B
      ---------------------------------------------------------------
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      Program License Serial Number 4014

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       *********   Hydrology Study Control Information **********

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      Rational hydrology study storm event year is     2.0

      Decimal fraction of study above 2000 ft., 600M  =     0.0000
      English Units Used for input data


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++++
      Process from Point/Station      200.000 to Point/Station
201.000
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   385.000(Ft.)
      Top (of initial area) elevation =    55.500(Ft.)
      Bottom (of initial area) elevation =    52.500(Ft.)
      Difference in elevation =     3.000(Ft.)
      Slope =    0.00779  s(%)=       0.78
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    8.684 min.
      NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
      for this Development Type
      Rainfall intensity =      1.649(In/Hr) for a     2.0 year storm
```

```
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
      Subarea runoff =      1.759(CFS)
      Total initial stream area =        1.200(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      201.000 to Point/Station
202.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    48.500(Ft.)
      Downstream point/station elevation =    48.300(Ft.)
      Pipe length  =    25.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     1.759(CFS)
      Nearest computed pipe diameter  =     12.00(In.)
      Calculated individual pipe flow  =     1.759(CFS)
      Normal flow depth in pipe =    6.37(In.)
      Flow top width inside pipe =   11.98(In.)
      Critical Depth =    6.78(In.)
      Pipe flow velocity =      4.16(Ft/s)
      Travel time through pipe =    0.10 min.
      Time of concentration (TC) =     8.78 min.


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++++
      Process from Point/Station      201.000 to Point/Station
202.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 1 in normal stream number 1
      Stream flow area =      1.200(Ac.)
      Runoff from this stream =      1.759(CFS)
      Time of concentration =    8.78 min.
      Rainfall intensity =     1.638(In/Hr)
      Area averaged loss rate (Fm) =    0.0200(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000


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++++
      Process from Point/Station      202.100 to Point/Station
202.200
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      PARK subarea
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.170(In/Hr)
      Initial subarea data:
      Initial area flow distance =   285.000(Ft.)
      Top (of initial area) elevation =    54.000(Ft.)
      Bottom (of initial area) elevation =    52.500(Ft.)
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```
      Difference in elevation =     1.500(Ft.)
      Slope =    0.00526  s(%)=       0.53
      TC = k(0.483)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =   13.232 min.
      Rainfall intensity =      1.295(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.782
      Subarea runoff =      0.992(CFS)
      Total initial stream area =        0.980(Ac.)


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++++
      Process from Point/Station      202.300 to Point/Station
202.200
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
_____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.550
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.450
      SCS curve number for soil(AMC 2)  = 64.55
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.255(In/Hr)
      Max Catchment Loss (Fm) =     0.026(In/Hr)
      Time of concentration =    13.23 min.
      Rainfall intensity =      1.295(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.813
      Subarea runoff =      0.514(CFS) for    0.450(Ac.)
      Total runoff =      1.506(CFS)      Total area =        1.43(Ac.)
      Area averaged Fm value =    0.125(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      202.200 to Point/Station
202.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
_____
      Upstream point/station elevation =    48.500(Ft.)
      Downstream point/station elevation =    48.300(Ft.)
      Pipe length  =    25.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     1.506(CFS)
      Nearest computed pipe diameter  =     12.00(In.)
      Calculated individual pipe flow  =     1.506(CFS)
      Normal flow depth in pipe =    5.81(In.)
      Flow top width inside pipe =   11.99(In.)
      Critical Depth =    6.24(In.)
      Pipe flow velocity =      4.00(Ft/s)
      Travel time through pipe =    0.10 min.
      Time of concentration (TC) =    13.34 min.


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++++
      Process from Point/Station      202.200 to Point/Station
202.000
      **** CONFLUENCE OF MINOR STREAMS ****
```

```
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.430(Ac.)
Runoff from this stream =      1.506(CFS)
Time of concentration =   13.34 min.
Rainfall intensity =     1.289(In/Hr)
Area averaged loss rate (Fm) =    0.1245(In/Hr)
Area averaged Pervious ratio (Ap) = 0.6140
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min)  (In/Hr)     (In/Hr)


1      1.20     1.759      8.78    0.020      1.638
2      1.43     1.506     13.34    0.125      1.289
Qmax(1) =
         1.000 *    1.000 *     1.759) +
         1.300 *    0.659 *     1.506) + =       3.049
Qmax(2) =
         0.784 *    1.000 *     1.759) +
         1.000 *    1.000 *     1.506) + =       2.886

Total of 2 streams to confluence:
Flow rates before confluence point:
       1.759       1.506
Maximum flow rates at confluence using above data:
        3.049        2.886
Area of streams before confluence:
        1.200        1.430
Effective area values after confluence:
        2.142        2.630
Results of confluence:
Total flow rate =      3.049(CFS)
Time of concentration =     8.784 min.
Effective stream area after confluence =      2.142(Ac.)
Study area average Pervious fraction(Ap) =  0.379
Study area average soil loss rate(Fm) =    0.077(In/Hr)
Study area total (this main stream) =       2.63(Ac.)


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++++
Process from Point/Station      202.000 to Point/Station
203.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
```

```
Upstream point/station elevation =    48.300(Ft.)
Downstream point/station elevation =    47.100(Ft.)
Pipe length  =   225.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.049(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     3.049(CFS)
Normal flow depth in pipe =    8.78(In.)
Flow top width inside pipe =   14.78(In.)
Critical Depth =    8.43(In.)
Pipe flow velocity =      4.09(Ft/s)
Travel time through pipe =    0.92 min.
Time of concentration (TC) =     9.70 min.
```

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++++
Process from Point/Station      203.100 to Point/Station
203.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
_____
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.790
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.210
SCS curve number for soil(AMC 2)  = 59.99
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.279(In/Hr)
Max Catchment Loss (Fm) =     0.237(In/Hr)
Time of concentration =     9.70 min.
Rainfall intensity =      1.547(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with
modified
rational method)(Q=KCIA) is C = 0.846
Subarea runoff =      0.069(CFS) for    0.240(Ac.)
Total runoff =      3.118(CFS)      Total area =        2.38(Ac.)
Area averaged Fm value =    0.093(In/Hr)


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++++
Process from Point/Station      203.000 to Point/Station
204.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
_____
Upstream point/station elevation =    47.100(Ft.)
Downstream point/station elevation =    40.500(Ft.)
Pipe length  =    60.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.118(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     3.118(CFS)
Normal flow depth in pipe =    4.86(In.)
Flow top width inside pipe =    8.97(In.)
Critical depth could not be calculated.
Pipe flow velocity =     12.81(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     9.78 min.


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++++
Process from Point/Station      203.000 to Point/Station
204.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
_____
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      2.382(Ac.)
Runoff from this stream =      3.118(CFS)
Time of concentration =    9.78 min.
Rainfall intensity =     1.540(In/Hr)
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      Area averaged loss rate (Fm) =    0.0930(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.4269
      Program is now starting with Main Stream No. 2


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      205.100 to Point/Station
205.200
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.020(In/Hr)
      Initial subarea data:
      Initial area flow distance =   370.000(Ft.)
      Top (of initial area) elevation =    57.900(Ft.)
      Bottom (of initial area) elevation =    56.000(Ft.)
      Difference in elevation =     1.900(Ft.)
      Slope =    0.00514  s(%)=       0.51
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    9.291 min.
      NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
      for this Development Type
      Rainfall intensity =      1.586(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
      Subarea runoff =      2.185(CFS)
      Total initial stream area =        1.550(Ac.)


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++++
      Process from Point/Station      205.200 to Point/Station
205.300
      **** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
____
      Top of street segment elevation =    56.000(Ft.)
      End of street segment elevation =    48.500(Ft.)
      Length of street segment  =   305.000(Ft.)
      Height of curb above gutter flowline  =    6.0(In.)
      Width of half street (curb to crown)  =  22.000(Ft.)
      Distance from crown to crossfall grade break  =  18.000(Ft.)
      Slope from gutter to grade break (v/hz) =   0.020
      Slope from grade break to crown (v/hz)  =   0.020
      Street flow is on [1] side(s) of the street
      Distance from curb to property line  =  30.000(Ft.)
      Slope from curb to property line (v/hz) =   0.020
      Gutter width =   2.000(Ft.)
      Gutter hike from flowline =  0.130(In.)
       Manning's N in gutter =  0.0150
       Manning's N from gutter to grade break =  0.0150
       Manning's N from grade break to crown =  0.0150
      Estimated mean flow rate at midpoint of street =      2.637(CFS)
      Depth of flow =   0.158(Ft.), Average velocity =   3.100(Ft/s)
```

```
      Streetflow hydraulics at midpoint of street travel:
      Halfstreet flow width =   9.379(Ft.)
      Flow velocity =   3.10(Ft/s)
      Travel time =    1.64 min.     TC =   10.93  min.
       Adding area flow to street
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.260
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.740
      SCS curve number for soil(AMC 2)  = 70.06
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.226(In/Hr)
      Max Catchment Loss (Fm) =     0.023(In/Hr)
      Rainfall intensity =      1.445(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.887
      Subarea runoff =      0.827(CFS) for    0.800(Ac.)
      Total runoff =      3.012(CFS)      Total area =        2.35(Ac.)
      Area averaged Fm value =    0.021(In/Hr)
      Street flow at end of street =      3.012(CFS)
      Half street flow at end of street =      3.012(CFS)
      Depth of flow =   0.168(Ft.), Average velocity =   3.207(Ft/s)
      Flow width (from curb towards crown)=   9.840(Ft.)


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      Process from Point/Station      205.200 to Point/Station
205.300
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 2 in normal stream number 1
      Stream flow area =      2.350(Ac.)
      Runoff from this stream =      3.012(CFS)
      Time of concentration =   10.93 min.
      Rainfall intensity =     1.445(In/Hr)
      Area averaged loss rate (Fm) =    0.0209(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.1000


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      Process from Point/Station      205.310 to Point/Station
205.320
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
____
      PARK subarea
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.170(In/Hr)
      Initial subarea data:
      Initial area flow distance =   350.000(Ft.)
      Top (of initial area) elevation =    56.000(Ft.)
      Bottom (of initial area) elevation =    52.000(Ft.)
```

```
      Difference in elevation =     4.000(Ft.)
      Slope =    0.01143  s(%)=       1.14
      TC = k(0.483)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =   12.302 min.
      Rainfall intensity =      1.350(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.787
      Subarea runoff =      0.244(CFS)
      Total initial stream area =        0.230(Ac.)


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      Process from Point/Station      205.320 to Point/Station
205.300
      **** IMPROVED CHANNEL TRAVEL TIME ****
      ______________________________________________________________________
____
      Upstream point elevation =    52.000(Ft.)
      Downstream point elevation =    48.500(Ft.)
      Channel length thru subarea  =   560.000(Ft.)
      Channel base width      =    0.000(Ft.)
      Slope or 'Z' of left channel bank =   1.000
      Slope or 'Z' of right channel bank =   1.000
      Estimated mean flow rate at midpoint of channel =      0.340(CFS)
      Manning's 'N'    = 0.015
      Maximum depth of channel  =    1.000(Ft.)
      Flow(q) thru subarea =      0.340(CFS)
      Depth of flow =   0.400(Ft.), Average velocity =   2.125(Ft/s)
      Channel flow top width =    0.800(Ft.)
      Flow Velocity =    2.13(Ft/s)
      Travel time  =    4.39 min.
      Time of concentration =   16.69 min.
      Critical depth =      0.371(Ft.)
       Adding area flow to channel
      PARK subarea
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      SCS curve number for soil(AMC 2)  = 75.00
      Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
      Max Catchment Loss (Fm) =     0.170(In/Hr)
      Rainfall intensity =      1.133(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.765
      Subarea runoff =      0.111(CFS) for    0.180(Ac.)
      Total runoff =      0.355(CFS)      Total area =        0.41(Ac.)
      Area averaged Fm value =    0.170(In/Hr)
      Depth of flow =   0.407(Ft.), Average velocity =   2.149(Ft/s)
      Critical depth =      0.379(Ft.)


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      Process from Point/Station      205.320 to Point/Station
205.300
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
____
      Along Main Stream number: 2 in normal stream number 2
```

```
Stream flow area =       0.410(Ac.)
Runoff from this stream =       0.355(CFS)
Time of concentration =   16.69 min.
Rainfall intensity =     1.133(In/Hr)
Area averaged loss rate (Fm) =    0.1700(In/Hr)
Area averaged Pervious ratio (Ap) = 0.8500
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)      (In/Hr)


1      2.35     3.012     10.93    0.021      1.445
2      0.41     0.355     16.69    0.170      1.133
Qmax(1) =
         1.000 *    1.000 *     3.012) +
         1.324 *    0.655 *     0.355) + =       3.320
Qmax(2) =
         0.781 *    1.000 *     3.012) +
         1.000 *    1.000 *     0.355) + =       2.708

Total of 2 streams to confluence:
Flow rates before confluence point:
       3.012       0.355
Maximum flow rates at confluence using above data:
        3.320        2.708
Area of streams before confluence:
        2.350        0.410
Effective area values after confluence:
        2.618        2.760
Results of confluence:
Total flow rate =      3.320(CFS)
Time of concentration =    10.930 min.
Effective stream area after confluence =      2.618(Ac.)
Study area average Pervious fraction(Ap) =  0.211
Study area average soil loss rate(Fm) =    0.043(In/Hr)
Study area total (this main stream) =       2.76(Ac.)


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Process from Point/Station      205.300 to Point/Station
205.400
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
____
Upstream point/station elevation =    44.500(Ft.)
Downstream point/station elevation =    44.300(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.320(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     3.320(CFS)
Normal flow depth in pipe =    8.15(In.)
Flow top width inside pipe =   14.94(In.)
Critical Depth =    8.81(In.)
Pipe flow velocity =      4.87(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =    11.02 min.


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      Process from Point/Station      205.300 to Point/Station
205.400
      **** CONFLUENCE OF MINOR STREAMS ****
      ____________________________________________________________________
____
      Along Main Stream number: 2 in normal stream number 1
      Stream flow area =      2.618(Ac.)
      Runoff from this stream =      3.320(CFS)
      Time of concentration =   11.02 min.
      Rainfall intensity =     1.439(In/Hr)
      Area averaged loss rate (Fm) =    0.0430(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.2114


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      Process from Point/Station      205.410 to Point/Station
205.420
      **** INITIAL AREA EVALUATION ****
      ____________________________________________________________________
____
      COMMERCIAL subarea type
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.890
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.110
      SCS curve number for soil(AMC 2)  = 58.09
      Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.289(In/Hr)
      Max Catchment Loss (Fm) =     0.029(In/Hr)
      Initial subarea data:
      Initial area flow distance =   450.000(Ft.)
      Top (of initial area) elevation =    54.300(Ft.)
      Bottom (of initial area) elevation =    48.500(Ft.)
      Difference in elevation =     5.800(Ft.)
      Slope =    0.01289  s(%)=       1.29
      TC = k(0.304)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    8.358 min.
      NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
      for this Development Type
      Rainfall intensity =      1.686(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.885
      Subarea runoff =      0.790(CFS)
      Total initial stream area =        0.530(Ac.)


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      Process from Point/Station      205.420 to Point/Station
205.400
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ____________________________________________________________________
____
      Upstream point/station elevation =    44.500(Ft.)
      Downstream point/station elevation =    44.300(Ft.)
      Pipe length  =    25.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     0.790(CFS)
      Nearest computed pipe diameter  =      9.00(In.)
      Calculated individual pipe flow  =     0.790(CFS)
      Normal flow depth in pipe =    4.68(In.)
      Flow top width inside pipe =    8.99(In.)
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Critical Depth =    4.87(In.)
Pipe flow velocity =      3.40(Ft/s)
Travel time through pipe =    0.12 min.
Time of concentration (TC) =     8.48 min.


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Process from Point/Station      205.420 to Point/Station
205.400
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
_____
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.530(Ac.)
Runoff from this stream =      0.790(CFS)
Time of concentration =    8.48 min.
Rainfall intensity =     1.672(In/Hr)
Area averaged loss rate (Fm) =    0.0289(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min)  (In/Hr)     (In/Hr)


1      2.62     3.320     11.02    0.043      1.439
2      0.53     0.790      8.48    0.029      1.672
Qmax(1) =
         1.000 *    1.000 *     3.320) +
         0.858 *    1.000 *     0.790) + =       3.998
Qmax(2) =
         1.167 *    0.770 *     3.320) +
         1.000 *    1.000 *     0.790) + =       3.773

Total of 2 streams to confluence:
Flow rates before confluence point:
       3.320       0.790
Maximum flow rates at confluence using above data:
        3.998        3.773
Area of streams before confluence:
        2.618        0.530
Effective area values after confluence:
        3.148        2.546
Results of confluence:
Total flow rate =      3.998(CFS)
Time of concentration =    11.016 min.
Effective stream area after confluence =      3.148(Ac.)
Study area average Pervious fraction(Ap) =  0.193
Study area average soil loss rate(Fm) =    0.041(In/Hr)
Study area total (this main stream) =       3.15(Ac.)


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Process from Point/Station      205.400 to Point/Station
205.500
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
_____
Upstream point/station elevation =    44.300(Ft.)
```

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      Downstream point/station elevation =    44.100(Ft.)
      Pipe length  =    20.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     3.998(CFS)
      Nearest computed pipe diameter  =     15.00(In.)
      Calculated individual pipe flow  =     3.998(CFS)
      Normal flow depth in pipe =    8.54(In.)
      Flow top width inside pipe =   14.86(In.)
      Critical Depth =    9.71(In.)
      Pipe flow velocity =      5.54(Ft/s)
      Travel time through pipe =    0.06 min.
      Time of concentration (TC) =    11.08 min.


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      Process from Point/Station      205.510 to Point/Station
205.500
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
____
      PARK subarea
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 1.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.000
      SCS curve number for soil(AMC 2)  = 56.00
      Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.300(In/Hr)
      Max Catchment Loss (Fm) =     0.255(In/Hr)
      Time of concentration =    11.08 min.
      Rainfall intensity =      1.434(In/Hr) for a     2.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.870
      Subarea runoff =      0.078(CFS) for    0.120(Ac.)
      Total runoff =      4.076(CFS)      Total area =        3.27(Ac.)
      Area averaged Fm value =    0.049(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      205.500 to Point/Station
205.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    44.100(Ft.)
      Downstream point/station elevation =    42.700(Ft.)
      Pipe length  =    75.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     4.076(CFS)
      Nearest computed pipe diameter  =     12.00(In.)
      Calculated individual pipe flow  =     4.076(CFS)
      Normal flow depth in pipe =    8.40(In.)
      Flow top width inside pipe =   11.00(In.)
      Critical Depth =   10.25(In.)
      Pipe flow velocity =      6.94(Ft/s)
      Travel time through pipe =    0.18 min.
      Time of concentration (TC) =    11.26 min.


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      Process from Point/Station      205.000 to Point/Station
204.500
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    42.700(Ft.)
      Downstream point/station elevation =    41.500(Ft.)
      Pipe length  =   245.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     4.076(CFS)
      Nearest computed pipe diameter  =     15.00(In.)
      Calculated individual pipe flow  =     4.076(CFS)
      Normal flow depth in pipe =   11.14(In.)
      Flow top width inside pipe =   13.11(In.)
      Critical Depth =    9.81(In.)
      Pipe flow velocity =      4.17(Ft/s)
      Travel time through pipe =    0.98 min.
      Time of concentration (TC) =    12.24 min.


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      Process from Point/Station      204.500 to Point/Station
204.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
____
      Upstream point/station elevation =    41.500(Ft.)
      Downstream point/station elevation =    40.500(Ft.)
      Pipe length  =   200.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     4.076(CFS)
      Nearest computed pipe diameter  =     15.00(In.)
      Calculated individual pipe flow  =     4.076(CFS)
      Normal flow depth in pipe =   11.04(In.)
      Flow top width inside pipe =   13.22(In.)
      Critical Depth =    9.81(In.)
      Pipe flow velocity =      4.21(Ft/s)
      Travel time through pipe =    0.79 min.
      Time of concentration (TC) =    13.03 min.


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++++
      Process from Point/Station      204.500 to Point/Station
204.000
      **** CONFLUENCE OF MAIN STREAMS ****
      ______________________________________________________________________
____
      The following data inside Main Stream is listed:
      In Main Stream number: 2
      Stream flow area =      3.268(Ac.)
      Runoff from this stream =      4.076(CFS)
      Time of concentration =   13.03 min.
      Rainfall intensity =     1.306(In/Hr)
      Area averaged loss rate (Fm) =    0.0485(In/Hr)
      Area averaged Pervious ratio (Ap) = 0.2168
      Summary of stream data:

      Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
       No.    (Ac.)   (CFS)       (min)  (In/Hr)     (In/Hr)
```

```
1       2.38      3.118       9.78     0.093       1.540
2       3.27      4.076      13.03     0.049       1.306
Qmax(1) =
          1.000 *     1.000 *      3.118) +
          1.186 *     0.751 *      4.076) + =        6.746
Qmax(2) =
          0.838 *     1.000 *      3.118) +
          1.000 *     1.000 *      4.076) + =        6.690

Total of 2 main streams to confluence:
Flow rates before confluence point:
       4.118        5.076
Maximum flow rates at confluence using above data:
        6.746        6.690
Area of streams before confluence:
        2.382        3.268
Effective area values after confluence:
        4.836        5.650


Results of confluence:
Total flow rate =       6.746(CFS)
Time of concentration =      9.780 min.
Effective stream area after confluence  =       4.836(Ac.)
Study area average Pervious fraction(Ap) =  0.305
Study area average soil loss rate(Fm) =    0.067(In/Hr)
Study area total =        5.65(Ac.)
End of computations, total study area =            6.28 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.309
Area averaged SCS curve number (AMC 2) =  71.3
```

U n i t H y d r o g r a p h A n a l y s i s

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Study date 11/14/11 File Name 100288PRB2UH.out

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Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996

Program License Serial Number 4014

UPTOWN NEWPORT
HFI JOB NO. II.100288.0000
DEVELOPED CONDITION
AREA B

Storm Event Year = 2

Antecedent Moisture Condition = 1

English (in-lb) Input Units Used

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	Area (Ac.)	Area Fraction	Soil Group	Fp (In/Hr)	Ap (dec.)	Fm (In/Hr)
71.3	6.3	1.00	D	0.200	0.309	0.062

Area-averaged adjusted loss rate Fm (In/Hr) = 0.062

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC1)	S	Pervious Yield Fr
1.94	0.309	71.3	52.6	9.03	0.003
4.34	0.691	98.0	98.0	0.20	0.890

Area-averaged catchment yield fraction, Y = 0.616
Area-averaged low loss fraction, Yb = 0.384

++

User entry of time of concentration = 0.163 (hours)
Watershed area = 6.28(Ac.)
Catchment Lag time = 0.130 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 63.9059
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.062(In/Hr)
Average low loss rate fraction (Yb) = 0.384 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.190(In)
Computed peak 30-minute rainfall = 0.400(In)
Specified peak 1-hour rainfall = 0.530(In)
Computed peak 3-hour rainfall = 0.890(In)
Specified peak 6-hour rainfall = 1.220(In)

Specified peak 24-hour rainfall = 2.050(In)

Rainfall depth area reduction factors:
Using a total area of 6.28(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.190(In)
30-minute factor = 1.000 Adjusted rainfall = 0.400(In)
1-hour factor = 1.000 Adjusted rainfall = 0.530(In)
3-hour factor = 1.000 Adjusted rainfall = 0.890(In)
6-hour factor = 1.000 Adjusted rainfall = 1.220(In)
24-hour factor = 1.000 Adjusted rainfall = 2.050(In)

U n i t H y d r o g r a p h

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
	(K = 75.95 (CFS))	
1	7.364	5.593
2	46.434	29.673
3	85.085	29.355
4	96.763	8.869
5	98.976	1.681
6	100.000	0.777

Total soil rain loss = 0.63(In)
Total effective rainfall = 1.42(In)
Peak flow rate in flood hydrograph = 7.81(CFS)

24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0001	0.01	Q				
0+10	0.0005	0.06	Q				
0+15	0.0012	0.11	Q				
0+20	0.0020	0.12	Q				
0+25	0.0029	0.12	Q				
0+30	0.0038	0.13	Q				
0+35	0.0046	0.13	Q				
0+40	0.0055	0.13	Q				
0+45	0.0064	0.13	Q				
0+50	0.0073	0.13	Q				
0+55	0.0081	0.13	Q				
1+ 0	0.0090	0.13	Q				
1+ 5	0.0099	0.13	Q				
1+10	0.0108	0.13	Q				
1+15	0.0117	0.13	Q				
1+20	0.0126	0.13	Q				
1+25	0.0135	0.13	Q				
1+30	0.0144	0.13	Q				
1+35	0.0153	0.13	Q				
1+40	0.0162	0.13	Q				
1+45	0.0171	0.13	Q				
1+50	0.0181	0.13	Q				
1+55	0.0190	0.13	QV				

2+ 0	0.0199	0.13	QV			
2+ 5	0.0208	0.13	QV			
2+10	0.0218	0.14	QV			
2+15	0.0227	0.14	QV			
2+20	0.0236	0.14	QV			
2+25	0.0246	0.14	QV			
2+30	0.0255	0.14	QV			
2+35	0.0265	0.14	QV			
2+40	0.0274	0.14	QV			
2+45	0.0284	0.14	QV			
2+50	0.0293	0.14	QV			
2+55	0.0303	0.14	QV			
3+ 0	0.0313	0.14	QV			
3+ 5	0.0322	0.14	QV			
3+10	0.0332	0.14	QV			
3+15	0.0342	0.14	QV			
3+20	0.0352	0.14	QV			
3+25	0.0362	0.14	QV			
3+30	0.0372	0.14	QV			
3+35	0.0382	0.14	Q V			
3+40	0.0392	0.15	Q V			
3+45	0.0402	0.15	Q V			
3+50	0.0412	0.15	Q V			
3+55	0.0422	0.15	Q V			
4+ 0	0.0432	0.15	Q V			
4+ 5	0.0442	0.15	Q V			
4+10	0.0452	0.15	Q V			
4+15	0.0463	0.15	Q V			
4+20	0.0473	0.15	Q V			
4+25	0.0483	0.15	Q V			
4+30	0.0494	0.15	Q V			
4+35	0.0504	0.15	Q V			
4+40	0.0515	0.15	Q V			
4+45	0.0526	0.15	Q V			
4+50	0.0536	0.15	Q V			
4+55	0.0547	0.15	Q V			
5+ 0	0.0558	0.16	Q V			
5+ 5	0.0568	0.16	Q V			
5+10	0.0579	0.16	Q V			
5+15	0.0590	0.16	Q V			
5+20	0.0601	0.16	Q V			
5+25	0.0612	0.16	Q V			
5+30	0.0623	0.16	Q V			
5+35	0.0634	0.16	Q V			
5+40	0.0645	0.16	Q V			
5+45	0.0656	0.16	Q V			
5+50	0.0668	0.16	Q V			
5+55	0.0679	0.16	Q V			
6+ 0	0.0690	0.17	Q V			
6+ 5	0.0702	0.17	Q V			
6+10	0.0713	0.17	Q V			
6+15	0.0725	0.17	Q V			
6+20	0.0736	0.17	Q V			
6+25	0.0748	0.17	Q V			
6+30	0.0760	0.17	Q V			
6+35	0.0772	0.17	Q V			
6+40	0.0783	0.17	Q V			
6+45	0.0795	0.17	Q V			
6+50	0.0807	0.17	Q V			
6+55	0.0819	0.18	Q V			
7+ 0	0.0832	0.18	Q V			
7+ 5	0.0844	0.18	Q V			
7+10	0.0856	0.18	Q V			
7+15	0.0868	0.18	Q V			
7+20	0.0881	0.18	Q V			
7+25	0.0893	0.18	Q V			

```
 7+30        0.0906       0.18  Q   V     |          |          |          |
 7+35        0.0918       0.18  Q   V     |          |          |          |
 7+40        0.0931       0.18  Q    V    |          |          |          |
 7+45        0.0944       0.19  Q    V    |          |          |          |
 7+50        0.0957       0.19  Q    V    |          |          |          |
 7+55        0.0970       0.19  Q    V    |          |          |          |
 8+ 0        0.0983       0.19  Q    V    |          |          |          |
 8+ 5        0.0996       0.19  Q    V    |          |          |          |
 8+10        0.1009       0.19  Q    V    |          |          |          |
 8+15        0.1022       0.19  Q    V    |          |          |          |
 8+20        0.1036       0.19  Q    V    |          |          |          |
 8+25        0.1049       0.20  Q    V    |          |          |          |
 8+30        0.1063       0.20  Q    V    |          |          |          |
 8+35        0.1076       0.20  Q    V    |          |          |          |
 8+40        0.1090       0.20  Q    V    |          |          |          |
 8+45        0.1104       0.20  Q    V    |          |          |          |
 8+50        0.1118       0.20  Q     V   |          |          |          |
 8+55        0.1132       0.20  Q     V   |          |          |          |
 9+ 0        0.1146       0.21  Q     V   |          |          |          |
 9+ 5        0.1160       0.21  Q     V   |          |          |          |
 9+10        0.1175       0.21  Q     V   |          |          |          |
 9+15        0.1189       0.21  Q     V   |          |          |          |
 9+20        0.1204       0.21  Q     V   |          |          |          |
 9+25        0.1218       0.21  Q     V   |          |          |          |
 9+30        0.1233       0.21  Q     V   |          |          |          |
 9+35        0.1248       0.22  Q     V   |          |          |          |
 9+40        0.1263       0.22  Q     V   |          |          |          |
 9+45        0.1278       0.22  Q     V   |          |          |          |
 9+50        0.1294       0.22  Q     V   |          |          |          |
 9+55        0.1309       0.22  Q      V  |          |          |          |
10+ 0        0.1324       0.23  Q      V  |          |          |          |
10+ 5        0.1340       0.23  Q      V  |          |          |          |
10+10        0.1356       0.23  Q      V  |          |          |          |
10+15        0.1372       0.23  Q      V  |          |          |          |
10+20        0.1388       0.23  Q      V  |          |          |          |
10+25        0.1404       0.24  Q      V  |          |          |          |
10+30        0.1421       0.24  Q      V  |          |          |          |
10+35        0.1437       0.24  Q      V  |          |          |          |
10+40        0.1454       0.24  Q      V  |          |          |          |
10+45        0.1471       0.24  Q      V  |          |          |          |
10+50        0.1487       0.25  Q       V |          |          |          |
10+55        0.1505       0.25  Q       V |          |          |          |
11+ 0        0.1522       0.25  |Q      V |          |          |          |
11+ 5        0.1539       0.25  |Q      V |          |          |          |
11+10        0.1557       0.26  |Q      V |          |          |          |
11+15        0.1575       0.26  |Q      V |          |          |          |
11+20        0.1593       0.26  |Q      V |          |          |          |
11+25        0.1611       0.27  |Q      V |          |          |          |
11+30        0.1630       0.27  |Q      V |          |          |          |
11+35        0.1648       0.27  |Q      V |          |          |          |
11+40        0.1667       0.27  |Q      V |          |          |          |
11+45        0.1686       0.28  |Q       V|          |          |          |
11+50        0.1706       0.28  |Q       V|          |          |          |
11+55        0.1725       0.28  |Q       V|          |          |          |
12+ 0        0.1745       0.29  |Q       V|          |          |          |
12+ 5        0.1765       0.30  |Q       V|          |          |          |
12+10        0.1788       0.32  |Q       V|          |          |          |
12+15        0.1812       0.35  |Q       V|          |          |          |
12+20        0.1837       0.36  |Q       V|          |          |          |
12+25        0.1863       0.37  |Q        V          |          |          |
12+30        0.1889       0.38  |Q        V          |          |          |
12+35        0.1915       0.38  |Q        V          |          |          |
12+40        0.1941       0.39  |Q        V          |          |          |
12+45        0.1968       0.39  |Q        V          |          |          |
12+50        0.1996       0.40  |Q        V          |          |          |
12+55        0.2023       0.40  |Q        V          |          |          |
```

```
13+ 0      0.2051     0.41  |Q         |V         |          |          |
13+ 5      0.2080     0.41  |Q         |V         |          |          |
13+10      0.2109     0.42  |Q         |V         |          |          |
13+15      0.2138     0.43  |Q         |V         |          |          |
13+20      0.2168     0.43  |Q         |V         |          |          |
13+25      0.2198     0.44  |Q         |V         |          |          |
13+30      0.2229     0.45  |Q         |V         |          |          |
13+35      0.2260     0.45  |Q         | V        |          |          |
13+40      0.2292     0.46  |Q         | V        |          |          |
13+45      0.2324     0.47  |Q         | V        |          |          |
13+50      0.2357     0.48  |Q         | V        |          |          |
13+55      0.2391     0.49  |Q         | V        |          |          |
14+ 0      0.2425     0.50  |Q         |  V       |          |          |
14+ 5      0.2460     0.51  | Q        |  V       |          |          |
14+10      0.2497     0.53  | Q        |  V       |          |          |
14+15      0.2535     0.55  | Q        |  V       |          |          |
14+20      0.2573     0.56  | Q        |  V       |          |          |
14+25      0.2613     0.58  | Q        |   V      |          |          |
14+30      0.2654     0.59  | Q        |   V      |          |          |
14+35      0.2696     0.61  | Q        |   V      |          |          |
14+40      0.2740     0.63  | Q        |   V      |          |          |
14+45      0.2785     0.66  | Q        |   V      |          |          |
14+50      0.2833     0.69  | Q        |    V     |          |          |
14+55      0.2883     0.73  | Q        |    V     |          |          |
15+ 0      0.2936     0.77  |  Q       |    V     |          |          |
15+ 5      0.2992     0.81  |  Q       |     V    |          |          |
15+10      0.3051     0.86  |  Q       |     V    |          |          |
15+15      0.3115     0.92  |  Q       |     V    |          |          |
15+20      0.3182     0.99  |  Q       |      V   |          |          |
15+25      0.3254     1.04  |   Q      |      V   |          |          |
15+30      0.3327     1.05  |   Q      |      V   |          |          |
15+35      0.3400     1.07  |   Q      |       V  |          |          |
15+40      0.3481     1.18  |   Q      |       V  |          |          |
15+45      0.3573     1.34  |    Q     |        V|          |          |
15+50      0.3683     1.60  |     Q    |        V|          |          |
15+55      0.3818     1.96  |      Q   |         V          |          |
16+ 0      0.3999     2.62  |        Q |         |V         |          |
16+ 5      0.4293     4.28  |          |      Q  |  V       |          |
16+10      0.4831     7.81  |          |         |    V     |Q         |
16+15      0.5322     7.12  |          |         |      Q   |          |
16+20      0.5558     3.44  |          |  Q      |       V|           |
16+25      0.5682     1.80  |      Q   |         |        V           |
16+30      0.5776     1.36  |    Q     |         |         |V         |
16+35      0.5852     1.10  |   Q      |         |         |V         |
16+40      0.5918     0.96  |  Q       |         |         |V         |
16+45      0.5976     0.84  |  Q       |         |         | V        |
16+50      0.6027     0.75  |  Q       |         |         | V        |
16+55      0.6074     0.68  | Q        |         |         | V        |
17+ 0      0.6117     0.63  | Q        |         |         | V        |
17+ 5      0.6158     0.59  | Q        |         |         |  V       |
17+10      0.6195     0.55  | Q        |         |         |  V       |
17+15      0.6231     0.52  | Q        |         |         |  V       |
17+20      0.6265     0.49  |Q         |         |         |  V       |
17+25      0.6298     0.48  |Q         |         |         |  V       |
17+30      0.6330     0.46  |Q         |         |         |   V      |
17+35      0.6360     0.44  |Q         |         |         |   V      |
17+40      0.6390     0.43  |Q         |         |         |   V      |
17+45      0.6418     0.42  |Q         |         |         |   V      |
17+50      0.6446     0.40  |Q         |         |         |   V      |
17+55      0.6473     0.39  |Q         |         |         |   V      |
18+ 0      0.6499     0.38  |Q         |         |         |   V      |
18+ 5      0.6525     0.37  |Q         |         |         |    V     |
18+10      0.6548     0.34  |Q         |         |         |    V     |
18+15      0.6569     0.30  |Q         |         |         |    V     |
18+20      0.6589     0.29  |Q         |         |         |    V     |
18+25      0.6608     0.28  |Q         |         |         |     V    |
```

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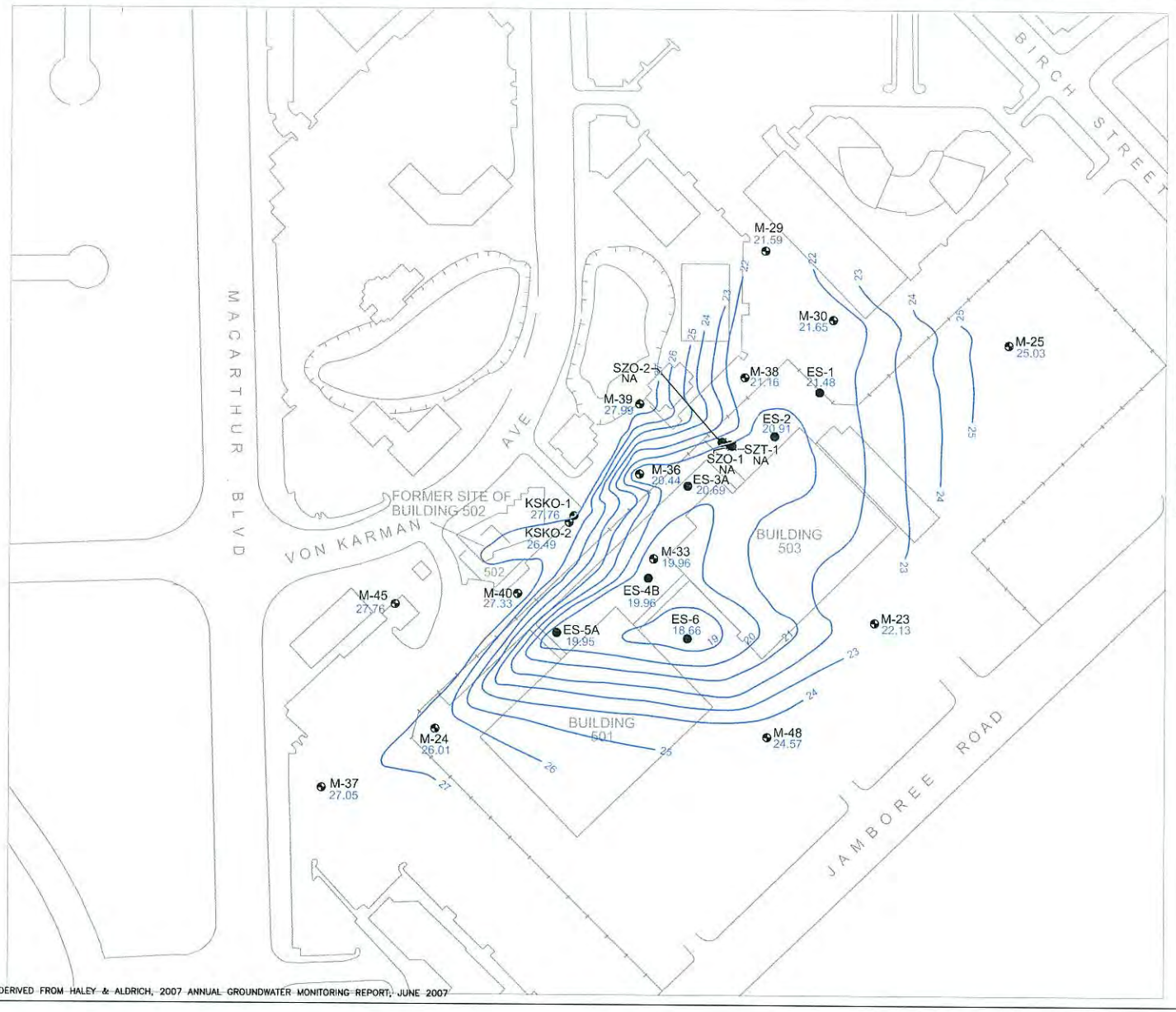
18+30       0.6627      0.27  |Q         |          |          |     V     |
18+35       0.6645      0.27  |Q         |          |          |     V     |
18+40       0.6663      0.26  |Q         |          |          |     V     |
18+45       0.6681      0.26  |Q         |          |          |     V     |
18+50       0.6698      0.25  |Q         |          |          |      V    |
18+55       0.6715      0.25  Q          |          |          |      V    |
19+ 0       0.6731      0.24  Q          |          |          |      V    |
19+ 5       0.6748      0.24  Q          |          |          |      V    |
19+10       0.6764      0.23  Q          |          |          |      V    |
19+15       0.6779      0.23  Q          |          |          |      V    |
19+20       0.6795      0.22  Q          |          |          |      V    |
19+25       0.6810      0.22  Q          |          |          |      V    |
19+30       0.6825      0.22  Q          |          |          |      V    |
19+35       0.6840      0.21  Q          |          |          |      V    |
19+40       0.6854      0.21  Q          |          |          |      V    |
19+45       0.6868      0.21  Q          |          |          |      V    |
19+50       0.6882      0.20  Q          |          |          |       V   |
19+55       0.6896      0.20  Q          |          |          |       V   |
20+ 0       0.6910      0.20  Q          |          |          |       V   |
20+ 5       0.6924      0.20  Q          |          |          |       V   |
20+10       0.6937      0.19  Q          |          |          |       V   |
20+15       0.6950      0.19  Q          |          |          |       V   |
20+20       0.6963      0.19  Q          |          |          |       V   |
20+25       0.6976      0.19  Q          |          |          |       V   |
20+30       0.6989      0.18  Q          |          |          |       V   |
20+35       0.7001      0.18  Q          |          |          |       V   |
20+40       0.7013      0.18  Q          |          |          |       V   |
20+45       0.7026      0.18  Q          |          |          |       V   |
20+50       0.7038      0.18  Q          |          |          |       V   |
20+55       0.7050      0.17  Q          |          |          |       V   |
21+ 0       0.7062      0.17  Q          |          |          |       V   |
21+ 5       0.7073      0.17  Q          |          |          |        V  |
21+10       0.7085      0.17  Q          |          |          |        V  |
21+15       0.7096      0.17  Q          |          |          |        V  |
21+20       0.7108      0.16  Q          |          |          |        V  |
21+25       0.7119      0.16  Q          |          |          |        V  |
21+30       0.7130      0.16  Q          |          |          |        V  |
21+35       0.7141      0.16  Q          |          |          |        V  |
21+40       0.7152      0.16  Q          |          |          |        V  |
21+45       0.7163      0.16  Q          |          |          |        V  |
21+50       0.7173      0.16  Q          |          |          |        V  |
21+55       0.7184      0.15  Q          |          |          |        V  |
22+ 0       0.7194      0.15  Q          |          |          |        V  |
22+ 5       0.7205      0.15  Q          |          |          |        V  |
22+10       0.7215      0.15  Q          |          |          |        V  |
22+15       0.7225      0.15  Q          |          |          |        V  |
22+20       0.7236      0.15  Q          |          |          |        V  |
22+25       0.7246      0.15  Q          |          |          |        V  |
22+30       0.7256      0.14  Q          |          |          |         V|
22+35       0.7266      0.14  Q          |          |          |         V|
22+40       0.7275      0.14  Q          |          |          |         V|
22+45       0.7285      0.14  Q          |          |          |         V|
22+50       0.7295      0.14  Q          |          |          |         V|
22+55       0.7304      0.14  Q          |          |          |         V|
23+ 0       0.7314      0.14  Q          |          |          |         V|
23+ 5       0.7323      0.14  Q          |          |          |         V|
23+10       0.7333      0.14  Q          |          |          |         V|
23+15       0.7342      0.13  Q          |          |          |         V|
23+20       0.7351      0.13  Q          |          |          |         V|
23+25       0.7360      0.13  Q          |          |          |         V|
23+30       0.7369      0.13  Q          |          |          |         V|
23+35       0.7378      0.13  Q          |          |          |         V|
23+40       0.7387      0.13  Q          |          |          |         V|
23+45       0.7396      0.13  Q          |          |          |         V|
23+50       0.7405      0.13  Q          |          |          |         V|
23+55       0.7414      0.13  Q          |          |          |         V|
```

```
   24+ 0       0.7423      0.13  Q          |          |          |         V|
   24+ 5       0.7431      0.12  Q          |          |          |         V|
   24+10       0.7435      0.07  Q          |          |          |         V|
   24+15       0.7437      0.02  Q          |          |          |         V|
   24+20       0.7437      0.00  Q          |          |          |         V|
   24+25       0.7437      0.00  Q          |          |          |          V
-------------------------------------------------------------------------------
```

Appendix H - Geotechnical Reference Data

- **Shallow Zone Groundwater Elevation - March 2010, Reference from Jacob and Hefner Associates, Inc.**
- **Intermediate Zone Historic Groundwater Elevation, Reference from Jacob and Hefner Associates, Inc.**
- **Cross-Section A-A, Reference Ginter & Associates**



BASE MAP DERIVED FROM HALEY & ALDRICH, 2007 ANNUAL GROUNDWATER MONITORING REPORT, JUNE 2007

EXPLANATION

M-33	SHALLOW ZONE MONITOR WELL
ES-4B	SHALLOW ZONE EXTRACTION WELL (NOT IN OPERATION)
SZO-2	DPE TEST WELL
25.03	GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL (msl)
	CONTOUR OF EQUAL GROUNDWATER ELEVATION IN FEET ABOVE MSL
NA	NOT APPLICABLE - WELL CASING ELEVATIONS NOT SURVEYED

N

GRAPHIC SCALE 1"=200

0 100 200 400

FIGURE 5

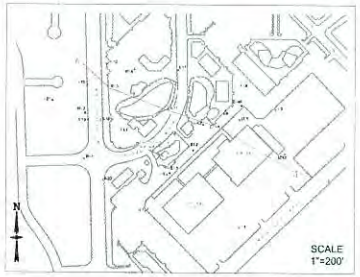
SHALLOW ZONE GROUNDWATER ELEVATION – MARCH 2010

CONEXANT FACILITY

4311 JAMBOREE ROAD

NEWPORT BEACH, CA

JACOB & HEFNER ASSOCIATES, INC.
ENVIRONMENTAL REMEDIATION SERVICES
15375 BARRANCA PARKWAY, SUITE #J-101
IRVINE, CALIFORNIA 92618
PHONE: (949) 453-1045 FAX: (949) 453-1047



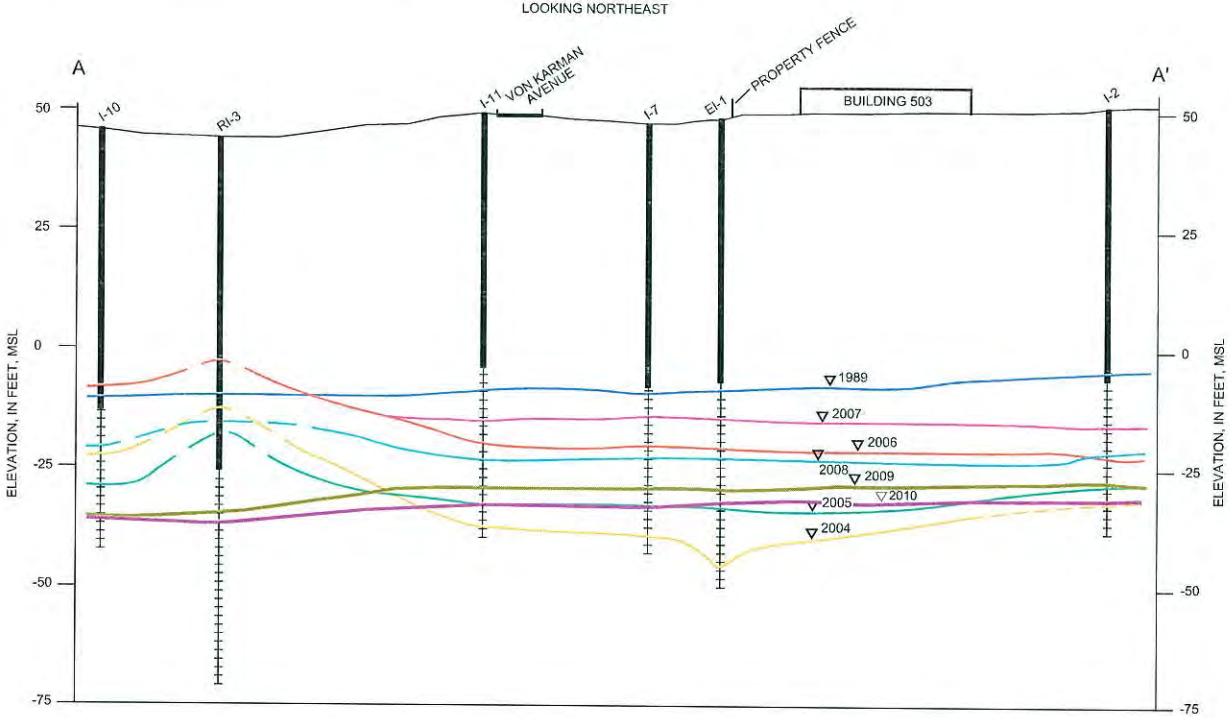
I-10 WELL IDENTIFIER

SEALED INTERVAL

OPEN INTERVAL

WATER LEVEL ELEVATION (FEET, MEAN SEA LEVEL, DASHED WHERE INFERRED)
JUNE 1989
MARCH 2004 (PUMPING)
JANUARY 2005
MARCH 2006
MARCH 2007
MARCH 2008 (RECHARGE SYSTEM SHUT DOWN)
MARCH 2009 (RECHARGE SYSTEM SHUT DOWN)
MARCH 2010 (RECHARGE SYSTEM SHUT DOWN)

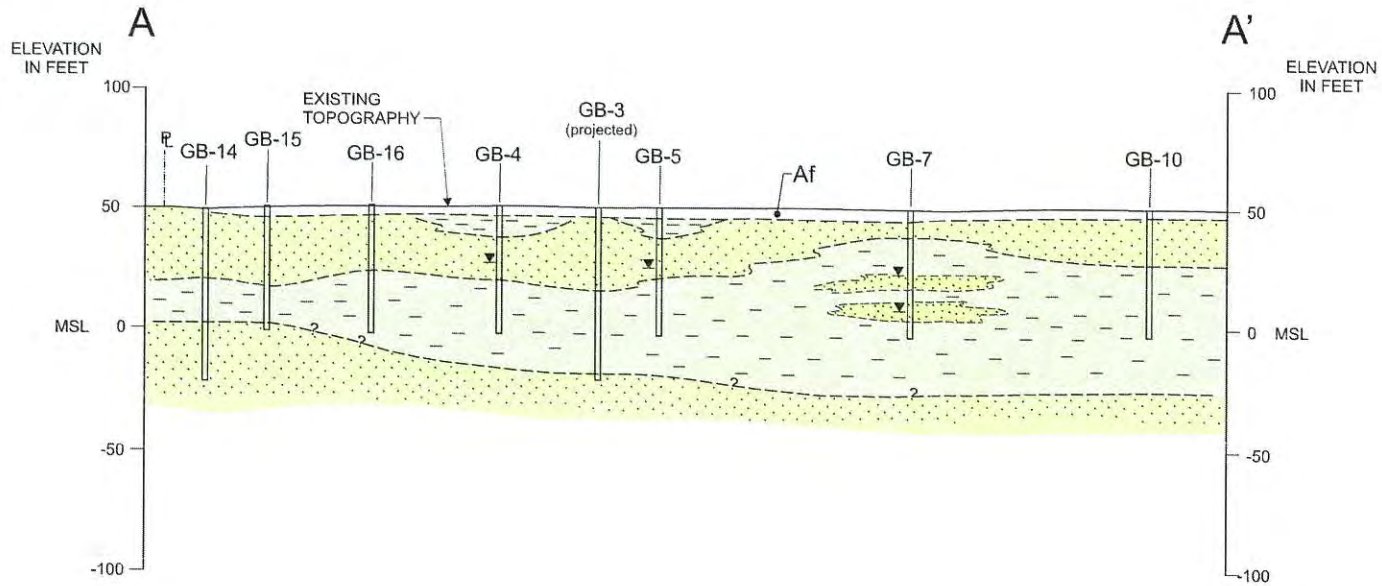
LOOKING NORTHEAST



SCALE
1"=200' HORIZONTAL
1"=25' VERTICAL

FIGURE 11
INTERMEDIATE ZONE HISTORIC GROUNDWATER ELEVATION
CONEXANT FACILITY
4311 JAMBOREE ROAD
NEWPORT BEACH, CA

JACOB & HEFNER ASSOCIATES, INC.
ENVIRONMENTAL REMEDIATION SERVICES
15375 BARRANCA PARKWAY, SUITE #J-101
IRVINE, CALIFORNIA 92618
PHONE: (949) 453-1045 FAX: (949) 453-1047



CROSS-SECTION A-A'

HORIZONTAL SCALE: 1"=200'
VERTICAL SCALE: 1"= 50'

Legend

- OLIVE GREEN CLAY AND SILTY CLAY
- FINE TO COARSE GRAINED SANDS WITH SOME SILTS AND GRAVELS
- PERCHED GROUNDWATER
- APPROXIMATE GEOLOGIC CONTACT

GA inc.

PROJECT NO.:	116-02
DATE:	Nov., 2011