CONCEPTUAL WATER QUALITY MANAGEMENT PLAN

"The Preserve"
Vesting Tentative Tract Map No. 17269

Planning Application: PA130026

Project Address:
Northwest of Long Canyon Road and Ortega Highway
County of Orange, CA

Prepared for:
The Preserve at San Juan, LLC
100 Pacifica, Suite 345
Irvine, CA 92618
(949) 296-3078

Prepared by:

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WQMP Preparation Date:
July 28, 2014
Revised: December 11, 2014

W.O. 3852-1

Conceptual
Water Quality Management Plan
(WQMP)

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APN's 125-120-32 and 125-120-37

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Three Hughes
Irvine, CA 92618
(949) 583-1010
Contact: Tommy I Hsu

Prepared: July 28, 2014
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Project Owner's Certification			
Planning Application No. (If applicable)	PA130026	Grading Permit No.	N/A
Tract/Parcel Map No.	VTTM 17269	Building Permit No.	N/A
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract)			125-120-32 & 37

This Water Quality Management Plan (WQMP) has been prepared for The Preserve at San Juan, LLC by Hunsaker and Associates Irvine, Inc. The WQMP is intended to comply with the requirements of the County of Orange 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 San Diego 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: The Preserve at San Juan, LLC			
Title	Jeff Weber, Managing Member		
Company	The Preserve at San Juan, LLC		
Address	100 Pacifica, Suite 345 Irvine, CA 92618		
Email	jweber@preserve.com		
Telephone #	(949) 296-3078		
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):			
Title	Francisco Calderon	PE Registration #	RCE 58840
Company	Hunsaker and Associates Irvine, Inc.		
Address	Three Hughes, Irvine, CA 92618		
Email	fcalderon@hunsaker.com		
Telephone #	(949) 583-1010		
I hereby certify that this Water Quality Management Plan is in compliance with, and meets the requirements set forth in, Order No. R9-2009-0002/NPDES No. CAS0108740, of the San Diego Regional Water Quality Control Board.			
Preparer Signature		Date	
Place Stamp Here			

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

PROJECT INFOMATION			
Permit/Application No. (If applicable)	PA130026	Grading or Building Permit No. (If applicable)	N/A
Additional Information/Comments:	Construction of the proposed project is not anticipated to commence until after the adoption of Order No. R-9-2013-0001 (NPDES No. CAS0109266). As such, the WQMP shall be revised at a later date to ensure the project's compliance with the requirements of the most updated/current MS4 Permit.		
WATER QUALITY CONDITIONS			
Water Quality Conditions (Please list verbatim.)	This WQMP has been prepared pursuant to the requirements of the County of Orange MS4 Permit (Order No. R9-2009-0002/NPDES No. CAS0108740, of the San Diego Regional Water Quality Control Board) and the County of Orange Municipal Code (Title 6, Division 3, Article 5, Section 6-3-4—through 6-3-599) and the Local Implementation Plan (LIP) for Jurisdictional Runoff Management Program, which require the approval of a WQMP prior to issuance of a grading or building permit. Site specific conditions of approval will be provided once available from the County of Orange.		
WATERSHED-BASED PLAN CONDITIONS			
Provide applicable conditions from watershed-based plans including TMDLs	The project is located within the San Juan Creek Watershed Work Plan. Current conditions to meet the receiving water's water quality objectives include requirements for the preparation of a WQMP and BMPs to address potential storm water pollutants present in runoff. San Juan Creek currently has an established TMDL for pathogens.		

Section II Project Description

II.1 PROJECT DESCRIPTION

DESCRIPTION OF PROPOSED PROJECT		
Development Category (Verbatim from WQMP):	This project is considered a priority project under the following categories: Category 1 – New development projects that create or add 10,000 square feet or more of impervious surface. This category includes commercial, industrial, residential housing subdivisions, mixed-use and public projects on private or public property that falls under the planning and building authority of the Permittees. Category 4 – Hillside development greater than 5,000 square feet. Hillside development is defined as any development which is located in an area with known erosive soil conditions or where the natural slope is twenty-five percent or greater.	
Project Area (ft^2): 8,472,420 ft^2 (194.5 acres)	Number of Units: 22	SIC Code: N/A for residential.
Narrative Project Description:	The proposed project consists of Vesting Tentative Tract Map No. 17269, located on the north side of existing Long Canyon Road and west of Ortega Highway (SR-74), in the County of Orange, California. Specifically, the site is bound to the north and west by limited residential land use and open space; existing Long Canyon Road to the south; and natural areas to the east. Proposed improvements include the development of 29 detached, residential lots, a reservoir site, private streets, common drives, parkway improvements, open space/natural areas, infrastructure improvements (wet and dry utilities, including lot specific septic systems), storm drains and structural Best Management Practices (BMPs). Paved and other impervious portions of the site include the project's street and gutter improvements and the residential building footprint of each residential lot. Proposed common area landscaping consists of open space/natural land, parkway swales and landscaped slopes. These common landscape areas shall be considered private, to be maintained by the Homeowners' Association (HOA). Total common landscaping area is approximately 165.3 acres, or 85% of the project site. Other landscaping areas include those located within each individual lot, which is anticipated to consist of approximately 60% of each residential	

DESCRIPTION OF PROPOSED PROJECT

lot, totaling approximately 12.7 acres.

A summary of the project site is as follows:

Lots	Use	Acreage
1-29	Residential	21.19
30	Reservoir Site	2.6
A – C	Private Streets	6.7
D, E	Common Drives	1.5
F-L	Open Space/Natural	162.5
Total	--	**194.5**

Parking will be provided via covered (garage) and uncovered (surface) parking. Each dwelling unit will have, at minimum, a two car garage and driveway space for parking use, with additional parking provided within project streets. Project parking shall comply with the parking requirements of the County of Orange.

There are no proposed community facilities, such as car wash areas, trash enclosures, community center, pool, parks, tot lots or other similar facilities for the project.

All improvements are shown in the WQMP Site Plan for the project site, located in Section VI of this WQMP.

Activities similar to those of residential developments can be anticipated for the project. These are anticipated to include day to day activities such as recreation, commuting and other activities typical of residential developments.

Project Area	Pervious Surface		Impervious Surface	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	192.5 AC	99%	2.0 AC	1%
Post-Project Conditions	165.3 AC	85%	29.2 AC	15%

DESCRIPTION OF PROPOSED PROJECT	
Drainage Patterns/Connections	In general, the site drains to the southeast, mostly discharging at several points at the south and east property boundary to Long Canyon Creek. Project flows are eventually conveyed to and drain to San Juan Creek located downstream and offsite. San Juan Creek is located in the San Juan (901.00) Hydrologic Unit in the South Orange County Watershed. The descriptions of the project's existing and proposed drainage conditions have been linked with adjacent, downstream VTTMs 35909, 35910 and 35911 located offsite in Riverside County. Relevant portions of a hydrology report covering both the drainage for this project and offsite, downstream VTTMs 35909, 35910 and 35911 and a related Hydromodification Report is included in Appendix C.

II.2 POTENTIAL STORMWATER POLLUTANTS

Table 2.1, Anticipated and Potential Pollutants Generated by Land Use Type, from the Technical Guidance Document (May 2011) lists the following Pollutants of Concern (POC's) associated with detached single-family residential developments:

POLLUTANTS OF CONCERN			
Pollutant	Check One: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended Solids/Sediment	E ☒	N ☐	Pollutant is not a Primary Pollutant of Concern (POC). Potential sources of sediment include landscaping areas and disturbed earth surfaces.
Nutrients	E ☒	N ☐	Pollutant is a Primary POC. Potential sources onsite include fertilizers, sediment and trash/debris.
Metals	E ☐	N ☒	
Pathogens (Bacteria and Viruses)	E ☒	N ☐	Pollutant is a Primary POC. Potential sources for the project include food wastes, sediment and landscaping areas.
Pesticides	E ☒	N ☐	Pollutant is a Primary POC. Potential sources include landscaping areas onsite.
Oil and Grease	E ☒	N ☐	Pollutant is not Primary POC. Potential sources include automobiles in parking areas, drive aisles and drive through.

POLLUTANTS OF CONCERN			
Pollutant	Check One: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Toxic Organic Compounds	E ☐	N ☒	
Trash and Debris	E ☒	N ☐	Pollutant is not a Primary POC. Potential sources of trash and debris include landscaping activities, food wrappers and food wastes.

** Bold denotes primary pollutants of concern.*

II.3 HYDROLOGIC CONDITIONS OF CONCERN

The purpose of this section is to identify any hydrologic conditions of concern (HCOC) with respect to downstream flooding, erosion potential of natural channels downstream, impacts of increased flows on natural habitat, etc. that may occur as the result of project implementation. As specified in Section 2.3.3 of the 2011 Model WQMP, projects must identify and mitigate any HCOCs. A HCOC is a combination of upland hydrologic conditions and stream biological and physical conditions that presents a condition of concern for physical and/or biological degradation of streams.

Is the proposed project potentially susceptible to hydromodification impacts?

☐ No – Show map and/or describe and reference supporting documentation in the space below.

☒ Yes – Describe applicable hydrologic conditions of concern in the space below.

Based on the information provided in the South Orange County Hydromodification Management Plan (HMP), the project has the potential for downstream impacts (HCOC), as it discharges to natural creeks (Long Canyon Creek and San Juan Creek).

The project's Hydromodification Analysis provided in Attachment C of this report, with implementation of the project's BMPs, post-development runoff flow rates and durations will not exceed the site's natural conditions by more than 10% of the time, from 10% of the 2-year runoff event up to the 10-year runoff event.

II.4 POST DEVELOPMENT DRAINAGE CHARACTERISTICS

Describe post development drainage characteristics

In the post-development condition, runoff from northern and northeastern portions of the project site, shown as Drainage Management Areas (DMA) 1 and 2 in the WQMP Site Plan provided in Section VI, will be conveyed parkway swales as sheet flow and via parkway culverts for conveyance to one of the project's two infiltration basins. Runoff from the project's western DMA (DMA 3) will be conveyed as sheet flow and via parkway culverts for conveyance to a subsurface detention/drywell system. Runoff from the project's entry road located (DMA 4) will be conveyed as gutter flow to proposed catch basins prior to conveyance to a subsurface detention/drywell system.

Overflows from the swales located within DMA 1, 2 and 3 will be conveyed within the project's street gutters to proposed catch basins prior to discharging to the existing natural drainage system.

Overflow from the project's entry road (DMA 4) will be conveyed as gutter flow to Long Canyon Road prior to discharging to natural areas adjacent to the roadway.

The swales, basins and subsurface detention/drywell systems also serve to satisfy the project's Low Impact Development (LID) requirements for mitigating the project's pollutants of concern and HCOC/hydromodification impacts, with the vegetated swales and pervious pavement designed to pre-treat runoff and to reduce runoff velocity or detain runoff, and the infiltration basins and drywells designed to capture and retain the water quality volume and the difference in runoff flow rates between the site's natural and proposed conditions.

II.5 PROPERTY OWNERSHIP/MANAGEMENT

The property owner and developer, The Preserve at San Juan, LLC, shall assume all maintenance and inspection responsibilities for the project's BMPs, project streets, drainage system and common areas until such time, these improvements are accepted for responsibility by the Homeowner's Association, as appropriate. Thereafter, the HOA shall be mechanism to ensure long-term funding, maintenance and inspection responsibilities for the project's BMPs, drainage system and common areas.

Section III Site Description

III.1 PHYSICAL SETTING

General descriptions of the project area are provided below:

PHYSICAL SETTING	
Name of Planned Community/Planning Area (if applicable)	The Preserve – VTTM 17269
Location/Address	Unincorporated area of the County of Orange. The project is located approximately 2200' northwest of the intersection of Ortega Highway and Long Canyon Road.
General Plan Land Use Designation	Existing: Open Space and Cleveland National Forest; Proposed: Rural Residential (1A)
Zoning	Existing: General Agricultural (A1) Proposed: Planned Community
Acreage of Project Site	194.5 AC
Predominant Soil Type	Per NRCS, site consists primarily of C-Type soils. However, preliminary geotechnical studies have encountered soils with favorable infiltration rates.

III.2 SITE CHARACTERISTICS

The following table summarizes general characteristics of the project site:

SITE CHARACTERISTICS	
Precipitation Zone	1.0 in.
Topography	The San Juan Creek watershed, located in the southern portion of Orange County and in the South Orange County Watershed Management Area, encompasses a drainage area of approximately 176 square miles and extends from the Cleveland National Forest in the Santa Ana Mountains to the Pacific Ocean at Doheny State Beach near Dana Point Harbor. The project is sited within the upstream tributaries of the watershed with surface runoff that flows out of steep canyons and widen into several alluvial floodplains. The major streams in the watershed include downstream and offsite San Juan Creek, Bell Canyon Creek, Chiquita Creek, Gobernadora Creek, Verdugo Canyon Creek, Oso Creek, Trabuco Creek, and Lucas Canyon Creek. Elevations range from over 5,800 feet above sea level at Santiago

SITE CHARACTERISTICS	
	Peak to sea level at the mouth of San Juan Creek. Specifically, the project site consists of rough/steep terrain, sloping to the southeast.
Drainage Patterns/Connections	In general, the site drains to the southeast, mostly discharging at several points at the south and east property boundary to Long Canyon Creek. Project flows are eventually conveyed to and drain to San Juan Creek located downstream and offsite. San Juan Creek is located in the San Juan (901.00) Hydrologic Unit in the South Orange County Watershed. The descriptions of the project's existing and proposed drainage conditions have been linked with adjacent, downstream VTTMs 35909, 35910 and 35911 located offsite in Riverside County.

SITE CHARACTERISTICS	
Soil Type, Geology, and Infiltration Properties	In general, there are three major geomorphic terrains found within the San Juan Creek watershed: sandy and silty-sandy, clayey, and crystalline. These terrains are manifested primarily as roughly north-south oriented bands of different soil types. The soils and bedrock that comprise the western portions of the San Juan Creek watershed (i.e., Oso Creek, Arroyo Trabuco, and the lower third of San Juan Creek (the location of Planning Area 1) contain a high percentage of clays. The typical of the clayey terrain include the Alo and Bosanko clays on upland slopes and the Sorrento and Mocho loams in floodplain areas. In contrast, the middle portion of the San Juan basin, (i.e., Cañada Chiquita, Bell Canyon, and the middle reaches of San Juan Creek) is a region characterized by silty-sandy substrate that features the Cieneba, Anaheim, and Soper loams on the hillslopes and the Metz and San Emigdio loams on the floodplains. The upstream portions of the San Juan Creek watershed, including the headwaters of San Juan Creek (where the project is sited), Lucas Canyon Creek, Bell Creek, and Trabuco Creek, may be characterized as a "crystalline" terrain because the bedrock underlying this mountainous region is composed of igneous and metamorphic rocks. In this portion of the watershed, slopes are covered by the Friant, Exchequer, and Cieneba soils, while stream valleys contain deposits of rock and cobbly sand. Based on the County of Orange Technical Guidance Document for Preparation of WQMPs and NRCS Web Soil Survey, onsite soils consist primarily of Hydrologic Soil Group "C" soils. However, preliminary geotechnical investigation has encountered scattered areas of soils with favorable infiltration rates.
Hydrogeologic (Groundwater) Conditions	The Mediterranean climate in Southern California is characterized by brief, intense storms between November and March. It is not unusual for a majority of the annual precipitation to fall during a few storms in close time proximity to one another. The higher elevation portions of the watershed typically receive significantly greater precipitation due to the effect of the Santa Ana Mountains. In addition, rainfall patterns are subject to extreme variations from year to year and longer term wet and dry cycles. The combination of steep watersheds, brief intense storms and extreme temporal variability in rainfall results in "flashy" systems where stream discharge can vary by several orders of magnitude over very short

SITE CHARACTERISTICS	
	periods of time. Southern California is characterized by wet and dry cycles, typically lasting up to 15 to 20 years. The area appears to be emerging from a wetter-than-normal cycle of years beginning in 1993. Previously, five consecutive years of sub-normal rainfall and runoff occurred in 1987 through 1991. Prior droughts of note include severe droughts in 1976-77 and 1946-51. Previous notable wet periods in the past occurred in 1937-44 and 1978-83. An unusually long period of generally dry years extended from 1945 through 1977. During this period, rainfall was approximately 25 percent below normal. Both groundwater recharge and sediment transport were considerably diminished during this period. Dry conditions were sufficiently persistent during this period to cause lower groundwater levels and to reduce the size of riparian corridors. Additionally, landslide activity was lessened during this period. The watersheds have been subject to numerous large-scale fires during the past 100 years. Most of these fire events were of human origin. The majority of ignitions have been associated with roadways, arson and person-related activities. Large fire events in the watersheds occurred in 1989, 1961, 1959, 1958, 1952, 1937, 1917 and 1915. The primary effects of these fires are a sharp increase in sediment yield and downstream channel aggradation for a period of time following the fire. Groundwater was not encountered onsite during the project's preliminary geotechnical investigations and percolation testing.
Geotechnical Conditions (relevant to infiltration)	Based on the soils report, the TGD and the NRCS Web Soil Survey, onsite soils consist primarily of Hydrologic Group C soils, which are not conducive for infiltration. However, percolation tests conducted onsite have shown the presence of soils that are more representative of Group B Soils.

SITE CHARACTERISTICS	
Off-Site Drainage	Run-on from natural offsite areas will be collected via proposed storm drain systems and conveyed through the site prior to discharging downstream and offsite. A bulking factor was used in determine the runoff flow rates to account for potential debris present in the storm water run-on from natural areas. Runoff from the proposed project will meet the County of Orange's requirements for hydromodification impacts and storm water pollutant treatment. Therefore, downstream receiving water impacts to the natural drainages for hydromodification and pollutant loading are not anticipated.
Utility and Infrastructure Information	There are no existing utilities and connections onsite. Project improvements will provide wet and dry utility connections to each individual homeowner, with an onsite septic system provided for each lot. Each lot will be subject to the State Water Resources Control Board (SWRCB) Onsite Wastewater Treatment Systems (OWTS) Policy, which establishes a statewide, risk-based, tiered approach for regulation and management of OWTS installations and replacements. Each lot will be considered a Tier 1 OWTS (Low Risk New or Replacement), with a maximum flow rate of 3,500 gpd.

III.3 WATERSHED DESCRIPTION

The following table provides descriptions of the project's receiving waters.

WATERSHED DESCRIPTION	
Receiving Waters	Long Canyon Creek, San Juan Creek, San Juan Creek (Mouth), Pacific Ocean
303(d) Listed Impairments	Pesticides (DDE), Pathogens (Indicator Bacteria), Nutrients (Phosphorus & Total Nitrogen), Metals (Selenium), Toxicity
Applicable TMDLs	Pathogens (Indicator Bacteria)
Pollutants of Concern for the Project	Pollutants of Concern – Suspended Solids/Sediment, Oil and Grease, Trash and Debris Primary Pollutants of Concern – Nutrients, Pathogens, Pesticides

WATERSHED DESCRIPTION	
Environmentally Sensitive and Special Biological Significant Areas	Areas of Special Biological Significance (ASBS) are those areas designated by the State Water Board as ocean areas requiring protection of species or biological communities to the extent that alteration of natural water quality is undesirable. There are no ASBS designations in the vicinity of the project. The project site does not contain any environmentally sensitive areas (ESAs), as defined in the Basin Plan and the County of Orange Drainage Area Management Plan (DAMP). Although the site does not discharge directly to areas defined as ESAs or Areas of Special Biological Significance (ASBS), the site is tributary to impaired water bodies, which are designated as ESAs under DAMP guidelines.

Section IV Best Management Practices (BMPs)

IV.1 PROJECT PERFORMANCE CRITERIA

PROJECT PERFORMANCE CRITERIA	
If HCOC exists, list applicable hydromodification control performance criteria (Per Section 4.1 of SOC HMP)	All Priority Development Projects (PDP) must use continuous simulation to ensure that post-project runoff flow rates and durations for the PDP shall not exceed pre-development, naturally occurring, runoff flow rates and durations by more than 10% of the time, from 10% of the 2-year runoff event up to the 10-year runoff event.
List applicable LID performance criteria (Per Section 7.II-2.4.3 of SOC MWQMP)	• LID BMPs must be designed to retain, on-site, (infiltrate, harvest and use, or evapotranspire) storm water runoff up to 80 percent average annual capture efficiency. • LID BMPs must be designed to: - Retain, onsite, (infiltrate, harvest and use, or evapotranspire) stormwater runoff as feasible up to the Design Capture Volume, and - Recover (i.e., draw down) the storage volume as soon as possible after a storm event, and if necessary - Biotreat, on-site, additional runoff, as feasible, up to 80 percent average annual capture efficiency (cumulative, retention plus biotreatment), and, if necessary - Fulfill alternative compliance obligations for runoff volume not retained or biotreated up to 80 percent average annual capture efficiency using treatment controls or other alternative approaches as described in Section 7.II-3 of the SOC MWQMP.
Calculate LID design storm capture volume for Project.	DCV = C x D x A x 43560 sf/ac x 1 ft/12 in Where: DCV = design storm capture volume, cu-ft C = runoff coefficient = (0.75 x imp + 0.15) Imp = impervious fraction of drainage area (ranges from 0 to 1) D = storm depth (inches) A = tributary area (acres) DCV for each Drainage Management Area is provided in Section IV.2.1.

IV.2 SITE DESIGN AND DRAINAGE PLAN

The primary goal of site design principles and techniques is to reduce land development impacts on water quality and downstream hydrologic conditions. Benefits of site design include reductions in the size of downstream BMPs, conveyance systems, pollutant loading and hydromodification impacts.

IV.2.1 Site Design BMPs

The following section describes the site design BMPs that have been incorporated into this project.

Minimize Impervious Area

The project will increase impervious surfaces as compared to pre-project conditions. However, development of the site will include conservation of existing natural land, open space landscaping areas and private landscaping areas located within each homeowner lot to minimize the project's impervious footprint.

Maximize Natural Infiltration Capacity

Where feasible, lot-specific improvements will be designed with roof downspout disconnection to direct runoff to landscaped areas. Runoff from paved walkways and patios will also be directed to adjacent landscaping areas. Project will also incorporate vegetated drainage swales for storm water conveyance.

Preserve Existing Drainage Patterns and Time of Concentration

The project has been designed to retain existing drainage patterns and the use of vegetated swales and infiltration basins to retain pre-project time of concentration.

Disconnect Impervious Areas

Landscaping will be provided adjacent to walkways, with open space/landscape lots located throughout the project site and within private residential lot areas to disconnect the project's impervious areas.

Protect Existing Vegetation and Sensitive Areas, and Revegetate Disturbed Areas

The project has been designed to conserve approximately 117.3 acres of natural land.

Re-Vegetate Disturbed Areas and Xeriscape Landscaping

Native and/or tolerant landscaping will be incorporated into site design, consistent with County guidelines, in proposed landscaping areas.

IV.2.1 Drainage Management Areas (DMAs)

Per the TGD, the project site has been divided into Drainage Management Areas (DMAs) to be utilized for defining drainage areas tributary to the project's BMPs. DMA limits have been delineated based on the tributary drainage area for each BMP.

The design capture volume (DCV) utilizing the "Simple Method" described in TGD Section III.1.1 is provided below. Locations of DMAs and associated treatment BMPs are provided on the exhibits in Section VI. Additional calculations and TGD Worksheets are provided in Attachment D of this WQMP.

DMA	Tributary Drainage Area (Ac.)	% Imp.	C-value	Design Storm Depth (in.)	Simple Method DCV (ft^3)	Design Intensity (in/hr)	Design Flowrate (cfs)
1	20.13	65	0.6375	1.0	46,583	0.23	2.95
2	4.86	65	0.6375	1.0	11,247	0.23	0.71
3	8.67	65	0.6375	1.0	20,063	0.23	1.27
4	0.55	80	0.75	1.0	1,497	0.23	0.09

IV.3 LID BMP SELECTION AND PROJECT CONFORMANCE ANALYSIS

Per the South County Model WQMP, Low Impact Development (LID) BMPs must be incorporated into design features and source controls to reduce project related storm water pollutants. The incorporation of LID BMPs into project design requires evaluation of LID measures in the following treatment hierarchy: infiltration, evapotranspiration, harvest/reuse and biotreatment.

IV.3.1 Hydrologic Source Controls (HSC)

Hydrologic source controls (HSCs) can be considered to be an integration of site design practices and LID BMPs. The goal of HSCs is to reduce runoff volume for a given drainage area without reducing the site's true impervious area.

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)	☐

Runoff from the project's roof drains and pavement areas will be directed to adjacent landscaping areas (wherever feasible) to allow for some filtration of runoff prior to discharging to the project's drainage system.

Since the project has proposed infiltration BMPs to provide full retention of the project's DCV, the effects of individual HSC BMPs have not been calculated.

IV.3.2 Infiltration BMPs

Infiltration BMPs are LID BMPs that capture, store and infiltrate storm water runoff. These BMPs are engineered to store a specified volume of water and have no design surface discharge (underdrain or outlet structure) until this volume is exceeded. Examples of infiltration BMPs include infiltration trenches, bioretention without underdrains, drywells, permeable pavement, and underground infiltration galleries.

Infiltration basins were selected based on their ability to treat the project's pollutants of concern, in accordance with the Model WQMP and TGD requirements

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:	☐

The project will employ infiltration basins and drywells, as shown in the WQMP Site Plan. Although current County Soil Maps indicate that the underlying soil consists of Type C soils, percolation tests conducted onsite have found areas with favorable infiltration rates.

The project's proposed infiltration BMPs have been designed for the Design Capture Volume (DCV) and will function to capture, store and infiltrate runoff. Prior to runoff entering the basins, runoff will receive pre-treatment via proposed vegetated swales. Pre-treatment of runoff entering the drywells include a combination of pervious pavement and the Maxwell Plus pre-treatment unit.

Summary of the basins is provided in the following table:

DMA	Simple Method DCV (ft^3)	Basin Footprint (ft)*	Basin Capacity (ft^3)
1	46,583	175x85x6	82,328
2	11,247	115x42x5	21,344

*Footprint based on variable depth and 3:1 side slopes

Summary of the drywells and subsurface detention facilities is provided in the following table:

DMA	Simple Method DCV (ft^3)	Vault Footprint (ft)*	Vault Capacity (ft^3)
3	20,063	50x95x5	24,393
4	1,273	19x55x3	3,485

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

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

Evapotranspiration

Evapotranspiration BMPs are a class of retention BMPs that discharges stored volume predominately to ET, through some infiltration may occur. ET includes both evaporation and transpiration, and ET BMPs may incorporate one or more of these processes. BMPs must be designed to achieve the maximum feasible ET, where required to demonstrate that the maximum amount of water has been retained on-site.

Harvest and Reuse

Harvest and Reuse (aka. Rainwater Harvesting) BMPs are LID BMPs that capture and store storm water runoff for later use. These BMPs are engineered to store a specified volume of water and have no design surface discharge until this volume is exceeded. Harvest and use BMPs include both above-ground and below-ground cisterns. Examples of uses for harvested water include

irrigation, toilet and urinal flushing, vehicle washing, evaporative cooling, industrial processes and other non-potable uses.

The project does not propose the use of evapotranspiration or harvesting BMPs, as the project's requirement for LID BMPs has addressed via infiltration basins.

IV.3.4 Biofiltration BMPs

Biofiltration BMPs are a class of structural LID BMPs that treat suspended solids and dissolved pollutants in storm water using mechanisms characteristic of biologically active systems. These BMPs are considered treat and release facilities and include treatment mechanisms that employ soil microbes and plants. Additional benefits of these BMPs may include aesthetic enjoyment, recreational use, wildlife habitat and reduction in storm water volume.

The project does not propose the use of biofiltration BMPs as the primary LID BMP to address project pollutants, as the project's requirement for LID BMPs has been addressed via infiltration BMPs. Vegetated swales will be employed as a pre-treatment BMP and runoff conveyance for DMA 1, 2 and 3.

BIOFILTRATION		
ID	Name	Included?
BIO-1	Bioretention with underdrains	☐
	Stormwater planter boxes with underdrains	☐
	Rain gardens with underdrains	☐
BIO-7	Proprietary vegetated biotreatment systems	☐
BIO-2	Other: Vegetated Swale	☒

A summary of the project's vegetated swales are as follows:

BIOFILTRATION (VEGETATED SWALE) DESIGN SUMMARY								
Drainage Management Area (DMA)*	Tributary Drainage Area (acres)	% Imp.	Runoff Coefficient	Tc (min)	Design Storm Intensity (in.)	Q (ft^3/s)	Swale Length (ft)*	Swale Width (ft)*
1	20.13	65	0.6375	10	0.23	2.95	2,762	2 at 7'
2	6.22	65	0.6375	10	0.23	0.71	524	2 at 4'
3	8.52	65	0.6375	10	0.23	1.27	3680	2 at 7'

* No swale proposed for DMA 4.

IV.3.5 Hydromodification Control BMPs

The South Orange County Hydrology Model (SOCHM) was used to determine the project's hydromodification requirements.

HYDROMODIFICATION CONTROL BMPS	
BMP Name	BMP Description
Infiltration Basins	Infiltration basins will be employed to address the project's HCOC for DMA 1 and 2.
Drywell	Drywells will be employed to address the project's HCOC for DMA 3 and 4.
Vegetated Swales	Vegetated swales will be employed for storm water conveyance and pre-treatment. The swales will also be employed to address the project's HCOC for DMA 1, 2 and 3.

With implementation of the proposed BMPs to address hydromodification impacts, the proposed project would not have any HCOC. The project's hydromodification analysis is provided in Attachment C of this WQMP.

Source Control BMPs

In accordance with the County DAMP and County of Orange Local Implementation Plan (LIP), both structural and non-structural source control BMPs are required for all priority projects unless deemed not applicable based on project characteristics. The following tables summarize the source control BMPs (Non-Structural and Structural) specified in the County DAMP and the Technical Guidance Document.

The following tables show source control BMPs (routine non-structural and routine structural) included in this project and those that were not included.

IV.3.8 Non-Structural Source Control BMPs

The Table below indicates all Non-Structural Source Control BMPs to be utilized in the project. Additional discussions of the selected BMPs are provided in the BMP Inspection and Maintenance Responsibility Matrix provided in Section V of this WQMP.

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	☒	☐	

NON-STRUCTURAL SOURCE CONTROL BMPS				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Proposed project will not generate waste subject to Title 22 CCR compliance.
N6	Local Industrial Permit Compliance	☐	☒	Not applicable to residential.
N7	Spill Contingency Plan	☐	☒	Proposed project will not generate waste or store materials subject to the requirements of Chapter 6.95 of the CA Health and Safety Code.
N8	Underground Storage Tank Compliance	☐	☒	No underground storage tanks proposed for the project.
N9	Hazardous Materials Disclosure Compliance	☐	☒	Proposed project will not store or generate hazardous materials subject to agency requirements.
N10	Uniform Fire Code Implementation	☐	☒	Proposed project does not propose to store toxic or highly toxic compressed gases.
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☐	☒	Not applicable to residential projects.
N13	Housekeeping of Loading Docks	☐	☒	No loading docks proposed for project.
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	No gasoline outlets proposed.

N1 – Education for Property Owners, Tenants and Occupants

Educational materials will be provided to homeowners at close of escrow by owner/developer and periodically thereafter by the HOA to inform them of their potential impacts to downstream water quality. Materials include those described in Section VII of this WQMP and provided in the Final WQMP for the project.

N2 – Activity Restrictions

Activity restrictions to minimize potential impacts to water quality and with the purpose of protecting water quality will be prescribed by the project's Covenant, Conditions and Restrictions (CC&Rs), or other equally effective measure.

N3 – Common Area Landscape Management

Ongoing maintenance shall be consistent with County Water Conservation Resolution. Any fertilizer and/or pesticide usage shall be consistent with County Management Guidelines for Use of Fertilizers (DAMP Section 5.5) and per manufacturer's recommendations.

N4 – BMP Maintenance

Responsibility for implementation, inspection and maintenance of all BMPs (structural and non-structural) shall be consistent with the BMP Inspection and Maintenance Responsibilities Matrix provided in Section V of this WQMP, with documented records of inspections and maintenance activities completed.

N11 – Common Area Litter Control

Litter patrol, emptying of trash receptacles in common areas, and noting trash disposal violations by residents and reporting the violations to the HOA for investigation shall be conducted.

N14 – Common Area Catch Basin Inspection

As required by the TGD, at least 80% of all privately-maintained drainage facilities shall be inspected each year and, if necessary, cleaned and maintained prior to the storm season, no later than October 15th each year; 100 % of all privately-maintained drainage facilities shall be inspected, cleaned and maintained in a two year period. Drainage facilities include catch basins and inlets, detention basins, the project's treatment BMPs, open drainage channels, and lift stations.

N15 – Street Sweeping Private Streets and Parking Lots

Private streets shall be swept at a minimum prior to the storm season, in early fall or late summer.

Refer to Section V for implementation frequency and maintenance responsibilities.

IV.3.9 Structural Source Control BMPs

The source control BMPs have been selected in the following table to address the anticipated pollutants generated by the proposed project. These BMPs are designed to work in conjunction with the project's LID BMPs to minimize potential impacts to the site's receiving waters.

STRUCTURAL SOURCE CONTROL BMPS				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	No outdoor storage areas proposed for project.
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☐	☒	No designated waste storage areas or trash enclosures proposed onsite.
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	☐	☒	No dock areas proposed for project.
S7	Maintenance bays	☐	☒	No maintenance bays proposed for project.
S8	Vehicle wash areas	☐	☒	No vehicle washing anticipated.
S9	Outdoor processing areas	☐	☒	No outdoor processing areas.
S10	Equipment wash areas	☐	☒	No equipment wash areas proposed.
S11	Fueling areas	☐	☒	No fueling areas in project scope.
S12	Hillside landscaping	☒	☐	
S13	Wash water control for food preparation areas	☐	☒	Project is residential.

STRUCTURAL SOURCE CONTROL BMPS				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S14	Community car wash racks	☐	☒	No community wash racks proposed.

S1 – Provide Storm Drain System Stenciling and Signage (CASQA SD-13)

Storm drain stenciling with a brief message or graphical icons with symbols, prohibiting the dumping of improper materials into the storm drain system shall be placed in highly visible areas adjacent to all storm drain inlets. The BMP is designed to alert, educate and discourage the public of the destination of pollutants discharged into storm drain systems. Legibility of stencils and signs shall be maintained.

S4 – Efficient Irrigation System & Landscape Design (CASQA SD-10 & SD-12)

Landscaping will be designed to consist of native species or drought tolerant, water conserving landscaping. Irrigation system will be designed, constructed and adjusted to eliminate overspray to hardscape areas, with timing and cycle lengths adjusted in accordance with water demands, given time of year, weather, day or night time temperatures based on system specifications and local climate patterns.

S5 – Project Slopes and Channels

Energy dissipation devices shall be included at culvert outlets to reduce runoff velocity and decrease the potential for erosion of slopes and/or channels.

S12 – Hillside Landscaping

Hillside areas that are disturbed by project development shall be landscaped with deep-rooted, drought tolerant plant species selected for erosion control and consistent with County of Orange requirements.

IV.4 ALTERNATIVE COMPLIANCE PLAN (IF APPLICABLE)

The project is able to fully capture the design capture volume via onsite LID BMPs. Therefore, an alternative compliance plan is not applicable to this project.

IV.4.1 Request of Waiver of LID BMPs

Not applicable to project. Project will utilize LID BMPs to address project runoff.

IV.4.2 Water Quality Credits

Not applicable to project. Project will utilize LID BMPs to address project runoff.

IV.4.3 Treatment Control BMPs

Not applicable to project. Project will utilize LID BMPs to address project runoff.

IV.4.4 Regional/Sub-Regional LID BMPs

Not applicable. Project will incorporate onsite LID BMPs. Project will not participate in any regional/sub-regional programs.

IV.4.5 Other Alternative Compliance Measures

Not applicable. Project will capture and treat all runoff via a regional LID BMP.

Section V Inspection/Maintenance Responsibility for BMPs

It has been determined that the Owner, The Preserve at San Juan, LLC, shall assume all BMP funding, inspection and maintenance responsibilities for the project until such time, these responsibilities have been turned over to the HOA, as appropriate.

Contact/Title	Jeff Weber, Managing Member
Company	The Preserve at San Juan, LLC
Address	100 Pacifica, Suite 345 Irvine, CA 92618
Email	jweber@preserve.com
Telephone #	(949) 296-3078

The owner shall verify BMP implementation and ongoing maintenance through inspection, self-certification or other equally effective measure. The certification shall verify that the inspection and maintenance of all BMPs are performed in accordance to the requirements of this WQMP.

The BMP Inspection and Maintenance Responsibility Matrix is provided in the following table:

BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
BMP		Inspection/ Maintenance Activities Required	Minimum Frequency	Reponsible Party(s)
INFILTRATION BMPs				
INF-1 (TC-11)	Infiltration Basin	Ensure that water infiltrates into the subsurface completely and that vegetation is carefully managed to prevent vectors. Inspect for erosion, standing water, trash, debris, excessive vegetation. Remove accumulated sediment and regrade when sediment volume exceeds 10% of basin.	Semi-Annually	HOA
INF-5	Drywell	Ensure that water infiltrates drywell within 48 hours after end of storm event. Inspect unit for standing water, debris, trash, sediment and other materials that may impact infiltration rate.	Semi-Annually and per manufacturer	HOA

BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
HYDROLOGIC SOURCE CONTROL BMPs				
HSC-2	Impervious Area Dispersion	Conduct general inspection and maintenance weekly per routine landscaping maintenance activities. Trim, remove, replace mulch or vegetation as necessary. Inspect for standing water or saturated conditions. Conduct bi-annual landscaping health evaluations.	Weekly/Semi-Annual	Homeowner/ HOA
BIOFILTRATION BMPs				
BIO-2 (TC-30)	Vegetated Swales	Maintenance includes, weeding, and debris removal on a weekly basis and mowing on a monthly basis to maintain designed vegetation height. Trimming, reseeding, replanting and replacement of dying/deceased vegetation shall be performed on an as-needed basis. Trimmings, clippings, and other waste shall be properly disposed of off-site in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and drain inlets. Inspect at minimum twice per year for erosion and with routine maintenance for burrows and standing water.	Weekly, Monthly and Semi-Annually	HOA
NON-STRUCTURAL SOURCE CONTROL BMPs				
N1	Education for Property Owners, Tenants and Occupants	Educational materials will be provided to homeowners at close of escrow by the developer and thereafter on an annual basis by the HOA. Materials shall include those provided listed in Section VII of this WQMP.	Annually	HOA

BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
N2	Activity Restrictions	The Owner will prescribe activity restrictions to protect surface water quality, through a Covenant, Conditions and Restrictions (CC&Rs) agreement, or other equally effective measure, for the property. Upon takeover of site responsibilities by the Homeowners Association (HOA), the HOA shall be responsible for ensuring residents compliance.	Ongoing	HOA
N3	Common Area Landscape Management	Maintenance shall be consistent with County requirements, plus fertilizer and/or pesticide usages shall be consistent with County guidelines for use of fertilizers and pesticides (OC DAMP Section 5.5). Maintenance includes mowing, weeding, and debris removal on a weekly basis. Trimming, replanting and replacement of mulch shall be performed on an as-needed basis. Trimmings, clippings, and other waste shall be properly disposed of off-site in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and drain inlets.	Weekly	HOA
N4	BMP Maintenance	Maintenance of BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP. Records of inspections and BMP maintenance shall be maintained by the responsible party and documented with the WQMP, and shall be available for review upon request.	Ongoing	HOA

BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
N11	Common Area Litter control	Litter patrol, violations investigation, reporting and other litter control activities shall be performed in conjunction with maintenance activities. Littler collection and removal shall be performed on a weekly basis.	Weekly	HOA
N12	Employee Training	The owner/HOA shall educate all new employees and contractors on storm water pollution prevention, particularly good housekeeping practices upon hire. Refresher courses shall be conducted on an annual basis, and as needed. Materials that may be used are attached to this WQMP.	Annually	HOA
N14	Common Area Catch Basin Inspection	80% of the project's storm drain system, including catch basin inlets, area drains, swales, curb-and-gutter systems and other drainage systems shall be inspected, cleaned and maintained on an annual basis. 100% of the system shall be inspected, cleaned and maintained within a two-year period.	Annually	HOA
N15	Street Sweeping Private Streets	Streets shall be swept prior to the storm season, in late summer or early fall.	Annually	HOA
STRUCTURAL SOURCE CONTROL BMPs				
S1 SD-13	Provide storm drain system stencilling and signage	Storm drain stencils shall be inspected for legibility, at minimum, once prior to the storm season, no later than October 1st each year. Those determined to be illegible will be re-stencilled as soon as possible.	Annually	HOA

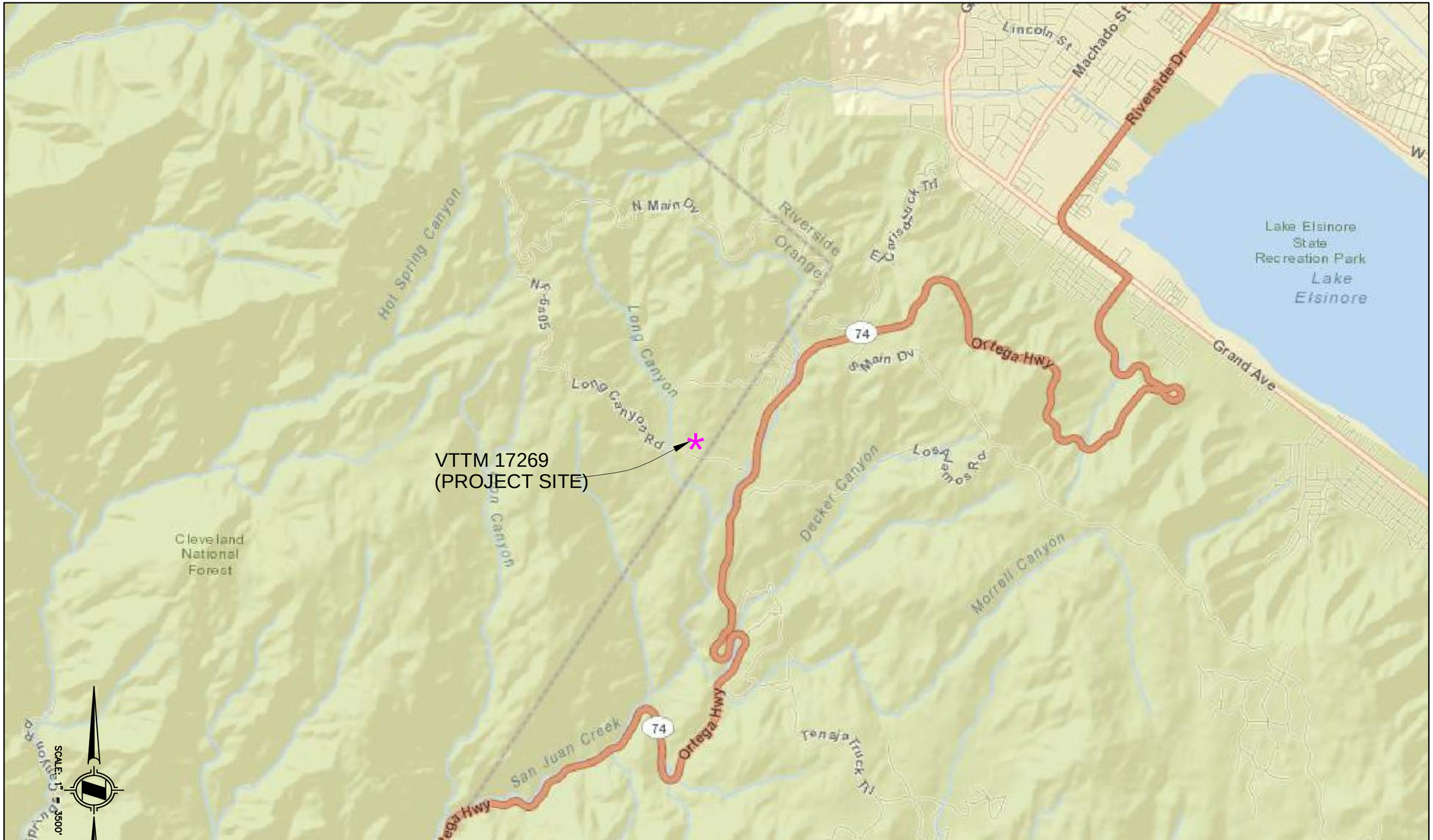
BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
S4 SD-12	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	In conjunction with routine maintenance activities, verify that landscape design continues to function properly by adjusting properly to eliminate overspray to hardscape areas, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, weather, day or night time temperatures based on system specifications and local climate patterns.	Monthly	HOA
S5	Protect Slopes and Channels	Slopes and swales shall be inspected for rills, dead or dying vegetation and repaired with routine landscaping maintenance. Energy dissipaters shall be inspected for signs of erosion.	Monthly and Annually	HOA
S12	Hillside Landscaping	Hillside landscaping shall be inspected for rills and dead or dying vegetation. Areas shall be repaired with routine landscaping maintenance operations.	Monthly	HOA

Section VI Site Plan and Drainage Plan

The exhibits provided in this section are to illustrate the post construction BMPs prescribed within this WQMP. Drainage flow information of the proposed project, such as general surface flow lines, concrete or other surface drainage conveyances, and storm drain facilities are also depicted. All structural source control and treatment control BMPs are shown as well.

Exhibits

- Vicinity Map
- WQMP Site Plan Exhibit



DRAWN BY: TIH	HUNSAKER & ASSOCIATES IRVINE, INC. PLANNING ▪ ENGINEERING ▪ SURVEYING Three Hughes, Irvine, CA 92618 ▪ PH: (949) 583-1010 ▪ FX: (949) 583-0759	PREPARED FOR: *THE PRESERVE AT SAN JUAN, LLC* 100 PACIFICA, SUITE 345 IRVINE, CA 92618 TELEPHONE: (949) 296-3078	***"THE PRESERVE"*** ***VESTING TENTATIVE TRACT MAP NO. 17269*** ***PA 130026*** ***COUNTY OF ORANGE, CA***
DATE: 07/25/14			
REVISED:			
W.O. #: 3852-1			

CONCEPTUAL WQMP VICINITY MAP

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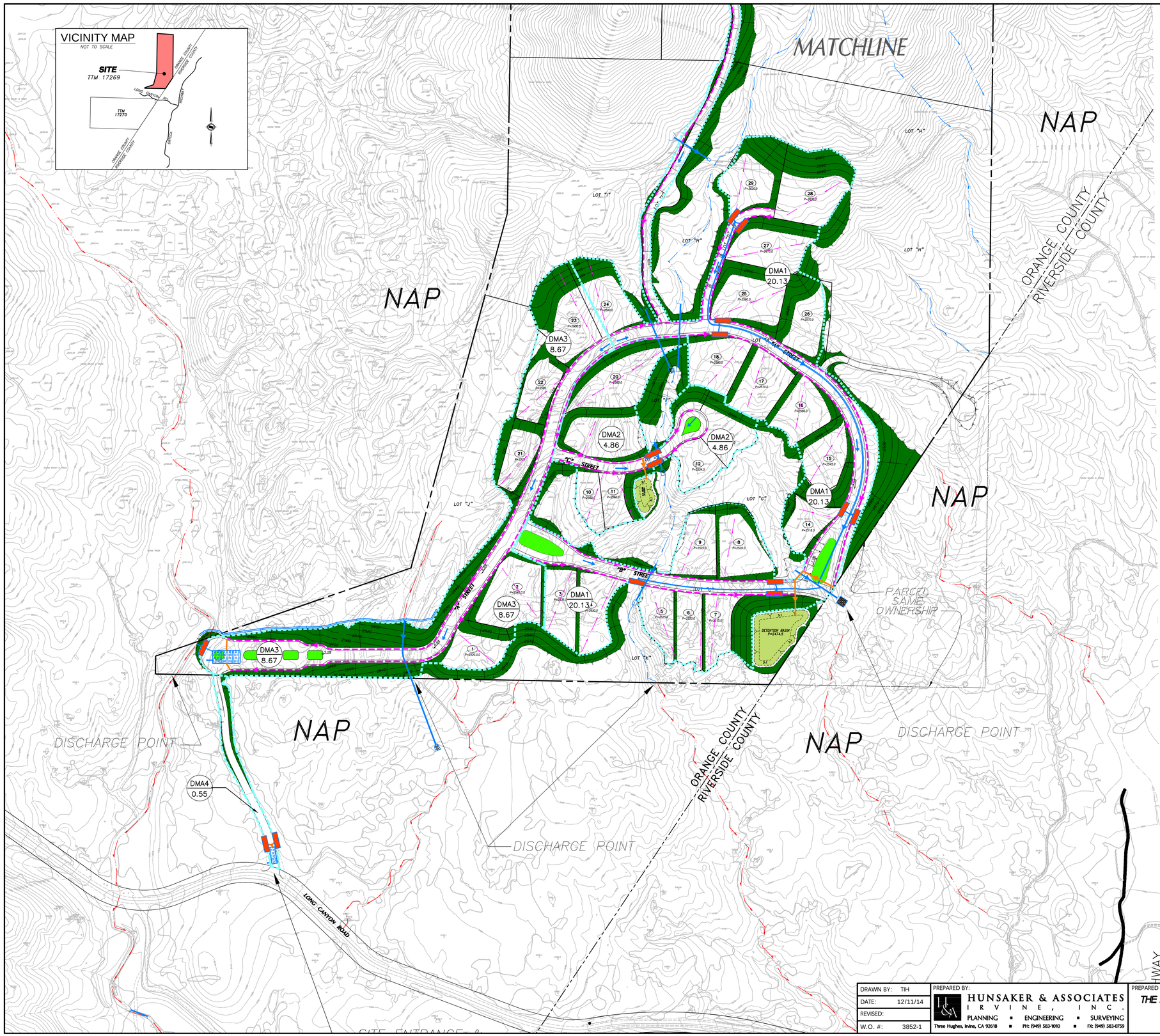

LEGEND

- TRACT BOUNDARY
- NAP — NOT A PART
- DIRECTION OF FLOW (ONSITE)
- DIRECTION OF FLOW (OFFSITE)
- DIRECTION OF DCV FLOW (TYPICAL) FROM LOT TO BIOSWALE
- DRAINAGE MANAGEMENT AREA (DMA) BOUNDARY
- 188 / 7.85 — DMA DESIGNATION AND ACREAGE
- BIO-2 VEGETATED SWALE & DCV FLOW DIRECTION
- PROPOSED STORM DRAIN & FLOW DIRECTION
- PROPOSED DCV DRAIN & FLOW DIRECTION
- LANDSCAPE AREAS (PRIVATE) WITH BMP's: S4 (SD-10, 12) SITE DESIGN/LANDSCAPE PLANNING, EFFICIENT IRRIGATION HSC-3 CANOPY INTERCEPTION
- LANDSCAPE SLOPES (PRIVATE) WITH BMP's: S4 (SD-10, 12) SITE DESIGN/LANDSCAPE PLANNING, EFFICIENT IRRIGATION HSC-3 CANOPY INTERCEPTION
- INF-1 INFILTRATION BASIN
- SUBSURFACE DETENTION FACILITY WITH DRYWELL (INF-5)
- CATCH BASIN (PROPOSED)

BIOFILTRATION (VEGETATED SWALE) DESIGN SUMMARY								
Drainage Management Area (DMA)*	Tributary Drainage Area (acres)	% Imp.	Runoff Coefficient	Tc (min)	Design Storm Intensity (in.)	Q (ft^3/s)	Swale Length (ft)*	Swale Width (ft)*
1	20.13	65	0.6375	10	0.23	2.95	2,762	2 at 7'
2	6.22	65	0.6375	10	0.23	0.71	524	2 at 4'
3	8.52	65	0.6375	10	0.23	1.27	3680	2 at 7'

* No swale proposed for DMA 4.

INFILTRATION BMP DESIGN SUMMARY				
DMA	Simple Method DCV (ft^3)	BMP	Footprint (ft)**	Basin Capacity (ft^3)
1	46,583	Basin	175x85x6	82,328
2	11,247	Basin	115x42x5	21,344
3	20,063	Drywell*	50x95x5	24,393
4	1,273	Drywell	19x55x3	3,485

*Footprint based on variable depth and 3:1 side slopes
** Drywell infiltration volume footprint based on vault configuration

NOTES

1. ASSESSOR PARCEL NUMBERS: 125-120-32 AND 12
2. DESIGN CAPTURE VOLUME (DCV) FROM LOTS AND STREETS FROM DMA 1 and 2 CONVEYED IN BIOSWALES PRIOR TO DISCHARGING TO INFILTRATION BMPs.
3. DESIGN CAPTURE VOLUME (DCV) FROM DMA 3 CONVEYED VIA BIOSWALES TO DRYWELL.
4. DESIGN CAPTURE VOLUME (DCV) FROM DMA 4 CONVEYED AS GUTTER FLOW TO DRYWELL.

SCALE: 1" = 150'

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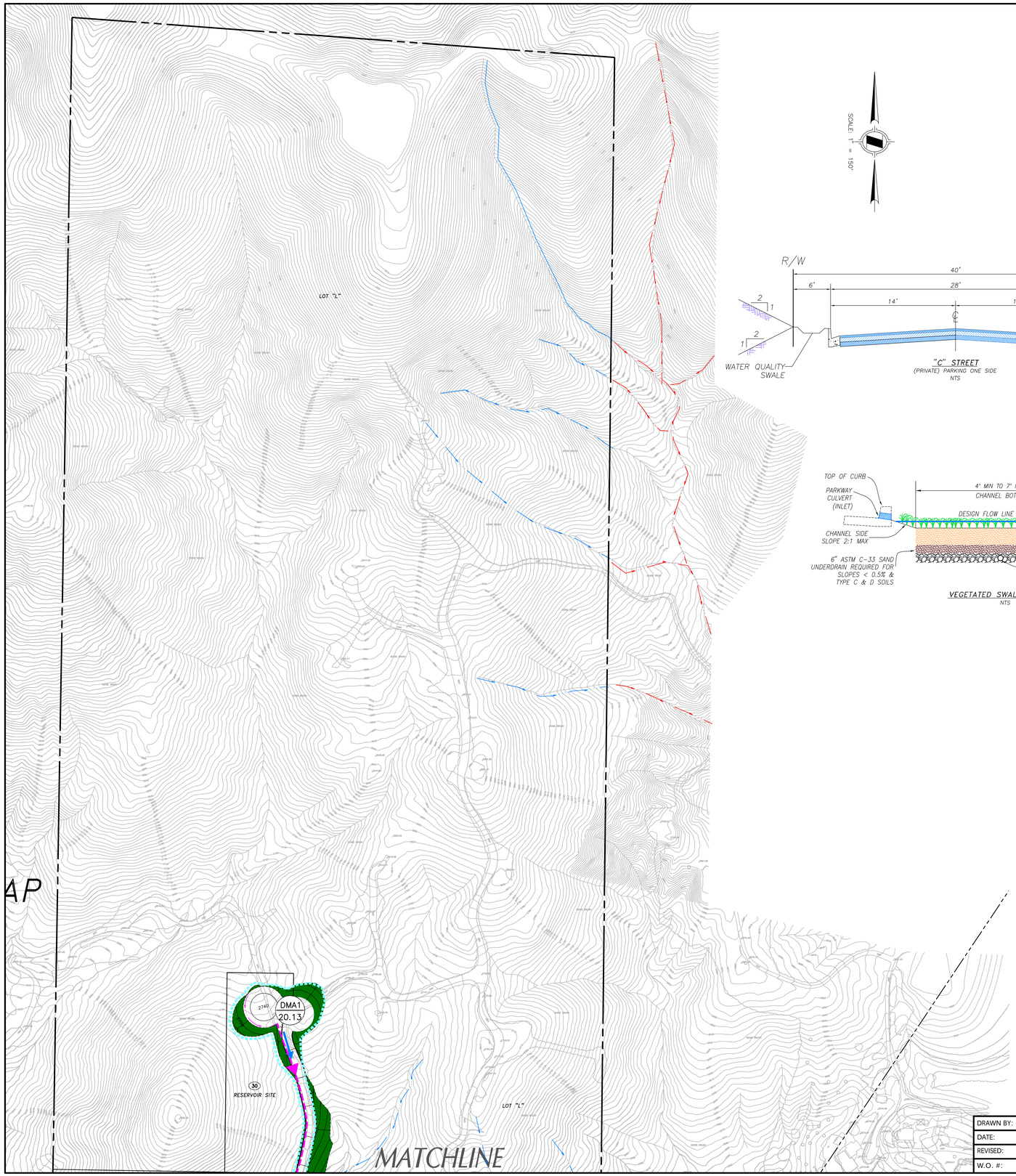
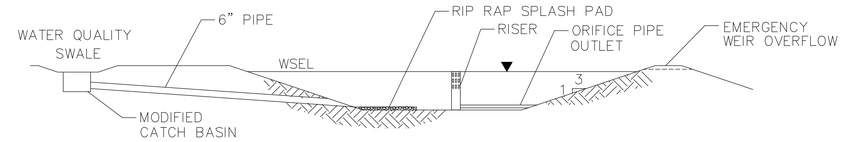
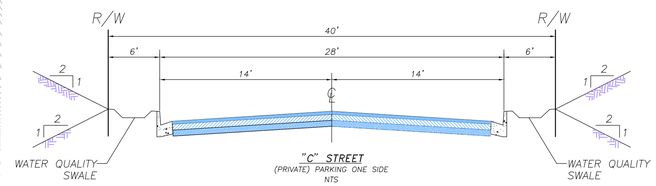
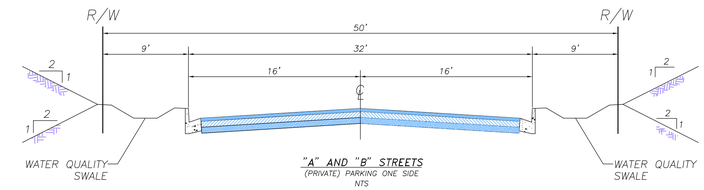




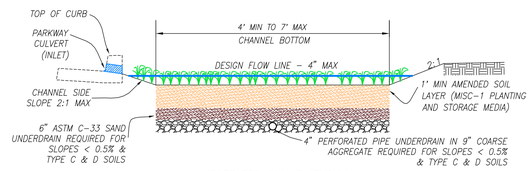
INFILTRATION BASIN, INLET/OUTLET DETAILS (TYPICAL)
NTS



"C" STREET
(PRIVATE) PARKING ONE SIDE
NTS



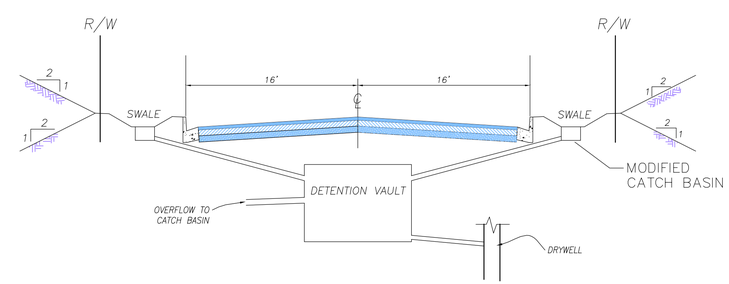
"A" AND "B" STREETS
(PRIVATE) PARKING ONE SIDE
NTS



VEGETATED SWALE (TYPICAL)
NTS

VEGETATED SWALE INLET
NTS

VEGETATED SWALE OUTLET
NTS



SUBSURFACE DETENTION VAULT TO DRYWELL
NTS

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Section VII Educational Materials Included

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)	☐		☐
Recycle at Your Local Used Oil Collection Center (Central County)	☐		☐
Recycle at Your Local Used Oil Collection Center (South County)	☒		☐
Tips for Maintaining a Septic Tank System	☒		☐
Responsible Pest Control	☒		☐
Sewer Spill	☒		☐
Tips for the Home Improvement Projects	☒		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☒		☐
Tips for Pet Care	☒		☐
Tips for Pool Maintenance	☐		☐
Tips for Residential Pool, Landscape and Hardscape Drains	☒		☐
Tips for Projects Using Paint	☒		☐

Attachment A

Educational Materials

Educational materials to be provided at Final WQMP.

Attachment B

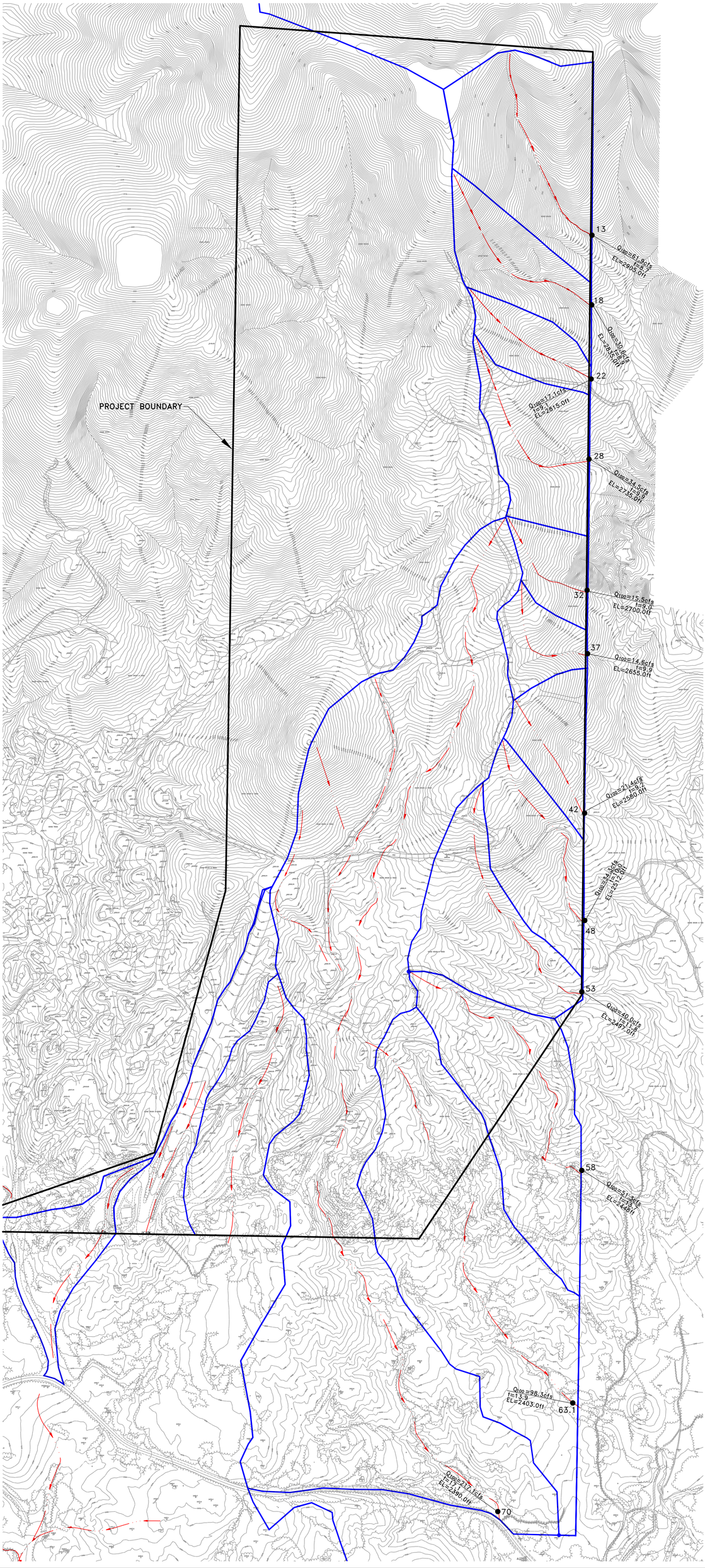
Conditions of Approval

Project Conditions of Approval are not available and have not yet been applied. Once Project Conditions of Approval have been approved by the County of Orange, they will be provided in this section.

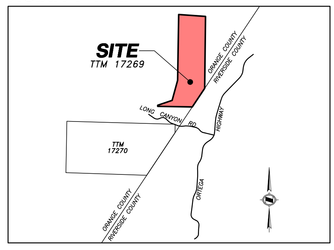
Attachment C

Hydrology Maps/Hydromodification Management Plan

Hydrology Maps



VICINITY MAP



LEGEND

	MAJOR DRAINAGE BOUNDARY
12 ●	NODE NUMBER
Q100=29.5cfs T=8.0 EL=3050.0ft	PEAK FLOW RATE TIME OF CONCENTRATION ELEVATION POINT
	FLOW LINE

SCALE: 1" = 200'

200 100 0 200 600

GRAPHIC SCALE 1"=200'

PREPARED BY:

HUNSAKER & ASSOCIATES
IRVINE, INC.
PLANNING • ENGINEERING • SURVEYING
Three Hughes • Irvine, CA 92618 • Ph: (949) 583-1010 • Fx: (949) 583-0759

EXISTING HYDROLOGY MAP
THE PRESERVE
AT SAN JUAN - NORTH

WO: 3226-1
HYDROLOGY MAP THE PRESERVE

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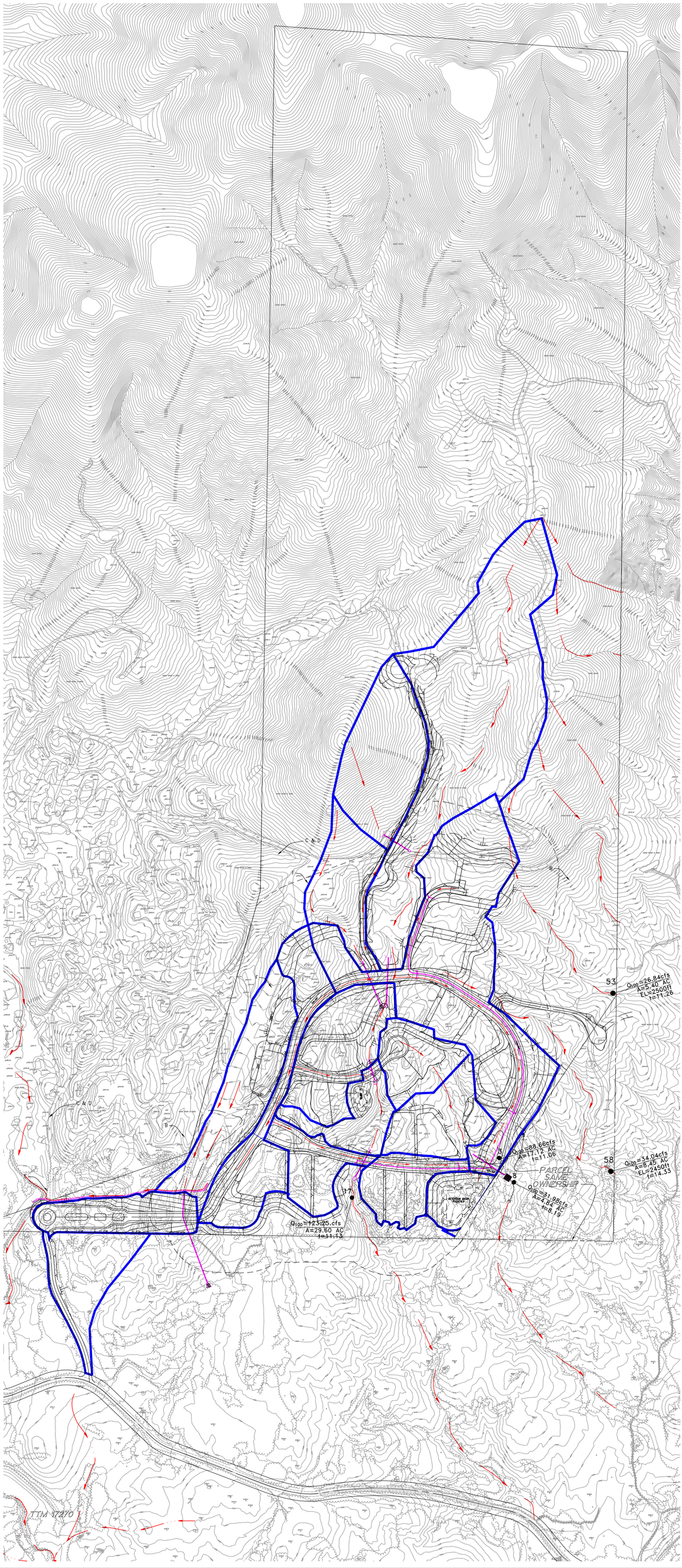
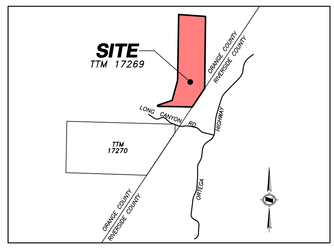
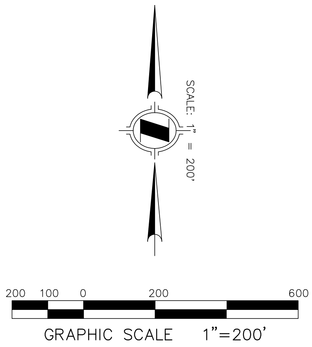


VICINITY MAP



LEGEND

	MAJOR DRAINAGE BOUNDARY
12 ●	NODE NUMBER
Q100=29.5cfs t=8.0 EL=3050.0ft	PEAK FLOW RATE TIME OF CONCENTRATION ELEVATION POINT
	FLOW LINE



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PROPOSED HYDROLOGY MAP
THE PRESERVE
AT SAN JUAN - NORTH

WO: 3226-1
HYDROLOGY MAP THE PRESERVE

\\ASHUR\Projects\0188\Planning\OA_Project\Hydrology\EXHIBIT Hydrology North – Proposed.dwg

Hydromodification Management Plan

PRELIMINARY HYDROMODIFICATION ANALYSIS

FOR

The Preserve at San Juan – North

Vesting Tentative Tract Map No. 171269
Planning Application PA130026

County of Orange
& Riverside

December 2014

PREPARED UNDER THE SUPERVISION OF:

Francisco Calderon, R.C.E. 58840, Exp. 6/30/16 Date:

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	A. PROJECT LOCATION
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	B. Natural Peak Events / Proposed Peak Events
	C. Swale Summary Table
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3	**EXHIBITS**
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INTRODUCTION

A. PROJECT LOCATION

The Preserve project site is located in the City of Rancho Santa Margarita, County of Orange/Riverside. The Preserve is bounded by the Old Dominion Mine to the north and Ortega Highway to the east. Long Canyon runs between The Preserve at San Juan north and south (see attached vicinity map for details).

B. STUDY PURPOSE

The purpose of this study is to determine the basis for analyzing and designing hydromodification, mitigation, and improvements for the proposed redevelopment.

Hydromodification control facilities (structural BMP's) are required to comply with the South Orange County Hydromodification Management Plan (HMP) per current MS4 Permit. The method used to size the system is per Orange County's Model WQMP Technical Guidance Document in conjunction with South Orange County Hydrology Model.

The MS4 Permit (South Orange County) defines hydromodification as the change in the natural watershed due to urbanization. This urbanization can lead to increased flows in the stream and excess sediment transport. In addition biological impacts can occur in the streams. The following are the criteria in which projects must comply with according to the MS4 Permit:

1. Flow rates from 10 percent of the 2-year storm event to the 10 year storm event, the post-project peak flows shall not exceed predevelopment peak flows.
2. For flow rates from the 5 year storm event to the 10 year storm event, the post-project peak flows may exceed pre-development flows by up to 10 percent for a 1 year frequency interval.

C. ANALYSIS

The pre-development shows that the existing condition of our property was on land that was fairly steep and had a slope of nearly 30%. For calculation purposes, we are using only 10% as a conservative approach. The soil type for the area is Type C in the majority of the area with patches of soil in the Type B category. For our approach, we used Type C for the soil. This tells us that permeability will be fairly low and our calculation approach will depend little on it. For the purpose of efficiency, we assumed the vegetation to be medium brush with the Impervious factor of 10%. This is enough to cover exposed rocks or concrete.

The proposed Preserve Development is comprised of property with a lot of natural land. The streets vary between a 28' to 32' width with a swale on either side. The swale varied between a 6' to 9' wide. The purpose is to keep the development as close to natural state as possible with the swale used as a walking path and also as a pretreatment for Water Quality purposes. In our analysis, we were able to take advantage of the vegetative swales for Hydromod purposes. Since the swales are on either side of the street, we were able to increase the area being used for mitigation. For nodes 68 and 69, since there is no room for a large basin, and underground basin is proposed which will discharge into a drywell.

Breaking up the development into smaller areas was essential to accurately analyze the flow patterns and calculate what is needed for hydromodification. A total of 4 different areas were used for this study. Most the areas took advantage of the use of the vegetation swale and others needed both the vegetation swale with the additional basin for infiltration. A summary of the different basins with their corresponding basin sizes are located in our tables in this report.

D.SIMULATION

Hydrologic simulation was done with continuous rainfall data, Trabuco rain station (National Climatic Data Center or NCDC). The data was analyzed using South Orange County Hydrology Model (SOHM). The statistical data in SOHM was used to calculate the 2 yr. 5 yr. and 10 yr. Vegetation swales and basins were all modeled using SOHM. SOHM calculates flow duration curve by calculating several hundred iterations until the proposed flow duration curve matches closest to the pre-developed flow duration curve. Each plot demonstrates the proposed curves are below the predevelopment flow durations between 0.1Q2 and Q10.

E.CONCLUSION

The calculations herein this report conclude that each plot comparison demonstrates that the proposed BMP's satisfy the HMP requirements. The BMP's were designed so that the system is not contingent on any testing of the soil for infiltration. Any infiltration occurring during actual use will only improve system performance.

Area Summary Table

Hydrologic Characteristic	Natural Node 3	Natural Node 15	Proposed Node 3	Proposed Node 15
Drainage Area	17.12 Ac	6.22 Ac	17.12 Ac	6.22 Ac
Soil Type	C	C	C	C
Vegetation Cover	Med. Shrub	Med. Shrub	LS C.A.	LS C.A.
Impervious Cover	10.00%	10.00%	65.00%	65.00%
Overland Slope	20.00%	20.00%	8.00%	8.00%

Hydrologic Characteristic	Natural Node 68	Natural Node 69	Proposed Node 68	Proposed Node 69
Drainage Area	8.52 Ac	0.55 Ac	8.52 Ac	0.55 Ac
Soil Type	C	C	C	C
Vegetation Cover	Med. Shrub	Med. Shrub	LS C.A.	LS C.A.
Impervious Cover	10.00%	10.00%	65.00%	80.00%
Overland Slope	20.00%	20.00%	8.00%	8.00%

Peak Event for Natural Condition Simulation

Node 3

Q2	8.53 cfs
Q5	13.39 cfs
Q10	10.68 cfs

Node 15

Q2	2.63 cfs
Q5	4.13 cfs
Q10	6.08 cfs

Node 68

Q2	3.61 cfs
Q5	5.66 cfs
Q10	8.33 cfs

Node 69

Q2	0.23 cfs
Q5	0.37 cfs
Q10	0.53 cfs

Peak Event for Mitigated Condition Simulation

Node 3

Q2	5.69 cfs
Q5	11.23 cfs
Q10	15.02 cfs

Node 15

Q2	1.87 cfs
Q5	4.09 cfs
Q10	5.72 cfs

Node 68

Q2	1.44 cfs
Q5	5.55 cfs
Q10	8.33 cfs

Node 69

Q2	0.20 cfs
Q5	0.40 cfs
Q10	0.48 cfs

Swale Summary Table

Node	Tc(min)	Area (Ac)	Swale Length	Swale Width	Slope (%)	%imp	C	Q (cfs)
3	10	17.12	2,762	14	6	0.65	0.6375	2.51
15	10	6.22	524	8	6	0.65	0.6375	0.91
68	13	8.52	3680	14	6	0.65	0.6375	1.25

Hydromodification Basin Requirements

Location	Node	Area(Ac)	Basin Size Supplied	Basin Volume(ac-ft) Required)
North	3	18.5	175x85x6	1.89
North	15	6.22	115x42x5	0.49
North	68	8.52	50x95x5	0.56
North	69	0.55	19x55x3	0.08

100 Yr. Basin Requirement

Location	Node	Area(Ac)	Basin Size Required	Basin Volume(ac-ft)
North	3	17.12	170x80x5	1.67

Provided size for Node 3: 115x115x6 = 1.8 ac-ft

DCV(ac-ft)
1.06
0.33
0.46
0.03

SOHM

PROJECT REPORT

General Model Information

Project Name:	SOHM Node 03
Site Name:	
Site Address:	
City:	
Report Date:	12/1/2014
Gage:	Trabuco Canyon
Data Start:	10/01/1958
Data End:	09/30/2005
Timestep:	15 Minute
Precip Scale:	1.00
Version:	2014/11/12

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
D,Scrub,Flat(0-5%)	20.13
Pervious Total	20.13
Impervious Land Use	Acres
Impervious Total	0
Basin Total	20.13

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
D,Scrub,Flat(0-5%)	6.5
Pervious Total	6.5
Impervious Land Use	Acres
Impervious,Flat(0-5)	13.63
Impervious Total	13.63
Basin Total	20.13

Element Flows To:

Surface	Interflow	Groundwater
Surface Bio Swale 1	Surface Bio Swale 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length:	130.28 ft.	
Bottom Width:	130.28 ft.	
Depth:	5 ft.	
Volume at riser head:	1.8937 acre-ft.	
Infiltration On		
Infiltration rate:	0.5	
Infiltration safety factor:	1	
Total Volume Infiltrated (ac-ft):		743.913
Total Volume Through Riser (ac-ft):		149.448
Total Volume Through Facility (ac-ft):		893.36
Percent Infiltrated:		83.27
Total Precip Applied to Facility:		155.676
Total Evap From Facility:		13.457
Side slope 1:	3 To 1	
Side slope 2:	3 To 1	
Side slope 3:	3 To 1	
Side slope 4:	3 To 1	
Discharge Structure		
Riser Height:	4 ft.	
Riser Diameter:	18 in.	
Notch Type:	Rectangular	
Notch Width:	1.500 ft.	
Notch Height:	0.974 ft.	
Orifice 1 Diameter:	4.321 in. Elevation:0 ft.	
Element Flows To:		
Outlet 1	Outlet 2	

Pond Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.389	0.000	0.000	0.000
0.0556	0.391	0.021	0.115	0.196
0.1111	0.393	0.043	0.163	0.196
0.1667	0.395	0.065	0.200	0.196
0.2222	0.397	0.087	0.231	0.196
0.2778	0.399	0.109	0.258	0.196
0.3333	0.401	0.131	0.283	0.196
0.3889	0.403	0.154	0.305	0.196
0.4444	0.405	0.176	0.326	0.196
0.5000	0.407	0.199	0.346	0.196
0.5556	0.409	0.222	0.365	0.196
0.6111	0.411	0.244	0.383	0.196
0.6667	0.413	0.267	0.400	0.196
0.7222	0.416	0.290	0.416	0.196
0.7778	0.418	0.314	0.432	0.196
0.8333	0.420	0.337	0.447	0.196
0.8889	0.422	0.360	0.462	0.196
0.9444	0.424	0.384	0.476	0.196
1.0000	0.426	0.407	0.490	0.196
1.0556	0.428	0.431	0.503	0.196
1.1111	0.430	0.455	0.516	0.196
1.1667	0.432	0.479	0.529	0.196
1.2222	0.434	0.503	0.542	0.196

1.2778	0.436	0.527	0.554	0.196
1.3333	0.438	0.552	0.566	0.196
1.3889	0.441	0.576	0.577	0.196
1.4444	0.443	0.601	0.589	0.196
1.5000	0.445	0.625	0.600	0.196
1.5556	0.447	0.650	0.611	0.196
1.6111	0.449	0.675	0.622	0.196
1.6667	0.451	0.700	0.633	0.196
1.7222	0.453	0.725	0.643	0.196
1.7778	0.456	0.750	0.653	0.196
1.8333	0.458	0.776	0.664	0.196
1.8889	0.460	0.801	0.674	0.196
1.9444	0.462	0.827	0.683	0.196
2.0000	0.464	0.853	0.693	0.196
2.0556	0.466	0.879	0.703	0.196
2.1111	0.469	0.905	0.712	0.196
2.1667	0.471	0.931	0.721	0.196
2.2222	0.473	0.957	0.731	0.196
2.2778	0.475	0.983	0.740	0.196
2.3333	0.477	1.010	0.749	0.196
2.3889	0.480	1.036	0.757	0.196
2.4444	0.482	1.063	0.766	0.196
2.5000	0.484	1.090	0.775	0.196
2.5556	0.486	1.117	0.783	0.196
2.6111	0.489	1.144	0.792	0.196
2.6667	0.491	1.171	0.800	0.196
2.7222	0.493	1.199	0.809	0.196
2.7778	0.495	1.226	0.817	0.196
2.8333	0.497	1.254	0.825	0.196
2.8889	0.500	1.282	0.833	0.196
2.9444	0.502	1.309	0.841	0.196
3.0000	0.504	1.337	0.849	0.196
3.0556	0.507	1.365	0.882	0.196
3.1111	0.509	1.394	0.989	0.196
3.1667	0.511	1.422	1.136	0.196
3.2222	0.513	1.451	1.315	0.196
3.2778	0.516	1.479	1.519	0.196
3.3333	0.518	1.508	1.747	0.196
3.3889	0.520	1.537	1.995	0.196
3.4444	0.523	1.566	2.263	0.196
3.5000	0.525	1.595	2.548	0.196
3.5556	0.527	1.624	2.851	0.196
3.6111	0.530	1.654	3.169	0.196
3.6667	0.532	1.683	3.502	0.196
3.7222	0.534	1.713	3.849	0.196
3.7778	0.537	1.742	4.210	0.196
3.8333	0.539	1.772	4.585	0.196
3.8889	0.541	1.802	4.972	0.196
3.9444	0.544	1.833	5.372	0.196
4.0000	0.546	1.863	5.784	0.196
4.0556	0.548	1.893	5.982	0.196
4.1111	0.551	1.924	6.338	0.196
4.1667	0.553	1.954	6.798	0.196
4.2222	0.555	1.985	7.341	0.196
4.2778	0.558	2.016	7.956	0.196
4.3333	0.560	2.047	8.635	0.196
4.3889	0.563	2.079	9.373	0.196
4.4444	0.565	2.110	10.16	0.196

4.5000	0.567	2.141	11.00	0.196
4.5556	0.570	2.173	11.89	0.196
4.6111	0.572	2.205	12.83	0.196
4.6667	0.575	2.237	13.81	0.196
4.7222	0.577	2.269	14.83	0.196
4.7778	0.580	2.301	15.89	0.196
4.8333	0.582	2.333	16.99	0.196
4.8889	0.584	2.365	18.13	0.196
4.9444	0.587	2.398	19.30	0.196
5.0000	0.589	2.431	20.50	0.196
5.0556	0.592	2.464	21.74	0.196

Bio Swale 1

Bottom Length:	2762.00 ft.
Bottom Width:	14.00 ft.
Material thickness of first layer:	0.2
Material type for first layer:	GRAVEL
Material thickness of second layer:	0.2
Material type for second layer:	Sand
Material thickness of third layer:	0.2
Material type for third layer:	GRAVEL
Infiltration On	
Infiltration rate:	0.5
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft):	229.611
Total Volume Through Riser (ac-ft):	751.065
Total Volume Through Facility (ac-ft):	980.676
Percent Infiltrated:	23.41
Total Precip Applied to Facility:	53.045
Total Evap From Facility:	14.526
Underdrain not used	
Discharge Structure	
Riser Height:	0.25 ft.
Riser Diameter:	48 in.
Notch Type:	Rectangular
Notch Width:	2.000 ft.
Notch Height:	0.500 ft.
Orifice 1 Diameter:	24 in. Elevation:0.05 ft.
Element Flows To:	
Outlet 1	Outlet 2
Trapezoidal Pond 1	

Landscape Swale Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	1.0399	0.0000	0.0000	0.0000
0.0148	1.0382	0.0027	0.0000	0.0000
0.0297	1.0344	0.0055	0.0000	0.0000
0.0445	1.0307	0.0082	0.0000	0.0000
0.0593	1.0269	0.0110	0.0000	0.0000
0.0742	1.0231	0.0138	0.0000	0.0000
0.0890	1.0194	0.0166	0.0000	0.0000
0.1038	1.0156	0.0194	0.0000	0.0000
0.1187	1.0119	0.0222	0.0000	0.0000
0.1335	1.0081	0.0251	0.0000	0.0000
0.1484	1.0043	0.0279	0.1020	0.1020
0.1632	1.0006	0.0308	0.2406	0.2406
0.1780	0.9968	0.0336	0.4475	0.4475
0.1929	0.9930	0.0365	0.4475	0.4475
0.2077	0.9893	0.0393	0.4475	0.4475
0.2225	0.9855	0.0421	0.4475	0.4475
0.2374	0.9818	0.0449	0.4475	0.4475
0.2522	0.9780	0.0477	0.4475	0.4475
0.2670	0.9742	0.0505	0.4475	0.4475
0.2819	0.9705	0.0534	0.4475	0.4475
0.2967	0.9667	0.0562	0.4475	0.4475
0.3115	0.9629	0.0591	0.4475	0.4475
0.3264	0.9592	0.0620	0.4475	0.4475
0.3412	0.9554	0.0649	0.4475	0.4475

0.3560	0.9517	0.0677	0.4475	0.4475
0.3709	0.9479	0.0707	0.4475	0.4475
0.3857	0.9441	0.0736	0.4475	0.4475
0.4005	0.9404	0.0766	0.4475	0.4475
0.4154	0.9366	0.0797	0.4475	0.4475
0.4302	0.9328	0.0827	0.4475	0.4475
0.4451	0.9291	0.0858	0.4475	0.4475
0.4599	0.9253	0.0889	0.4475	0.4475
0.4747	0.9216	0.0920	0.4475	0.4475
0.4896	0.9178	0.0951	0.4475	0.4475
0.5044	0.9140	0.0982	0.4475	0.4475
0.5192	0.9103	0.1013	0.4475	0.4475
0.5341	0.9065	0.1045	0.4475	0.4475
0.5489	0.9027	0.1076	0.4475	0.4475
0.5637	0.8990	0.1108	0.4475	0.4475
0.5786	0.8952	0.1140	0.4475	0.4475
0.5934	0.8915	0.1172	0.4475	0.4475
0.6000	0.8877	0.1186	0.4475	0.4475

Landscape Swale Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
0.6000	1.0399	0.1186	0.0000	8.6104	0.0000
0.6148	1.0436	0.1341	0.0000	8.6104	0.0000
0.6297	1.0474	0.1496	0.0000	8.9184	0.0000
0.6445	1.0512	0.1651	0.0000	9.2263	0.0000
0.6593	1.0549	0.1808	0.0000	9.5342	0.0000
0.6742	1.0587	0.1964	0.0000	9.8421	0.0000
0.6890	1.0624	0.2122	0.0000	10.150	0.0000
0.7038	1.0662	0.2280	0.0000	10.458	0.0000
0.7187	1.0700	0.2438	0.0000	10.766	0.0000
0.7335	1.0737	0.2597	0.0000	11.074	0.0000
0.7484	1.0775	0.2757	0.0000	11.382	0.0000
0.7632	1.0813	0.2917	0.0000	11.690	0.0000
0.7780	1.0850	0.3077	0.0000	11.998	0.0000
0.7929	1.0888	0.3239	0.0000	12.306	0.0000
0.8077	1.0925	0.3400	0.0000	12.613	0.0000
0.8225	1.0963	0.3563	0.0000	12.921	0.0000
0.8374	1.1001	0.3726	0.0000	13.229	0.0000
0.8522	1.1038	0.3889	0.0000	13.537	0.0000
0.8670	1.1076	0.4053	0.0000	13.845	0.0000
0.8819	1.1114	0.4218	0.0000	14.153	0.0000
0.8967	1.1151	0.4383	0.0000	14.461	0.0000
0.9115	1.1189	0.4549	0.0000	14.769	0.0000
0.9264	1.1226	0.4715	0.0000	15.077	0.0000
0.9412	1.1264	0.4882	0.0000	15.385	0.0000
0.9560	1.1302	0.5049	0.0000	15.693	0.0000
0.9709	1.1339	0.5217	0.0000	16.001	0.0000
0.9857	1.1377	0.5386	0.0000	16.309	0.0000
1.0005	1.1415	0.5555	0.0000	16.616	0.0000
1.0154	1.1452	0.5724	0.0000	16.924	0.0000
1.0302	1.1490	0.5894	0.0000	17.232	0.0000
1.0451	1.1527	0.6065	0.0000	17.540	0.0000
1.0599	1.1565	0.6236	0.0000	17.848	0.0000
1.0747	1.1603	0.6408	0.0000	18.156	0.0000
1.0896	1.1640	0.6581	0.0000	18.464	0.0000
1.1044	1.1678	0.6754	0.0000	18.772	0.0000
1.1192	1.1716	0.6927	0.0000	19.080	0.0000
1.1341	1.1753	0.7101	0.0000	19.388	0.0000

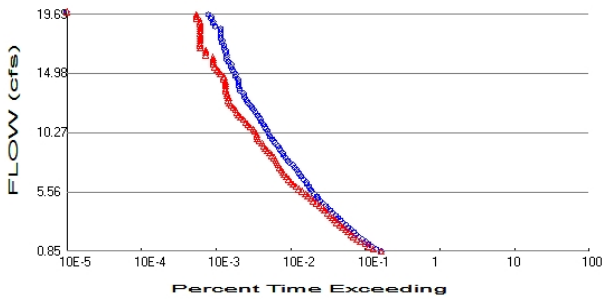
1.1489	1.1791	0.7276	0.0000	19.696	0.0000
1.1637	1.1829	0.7451	0.0000	20.004	0.0000
1.1786	1.1866	0.7627	0.0000	20.312	0.0000
1.1934	1.1904	0.7803	0.0000	20.619	0.0000
1.2082	1.1941	0.7980	0.0000	20.927	0.0000
1.2231	1.1979	0.8158	22.684	21.235	0.0000
1.2379	1.2017	0.8336	23.366	21.543	0.0000
1.2527	1.2054	0.8514	24.056	21.851	0.0000
1.2676	1.2092	0.8693	24.755	22.159	0.0000
1.2824	1.2130	0.8873	25.462	22.467	0.0000
1.2973	1.2167	0.9053	26.178	22.775	0.0000
1.3121	1.2205	0.9234	26.901	23.083	0.0000
1.3269	1.2242	0.9415	27.632	23.391	0.0000
1.3418	1.2280	0.9597	28.371	23.699	0.0000
1.3500	1.2301	0.9698	29.117	23.870	0.0000

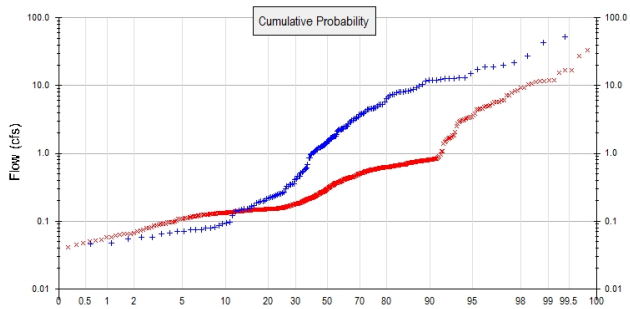
Surface Bio Swale 1

Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bio Swale 1

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 20.13
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 6.5
Total Impervious Area: 13.63

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	8.530885
5 year	13.391443
10 year	19.688128
25 year	36.715174

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	5.69524
5 year	11.239683
10 year	15.02589
25 year	23.191648

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.8531	2665	2663	99	Pass
1.0433	2312	2106	91	Pass
1.2336	2040	1851	90	Pass
1.4238	1814	1646	90	Pass
1.6141	1640	1422	86	Pass
1.8044	1498	1267	84	Pass
1.9946	1361	1144	84	Pass
2.1849	1252	1050	83	Pass
2.3751	1149	973	84	Pass
2.5654	1063	895	84	Pass
2.7556	975	821	84	Pass
2.9459	906	759	83	Pass
3.1361	831	690	83	Pass
3.3264	764	642	84	Pass
3.5166	712	595	83	Pass
3.7069	662	552	83	Pass
3.8971	598	508	84	Pass
4.0874	558	467	83	Pass
4.2776	516	436	84	Pass
4.4679	484	400	82	Pass
4.6581	442	363	82	Pass
4.8484	407	327	80	Pass
5.0387	381	308	80	Pass
5.2289	367	280	76	Pass
5.4192	341	260	76	Pass
5.6094	319	235	73	Pass
5.7997	306	209	68	Pass
5.9899	290	194	66	Pass
6.1802	270	177	65	Pass
6.3704	264	165	62	Pass
6.5607	243	155	63	Pass
6.7509	227	143	62	Pass
6.9412	215	134	62	Pass
7.1314	209	129	61	Pass
7.3217	199	123	61	Pass
7.5119	184	116	63	Pass
7.7022	177	112	63	Pass
7.8924	160	108	67	Pass
8.0827	150	104	69	Pass
8.2730	141	98	69	Pass
8.4632	132	92	69	Pass
8.6535	128	86	67	Pass
8.8437	121	80	66	Pass
9.0340	117	75	64	Pass
9.2242	111	71	63	Pass
9.4145	102	68	66	Pass
9.6047	97	62	63	Pass
9.7950	93	59	63	Pass
9.9852	86	58	67	Pass
10.1755	84	58	69	Pass
10.3657	81	54	66	Pass
10.5560	77	52	67	Pass
10.7462	74	47	63	Pass

10.9365	71	44	61	Pass
11.1267	67	41	61	Pass
11.3170	65	38	58	Pass
11.5073	62	35	56	Pass
11.6975	59	33	55	Pass
11.8878	55	31	56	Pass
12.0780	53	30	56	Pass
12.2683	50	28	56	Pass
12.4585	47	26	55	Pass
12.6488	44	25	56	Pass
12.8390	43	24	55	Pass
13.0293	40	24	60	Pass
13.2195	39	23	58	Pass
13.4098	38	23	60	Pass
13.6000	34	22	64	Pass
13.7903	34	22	64	Pass
13.9805	33	22	66	Pass
14.1708	33	22	66	Pass
14.3610	33	22	66	Pass
14.5513	32	21	65	Pass
14.7416	30	21	70	Pass
14.9318	30	19	63	Pass
15.1221	28	18	64	Pass
15.3123	27	17	62	Pass
15.5026	26	16	61	Pass
15.6928	26	15	57	Pass
15.8831	24	15	62	Pass
16.0733	23	15	65	Pass
16.2636	23	15	65	Pass
16.4538	23	12	52	Pass
16.6441	22	12	54	Pass
16.8343	22	12	54	Pass
17.0246	21	10	47	Pass
17.2148	21	10	47	Pass
17.4051	20	10	50	Pass
17.5953	20	10	50	Pass
17.7856	19	10	52	Pass
17.9759	19	10	52	Pass
18.1661	19	10	52	Pass
18.3564	19	10	52	Pass
18.5466	19	10	52	Pass
18.7369	16	10	62	Pass
18.9271	15	10	66	Pass
19.1174	15	10	66	Pass
19.3076	14	9	64	Pass
19.4979	14	9	64	Pass
19.6881	13	9	69	Pass

Water Quality

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic

Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1958 10 01        END    2005 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   SOHM Node 03.wdm
MESSU      25   PreSOHM Node 03.MES
           27   PreSOHM Node 03.L61
           28   PreSOHM Node 03.L62
           30   POCSOHM Node 031.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      37
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   37     D,Scrub,Flat(0-5%)      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   37         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   37         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   37         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   37             0       4.6      0.04       400      0.05       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   37            40        35         4         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   37             0       0.9       0.3         1       0.7         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37      0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   37             0         0      0.09         0      0.92       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2
```

```
  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  37                       20.13     COPY   501     12
PERLND  37                       20.13     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                               ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                      ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES
```

```
SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1958 10 01        END    2005 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   SOHM Node 03.wdm
MESSU      25   MitSOHM Node 03.MES
           27   MitSOHM Node 03.L61
           28   MitSOHM Node 03.L62
           30   POCSOHM Node 031.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      37
      IMPLND       1
      GENER        2
      RCHRES       1
      RCHRES       2
      RCHRES       3
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
    2        24
  END OPCODE
  PARM
    #    #         K ***
    2             0.
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   37     D,Scrub,Flat(0-5%)      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   37         0    0    1    0    0    0    0    0    0    0    0    0
```

```
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   37         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   37         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   37             0       4.6      0.04       400      0.05       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   37             40        35         4         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   37             0       0.9       0.3         1       0.7         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37      0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   37             0         0      0.09         0      0.92       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1     Impervious,Flat(0-5)    1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO
```

```
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            100      0.05       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  37                        6.5     RCHRES   1      2
PERLND  37                        6.5     RCHRES   1      3
IMPLND   1                      13.63     RCHRES   1      5

******Routing******
RCHRES   1                          1     RCHRES   3      7
RCHRES   1                                COPY     1     17
RCHRES   1                          1     RCHRES   2      8
RCHRES   3                          1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
GENER    2 OUTPUT TIMSER      .0011111     RCHRES   1     EXTNL  OUTDGT 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                             ***
    1     Surface Bio Swal-007    3    1    1    1   28    0    1
    2     Bio Swale  1            2    1    1    1   28    0    1
    3     Trapezoidal Pond-004    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
```

```
    3         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  5  6  0  0       0  1  0  0  0       2  1  2  2  2
    2        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    3        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.01       0.0       0.0       0.5       0.0
    2              2      0.52       0.0       0.0       0.5       0.0
    3              3      0.02       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** User-Defined Variable Quantity Lines
***                          addr
***                        <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol2   RCHRES   2 VOL              4
  UVQUAN v2m2   GLOBAL     WORKSP  1        3
  UVQUAN vpo2   GLOBAL     WORKSP  2        3
  UVQUAN v2d2   GENER    2 K       1        3
*** User-Defined Target Variable Names
***                  addr or                       addr or
***                <------>                      <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m2    1 WORKSP  1         1.0 QUAN
  UVNAME  vpo2    1 WORKSP  2         1.0 QUAN
  UVNAME  v2d2    1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   2                              v2m2            =  4849.
*** Compute remaining available pore space
  GENER   2                              vpo2            =  v2m2
  GENER   2                              vpo2           -=  vol2
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo2 < 0.0) THEN
  GENER   2                              vpo2            =  0.0
END IF
*** Infiltration volume
  GENER   2                              v2d2            =  vpo2
END SPEC-ACTIONS
```

FTABLES
FTABLE 3
91 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.389625	0.000000	0.000000	0.000000		
0.055556	0.391622	0.021701	0.115582	0.196436		
0.111111	0.393623	0.043514	0.163458	0.196436		
0.166667	0.395630	0.065437	0.200194	0.196436		
0.222222	0.397641	0.087473	0.231165	0.196436		
0.277778	0.399658	0.109620	0.258450	0.196436		
0.333333	0.401680	0.131879	0.283118	0.196436		
0.388889	0.403707	0.154251	0.305802	0.196436		
0.444444	0.405739	0.176736	0.326916	0.196436		
0.500000	0.407776	0.199333	0.346747	0.196436		
0.555556	0.409819	0.222044	0.365503	0.196436		
0.611111	0.411866	0.244869	0.383343	0.196436		
0.666667	0.413918	0.267807	0.400389	0.196436		
0.722222	0.415976	0.290860	0.416738	0.196436		
0.777778	0.418039	0.314027	0.432469	0.196436		
0.833333	0.420107	0.337309	0.447648	0.196436		
0.888889	0.422179	0.360706	0.462329	0.196436		
0.944444	0.424257	0.384218	0.476558	0.196436		
1.000000	0.426341	0.407846	0.490374	0.196436		
1.055556	0.428429	0.431589	0.503812	0.196436		
1.111111	0.430522	0.455449	0.516900	0.196436		
1.166667	0.432620	0.479425	0.529665	0.196436		
1.222222	0.434724	0.503518	0.542129	0.196436		
1.277778	0.436833	0.527728	0.554313	0.196436		
1.333333	0.438946	0.552055	0.566235	0.196436		
1.388889	0.441065	0.576500	0.577911	0.196436		
1.444444	0.443189	0.601062	0.589356	0.196436		
1.500000	0.445318	0.625743	0.600583	0.196436		
1.555556	0.447452	0.650542	0.611604	0.196436		
1.611111	0.449591	0.675460	0.622430	0.196436		
1.666667	0.451736	0.700497	0.633070	0.196436		
1.722222	0.453885	0.725653	0.643535	0.196436		
1.777778	0.456040	0.750929	0.653832	0.196436		
1.833333	0.458199	0.776324	0.663970	0.196436		
1.888889	0.460364	0.801840	0.673955	0.196436		
1.944444	0.462534	0.827476	0.683794	0.196436		
2.000000	0.464709	0.853233	0.693494	0.196436		
2.055556	0.466889	0.879111	0.703060	0.196436		
2.111111	0.469074	0.905110	0.712497	0.196436		
2.166667	0.471264	0.931230	0.721811	0.196436		
2.222222	0.473460	0.957472	0.731007	0.196436		
2.277778	0.475660	0.983837	0.740088	0.196436		
2.333333	0.477866	1.010324	0.749059	0.196436		
2.388889	0.480076	1.036933	0.757924	0.196436		
2.444444	0.482292	1.063666	0.766686	0.196436		
2.500000	0.484513	1.090521	0.775350	0.196436		
2.555556	0.486739	1.117501	0.783917	0.196436		
2.611111	0.488970	1.144604	0.792392	0.196436		
2.666667	0.491206	1.171831	0.800778	0.196436		
2.722222	0.493447	1.199182	0.809076	0.196436		
2.777778	0.495694	1.226658	0.817290	0.196436		
2.833333	0.497945	1.254259	0.825423	0.196436		
2.888889	0.500202	1.281986	0.833476	0.196436		
2.944444	0.502463	1.309837	0.841452	0.196436		
3.000000	0.504730	1.337815	0.849353	0.196436		
3.055556	0.507002	1.365919	0.882901	0.196436		
3.111111	0.509279	1.394149	0.989541	0.196436		
3.166667	0.511561	1.422505	1.136893	0.196436		
3.222222	0.513848	1.450989	1.315291	0.196436		
3.277778	0.516140	1.479600	1.519841	0.196436		
3.333333	0.518438	1.508338	1.747430	0.196436		
3.388889	0.520740	1.537204	1.995848	0.196436		
3.444444	0.523048	1.566198	2.263420	0.196436		
3.500000	0.525360	1.595321	2.548822	0.196436		
3.555556	0.527678	1.624572	2.850970	0.196436		

3.611111	0.530001	1.653952	3.168958	0.196436
3.666667	0.532329	1.683461	3.502011	0.196436
3.722222	0.534662	1.713100	3.849460	0.196436
3.777778	0.537000	1.742868	4.210716	0.196436
3.833333	0.539344	1.772766	4.585259	0.196436
3.888889	0.541692	1.802795	4.972621	0.196436
3.944444	0.544046	1.832955	5.372383	0.196436
4.000000	0.546404	1.863245	5.784162	0.196436
4.055556	0.548768	1.893666	5.982241	0.196436
4.111111	0.551137	1.924219	6.338746	0.196436
4.166667	0.553510	1.954904	6.798368	0.196436
4.222222	0.555889	1.985720	7.341373	0.196436
4.277778	0.558274	2.016669	7.956354	0.196436
4.333333	0.560663	2.047751	8.635616	0.196436
4.388889	0.563057	2.078965	9.373509	0.196436
4.444444	0.565456	2.110313	10.16566	0.196436
4.500000	0.567861	2.141794	11.00854	0.196436
4.555556	0.570271	2.173409	11.89924	0.196436
4.611111	0.572685	2.205158	12.83530	0.196436
4.666667	0.575105	2.237041	13.81460	0.196436
4.722222	0.577530	2.269058	14.83530	0.196436
4.777778	0.579960	2.301211	15.89577	0.196436
4.833333	0.582395	2.333499	16.99456	0.196436
4.888889	0.584835	2.365922	18.13036	0.196436
4.944444	0.587281	2.398480	19.30201	0.196436
5.000000	0.589731	2.431175	20.50842	0.196436

END FTABLE 3
FTABLE 2
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Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	1.039871	0.000000	0.000000	0.000000		
0.014835	1.038199	0.002738	0.000000	0.000000		
0.029670	1.034437	0.005488	0.000000	0.000000		
0.044505	1.030674	0.008250	0.000000	0.000000		
0.059341	1.026911	0.011023	0.000000	0.000000		
0.074176	1.023149	0.013808	0.000000	0.000000		
0.089011	1.019386	0.016604	0.000000	0.000000		
0.103846	1.015624	0.019412	0.000000	0.000000		
0.118681	1.011861	0.022231	0.000000	0.000000		
0.133516	1.008098	0.025062	0.000000	0.000000		
0.148352	1.004336	0.027905	0.000000	0.102028		
0.163187	1.000573	0.030759	0.000000	0.240598		
0.178022	0.996811	0.033625	0.000000	0.447546		
0.192857	0.993048	0.036502	0.000000	0.447546		
0.207692	0.989285	0.039287	0.000000	0.447546		
0.222527	0.985523	0.042083	0.000000	0.447546		
0.237363	0.981760	0.044889	0.000000	0.447546		
0.252198	0.977998	0.047707	0.000000	0.447546		
0.267033	0.974235	0.050537	0.000000	0.447546		
0.281868	0.970472	0.053377	0.000000	0.447546		
0.296703	0.966710	0.056229	0.000000	0.447546		
0.311538	0.962947	0.059091	0.000000	0.447546		
0.326374	0.959185	0.061965	0.000000	0.447546		
0.341209	0.955422	0.064850	0.000000	0.447546		
0.356044	0.951659	0.067746	0.000000	0.447546		
0.370879	0.947897	0.070654	0.000000	0.447546		
0.385714	0.944134	0.073572	0.000000	0.447546		
0.400549	0.940372	0.076612	0.000000	0.447546		
0.415385	0.936609	0.079663	0.000000	0.447546		
0.430220	0.932846	0.082725	0.000000	0.447546		
0.445055	0.929084	0.085800	0.000000	0.447546		
0.459890	0.925321	0.088885	0.000000	0.447546		
0.474725	0.921559	0.091983	0.000000	0.447546		
0.489560	0.917796	0.095092	0.000000	0.447546		
0.504396	0.914033	0.098213	0.000000	0.447546		
0.519231	0.910271	0.101345	0.000000	0.447546		
0.534066	0.906508	0.104488	0.000000	0.447546		
0.548901	0.902746	0.107644	0.000000	0.447546		
0.563736	0.898983	0.110811	0.000000	0.447546		

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  0.578571  0.895220  0.113989  0.000000  0.447546
  0.593407  0.891458  0.117179  0.000000  0.447546
  0.600000  0.887695  176.0986  0.000000  0.447546
  END FTABLE  2
  FTABLE      1
   52    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.887695  0.000000  0.832500  0.000000  0.000000
  0.014835  1.043634  0.015455  0.907690  8.610442  0.000000
  0.029670  1.047397  0.030965  0.985017  8.918365  0.000000
  0.044505  1.051159  0.046531  1.064423  9.226288  0.000000
  0.059341  1.054922  0.062153  2.607932  9.534211  0.000000
  0.074176  1.058684  0.077831  3.581453  9.842135  0.000000
  0.089011  1.062447  0.093565  4.302565  10.15006  0.000000
  0.103846  1.066210  0.109354  4.912250  10.45798  0.000000
  0.118681  1.069972  0.125200  5.455522  10.76590  0.000000
  0.133516  1.073735  0.141101  5.953669  11.07383  0.000000
  0.148352  1.077497  0.157058  6.418760  11.38175  0.000000
  0.163187  1.081260  0.173070  6.858412  11.68967  0.000000
  0.178022  1.085023  0.189139  7.277799  11.99760  0.000000
  0.192857  1.088785  0.205263  7.680618  12.30552  0.000000
  0.207692  1.092548  0.221444  8.069621  12.61344  0.000000
  0.222527  1.096310  0.237680  8.446921  12.92137  0.000000
  0.237363  1.100073  0.253971  8.814178  13.22929  0.000000
  0.252198  1.103836  0.270319  9.161198  13.53721  0.000000
  0.267033  1.107598  0.286723  9.488915  13.84513  0.000000
  0.281868  1.111361  0.303182  9.860824  14.15306  0.000000
  0.296703  1.115123  0.319697  10.26181  14.46098  0.000000
  0.311538  1.118886  0.336268  10.68595  14.76890  0.000000
  0.326374  1.122649  0.352895  11.12987  15.07683  0.000000
  0.341209  1.126411  0.369577  11.59138  15.38475  0.000000
  0.356044  1.130174  0.386316  12.06891  15.69267  0.000000
  0.370879  1.133936  0.403110  12.56130  16.00060  0.000000
  0.385714  1.137699  0.419960  13.06762  16.30852  0.000000
  0.400549  1.141462  0.436866  13.58712  16.61644  0.000000
  0.415385  1.145224  0.453828  14.11919  16.92437  0.000000
  0.430220  1.148987  0.470845  14.66331  17.23229  0.000000
  0.445055  1.152749  0.487918  15.21903  17.54021  0.000000
  0.459890  1.156512  0.505048  15.78597  17.84814  0.000000
  0.474725  1.160275  0.522232  16.36377  18.15606  0.000000
  0.489560  1.164037  0.539473  16.95213  18.46398  0.000000
  0.504396  1.167800  0.556770  17.55077  18.77190  0.000000
  0.519231  1.171562  0.574122  18.15945  19.07983  0.000000
  0.534066  1.175325  0.591530  18.77793  19.38775  0.000000
  0.548901  1.179088  0.608995  19.40600  19.69567  0.000000
  0.563736  1.182850  0.626514  20.04348  20.00360  0.000000
  0.578571  1.186613  0.644090  20.69017  20.31152  0.000000
  0.593407  1.190375  0.661722  21.34592  20.61944  0.000000
  0.608242  1.194138  0.679409  22.01056  20.92737  0.000000
  0.623077  1.197901  0.697152  22.68396  21.23529  0.000000
  0.637912  1.201663  0.714951  23.36596  21.54321  0.000000
  0.652747  1.205426  0.732806  24.05644  21.85114  0.000000
  0.667582  1.209188  0.750716  24.75527  22.15906  0.000000
  0.682418  1.212951  0.768683  25.46234  22.46698  0.000000
  0.697253  1.216714  0.786705  26.17754  22.77490  0.000000
  0.712088  1.220476  0.804783  26.90075  23.08283  0.000000
  0.726923  1.224239  0.822917  27.63188  23.39075  0.000000
  0.741758  1.228001  0.841107  28.37082  23.69867  0.000000
  0.750000  1.230092  0.851236  29.11748  23.86974  0.000000
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1              RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1              RCHRES   3     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7            RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   3     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   3 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   3 HYDR   O      1 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   3 HYDR   O      2 1        1      WDM   1003 FLOW     ENGL      REPL
RCHRES   3 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1978/ 3/ 4 14:15

RCHRES:     1

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
52 3.6639E+04 3.7080E+04 5.5793E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1978/ 3/ 4 14:15

RCHRES:     1

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
9.1086E+01 1.0698E+05 -4.648E+06   41.950   4.1950E+01      4
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1978/ 3/ 4 14:30

RCHRES:     1

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
52 3.6639E+04 3.7080E+04 4.6812E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1978/ 3/ 4 14:30

RCHRES:     1

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
9.1086E+01 1.0698E+05 -2.469E+06   22.641   2.2641E+01      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1978/ 3/ 4 14:30

RCHRES:     3
```

```
The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
91 1.0448E+05 1.0590E+05 1.0803E+05
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1978/ 3/ 4 14:30

RCHRES:     3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
1.0672E+02 5.1164E+04 -1.280E+05    2.4883  2.4883E+00      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1978/ 3/ 4 14:45

RCHRES:     3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
91 1.0448E+05 1.0590E+05 1.1675E+05
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1978/ 3/ 4 14:45

RCHRES:     3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
1.0672E+02 5.1164E+04 -4.418E+05    8.4842  8.4842E+00      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1978/ 3/ 4 15: 0

RCHRES:     3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
91 1.0448E+05 1.0590E+05 1.1119E+05
```

ERROR/WARNING ID: 341 5

DATE/TIME: 1978/ 3/ 4 15: 0

RCHRES: 3

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
1.0672E+02	5.1164E+04	-2.415E+05	4.6749	4.6749	3

ERROR/WARNING ID: 341 6

DATE/TIME: 1980/ 1/30 16:45

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
52	3.6639E+04	3.7080E+04	3.9596E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1980/ 1/30 16:45

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
9.1086E+01	1.0698E+05	-7.177E+05	6.6705	6.6705E+00	3

ERROR/WARNING ID: 341 6

DATE/TIME: 1980/ 1/30 17: 0

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
52	3.6639E+04	3.7080E+04	4.9881E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1980/ 1/30 17: 0

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0).

```
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
9.1086E+01 1.0698E+05 -3.214E+06   29.307   2.9307E+01      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1980/ 1/30 17: 0

RCHRES:     3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
91 1.0448E+05 1.0590E+05 1.0922E+05
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1980/ 1/30 17: 0

RCHRES:     3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
1.0672E+02 5.1164E+04 -1.708E+05    3.3157     3.3157       3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1980/ 1/30 17:15

RCHRES:     1

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
52 3.6639E+04 3.7080E+04 3.9852E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1980/ 1/30 17:15

RCHRES:     1

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
9.1086E+01 1.0698E+05 -7.799E+05    7.2453  7.2453E+00      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1980/ 1/30 17:15
```

```
RCHRES:     3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
91 1.0448E+05 1.0590E+05 1.2191E+05
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1980/ 1/30 17:15

RCHRES:     3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
1.0672E+02 5.1164E+04 -6.277E+05   11.970     11.970        3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1980/ 1/30 17:30

RCHRES:     3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
91 1.0448E+05 1.0590E+05 1.1958E+05
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1980/ 1/30 17:30

RCHRES:     3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
1.0672E+02 5.1164E+04 -5.437E+05   10.400   1.0400E+01      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1980/ 1/30 17:45

RCHRES:     3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:
```

```
NROWS         V1         V2        VOL
91 1.0448E+05 1.0590E+05 1.1465E+05
```

ERROR/WARNING ID: 341 5

DATE/TIME: 1980/ 1/30 17:45

RCHRES: 3

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

```
A          B          C      RDEP1      RDEP2  COUNT
1.0672E+02 5.1164E+04 -3.663E+05    7.0561  7.0561E+00      3
```

ERROR/WARNING ID: 341 6

DATE/TIME: 1980/ 1/30 18: 0

RCHRES: 3

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

```
NROWS         V1         V2        VOL
91 1.0448E+05 1.0590E+05 1.1272E+05
```

ERROR/WARNING ID: 341 5

DATE/TIME: 1980/ 1/30 18: 0

RCHRES: 3

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

```
A          B          C      RDEP1      RDEP2  COUNT
1.0672E+02 5.1164E+04 -2.967E+05    5.7310     5.7310       3
```

ERROR/WARNING ID: 341 6

DATE/TIME: 1980/ 1/30 18:15

RCHRES: 3

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

```
NROWS         V1         V2        VOL
91 1.0448E+05 1.0590E+05 1.1124E+05
```

ERROR/WARNING ID: 341 5

DATE/TIME: 1980/ 1/30 18:15

RCHRES: 3

```
Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
1.0672E+02 5.1164E+04 -2.435E+05    4.7129  4.7129E+00      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1980/ 1/30 18:30

RCHRES:     3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
91 1.0448E+05 1.0590E+05 1.0709E+05
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1980/ 1/30 18:30

RCHRES:     3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
1.0672E+02 5.1164E+04 -9.404E+04    1.8310     1.8310       3
```

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SOHM

PROJECT REPORT

General Model Information

Project Name:	SOHM Node 15
Site Name:	
Site Address:	
City:	
Report Date:	12/1/2014
Gage:	Trabuco Canyon
Data Start:	10/01/1958
Data End:	09/30/2005
Timestep:	15 Minute
Precip Scale:	1.00
Version:	2014/11/12

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
D,Scrub,Flat(0-5%)	6.22
Pervious Total	6.22
Impervious Land Use	Acres
Impervious Total	0
Basin Total	6.22

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
D,Scrub,Flat(0-5%)	3.85
Pervious Total	3.85
Impervious Land Use	Acres
Impervious,Mod(5-10)	2.35
Impervious Total	2.35
Basin Total	6.2

Element Flows To:

Surface	Interflow	Groundwater
Surface Bio Swale 1	Surface Bio Swale 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length:	60.25 ft.	
Bottom Width:	60.25 ft.	
Depth:	5 ft.	
Volume at riser head:	0.4929 acre-ft.	
Infiltration On		
Infiltration rate:	0.5	
Infiltration safety factor:	1	
Total Volume Infiltrated (ac-ft):		134.525
Total Volume Through Riser (ac-ft):		37.321
Total Volume Through Facility (ac-ft):		171.845
Percent Infiltrated:		78.28
Total Precip Applied to Facility:		29.561
Total Evap From Facility:		1.201
Side slope 1:	3 To 1	
Side slope 2:	3 To 1	
Side slope 3:	3 To 1	
Side slope 4:	3 To 1	
Discharge Structure		
Riser Height:	4 ft.	
Riser Diameter:	18 in.	
Notch Type:	Rectangular	
Notch Width:	1.500 ft.	
Notch Height:	0.958 ft.	
Orifice 1 Diameter:	2.398 in. Elevation:0 ft.	
Element Flows To:		
Outlet 1	Outlet 2	

Pond Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.083	0.000	0.000	0.000
0.0556	0.084	0.004	0.035	0.042
0.1111	0.085	0.009	0.050	0.042
0.1667	0.086	0.014	0.061	0.042
0.2222	0.087	0.018	0.071	0.042
0.2778	0.088	0.023	0.079	0.042
0.3333	0.089	0.028	0.087	0.042
0.3889	0.089	0.033	0.094	0.042
0.4444	0.090	0.038	0.100	0.042
0.5000	0.091	0.043	0.106	0.042
0.5556	0.092	0.048	0.112	0.042
0.6111	0.093	0.054	0.118	0.042
0.6667	0.094	0.059	0.123	0.042
0.7222	0.095	0.064	0.128	0.042
0.7778	0.096	0.070	0.133	0.042
0.8333	0.097	0.075	0.137	0.042
0.8889	0.098	0.080	0.142	0.042
0.9444	0.099	0.086	0.146	0.042
1.0000	0.100	0.091	0.151	0.042
1.0556	0.101	0.097	0.155	0.042
1.1111	0.102	0.103	0.159	0.042
1.1667	0.103	0.109	0.163	0.042
1.2222	0.104	0.114	0.167	0.042

1.2778	0.105	0.120	0.170	0.042
1.3333	0.106	0.126	0.174	0.042
1.3889	0.108	0.132	0.178	0.042
1.4444	0.109	0.138	0.181	0.042
1.5000	0.110	0.144	0.185	0.042
1.5556	0.111	0.150	0.188	0.042
1.6111	0.112	0.157	0.191	0.042
1.6667	0.113	0.163	0.195	0.042
1.7222	0.114	0.169	0.198	0.042
1.7778	0.115	0.175	0.201	0.042
1.8333	0.116	0.182	0.204	0.042
1.8889	0.117	0.188	0.207	0.042
1.9444	0.118	0.195	0.210	0.042
2.0000	0.119	0.202	0.213	0.042
2.0556	0.121	0.208	0.216	0.042
2.1111	0.122	0.215	0.219	0.042
2.1667	0.123	0.222	0.222	0.042
2.2222	0.124	0.229	0.225	0.042
2.2778	0.125	0.236	0.227	0.042
2.3333	0.126	0.243	0.230	0.042
2.3889	0.127	0.250	0.233	0.042
2.4444	0.128	0.257	0.236	0.042
2.5000	0.130	0.264	0.238	0.042
2.5556	0.131	0.271	0.241	0.042
2.6111	0.132	0.279	0.244	0.042
2.6667	0.133	0.286	0.246	0.042
2.7222	0.134	0.293	0.249	0.042
2.7778	0.135	0.301	0.251	0.042
2.8333	0.137	0.309	0.254	0.042
2.8889	0.138	0.316	0.256	0.042
2.9444	0.139	0.324	0.259	0.042
3.0000	0.140	0.332	0.261	0.042
3.0556	0.141	0.340	0.272	0.042
3.1111	0.143	0.347	0.357	0.042
3.1667	0.144	0.355	0.489	0.042
3.2222	0.145	0.363	0.654	0.042
3.2778	0.146	0.372	0.846	0.042
3.3333	0.147	0.380	1.062	0.042
3.3889	0.149	0.388	1.299	0.042
3.4444	0.150	0.396	1.556	0.042
3.5000	0.151	0.405	1.832	0.042
3.5556	0.152	0.413	2.124	0.042
3.6111	0.154	0.422	2.432	0.042
3.6667	0.155	0.430	2.756	0.042
3.7222	0.156	0.439	3.095	0.042
3.7778	0.157	0.448	3.447	0.042
3.8333	0.159	0.457	3.813	0.042
3.8889	0.160	0.465	4.192	0.042
3.9444	0.161	0.474	4.583	0.042
4.0000	0.163	0.483	4.987	0.042
4.0556	0.164	0.492	5.180	0.042
4.1111	0.165	0.502	5.532	0.042
4.1667	0.166	0.511	5.987	0.042
4.2222	0.168	0.520	6.526	0.042
4.2778	0.169	0.530	7.136	0.042
4.3333	0.170	0.539	7.811	0.042
4.3889	0.172	0.549	8.544	0.042
4.4444	0.173	0.558	9.332	0.042

4.5000	0.174	0.568	10.17	0.042
4.5556	0.176	0.578	11.05	0.042
4.6111	0.177	0.587	11.98	0.042
4.6667	0.178	0.597	12.96	0.042
4.7222	0.180	0.607	13.98	0.042
4.7778	0.181	0.617	15.03	0.042
4.8333	0.182	0.627	16.13	0.042
4.8889	0.184	0.638	17.26	0.042
4.9444	0.185	0.648	18.42	0.042
5.0000	0.187	0.658	19.63	0.042
5.0556	0.188	0.669	20.86	0.042

Bio Swale 1

Bottom Length:	524.00 ft.
Bottom Width:	8.00 ft.
Material thickness of first layer:	0.2
Material type for first layer:	GRAVEL
Material thickness of second layer:	0.3
Material type for second layer:	Sand
Material thickness of third layer:	0.2
Material type for third layer:	GRAVEL
Infiltration On	
Infiltration rate:	0.5
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft):	63.6
Total Volume Through Riser (ac-ft):	143.506
Total Volume Through Facility (ac-ft):	207.106
Percent Infiltrated:	30.71
Total Precip Applied to Facility:	8.447
Total Evap From Facility:	2.71
Underdrain not used	
Discharge Structure	
Riser Height:	0.25 ft.
Riser Diameter:	48 in.
Notch Type:	Rectangular
Notch Width:	0.000 ft.
Notch Height:	0.000 ft.
Orifice 1 Diameter:	48 in. Elevation:0.05 ft.
Element Flows To:	
Outlet 1	Outlet 2
Trapezoidal Pond 1	

Landscape Swale Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.1299	0.0000	0.0000	0.0000
0.0159	0.1292	0.0003	0.0000	0.0000
0.0319	0.1284	0.0006	0.0000	0.0000
0.0478	0.1277	0.0010	0.0000	0.0000
0.0637	0.1269	0.0013	0.0000	0.0000
0.0797	0.1261	0.0016	0.0000	0.0000
0.0956	0.1254	0.0020	0.0000	0.0000
0.1115	0.1246	0.0023	0.0000	0.0000
0.1275	0.1238	0.0026	0.0050	0.0050
0.1434	0.1231	0.0030	0.0116	0.0116
0.1593	0.1223	0.0033	0.0220	0.0220
0.1753	0.1215	0.0037	0.0367	0.0367
0.1912	0.1208	0.0040	0.0485	0.0485
0.2071	0.1200	0.0043	0.0485	0.0485
0.2231	0.1192	0.0047	0.0485	0.0485
0.2390	0.1185	0.0050	0.0485	0.0485
0.2549	0.1177	0.0054	0.0485	0.0485
0.2709	0.1169	0.0057	0.0485	0.0485
0.2868	0.1162	0.0061	0.0485	0.0485
0.3027	0.1154	0.0064	0.0485	0.0485
0.3187	0.1146	0.0068	0.0485	0.0485
0.3346	0.1139	0.0071	0.0485	0.0485
0.3505	0.1131	0.0075	0.0485	0.0485
0.3665	0.1123	0.0078	0.0485	0.0485

0.3824	0.1116	0.0082	0.0485	0.0485
0.3984	0.1108	0.0086	0.0485	0.0485
0.4143	0.1100	0.0089	0.0485	0.0485
0.4302	0.1093	0.0093	0.0485	0.0485
0.4462	0.1085	0.0097	0.0485	0.0485
0.4621	0.1077	0.0101	0.0485	0.0485
0.4780	0.1070	0.0104	0.0485	0.0485
0.4940	0.1062	0.0108	0.0485	0.0485
0.5099	0.1054	0.0112	0.0485	0.0485
0.5258	0.1047	0.0116	0.0485	0.0485
0.5418	0.1039	0.0120	0.0485	0.0485
0.5577	0.1031	0.0124	0.0485	0.0485
0.5736	0.1024	0.0128	0.0485	0.0485
0.5896	0.1016	0.0133	0.0485	0.0485
0.6055	0.1008	0.0137	0.0485	0.0485
0.6214	0.1001	0.0141	0.0485	0.0485
0.6374	0.0993	0.0145	0.0485	0.0485
0.6533	0.0985	0.0149	0.0485	0.0485
0.6692	0.0978	0.0153	0.0485	0.0485
0.6852	0.0970	0.0158	0.0485	0.0485
0.7000	0.0962	0.0162	0.0485	0.0485

Landscape Swale Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
0.7000	0.1299	0.0162	0.0000	0.9288	0.0000
0.7159	0.1307	0.0182	0.0000	0.9288	0.0000
0.7319	0.1315	0.0203	0.0000	0.9574	0.0000
0.7478	0.1322	0.0224	0.0000	0.9861	0.0000
0.7637	0.1330	0.0245	0.0000	1.0148	0.0000
0.7797	0.1338	0.0267	0.0000	1.0435	0.0000
0.7956	0.1345	0.0288	0.0000	1.0722	0.0000
0.8115	0.1353	0.0310	0.0000	1.1009	0.0000
0.8275	0.1361	0.0331	0.0000	1.1295	0.0000
0.8434	0.1368	0.0353	0.0000	1.1582	0.0000
0.8593	0.1376	0.0375	0.0000	1.1869	0.0000
0.8753	0.1384	0.0397	0.0000	1.2156	0.0000
0.8912	0.1391	0.0419	0.0000	1.2443	0.0000
0.9071	0.1399	0.0441	0.0000	1.2730	0.0000
0.9231	0.1407	0.0463	0.0000	1.3016	0.0000
0.9390	0.1414	0.0486	0.0000	1.3303	0.0000
0.9549	0.1422	0.0509	0.0000	1.3590	0.0000
0.9709	0.1430	0.0531	0.0000	1.3877	0.0000
0.9868	0.1437	0.0554	0.0000	1.4164	0.0000
1.0027	0.1445	0.0577	0.0000	1.4451	0.0000
1.0187	0.1453	0.0600	0.0000	1.4738	0.0000
1.0346	0.1460	0.0623	0.0000	1.5024	0.0000
1.0505	0.1468	0.0647	0.0000	1.5311	0.0000
1.0665	0.1476	0.0670	0.0000	1.5598	0.0000
1.0824	0.1483	0.0694	0.0000	1.5885	0.0000
1.0984	0.1491	0.0717	0.0000	1.6172	0.0000
1.1143	0.1499	0.0741	0.0000	1.6459	0.0000
1.1302	0.1506	0.0765	0.0000	1.6745	0.0000
1.1462	0.1514	0.0789	0.0000	1.7032	0.0000
1.1621	0.1522	0.0813	0.0000	1.7319	0.0000
1.1780	0.1529	0.0838	0.0000	1.7606	0.0000
1.1940	0.1537	0.0862	0.0000	1.7893	0.0000
1.2099	0.1545	0.0887	0.0000	1.8180	0.0000
1.2258	0.1552	0.0911	0.0000	1.8466	0.0000

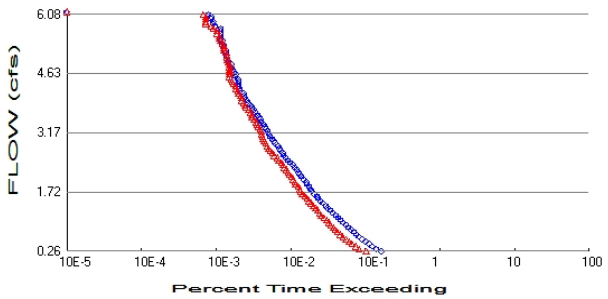
1.2418	0.1560	0.0936	0.0000	1.8753	0.0000
1.2577	0.1568	0.0961	0.0000	1.9040	0.0000
1.2736	0.1575	0.0986	0.0000	1.9327	0.0000
1.2896	0.1583	0.1011	0.0000	1.9614	0.0000
1.3055	0.1591	0.1037	0.0000	1.9901	0.0000
1.3214	0.1598	0.1062	0.0000	2.0187	0.0000
1.3374	0.1606	0.1087	0.0000	2.0474	0.0000
1.3533	0.1614	0.1113	0.0000	2.0761	0.0000
1.3692	0.1621	0.1139	0.0000	2.1048	0.0000
1.3852	0.1629	0.1165	0.0000	2.1335	0.0000
1.4011	0.1637	0.1191	0.0000	2.1622	0.0000
1.4170	0.1644	0.1217	61.855	2.1908	0.0000
1.4330	0.1652	0.1243	63.083	2.2195	0.0000
1.4489	0.1660	0.1270	64.316	2.2482	0.0000
1.4500	0.1660	0.1271	65.552	2.2502	0.0000

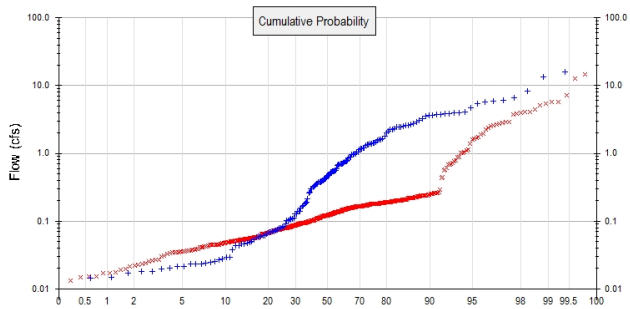
Surface Bio Swale 1

Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bio Swale 1

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 6.22
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 3.85
Total Impervious Area: 2.35

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	2.635971
5 year	4.137843
10 year	6.083465
25 year	11.344678

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	1.879027
5 year	4.091488
10 year	5.722407
25 year	10.537921

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.2636	2670	1684	63	Pass
0.3224	2312	1353	58	Pass
0.3812	2040	1226	60	Pass
0.4400	1818	1094	60	Pass
0.4987	1640	996	60	Pass
0.5575	1500	902	60	Pass
0.6163	1361	828	60	Pass
0.6751	1252	763	60	Pass
0.7339	1150	694	60	Pass
0.7927	1063	646	60	Pass
0.8515	975	610	62	Pass
0.9102	906	567	62	Pass
0.9690	831	536	64	Pass
1.0278	765	499	65	Pass
1.0866	715	457	63	Pass
1.1454	662	419	63	Pass
1.2042	598	398	66	Pass
1.2630	559	377	67	Pass
1.3218	516	356	68	Pass
1.3805	485	327	67	Pass
1.4393	442	306	69	Pass
1.4981	407	291	71	Pass
1.5569	381	272	71	Pass
1.6157	367	255	69	Pass
1.6745	341	235	68	Pass
1.7333	319	223	69	Pass
1.7920	306	217	70	Pass
1.8508	290	207	71	Pass
1.9096	270	192	71	Pass
1.9684	264	186	70	Pass
2.0272	243	179	73	Pass
2.0860	228	169	74	Pass
2.1448	215	157	73	Pass
2.2036	209	152	72	Pass
2.2623	199	143	71	Pass
2.3211	184	136	73	Pass
2.3799	177	130	73	Pass
2.4387	161	123	76	Pass
2.4975	150	113	75	Pass
2.5563	141	109	77	Pass
2.6151	132	99	75	Pass
2.6738	128	94	73	Pass
2.7326	121	87	71	Pass
2.7914	117	83	70	Pass
2.8502	111	79	71	Pass
2.9090	102	76	74	Pass
2.9678	98	72	73	Pass
3.0266	93	70	75	Pass
3.0854	86	69	80	Pass
3.1441	84	67	79	Pass
3.2029	81	66	81	Pass
3.2617	77	64	83	Pass
3.3205	74	60	81	Pass

3.3793	71	58	81	Pass
3.4381	67	57	85	Pass
3.4969	65	53	81	Pass
3.5556	62	50	80	Pass
3.6144	59	49	83	Pass
3.6732	55	48	87	Pass
3.7320	53	45	84	Pass
3.7908	50	41	82	Pass
3.8496	47	40	85	Pass
3.9084	44	38	86	Pass
3.9671	43	36	83	Pass
4.0259	40	36	90	Pass
4.0847	39	35	89	Pass
4.1435	38	33	86	Pass
4.2023	34	32	94	Pass
4.2611	34	30	88	Pass
4.3199	33	30	90	Pass
4.3787	33	28	84	Pass
4.4374	33	27	81	Pass
4.4962	32	26	81	Pass
4.5550	30	25	83	Pass
4.6138	30	25	83	Pass
4.6726	28	25	89	Pass
4.7314	27	25	92	Pass
4.7902	26	25	96	Pass
4.8489	26	25	96	Pass
4.9077	24	24	100	Pass
4.9665	23	23	100	Pass
5.0253	23	23	100	Pass
5.0841	23	23	100	Pass
5.1429	22	22	100	Pass
5.2017	22	21	95	Pass
5.2605	21	21	100	Pass
5.3192	21	21	100	Pass
5.3780	20	20	100	Pass
5.4368	20	19	95	Pass
5.4956	19	18	94	Pass
5.5544	19	18	94	Pass
5.6132	19	17	89	Pass
5.6720	19	17	89	Pass
5.7307	19	15	78	Pass
5.7895	16	14	87	Pass
5.8483	15	12	80	Pass
5.9071	15	12	80	Pass
5.9659	14	12	85	Pass
6.0247	14	12	85	Pass
6.0835	13	11	84	Pass

Water Quality

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

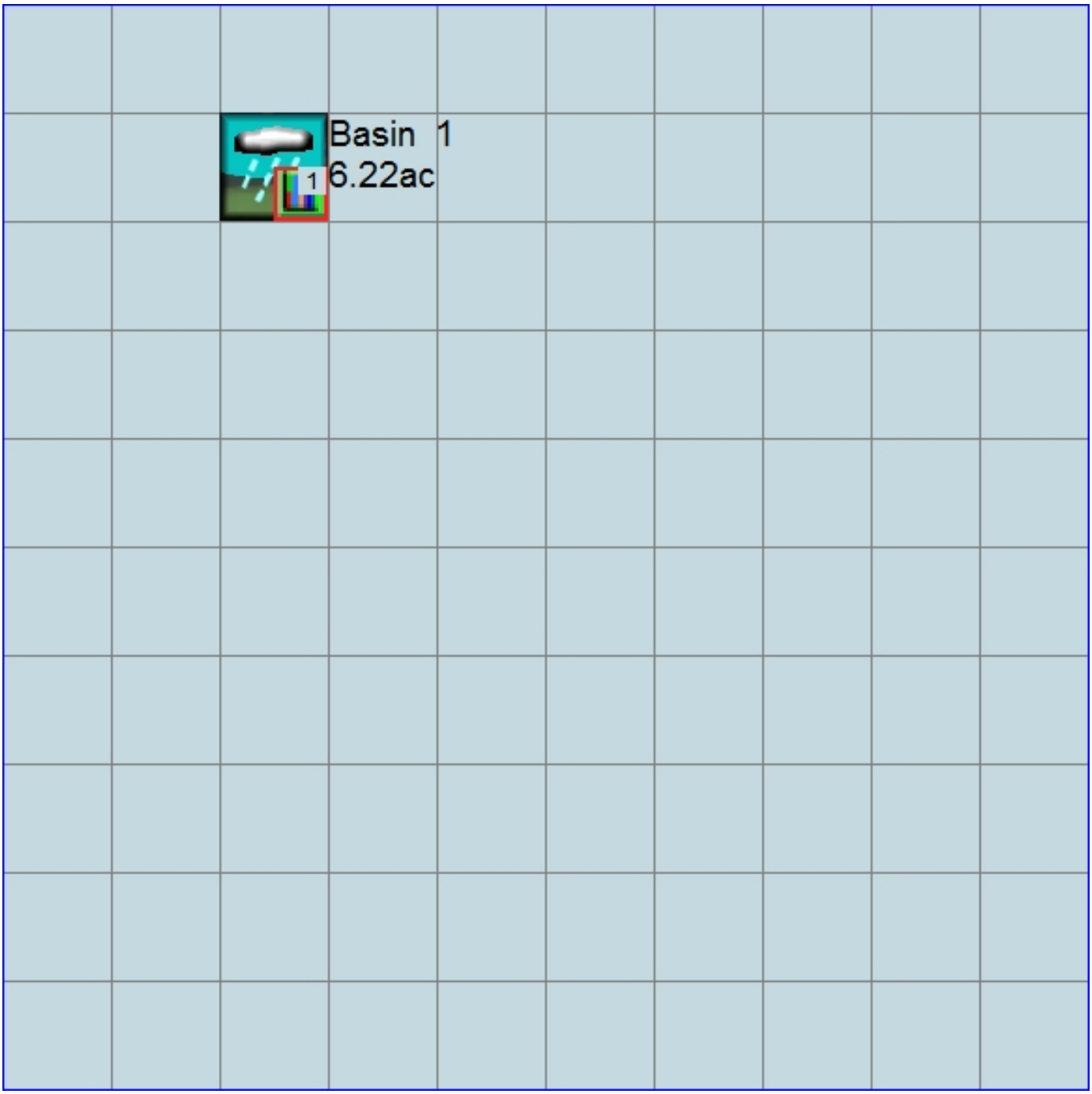
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1958 10 01        END    2005 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   SOHM Node 15.wdm
MESSU      25   PreSOHM Node 15.MES
           27   PreSOHM Node 15.L61
           28   PreSOHM Node 15.L62
           30   POCSOHM Node 151.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      37
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   37     D,Scrub,Flat(0-5%)      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   37         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   37         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   37         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   37              0       4.6      0.04       400      0.05       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   37             40        35         4         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   37              0       0.9       0.3         1       0.7         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37      0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   37              0         0      0.09         0      0.92       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2
```

```
  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  37                        6.22     COPY   501     12
PERLND  37                        6.22     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                               ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                      ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES
```

```
SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1958 10 01        END    2005 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   SOHM Node 15.wdm
MESSU      25   MitSOHM Node 15.MES
           27   MitSOHM Node 15.L61
           28   MitSOHM Node 15.L62
           30   POCSOHM Node 151.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      37
      IMPLND       2
      GENER        2
      RCHRES       1
      RCHRES       2
      RCHRES       3
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
    2        24
  END OPCODE
  PARM
    #    #         K ***
    2             0.
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   37     D,Scrub,Flat(0-5%)      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   37         0    0    1    0    0    0    0    0    0    0    0    0
```

```
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   37         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   37         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   37             0       4.6      0.04       400      0.05       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   37             40        35         4         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   37             0       0.9       0.3         1       0.7         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37      0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   37             0         0      0.09         0      0.92       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    2     Impervious,Mod(5-10)    1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    2         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         0    0    4    0    0    0    1    9
  END PRINT-INFO
```

```
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    2         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    2            100       0.1       0.1      0.09
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    2              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    2              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  37                        3.85     RCHRES   1      2
PERLND  37                        3.85     RCHRES   1      3
IMPLND   2                        2.35     RCHRES   1      5

******Routing******
RCHRES   1                           1     RCHRES   3      7
RCHRES   1                                 COPY     1     17
RCHRES   1                           1     RCHRES   2      8
RCHRES   3                           1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
GENER    2 OUTPUT TIMSER      .0011111     RCHRES   1     EXTNL  OUTDGT 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                             ***
    1     Surface Bio Swal-007    3    1    1    1   28    0    1
    2     Bio Swale  1            2    1    1    1   28    0    1
    3     Trapezoidal Pond-004    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
```

```
    3         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  5  6  0  0       0  1  0  0  0       2  1  2  2  2
    2        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    3        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.01       0.0       0.0       0.5       0.0
    2              2       0.1       0.0       0.0       0.5       0.0
    3              3      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** User-Defined Variable Quantity Lines
***                          addr
***                        <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol2   RCHRES   2 VOL              4
  UVQUAN v2m2   GLOBAL     WORKSP  1        3
  UVQUAN vpo2   GLOBAL     WORKSP  2        3
  UVQUAN v2d2   GENER    2 K       1        3
*** User-Defined Target Variable Names
***                  addr or                      addr or
***                <------>                     <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m2    1 WORKSP  1         1.0 QUAN
  UVNAME  vpo2    1 WORKSP  2         1.0 QUAN
  UVNAME  v2d2    1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   2                              v2m2            =  652.
*** Compute remaining available pore space
  GENER   2                              vpo2            =  v2m2
  GENER   2                              vpo2           -=  vol2
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo2 < 0.0) THEN
  GENER   2                              vpo2            =  0.0
END IF
*** Infiltration volume
  GENER   2                              v2d2            =  vpo2
END SPEC-ACTIONS
```

FTABLES
FTABLE 3
91 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.083346	0.000000	0.000000	0.000000		
0.055556	0.084271	0.004656	0.035598	0.042020		
0.111111	0.085201	0.009364	0.050343	0.042020		
0.166667	0.086136	0.014123	0.061657	0.042020		
0.222222	0.087076	0.018934	0.071195	0.042020		
0.277778	0.088021	0.023798	0.079599	0.042020		
0.333333	0.088971	0.028715	0.087196	0.042020		
0.388889	0.089926	0.033684	0.094182	0.042020		
0.444444	0.090887	0.038706	0.100685	0.042020		
0.500000	0.091852	0.043783	0.106793	0.042020		
0.555556	0.092823	0.048912	0.112570	0.042020		
0.611111	0.093799	0.054096	0.118064	0.042020		
0.666667	0.094779	0.059335	0.123314	0.042020		
0.722222	0.095765	0.064628	0.128349	0.042020		
0.777778	0.096756	0.069975	0.133194	0.042020		
0.833333	0.097752	0.075378	0.137869	0.042020		
0.888889	0.098754	0.080837	0.142391	0.042020		
0.944444	0.099760	0.086351	0.146773	0.042020		
1.000000	0.100771	0.091921	0.151028	0.042020		
1.055556	0.101788	0.097548	0.155166	0.042020		
1.111111	0.102810	0.103231	0.159197	0.042020		
1.166667	0.103836	0.108972	0.163129	0.042020		
1.222222	0.104868	0.114769	0.166968	0.042020		
1.277778	0.105905	0.120624	0.170720	0.042020		
1.333333	0.106947	0.126536	0.174392	0.042020		
1.388889	0.107994	0.132507	0.177988	0.042020		
1.444444	0.109047	0.138536	0.181513	0.042020		
1.500000	0.110104	0.144623	0.184971	0.042020		
1.555556	0.111166	0.150770	0.188365	0.042020		
1.611111	0.112234	0.156975	0.191699	0.042020		
1.666667	0.113307	0.163240	0.194976	0.042020		
1.722222	0.114384	0.169565	0.198199	0.042020		
1.777778	0.115467	0.175950	0.201371	0.042020		
1.833333	0.116555	0.182395	0.204493	0.042020		
1.888889	0.117648	0.188901	0.207568	0.042020		
1.944444	0.118746	0.195467	0.210598	0.042020		
2.000000	0.119850	0.202095	0.213586	0.042020		
2.055556	0.120958	0.208784	0.216532	0.042020		
2.111111	0.122072	0.215535	0.219439	0.042020		
2.166667	0.123190	0.222347	0.222307	0.042020		
2.222222	0.124314	0.229223	0.225139	0.042020		
2.277778	0.125443	0.236160	0.227936	0.042020		
2.333333	0.126576	0.243161	0.230699	0.042020		
2.388889	0.127715	0.250224	0.233429	0.042020		
2.444444	0.128859	0.257352	0.236128	0.042020		
2.500000	0.130009	0.264542	0.238796	0.042020		
2.555556	0.131163	0.271797	0.241435	0.042020		
2.611111	0.132322	0.279116	0.244045	0.042020		
2.666667	0.133487	0.286500	0.246628	0.042020		
2.722222	0.134656	0.293948	0.249183	0.042020		
2.777778	0.135831	0.301462	0.251713	0.042020		
2.833333	0.137011	0.309041	0.254218	0.042020		
2.888889	0.138196	0.316685	0.256698	0.042020		
2.944444	0.139386	0.324396	0.259155	0.042020		
3.000000	0.140581	0.332173	0.261588	0.042020		
3.055556	0.141781	0.340016	0.272101	0.042020		
3.111111	0.142986	0.347926	0.357632	0.042020		
3.166667	0.144197	0.355904	0.489283	0.042020		
3.222222	0.145412	0.363948	0.654059	0.042020		
3.277778	0.146633	0.372061	0.846197	0.042020		
3.333333	0.147859	0.380241	1.062200	0.042020		
3.388889	0.149089	0.388490	1.299645	0.042020		
3.444444	0.150325	0.396807	1.556728	0.042020		
3.500000	0.151566	0.405192	1.832035	0.042020		
3.555556	0.152812	0.413647	2.124420	0.042020		

3.611111	0.154064	0.422172	2.432931	0.042020
3.666667	0.155320	0.430766	2.756757	0.042020
3.722222	0.156581	0.439430	3.095200	0.042020
3.777778	0.157848	0.448164	3.447650	0.042020
3.833333	0.159119	0.456968	3.813566	0.042020
3.888889	0.160396	0.465844	4.192466	0.042020
3.944444	0.161678	0.474790	4.583917	0.042020
4.000000	0.162965	0.483808	4.987526	0.042020
4.055556	0.164257	0.492898	5.180908	0.042020
4.111111	0.165554	0.502059	5.532748	0.042020
4.166667	0.166856	0.511293	5.987737	0.042020
4.222222	0.168164	0.520599	6.526139	0.042020
4.277778	0.169476	0.529978	7.136548	0.042020
4.333333	0.170794	0.539430	7.811267	0.042020
4.388889	0.172116	0.548955	8.544647	0.042020
4.444444	0.173444	0.558554	9.332309	0.042020
4.500000	0.174777	0.568227	10.17073	0.042020
4.555556	0.176115	0.577974	11.05701	0.042020
4.611111	0.177458	0.587795	11.98866	0.042020
4.666667	0.178806	0.597691	12.96359	0.042020
4.722222	0.180159	0.607663	13.97994	0.042020
4.777778	0.181517	0.617709	15.03608	0.042020
4.833333	0.182881	0.627831	16.13057	0.042020
4.888889	0.184249	0.638029	17.26210	0.042020
4.944444	0.185623	0.648304	18.42949	0.042020
5.000000	0.187002	0.658654	19.63168	0.042020

END FTABLE 3
FTABLE 2
45 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.129917	0.000000	0.000000	0.000000		
0.015934	0.129204	0.000319	0.000000	0.000000		
0.031868	0.128437	0.000641	0.000000	0.000000		
0.047802	0.127670	0.000966	0.000000	0.000000		
0.063736	0.126903	0.001293	0.000000	0.000000		
0.079670	0.126137	0.001623	0.000000	0.000000		
0.095604	0.125370	0.001955	0.000000	0.000000		
0.111538	0.124603	0.002289	0.000000	0.000000		
0.127473	0.123837	0.002627	0.000000	0.004961		
0.143407	0.123070	0.002966	0.000000	0.011573		
0.159341	0.122303	0.003309	0.000000	0.021954		
0.175275	0.121536	0.003653	0.000000	0.036689		
0.191209	0.120770	0.004001	0.000000	0.048519		
0.207143	0.120003	0.004338	0.000000	0.048519		
0.223077	0.119236	0.004678	0.000000	0.048519		
0.239011	0.118470	0.005020	0.000000	0.048519		
0.254945	0.117703	0.005364	0.000000	0.048519		
0.270879	0.116936	0.005711	0.000000	0.048519		
0.286813	0.116169	0.006061	0.000000	0.048519		
0.302747	0.115403	0.006413	0.000000	0.048519		
0.318681	0.114636	0.006767	0.000000	0.048519		
0.334615	0.113869	0.007124	0.000000	0.048519		
0.350549	0.113103	0.007483	0.000000	0.048519		
0.366484	0.112336	0.007845	0.000000	0.048519		
0.382418	0.111569	0.008209	0.000000	0.048519		
0.398352	0.110803	0.008575	0.000000	0.048519		
0.414286	0.110036	0.008944	0.000000	0.048519		
0.430220	0.109269	0.009316	0.000000	0.048519		
0.446154	0.108502	0.009690	0.000000	0.048519		
0.462088	0.107736	0.010066	0.000000	0.048519		
0.478022	0.106969	0.010445	0.000000	0.048519		
0.493956	0.106202	0.010826	0.000000	0.048519		
0.509890	0.105436	0.011224	0.000000	0.048519		
0.525824	0.104669	0.011624	0.000000	0.048519		
0.541758	0.103902	0.012028	0.000000	0.048519		
0.557692	0.103135	0.012433	0.000000	0.048519		
0.573626	0.102369	0.012841	0.000000	0.048519		
0.589560	0.101602	0.013252	0.000000	0.048519		
0.605495	0.100835	0.013665	0.000000	0.048519		

```
  0.621429  0.100069  0.014081  0.000000  0.048519
  0.637363  0.099302  0.014499  0.000000  0.048519
  0.653297  0.098535  0.014920  0.000000  0.048519
  0.669231  0.097768  0.015344  0.000000  0.048519
  0.685165  0.097002  0.015770  0.000000  0.048519
  0.700000  0.096235  0.048505  0.000000  0.048519
  END FTABLE  2
  FTABLE      1
   49    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.096235  0.000000  0.000000  0.000000  0.000000
  0.015934  0.130684  0.002076  0.000000  0.928760  0.000000
  0.031868  0.131451  0.004165  0.000000  0.957444  0.000000
  0.047802  0.132217  0.006265  0.000000  0.986128  0.000000
  0.063736  0.132984  0.008378  7.092116  1.014812  0.000000
  0.079670  0.133751  0.010503  10.42324  1.043495  0.000000
  0.095604  0.134518  0.012641  12.92245  1.072179  0.000000
  0.111538  0.135284  0.014790  15.01118  1.100863  0.000000
  0.127473  0.136051  0.016952  16.84284  1.129547  0.000000
  0.143407  0.136818  0.019126  18.49398  1.158230  0.000000
  0.159341  0.137584  0.021312  20.00932  1.186914  0.000000
  0.175275  0.138351  0.023510  21.41772  1.215598  0.000000
  0.191209  0.139118  0.025721  22.73905  1.244282  0.000000
  0.207143  0.139885  0.027944  23.98771  1.272965  0.000000
  0.223077  0.140651  0.030179  25.17451  1.301649  0.000000
  0.239011  0.141418  0.032426  26.30783  1.330333  0.000000
  0.254945  0.142185  0.034686  27.40785  1.359017  0.000000
  0.270879  0.142951  0.036957  28.55682  1.387700  0.000000
  0.286813  0.143718  0.039241  29.72239  1.416384  0.000000
  0.302747  0.144485  0.041537  30.89371  1.445068  0.000000
  0.318681  0.145252  0.043846  32.06726  1.473752  0.000000
  0.334615  0.146018  0.046166  33.24161  1.502435  0.000000
  0.350549  0.146785  0.048499  34.41619  1.531119  0.000000
  0.366484  0.147552  0.050844  35.59087  1.559803  0.000000
  0.382418  0.148318  0.053201  36.76572  1.588487  0.000000
  0.398352  0.149085  0.055571  37.94092  1.617170  0.000000
  0.414286  0.149852  0.057952  39.11670  1.645854  0.000000
  0.430220  0.150618  0.060346  40.29331  1.674538  0.000000
  0.446154  0.151385  0.062752  41.47101  1.703222  0.000000
  0.462088  0.152152  0.065170  42.65006  1.731906  0.000000
  0.478022  0.152919  0.067601  43.83070  1.760589  0.000000
  0.493956  0.153685  0.070044  45.01315  1.789273  0.000000
  0.509890  0.154452  0.072499  46.19763  1.817957  0.000000
  0.525824  0.155219  0.074966  47.38435  1.846641  0.000000
  0.541758  0.155985  0.077445  48.57349  1.875324  0.000000
  0.557692  0.156752  0.079937  49.76522  1.904008  0.000000
  0.573626  0.157519  0.082440  50.95971  1.932692  0.000000
  0.589560  0.158286  0.084957  52.15710  1.961376  0.000000
  0.605495  0.159052  0.087485  53.35753  1.990059  0.000000
  0.621429  0.159819  0.090025  54.56112  2.018743  0.000000
  0.637363  0.160586  0.092578  55.76799  2.047427  0.000000
  0.653297  0.161352  0.095143  56.97825  2.076111  0.000000
  0.669231  0.162119  0.097720  58.19199  2.104794  0.000000
  0.685165  0.162886  0.100309  59.40930  2.133478  0.000000
  0.701099  0.163653  0.102911  60.63027  2.162162  0.000000
  0.717033  0.164419  0.105525  61.85498  2.190846  0.000000
  0.732967  0.165186  0.108150  63.08349  2.219529  0.000000
  0.748901  0.165953  0.110789  64.31586  2.248213  0.000000
  0.750000  0.166006  0.110971  65.55217  2.250191  0.000000
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1              RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1              RCHRES   3     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7            RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   3     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   3 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   3 HYDR   O      1 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   3 HYDR   O      2 1        1      WDM   1003 FLOW     ENGL      REPL
RCHRES   3 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1975/ 1/ 1  6:45

RCHRES:     2

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
-3.337E+01 1.0855E+04 -1.953E-05   -0.00077 -9.075E-11      2
```

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SOHM

PROJECT REPORT

General Model Information

Project Name:	SOHM Node 68
Site Name:	
Site Address:	
City:	
Report Date:	12/1/2014
Gage:	Trabuco Canyon
Data Start:	10/01/1958
Data End:	09/30/2005
Timestep:	15 Minute
Precip Scale:	1.00
Version:	2014/11/12

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
D,Scrub,Flat(0-5%)	8.52
Pervious Total	8.52
Impervious Land Use	Acres
Impervious Total	0
Basin Total	8.52

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
D,Scrub,Flat(0-5%)	5.96
Pervious Total	5.96
Impervious Land Use	Acres
Impervious,Flat(0-5)	2.56
Impervious Total	2.56
Basin Total	8.52

Element Flows To:

Surface	Interflow	Groundwater
Surface Bio Swale 1	Surface Bio Swale 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length:	64.89 ft.	
Bottom Width:	64.89 ft.	
Depth:	5 ft.	
Volume at riser head:	0.5574 acre-ft.	
Infiltration On		
Infiltration rate:	0.5	
Infiltration safety factor:	1	
Total Volume Infiltrated (ac-ft):		210.317
Total Volume Through Riser (ac-ft):		49.114
Total Volume Through Facility (ac-ft):		259.431
Percent Infiltrated:		81.07
Total Precip Applied to Facility:		49.632
Total Evap From Facility:		5.286
Side slope 1:	3 To 1	
Side slope 2:	3 To 1	
Side slope 3:	3 To 1	
Side slope 4:	3 To 1	
Discharge Structure		
Riser Height:	4 ft.	
Riser Diameter:	18 in.	
Notch Type:	Rectangular	
Notch Width:	1.500 ft.	
Notch Height:	0.950 ft.	
Orifice 1 Diameter:	2.805 in. Elevation:0 ft.	
Element Flows To:		
Outlet 1	Outlet 2	

Pond Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.096	0.000	0.000	0.000
0.0556	0.097	0.005	0.048	0.048
0.1111	0.098	0.010	0.068	0.048
0.1667	0.099	0.016	0.084	0.048
0.2222	0.100	0.021	0.097	0.048
0.2778	0.101	0.027	0.108	0.048
0.3333	0.102	0.033	0.119	0.048
0.3889	0.103	0.039	0.128	0.048
0.4444	0.104	0.044	0.137	0.048
0.5000	0.105	0.050	0.146	0.048
0.5556	0.106	0.056	0.154	0.048
0.6111	0.107	0.062	0.161	0.048
0.6667	0.108	0.068	0.168	0.048
0.7222	0.110	0.074	0.175	0.048
0.7778	0.111	0.080	0.182	0.048
0.8333	0.112	0.086	0.188	0.048
0.8889	0.113	0.093	0.194	0.048
0.9444	0.114	0.099	0.200	0.048
1.0000	0.115	0.105	0.206	0.048
1.0556	0.116	0.112	0.212	0.048
1.1111	0.117	0.118	0.217	0.048
1.1667	0.118	0.125	0.223	0.048
1.2222	0.119	0.132	0.228	0.048

1.2778	0.120	0.138	0.233	0.048
1.3333	0.122	0.145	0.238	0.048
1.3889	0.123	0.152	0.243	0.048
1.4444	0.124	0.159	0.248	0.048
1.5000	0.125	0.166	0.253	0.048
1.5556	0.126	0.173	0.257	0.048
1.6111	0.127	0.180	0.262	0.048
1.6667	0.128	0.187	0.266	0.048
1.7222	0.129	0.194	0.271	0.048
1.7778	0.131	0.201	0.275	0.048
1.8333	0.132	0.209	0.279	0.048
1.8889	0.133	0.216	0.284	0.048
1.9444	0.134	0.223	0.288	0.048
2.0000	0.135	0.231	0.292	0.048
2.0556	0.136	0.238	0.296	0.048
2.1111	0.138	0.246	0.300	0.048
2.1667	0.139	0.254	0.304	0.048
2.2222	0.140	0.262	0.308	0.048
2.2778	0.141	0.269	0.311	0.048
2.3333	0.142	0.277	0.315	0.048
2.3889	0.144	0.285	0.319	0.048
2.4444	0.145	0.293	0.323	0.048
2.5000	0.146	0.301	0.326	0.048
2.5556	0.147	0.310	0.330	0.048
2.6111	0.149	0.318	0.333	0.048
2.6667	0.150	0.326	0.337	0.048
2.7222	0.151	0.334	0.340	0.048
2.7778	0.152	0.343	0.344	0.048
2.8333	0.153	0.351	0.347	0.048
2.8889	0.155	0.360	0.351	0.048
2.9444	0.156	0.369	0.354	0.048
3.0000	0.157	0.377	0.357	0.048
3.0556	0.159	0.386	0.363	0.048
3.1111	0.160	0.395	0.440	0.048
3.1667	0.161	0.404	0.566	0.048
3.2222	0.162	0.413	0.728	0.048
3.2778	0.164	0.422	0.917	0.048
3.3333	0.165	0.431	1.130	0.048
3.3889	0.166	0.440	1.366	0.048
3.4444	0.168	0.450	1.621	0.048
3.5000	0.169	0.459	1.894	0.048
3.5556	0.170	0.469	2.185	0.048
3.6111	0.172	0.478	2.492	0.048
3.6667	0.173	0.488	2.814	0.048
3.7222	0.174	0.497	3.152	0.048
3.7778	0.176	0.507	3.503	0.048
3.8333	0.177	0.517	3.868	0.048
3.8889	0.178	0.527	4.245	0.048
3.9444	0.180	0.537	4.636	0.048
4.0000	0.181	0.547	5.038	0.048
4.0556	0.182	0.557	5.233	0.048
4.1111	0.184	0.567	5.585	0.048
4.1667	0.185	0.577	6.041	0.048
4.2222	0.186	0.588	6.580	0.048
4.2778	0.188	0.598	7.191	0.048
4.3333	0.189	0.609	7.867	0.048
4.3889	0.191	0.619	8.601	0.048
4.4444	0.192	0.630	9.389	0.048

4.5000	0.193	0.641	10.22	0.048
4.5556	0.195	0.651	11.11	0.048
4.6111	0.196	0.662	12.04	0.048
4.6667	0.198	0.673	13.02	0.048
4.7222	0.199	0.684	14.04	0.048
4.7778	0.200	0.695	15.09	0.048
4.8333	0.202	0.707	16.19	0.048
4.8889	0.203	0.718	17.32	0.048
4.9444	0.205	0.729	18.49	0.048
5.0000	0.206	0.741	19.69	0.048
5.0556	0.208	0.752	20.93	0.048

Bio Swale 1

Bottom Length:	3850.00 ft.
Bottom Width:	14.00 ft.
Material thickness of first layer:	0.2
Material type for first layer:	GRAVEL
Material thickness of second layer:	0.2
Material type for second layer:	Sand
Material thickness of third layer:	0.2
Material type for third layer:	GRAVEL
Infiltration On	
Infiltration rate:	0.5
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft):	46.623
Total Volume Through Riser (ac-ft):	215.056
Total Volume Through Facility (ac-ft):	261.679
Percent Infiltrated:	17.82
Total Precip Applied to Facility:	30.088
Total Evap From Facility:	10.377
Underdrain not used	
Discharge Structure	
Riser Height:	0.25 ft.
Riser Diameter:	48 in.
Notch Type:	Rectangular
Notch Width:	2.000 ft.
Notch Height:	0.500 ft.
Orifice 1 Diameter:	48 in. Elevation:0.05 ft.
Element Flows To:	
Outlet 1	Outlet 2
Trapezoidal Pond 1	

Landscape Swale Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	1.4495	0.0000	0.0000	0.0000
0.0148	1.4472	0.0038	0.0000	0.0000
0.0297	1.4419	0.0077	0.0000	0.0000
0.0445	1.4367	0.0115	0.0000	0.0000
0.0593	1.4314	0.0154	0.0000	0.0000
0.0742	1.4262	0.0192	0.0000	0.0000
0.0890	1.4209	0.0231	0.0000	0.0000
0.1038	1.4157	0.0271	0.0000	0.0000
0.1187	1.4105	0.0310	0.0000	0.0000
0.1335	1.4052	0.0349	0.0000	0.0000
0.1484	1.4000	0.0389	0.1422	0.1422
0.1632	1.3947	0.0429	0.3354	0.3354
0.1780	1.3895	0.0469	0.6238	0.6238
0.1929	1.3842	0.0509	0.6238	0.6238
0.2077	1.3790	0.0548	0.6238	0.6238
0.2225	1.3737	0.0587	0.6238	0.6238
0.2374	1.3685	0.0626	0.6238	0.6238
0.2522	1.3632	0.0665	0.6238	0.6238
0.2670	1.3580	0.0704	0.6238	0.6238
0.2819	1.3528	0.0744	0.6238	0.6238
0.2967	1.3475	0.0784	0.6238	0.6238
0.3115	1.3423	0.0824	0.6238	0.6238
0.3264	1.3370	0.0864	0.6238	0.6238
0.3412	1.3318	0.0904	0.6238	0.6238

0.3560	1.3265	0.0944	0.6238	0.6238
0.3709	1.3213	0.0985	0.6238	0.6238
0.3857	1.3160	0.1026	0.6238	0.6238
0.4005	1.3108	0.1068	0.6238	0.6238
0.4154	1.3056	0.1110	0.6238	0.6238
0.4302	1.3003	0.1153	0.6238	0.6238
0.4451	1.2951	0.1196	0.6238	0.6238
0.4599	1.2898	0.1239	0.6238	0.6238
0.4747	1.2846	0.1282	0.6238	0.6238
0.4896	1.2793	0.1326	0.6238	0.6238
0.5044	1.2741	0.1369	0.6238	0.6238
0.5192	1.2688	0.1413	0.6238	0.6238
0.5341	1.2636	0.1456	0.6238	0.6238
0.5489	1.2584	0.1500	0.6238	0.6238
0.5637	1.2531	0.1545	0.6238	0.6238
0.5786	1.2479	0.1589	0.6238	0.6238
0.5934	1.2426	0.1633	0.6238	0.6238
0.6000	1.2374	0.1653	0.6238	0.6238

Landscape Swale Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
0.6000	1.4495	0.1653	0.0000	12.002	0.0000
0.6148	1.4547	0.1869	0.0000	12.002	0.0000
0.6297	1.4600	0.2085	0.0000	12.431	0.0000
0.6445	1.4652	0.2302	0.0000	12.861	0.0000
0.6593	1.4705	0.2520	0.0000	13.290	0.0000
0.6742	1.4757	0.2738	0.0000	13.719	0.0000
0.6890	1.4810	0.2957	0.0000	14.148	0.0000
0.7038	1.4862	0.3178	0.0000	14.578	0.0000
0.7187	1.4915	0.3398	0.0000	15.007	0.0000
0.7335	1.4967	0.3620	0.0000	15.436	0.0000
0.7484	1.5019	0.3842	0.0000	15.865	0.0000
0.7632	1.5072	0.4066	0.0000	16.294	0.0000
0.7780	1.5124	0.4290	0.0000	16.724	0.0000
0.7929	1.5177	0.4514	0.0000	17.153	0.0000
0.8077	1.5229	0.4740	0.0000	17.582	0.0000
0.8225	1.5282	0.4966	0.0000	18.011	0.0000
0.8374	1.5334	0.5193	0.0000	18.441	0.0000
0.8522	1.5387	0.5421	0.0000	18.870	0.0000
0.8670	1.5439	0.5650	0.0000	19.299	0.0000
0.8819	1.5491	0.5879	0.0000	19.728	0.0000
0.8967	1.5544	0.6110	0.0000	20.157	0.0000
0.9115	1.5596	0.6340	0.0000	20.587	0.0000
0.9264	1.5649	0.6572	0.0000	21.016	0.0000
0.9412	1.5701	0.6805	0.0000	21.445	0.0000
0.9560	1.5754	0.7038	0.0000	21.874	0.0000
0.9709	1.5806	0.7272	0.0000	22.304	0.0000
0.9857	1.5859	0.7507	0.0000	22.733	0.0000
1.0005	1.5911	0.7743	0.0000	23.162	0.0000
1.0154	1.5963	0.7979	0.0000	23.591	0.0000
1.0302	1.6016	0.8216	0.0000	24.020	0.0000
1.0451	1.6068	0.8454	0.0000	24.450	0.0000
1.0599	1.6121	0.8693	0.0000	24.879	0.0000
1.0747	1.6173	0.8933	0.0000	25.308	0.0000
1.0896	1.6226	0.9173	0.0000	25.737	0.0000
1.1044	1.6278	0.9414	0.0000	26.166	0.0000
1.1192	1.6331	0.9656	0.0000	26.596	0.0000
1.1341	1.6383	0.9899	0.0000	27.025	0.0000

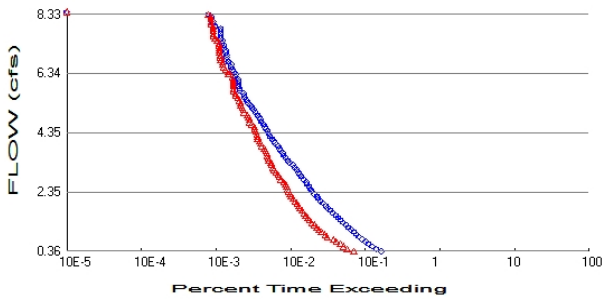
1.1489	1.6436	1.0142	0.0000	27.454	0.0000
1.1637	1.6488	1.0386	0.0000	27.883	0.0000
1.1786	1.6540	1.0631	0.0000	28.313	0.0000
1.1934	1.6593	1.0877	0.0000	28.742	0.0000
1.2082	1.6645	1.1124	0.0000	29.171	0.0000
1.2231	1.6698	1.1371	57.040	29.600	0.0000
1.2379	1.6750	1.1619	58.164	30.029	0.0000
1.2527	1.6803	1.1868	59.291	30.459	0.0000
1.2676	1.6855	1.2118	60.421	30.888	0.0000
1.2824	1.6908	1.2368	61.554	31.317	0.0000
1.2973	1.6960	1.2619	62.690	31.746	0.0000
1.3121	1.7012	1.2871	63.829	32.176	0.0000
1.3269	1.7065	1.3124	64.972	32.605	0.0000
1.3418	1.7117	1.3378	66.118	33.034	0.0000
1.3500	1.7146	1.3519	67.267	33.272	0.0000

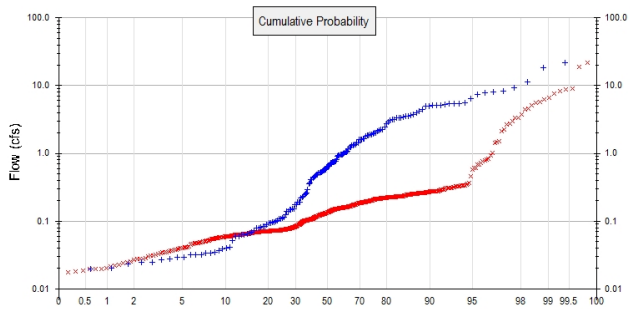
Surface Bio Swale 1

Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bio Swale 1

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 8.52
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 5.96
Total Impervious Area: 2.56

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	3.610688
5 year	5.667914
10 year	8.332978
25 year	15.539657

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	1.441049
5 year	5.554254
10 year	8.210502
25 year	15.058007

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.3611	2665	1155	43	Pass
0.4416	2312	933	40	Pass
0.5221	2040	839	41	Pass
0.6026	1816	758	41	Pass
0.6832	1640	673	41	Pass
0.7637	1500	612	40	Pass
0.8442	1361	508	37	Pass
0.9247	1252	474	37	Pass
1.0053	1149	426	37	Pass
1.0858	1063	392	36	Pass
1.1663	975	364	37	Pass
1.2468	906	339	37	Pass
1.3274	832	315	37	Pass
1.4079	765	294	38	Pass
1.4884	713	277	38	Pass
1.5689	662	261	39	Pass
1.6495	598	247	41	Pass
1.7300	558	233	41	Pass
1.8105	516	218	42	Pass
1.8910	484	209	43	Pass
1.9716	442	200	45	Pass
2.0521	407	188	46	Pass
2.1326	381	176	46	Pass
2.2131	367	167	45	Pass
2.2937	341	161	47	Pass
2.3742	319	155	48	Pass
2.4547	306	150	49	Pass
2.5352	290	145	50	Pass
2.6158	270	141	52	Pass
2.6963	264	132	50	Pass
2.7768	243	121	49	Pass
2.8573	227	115	50	Pass
2.9378	215	111	51	Pass
3.0184	209	104	49	Pass
3.0989	199	98	49	Pass
3.1794	184	95	51	Pass
3.2599	177	91	51	Pass
3.3405	160	90	56	Pass
3.4210	150	84	56	Pass
3.5015	141	83	58	Pass
3.5820	132	80	60	Pass
3.6626	128	79	61	Pass
3.7431	121	76	62	Pass
3.8236	117	73	62	Pass
3.9041	111	67	60	Pass
3.9847	102	65	63	Pass
4.0652	97	63	64	Pass
4.1457	93	59	63	Pass
4.2262	86	59	68	Pass
4.3068	84	58	69	Pass
4.3873	81	56	69	Pass
4.4678	77	54	70	Pass
4.5483	74	54	72	Pass

4.6289	71	50	70	Pass
4.7094	67	46	68	Pass
4.7899	65	46	70	Pass
4.8704	62	45	72	Pass
4.9510	59	43	72	Pass
5.0315	55	39	70	Pass
5.1120	53	38	71	Pass
5.1925	50	37	74	Pass
5.2731	47	35	74	Pass
5.3536	44	35	79	Pass
5.4341	43	34	79	Pass
5.5146	40	32	80	Pass
5.5952	39	30	76	Pass
5.6757	38	30	78	Pass
5.7562	34	28	82	Pass
5.8367	34	28	82	Pass
5.9172	33	28	84	Pass
5.9978	33	28	84	Pass
6.0783	33	28	84	Pass
6.1588	32	28	87	Pass
6.2393	30	27	90	Pass
6.3199	30	24	80	Pass
6.4004	28	24	85	Pass
6.4809	27	22	81	Pass
6.5614	26	21	80	Pass
6.6420	26	20	76	Pass
6.7225	24	20	83	Pass
6.8030	23	19	82	Pass
6.8835	23	19	82	Pass
6.9641	23	19	82	Pass
7.0446	22	18	81	Pass
7.1251	22	18	81	Pass
7.2056	21	18	85	Pass
7.2862	21	18	85	Pass
7.3667	20	18	90	Pass
7.4472	20	17	85	Pass
7.5277	19	16	84	Pass
7.6083	19	15	78	Pass
7.6888	19	15	78	Pass
7.7693	19	15	78	Pass
7.8498	19	15	78	Pass
7.9304	16	15	93	Pass
8.0109	15	14	93	Pass
8.0914	15	14	93	Pass
8.1719	14	14	100	Pass
8.2525	14	14	100	Pass
8.3330	13	13	100	Pass

Water Quality

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic

Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1958 10 01        END    2005 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   SOHM Node 68.wdm
MESSU      25   PreSOHM Node 68.MES
           27   PreSOHM Node 68.L61
           28   PreSOHM Node 68.L62
           30   POCSOHM Node 681.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      37
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   37     D,Scrub,Flat(0-5%)      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   37         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   37         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   37         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   37             0       4.6      0.04       400      0.05       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   37            40        35         4         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   37             0       0.9       0.3         1       0.7         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37      0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   37             0         0      0.09         0      0.92       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2
```

```
  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  37                        8.52     COPY   501     12
PERLND  37                        8.52     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                               ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                      ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES
```

```
SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1958 10 01        END    2005 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   SOHM Node 68.wdm
MESSU      25   MitSOHM Node 68.MES
           27   MitSOHM Node 68.L61
           28   MitSOHM Node 68.L62
           30   POCSOHM Node 681.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      37
      IMPLND       1
      GENER        2
      RCHRES       1
      RCHRES       2
      RCHRES       3
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
    2        24
  END OPCODE
  PARM
    #    #         K ***
    2             0.
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   37     D,Scrub,Flat(0-5%)      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   37         0    0    1    0    0    0    0    0    0    0    0    0
```

```
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   37         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   37         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   37             0       4.6      0.04       400      0.05       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   37             40        35         4         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   37             0       0.9       0.3         1       0.7         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37      0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   37             0         0      0.09         0      0.92       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1     Impervious,Flat(0-5)    1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO
```

```
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            100      0.05       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  37                        5.96     RCHRES   1      2
PERLND  37                        5.96     RCHRES   1      3
IMPLND   1                        2.56     RCHRES   1      5

******Routing******
RCHRES   1                           1     RCHRES   3      7
RCHRES   1                                 COPY     1     17
RCHRES   1                           1     RCHRES   2      8
RCHRES   3                           1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
GENER    2 OUTPUT TIMSER      .0011111     RCHRES   1     EXTNL  OUTDGT 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                             ***
    1     Surface Bio Swal-007    3    1    1    1   28    0    1
    2     Bio Swale  1            2    1    1    1   28    0    1
    3     Trapezoidal Pond-004    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
```

```
    3         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  5  6  0  0       0  1  0  0  0       2  1  2  2  2
    2        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    3        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.01       0.0       0.0       0.5       0.0
    2              2      0.73       0.0       0.0       0.5       0.0
    3              3      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** User-Defined Variable Quantity Lines
***                          addr
***                        <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol2   RCHRES   2 VOL              4
  UVQUAN v2m2   GLOBAL     WORKSP  1        3
  UVQUAN vpo2   GLOBAL     WORKSP  2        3
  UVQUAN v2d2   GENER    2 K       1        3
*** User-Defined Target Variable Names
***                  addr or                       addr or
***                <------>                      <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m2    1 WORKSP  1         1.0 QUAN
  UVNAME  vpo2    1 WORKSP  2         1.0 QUAN
  UVNAME  v2d2    1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   2                               v2m2            =  6759.
*** Compute remaining available pore space
  GENER   2                               vpo2            =  v2m2
  GENER   2                               vpo2           -=  vol2
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo2 < 0.0) THEN
  GENER   2                               vpo2            =  0.0
END IF
*** Infiltration volume
  GENER   2                               v2d2            =  vpo2
END SPEC-ACTIONS
```

FTABLES
FTABLE 3
91 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.096661	0.000000	0.000000	0.000000		
0.055556	0.097656	0.005398	0.048707	0.048733		
0.111111	0.098657	0.010851	0.068882	0.048733		
0.166667	0.099663	0.016360	0.084362	0.048733		
0.222222	0.100674	0.021925	0.097413	0.048733		
0.277778	0.101690	0.027546	0.108911	0.048733		
0.333333	0.102711	0.033224	0.119307	0.048733		
0.388889	0.103737	0.038958	0.128866	0.048733		
0.444444	0.104769	0.044750	0.137763	0.048733		
0.500000	0.105805	0.050599	0.146120	0.048733		
0.555556	0.106847	0.056506	0.154024	0.048733		
0.611111	0.107893	0.062471	0.161542	0.048733		
0.666667	0.108945	0.068495	0.168725	0.048733		
0.722222	0.110002	0.074577	0.175614	0.048733		
0.777778	0.111064	0.080717	0.182244	0.048733		
0.833333	0.112131	0.086917	0.188640	0.048733		
0.888889	0.113203	0.093176	0.194827	0.048733		
0.944444	0.114280	0.099495	0.200823	0.048733		
1.000000	0.115363	0.105874	0.206645	0.048733		
1.055556	0.116450	0.112314	0.212307	0.048733		
1.111111	0.117543	0.118813	0.217823	0.048733		
1.166667	0.118641	0.125374	0.223202	0.048733		
1.222222	0.119743	0.131996	0.228455	0.048733		
1.277778	0.120851	0.138679	0.233589	0.048733		
1.333333	0.121964	0.145424	0.238613	0.048733		
1.388889	0.123082	0.152231	0.243533	0.048733		
1.444444	0.124205	0.159100	0.248356	0.048733		
1.500000	0.125334	0.166032	0.253087	0.048733		
1.555556	0.126467	0.173026	0.257732	0.048733		
1.611111	0.127606	0.180084	0.262293	0.048733		
1.666667	0.128749	0.187205	0.266777	0.048733		
1.722222	0.129898	0.194389	0.271187	0.048733		
1.777778	0.131052	0.201638	0.275527	0.048733		
1.833333	0.132211	0.208951	0.279799	0.048733		
1.888889	0.133375	0.216328	0.284006	0.048733		
1.944444	0.134544	0.223770	0.288153	0.048733		
2.000000	0.135718	0.231277	0.292240	0.048733		
2.055556	0.136897	0.238850	0.296271	0.048733		
2.111111	0.138082	0.246488	0.300248	0.048733		
2.166667	0.139271	0.254193	0.304173	0.048733		
2.222222	0.140466	0.261963	0.308048	0.048733		
2.277778	0.141665	0.269800	0.311875	0.048733		
2.333333	0.142870	0.277704	0.315655	0.048733		
2.388889	0.144080	0.285675	0.319391	0.048733		
2.444444	0.145295	0.293713	0.323084	0.048733		
2.500000	0.146515	0.301819	0.326734	0.048733		
2.555556	0.147740	0.309992	0.330345	0.048733		
2.611111	0.148971	0.318234	0.333916	0.048733		
2.666667	0.150206	0.326545	0.337450	0.048733		
2.722222	0.151447	0.334924	0.340947	0.048733		
2.777778	0.152692	0.343372	0.344408	0.048733		
2.833333	0.153943	0.351890	0.347835	0.048733		
2.888889	0.155199	0.360477	0.351229	0.048733		
2.944444	0.156460	0.369134	0.354590	0.048733		
3.000000	0.157726	0.377862	0.357920	0.048733		
3.055556	0.158997	0.386660	0.363320	0.048733		
3.111111	0.160273	0.395528	0.440056	0.048733		
3.166667	0.161554	0.404468	0.566924	0.048733		
3.222222	0.162841	0.413479	0.728122	0.048733		
3.277778	0.164132	0.422562	0.917336	0.048733		
3.333333	0.165429	0.431716	1.130838	0.048733		
3.388889	0.166731	0.440943	1.366087	0.048733		
3.444444	0.168038	0.450242	1.621204	0.048733		
3.500000	0.169349	0.459614	1.894728	0.048733		
3.555556	0.170667	0.469059	2.185480	0.048733		

3.611111	0.171989	0.478577	2.492481	0.048733
3.666667	0.173316	0.488169	2.814902	0.048733
3.722222	0.174648	0.497834	3.152032	0.048733
3.777778	0.175986	0.507574	3.503248	0.048733
3.833333	0.177328	0.517388	3.868000	0.048733
3.888889	0.178676	0.527277	4.245798	0.048733
3.944444	0.180029	0.537241	4.636203	0.048733
4.000000	0.181386	0.547281	5.038816	0.048733
4.055556	0.182749	0.557396	5.232968	0.048733
4.111111	0.184118	0.567586	5.585572	0.048733
4.166667	0.185491	0.577853	6.041320	0.048733
4.222222	0.186869	0.588196	6.580477	0.048733
4.277778	0.188252	0.598617	7.191635	0.048733
4.333333	0.189641	0.609114	7.867099	0.048733
4.388889	0.191034	0.619688	8.601218	0.048733
4.444444	0.192433	0.630340	9.389616	0.048733
4.500000	0.193837	0.641069	10.22877	0.048733
4.555556	0.195246	0.651877	11.11577	0.048733
4.611111	0.196660	0.662764	12.04815	0.048733
4.666667	0.198079	0.673728	13.02379	0.048733
4.722222	0.199503	0.684772	14.04085	0.048733
4.777778	0.200932	0.695896	15.09770	0.048733
4.833333	0.202366	0.707098	16.19289	0.048733
4.888889	0.203806	0.718381	17.32512	0.048733
4.944444	0.205251	0.729744	18.49322	0.048733
5.000000	0.206700	0.741187	19.69610	0.048733

END FTABLE 3
FTABLE 2
42 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	1.449495	0.000000	0.000000	0.000000		
0.014835	1.447164	0.003817	0.000000	0.000000		
0.029670	1.441919	0.007650	0.000000	0.000000		
0.044505	1.436674	0.011500	0.000000	0.000000		
0.059341	1.431430	0.015365	0.000000	0.000000		
0.074176	1.426185	0.019247	0.000000	0.000000		
0.089011	1.420940	0.023145	0.000000	0.000000		
0.103846	1.415695	0.027059	0.000000	0.000000		
0.118681	1.410451	0.030989	0.000000	0.000000		
0.133516	1.405206	0.034935	0.000000	0.000000		
0.148352	1.399961	0.038897	0.000000	0.142219		
0.163187	1.394716	0.042876	0.000000	0.335374		
0.178022	1.389472	0.046870	0.000000	0.623843		
0.192857	1.384227	0.050881	0.000000	0.623843		
0.207692	1.378982	0.054763	0.000000	0.623843		
0.222527	1.373737	0.058660	0.000000	0.623843		
0.237363	1.368493	0.062572	0.000000	0.623843		
0.252198	1.363248	0.066500	0.000000	0.623843		
0.267033	1.358003	0.070444	0.000000	0.623843		
0.281868	1.352758	0.074403	0.000000	0.623843		
0.296703	1.347514	0.078378	0.000000	0.623843		
0.311538	1.342269	0.082368	0.000000	0.623843		
0.326374	1.337024	0.086374	0.000000	0.623843		
0.341209	1.331779	0.090396	0.000000	0.623843		
0.356044	1.326535	0.094433	0.000000	0.623843		
0.370879	1.321290	0.098485	0.000000	0.623843		
0.385714	1.316045	0.102553	0.000000	0.623843		
0.400549	1.310800	0.106790	0.000000	0.623843		
0.415385	1.305556	0.111043	0.000000	0.623843		
0.430220	1.300311	0.115312	0.000000	0.623843		
0.445055	1.295066	0.119598	0.000000	0.623843		
0.459890	1.289821	0.123899	0.000000	0.623843		
0.474725	1.284577	0.128217	0.000000	0.623843		
0.489560	1.279332	0.132550	0.000000	0.623843		
0.504396	1.274087	0.136900	0.000000	0.623843		
0.519231	1.268842	0.141266	0.000000	0.623843		
0.534066	1.263598	0.145648	0.000000	0.623843		
0.548901	1.258353	0.150047	0.000000	0.623843		
0.563736	1.253108	0.154461	0.000000	0.623843		

```
  0.578571  1.247863  0.158892  0.000000  0.623843
  0.593407  1.242618  0.163338  0.000000  0.623843
  0.600000  1.237374  3.835421  0.000000  0.623843
  END FTABLE  2
  FTABLE      1
   52    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  1.237374  0.000000  0.832500  0.000000  0.000000
  0.014835  1.454740  0.021542  0.907690  12.00225  0.000000
  0.029670  1.459984  0.043163  0.985017  12.43146  0.000000
  0.044505  1.465229  0.064861  1.064423  12.86068  0.000000
  0.059341  1.470474  0.086636  6.994164  13.28990  0.000000
  0.074176  1.475719  0.108490  10.63802  13.71912  0.000000
  0.089011  1.480963  0.130422  13.26645  14.14834  0.000000
  0.103846  1.486208  0.152431  15.44350  14.57756  0.000000
  0.118681  1.491453  0.174518  17.34936  15.00678  0.000000
  0.133516  1.496698  0.196683  19.06929  15.43600  0.000000
  0.148352  1.501943  0.218925  20.65167  15.86522  0.000000
  0.163187  1.507187  0.241246  22.12706  16.29444  0.000000
  0.178022  1.512432  0.263644  23.51627  16.72366  0.000000
  0.192857  1.517677  0.286120  24.83416  17.15288  0.000000
  0.207692  1.522922  0.308674  26.09183  17.58210  0.000000
  0.222527  1.528166  0.331306  27.29781  18.01132  0.000000
  0.237363  1.533411  0.354015  28.45883  18.44054  0.000000
  0.252198  1.538656  0.376803  29.56875  18.86976  0.000000
  0.267033  1.543901  0.399668  30.63187  19.29897  0.000000
  0.281868  1.549145  0.422611  31.71444  19.72819  0.000000
  0.296703  1.554390  0.445631  32.80370  20.15741  0.000000
  0.311538  1.559635  0.468730  33.89570  20.58663  0.000000
  0.326374  1.564880  0.491906  34.98880  21.01585  0.000000
  0.341209  1.570124  0.515160  36.08229  21.44507  0.000000
  0.356044  1.575369  0.538492  37.17590  21.87429  0.000000
  0.370879  1.580614  0.561902  38.26961  22.30351  0.000000
  0.385714  1.585859  0.585390  39.36349  22.73273  0.000000
  0.400549  1.591103  0.608955  40.45772  23.16195  0.000000
  0.415385  1.596348  0.632598  41.55248  23.59117  0.000000
  0.430220  1.601593  0.656319  42.64798  24.02039  0.000000
  0.445055  1.606838  0.680118  43.74442  24.44961  0.000000
  0.459890  1.612082  0.703995  44.84201  24.87883  0.000000
  0.474725  1.617327  0.727949  45.94095  25.30805  0.000000
  0.489560  1.622572  0.751981  47.04142  25.73727  0.000000
  0.504396  1.627817  0.776091  48.14361  26.16649  0.000000
  0.519231  1.633061  0.800279  49.24768  26.59570  0.000000
  0.534066  1.638306  0.824545  50.35377  27.02492  0.000000
  0.548901  1.643551  0.848888  51.46205  27.45414  0.000000
  0.563736  1.648796  0.873309  52.57264  27.88336  0.000000
  0.578571  1.654040  0.897808  53.68566  28.31258  0.000000
  0.593407  1.659285  0.922385  54.80124  28.74180  0.000000
  0.608242  1.664530  0.947040  55.91948  29.17102  0.000000
  0.623077  1.669775  0.971772  57.04048  29.60024  0.000000
  0.637912  1.675019  0.996583  58.16433  30.02946  0.000000
  0.652747  1.680264  1.021471  59.29112  30.45868  0.000000
  0.667582  1.685509  1.046437  60.42093  30.88790  0.000000
  0.682418  1.690754  1.071480  61.55383  31.31712  0.000000
  0.697253  1.695998  1.096602  62.68988  31.74634  0.000000
  0.712088  1.701243  1.121801  63.82916  32.17556  0.000000
  0.726923  1.706488  1.147078  64.97171  32.60478  0.000000
  0.741758  1.711733  1.172433  66.11760  33.03400  0.000000
  0.750000  1.714646  1.186553  67.26687  33.27245  0.000000
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1              RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1              RCHRES   3     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7            RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   3     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   3 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   3 HYDR   O      1 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   3 HYDR   O      2 1        1      WDM   1003 FLOW     ENGL      REPL
RCHRES   3 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1978/ 3/ 4 14:30

RCHRES:     3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
91 3.1788E+04 3.2286E+04 3.4800E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1978/ 3/ 4 14:30

RCHRES:     3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
6.3118E+01 1.7881E+04 -1.084E+05    5.9396  5.9396E+00      3
```

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SOHM

PROJECT REPORT

General Model Information

Project Name:	SOHM Node 69
Site Name:	
Site Address:	
City:	
Report Date:	12/1/2014
Gage:	Trabuco Canyon
Data Start:	10/01/1958
Data End:	09/30/2005
Timestep:	15 Minute
Precip Scale:	1.00
Version:	2014/11/12

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
D,Scrub,Flat(0-5%)	0.55
Pervious Total	0.55
Impervious Land Use	Acres
Impervious Total	0
Basin Total	0.55

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
D,Scrub,Flat(0-5%)	0.1
Pervious Total	0.1
Impervious Land Use	Acres
Impervious,Flat(0-5)	0.45
Impervious Total	0.45
Basin Total	0.55

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length:	32.47 ft.	
Bottom Width:	32.47 ft.	
Depth:	4 ft.	
Volume at riser head:	0.0802 acre-ft.	
Infiltration On		
Infiltration rate:	0.5	
Infiltration safety factor:	1	
Total Volume Infiltrated (ac-ft):		15.006
Total Volume Through Riser (ac-ft):		15.597
Total Volume Through Facility (ac-ft):		30.603
Percent Infiltrated:		49.03
Total Precip Applied to Facility:		1.605
Total Evap From Facility:		0.101
Side slope 1:	0.5 To 1	
Side slope 2:	0.5 To 1	
Side slope 3:	0.5 To 1	
Side slope 4:	0.5 To 1	
Discharge Structure		
Riser Height:	3 ft.	
Riser Diameter:	18 in.	
Notch Type:	Rectangular	
Notch Width:	0.280 ft.	
Notch Height:	0.734 ft.	
Orifice 1 Diameter:	0.767 in. Elevation:0 ft.	
Element Flows To:		
Outlet 1	Outlet 2	

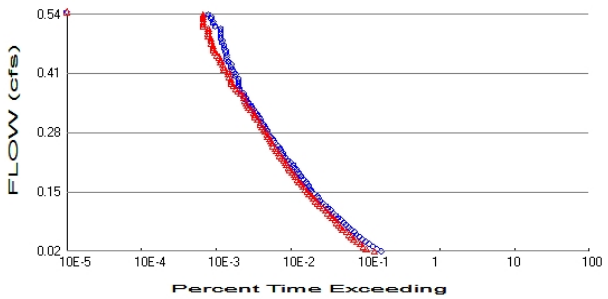
Pond Hydraulic Table

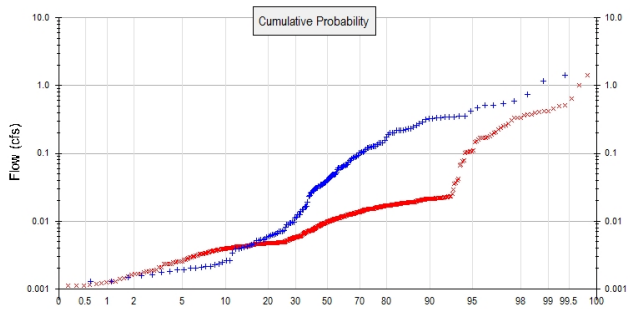
Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.024	0.000	0.000	0.000
0.0444	0.024	0.001	0.003	0.012
0.0889	0.024	0.002	0.004	0.012
0.1333	0.024	0.003	0.005	0.012
0.1778	0.024	0.004	0.006	0.012
0.2222	0.024	0.005	0.007	0.012
0.2667	0.024	0.006	0.008	0.012
0.3111	0.024	0.007	0.008	0.012
0.3556	0.024	0.008	0.009	0.012
0.4000	0.024	0.009	0.009	0.012
0.4444	0.024	0.010	0.010	0.012
0.4889	0.024	0.012	0.010	0.012
0.5333	0.025	0.013	0.011	0.012
0.5778	0.025	0.014	0.011	0.012
0.6222	0.025	0.015	0.012	0.012
0.6667	0.025	0.016	0.012	0.012
0.7111	0.025	0.017	0.013	0.012
0.7556	0.025	0.018	0.013	0.012
0.8000	0.025	0.019	0.013	0.012
0.8444	0.025	0.021	0.014	0.012
0.8889	0.025	0.022	0.014	0.012
0.9333	0.025	0.023	0.014	0.012
0.9778	0.025	0.024	0.015	0.012

1.0222	0.025	0.025	0.015	0.012
1.0667	0.025	0.026	0.016	0.012
1.1111	0.025	0.027	0.016	0.012
1.1556	0.026	0.029	0.016	0.012
1.2000	0.026	0.030	0.016	0.012
1.2444	0.026	0.031	0.017	0.012
1.2889	0.026	0.032	0.017	0.012
1.3333	0.026	0.033	0.017	0.012
1.3778	0.026	0.034	0.018	0.012
1.4222	0.026	0.036	0.018	0.012
1.4667	0.026	0.037	0.018	0.012
1.5111	0.026	0.038	0.019	0.012
1.5556	0.026	0.039	0.019	0.012
1.6000	0.026	0.040	0.019	0.012
1.6444	0.026	0.041	0.019	0.012
1.6889	0.026	0.043	0.020	0.012
1.7333	0.026	0.044	0.020	0.012
1.7778	0.026	0.045	0.020	0.012
1.8222	0.027	0.046	0.020	0.012
1.8667	0.027	0.047	0.021	0.012
1.9111	0.027	0.049	0.021	0.012
1.9556	0.027	0.050	0.021	0.012
2.0000	0.027	0.051	0.021	0.012
2.0444	0.027	0.052	0.022	0.012
2.0889	0.027	0.053	0.022	0.012
2.1333	0.027	0.055	0.022	0.012
2.1778	0.027	0.056	0.022	0.012
2.2222	0.027	0.057	0.023	0.012
2.2667	0.027	0.058	0.023	0.012
2.3111	0.027	0.060	0.032	0.012
2.3556	0.027	0.061	0.048	0.012
2.4000	0.027	0.062	0.068	0.012
2.4444	0.028	0.063	0.091	0.012
2.4889	0.028	0.065	0.117	0.012
2.5333	0.028	0.066	0.146	0.012
2.5778	0.028	0.067	0.176	0.012
2.6222	0.028	0.068	0.208	0.012
2.6667	0.028	0.070	0.242	0.012
2.7111	0.028	0.071	0.277	0.012
2.7556	0.028	0.072	0.313	0.012
2.8000	0.028	0.073	0.350	0.012
2.8444	0.028	0.075	0.388	0.012
2.8889	0.028	0.076	0.427	0.012
2.9333	0.028	0.077	0.466	0.012
2.9778	0.028	0.078	0.506	0.012
3.0222	0.028	0.080	0.575	0.012
3.0667	0.029	0.081	0.778	0.012
3.1111	0.029	0.082	1.068	0.012
3.1556	0.029	0.084	1.423	0.012
3.2000	0.029	0.085	1.834	0.012
3.2444	0.029	0.086	2.293	0.012
3.2889	0.029	0.088	2.796	0.012
3.3333	0.029	0.089	3.339	0.012
3.3778	0.029	0.090	3.920	0.012
3.4222	0.029	0.091	4.536	0.012
3.4667	0.029	0.093	5.185	0.012
3.5111	0.029	0.094	5.866	0.012
3.5556	0.029	0.095	6.578	0.012

3.6000	0.029	0.097	7.318	0.012
3.6444	0.029	0.098	8.087	0.012
3.6889	0.030	0.099	8.882	0.012
3.7333	0.030	0.101	9.703	0.012
3.7778	0.030	0.102	10.55	0.012
3.8222	0.030	0.103	11.42	0.012
3.8667	0.030	0.105	12.31	0.012
3.9111	0.030	0.106	13.23	0.012
3.9556	0.030	0.107	14.17	0.012
4.0000	0.030	0.109	15.13	0.012
4.0444	0.030	0.110	16.12	0.012

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.55
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.1
Total Impervious Area: 0.45

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.233084
5 year	0.365886
10 year	0.537927
25 year	1.003147

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.199095
5 year	0.401703
10 year	0.486011
25 year	0.868235

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0233	2690	2174	80	Pass
0.0285	2339	1681	71	Pass
0.0337	2077	1539	74	Pass
0.0389	1847	1405	76	Pass
0.0441	1643	1276	77	Pass
0.0493	1511	1159	76	Pass
0.0545	1374	1072	78	Pass
0.0597	1265	998	78	Pass
0.0649	1167	917	78	Pass
0.0701	1063	821	77	Pass
0.0753	979	775	79	Pass
0.0805	910	725	79	Pass
0.0857	844	682	80	Pass
0.0909	774	647	83	Pass
0.0961	715	596	83	Pass
0.1013	666	559	83	Pass
0.1065	603	515	85	Pass
0.1117	563	482	85	Pass
0.1169	524	443	84	Pass
0.1221	485	402	82	Pass
0.1273	443	381	86	Pass
0.1325	409	355	86	Pass
0.1377	385	332	86	Pass
0.1429	373	313	83	Pass
0.1481	342	291	85	Pass
0.1533	319	273	85	Pass
0.1585	307	256	83	Pass
0.1637	290	242	83	Pass
0.1689	274	231	84	Pass
0.1741	264	213	80	Pass
0.1793	243	200	82	Pass
0.1845	228	191	83	Pass
0.1896	215	182	84	Pass
0.1948	211	171	81	Pass
0.2000	199	159	79	Pass
0.2052	184	152	82	Pass
0.2104	178	145	81	Pass
0.2156	164	140	85	Pass
0.2208	151	133	88	Pass
0.2260	141	125	88	Pass
0.2312	133	118	88	Pass
0.2364	128	113	88	Pass
0.2416	122	107	87	Pass
0.2468	118	102	86	Pass
0.2520	111	94	84	Pass
0.2572	102	92	90	Pass
0.2624	98	89	90	Pass
0.2676	94	86	91	Pass
0.2728	87	80	91	Pass
0.2780	84	79	94	Pass
0.2832	81	75	92	Pass
0.2884	77	73	94	Pass
0.2936	74	67	90	Pass

0.2988	72	65	90	Pass
0.3040	67	64	95	Pass
0.3092	65	59	90	Pass
0.3144	62	54	87	Pass
0.3196	59	54	91	Pass
0.3248	56	53	94	Pass
0.3300	53	48	90	Pass
0.3352	50	45	90	Pass
0.3404	48	43	89	Pass
0.3456	45	42	93	Pass
0.3508	43	40	93	Pass
0.3560	41	39	95	Pass
0.3612	39	38	97	Pass
0.3664	38	35	92	Pass
0.3716	34	33	97	Pass
0.3768	34	30	88	Pass
0.3820	33	28	84	Pass
0.3872	33	26	78	Pass
0.3924	33	26	78	Pass
0.3976	33	26	78	Pass
0.4028	30	25	83	Pass
0.4080	30	24	80	Pass
0.4132	28	24	85	Pass
0.4184	27	21	77	Pass
0.4236	26	21	80	Pass
0.4288	26	20	76	Pass
0.4340	24	19	79	Pass
0.4392	23	19	82	Pass
0.4444	23	18	78	Pass
0.4496	23	17	73	Pass
0.4548	22	16	72	Pass
0.4600	22	15	68	Pass
0.4652	21	15	71	Pass
0.4704	21	15	71	Pass
0.4755	20	14	70	Pass
0.4807	20	14	70	Pass
0.4859	19	14	73	Pass
0.4911	19	13	68	Pass
0.4963	19	13	68	Pass
0.5015	19	13	68	Pass
0.5067	19	13	68	Pass
0.5119	16	11	68	Pass
0.5171	15	11	73	Pass
0.5223	15	11	73	Pass
0.5275	14	11	78	Pass
0.5327	14	11	78	Pass
0.5379	13	11	84	Pass

Water Quality

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

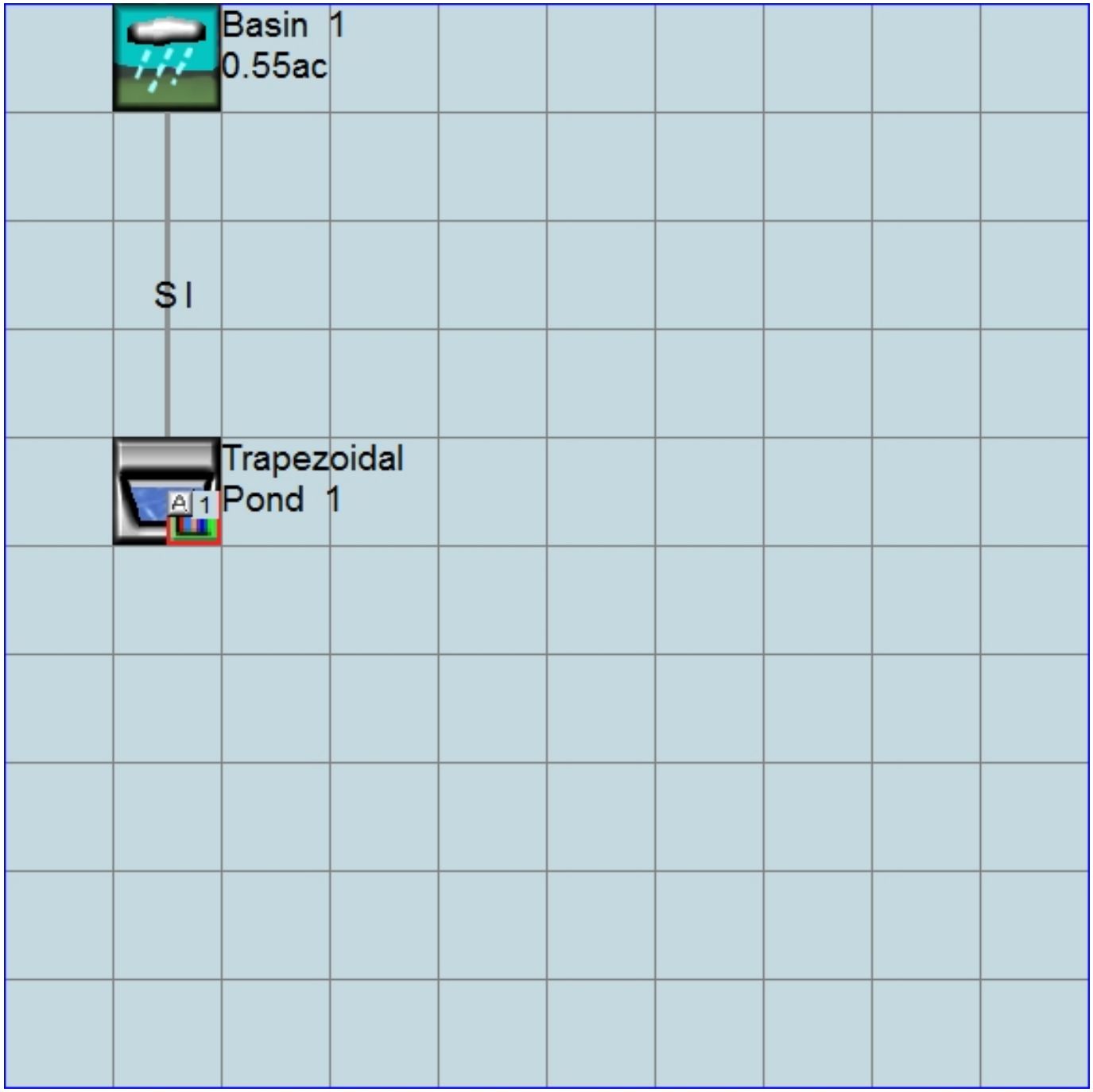
IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1958 10 01        END    2005 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   SOHM Node 69.wdm
MESSU      25   PreSOHM Node 69.MES
           27   PreSOHM Node 69.L61
           28   PreSOHM Node 69.L62
           30   POCSOHM Node 691.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      37
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   37     D,Scrub,Flat(0-5%)      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   37         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   37         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   37         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   37              0       4.6      0.04       400      0.05       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   37             40        35         4         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   37              0       0.9       0.3         1       0.7         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   37      0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   37              0         0      0.09         0      0.92       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2
```

```
  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  37                        0.55     COPY   501     12
PERLND  37                        0.55     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                               ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                      ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES
```

```
SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1958 10 01        END    2005 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   SOHM Node 69.wdm
MESSU      25   MitSOHM Node 69.MES
           27   MitSOHM Node 69.L61
           28   MitSOHM Node 69.L62
           30   POCSOHM Node 691.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      37
      IMPLND       1
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                            in  out           ***
   37     D,Scrub,Flat(0-5%)      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   37         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
```

```
  37         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  37         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  37              0       4.6      0.04       400      0.05       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  37             40        35         4         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  37              0       0.9       0.3         1       0.7         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
  37       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
  37      0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  37              0         0      0.09         0      0.92       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1     Impervious,Flat(0-5)    1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
```

```
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            100      0.05       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  37                        0.1     RCHRES   1      2
IMPLND   1                       0.45     RCHRES   1      5

******Routing******
PERLND  37                        0.1     COPY     1     12
IMPLND   1                       0.45     COPY     1     15
RCHRES   1                          1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<-----------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                            ***
    1     Trapezoidal Pond-004    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
```

```
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.024210  0.000000  0.000000  0.000000
  0.044444  0.024276  0.001077  0.003257  0.012206
  0.088889  0.024342  0.002158  0.004607  0.012206
  0.133333  0.024409  0.003241  0.005642  0.012206
  0.177778  0.024475  0.004328  0.006515  0.012206
  0.222222  0.024542  0.005417  0.007284  0.012206
  0.266667  0.024609  0.006509  0.007979  0.012206
  0.311111  0.024676  0.007604  0.008618  0.012206
  0.355556  0.024743  0.008702  0.009213  0.012206
  0.400000  0.024810  0.009804  0.009772  0.012206
  0.444444  0.024877  0.010908  0.010301  0.012206
  0.488889  0.024944  0.012015  0.010803  0.012206
  0.533333  0.025011  0.013125  0.011284  0.012206
  0.577778  0.025079  0.014238  0.011744  0.012206
  0.622222  0.025146  0.015354  0.012188  0.012206
  0.666667  0.025214  0.016473  0.012615  0.012206
  0.711111  0.025282  0.017596  0.013029  0.012206
  0.755556  0.025349  0.018721  0.013430  0.012206
  0.800000  0.025417  0.019849  0.013820  0.012206
  0.844444  0.025485  0.020980  0.014198  0.012206
  0.888889  0.025553  0.022114  0.014567  0.012206
  0.933333  0.025621  0.023251  0.014927  0.012206
  0.977778  0.025690  0.024392  0.015278  0.012206
  1.022222  0.025758  0.025535  0.015621  0.012206
  1.066667  0.025826  0.026681  0.015957  0.012206
  1.111111  0.025895  0.027831  0.016287  0.012206
  1.155556  0.025963  0.028983  0.016609  0.012206
  1.200000  0.026032  0.030138  0.016925  0.012206
  1.244444  0.026101  0.031297  0.017236  0.012206
  1.288889  0.026170  0.032458  0.017541  0.012206
  1.333333  0.026239  0.033623  0.017841  0.012206
  1.377778  0.026308  0.034791  0.018136  0.012206
  1.422222  0.026377  0.035962  0.018426  0.012206
  1.466667  0.026446  0.037135  0.018712  0.012206
  1.511111  0.026515  0.038312  0.018993  0.012206
  1.555556  0.026585  0.039492  0.019270  0.012206
  1.600000  0.026654  0.040675  0.019544  0.012206
  1.644444  0.026724  0.041862  0.019813  0.012206
  1.688889  0.026793  0.043051  0.020079  0.012206
  1.733333  0.026863  0.044243  0.020342  0.012206
  1.777778  0.026933  0.045439  0.020601  0.012206
  1.822222  0.027003  0.046637  0.020857  0.012206
  1.866667  0.027073  0.047839  0.021110  0.012206
  1.911111  0.027143  0.049044  0.021360  0.012206
```

```
  1.955556  0.027213  0.050252  0.021607  0.012206
  2.000000  0.027284  0.051463  0.021851  0.012206
  2.044444  0.027354  0.052677  0.022092  0.012206
  2.088889  0.027424  0.053894  0.022331  0.012206
  2.133333  0.027495  0.055115  0.022567  0.012206
  2.177778  0.027566  0.056338  0.022801  0.012206
  2.222222  0.027636  0.057565  0.023033  0.012206
  2.266667  0.027707  0.058795  0.023267  0.012206
  2.311111  0.027778  0.060028  0.032243  0.012206
  2.355556  0.027849  0.061264  0.048118  0.012206
  2.400000  0.027920  0.062503  0.068282  0.012206
  2.444444  0.027992  0.063746  0.091746  0.012206
  2.488889  0.028063  0.064991  0.117911  0.012206
  2.533333  0.028134  0.066240  0.146359  0.012206
  2.577778  0.028206  0.067492  0.176769  0.012206
  2.622222  0.028277  0.068747  0.208886  0.012206
  2.666667  0.028349  0.070006  0.242494  0.012206
  2.711111  0.028421  0.071267  0.277412  0.012206
  2.755556  0.028493  0.072532  0.313480  0.012206
  2.800000  0.028565  0.073800  0.350556  0.012206
  2.844444  0.028637  0.075071  0.388513  0.012206
  2.888889  0.028709  0.076345  0.427236  0.012206
  2.933333  0.028781  0.077623  0.466619  0.012206
  2.977778  0.028853  0.078904  0.506564  0.012206
  3.022222  0.028926  0.080188  0.575211  0.012206
  3.066667  0.028998  0.081475  0.778474  0.012206
  3.111111  0.029071  0.082765  1.068265  0.012206
  3.155556  0.029143  0.084059  1.423663  0.012206
  3.200000  0.029216  0.085356  1.834220  0.012206
  3.244444  0.029289  0.086656  2.293321  0.012206
  3.288889  0.029362  0.087959  2.796285  0.012206
  3.333333  0.029435  0.089266  3.339573  0.012206
  3.377778  0.029508  0.090576  3.920388  0.012206
  3.422222  0.029581  0.091889  4.536443  0.012206
  3.466667  0.029654  0.093205  5.185827  0.012206
  3.511111  0.029728  0.094525  5.866909  0.012206
  3.555556  0.029801  0.095848  6.578276  0.012206
  3.600000  0.029875  0.097174  7.318690  0.012206
  3.644444  0.029949  0.098503  8.087052  0.012206
  3.688889  0.030022  0.099836  8.882381  0.012206
  3.733333  0.030096  0.101172  9.703790  0.012206
  3.777778  0.030170  0.102511  10.55048  0.012206
  3.822222  0.030244  0.103854  11.42171  0.012206
  3.866667  0.030318  0.105199  12.31681  0.012206
  3.911111  0.030392  0.106549  13.23516  0.012206
  3.955556  0.030467  0.107901  14.17619  0.012206
  4.000000  0.030541  0.109257  15.13936  0.012206
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1              RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    1              RCHRES   1     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      2 1        1      WDM   1003 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
```

```
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
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<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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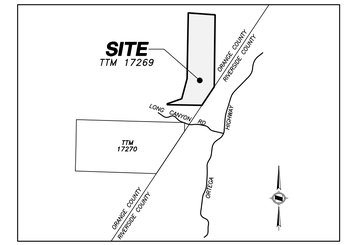
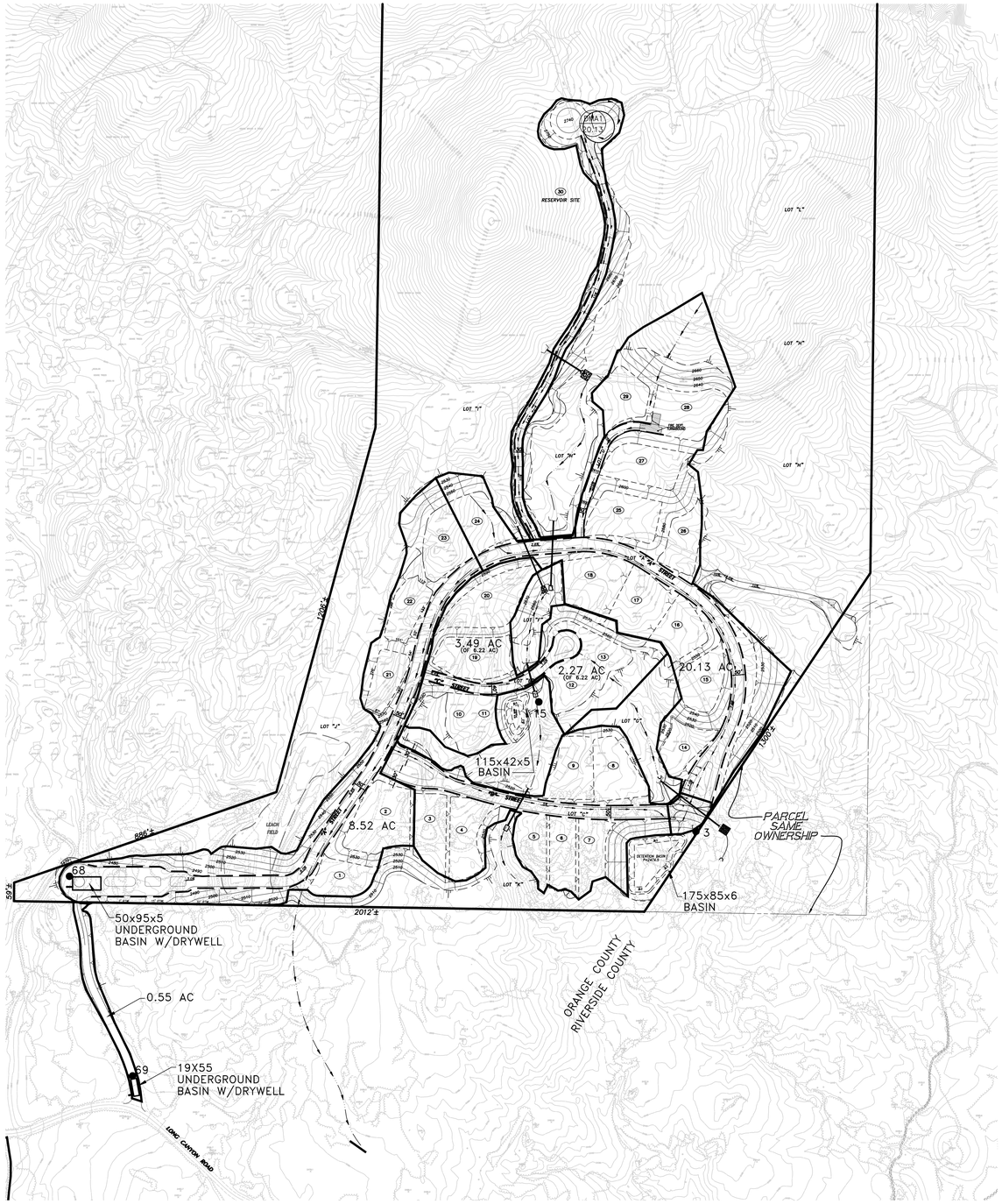
VICINITY MAP



LEGEND

MITIGATED AREA
VEGETATED SWALE
13 • NODE NUMBER
BASIN
FLOW LINE



SCALE: 1" = 200'

200 100 0 200 600
GRAPHIC SCALE 1"=200'

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MAP DATE IDENTIFIER
DATE OF LATEST CHANGE TO THIS MAP
01/08/08 BY: T.LEE
DATE OF THIS PLOT
11/26/13

HYDROMODIFICATION MAP
THE PRESERVE
AT SAN JUAN - NORTH

WO: 3226-1
HYDROLOGY MAP THE PRESERVE

F:\0188\Planning\OA_Project\Hydromodification\Proposed Hydromodification North MapHC.dwg

Attachment D

BMP Calculations &

BMP Details

HSC-2 – Impervious Area Dispersion

INF-1 – Infiltration Basin

INF-5 – Drywell

BIO-2 – Vegetated Swale

BMP Calculations

Worksheet B: Simple Design Capture Volume Sizing Method – DMA 1

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	1.0	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	1.0	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	20.13	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.65	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.6375	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	46,583	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	TBD	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=		
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=		In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	TBD	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=		feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=		sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method – DMA 2

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	1.0	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	1.0	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	4.86	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.65	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.6375	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	11,247	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	TBD	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=		
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=		In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	TBD	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=		feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=		sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method – DMA 3

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	1.0	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	1.0	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	8.67	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.65	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.6375	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	20,063	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	TBD	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=		
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=		In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	TBD	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=		feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=		sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method – DMA 4

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	1.0	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	1.0	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.55	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.8	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.75	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	1,497	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	TBD	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=		
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=		In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	TBD	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=		feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=		sq-ft

Worksheet D: Capture Efficiency Method for Flow-Based BMPs – DMA 1

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	10	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.23	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 *(Worksheet A)*	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.23	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	20.13	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.65	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.6375	
4	Calculate design flowrate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	2.95	cfs
Supporting Calculations				
Describe system: Runoff from residential lots conveyed as sheet flow to parkway swales. Runoff from streets conveyed as gutter flow to swale via parkway culverts. Swale designed to provide pre-treatment of runoff and conveyance to downstream infiltration basin.				
Provide time of concentration assumptions: Assume 10 minutes minimum.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs – DMA 2

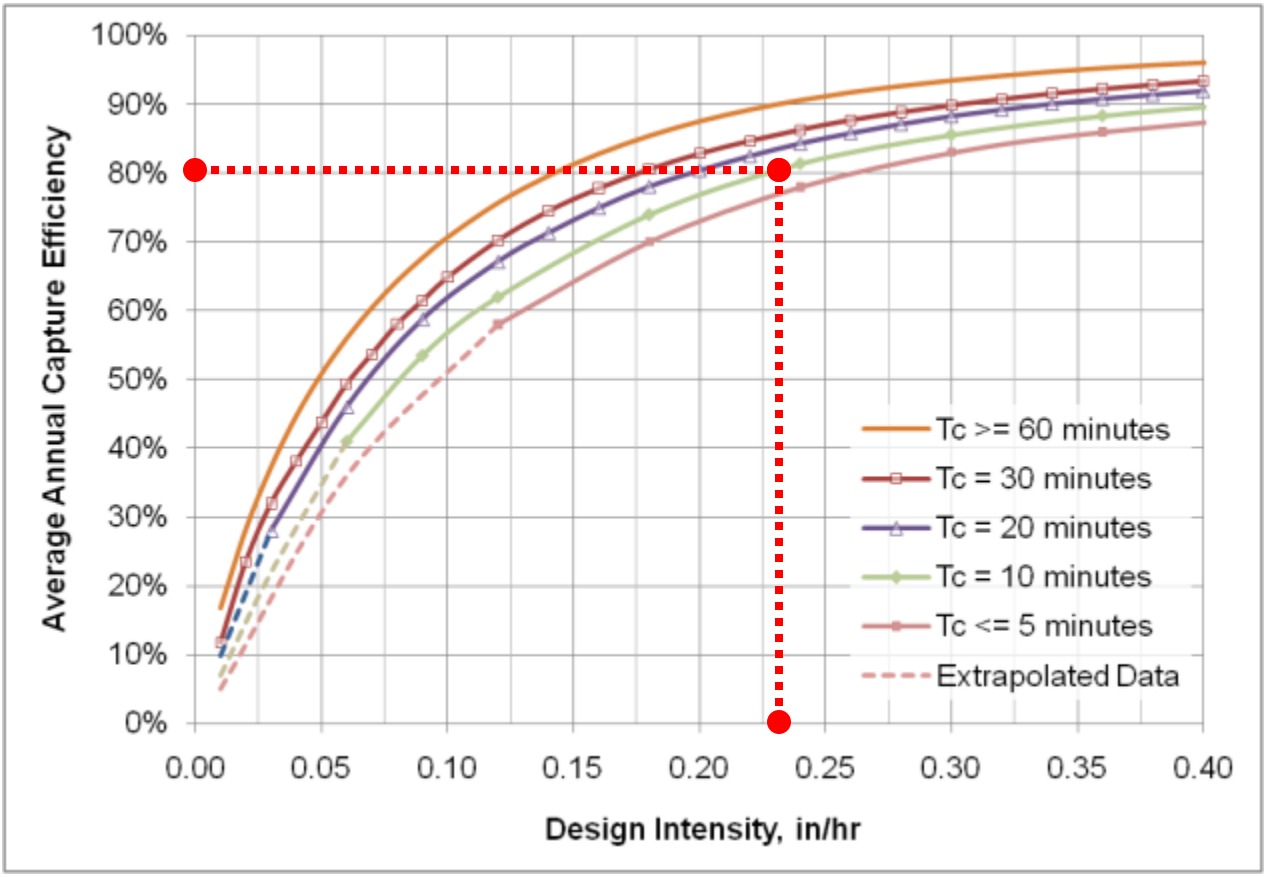
Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	10	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.23	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 *(Worksheet A)*	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.23	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	4.86	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.65	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.6375	
4	Calculate design flowrate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.71	cfs
Supporting Calculations				
Describe system: Runoff from residential lots conveyed as sheet flow to parkway swales. Runoff from streets conveyed as gutter flow to swale via parkway culverts. Swale designed to provide pre-treatment of runoff and conveyance to downstream infiltration basin.				
Provide time of concentration assumptions: Assume 10 minutes minimum.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs – DMA 3

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	10	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.23	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 *(Worksheet A)*	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.23	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	8.67	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.65	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.6375	
4	Calculate design flowrate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	1.27	cfs
Supporting Calculations				
Describe system: Runoff from residential lots conveyed as sheet flow to parkway swales. Runoff from streets conveyed as gutter flow to swale via parkway culverts. Swale designed to provide pre-treatment of runoff and conveyance to downstream subsurface detention facility and drywell infiltration.				
Provide time of concentration assumptions: Assume 10 minutes minimum.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs – DMA 3

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Worksheet H: Factor of Safety and Design Infiltration Rate Worksheet					
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	TBD	TBD
		Predominant soil texture	0.25	TBD	TBD
		Site soil variability	0.25	TBD	TBD
		Depth to groundwater / impervious layer	0.25	TBD	TBD
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			TBD
B	Design	Tributary area size	0.25	2	0.5
		Level of pretreatment/ expected sediment loads	0.25	1	0.25
		Redundancy	0.25	2	0.5
		Compaction during construction	0.25	1	0.25
		Design Safety Factor, $S_B = \Sigma p$			1.5
Combined Safety Factor, $S_{TOT} = S_A \times S_B$					TBD
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)					TBD
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT} / K_M$					TBD
Supporting Data					
Briefly describe infiltration test and provide reference to test forms:					

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

Worksheet I: Summary of Groundwater-related Feasibility Criteria

1	Is project large or small? (as defined by Table VIII.2) circle one	Large		Small
2	What is the tributary area to the BMP?	A	20.13, 4.86, 8.67, 0.55	acres
3	What type of BMP is proposed?	Infiltration basins and drywells		
4	What is the infiltrating surface area of the proposed BMP?	A_{BMP}	12,536, 1,717, drywells TBD	sq-ft
5	What land use activities are present in the tributary area (list all) Currently natural/open space.			
6	What land use-based risk category is applicable?	L	M	H
7	If M or H, what pretreatment and source isolation BMPs have been considered and are proposed (describe all): Project is considered low potential. However, swales will be used as pre-treatment for infiltration basins and one drywell unit. The remaining drywell unit will be equipped with a pre-treatment manhole unit (e.g. Maxwell Plus or equivalent).			
8	What minimum separation to mounded seasonally high groundwater applies to the proposed BMP? See Section VIII.2 (circle one) TBD	5 ft		10 ft
9	Provide rationale for selection of applicable minimum separation to seasonally high mounded groundwater: To be determined. Will be provided once site specific infiltration rates are known.			
10	What is separation from the infiltrating surface to seasonally high groundwater?	SHGWT	TBD	ft
11	What is separation from the infiltrating surface to mounded seasonally high groundwater?	Mounded SHGWT	TBD	ft
12	Describe assumptions and methods used for mounding analysis: TBD			
13	Is the site within a plume protection boundary (See Figure VIII.2)?	Y	N	N/A
14	Is the site within a selenium source area or other natural plume area (See Figure VIII.2)?	Y	N	N/A
15	Is the site within 250 feet of a contaminated site?	Y	N	N/A
16	If site-specific study has been prepared, provide citation and briefly summarize relevant findings: A site specific study was preliminary conducted to examine the feasibility for use of leach fields. The study determined that percolation rates onsite ranged from 0.5″ per hour to 1.0″ per hour. A site specific study of the locations of the proposed infiltration BMPs will provide additional information regarding the feasibility of infiltration BMPs for the project.			

Worksheet I: Summary of Groundwater-related Feasibility Criteria

17	Is the site within 100 feet of a water supply well, spring, septic system?	Y	N	N/A
18	Is infiltration feasible on the site relative to groundwater-related criteria?	Y	N	N/A
Provide rationale for feasibility determination: Site specific infiltration testing of the proposed infiltration BMP areas is necessary to ensure that infiltration BMPs are feasible for the project.				

BMP Details

HSC-2: Impervious Area Dispersion

Impervious area dispersion refers to the practice of routing runoff from impervious areas, such as rooftops, walkways, and patios onto the surface of adjacent pervious areas. Runoff is dispersed uniformly via splash block or dispersion trench and soaks into the ground as it move slowly across the surface of pervious areas. Minor ponding may occur, but it is not the intent of this practice to actively promote localized on-lot storage (See HSC-1: Localized On-Lot Infiltration).

Also known as:

- *Downspout disconnection*
- *Impervious area disconnection*
- *Sheet flow dispersion*

Simple Downspout Dispersion
Source: toronto.ca/environment/water.htm

Feasibility Screening Considerations

- Impervious area dispersion can be used where infiltration would otherwise be infeasible, however dispersion depth over landscaped areas should be limited by site-specific conditions to prevent standing water or geotechnical issues.

Opportunity Criteria

- Rooftops and other low traffic impervious surface present in drainage area.
- Soils are adequate for infiltration. If not, soils can be amended to improve capacity to absorb dispersed water (see MISC-2: Amended Soils).
- Significant pervious area present in drainage area with shallow slope
- Overflow from pervious area can be safely managed.

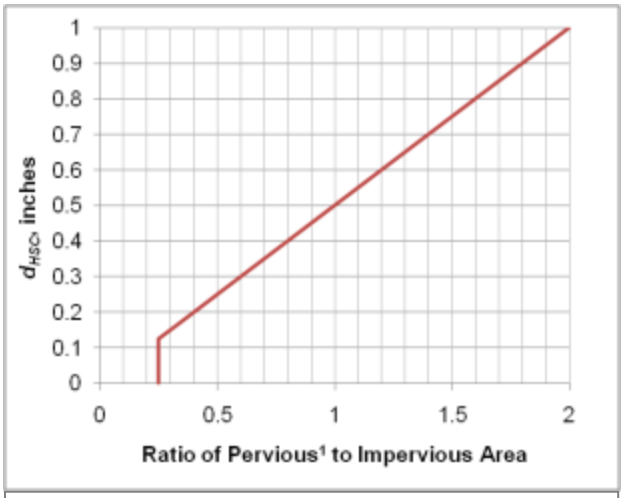
OC-Specific Design Criteria and Considerations

- ☐ Soils should be preserved from their natural condition or restored via soil amendments to meet minimum criteria described in Section .
- ☐ A minimum of 1 part pervious area capable of receiving flow should be provided for every 2 parts of impervious area disconnected.
- ☐ The pervious area receiving flow should have a slope ≤ 2 percent and path lengths of ≥ 20 feet per 1000 sf of impervious area.
- ☐ Dispersion areas should be maintained to remove trash and debris, loose vegetation, and protect any areas of bare soil from erosion.
- ☐ Velocity of dispersed flow should not be greater than 0.5 ft per second to avoid scour.

Calculating HSC Retention Volume

- The retention volume provided by downspout dispersion is a function of the ratio of impervious to pervious area and the condition of soils in the pervious area.
- Determine flow patterns in pervious area and estimate footprint of pervious area receiving dispersed flow. Calculate the ratio of pervious to impervious area.
- Check soil conditions using the soil condition design criteria below; amend if necessary.
- Look up the storm retention depth, d_{HSC} from the chart below.

- The max d_{HSC} is equal to the design storm depth for the project site.



[1] Pervious area used in calculation should only include the pervious area receiving flow, not pervious area receiving only direct rainfall or upslope pervious drainage.

Soil Condition Design Criteria

- ☐ Maximum slope of 2 percent
- ☐ Well-established lawn or landscaping
- ☐ Minimum soil amendments per criteria in MISC-2: Amended Soils.

Configuration for Use in a Treatment Train

- Impervious area disconnection is an HSC that may be used as the first element in any treatment train
- The use of impervious area disconnection reduces the sizing requirement for downstream LID and/or treatment control BMPs

Additional References for Design Guidance

- SMC LID Manual (pp 131) http://www.lowimpactdevelopment.org/guest75/pub/All_Projects/SoCal_LID_Manual/SoCalLID_Manual_FINAL_040910.pdf
- City of Portland Bureau of Environmental Services. 2010. How to manage stormwater – Disconnect Downspouts. http://www.portlandonline.com/bes/index.cfm?c=43081&a=177702
- Seattle Public Utility: http://www.cityofseattle.org/util/stellent/groups/public/@spu/@usm/documents/webcontent/spu01_006395.pdf
- Thurston County, Washington State (pp 10): http://www.co.thurston.wa.us/stormwater/manual/docs-faqs/DG-5-Roof-Runoff-Control_Rev11Jan24.pdf

XIV.3. Infiltration BMP Fact Sheets (INF)

INF-1: Infiltration Basin Fact Sheet

An infiltration basin consists of an earthen basin constructed in naturally pervious soils (Type A or B soils) with a flat bottom. An energy dissipating inlet must be provided, along with an emergency spillway to control excess flows. An optional relief underdrain may be provided to drain the basin if standing water conditions occur. A forebay settling basin or separate treatment control measure must be provided as pretreatment. An infiltration basin retains the stormwater quality design volume in the basin and allows the retained runoff to percolate into the underlying soils in 72 hours or less. The bottom of an infiltration basin is typically vegetated with dryland grasses or irrigated turf grass; however other types of vegetation are permissible if they can survive periodic inundation and long inter-event dry periods.

Feasibility Screening Considerations

- Infiltration bains shall pass infeasibility screening criteria to be considered for use
- Infiltration basins pose a potential risk of groundwater contamination if underlying soils have very high permeability and low pollutant assimilation capacity; pretreatment should always be provided.
- Evaporation tends to be minor, therefore increases in infiltration compared to natural conditions may result.
- The potential for groundwater mounding should be evaluated if depth to seasonally high groundwater (unmounded) is less than 15 feet.

Also known as:

- *Recharge basins*
- *Infiltration pond*

Infiltration Basin

Source: Pennsylvania Stormwater BMP Manual

Opportunity Criteria

- Soils are adequate for infiltration or can be amended to provide an adequate infiltration rate.
- Typically need 2-5 percent of drainage area available for infiltration.
- Space available for pretreatment (biotreatment or treatment control BMP as described below).
- Potential for groundwater contamination can be mitigated through isolation of pollutant sources, pretreatment of inflow, and/or demonstration of adequate treatment capacity of underlying soils.
- Infiltration is into native soil, or
- The depth of engineered fill is ≤ 5 feet from the bottom of the facility to native material and infiltration into fill is approved by a geotechnical professional.
- Tributary area land uses include mixed-use and commercial, sngle-family and multi-family, roads and parking lots, and parks and open spaces. Basins can be integrated into parks and open spaces. High pollutant land uses should not be tributary to infiltration BMPs.

OC-Specific Design Criteria and Considerations

☐ Placement of BMPs shall observe geotechnical recommendations with respect to geological hazards (e.g. landslides, liquefaction zones, erosion, etc.) and set-backs (e.g., foundations,

utilities, roadways, etc.)

- ☐ For facilities with tributary area less than 5 acres, minimum separation to mounded seasonally high groundwater of 5 feet shall be observed.
- ☐ For facilities with tributary area greater than 5 acres, minimum separation to mounded seasonally high groundwater of 10 feet shall be observed.
- ☐ Minimum pretreatment (settling forebay or separate BMP) should be provided upstream of the infiltration basin, and water bypassing pretreatment should not be directed to the infiltration basin.
- ☐ If a settling forebay is used, forebay should have a volume equal to 25% of facility volume and have a minimum length to width ratio of 2:1
- ☐ Infiltration basins should not be used for drainage areas with high sediment production potential unless preceded by full treatment control with a BMP effective for sediment removal.
- ☐ Side-slopes should be no steeper than 3H:1V.
- ☐ Design infiltration rate should be determined consistent with guidance contained in **Appendix VII**.
- ☐ Energy dissipators should be provided at inlet and outlet to prevent erosion.
- ☐ An overflow device must be provided if basin is on-line.
- ☐ A minimum freeboard of one foot should be provided above the overflow device (for an on-line basin) or the outlet (for an off-line basin).
- ☐ Infiltration basin bottom must be as flat as possible.
- ☐ Basin length to width ratio should be a minimum of 2:1 L:W.

Simple Sizing Method for Infiltration Basins

If the Simple DCV Sizing Method is used to size an infiltration basin, the user calculates the DCV and designs the BMP geometry required to draw down the DCV in 48 hours. The sizing steps are as follows:

Step 1: Determine Infiltration Basin DCV

Calculate the DCV using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1**.

Step 2: Determine the 48-hour Depth

The depth of water that can be drawn down in 48 hours can be calculated using the following equation:

$$d_{48} = K_{DESIGN} \times 4$$

Where:

d_{48} = basin 48-hour drawdown depth, ft

K_{DESIGN} = basin design infiltration rate, in/hr (See **Appendix VII**)

This is the maximum depth of the basin below the overflow device to achieve drawdown in 48 hours.

Step 3: Calculate the Required Infiltrating Area

The required infiltrating area (i.e. basin area at mid ponding depth) can be calculated using the following equation:

$$A = DCV / (d_P)$$

Where:

A = required basin infiltrating area, sq-ft (assumed to be the basin area at mid-ponding depth)

DCV = design capture volume, cu-ft (see Step 1)

d_P = ponding depth, ft (should be equal to or less than d_{48})

Capture Efficiency Method for Infiltration Basins

If BMP geometry has already been defined and deviates from the 48 hour drawdown time, the designer can use the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See **Appendix III.3.2**) to determine the fraction of the DCV that must be provided to manage 80 percent of average annual runoff volume. This method accounts for drawdown time different than 48 hours.

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

$$DD = (d_P / K_{DESIGN}) \times 12$$

Where:

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

d_P = ponding depth below overflow device, ft

K_{DESIGN} = basin design infiltration rate, in/hr (See **Appendix VII**)

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

Use the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (**Appendix III.3.2**) to calculate the fraction of the DCV the basin must hold to achieve 80 percent capture of average annual stormwater runoff volume based on the basin drawdown time calculated above.

Step 3: Determine the Basin Infiltrating Area Needed

The required infiltrating area (i.e. basin bottom) can be calculated using the following equation:

$$A = DCV/ ((d_P)$$

Where:

A = required basin infiltrating area, sq-ft (assumed to be the basin area at mid-ponding depth)

DCV = design capture volume, adjusted for drawdown time, cu-ft (see Step 1)

d_P = ponding depth, ft

If the area required is greater than the selected basin area, adjust surface area or adjust ponding depth and recalculate required area until the required area is achieved.

Configuration for Use in a Treatment Train

- Infiltration basins may be preceeded in a treatment train by HSCs in the drainage area, which would reduce the required design volume of the basins.
- Infiltration basins must be preceeded by some form of pretreatment, which may be biotreatment or a treatment control BMP; if an approved biotreatment BMP is used as pretreatment, the overflow from the infiltration basin may be considered “biotreated” for the purposes of meeting the LID requirements.
- The overflow or bypass from an infiltration basin can be routed to a downstream biotreatment BMP and/or a treatment control BMP if additional control is required to achieve LID or treatment control requirements.

Additional References for Design Guidance

- CASQA BMP Handbook for New and Redevelopment:
  http://www.cabmphandbooks.com/Documents/Development/TC-11.pdf
- SMC LID Manual (pp 139):
  http://www.lowimpactdevelopment.org/guest75/pub/All_Projects/SoCal_LID_Manual/SoCalLID_Manual_FINAL_040910.pdf
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 6:
  http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf
- City of Portland Stormwater Management Manual (Basin, page 2-57)
  http://www.portlandonline.com/bes/index.cfm?c=47954&a=202883
- San Diego County LID Handbook Appendix 4 (Factsheet 2):
  http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf

BIO-2: Vegetated Swale

Also known as:

- *Bioswale*
- *Biofiltration swale*
- *Grass swale*

Vegetated Swale
Source: Geosyntec Consultants

Vegetated swale filters (vegetated swales) are open, shallow channels with low-lying vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. Vegetated swales provide pollutant removal through settling and filtration in the vegetation (usually grasses) lining the channels. In addition, they provide the opportunity for volume reduction through infiltration and ET, and reduce the flow velocity in addition to conveying storm water runoff. Where soil conditions allow, volume reduction in vegetated swales can be enhanced by adding a gravel drainage layer underneath the swale allowing additional flows to be retained and infiltrated. Where slopes are shallow and soil conditions limit or prohibit infiltration, an underdrain system or low flow channel for dry weather flows may be required to minimize ponding and convey treated and/or dry weather flows to an acceptable discharge point. An effective vegetated swale achieves uniform sheet flow through a densely vegetated area for a period of several minutes. The vegetation in the swale can vary depending on its location within the project area and is generally the choice of the designer, subject to the design criteria outlined in this section.

Feasibility Screening Considerations

- Swales may cause incidental infiltration; however, infiltration is not a mandatory mechanism for pollutant removal for swales and it may create hazards in some circumstances. Therefore, conditions should be evaluated to determine whether circumstances require an impermeable liner to avoid infiltration into the subsurface.

Opportunity Criteria

- Open areas are needed for vegetated swales, including, but not limited to, road shoulders, road medians, parks and athletic fields and can be constructed in residential or commercial areas.
- Site slope is less than 10 percent.
- Drainage area is ≤ 5 acres.
- Vegetated swales must not interfere with flood control functions of existing conveyance and detention structures.

OC-Specific Design Criteria and Considerations

☐ Swales should have a minimum bottom width of 2 feet and a maximum bottom width of 10 feet. Swale dividers should be used if the bottom width must exceed 10 feet to promote even distribution of flow across the swale. Local juridictions may require larger minimum widths based on maintenance requirements.

☐ The channel side slope should not exceed 2:1 (H:V) for a total swale depth of 1 foot or less. For deeper swales or mowed grass swales, the maximum channel side slope should be 3:1. Where space is constrained, swales may have vertical concrete or block walls provided that slope

stability, maintenance access and public safety considerations are met.

- ☐ The minimum swale length for biotreatment applications is 100 feet. The minimum residence time for flows in the swale is 10 minutes.
- ☐ If slope is less than 1.5%, underdrains should be provided for the length of the swale
- ☐ A gravel blanket or bedding is required around the underdrain pipe(s). At least 0.5 feet of washed aggregate must be placed below, to the top, and to the sides of the underdrain pipe(s).
- ☐ If an underdrain is included, an amended soil layer of 1 foot minimum thickness must be provided above the underdrain meeting the specifications of MISC-1: Planting/Storage Media.
- ☐ The maximum bed slope in flow direction should not exceed 6% (unles check dams are provided).
- ☐ The maximum flow velocity should not exceed 1.0 ft/sec for water quality treatment swales.
- ☐ For infrequently mowed swales, a maximum flow depth of 4 inches should be implemented. For frequently mowed turf swales, the maximum flow depth is 2 inches.
- ☐ The vegetation height should be maintained between 4 to 6 inches.
- ☐ Gradual meandering bends in the swale are desirable for aesthetic purposes and to promote slower flow and particulate settling.
- ☐ Blockages in the swale that result in uneven flow distribution and points of concentrated flow should be avoided. Blockages that should be avoided include trees, bushes, light pole piers, and utility vaults or pads.

Sizing Method for Vegetated Swales

The Design Capture Method for Flow-based BMPs should be used to determine the design flowrate for a vegetated swale. The user then selects the design flow depth and longitudinal slope and uses the sizing steps below to determine the length and width of the swale. The sizing steps are as follows:

Step 1: Determine Design Flowrate (Q)

Calculate the Design Flowrate (Q) using the Capture Efficiency Method for Flow-based BMPs (See **Appendix III.3.3**). Inputs include the time of concentration of the catchment (T_c) and the capture efficiency achieved upstream by HSCs or other BMPs.

Step 2: Estimate the Swale Bottom Width

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

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

Where:

b = estimated swale bottom width, ft

Q = design flowrate, cfs

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

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

s = longitudinal slope in flow direction, ft/ft (not to exceed 0.06)

If b is between 2 and 10 feet, proceed to step 3.

If b is less than 2 feet, increase b to 2 feet and recalculate design flow depth using the following:

$y = ((Q \times n_{WQ}) / (1.49 \times b \times s^{0.5}))^{0.6}$

If b is greater than 10 feet, one of the following steps is necessary:

- Increase longitudinal slope to a maximum of 6% or 0.06, and recalculate b
- Increase design flow depth to a maximum of 4 inches or 0.33 ft, and recalculate b
- Install a divider lengthwise along swale bottom at least three-quarters of the swale length, beginning at the inlet. The swale width can be increased to 16 feet if a divider is provided.

Step 3: Determine Design Flow Velocity

Calculate the design flow velocity using the following equation:

$V_{WQ} = Q / A_{WQ}$

Where:

V_{WQ} = design flow velocity, fps

Q = design flowrate, cfs

$A_{WQ} = by + Zy^2$, cross sectional area of flow at design depth

Z = side slope length per unit height

If the design flow velocity exceeds 1 foot per second, design parameters in Step 2 should be adjusted (slope, bottom width, or design flow depth) until V_{WQ} is equal or less than 1 fps.

Step 4: Calculate Swale Length

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

$L = 60 \times t_{HR} \times V_{WQ}$

Where:

L = swale length, ft

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

V_{WQ} = design flow velocity, fps

Step 5: If Needed, Adjust Swale Length to Site Constraints

Note that oftentimes swale length can be accomodated by providing a meandering swale. However, if swale length is too large for the site, the length can be adjusted as follows:

- Calculate the swale treatment top area (A_{top}), based on the swale length calculated in Step 4:

$A_{TOP} = (b_i + b_{SLOPE}) \times L_i$

Where:

A_{TOP} = top area (ft^2) at the design treatment depth

b_i = bottom width (ft), calculated in Step 2

b_{SLOPE} = the additional top width (ft) above the side slope for the design water depth (for 3:1 side slopes and a 4-inch water depth, b_{slope} = 2 feet)

L_i = initial length (ft) calculated in Step 4

- Use the swale top area and a reduced swale length (L_f) to increase the bottom width, using the following equation:

$L_F = A_{TOP} / (b_F + b_{SLOPE})$

Where:

L_F = reduced swale length (ft)

b_F = increased bottom width (ft)

- Recalculate V_{WQ} according to Step 3 using the revised cross-sectional area A_{WQ} based on the increased bottom width (b_F). Revise the design as necessary if the design flow velocity exceeds 1 foot per second.
- Recalculate to ensure that the 10 minute retention time is retained.

Configuration for Use in a Treatment Train

- Vegetated swales can be incorporated in a treatment train to provide enhanced water quality treatment and reductions in runoff volume and rate. For example, if a vegetated swale is placed upgradient of a dry extended detention (ED) basin, the rate and volume of water flowing to the dry ED basin can be reduced and the water quality enhanced. As another example, dry ED basins may be placed upstream a vegetated swale to reduce the size of the vegetated swale.
- Vegetated swales can be used as pretreatment for infiltration BMPs.
- If designed with an infiltration sump, vegetated "bioinfiltration" swales can provide retention and biotreatment capacity.

Additional References for Design Guidance

Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: **http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850**

Santa Barbara BMP Guidance Manual, Chapter 6: **http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf**

- County of San Diego Drainage Design Manual for design criteria, Section 5.5: **http://www.co.san-diego.ca.us/dpw/floodcontrol/floodcontrolpdf/drainage-designmanual05.pdf**

  County of Los Angeles Low Impact Development Standards Manual, Chapter 5: **http://dpw.lacounty.gov/wmd/LA_County_LID_Manual.pdf**

- Los Angeles County Stormwater BMP Design and Maintenance Manual: **http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf**

Attachment E

Operation and Maintenance Plan

OPERATIONS AND MAINTENANCE (O&M) PLAN

WATER QUALITY MANAGEMENT PLAN
FOR

THE PRESERVE AT SAN JUAN, LLC

CONCEPTUAL WATER QUALITY MANAGEMENT PLAN

FOR

TENTATIVE TRACT MAP NO. 17269

COUNTY OF ORANGE, CALIFORNIA

LEGAL DESCRIPTION:

BEING A PORTION OF THE NORTHWEST QUARTER OF SECTION 20, TOWNSHIP 6 SOUTH, RANGE 5 WEST, SBM.

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
	Non-Structural Source Control BMPs		
Yes	N1. Education for Property Owners, Tenants and Occupants The Developer will insure that all homeowners will be given a copy of the recorded CC&R's which will contain a section outlining the environmental awareness education materials. The Developer shall establish requirements for the implementation of a community awareness program that informs home buyers of the impacts of dumping oil, paints, solvents or other potentially harmful chemicals into the storm drain; the proper use and management of fertilizers, pesticides and herbicides in home landscaping and gardening practices; the impacts of littering and improper watering. Environmental awareness education materials, including, but not limited to those included in Section VII of this WQMP, shall be provided to all members of the HOA and periodically thereafter by the HOA after the first sale of units.	Developer to provide educational materials to homeowners at sale of property. Thereafter, HOA to distribute materials to homeowners annually via HOA newsletter.	Owner/HOA
Yes	N2. Activity Restriction Within the Master CC&R's prepared by the Developer, language shall be included to identify surface water quality protection required by the HOA. Surface water quality activities shall also be conducted in conformance with the Water Quality Management Plan as it relates to the handling and disposal of contaminants.	Continuous enforcement via CC&R's.	Owner/HOA

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	N3. Common Area Landscape Management Maintenance shall be consistent with City requirements, plus fertilizer and/or pesticide usages shall be consistent with County guidelines for use of fertilizers and pesticides (OC DAMP Section 5.5). Maintenance includes mowing, weeding, and debris removal on a weekly basis. Trimming, replanting and replacement of mulch shall be performed on an as-needed basis. Trimmings, clippings, and other waste shall be properly disposed of off-site in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and drain inlets.	Weekly trimming and monthly inspection of all common landscape areas. Inspect for and replace dead/dying vegetation.	Owner/HOA
Yes	N4. BMP Maintenance As indicated in (N2) above, the CC&R's shall identify the HOA as being responsible for implementation of each applicable non-structural BMP as well as scheduling inspection and maintenance cleaning of all applicable structural BMP facilities the HOA, through its landscape maintenance contractor, will be responsible for inspection and maintenance activities in landscape areas. Debris and other water pollutants will be controlled, contained and disposed of in a proper manner by the maintenance contractor.	Ongoing, as prescribed per WQMP.	Owner/HOA
No	N5. Title 22 CCR Compliance Not applicable to residential projects.		

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
No	N6. Local Water Quality Permit Compliance Not applicable. No local water quality permits are required for the operation of the project.		
No	N7. Spill Contingency Plan Not applicable to residential projects.		
No	N8. Underground Storage Tank Compliance Not applicable. None onsite.		
No	N9. Hazardous Materials Disclosure Compliance Not applicable to residential projects.		
No	N10. Uniform Fire Code Implementation Not applicable to residential projects.		
Yes	N11. Common Area Litter Control Inspect the site (both roadway and adjacent areas) for trash, litter and other debris that may enter the storm drain system. These activities will become the responsibility of the HOA upon completion of the project. Responsibility shall include removing litter and debris, noting illegal dumping activities and reporting to the HOA, as appropriate, for investigation.	Ongoing patrols. Weekly (minimum) pick up and removal.	Owner/HOA

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	N12. Employee Training Post construction, an employee training/education program will be established as it would apply to future employees, contractors of the HOA, and the HOA volunteers to inform and train employees engaged in maintenance activities regarding the impact of dumping oil, paints, solvents or other potentially harmful chemicals into storm drain; the proper use of fertilizers and pesticides in landscaping maintenance practices; and the impacts of littering and improper water disposal. During construction, and until improvements are accepted by the HOA, or the County of Orange, whichever is applicable, the Developer will be responsible for these activities as they relate to the Developer's employees, subcontractors, and contractors. Thereafter, the HOA shall be responsible.	Training regarding the potential impacts of various maintenance activities on water quality. To be conducted upon hire and annually thereafter for HOA staff and all contractors and volunteers of the HOA.	Owner/HOA
No	N13. Housekeeping of Loading Docks Not applicable. No loading docks onsite.		
Yes	N14. Common Area Catch Basin Inspection Catch basin inlets, area drains, curb-and-gutter systems and other drainage systems shall be inspected prior to October 1st of each year and after large storm events. If necessary, drains shall be cleaned prior to any succeeding rain events. 80% of private facilities shall be inspected and cleaned annually, with 100% of private facilities inspected and maintained within a 2-year period.	Annually	Owner/HOA

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**N15. Street Sweeping Private Streets and Parking Lots** Private alleys and public street shall be swept at minimum monthly, prior to the start of the rainy season (October 1st).	Annually	Owner/HOA
	Structural Source Control BMPs		
Yes	**S1. Provide Storm Drain System Stenciling and Signage** As a part of the final civil engineering drawings, it will be required by the Developer to stencil on all of the project's catch basins, where applicable in paved areas, the words, "No Dumping - Drains to Ocean." This will be done in a location that can be clearly seen by all and will be routinely inspected and re-stenciled, as required, until the HOA accepts maintenance responsibility for the catch basins. Thereafter, the responsible party shall routinely inspect and re-stencil the catch basins, as necessary.	Annually	Owner/HOA and County of Orange, as appropriate
No	**S2. Design Outdoor Hazardous Material Storage Areas to Reduce Pollutant Introduction** Not applicable. No outdoor storage of hazardous materials onsite.		
No	**S3. Design Trash Enclosures to Reduce Pollutant Introduction** Not applicable. None proposed.		

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	S4. Use Efficient Irrigation Systems and Landscape Design As a part of the design of all common area landscape irrigation, implementation of the Orange County Water Conservation Resolution (Ord. No. 3802) including, but not limited to, such provisions as water sensors, programmable irrigation times (for short cycles), etc., will be used. Such common areas will be maintained by the Developer until they are turned over to the HOA for ownership and maintenance.	Monthly inspection in conjunction with routine landscaping maintenance activities (mowing, trimming, etc.). Verify that plants continue to be grouped according to similar watering requirements. Inspect for dying or deceased vegetation and remove/replace accordingly. Inspect for leaks and broken sprinkler heads.	Owner/HOA
Yes	S5. Protect Slopes and Channels Lined concrete drains and down drains will be constructed on slope areas to convey runoff safely from top of slopes and to prevent storm and irrigation runoff from discharging in an uncontrolled manner, thereby causing erosion. Runoff from the slope areas will be conveyed to either the storm drain system or to outlet dissipation devices to prevent scouring and erosion. All slope areas will have at least 70% vegetative cover consisting of native and/or drought tolerant plant species with a deep root system. These areas will be inspected on a monthly basis for signs of erosion and plant health. These areas shall be maintained by the HOA.	Monthly inspection of slope areas for erosion and dying/deceased vegetation. Annually cleaning of slope and down drains for sediment and other debris that may obstruct flow.	Owner/HOA
No	S6. Loading Dock Areas Not applicable. No loading docks onsite.		

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
No	S7. Maintenance Bays and Docks Not applicable. No maintenance bays onsite.		
No	S8. Vehicle Wash Areas Not applicable. Not vehicle wash areas onsite.		
No	S9. Outdoor Processing Areas Not applicable. No outdoor processing onsite.		
No	S10. Equipment Wash Areas Not applicable. No equipment wash areas onsite.		
No	S11. Fueling Areas Not applicable. No fueling areas onsite.		
Yes	S12. Site Design and Landscape Planning (Hillside Landscaping) All hillside landscaping shall be landscaped with deep-rooted drought tolerant plant species that are consistent with the county's landscape ordinance and also approved for use by the County. The plants will be used to stabilize slope areas and prevent erosion. These areas shall be maintained by the HOA.	Monthly inspection of slope areas for erosion and dying/deceased vegetation.	Owner/HOA
No	S13. Wash Water Controls for Food Preparation Areas Not applicable. No restaurant facilities onsite.		
No	S14. Community Car Wash Racks Not applicable. No community car wash areas onsite.		

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
	Infiltration BMPs		
Yes	INF-1. Infiltration Basin Ensure that water infiltrates into the subsurface completely and that vegetation is carefully managed to prevent vectors. Inspect for erosion, standing water, trash, debris, excessive vegetation. Remove accumulated sediment and regrade when sediment volume exceeds 10% of basin.	Semi-Annually	Owner/HOA
Yes	INF-5. Drywell Ensure that water infiltrates drywell within 48 hours after end of storm event. Inspect unit for standing water, debris, trash, sediment and other materials that may impact infiltration rate.	Semi-Annually and per Manufacturer	Owner/HOA
	Hydrologic Source Control BMPs		
Yes	HSC-2 Impervious Area Dispersion Conduct general inspection and maintenance weekly per routine landscaping maintenance activities. Trim, remove, replace mulch or vegetation as necessary. Inspect for standing water or saturated conditions. Conduct bi-annual landscaping health evaluations.	Weekly/Semi-Annually	Owner/HOA

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Biofiltration BMPs			
Yes	BIO-2 Vegetated Swales Maintenance includes, weeding, and debris removal on a weekly basis and mowing on a monthly basis to maintain designed vegetation height. Trimming, reseeding, replanting and replacement of dying/deceased vegetation shall be performed on an as-needed basis. Trimmings, clippings, and other waste shall be properly disposed of off-site in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and drain inlets. Inspect at minimum twice per year for erosion and with routine maintenance for burrows and standing water.	Weekly, Monthly and Semi-Annually	Owner/HOA

Required Permits

There are no permits required for the maintenance of the project's BMPs.

Forms to Record BMP Implementation, Maintenance, and Inspection

See following page.

Recordkeeping

All records must be maintained for at least five (5) years and must be made available for review upon request.

Record of BMP Implementation, Maintenance, and Inspection

Today's Date: _____

Name of Person Performing Activity (Printed): _____

Signature: _____

BMP Name (As Shown in O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed