Appendix H

Water Quality Management Plan

ESA

WATER QUALITY MANAGEMENT PLAN

"CRAWFORD CANYON PARK"

Project Address:
Northwest of Crawford Canyon Road and Newport Boulevard
County of Orange, California

Prepared For:

13042 Old Myford Road
Irvine, CA 92602
(714) 973-6855

Prepared By:

Hunsaker & Associates Irvine, Inc.
3 Hughes
Irvine, CA 92618
(949) 583-1010

WQMP Preparation/Revision Date:
November 17, 2020

W.O. 3644-10X

WATER QUALITY MANAGEMENT PLAN

"CRAWFORD CANYON PARK"

Northwest of Crawford Canyon Road and Newport Boulevard
County of Orange, California

WQ XX-XXXX

COUNTY OF ORANGE/SANTA ANA REGION PRIORITY PROJECT WATER QUALITY MANAGEMENT PLAN (WQMP)

Project Name:

"CRAWFORD CANYON PARK"

GRADING PERMIT NO. TBD

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Hunsaker and Associates Irvine, Inc.
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(949) 583-1010
Contact: Vojta Safranek

Prepared: November 17, 2020

Project Owner's Certification			
Permit/Planning Application No.	N/A	Grading Permit No.	TBD
Tract/Parcel Map and Lot(s) No.	N/A	Building Permit No.	N/A
Address of Project Site and APN (If no address, specify Tract/Parcel Map and Lot Numbers)			West of Crawford Canyon Road and Newport Avenue APN 503-382-04

This Water Quality Management Plan (WQMP) has been prepared for OC Parks by Hunsaker and Associates Irvine, Inc. The WQMP is intended to comply with the requirements of the local NPDES Stormwater Program requiring the preparation of the plan.

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

Owner: OC Parks			
Name/Title			
Company	OC Parks		
Address	13042 Old Myford Road Irvine, CA 92602		
Email			
Telephone #	(714) 973-6855		
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.			
Signature		Date	

Preparer (Engineer): Vojta Safranek			
Title	Project Manager	PE Registration #	
Company	Hunsaker & Associates Irvine, Inc.		
Address	3 Hughes Irvine, CA 92618		
Email	vsafranek@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. R8-2009-0030/NPDES No. CAS618030, of the Santa Ana Regional Water Quality Control Board.			
Preparer Signature		Date	
Place Stamp Here			

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Attachment F ..... WQMP Notice of Transfer of Responsibility
Attachment G ..... BMP Operation and Maintenance Plan

SECTION I PERMIT(S) AND WATER QUALITY CONDITIONS OF APPROVAL OR ISSUANCE

The project's discretionary permit and water quality information are provided in the following:

PROJECT INFOMATION			
Permit/Application No. (If applicable)	N/A	Grading or Building Permit No. (If applicable)	TBD
Address of Project Site (or Tract Map and Lot Number if no address) and APN	West of Crawford Canyon Road and Newport Avenue APN 503-382-04		
WATER QUALITY CONDITIONS OF APPROVAL OR ISSUANCE			
Water Quality Conditions of Approval or Issuance applied to this project. (Please list verbatim.)	This Water Quality Management Plan has been developed in accordance with Section 7.II-1.5 of the Model Water Quality Management Plan and provides the basic framework to address the water quality component for Crawford Canyon Park Project. The project is considered a priority project under the County of Orange Local Implementation Plan and the WQMP Technical Guidance Document (TGD) for North Orange County. Therefore, the project is subject to the requirements of a Water Quality Management Plan (WQMP) to minimize the adverse effects of urbanization on site hydrology, runoff flow rates and pollutant loads. There is currently no applicable s project-specific water quality conditions of approval for this project.		
CONCEPTUAL WQMP			
Was a Conceptual Water Quality Management Plan previously approved for this project?	No.		
WATERSHED-BASED PLAN CONDITIONS			
Provide applicable conditions from watershed-based plans including WIHMPs and TMDLs	The project is located within the San Diego Creek Watershed. Established TMDLs for the project's receiving waters are as follows: Peters Canyon Channel – No TMDL's established; San Diego Creek Reach 1 – Nutrients, Pesticides, Sedimentation/Siltation, Metals; Upper Newport Bay – Indicator Bacteria, Nutrients, Pesticides, Sedimentation/Siltation, Metals; and		

	Lower Newport Bay – Indicator Bacteria, Nutrients, Pesticides, Metals, Siltation. Per the WIHMP for San Diego Creek, the project is subject to hydromodification impacts as it is tributary to natural reaches of downstream San Diego Creek.

SECTION II PROJECT DESCRIPTION

II.1 PROJECT DESCRIPTION

DESCRIPTION OF PROPOSED PROJECT				
Development Category (From Model WQMP, Table 7.11-2; or -3):	This project is considered a priority project under the following categories: *Priority Project, Category 1 – New development projects that create 10,000 square feet or more of impervious surface. This category includes commercial, industrial, residential housing subdivisions, mixed-use, and public projects on private or public property that falls under the planning and building authority or the Permittees.*			
Project Area (ft2): 168,695 ft2 (3.87 AC)[1]	Number of Dwelling Units: None proposed		SIC Code: N/A. Project is for a public Park	
Project Area	Pervious Surface		Impervious Surface	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	3.5 AC	90	0.37 AC	10
Post-Project Conditions	3.0 AC	78	0.87 AC	22
Drainage Patterns/Connections	In the pre-project condition, onsite project runoff from the western, northern, central and also run-on from the western portion of Crawford Canyon Road sheet flow from east to west to a depressed area downstream (at the southern-central portion of the site), where flows are collected and conveyed to an existing trapezoidal channel located just west of the project site via an existing 36" corrugated metal pipe (CMP). Existing concrete v-ditches located along the southern project boundary adjacent to Newport Blvd also collect and convey flows within the eastern portions of the project site, southerly prior to discharging to the existing trapezoidal channel via a concrete down drain. Runoff is then conveyed downstream in the existing County Facility (F13) prior to discharging southerly to Peters Canyon Channel (OCFCD Facility No. and then southwesterly to San Diego Creek (Reach 1), Newport Bay (Upper and Lower) and the Pacific Ocean.			
Narrative Project Description: (Use as much space as necessary)	The proposed project, "Crawford Canyon Park" (The Project), consists of an approximately 3.87-acre irregularly shaped parcel located just northwest of the intersection of Crawford Canyon Road and Newport Avenue. Specifically, the site is bound to the north by existing residential homes; to the east by Crawford Canyon Road and existing residential homes beyond; to the south by Newport Boulevard; and to the west by an			

[1] Project gross area based on property/tract limits. Net improvement areas, hydrological boundaries and BMP Drainage Management Areas will differ based on project grading, proposed improvements areas, developed drainage areas and BMP management areas.

DESCRIPTION OF PROPOSED PROJECT	
	existing trapezoidal drainage channel and residential homes beyond. The project proposes a park facility consisting of 8-foot wide walks, 5-foot wide trails, picnic tables and benches, exercise stations, pedestrian bridges, various play areas, retaining walls, a new asphalt parking area, a maintenance access road, landscaping areas, a meandering dry creek and supporting infrastructure improvements. Project landscaping areas include open space and slope landscaping located throughout the project site, consisting of shrub and groundcover. Total landscaping is anticipated to consist of approximately 78% of the project site, or 3.0 acres. Paved project areas include project walkways, decorative pavement, hardscape areas, drainage structures and the project's entrance and parking lot. Total impervious area is anticipated to consist of approximately 22% of the project site, or 0.87 acres. No other improvements, such as food service facilities, delivery areas, loading docks, outdoor material storage areas or trash enclosure areas, are proposed for the project. Anticipated use onsite will consist primarily of active and passive recreational activities, such as playing, exercising, walking running, sports, lounging, reading and eating. Wastes typical of parks and recreational areas are anticipated to be generated daily from the project site. These include food wastes, paper products, plastics, green wastes and recyclable materials. Designated receptacles will be provided within the park for visitor use. The receptacles shall be covered at all times, with collected materials removed on a weekly basis (at minimum), or as needed, by the contracted park maintenance staff for disposal. All proposed improvements are shown in the WQMP Site Plan in Section VI of this WQMP.

II.2 POTENTIAL STORMWATER POLLUTANTS

Table 2.1, Anticipated and Potential Pollutants Generated by Land Use Type, from the Technical Guidance Document (December 2013) lists the following Pollutants of Concern (POC's) associated with the proposed development:

POLLUTANTS OF CONCERN			
Pollutant	Check One: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended Solid/Sediment	E ☒	N ☐	Pollutant is a Primary POC. Potential sources of sediment include disturbed or unstabilized landscaping areas and disturbed earth surfaces.
Nutrients	E ☒	N ☐	Pollutant is Primary POC as downstream water is impaired for Nutrients. Potential sources of nutrients include fertilizers, sediment and trash/debris.
Heavy Metals	E ☒	N ☐	Pollutant is a Primary POC. Potential sources for the project include automobiles from the project's parking lot area.
Pathogens (Bacteria/Virus)	E ☒	N ☐	Pollutant is a Primary POC. Potential sources for the project include food wastes, pet wastes, sediment and landscaping areas.
Pesticides	E ☒	N ☐	Pollutant is a Primary POC. Potential sources of pesticides include landscaping and open space areas.
Oil and Grease	E ☒	N ☐	Potential sources for the project include automobiles from the project's parking lot area.
Toxic Organic Compounds	E ☒	N ☐	Pollutant is a Primary POC. Potential sources for the project include automobiles from the project's parking lot area.
Trash and Debris	E ☒	N ☐	Potential sources of trash and debris include landscaping activities, food wrappers and food wastes.

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 Model WQMP, projects must identify and mitigate any HCOCs. An HCOC is a combination of upland hydrologic conditions and stream biological and physical conditions that present a condition of concern for physical and/or biological degradation of streams.

The project resides within the jurisdiction of the Santa Ana RWQCB and is subject to the requirements of the North Orange County WQMP TGD, in which HCOCs are considered to exist if the volume for the 2-year runoff event for post-development condition exceeds pre-development condition by more than 5% or the time of concentration is less than the pre-development condition by greater than 5%.

Is the proposed project potentially susceptible to hydromodification impacts?

☐ No – Show map

☒ Yes – Describe applicable hydrologic conditions of concern below.

The proposed project will increase the amount of impervious area located within the project site by a very small amount, thereby potentially increasing the developed condition runoff volume and rate. Therefore, the project is subject to the hydromodification requirements prescribed in the TGD for North Orange County.

A summary of the analysis is provided in the following table:

HCOC Analysis Summary (2-year event)									
Total Drainage Area [1]	Existing Condition			Proposed Condition			Δ Acres	Δ Q_2 (cfs)	Δ Tc (min)
	Acres	Q_2 (cfs)	Tc (min)	Acres[3]	Q_2 (cfs)	Tc (min)			
Overall (onsite plus offsite)	37.1	35.8	12.46	37.1	35.7	10.82	0.0	-0.1	-1.64

(1) Consists of onsite runoff and any offsite run-on areas to selected point of compliance (See Node 45 in project hydrology study).

Based on the project's hydrology analysis for the 2-year storm, the Tc to reach peak runoff for the developed condition is reduced by greater than 5%. Therefore, the project must implement hydromodification control BMPs to address HCOC impacts.

II.4 POST DEVELOPMENT DRAINAGE CHARACTERISTICS

The project's post-development drainage characteristics are described as follows:

In the developed condition, the project consists of 4 drainage areas.

Runoff from the eastern and central project areas (as well as the western portion of Crawford Canyon Road) is conveyed as sheet flow to a swale (dry creek) and conveyed southwesterly to a basin (bioretention basin) prior to discharging westerly to the existing open channel.

Runoff from the proposed parking lot is conveyed southwesterly as sheet flow and gutter to a catch basin prior to discharging southwesterly to the existing open channel.

Runoff from the sidewalk and landscaping area located at the southernmost portion of the project site is conveyed as sheet flow southwesterly to the existing open channel.

Low Impact Development

To satisfy the project's requirements for Low Impact Development (LID) requirements and water quality treatment, water qualify runoff from each of the project's Drainage Management Areas (DMAs) are addressed as follows.

DMA 1 (2.24 acres) – Consists of the eastern and central portions of the project site and western portion of Crawford Road. Runoff is conveyed southwesterly to a bioretention basin for infiltration of runoff.

DMA 2 (0.48 acres) – Consists of the proposed parking lot. Runoff is conveyed southwesterly to a proprietary biotreatment BMP (Filterra Biofiltration Unit or County approved equivalent) for treatment prior to discharge. Due to proximity of this DMA to a downstream retaining wall, infiltration BMPs are not proposed.

DMA 3 (0.07 acres) – Consists of landscaping and approximately 0.02 acres (840 ft^2) of sidewalk improvements located in the southernmost portion of the site. Runoff from the sidewalk will be conveyed northwesterly as sheet flow across the landscaping area, utilizing Hydrologic Source Control (HSC) BMP (HSC-2 Impervious Area Dispersion) prior to discharging offsite.

DMA 4 (0.17 acres) – Consists of entirely of landscaping improvements located on the southern perimeter of the site, adjacent to Newport Avenue. Site will be vegetated with native/drought tolerant plant species. Site's intended use is not anticipated to generate pollutants of concern as it consists only of vegetated slopes. HSC BMPs will be employed to address runoff.

DMA 5 (0.84 acres) – Consists of the northwestern and western perimeter of the project site and includes slope areas, open landscaping and decomposed granite areas, a maintenance access road comprised of Grasscrete and a ribbon gutter for runoff conveyance. HSC BMPs will be employed to address runoff.

DMA 6 (0.07 acres) – Consists of southern-western perimeter of the project site, which includes primarily slope areas that sheet flow to the existing channel. Site will be vegetated with native/drought tolerant plant species. Site's intended use is not anticipated to generate pollutants of concern as it consists only of vegetated slopes. HSC BMPs will be employed to address runoff.

The locations and sizes of the proposed BMPs are provided in the WQMP Site Plan (Section 6).

II.5 PROPERTY OWNERSHIP/MANAGEMENT

The project proponent, OC Parks, shall assume all onsite BMP maintenance, inspection and funding responsibilities. Inspection and maintenance activities are in Section V of this WQMP.

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)	Planning Area – Currently not located within Planning Area. Project Name – "Crawford Canyon Park"
Location/Address	No current address. Project is located northwest of the intersection of Crawford Canyon Road and Newport Avenue, County of Orange, California.
General Plan Land Use Designation	Existing: 1B Suburban Residential Proposed: Open Space/Park
Zoning	Existing: AR (Agriculture Residential) Proposed: Open Space/Park
Acreage of Project Site	3.87 acres
Predominant Soil Type	Hydrologic Soil Type B

III.2 SITE CHARACTERISTICS

The following table summarizes general characteristics of the project site:

SITE CHARACTERISTICS	
Precipitation Zone	0.80 in.
Topography	The pre-project site is vacant and heavily disturbed, consisting of dirt areas and scattered trees throughout the project site. Generally, the site slopes from the northeast at approximately 392 feet above mean sea level (MSL) to the southwest, at approximately 348 feet above MSL.
Drainage Patterns/Connections	In the pre-project condition, onsite project runoff from the western, northern, central and also run-on from the western portion of Crawford Canyon Road sheet flow from east to west to a depressed area downstream (at the southern-central portion of the site), where flows are collected and conveyed to an existing trapezoidal channel located just west of the project site via an existing 36" corrugated metal pipe (CMP). Existing concrete v-ditches located along the southern project boundary adjacent to Newport Blvd also collect and convey flows within the eastern portions of the project site, southerly prior to discharging to the existing trapezoidal channel via a concrete down drain.

SITE CHARACTERISTICS	
	Runoff is then conveyed downstream in the existing County Facility (F13) prior to discharging southerly to Peters Canyon Channel (OCFCD Facility No. and then southwesterly to San Diego Creek (Reach 1), Newport Bay (Upper and Lower) and the Pacific Ocean.
Soil Type, Geology, and Infiltration Properties	Based on the County of Orange Technical Guidance Document (TGD) for Preparation of WQMPs and the geotechnical investigation, onsite soils consist primarily of Hydrologic Group B, characterized as having good infiltration rates when thoroughly wet. These soils are favorable for infiltration. Infiltration testing conducted onsite as part of the project's geotechnical investigation (GMU Geotechnical, November 6. 2020) yielded rates ranging from 0.67 inches per hour to 1.35 inches per hour (without safety factor).
Hydrogeologic (Groundwater) Conditions	Project site is not located within a shallow groundwater zone, as defined by the TGD. Per the project's geotechnical report, groundwater was not encountered at a maximum exploration depth of 26' below existing grade.
Geotechnical Conditions (relevant to infiltration)	Based on the TGD, majority of underlying soils consist primarily of Group "B" soils, which are favorable for infiltration. However, per the geotechnical investigation, artificial fill soils were encountered in majority of the excavations at the site. The fills were encountered to a maximum depth of 5 feet below the existing grade and generally consists of yellow and dark brown, damp to moist, firm to stiff, sandy clays. Alluvium underlay the artificial fill to the maximum depth of the exploratory drill holes. The alluvium consists of brown to dark gray brown to yellow brown, damp to moist, medium dense to very dense, sands and firm to stiff clays.
Off-Site Drainage	The project site receives run-on from the western portion of Crawford Canyon Road to the east. In the developed condition, storm water run-on from this area will be conveyed through the project site via onsite storm drain improvements prior to discharging to the existing channel to the southwest.
Utility and Infrastructure Information	The project site contains existing storm drain facilities, sewer, electric and water utilities. These facilities will be retained as in pre-project conditions. There are no facilities onsite that would obstruct interfere with the project's LID BMPs.

III.3 WATERSHED DESCRIPTION

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

WATERSHED DESCRIPTION	
Receiving Waters	Peters Canyon Channel, San Diego Creek (Reach 1), Upper and Lower Newport Bay.
303(d) Listed Impairments	Peters Canyon Channel – Pesticides, Pathogens, pH San Diego Creek (Reach 1) – Fecal Coliform, Selenium, Toxaphene, Nutrients, Pesticides, Sedimentation/Siltation, Benthic Community Effects, DDT, Malathion, Toxicity Newport Bay (Upper) – Chlordane, Copper, DDT, Indicator Bacteria, Metals, Nutrients, PCBs, Pesticides, Sediment Toxicity, Sedimentation Siltation, Malathion Newport Bay (Lower) – Chlordane, Copper, DDT, Indicator Bacteria, Nutrients, PCBs, Pesticides, Sediment Toxicity
Applicable TMDLs	Peters Canyon Channel – None San Diego Creek (Reach 1) – Indicator Bacteria, Nutrients, Pesticides, Sedimentation/Siltation, Metals Newport Bay (Upper) – Indicator Bacteria, Nutrients, Pesticides, Sedimentation/Siltation, Metals, Siltation Newport Bay (Lower) – Indicator Bacteria, Nutrients, Pesticides, Metals, Siltation
Pollutants of Concern for the Project	Pollutants of Concern for the project include: Suspended Solids/Sediment, Nutrients, Metals, Pathogens, Pesticides, Oil & Grease, Toxic Organic Compounds and Trash & Debris. Primary Pollutants of Concern for the project include: Suspended Solids/Sediment, Nutrients, Metals, Pathogens, Pesticides and Toxic Organic Compounds.
Environmentally Sensitive and Special Biological Significant Areas	The project site is not located within 200 feet of any Areas of Special Biological Significance (ASBS) or designated Environmentally Sensitive Areas (ESAs).

SECTION IV BEST MANAGEMENT PRACTICES (BMPS)

IV. 1 PROJECT PERFORMANCE CRITERIA

The project's performance criteria for HCOCs and LID BMPs are provided in the following table:

PROJECT PERFORMANCE CRITERIA		
Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implanting LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.	There is currently no approved WIHMP for San Diego Creek.	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	Post-project runoff discharge volume for the 2-year frequency storm does not exceed that of the predevelopment condition by more than 5% and time of concentration of post-development runoff for the 2-year storm event is not less than that for the predevelopment condition by more than 5%.	
List applicable LID performance criteria (Section 7.II-2.4.3 from 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 - Retain or biotreat, in a regional facility, the remaining runoff up to 80 percent annual capture efficiency (cumulative, retention plus biotreatment, onsite plus offsite), 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.	

PROJECT PERFORMANCE CRITERIA	
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	Not applicable. Project proposes the use of LID BMPs to address the project's design capture volume.
Calculate LID design storm capture volume for Project.	DCV = C x D x A x 43560 sf/ac x 1ft/12in 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) *Imp = 0.70* *D = 0.80 inches (See Attachment D)* *A = 3.87 acres* *DCV[1] = [(0.22*0.75)+0.15](0.80)(3.87)(43560)(1/12)* *=3,540 cu-ft*

[1]DCV shown based on project limits. For actual DCV based on DMA limits, see Section IV.2.2.

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

Landscaping and trees will be provided throughout the park to reduce the project's impervious footprint, thereby reducing runoff generated during rain events.

Maximize Natural Infiltration Capacity

Project will take advantage of onsite soils to infiltrate runoff wherever feasible. These measures include the use of pervious drainage swales, Grasscrete maintenance access road, decomposed granite and bioretention basin.

Preserve Existing Drainage Patterns and Time of Concentration

In the developed condition, runoff from project areas is consistent with pre-project conditions. Changes in the time of concentration and peak flows from pre-project conditions will be controlled via the project's hydromodification controls/detention facilities.

Disconnect Impervious Areas

Landscaping will be provided onsite to break up the project's impervious areas.

Protect Existing Vegetation and Sensitive Areas, and Revegetate Disturbed Areas

The pre-project site consists of heavily disturbed vegetation. All areas within project limits will be removed and revegetated with native and/or drought tolerant plantings.

Revegetate 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.2.2 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 LID BMPs are provided on the exhibits in Section VI. Calculations and TGD Worksheets are provided in Appendix B of this WQMP.

DMA	Area (Ac.)	Imp.	C-value	Design Storm Depth (in.)	DCV_{SIMPLE} (cu-ft)
1	2.24	0.247	0.335	0.8	2180.8
2	0.48	0.494	0.521	0.8	725.5
3	0.07	0.286	0.365	0.8	74.1
4	0.17	0	0.150	0.8	74.1
5	0.84	0.064	0.198	0.8	488.7
6	0.07	0	0.150	0.8	30.5
Total	3.87	--	--	--	3573.7

IV.3 LID BMP Selection and Project Conformance Analysis

Per the TGD, 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)	☐

Name	Included?
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☒

HSC-2 Impervious Area Dispersion

Where feasible, runoff from the project's impervious areas and walkways will be directed to adjacent landscaping areas for filtration, evapotranspiration and incidental infiltration of runoff and volume reduction, prior to discharging to the storm drain system. Although HSC principles will be implemented throughout the project area, it will be solely employed in DMAs 3, 4, 5 and 6 to retain the DCV.

Summary of the project's HSC BMP credits are as follows:

HSC BMP SUMMARY TABLE								
DMA	BMP System	DCV (ft^3)	HSC System	Ratio [1]	D_{HSC}	D_{REM}	DCV_{HSC} [2] (ft^3)	Latitude/ Longitude
3	HSC-2 Impervious Area Dispersion	74.1	0.05 acres landscaping to 0.02 acres of walkway	>2:1	1.0"	0.0"	0.0	33.773436°, -117.789594°
4		74.1	0.17 acres landscaping to 0 acres of impervious	>2:1	1.0"	0.0"	0.0	33.774438°, -117.788238°
6		30.5	0.07 acres of landscaping to 0 acres of impervious	>2:1	1.0"	0.0"	0.0	33.774008°, -117.789376°
5	INF-6[3] (Grasscrete)	488.7	0.79 acres to 0.05 acres of gutter	>2:1	1.0"	0.0"	0.0	33.774448°, -117.789009°

[1] Landscaping area meets or exceeds 2:1 requirement for HSC-2. Full capture of runoff achieved. See Attachment B, Worksheets A and B.
[2] Remaining DCV with HSC credit applied.
[3] Areas upstream of Grasscrete roadway consists entirely of pervious areas.

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.

Based to the project's predominant soil type (Type "B"), the project proposes the use of infiltration BMPs to address pollutants from project-related runoff. Supporting calculations are provided in Attachment B of this WQMP.

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:	☐

BMP Sizing

The proposed BMPs will be sized accordingly its tributary drainage area, as provided in the following table:

INFILTRATION DESIGN SUMMARY						
DMA	DCV_{SIMPLE} (cu-ft)	BMP	Maximum Ponding Depth (ft)	Minimum Footprint (ft^2)	Footprint Provided (ft^2)	Latitude/ Longitude
1	2180.8	INF-3 Bioretention	1.1 *(1)*	1,983	2,001	33.774192°, -117.789027°

(1) Based on K_{DES} of 0.275 in/hr (K_{OBS} = 0.6 in/hr, FS = 2.18).

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

Name	Included?
EVAPOTRANSPIRATION	
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☐

Name	Included?
HARVEST & REUSE/ RAINWATER HARVESTING	
Above-ground cisterns and basins	☐
Underground detention	☐

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. Since ET is not the sole process in these BMPs, specific design and sizing criteria have not been developed for ET-based BMPs.

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 harvesting BMPs, as the project will employ the use of infiltration BMPs to satisfy LID requirements.

IV.3.4 Biotreatment BMPs

Biotreatment 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.

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

The project proposes the use of a proprietary biotreatment BMP (Filterra Biofiltration or approved equivalent) to address runoff from the proposed parking lot area.

BIOTREATMENT BMP DESIGN SUMMARY				
DMA	BMP	Q_{BMP} (cfs)	BMP Unit/Model and capacity	BMP Location (Lat/Long)
2	BIO-7 Proprietary Biotreatment	0.065	Filterra 4x8 (0.074 cfs)	33.773779°, -117.789302°

IV.3.5 Hydromodification Control BMPs

The project is subject to hydromodification. The following BMPs will be employed to address project impacts.

HYDROMODIFICATION CONTROL BMPS	
BMP Name	BMP Description
Bioretention Basin and/or Upsized Storm Drain System (DMA 1)	The project's main storm drain line will be upsized and/or detention within the bioretention basin will be utilized to detain the difference in runoff for the 2-year storm event (volume and Tc) to mitigate HCOC.
Upsized Storm Drain System (DMA 2)	The project's main storm drain line in the parking lot area will be upsized to detain the difference in runoff for the 2-year storm event (volume and Tc) to mitigate HCOC

IV.3.6 Regional/Sub-Regional LID BMPs

Not applicable to project. Project is not part of any regional or sub-regional BMP programs. Project will employ use of onsite LID BMPs to address project runoff.

IV.3.7 Treatment Control BMPs

Not applicable to project. Project will employ use of onsite LID BMPs to address project runoff.

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.

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	☐	☒	Not applicable for public park.
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Proposed facility will not generate waste subject to Title 22 CCR compliance.
N6	Local Industrial Permit Compliance	☐	☒	Project is not subject to industrial permit.
N7	Spill Contingency Plan	☐	☒	Proposed facility 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.

NON-STRUCTURAL SOURCE CONTROL BMPS				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
N9	Hazardous Materials Disclosure Compliance	☐	☒	Proposed facility will not store or generate hazardous materials subject to agency requirements.
N10	Uniform Fire Code Implementation	☐	☒	Proposed facility does not propose to store toxic or highly toxic compressed gases.
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☐	☒	None proposed.
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Public Streets and Parking Lots	☐	☒	
N16	Retail Gasoline Outlets	☐	☒	Not in project scope.

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 County for facility users and maintenance staff. Restrictions include prohibited activities within park property that have the potential to impact water quality, such as illegal dumping of wastes, proper clean up and disposal of pet wastes, proper disposal of litter and trash, and prohibiting wash down of the park's paved areas.

N3 – Common Area Landscape Management

Maintenance activities for landscape areas shall be consistent with County and manufacturer guidelines for fertilizer and pesticide use (OC DAMP Section 5.5). Maintenance includes trimming, weeding and debris removal and vegetation planting and replacement and shall be consistent with the County's Landscape Ordinance. Stockpiled materials during maintenance activities shall be placed away from drain inlets and runoff conveyance devices. Wastes shall be properly disposed of or recycled.

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

The County shall implement a trash management and litter control procedures to minimize the potential for runoff pollution. These include the use of regular site patrols, ensuring all litter and trash are properly disposed, adequate capacity in waste receptacles and reporting any violations from facility users to management staff.

N12 – Employee Training

All employees, contractors and subcontractors involved for site maintenance shall be trained on the proper use and staging of landscaping and other materials with the potential to impact runoff and proper clean-up of spills and materials.

N14 – Common Area Catch Basin Inspection

As required by the TGD, at least 80% of all 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; with 100% of all drainage facilities inspected, cleaned and maintained within a two year period. Drainage facilities include catch basins and inlets, detention vaults and the project's LID BMPs.

N15 – Street Sweeping Public Streets and Parking Lots

Project parking lot will be vacuum swept on twice per month, consistent with County's sweeping schedule.

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 park.
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☐	☒	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☒	☐	
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☒	Not applicable to SARWQCB.
S6	Dock areas	☐	☒	None proposed.
S7	Maintenance bays	☐	☒	No maintenance bays proposed for project.

STRUCTURAL SOURCE CONTROL BMPS				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S8	Vehicle wash areas	☐	☒	No vehicle washing allowed onsite.
S9	Outdoor processing areas	☐	☒	No outdoor processing of goods required for project.
S10	Equipment wash areas	☐	☒	No wash areas onsite.
S11	Fueling areas	☐	☒	No fueling areas in project scope.
S12	Hillside landscaping	☒	☐	Project is not hillside development with large slopes.
S13	Wash water control for food preparation areas	☐	☒	Not in project scope.
S14	Community car wash racks	☐	☒	Not in project scope.

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 and educate facility users 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)

In conjunction with routine landscaping maintenance activities, inspect irrigation for signs of leaks, overspray and repair or adjust accordingly. Adjust system cycle to accommodate seasonal fluctuations in water demand and temperatures. Ensure use of native or drought tolerant/non-invasive plant species to minimize water consumption.

S5 – Protect Slopes and Channels and Provide Energy Dissipation

The project's landscaped slopes shall be inspected for adequate vegetation cover, vegetation health and signs of erosion. Dead or dying vegetation shall be replaced as needed. Signs of erosion and concentrated flow areas shall be noted and repaired as needed.

S12 – Site Design & Landscape Planning (Hillside Landscaping)

Hillside areas that are disturbed by the project shall be re-vegetated with deep-rooted, drought tolerant plant species selected for erosion control and consistent with County requirements.

IV.4 ALTERNATIVE COMPLIANCE PLAN (IF APPLICABLE)

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

IV.4.1 Water Quality Credits

Not applicable to project. Project will utilize LID BMPs onsite to address storm water.

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

IV.4.2 Alternative Compliance Plan Information

Not applicable to project. Project will utilize LID BMPs onsite to address storm water pollutants.

SECTION V INSPECTION/MAINTENANCE RESPONSIBILITY FOR BMPS

It has been determined that the Owner, OC Parks, shall assume all BMP funding, inspection and maintenance responsibilities for Crawford Canyon Park project.

Contact/Title _____

Company OC Parks

Address 13042 Old Myford Road
Irvine, CA 92602

Email _____

Telephone # (714) 973-6855

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. An Operations and Maintenance (O&M) Plan is also included as an attachment to this WQMP.

BMP INSPECTION/MAINTENANCE			
BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
HYDROLOGIC SOURCE CONTROL BMPs			
HSC-2 Impervious Area Dispersion	OC Parks	Inspect for standing water and that water infiltrates into underlying soil completely. Remove accumulated sediment or repair eroded areas as needed.	After qualifying storm events of 0.5" or greater and monthly with landscaping maintenance
INF-5 Permeable Pavement (Grasscrete)	OC Parks	Inspect for oil spills, dead vegetation, soil level within modules and stability. Remove/repairs as needed based on inspections. Trim vegetation as needed to maintain desired height.	Monthly with landscaping maintenance
INFILTRATION BMPs			
INF-3 Bioretention with no Underdrains	OC Parks	Conduct general inspection and maintenance per routine landscaping maintenance activities. Inspect surface area for debris, trash and vegetation accumulation. Inspect for general plant health. Inspect for sediment, build up on planting surface and in area drain inlet. Inspect for sediment or debris clogging inlet. Inspect for standing water after rain event of 0.5 inches or greater, based (48-hour draw down). Clean/repair items as necessary.	Monthly

BMP INSPECTION/MAINTENANCE			
BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
		Remove vegetation, permeable soil and drain rock. Replace in kind. Repair if necessary.	Every 5 to 7 years, or as needed
BIOTREATMENT BMPs			
BIO-7 Proprietary Biotreatment (Filterra Biofiltration)	OC Parks	Inspect unit for accumulated debris and sediment and plant health; remove trash; trim vegetation. Remove sediment, replace mulch (if included), replace media as needed.	2-4 weeks during rainy season or after significant events. Frequency to be customized after 1-2 years observation.
NON-STRUCTURAL SOURCE CONTROL BMPs			
N2 Activity Restrictions	OC Parks	Activity restrictions to minimize potential impacts to water quality and with the purpose of protecting water quality will be prescribed by the County for facility users and maintenance staff. Restrictions include prohibited activities within park property that have the potential to impact water quality, such as illegal dumping of wastes, proper clean up and disposal of pet wastes, proper disposal of litter and trash, and prohibiting wash down of the park's paved areas.	Ongoing
N3 Common Area Landscape Management	OC Parks	Maintenance shall be consistent with County requirements; any fertilizer and/or pesticide usages shall be consistent with County and manufacturer guidelines for use of fertilizers and pesticides. 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.	Monthly and as needed

BMP INSPECTION/MAINTENANCE			
BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
N4 BMP Maintenance	OC Parks	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 County and documented with the WQMP.	Ongoing
N11 Common Area Litter control	OC Parks	Litter patrol, violations investigation, reporting and other litter control activities shall be performed by the County staff as needed and in conjunction with maintenance activities for common areas.	Ongoing patrols. Weekly (minimum) pick up and removal. Monthly inspections with landscaping maintenance.
N12 Employee Training	OC Parks	All employees and any contractors will require training to ensure that employees are aware of maintenance activities that may result in pollutants reaching the storm drain. Training will include, but not limited to, spoil clean up procedures, proper waste disposal, housekeeping practices, etc.	Upon hire and annually thereafter
N14 Common Area Catch Basin Inspection	OC Parks	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 facilities inspected and maintained within a 2-year period.	Annually
N15 Street Sweeping	OC Parks	Project streets and parking areas shall be vacuum swept at a minimum, weekly basis, consistent with City schedules.	Twice per month

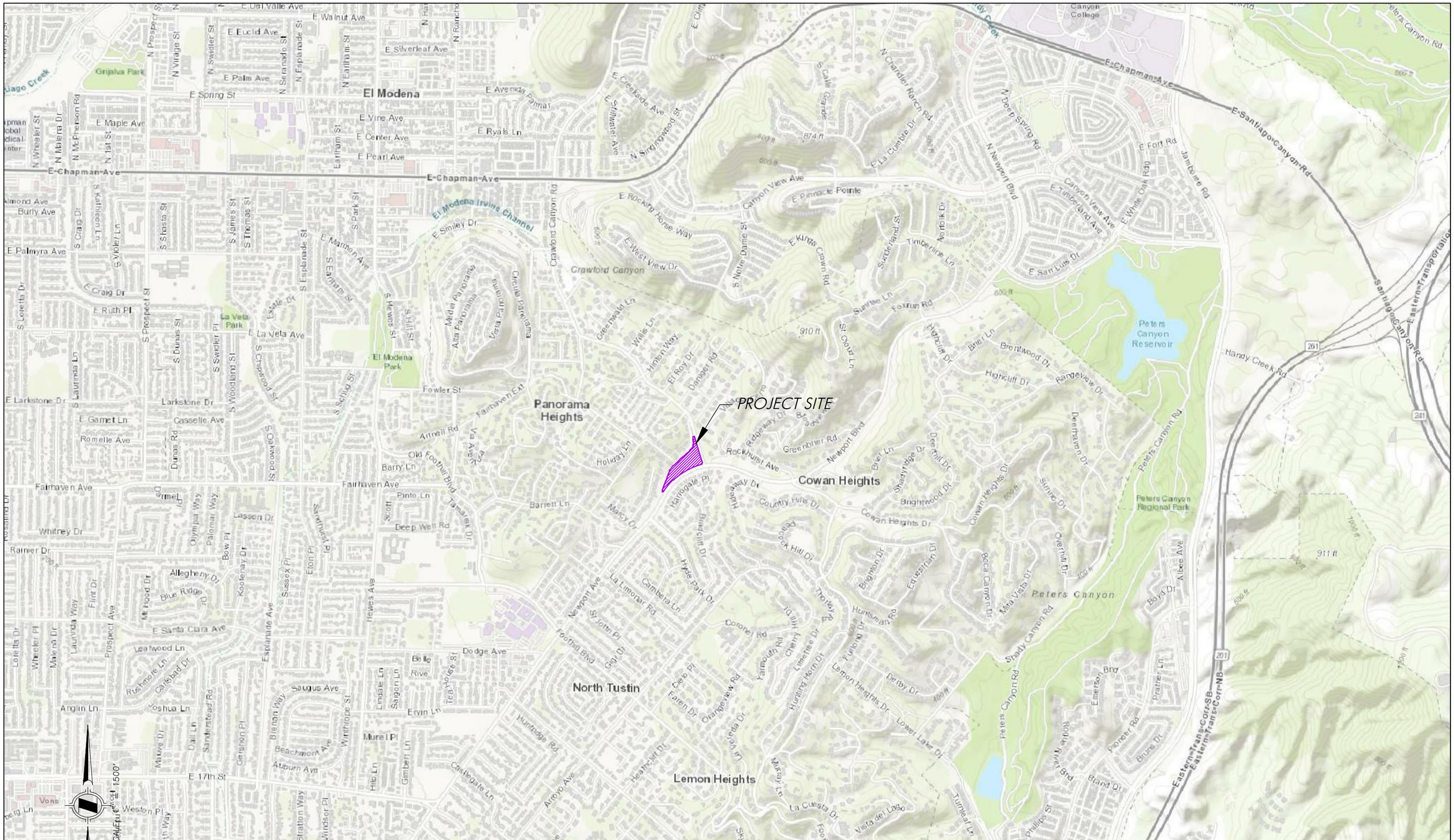
BMP INSPECTION/MAINTENANCE			
BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
STRUCTURAL SOURCE CONTROL BMPs			
S1 Provide storm drain system stencilling and signage	OC Parks	As a part of the civil engineering drawings, it will be required by the Developer to stencil on all of the project's catch basins, where applicable in paved areas, the words, "No Dumping - Drains to Ocean." 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-stenciled as soon as possible.	Annually
S4 Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	OC Parks	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
S5 Protect Slopes and Channels	OC Parks	The project's landscaped slopes shall be inspected for adequate vegetation cover, vegetation health and signs of erosion. Dead or dying vegetation shall be replaced as needed. Signs of erosion and concentrated flow areas shall be noted and repaired as needed.	Monthly
S12 Site Design and Landscape Planning (Hillside Landscaping)	OC Parks	Hillside areas that are disturbed by the project shall be re-vegetated with deep-rooted, drought tolerant plant species selected for erosion control and consistent with County requirements.	Monthly

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 LID BMPs are shown as well.

Exhibits

- Vicinity Map
- WQMP Site Plan Exhibit



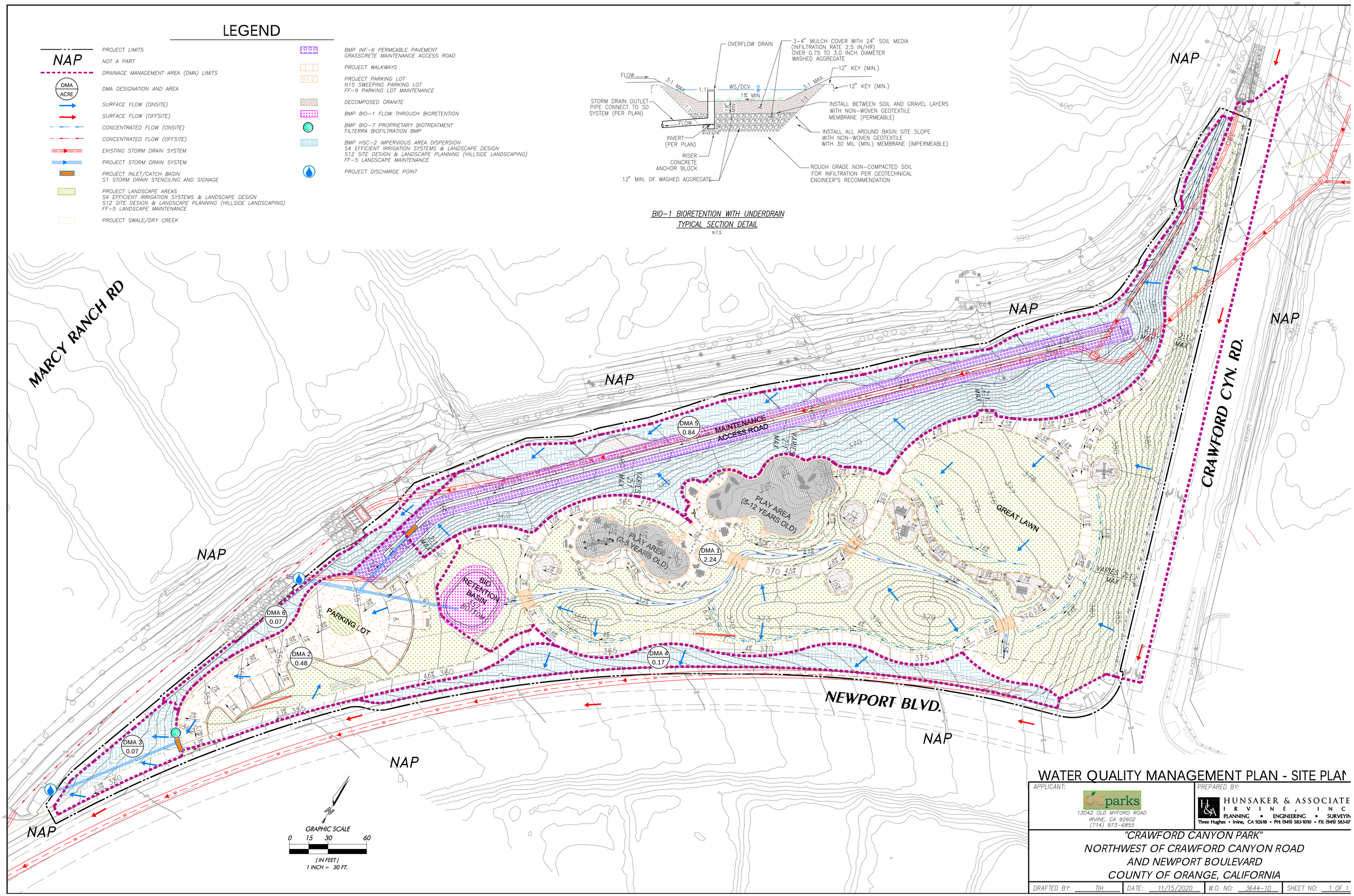
DRAWN BY: TIH	PREPARED BY: HUNSAKER & ASSOCIATES IRVINE, INC. PLANNING ▪ ENGINEERING ▪ SURVEYING Three Hughes, Irvine, CA 92618 ▪ PH: (949) 583-1010 ▪ FX: (949) 583-0759	PREPARED FOR: OCparks 13042 OLD MYFORD ROAD IRVINE, CA 92602 (714) 973-6385	"CRAWFORD CANYON PARK" NORTHWEST OF CRAWFORD CANYON ROAD AND NEWPORT BOULEVARD COUNTY OF ORANGE, CALIFORNIA
DATE: 11/13/2020			WQMP VICINITY MAP
W.O.: 3644-10			

DATE: Nov. 16, 2020 05:14:08 PM FILE: F:\1140\Engineering\SY_WQ\WQMP\Exhibits\WQMP_VIC Crawford.dwg

LEGEND

- PROJECT LIMITS
- NAP — NOT A PART
- DRAINAGE MANAGEMENT AREA (DMA) LIMITS
- DMA / ACRE — DMA DESIGNATION AND AREA
- SURFACE FLOW (ONSITE)
- SURFACE FLOW (OFFSITE)
- CONCENTRATED FLOW (ONSITE)
- CONCENTRATED FLOW (OFFSITE)
- EXISTING STORM DRAIN SYSTEM
- PROJECT STORM DRAIN SYSTEM
- PROJECT INLET/CATCH BASIN
  S1 STORM DRAIN STENCILING AND SIGNAGE
- PROJECT LANDSCAPE AREAS
  S4 EFFICIENT IRRIGATION SYSTEMS & LANDSCAPE DESIGN
  S12 SITE DESIGN & LANDSCAPE PLANNING (HILLSIDE LANDSCAPING)
  FF-5 LANDSCAPE MAINTENANCE
- PROJECT SWALE/DRY CREEK
- BMP INF-6 PERMEABLE PAVEMENT
  GRASSCRETE MAINTENANCE ACCESS ROAD
- PROJECT WALKWAYS
- PROJECT PARKING LOT
  N15 SWEEPING PARKING LOT
  FF-9 PARKING LOT MAINTENANCE
- DECOMPOSED GRANITE
- BMP BIO-1 FLOW THROUGH BIORETENTION
- BMP BIO-7 PROPRIETARY BIOTREATMENT
  FILTERRA BIOFILTRATION BMP
- BMP HSC-2 IMPERVIOUS AREA DISPERSION
  S4 EFFICIENT IRRIGATION SYSTEMS & LANDSCAPE DESIGN
  S12 SITE DESIGN & LANDSCAPE PLANNING (HILLSIDE LANDSCAPING)
  FF-5 LANDSCAPE MAINTENANCE
- PROJECT DISCHARGE POINT

BIO-1 BIORETENTION WITH UNDERDRAIN
TYPICAL SECTION DETAIL
N.T.S.



WATER QUALITY MANAGEMENT PLAN - SITE PLAN

APPLICANT:
OCparks
13042 OLD MYFORD ROAD
IRVINE, CA 92602
(714) 973-6855

PREPARED BY:
HUNSAKER & ASSOCIATES IRVINE, INC
PLANNING ▪ ENGINEERING ▪ SURVEYING
Three Hughes ▪ Irvine, CA 92618 ▪ PH: (949) 583-1010 ▪ FX: (949) 583-07

"CRAWFORD CANYON PARK"
NORTHWEST OF CRAWFORD CANYON ROAD
AND NEWPORT BOULEVARD
COUNTY OF ORANGE, CALIFORNIA

DRAFTED BY:	DATE:	W.O. NO:	SHEET NO:
TIH	11/15/2020	3644-10	1 OF 1

SECTION VII EDUCATIONAL MATERIALS INCLUDED

The following table contains a list of applicable educational materials to be included in the project's Final WQMP.

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

Attachment B

BMP Worksheets/Calculations

BMP Details

Table 2.7: Infiltration BMP Feasibility Worksheet			
	Infeasibility Criteria	*Yes*	*No*
1	Would Infiltration BMPs pose significant risk for groundwater related concerns? Refer to Appendix VII (Worksheet I) for guidance on groundwater-related infiltration feasibility criteria.		X
Provide basis: **Based on TGD data, there are no restrictions for groundwater infiltration or known plumes within project area.**			
2	Would Infiltration BMPs pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level? (Yes if the answer to any of the following questions is yes, as established by a geotechnical expert):		X
Provide basis: **Per geotechnical professional, no restrictions on infiltration.**			
3	Would infiltration of the DCV from drainage area violate downstream water rights?		X
Provide basis: **Per County TGD Maps, no restrictions on infiltration due to water rights.**			

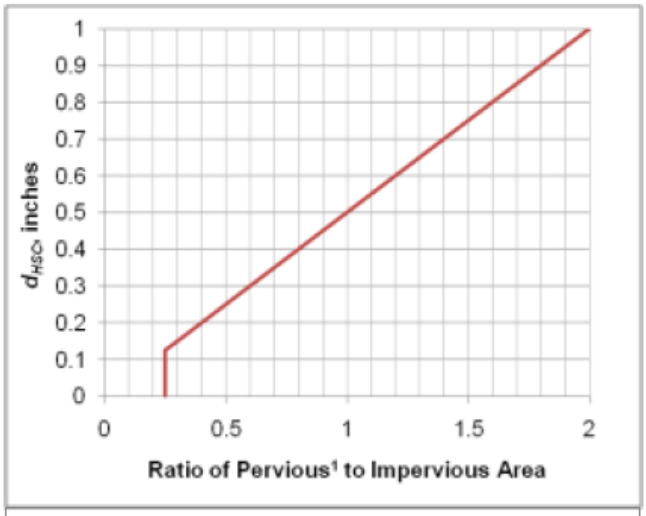
Table 2.7: Infiltration BMP Feasibility Worksheet (continued)			
	Partial Infeasibility Criteria	*Yes*	*No*
4	Is proposed infiltration facility located on HSG D soils or the site geotechnical investigation identifies presence of soil characteristics which support categorization as D soils?		X
Provide basis: **Based on TGD maps, majority of site contains HSG B soils.**			
5	Is measured infiltration rate below proposed facility less than 0.3 inches per hour? This calculation shall be based on the methods described in Appendix VII.		X
Provide basis: **Onsite testing yielded 0.67 in/hr and 1.35 in/hr, which equates to 0.34 in/hr and 0.67 in/hr when FS2 is applied.**			
6	Would reduction of over pre-developed conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?		X
Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible: **Project discharges to storm channel that is not ephemeral.**			
7	Would an increase in infiltration over pre-developed conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?		X
Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible: **Based on TGD and County GIS records, no restrictions on infiltration due to ephemeral washes or groundwater concerns.**			

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)		
Infiltration Screening Results (check box corresponding to result):		
8	Is there substantial evidence that infiltration from the project would result in a significant increase in I&I to the sanitary sewer that cannot be sufficiently mitigated? (See Appendix XVII)? Provide narrative discussion and supporting evidence: **Per TGD and County of Orange GIS data, project is not located in an area where increase in I&I to the sanitary sewer is of concern.**	
9	If any answer from row 1-3 is yes: infiltration of any volume is not feasible within the DMA or equivalent. Provide basis: **Items 1-3 are no.**	
10	If any answer from row 4-7 is yes, infiltration is permissible but is not presumed to be feasible for the entire DCV. Criteria for designing biotreatment BMPs to achieve the maximum feasible infiltration and ET shall apply. Provide basis: **Items 4-7 are no.**	
11	If all answers to rows 1 through 11 are no, infiltration of the full DCV is potentially feasible, BMPs must be designed to infiltrate the full DCV to the maximum extent practicable. Provide basis: **Project will infiltrate.**	

Worksheet A: Hydrologic Source Control Calculation Form

	Drainage area ID	DMA 3		
	Total drainage area	0.07	acres	
	Total drainage area Impervious Area (IA_{total})	0.020	acres	
HSC ID	HSC Type/ Description/ Reference BMP Fact Sheet	Effect of individual HSC_i per criteria in BMP Fact Sheets (XIV.1) (d_{HSCi})[1]	Impervious Area Tributary to HSC_i (IA_i)	$d_i \times IA_i$
Landscape	HSC-2 Impervious area dispersion. Sidewalks to adjacent landscaping areas. Pervious/impervious ratio = 0.05 acres to 0.02 acres	Perv/Imp > 2:1 d_{hsc} = 1.0	0.020	0.020
	Box 1:		$\sum d_i \times IA_i =$	0.020
	Box 2:		$IA_{total} =$	0.020
	[Box 1]/[Box 2]:		$d_{HSC\ total} =$	1.0"
			Percent Capture Provided by HSCs (Table III.1)	80%
	Drainage area ID	DMA 4		
	Total drainage area	0.17	acres	
	Total drainage area Impervious Area (IA_{total})	0.0	acres	
HSC ID	HSC Type/ Description/ Reference BMP Fact Sheet	Effect of individual HSC_i per criteria in BMP Fact Sheets (XIV.1) (d_{HSCi})[1]	Impervious Area Tributary to HSC_i (IA_i)	$d_i \times IA_i$
Landscape	HSC-2 Impervious area dispersion. Sidewalks to adjacent landscaping areas. Pervious/impervious ratio = 0.17 acres to 0.0 acres	Perv/Imp > 2:1 d_{hsc} = 1.0	0.0	0.0
	Box 1:		$\sum d_i \times IA_i =$	0.0
	Box 2:		$IA_{total} =$	0.0
	[Box 1]/[Box 2]:		$d_{HSC\ total} =$	1.0"
			Percent Capture Provided by HSCs (Table III.1)	80%

Worksheet A: Hydrologic Source Control Calculation Form				
	Drainage area ID	DMA 5		
	Total drainage area	0.07	acres	
	Total drainage area Impervious Area (IA_{total})	0.0	acres	
HSC ID	HSC Type/ Description/ Reference BMP Fact Sheet	Effect of individual HSC_i per criteria in BMP Fact Sheets (XIV.1) (d_{HSCi})[1]	Impervious Area Tributary to HSC_i (IA_i)	$d_i \times IA_i$
Landscape	HSC-2 Impervious area dispersion. Sidewalks to adjacent landscaping areas. Pervious/impervious ratio = 0.07 acres to 0.0 acres	Perv/Imp > 2:1 d_{hsc} = 1.0	0.0	0.0
	Box 1:	$\sum d_i \times IA_i =$		0.0
	Box 2:	$IA_{total} =$		0.0
	[Box 1]/[Box 2]:	$d_{HSC\ total} =$		1.0"
		Percent Capture Provided by HSCs (Table III.1)		80%
	Drainage area ID	DMA 6		
	Total drainage area	0.84	acres	
	Total drainage area Impervious Area (IA_{total})	0.05	acres	
HSC ID	HSC Type/ Description/ Reference BMP Fact Sheet	Effect of individual HSC_i per criteria in BMP Fact Sheets (XIV.1) (d_{HSCi})[1]	Impervious Area Tributary to HSC_i (IA_i)	$d_i \times IA_i$
Landscape	HSC-2 Impervious area dispersion. Sidewalks to adjacent landscaping areas. Pervious/impervious ratio = 0.79 acres to 0.05 acres	Perv/Imp > 2:1 d_{hsc} = 1.0	0.05	0.05
	Box 1:	$\sum d_i \times IA_i =$		0.05
	Box 2:	$IA_{total} =$		0.05
	[Box 1]/[Box 2]:	$d_{HSC\ total} =$		1.0"
		Percent Capture Provided by HSCs (Table III.1)		80%



[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.

Table III.1: Fraction of Average Long Term Runoff Reduced (Capture Efficiency) by HSCs

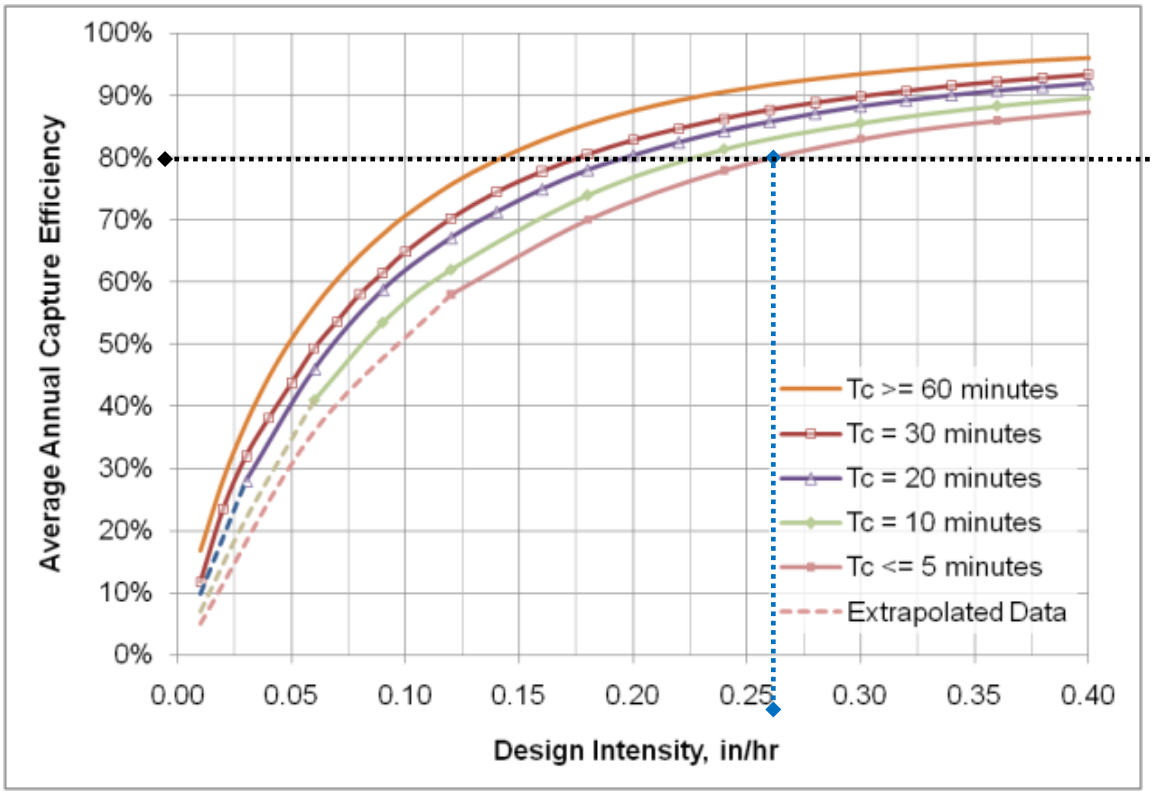
Cumulative HSC Adjustment to Design Capture Storm Depth (d_{hsc})	Capture Efficiency Achieved Lowland Regions (<1,000 ft)	Capture Efficiency Achieved Mountainous Regions (>1,000 ft)
<0.05	0	0%
0.05"	8%	7%
0.1"	20%	16%
0.2"	37%	31%
0.3"	48%	42%
0.4"	57%	50%
0.5"	64%	57%
0.6"	70%	63%
0.7"	75%	68%
0.8"	80%	72%
0.9"	80%	76%
1.0"	80%	80%

Worksheet B: Simple Design Capture Volume Sizing Method – DMAs 1-6				
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=	0.80	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)	$d_{remainder}$=	0.95	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	See table below	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=		
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=		
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=		cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate (DMA 1 only)				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	0.6	In/hr
2	Enter combined safety factor from Worksheet H, $S_{Preliminary}$ (unitless)	$S_{Preliminary}$=	2.18	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{Preliminary}$	K_{design}=	0.275	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	48	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}=	1.1 (13.2 in)	feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	2181/1.1 = 1983 Proposed = 2001	sq-ft
Calculations				

DMA	Area (Ac.)	Imp.	C-value	Design Storm Depth (in.)	DCV_{SIMPLE} (cu-ft)
1	2.24	0.247	0.335	0.8	2180.8
2	0.48	0.494	0.521	0.8	725.5
3	0.07	0.286	0.365	0.8	74.1
4	0.17	0	0.150	0.8	74.1
5	0.84	0.064	0.198	0.8	488.7
6	0.07	0	0.150	0.8	30.5

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=	5	
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=	0.26	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=	0.26	
6	Determine the design intensity that must be provided by BMP $I_{design} = I_1 - I_2$	I_{design}=	0.26	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.48	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.494	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.521	
4	Calculate design flow rate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.065	cfs
Supporting Calculations				
Describe system: Runoff from the parking lot will be conveyed as gutter flow to a Filterra Biofiltration BMP (or County approved equivalent) prior to discharging offsite. Filterra sizing required is 8'x4' unit with capacity of 0.074 cfs.				
Provide time of concentration assumptions: T_c based on minimum value of 5 minutes.				

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



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	2	0.25
		Predominant soil texture	0.25	2	0.25
		Site soil variability	0.25	2	0.50
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.75
B	Design	Tributary area size	0.25	1	0.25
		Level of pretreatment/ expected sediment loads	0.25	1	0.25
		Redundancy	0.25	2	0.75
		Compaction during construction	0.25	1	0.25
		Design Safety Factor, $S_B = \Sigma p$			1.25
Combined Safety Factor, $S_{TOT} = S_A \times S_B$				2.18	
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)				(0.6 in/hr) / FS 2 = 0.3 in/hr	
Design Infiltration Rate, in/hr, $K_{DESIGN} = K_{OBS} / S_{TOT}$				(0.6 in/hr) / FS 2.18 = 0.275 in/hr	
Supporting Data					
Infiltration test conducted at BMP location. Observed rate (K_{OBS}) without factors of safety is 0.6 in/hr.					

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	2.24	acres
3	What type of BMP is proposed?	Bioretention with no undedrains		
4	What is the infiltrating surface area of the proposed BMP?	A_{BMP}	2001	sq-ft
5	What land use activities are present in the tributary area (list all) - Walkways/Hardscape - Landscaping areas			
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): Bioretention media			
8	What minimum separation to mounded seasonally high groundwater applies to the proposed BMP? See Section VIII.2 (circle one)	5 ft	10 ft	
9	Provide rationale for selection of applicable minimum separation to seasonally high mounded groundwater: Based geotechnical investigation onsite, groundwater is greater than 26' deep.			
10	What is separation from the infiltrating surface to seasonally high groundwater?	SHGWT	greater than 20	ft
11	What is separation from the infiltrating surface to mounded seasonally high groundwater?	Mounded SHGWT	greater than 20	ft
12	Describe assumptions and methods used for mounding analysis: Based geotechnical investigation the project, groundwater is greater than 26' deep.			
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: Determination based off County data provided in TGD and geotechnical study. No issues with infiltration BMPs identified.			
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	

Worksheet I: Summary of Groundwater-related Feasibility Criteria
Provide rationale for feasibility determination: Based on soil report and testing conducted onsite, infiltration of runoff is feasible for the project.

INF-3: Bioretention with no Underdrain

Bioretention stormwater treatment facilities are landscaped shallow depressions that capture and filter stormwater runoff. These facilities function as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, and plants. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants. For areas with low permeability native soils or steep slopes, bioretention areas can be designed with an underdrain system that routes the treated runoff to the storm drain system rather than depending entirely on infiltration.

Also known as:

- *Rain gardens*
- *Infiltration planter*

Bioretention
Source: Geosyntec Consultants

Feasibility Screening Considerations

- Bioretention with no underdrains shall pass infiltration infeasibility screening criteria to be considered for use.

Opportunity Criteria

- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Bioretention may also be applied in parking lot islands, cul-de-sacs, traffic circles, road shoulders, and road medians.
- Drainage area is ≤ 5 acres, preferrably ≤ 1 acre.
- Area available for infiltration.
- Soils are adequate for infiltration or can be amended to improve infiltration capacity. Site slope is less than 15 percent.

OC-Specific Design Criteria and Considerations

- ☐ Placement of BMPs should observe geotechnical recommendations with respect to geological hazards (e.g. landslides, liquefaction zones, erosion, etc.) and set-backs (e.g., foundations, utilities, roadways, etc.)
- ☐ Depth to mounded seasonally high groundwater shall not be less than 5 feet.
- ☐ If sheet flow is conveyed to the treatment area over stabilized grassed areas, the site must be graded in such a way that minimizes erosive conditions; sheet flow velocities should not exceed 1 foot per second.
- ☐ Ponding depth should not exceed 18 inches; fencing may be required if ponding depth exceeds 6 inches to mitigate the risk of drowning.
- ☐ Planting/storage media shall be based on the recommendations contained in MISC-1: Planting/Storage Media
- ☐ The minimum amended soil depth is 1.5 feet (3 feet is preferred).
- ☐ The maximum drawdown time of the planting soil is 48 hours.

- ☐ Infiltration pathways may need to be restricted due to the close proximity of roads, foundations, or other infrastructure. A geomembrane liner, or other equivalent water proofing, may be placed along the vertical walls to reduce lateral flows. This liner should have a minimum thickness of 30 mils.
- ☐ Plant materials should be tolerant of summer drought, ponding fluctuations, and saturated soil conditions for 48 hours; native plant species and/or hardy cultivars that are not invasive and do not require chemical fertilizers or pesticides should be used to the maximum extent feasible.
- ☐ The bioretention area should be covered with 2-4 inches (average 3 inches) of mulch at startup and an additional placement of 1-2 inches of mulch should be added annually.
- ☐ An optional gravel drainage layer may be installed below planting media to augment storage volume.
- ☐ An overflow device is required at the top of the ponding depth.
- ☐ Dispersed flow or energy dissipation (i.e. splash rocks) for piped inlets should be provided at basin inlet to prevent erosion.

Simple Sizing Method for Bioretention with no Underdrain

If the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1** is used to size a bioretention area with underdrains, the user calculates the DCV and designs the system with geometry required to draw down the DCV in 48 hours. The sizing steps are as follows:

Step 1: Determine the Bioretention Design Capture Volume

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

Step 2: Determine the 48-hour Ponding Depth

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

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

Where:

d_{48} = bioretention 48-hour effective depth, ft

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

This is the maximum effective depth of the basin below the overflow device to achieve drawdown in 48 hours. Effective depth includes ponding water and media/aggregate pore space.

Step 3: Design System Geometry to Provide d_{48}

Design system geometry such that

$$d_{48} \geq d_{EFFECTIVE} = (d_P + n_M d_M + n_G d_G)$$

Where:

d_{48} = depth of water that can drain in 48 hours

$d_{EFFECTIVE}$ = total effective depth of water stored in bioretention area, ft

d_P = bioretention ponding depth, ft (should be less than or equal to 1.5 ft)

n_M = bioretention media porosity

d_M = bioretention media depth, ft

n_G = bioretention gravel layer porosity; 0.35 may be assumed where other information is not available

d_G = bioretention gravel layer depth, ft

Step 4: Calculate the Required Infiltrating Area

The required infiltrating area (i.e. measured at the media surface) can be calculated using the following equation:

$A = DCV / d_{EFFECTIVE}$

Where:

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

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

$d_{EFFECTIVE}$ = total effective depth of water stored in bioretention area, ft (from Step 3)

This does not include the side slopes, access roads, etc. which would increase bioretention footprint.

Capture Efficiency Method for Bioretention with no Underdrain

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

$DD = (d_{EFFECTIVE} / K_{DESIGN}) \times 12$ in/ft

Where:

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

$d_{EFFECTIVE} \leq (d_P + n_M d_M + n_G d_G)$

d_P = bioretention ponding depth, ft (should be less than or equal to 1.5 ft)

n_M = bioretention media porosity

d_M = bioretention media depth, ft

n_G = bioretention gravel layer porosity; 0.35 may be assumed where other information is not available

d_G = bioretention gravel layer depth, 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 (See **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 4: Check that the Bioretention Effective Depth Drains in no Greater than 96 Hours

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

Where:

DD = time to completely drain bioretention facility, hours

$d_{EFFECTIVE}$ = total effective depth of water stored in bioretention area, ft (from Step 3)

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

If DD_{ALL} is greater than 96 hours, adjust bioretention media depth and/or gravel layer depth until DD is less than 96 hours. This duration is based on preventing extended periods of saturation from causing plant mortality.

Step 5: Determine the Basin Infiltrating Area Needed

The required infiltrating area (i.e. the surface area of the top of the media layer) can be calculated using the following equation:

$$A = DCV / d_{EFFECTIVE}$$

Where:

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

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

$d_{EFFECTIVE}$ = total effective depth of water stored in bioretention area, ft (from Step 3)

This does not include the side slopes, access roads, etc. which would increase bioretention footprint. 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

- Bioretention areas may be preceeded in a treatment train by HSCs in the drainage area, which would reduce the required volume of the bioretention cell.
- Bioretention areas can be incorporated in a treatment train to provide enhanced water quality treatment and reductions in runoff volume and rate. For example, runoff can be collected from a roadway in a vegetated swale that then flows to a bioretention area. Similarly, bioretention could be used to manage overflow from a cistern.

Additional References for Design Guidance

- CASQA BMP Handbook for New and Redevelopment: **http://www.cabmphandbooks.com/Documents/Development/TC-32.pdf**
- SMC LID Manual (pp 68): **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 5: **http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf**
- San Diego County LID Handbook Appendix 4 (Factsheet 7): **http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf**
- 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**

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

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.

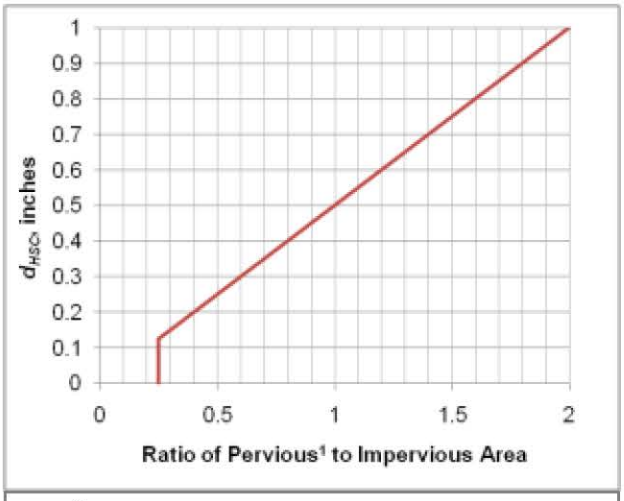
- The max d_{HSC} is equal to the design storm depth for the project site.

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



[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.

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

BIO-7: Proprietary Biotreatment

Proprietary biotreatment devices are devices that are manufactured to mimic natural systems such as bioretention areas by incorporating plants, soil, and microbes engineered to provide treatment at higher flow rates or volumes and with smaller footprints than their natural counterparts. Incoming flows are typically filtered through a planting media (mulch, compost, soil, plants, microbes, etc.) and either infiltrated or collected by an underdrain and delivered to the storm water conveyance system. Tree box filters are an increasingly common type of proprietary biotreatment device that are installed at curb level and filled with a bioretention type soil. For low to moderate flows they operate similarly to bioretention systems and are bypassed during high flows. Tree box filters are highly adaptable solutions that can be used in all types of development and in all types of soils but are especially applicable to dense urban parking lots, street, and roadways.

Also known as:

- *Catch basin planter box*
- *Bioretention vault*
- *Tree box filter*

Proprietary biotreatment
Source: http://www.americastusa.com /index.php/filterra/

Feasibility Screening Considerations

- Proprietary biotreatment devices that are unlined may cause incidental infiltration. Therefore, an evaluation of site conditions should be conducted to evaluate whether the BMP should include an impermeable liner to avoid infiltration into the subsurface.

Opportunity Criteria

- Drainage areas of 0.25 to 1.0 acres.
- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Proprietary biotreatment facilities may also be applied in parking lot islands, traffic circles, road shoulders, and road medians.
- Must not adversely affect the level of flood protection provided by the drainage system.

OC-Specific Design Criteria and Considerations

- ☐ Frequent maintenance and the use of screens and grates to keep trash out may decrease the likelihood of clogging and prevent obstruction and bypass of incoming flows.
- ☐ Consult proprietors for specific criteria concerning the design and performance.
- ☐ Proprietary biotreatment may include specific media to address pollutants of concern. However, for proprietary device to be considered a biotreatment device the media must be capable of supporting rigorous growth of vegetation.
- ☐ Proprietary systems must be acceptable to the reviewing agency. Reviewing agencies shall have the discretion to request performance information. Reviewing agencies shall have the discretion to deny the use of a proprietary BMP on the grounds of performance, maintenance considerations, or other relevant factors.

☐ In right of way areas, plant selection should not impair traffic lines of site. Local jurisdictions may also limit plant selection in keeping with landscaping themes.

Computing Sizing Criteria for Proprietary Biotreatment Device

- Proprietary biotreatment devices can be volume based or flow-based BMPs.
- Volume-based proprietary devices should be sized using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1** or the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs described in **Appendix III.3.2**.
- The required design flowrate for flow-based proprietary devices should be computed using the Capture Efficiency Method for Flow-based BMPs described in **Appendix III.3.3)**.

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**
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 9: **http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf**
- Santa Barbara BMP Guidance Manual, Chapter 6: **http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf**

CONTECH®
ENGINEERED SOLUTIONS

Filterra®
High Performance Bioretention

The experts you need to solve your stormwater challenges

Contech is the leader in stormwater solutions, helping engineers, contractors and owners with infrastructure and land development projects throughout North America.

With our responsive team of stormwater experts, local regulatory expertise and flexible solutions, Contech is the trusted partner you can count on for stormwater management solutions.

Your Contech Team

STORMWATER CONSULTANT

It's my job to recommend the best solution to meet permitting requirements.

STORMWATER DESIGN ENGINEER

I work with consultants to design the best approved solution to meet your project's needs.

REGULATORY MANAGER

I understand the local stormwater regulations and what solutions will be approved.

SALES ENGINEER

I make sure our solutions meet the needs of the contractor during construction.

Contech is your partner in stormwater management solutions

Low Impact Development in a Small Footprint – Filterra®

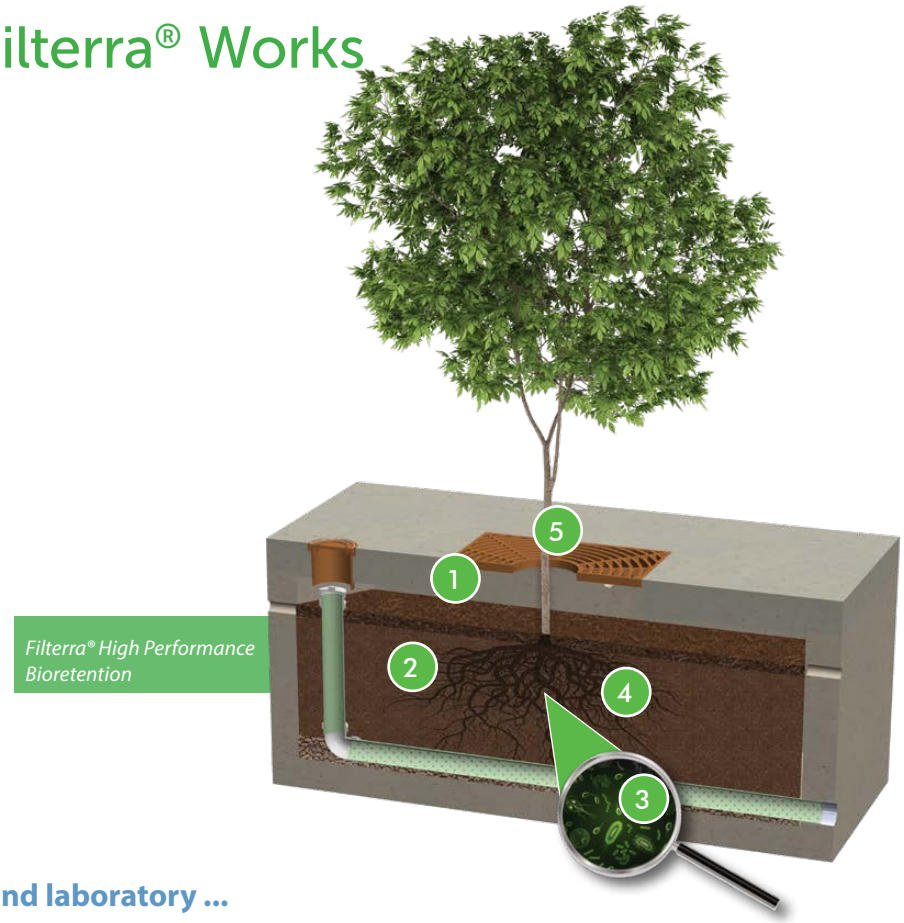
Filterra is an engineered high-performance bioretention system. While it operates similar to traditional bioretention, its high flow media allows for a reduction in footprint of up to 95% versus traditional bioretention practices. Filterra provides a Low Impact Development (LID) solution for tight, highly developed sites such as urban development projects, commercial parking lots, residential streets, and streetscapes. Its small footprint also reduces installation and life cycle costs versus traditional bioretention. Filterra can be configured in many different ways to enhance site aesthetics, integrate with other LID practices, or increase runoff reduction through infiltration below or downstream of the system.

At the Manchester Stormwater Park seen above, the Filterra systems surrounding the central courtyard allowed for the creation of a community space with parking, sidewalks, and benches in a quaint downtown area. A traditional bioretention system treating the same drainage area would have occupied the entire park area leaving no room for these amenities.

filterra®
Bioretention Systems

filterra® Bioscape®

How the Filterra® Works



Tested in the field and laboratory ...

1. Stormwater enters the Filterra through a pipe, curb inlet, or sheet flow and ponds over the pretreatment mulch layer, capturing heavy sediment and debris. Organics and microorganisms within the mulch trap and degrade metals and hydrocarbons. The mulch also provides water retention for the system's vegetation.

2. Stormwater flows through engineered Filterra media which filters fine pollutants and nutrients. Organic material in the media removes dissolved metals and acts as a food source for root-zone microorganisms. Treated water exits through an underdrain pipe or infiltrates (if designed accordingly).

3. Rootzone microorganisms digest and transform pollutants into forms easily absorbed by plants.

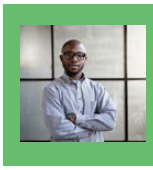
4. Plant roots absorb stormwater and pollutants that were transformed by microorganisms, regenerating the media's pollutant removal capacity. The roots grow, provide a hospitable environment for the rootzone microorganisms and penetrate the media, maintaining hydraulic conductivity.

5. The plant trunk and foliage utilize nutrients such as Nitrogen and Phosphorus for plant health, sequester heavy metals into the biomass, and provide evapotranspiration of residual water within the system.

Plants and organic material are vital to the long term performance of bioretention systems

Filterra® Features and Benefits

FEATURE	BENEFITS
High biofiltration media flow rate (up to 175”/hr+)	Greatly reduced footprint versus traditional bioretention and LID solutions
Filterra system is packaged, including all components necessary for system performance	Quality control for easy, fast and successful installation
Quick and easy maintenance	Low lifecycle costs
Variety of configurations and aesthetic options	Integrates easily into any site or landscape plan
Natural stormwater management processes featuring organics and vegetation	Meets Low Impact Development requirements and ensures long-term performance



The Filterra system can be configured with many different aesthetic options

Select Filterra® Approvals

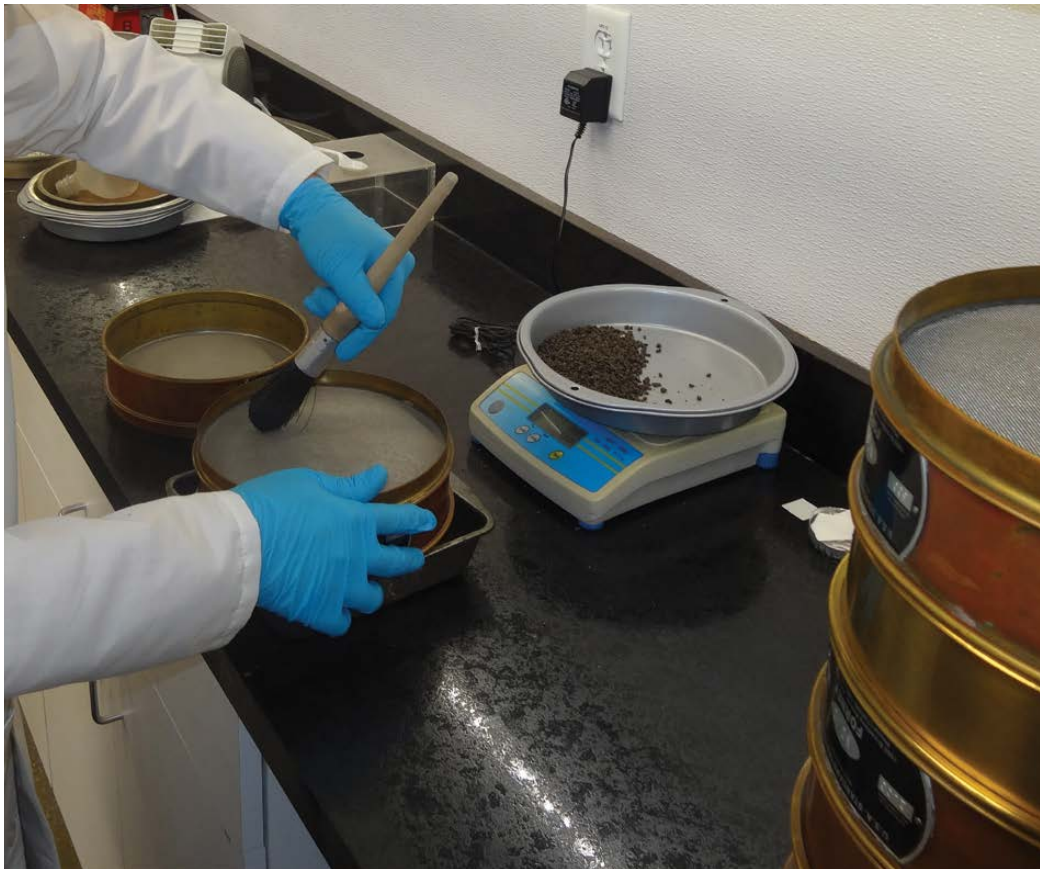
Filterra is approved through numerous local, state and federal verification programs, including:

- New Jersey Department of Environmental Protection (NJ DEP)
- Washington Department of Ecology (GULD) – Basic, Enhanced, Phosphorus, and Oil
- Maryland Department of the Environment - Environmental Site Design (ESD)
- Texas Commission on Environmental Quality (TCEQ)
- Virginia Department of Environmental Quality (VA DEQ)
- Maine Department of Environmental Protection (ME DEP)
- Atlanta, GA Regional Commission
- Los Angeles County, CA - Alternate to Attachment H
- City of Portland, Oregon Bureau of Environmental Services
- North Carolina Department of Environmental Quality (NC DEQ)

Filterra® Performance Testing Results

APPLICATION TIPS

- The Filterra system has been tested under industry standard protocols and has proven its pollutant removal performance and system longevity.
- Contech invests significant resources in media blending calibration and product testing to ensure our media meets our strict performance specifications every time.
- Keep regulators and owners happy by selecting a product with predictable and proven maintenance longevity.



POLLUTANT OF CONCERN	MEDIAN REMOVAL EFFICIENCY	MEDIAN EFFLUENT CONCENTRATION (MG/L)
Total Suspended Solids (TSS)	86%	3.3
Total Phosphorus - TAPE (TP)	70%	0.05
Total Nitrogen (TN)	34%	0.54
Total Copper (TCu)	55%	0.004
Total Dissolved Copper	43%	0.003
Total Zinc (TZn)	56%	0.04
Total Dissolved Zinc	54%	0.1
Total Zinc (TZn)	56%	0.04
Total Petroleum Hydrocarbons	87%	0.71

Each batch of Filterra® media has been extensively tested to ensure consistent performance every time.

Sources:
UVA (TARP) Field Study - 2006
Herrera (TAPE) Study - 2009
Herrera (TAPE) Study - 2014
NC State Study - 2015

Note: Some jurisdictions recognize higher removal rates. Contact your Contech Stormwater Consultant for performance expectations.

Field tested and performance verified

Filterra® Maintenance

Activation and first year of maintenance is included with every system.*

With proper routine maintenance, the engineered media within the Filterra system should last as long as traditional bioretention media. Routine maintenance is included by the manufacturer on all Filterra systems for the first year after activation.* This includes a maximum of 2 visits to remove debris, replace pretreatment mulch, and prune the vegetation.

Maintenance is low-cost, low-tech and simple:

- Remove trash, sediment, and mulch
- Replace with a fresh 3" layer of mulch
- No confined space entry or special tools
- Easily performed by landscape contractor or facilities maintenance provider

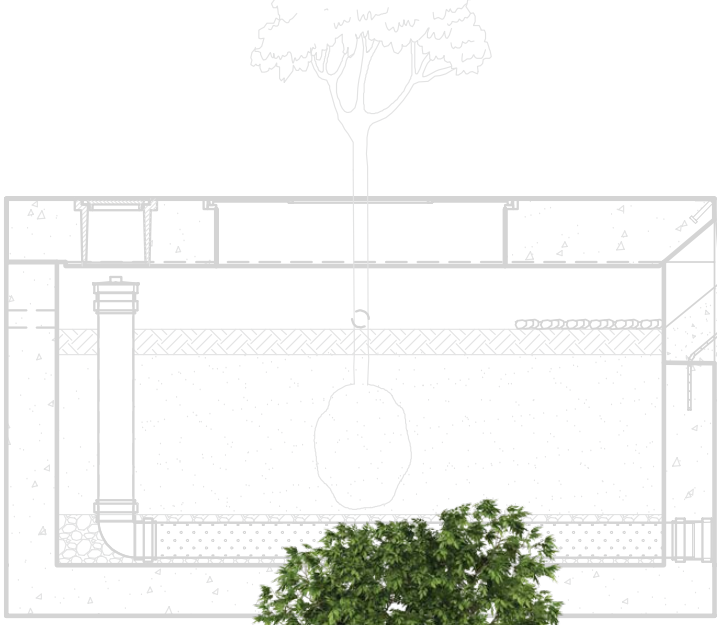
** Some exclusions may apply.*

Filterra offers high performance bioretention for advanced pollutant removal with easy maintenance.

Plant health evaluation and pruning is important to encourage growth.

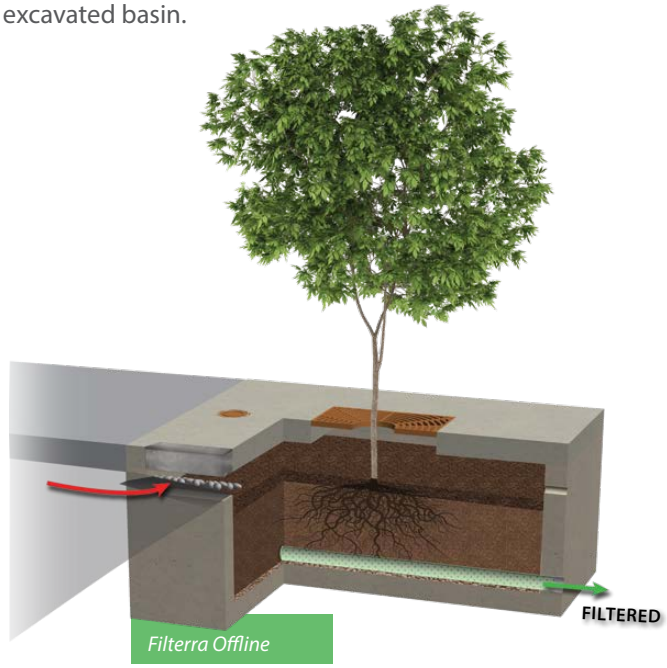
All stormwater treatment systems require maintenance for effective operation.

Filterra® Configurations

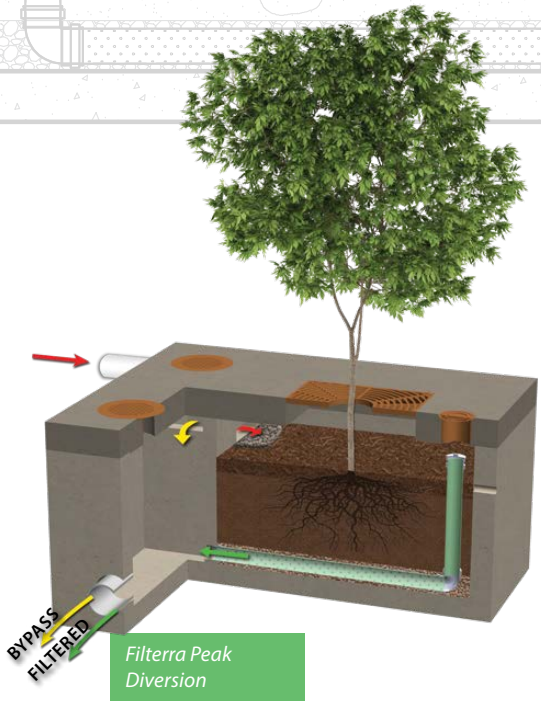


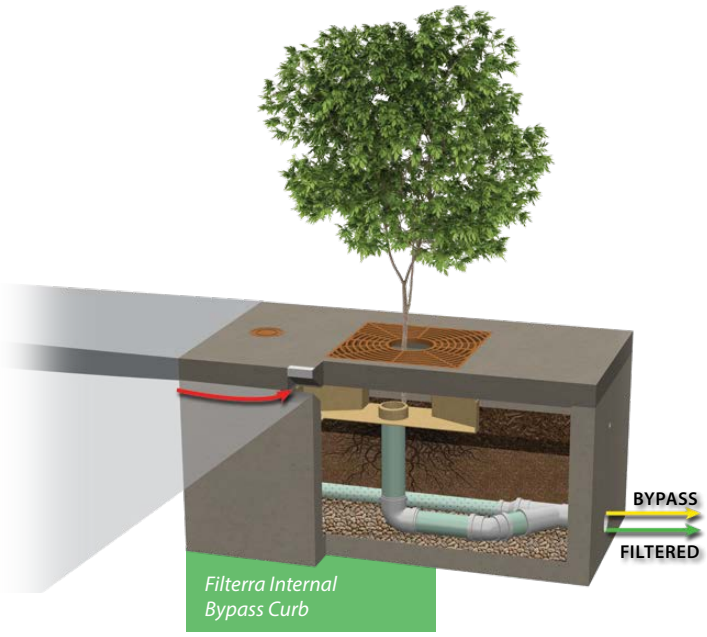
Multiple system configurations integrate with site hydraulic design and layout ...

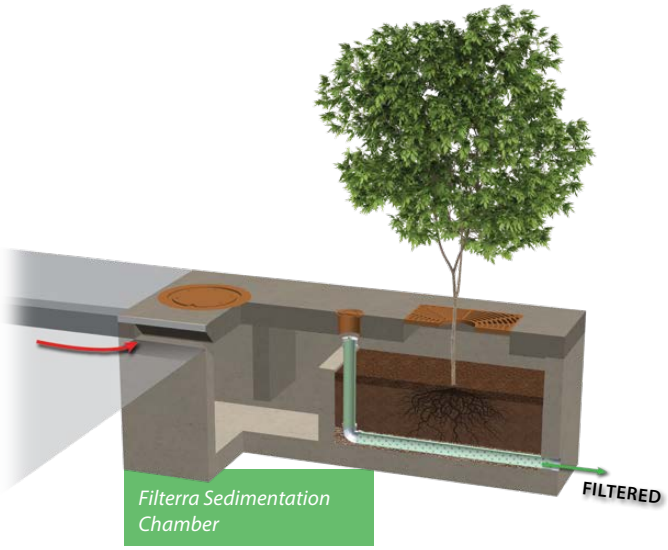
The Filterra is available in a variety of precast configurations as well as Filterra Bioscape, which can be installed directly into an excavated basin.



Bypass via downstream catch basin.





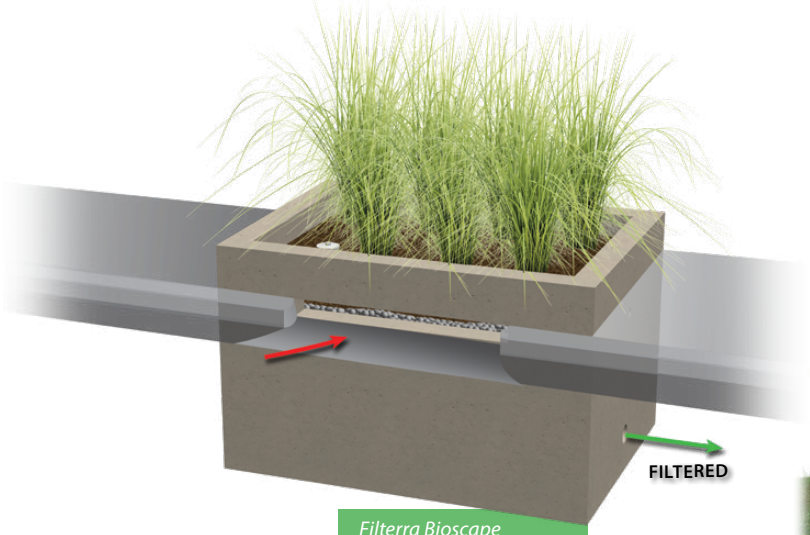


Bypass via downstream catch basin.

**Additional configurations available, including offline - pipe, peak diversion - grate, and internal bypass curb-chamber.*

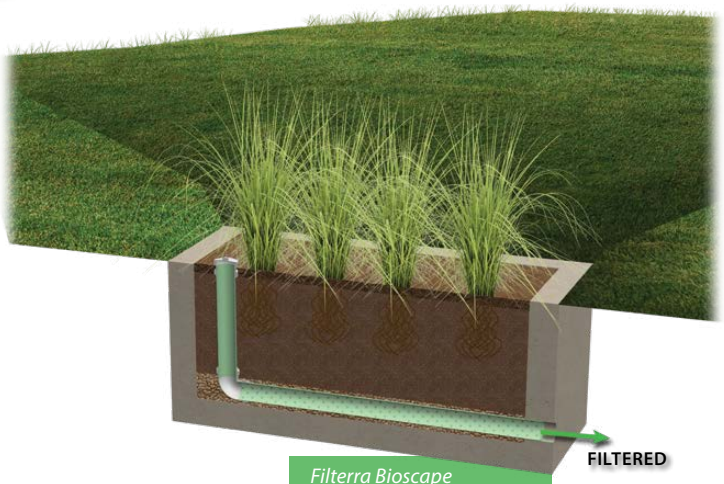
Multiple configurations allow for easy site integration

Filterra® Bioscape® Configurations



Filterra Bioscape Vault Offline

Bypass via downstream catch basin.



Filterra Bioscape Vault Basin

Bypass via upstream structure. Multiple inlet options.

Filterra Bioscape

Bypass via upstream structure. Multiple inlet options.

**Additional configurations available, including bioscape vault offline pipe.*

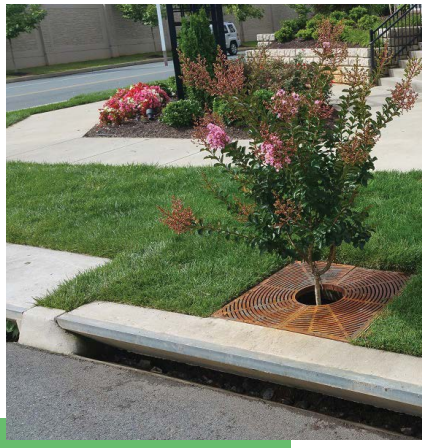
Filterra® Aesthetic Options

Multiple aesthetic options to enhance the appearance and integrate with landscaping ...

Standard Tree Grate

Custom/Decorative Tree Grate

Full Grate with Grasses



Recessed Top Slab

Open Top Planter - Filterra Bioscape

Street Tree

An aesthetic solution to meet your bioretention needs

Filterra® Bioscape®

Large-scale Filterra that can be customized to your site ...

- Ideal for Filterra systems greater than 300 square feet
- Design with or without containment structure
- Incorporate infiltration directly below the system, where required
- Combine with upstream storage or downstream infiltration
- Use as an alternative to larger regional traditional bioretention systems
- Easily add pretreatment Hydrodynamic Separator for large-scale or heavy pollutant loading applications

A partner you can rely on

STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURES SOLUTIONS

Few companies offer the wide range of high-quality stormwater resources you can find with us — state-of-the-art products, decades of expertise, and all the maintenance support you need to operate your system cost-effectively.

THE CONTECH WAY

Contech® Engineered Solutions provides innovative, cost-effective site solutions to engineers, contractors, and developers on projects across North America. Our portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer and stormwater management products.

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Attachment C

Hydromodification Analysis

(Excerpts provided. See project Hydrology Report)

```
____________________________________________________________________________
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1239

                          Analysis prepared by:

                          HUNSAKER & ASSOCIATES
                                Irvine,Inc
                     Planning * Engineering * Surveying
           Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************** DESCRIPTION OF STUDY **************************
* Hydrology Study for Crawford Park                                        *
* Existing Condition                                                       *
* 2-year Storm                                                             *
 ****************************************************************************

  FILE NAME: CPEX.DAT
  TIME/DATE OF STUDY: 19:25 11/13/2020
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   280.00
  ELEVATION DATA: UPSTREAM(FEET) =    915.00  DOWNSTREAM(FEET) =    750.00
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.475
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.797
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "OPEN BRUSH"               C        1.19      0.25     1.000    59    7.47
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      1.66
  TOTAL AREA(ACRES) =      1.19   PEAK FLOW RATE(CFS) =      1.66

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    750.00  DOWNSTREAM(FEET) =    600.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   325.00   CHANNEL SLOPE =  0.4615
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.66
  FLOW VELOCITY(FEET/SEC) =   5.24 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.03   Tc(MIN.) =    8.51
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     12.00 =     605.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     12.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.51
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.668
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL FAIR COVER
  "OPEN BRUSH"               C        0.90      0.25     1.000    59
  NATURAL FAIR COVER
  "OPEN BRUSH"               D        0.24      0.20     1.000    67
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.24
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    1.14      SUBAREA RUNOFF(CFS) =    1.47
  EFFECTIVE AREA(ACRES) =      2.33   AREA-AVERAGED Fm(INCH/HR) =  0.24
  AREA-AVERAGED Fp(INCH/HR) =  0.24  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =        2.3       PEAK FLOW RATE(CFS) =       2.98

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     13.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  600.00  DOWNSTREAM ELEVATION(FEET) =  503.00
```

```
  STREET LENGTH(FEET) =   730.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.11
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.25
    HALFSTREET FLOOD WIDTH(FEET) =    4.66
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    6.59
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.62
  STREET FLOW TRAVEL TIME(MIN.) =   1.85   Tc(MIN.) =   10.35
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.491
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         D        3.49      0.20     0.700    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =    3.49      SUBAREA RUNOFF(CFS) =    4.24
  EFFECTIVE AREA(ACRES) =      5.82    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.22  AREA-AVERAGED Ap =  0.82
  TOTAL AREA(ACRES) =        5.8        PEAK FLOW RATE(CFS) =       6.85

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   5.91
  FLOW VELOCITY(FEET/SEC.) =  6.78   DEPTH*VELOCITY(FT*FT/SEC.) =   1.82
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     13.00 =    1335.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     13.00 TO NODE     14.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  503.00  DOWNSTREAM ELEVATION(FEET) =  395.00
  STREET LENGTH(FEET) =  1085.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.89
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.31
    HALFSTREET FLOOD WIDTH(FEET) =    8.09
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    6.35
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.95
  STREET FLOW TRAVEL TIME(MIN.) =   2.85   Tc(MIN.) =   13.20
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.296
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         D        5.82      0.20     0.700    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =    5.82      SUBAREA RUNOFF(CFS) =    6.06
  EFFECTIVE AREA(ACRES) =     11.64    AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.76
  TOTAL AREA(ACRES) =       11.6        PEAK FLOW RATE(CFS) =      11.90

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =   8.91
  FLOW VELOCITY(FEET/SEC.) =  6.59   DEPTH*VELOCITY(FT*FT/SEC.) =   2.12
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     14.00 =    2420.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     14.00 TO NODE     15.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   395.00  DOWNSTREAM(FEET) =   394.00
  FLOW LENGTH(FEET) =    45.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.55
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      11.90
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =   13.28
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     15.00 =    2465.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     15.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.28
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.292
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         D       10.89      0.20     0.700    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =   10.89      SUBAREA RUNOFF(CFS) =   11.29
  EFFECTIVE AREA(ACRES) =     22.53   AREA-AVERAGED Fm(INCH/HR) =  0.15
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.73
  TOTAL AREA(ACRES) =       22.5       PEAK FLOW RATE(CFS) =      23.14

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     25.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   394.00  DOWNSTREAM(FEET) =   371.00
  FLOW LENGTH(FEET) =   240.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  19.58
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      23.14
  PIPE TRAVEL TIME(MIN.) =   0.20    Tc(MIN.) =   13.49
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     25.00 =    2705.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     25.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   13.49
  RAINFALL INTENSITY(INCH/HR) =   1.28
  AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.21
  AREA-AVERAGED Ap =  0.73
  EFFECTIVE STREAM AREA(ACRES) =      22.53
  TOTAL STREAM AREA(ACRES) =      22.53
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      23.14

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   295.00
  ELEVATION DATA: UPSTREAM(FEET) =    460.00  DOWNSTREAM(FEET) =    436.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.036
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.861
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         C        1.17      0.25     0.700    50    7.04
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA RUNOFF(CFS) =      1.77
  TOTAL AREA(ACRES) =      1.17   PEAK FLOW RATE(CFS) =      1.77

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     22.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  436.00  DOWNSTREAM ELEVATION(FEET) =  385.00
  STREET LENGTH(FEET) =   625.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.41
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    5.47
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.23
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.36
  STREET FLOW TRAVEL TIME(MIN.) =   1.99   Tc(MIN.) =    9.03
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.613
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         C        0.65      0.25     0.700    50
  COMMERCIAL                 C        0.30      0.25     0.100    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.511
  SUBAREA AREA(ACRES) =    0.95      SUBAREA RUNOFF(CFS) =    1.27
  EFFECTIVE AREA(ACRES) =      2.12    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.62
  TOTAL AREA(ACRES) =        2.1        PEAK FLOW RATE(CFS) =       2.78

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   6.03
  FLOW VELOCITY(FEET/SEC.) =  5.37   DEPTH*VELOCITY(FT*FT/SEC.) =   1.45
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     22.00 =     920.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     25.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   385.00  DOWNSTREAM(FEET) =   371.00
  FLOW LENGTH(FEET) =   225.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.48
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  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.78
  PIPE TRAVEL TIME(MIN.) =   0.40    Tc(MIN.) =    9.42
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     25.00 =    1145.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     25.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.42
  RAINFALL INTENSITY(INCH/HR) =   1.57
  AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.62
  EFFECTIVE STREAM AREA(ACRES) =       2.12
  TOTAL STREAM AREA(ACRES) =       2.12
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.78

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       23.14   13.49    1.281  0.21( 0.15) 0.73      22.5      10.00
      2        2.78    9.42    1.573  0.25( 0.15) 0.62       2.1      20.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       23.14    9.42    1.573  0.21( 0.15) 0.72      17.9      20.00
      2       25.35   13.49    1.281  0.21( 0.15) 0.72      24.6      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      25.35    Tc(MIN.) =    13.49
  EFFECTIVE AREA(ACRES) =      24.65   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.72
  TOTAL AREA(ACRES) =       24.6
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     25.00 =    2705.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     26.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   371.00  DOWNSTREAM(FEET) =   367.00
  FLOW LENGTH(FEET) =   110.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.77
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      25.35
  PIPE TRAVEL TIME(MIN.) =   0.13    Tc(MIN.) =   13.62
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     26.00 =    2815.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     26.00 TO NODE     26.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.62
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.274
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.33      0.30     0.600    36
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       C        3.00      0.25     0.600    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    3.33      SUBAREA RUNOFF(CFS) =    3.36
  EFFECTIVE AREA(ACRES) =     27.98   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.71
  TOTAL AREA(ACRES) =       28.0       PEAK FLOW RATE(CFS) =      28.26

****************************************************************************
  FLOW PROCESS FROM NODE     26.00 TO NODE     27.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   367.00  DOWNSTREAM(FEET) =   347.00
  FLOW LENGTH(FEET) =   480.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.82
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      28.26
  PIPE TRAVEL TIME(MIN.) =   0.54    Tc(MIN.) =   14.16
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     27.00 =    3295.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     27.00 TO NODE     27.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.16
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.245
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        2.00      0.30     0.600    36
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       C        0.50      0.25     0.600    50
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       D        2.16      0.20     0.600    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    4.66      SUBAREA RUNOFF(CFS) =    4.60
  EFFECTIVE AREA(ACRES) =     32.64   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.22  AREA-AVERAGED Ap =  0.69
  TOTAL AREA(ACRES) =       32.6       PEAK FLOW RATE(CFS) =      32.15

****************************************************************************
  FLOW PROCESS FROM NODE     27.00 TO NODE     35.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    347.00  DOWNSTREAM(FEET) =    345.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    70.00   CHANNEL SLOPE =  0.0286
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   5.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.238
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.13      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      32.21
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   8.13
  AVERAGE FLOW DEPTH(FEET) =   0.37   TRAVEL TIME(MIN.) =   0.14
  Tc(MIN.) =   14.30
  SUBAREA AREA(ACRES) =     0.13       SUBAREA RUNOFF(CFS) =    0.12
  EFFECTIVE AREA(ACRES) =     32.77     AREA-AVERAGED Fm(INCH/HR) =   0.15
  AREA-AVERAGED Fp(INCH/HR) =   0.22  AREA-AVERAGED Ap =   0.69
  TOTAL AREA(ACRES) =       32.8         PEAK FLOW RATE(CFS) =      32.15
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.37   FLOW VELOCITY(FEET/SEC.) =   8.11
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     35.00 =    3365.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     35.00 TO NODE     35.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   14.30
  RAINFALL INTENSITY(INCH/HR) =   1.24
  AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.22
  AREA-AVERAGED Ap =  0.69
  EFFECTIVE STREAM AREA(ACRES) =      32.77
  TOTAL STREAM AREA(ACRES) =      32.77
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      32.15

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   250.00
  ELEVATION DATA: UPSTREAM(FEET) =    393.00  DOWNSTREAM(FEET) =    372.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.10      0.20     0.100    57    5.00
  PUBLIC PARK                C        0.30      0.25     0.850    50    7.22
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.663
  SUBAREA RUNOFF(CFS) =      0.76
  TOTAL AREA(ACRES) =      0.40   PEAK FLOW RATE(CFS) =      0.76

****************************************************************************
  FLOW PROCESS FROM NODE     31.00 TO NODE     32.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    372.00  DOWNSTREAM(FEET) =    361.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   335.00   CHANNEL SLOPE =  0.0328
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.790
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        1.33      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.69
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.21
  AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   2.53
  Tc(MIN.) =    7.53
  SUBAREA AREA(ACRES) =     1.33       SUBAREA RUNOFF(CFS) =    1.84
  EFFECTIVE AREA(ACRES) =      1.73     AREA-AVERAGED Fm(INCH/HR) =   0.23
  AREA-AVERAGED Fp(INCH/HR) =   0.29  AREA-AVERAGED Ap =   0.81
  TOTAL AREA(ACRES) =        1.7         PEAK FLOW RATE(CFS) =       2.42

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.16   FLOW VELOCITY(FEET/SEC.) =   2.52
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     32.00 =     585.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     32.00 TO NODE     33.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    361.00  DOWNSTREAM(FEET) =    350.00
```

```
  CHANNEL LENGTH THRU SUBAREA(FEET) =   263.00   CHANNEL SLOPE =  0.0418
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.617
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        1.27      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.20
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.01
  AVERAGE FLOW DEPTH(FEET) =   0.18   TRAVEL TIME(MIN.) =   1.46
  Tc(MIN.) =    8.98
  SUBAREA AREA(ACRES) =     1.27       SUBAREA RUNOFF(CFS) =    1.56
  EFFECTIVE AREA(ACRES) =      3.00     AREA-AVERAGED Fm(INCH/HR) =   0.24
  AREA-AVERAGED Fp(INCH/HR) =   0.29  AREA-AVERAGED Ap =   0.82
  TOTAL AREA(ACRES) =        3.0         PEAK FLOW RATE(CFS) =       3.71

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.20   FLOW VELOCITY(FEET/SEC.) =   3.07
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     33.00 =     848.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     33.00 TO NODE     35.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   350.00  DOWNSTREAM(FEET) =   345.00
  FLOW LENGTH(FEET) =    80.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.32
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.71
  PIPE TRAVEL TIME(MIN.) =   0.13    Tc(MIN.) =    9.11
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     35.00 =     928.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     35.00 TO NODE     35.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.11
  RAINFALL INTENSITY(INCH/HR) =   1.60
  AREA-AVERAGED Fm(INCH/HR) =  0.24
  AREA-AVERAGED Fp(INCH/HR) =  0.29
  AREA-AVERAGED Ap =  0.82
  EFFECTIVE STREAM AREA(ACRES) =       3.00
  TOTAL STREAM AREA(ACRES) =       3.00
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.71

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       31.66   10.25    1.500  0.22( 0.15) 0.68      26.0      20.00
      1       32.15   14.30    1.238  0.22( 0.15) 0.69      32.8      10.00
      2        3.71    9.11    1.604  0.29( 0.24) 0.82       3.0      30.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       34.05    9.11    1.604  0.23( 0.16) 0.70      26.1      30.00
      2       35.09   10.25    1.500  0.23( 0.16) 0.70      29.0      20.00
      3       34.87   14.30    1.238  0.23( 0.16) 0.70      35.8      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      35.09    Tc(MIN.) =    10.25
  EFFECTIVE AREA(ACRES) =      28.98   AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap =  0.70
  TOTAL AREA(ACRES) =       35.8
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     35.00 =    3365.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     35.00 TO NODE     45.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    345.00  DOWNSTREAM(FEET) =    339.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   275.00   CHANNEL SLOPE =  0.0218
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   5.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.452
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.58      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      35.40
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   7.73
  AVERAGE FLOW DEPTH(FEET) =   0.42   TRAVEL TIME(MIN.) =   0.59
  Tc(MIN.) =   10.84
  SUBAREA AREA(ACRES) =     0.58       SUBAREA RUNOFF(CFS) =    0.62
  EFFECTIVE AREA(ACRES) =     29.56     AREA-AVERAGED Fm(INCH/HR) =   0.16
  AREA-AVERAGED Fp(INCH/HR) =   0.23  AREA-AVERAGED Ap =   0.70
  TOTAL AREA(ACRES) =       36.4         PEAK FLOW RATE(CFS) =      35.09
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.42   FLOW VELOCITY(FEET/SEC.) =   7.77
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     45.00 =    3640.00 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE     45.00 TO NODE     45.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.84
  RAINFALL INTENSITY(INCH/HR) =   1.45
  AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.23
  AREA-AVERAGED Ap =  0.70
  EFFECTIVE STREAM AREA(ACRES) =      29.56
  TOTAL STREAM AREA(ACRES) =      36.35
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      35.09

****************************************************************************
  FLOW PROCESS FROM NODE     40.00 TO NODE     41.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   160.00
  ELEVATION DATA: UPSTREAM(FEET) =    388.20  DOWNSTREAM(FEET) =    378.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.378
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.968
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.20      0.30     0.850    36    6.38
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      0.31
  TOTAL AREA(ACRES) =      0.20   PEAK FLOW RATE(CFS) =      0.31

****************************************************************************
  FLOW PROCESS FROM NODE     41.00 TO NODE     42.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    378.00  DOWNSTREAM(FEET) =    364.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   260.00   CHANNEL SLOPE =  0.0538
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.688
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.23      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.46
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.21
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   1.96
  Tc(MIN.) =    8.33
  SUBAREA AREA(ACRES) =     0.23       SUBAREA RUNOFF(CFS) =    0.30
  EFFECTIVE AREA(ACRES) =      0.43     AREA-AVERAGED Fm(INCH/HR) =   0.26
  AREA-AVERAGED Fp(INCH/HR) =   0.30  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        0.4         PEAK FLOW RATE(CFS) =       0.55

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.10   FLOW VELOCITY(FEET/SEC.) =   2.42
  LONGEST FLOWPATH FROM NODE     40.00 TO NODE     42.00 =     420.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     42.00 TO NODE     43.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    364.00  DOWNSTREAM(FEET) =    354.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   275.00   CHANNEL SLOPE =  0.0364
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.488
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.23      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.68
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.24
  AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   2.05
  Tc(MIN.) =   10.38
  SUBAREA AREA(ACRES) =     0.23       SUBAREA RUNOFF(CFS) =    0.26
  EFFECTIVE AREA(ACRES) =      0.66     AREA-AVERAGED Fm(INCH/HR) =   0.26
  AREA-AVERAGED Fp(INCH/HR) =   0.30  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        0.7         PEAK FLOW RATE(CFS) =       0.73

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.14   FLOW VELOCITY(FEET/SEC.) =   2.29
  LONGEST FLOWPATH FROM NODE     40.00 TO NODE     43.00 =     695.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     43.00 TO NODE     44.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    354.00  DOWNSTREAM(FEET) =    345.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   260.00   CHANNEL SLOPE =  0.0346
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.354
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.12      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.79
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.33
  AVERAGE FLOW DEPTH(FEET) =   0.15   TRAVEL TIME(MIN.) =   1.86
  Tc(MIN.) =   12.24
  SUBAREA AREA(ACRES) =     0.12       SUBAREA RUNOFF(CFS) =    0.12
  EFFECTIVE AREA(ACRES) =      0.78     AREA-AVERAGED Fm(INCH/HR) =   0.25
  AREA-AVERAGED Fp(INCH/HR) =   0.30  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        0.8         PEAK FLOW RATE(CFS) =       0.77

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.15   FLOW VELOCITY(FEET/SEC.) =   2.27
  LONGEST FLOWPATH FROM NODE     40.00 TO NODE     44.00 =     955.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     44.00 TO NODE     45.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    345.00  DOWNSTREAM(FEET) =    339.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    40.00   CHANNEL SLOPE =  0.1500
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   5.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.77
  FLOW VELOCITY(FEET/SEC.) =   2.98   FLOW DEPTH(FEET) =   0.03
  TRAVEL TIME(MIN.) =   0.22   Tc(MIN.) =   12.46
  LONGEST FLOWPATH FROM NODE     40.00 TO NODE     45.00 =     995.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     45.00 TO NODE     45.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.46
  RAINFALL INTENSITY(INCH/HR) =   1.34
  AREA-AVERAGED Fm(INCH/HR) =  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.85
  EFFECTIVE STREAM AREA(ACRES) =       0.78
  TOTAL STREAM AREA(ACRES) =       0.78
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.77

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       34.05    9.71    1.547  0.23( 0.16) 0.70      26.7      30.00
      1       35.09   10.84    1.452  0.23( 0.16) 0.70      29.6      20.00
      1       34.87   14.90    1.210  0.23( 0.16) 0.71      36.4      10.00
      2        0.77   12.46    1.340  0.30( 0.25) 0.85       0.8      40.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       34.77    9.71    1.547  0.24( 0.17) 0.70      27.3      30.00
      2       35.83   10.84    1.452  0.23( 0.16) 0.70      30.2      20.00
      3       35.77   12.46    1.340  0.23( 0.16) 0.71      33.1      40.00
      4       35.54   14.90    1.210  0.23( 0.16) 0.71      37.1      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      35.83    Tc(MIN.) =    10.84
  EFFECTIVE AREA(ACRES) =      30.24   AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap =  0.70
  TOTAL AREA(ACRES) =       37.1
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     45.00 =    3640.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       37.1  TC(MIN.) =     10.84
  EFFECTIVE AREA(ACRES) =     30.24  AREA-AVERAGED Fm(INCH/HR)=  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap = 0.703
  PEAK FLOW RATE(CFS)   =      35.83

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       34.77    9.71    1.547  0.24( 0.17) 0.70      27.3      30.00
      2       35.83   10.84    1.452  0.23( 0.16) 0.70      30.2      20.00
      3       35.77   12.46    1.340  0.23( 0.16) 0.71      33.1      40.00
      4       35.54   14.90    1.210  0.23( 0.16) 0.71      37.1      10.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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____________________________________________________________________________
****************************************************************************
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                          Analysis prepared by:

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 ************************** DESCRIPTION OF STUDY **************************
* Hydrology Study for Crawford Park                                        *
* Proposed Condition                                                       *
* 2-year Storm                                                             *
 ****************************************************************************

  FILE NAME: CPPR.DAT
  TIME/DATE OF STUDY: 15:44 11/14/2020
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   280.00
  ELEVATION DATA: UPSTREAM(FEET) =    915.00  DOWNSTREAM(FEET) =    750.00
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.475
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.797
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "OPEN BRUSH"               C        1.19      0.25     1.000    59    7.47
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      1.66
  TOTAL AREA(ACRES) =      1.19   PEAK FLOW RATE(CFS) =      1.66

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    750.00  DOWNSTREAM(FEET) =    600.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   325.00   CHANNEL SLOPE =  0.4615
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.66
  FLOW VELOCITY(FEET/SEC) =   5.24 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.03   Tc(MIN.) =    8.51
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     12.00 =     605.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     12.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.51
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.668
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL FAIR COVER
  "OPEN BRUSH"               C        0.90      0.25     1.000    59
  NATURAL FAIR COVER
  "OPEN BRUSH"               D        0.24      0.20     1.000    67
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.24
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    1.14      SUBAREA RUNOFF(CFS) =    1.47
  EFFECTIVE AREA(ACRES) =      2.33   AREA-AVERAGED Fm(INCH/HR) =  0.24
  AREA-AVERAGED Fp(INCH/HR) =  0.24  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =        2.3       PEAK FLOW RATE(CFS) =       2.98

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     13.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  600.00  DOWNSTREAM ELEVATION(FEET) =  503.00
```

```
  STREET LENGTH(FEET) =   730.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.11
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.25
    HALFSTREET FLOOD WIDTH(FEET) =    4.66
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    6.59
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.62
  STREET FLOW TRAVEL TIME(MIN.) =   1.85   Tc(MIN.) =   10.35
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.491
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         D        3.49      0.20     0.700    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =    3.49      SUBAREA RUNOFF(CFS) =    4.24
  EFFECTIVE AREA(ACRES) =      5.82    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.22  AREA-AVERAGED Ap =  0.82
  TOTAL AREA(ACRES) =        5.8        PEAK FLOW RATE(CFS) =       6.85

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   5.91
  FLOW VELOCITY(FEET/SEC.) =  6.78   DEPTH*VELOCITY(FT*FT/SEC.) =   1.82
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     13.00 =    1335.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     13.00 TO NODE     14.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  503.00  DOWNSTREAM ELEVATION(FEET) =  395.00
  STREET LENGTH(FEET) =  1085.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.89
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.31
    HALFSTREET FLOOD WIDTH(FEET) =    8.09
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    6.35
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.95
  STREET FLOW TRAVEL TIME(MIN.) =   2.85   Tc(MIN.) =   13.20
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.296
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         D        5.82      0.20     0.700    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =    5.82      SUBAREA RUNOFF(CFS) =    6.06
  EFFECTIVE AREA(ACRES) =     11.64    AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.76
  TOTAL AREA(ACRES) =       11.6        PEAK FLOW RATE(CFS) =      11.90

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =   8.91
  FLOW VELOCITY(FEET/SEC.) =  6.59   DEPTH*VELOCITY(FT*FT/SEC.) =   2.12
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     14.00 =    2420.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     14.00 TO NODE     15.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   395.00  DOWNSTREAM(FEET) =   394.00
  FLOW LENGTH(FEET) =    45.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.55
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      11.90
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =   13.28
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     15.00 =    2465.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     15.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.28
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.292
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         D       10.89      0.20     0.700    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =   10.89      SUBAREA RUNOFF(CFS) =   11.29
  EFFECTIVE AREA(ACRES) =     22.53   AREA-AVERAGED Fm(INCH/HR) =  0.15
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.73
  TOTAL AREA(ACRES) =       22.5       PEAK FLOW RATE(CFS) =      23.14

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     25.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   394.00  DOWNSTREAM(FEET) =   371.00
  FLOW LENGTH(FEET) =   240.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  19.58
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      23.14
  PIPE TRAVEL TIME(MIN.) =   0.20    Tc(MIN.) =   13.49
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     25.00 =    2705.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     25.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   13.49
  RAINFALL INTENSITY(INCH/HR) =   1.28
  AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.21
  AREA-AVERAGED Ap =  0.73
  EFFECTIVE STREAM AREA(ACRES) =      22.53
  TOTAL STREAM AREA(ACRES) =      22.53
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      23.14

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   295.00
  ELEVATION DATA: UPSTREAM(FEET) =    460.00  DOWNSTREAM(FEET) =    436.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.036
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.861
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         C        1.17      0.25     0.700    50    7.04
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA RUNOFF(CFS) =      1.77
  TOTAL AREA(ACRES) =      1.17   PEAK FLOW RATE(CFS) =      1.77

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     22.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  436.00  DOWNSTREAM ELEVATION(FEET) =  385.00
  STREET LENGTH(FEET) =   625.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.41
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    5.47
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.23
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.36
  STREET FLOW TRAVEL TIME(MIN.) =   1.99   Tc(MIN.) =    9.03
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.613
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         C        0.65      0.25     0.700    50
  COMMERCIAL                 C        0.30      0.25     0.100    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.511
  SUBAREA AREA(ACRES) =    0.95      SUBAREA RUNOFF(CFS) =    1.27
  EFFECTIVE AREA(ACRES) =      2.12    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.62
  TOTAL AREA(ACRES) =        2.1        PEAK FLOW RATE(CFS) =       2.78

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   6.03
  FLOW VELOCITY(FEET/SEC.) =  5.37   DEPTH*VELOCITY(FT*FT/SEC.) =   1.45
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     22.00 =     920.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     23.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   385.00  DOWNSTREAM(FEET) =   374.00
  FLOW LENGTH(FEET) =   180.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.41
```

```
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.78
  PIPE TRAVEL TIME(MIN.) =   0.32    Tc(MIN.) =    9.35
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     23.00 =    1100.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     23.00 TO NODE     23.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.35
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.581
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                C        0.14      0.25     0.850    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.14      SUBAREA RUNOFF(CFS) =    0.17
  EFFECTIVE AREA(ACRES) =      2.26   AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.63
  TOTAL AREA(ACRES) =        2.3       PEAK FLOW RATE(CFS) =       2.90

****************************************************************************
  FLOW PROCESS FROM NODE     23.00 TO NODE     25.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   374.00  DOWNSTREAM(FEET) =   371.00
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.24
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.90
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    9.41
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     25.00 =    1140.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     25.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.41
  RAINFALL INTENSITY(INCH/HR) =   1.57
  AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.63
  EFFECTIVE STREAM AREA(ACRES) =       2.26
  TOTAL STREAM AREA(ACRES) =       2.26
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.90

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       23.14   13.49    1.281  0.21( 0.15) 0.73      22.5      10.00
      2        2.90    9.41    1.575  0.25( 0.16) 0.63       2.3      20.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       23.24    9.41    1.575  0.21( 0.15) 0.72      18.0      20.00
      2       25.44   13.49    1.281  0.21( 0.15) 0.72      24.8      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      25.44    Tc(MIN.) =    13.49
  EFFECTIVE AREA(ACRES) =      24.79   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.72
  TOTAL AREA(ACRES) =       24.8
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     25.00 =    2705.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     26.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   371.00  DOWNSTREAM(FEET) =   367.00
  FLOW LENGTH(FEET) =   110.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.78
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      25.44
  PIPE TRAVEL TIME(MIN.) =   0.13    Tc(MIN.) =   13.62
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     26.00 =    2815.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     26.00 TO NODE     26.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.62
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.274
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.33      0.30     0.600    36
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       C        3.00      0.25     0.600    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    3.33      SUBAREA RUNOFF(CFS) =    3.36
  EFFECTIVE AREA(ACRES) =     28.12   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.71
```

```
  TOTAL AREA(ACRES) =       28.1       PEAK FLOW RATE(CFS) =      28.39

****************************************************************************
  FLOW PROCESS FROM NODE     26.00 TO NODE     27.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   367.00  DOWNSTREAM(FEET) =   347.00
  FLOW LENGTH(FEET) =   480.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.83
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      28.39
  PIPE TRAVEL TIME(MIN.) =   0.54    Tc(MIN.) =   14.16
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     27.00 =    3295.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     27.00 TO NODE     27.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.16
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.246
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        2.00      0.30     0.600    36
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       C        0.50      0.25     0.600    50
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       D        2.16      0.20     0.600    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    4.66      SUBAREA RUNOFF(CFS) =    4.60
  EFFECTIVE AREA(ACRES) =     32.78   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.22  AREA-AVERAGED Ap =  0.69
  TOTAL AREA(ACRES) =       32.8       PEAK FLOW RATE(CFS) =      32.28

****************************************************************************
  FLOW PROCESS FROM NODE     27.00 TO NODE     37.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    347.00  DOWNSTREAM(FEET) =    345.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    70.00   CHANNEL SLOPE =  0.0286
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   5.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.238
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.12      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      32.34
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   8.16
  AVERAGE FLOW DEPTH(FEET) =   0.37   TRAVEL TIME(MIN.) =   0.14
  Tc(MIN.) =   14.30
  SUBAREA AREA(ACRES) =     0.12       SUBAREA RUNOFF(CFS) =    0.11
  EFFECTIVE AREA(ACRES) =     32.90     AREA-AVERAGED Fm(INCH/HR) =   0.15
  AREA-AVERAGED Fp(INCH/HR) =   0.22  AREA-AVERAGED Ap =   0.69
  TOTAL AREA(ACRES) =       32.9         PEAK FLOW RATE(CFS) =      32.28
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.37   FLOW VELOCITY(FEET/SEC.) =   8.15
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     37.00 =    3365.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     37.00 TO NODE     37.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   14.30
  RAINFALL INTENSITY(INCH/HR) =   1.24
  AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.22
  AREA-AVERAGED Ap =  0.69
  EFFECTIVE STREAM AREA(ACRES) =      32.90
  TOTAL STREAM AREA(ACRES) =      32.90
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      32.28

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   275.00
  ELEVATION DATA: UPSTREAM(FEET) =    393.00  DOWNSTREAM(FEET) =    381.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.378
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.171
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.12      0.20     0.100    57    5.38
  PUBLIC PARK                D        0.14      0.20     0.850    57    8.54
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.504
  SUBAREA RUNOFF(CFS) =      0.48
  TOTAL AREA(ACRES) =      0.26   PEAK FLOW RATE(CFS) =      0.48

****************************************************************************
  FLOW PROCESS FROM NODE     31.00 TO NODE     32.00 IS CODE =  51
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    381.00  DOWNSTREAM(FEET) =    374.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0350
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.985
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.07      0.30     0.100    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.55
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.67
  AVERAGE FLOW DEPTH(FEET) =   0.17   TRAVEL TIME(MIN.) =   0.91
  Tc(MIN.) =    6.29
  SUBAREA AREA(ACRES) =     0.07       SUBAREA RUNOFF(CFS) =    0.12
  EFFECTIVE AREA(ACRES) =      0.33     AREA-AVERAGED Fm(INCH/HR) =   0.09
  AREA-AVERAGED Fp(INCH/HR) =   0.21  AREA-AVERAGED Ap =   0.42
  TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       0.56

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.18   FLOW VELOCITY(FEET/SEC.) =   3.55
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     32.00 =     475.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     32.00 TO NODE     33.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    374.00  DOWNSTREAM(FEET) =    371.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    65.00   CHANNEL SLOPE =  0.0462
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.947
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.10      0.30     0.100    36
  PUBLIC PARK                B        0.84      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.770
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.29
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.05
  AVERAGE FLOW DEPTH(FEET) =   0.23   TRAVEL TIME(MIN.) =   0.21
  Tc(MIN.) =    6.50
  SUBAREA AREA(ACRES) =     0.94       SUBAREA RUNOFF(CFS) =    1.45
  EFFECTIVE AREA(ACRES) =      1.27     AREA-AVERAGED Fm(INCH/HR) =   0.19
  AREA-AVERAGED Fp(INCH/HR) =   0.28  AREA-AVERAGED Ap =   0.68
  TOTAL AREA(ACRES) =        1.3         PEAK FLOW RATE(CFS) =       2.00

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.27   FLOW VELOCITY(FEET/SEC.) =   5.50
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     33.00 =     540.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     33.00 TO NODE     34.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    371.00  DOWNSTREAM(FEET) =    367.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    90.00   CHANNEL SLOPE =  0.0444
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.872
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.32      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.24
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.28
  AVERAGE FLOW DEPTH(FEET) =   0.37   TRAVEL TIME(MIN.) =   0.46
  Tc(MIN.) =    6.96
  SUBAREA AREA(ACRES) =     0.32       SUBAREA RUNOFF(CFS) =    0.47
  EFFECTIVE AREA(ACRES) =      1.59     AREA-AVERAGED Fm(INCH/HR) =   0.21
  AREA-AVERAGED Fp(INCH/HR) =   0.29  AREA-AVERAGED Ap =   0.71
  TOTAL AREA(ACRES) =        1.6         PEAK FLOW RATE(CFS) =       2.39

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.38   FLOW VELOCITY(FEET/SEC.) =   3.36
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     34.00 =     630.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     34.00 TO NODE     35.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    367.00  DOWNSTREAM(FEET) =    357.10
  CHANNEL LENGTH THRU SUBAREA(FEET) =   230.00   CHANNEL SLOPE =  0.0430
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.721
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.65      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.81
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.49
  AVERAGE FLOW DEPTH(FEET) =   0.40   TRAVEL TIME(MIN.) =   1.10
  Tc(MIN.) =    8.06
  SUBAREA AREA(ACRES) =     0.65       SUBAREA RUNOFF(CFS) =    0.86
  EFFECTIVE AREA(ACRES) =      2.24     AREA-AVERAGED Fm(INCH/HR) =   0.22
  AREA-AVERAGED Fp(INCH/HR) =   0.29  AREA-AVERAGED Ap =   0.75
```

```
  TOTAL AREA(ACRES) =        2.2         PEAK FLOW RATE(CFS) =       3.03

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.41   FLOW VELOCITY(FEET/SEC.) =   3.52
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     35.00 =     860.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     35.00 TO NODE     36.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   357.10  DOWNSTREAM(FEET) =   356.50
  FLOW LENGTH(FEET) =    75.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   7.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.65
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.03
  PIPE TRAVEL TIME(MIN.) =   0.27    Tc(MIN.) =    8.33
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     36.00 =     935.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     36.00 TO NODE     36.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.33
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.689
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        1.10      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    1.42
  EFFECTIVE AREA(ACRES) =      3.34   AREA-AVERAGED Fm(INCH/HR) =  0.23
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.78
  TOTAL AREA(ACRES) =        3.3       PEAK FLOW RATE(CFS) =       4.38

****************************************************************************
  FLOW PROCESS FROM NODE     36.00 TO NODE     37.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   356.50  DOWNSTREAM(FEET) =   345.00
  FLOW LENGTH(FEET) =    60.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.10
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.38
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    8.39
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     37.00 =     995.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     37.00 TO NODE     37.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.39
  RAINFALL INTENSITY(INCH/HR) =   1.68
  AREA-AVERAGED Fm(INCH/HR) =  0.23
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.78
  EFFECTIVE STREAM AREA(ACRES) =       3.34
  TOTAL STREAM AREA(ACRES) =       3.34
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.38

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       31.83   10.23    1.501  0.22( 0.15) 0.68      26.1      20.00
      1       32.28   14.30    1.238  0.22( 0.15) 0.69      32.9      10.00
      2        4.38    8.39    1.682  0.30( 0.23) 0.78       3.3      30.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       33.98    8.39    1.682  0.23( 0.16) 0.70      24.7      30.00
      2       35.66   10.23    1.501  0.23( 0.16) 0.69      29.4      20.00
      3       35.32   14.30    1.238  0.23( 0.16) 0.70      36.2      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      35.66    Tc(MIN.) =    10.23
  EFFECTIVE AREA(ACRES) =      29.43   AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap =  0.69
  TOTAL AREA(ACRES) =       36.2
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     37.00 =    3365.00 FEET.

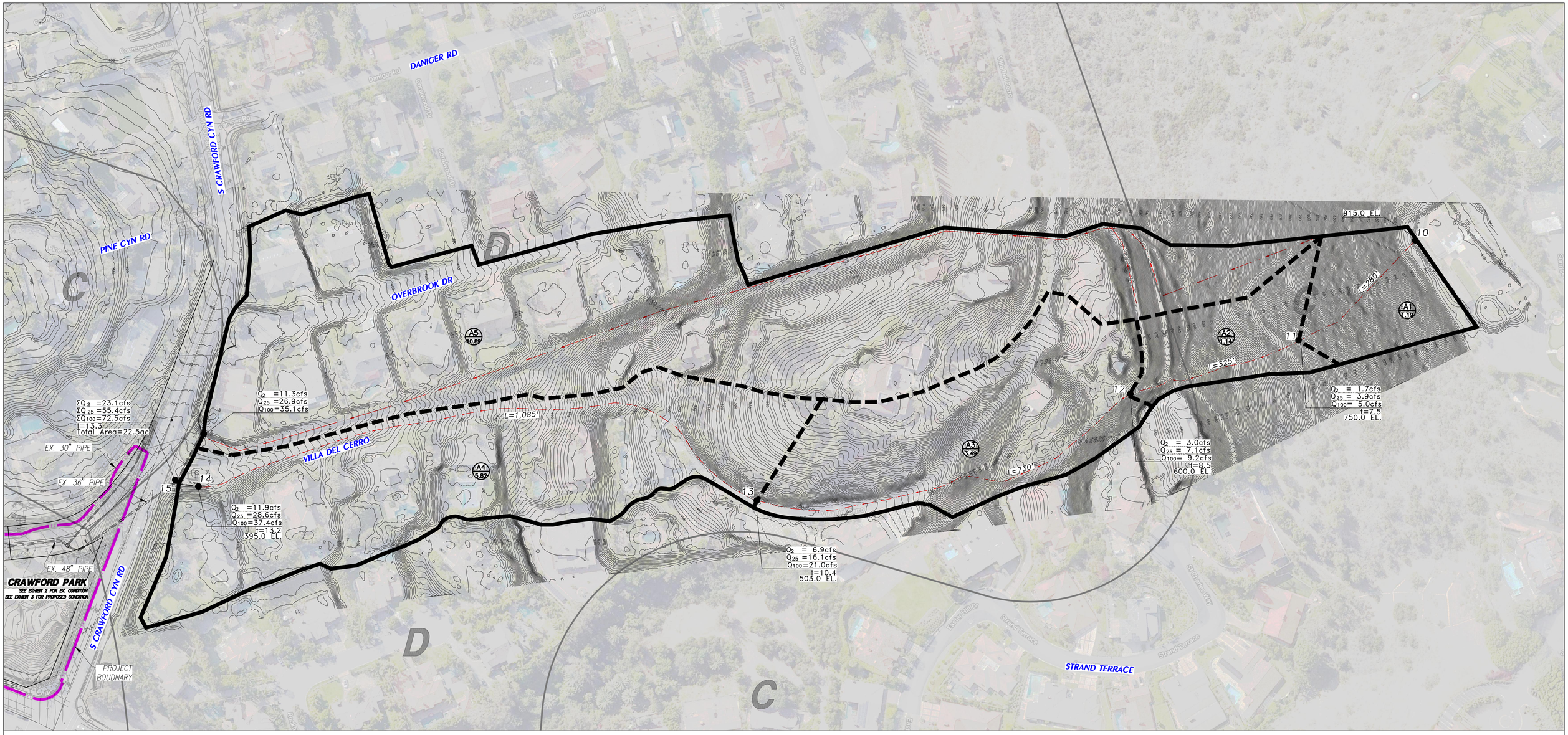
****************************************************************************
  FLOW PROCESS FROM NODE     37.00 TO NODE     45.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    345.00  DOWNSTREAM(FEET) =    339.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   275.00   CHANNEL SLOPE =  0.0218
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   5.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.453
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.41      0.30     0.850    36
```

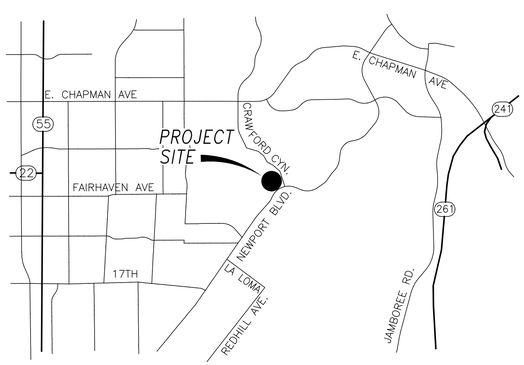
```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      35.88
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   7.79
  AVERAGE FLOW DEPTH(FEET) =   0.42   TRAVEL TIME(MIN.) =   0.59
  Tc(MIN.) =   10.82
  SUBAREA AREA(ACRES) =     0.41       SUBAREA RUNOFF(CFS) =    0.44
  EFFECTIVE AREA(ACRES) =     29.84     AREA-AVERAGED Fm(INCH/HR) =   0.16
  AREA-AVERAGED Fp(INCH/HR) =   0.23  AREA-AVERAGED Ap =   0.70
  TOTAL AREA(ACRES) =       36.6         PEAK FLOW RATE(CFS) =      35.66
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.42   FLOW VELOCITY(FEET/SEC.) =   7.75
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     45.00 =    3640.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     45.00 TO NODE     45.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   10.82
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.453
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.22      0.30     0.100    36
  PUBLIC PARK                B        0.26      0.30     0.850    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.506
  SUBAREA AREA(ACRES) =    0.48      SUBAREA RUNOFF(CFS) =    0.56
  EFFECTIVE AREA(ACRES) =     30.32   AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap =  0.69
  TOTAL AREA(ACRES) =       37.1       PEAK FLOW RATE(CFS) =      35.66
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       37.1  TC(MIN.) =     10.82
  EFFECTIVE AREA(ACRES) =     30.32  AREA-AVERAGED Fm(INCH/HR)=  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap = 0.693
  PEAK FLOW RATE(CFS)   =      35.66

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       33.98    8.99    1.617  0.24( 0.16) 0.70      25.6      30.00
      2       35.66   10.82    1.453  0.23( 0.16) 0.69      30.3      20.00
      3       35.32   14.89    1.210  0.23( 0.16) 0.70      37.1      10.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```





LOCATION MAP

PREPARED FOR:

OCparks

PREPARED BY:

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

SCALE: 1" =80'

80 40 0 80 160 240

GRAPHIC SCALE 1"= 80'

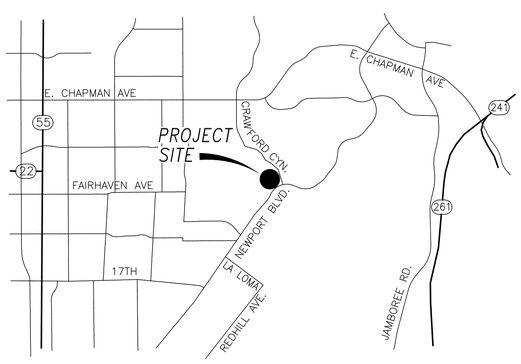
LEGEND

- PROJECT BOUNDARY
- MAJOR DRAINAGE BOUNDARY
- MINOR DRAINAGE BOUNDARY
- FLOW LINE WITH DIRECTION
- 100 — NODE NUMBER
- A / 1.0 — AREA DESIGNATION / AREA ACREAGE (IN ACRES)
- Q100=9.0cfs t=15.0 — PEAK FLOW RATE / TIME OF CONCENTRATION FOR 2-YEAR STORM
- ΣQ100=10.0cfs t=15.0 — PEAK CONFLUENCE FLOW RATE / TIME OF CONCENTRATION FOR 2-YEAR STORM
- EXISTING STORM DRAIN
- C / D — SOIL GROUP BOUNDARY

EXHIBIT 1
OFF-SITE HYDROLOGY MAP
CRAWFORD PARK
S. CRAWFORD CANYON RD. & NEWPORT BLVD.
TUSTIN, CALIFORNIA 92782

HYDROLOGY MAP FOR CRAWFORD PARK – OFF-SITE

PLOTTED BY: Gary Guan DATE: Nov. 13, 2020 08:16:49 PM FILE: F:\1140\Engineering\SY_Hydrology\Crawford Park Existing Hydrology – Offsite.dwg



LOCATION MAP

PREPARED FOR:

OCparks

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PLANNING ▪ ENGINEERING ▪ SURVEYING
Three Hughes ▪ Irvine, CA 92618 ▪ PH: (949) 583-1010 ▪ FX: (949) 583-0759

SCALE: 1" =50'

50 25 0 50 100 150

GRAPHIC SCALE 1"= 50'

LEGEND

- PROJECT BOUNDARY
- MAJOR DRAINAGE BOUNDARY
- MINOR DRAINAGE BOUNDARY
- FLOW LINE WITH DIRECTION
- 100 — NODE NUMBER
- A / 1.0 — AREA DESIGNATION / AREA ACREAGE (IN ACRES)
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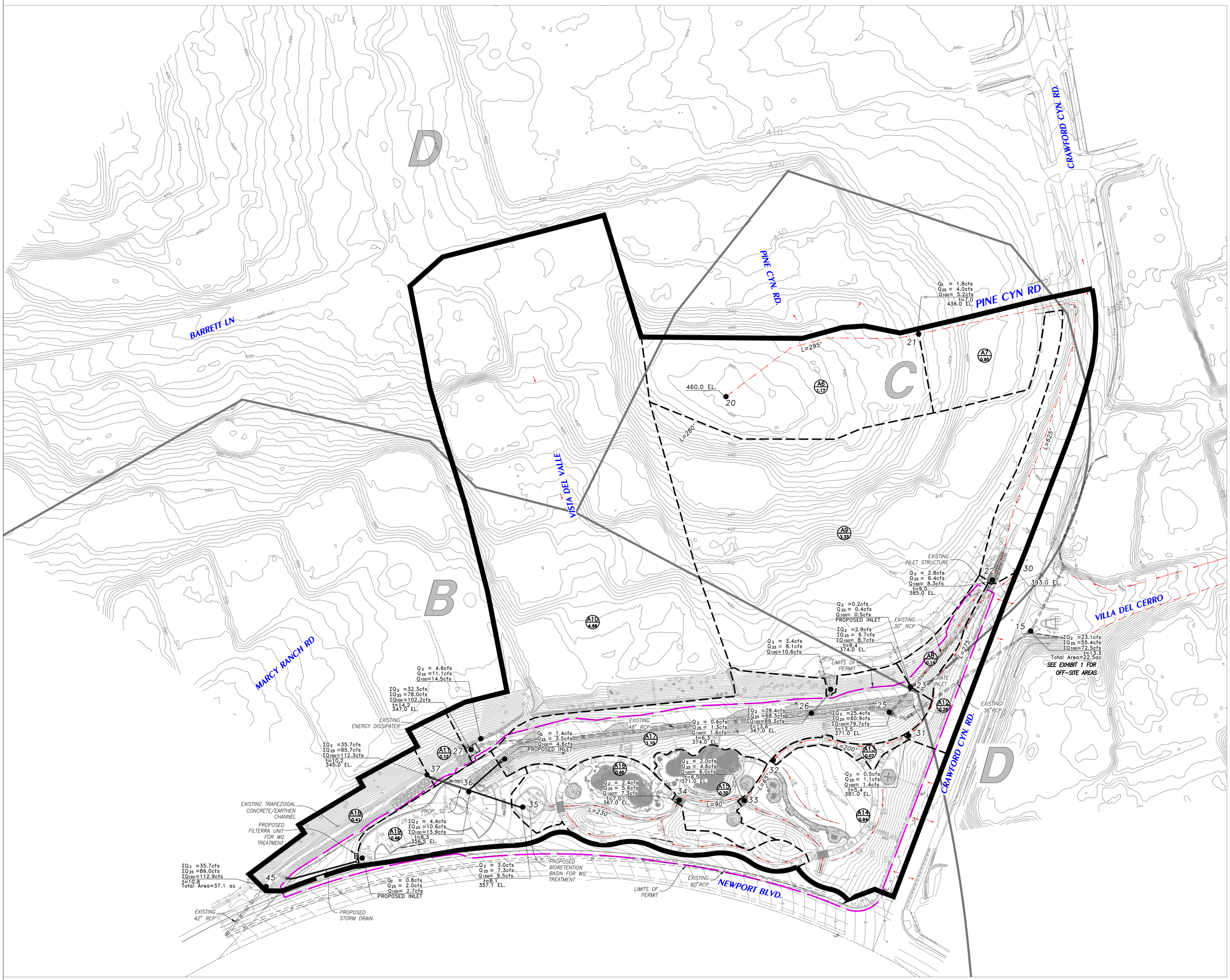
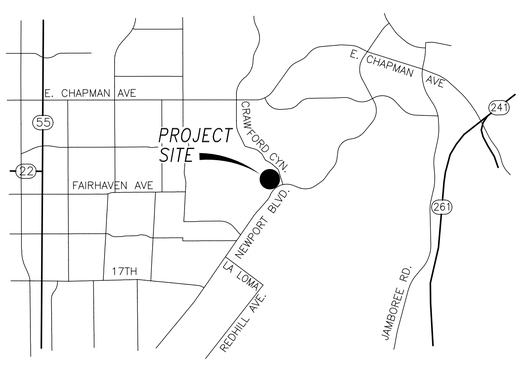
- EXISTING STORM DRAIN
- C / D — SOIL GROUP BOUNDARY

EXHIBIT 2
EXISTING CONDITION HYDROLOGY MAP (ONSITE)
CRAWFORD PARK
S. CRAWFORD CANYON RD. & NEWPORT BLVD.
TUSTIN, CALIFORNIA 92782

HYDROLOGY MAP FOR CRAWFORD PARK – ON-SITE

PLOTTED BY: Gary Guan DATE: Nov. 15, 2020 07:28:11 PM FILE: F:\1140\Engineering\SY_Hydrology\Crawford Park Existing Hydrology – Onsite.dwg





LOCATION MAP

PREPARED FOR:

OCparks

PREPARED BY:

HUNSAKER & ASSOCIATES IRVINE, INC.
PLANNING ▪ ENGINEERING ▪ SURVEYING
Three Hughes ▪ Irvine, CA 92618 ▪ PH: (949) 583-1010 ▪ FX: (949) 583-0759

SCALE: 1" =50'

50 25 0 50 100 150

GRAPHIC SCALE 1"= 50'

LEGEND

- PROJECT BOUNDARY
- MAJOR DRAINAGE BOUNDARY
- MINOR DRAINAGE BOUNDARY
- FLOW LINE WITH DIRECTION
- 100 — NODE NUMBER
- A / 1.0 — AREA DESIGNATION / AREA ACREAGE (IN ACRES)
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- ΣQ100=10.0cfs t=15.0 — PEAK CONFLUENCE FLOW RATE / TIME OF CONCENTRATION FOR 2-YEAR STORM
- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- C / D — SOIL GROUP BOUNDARY

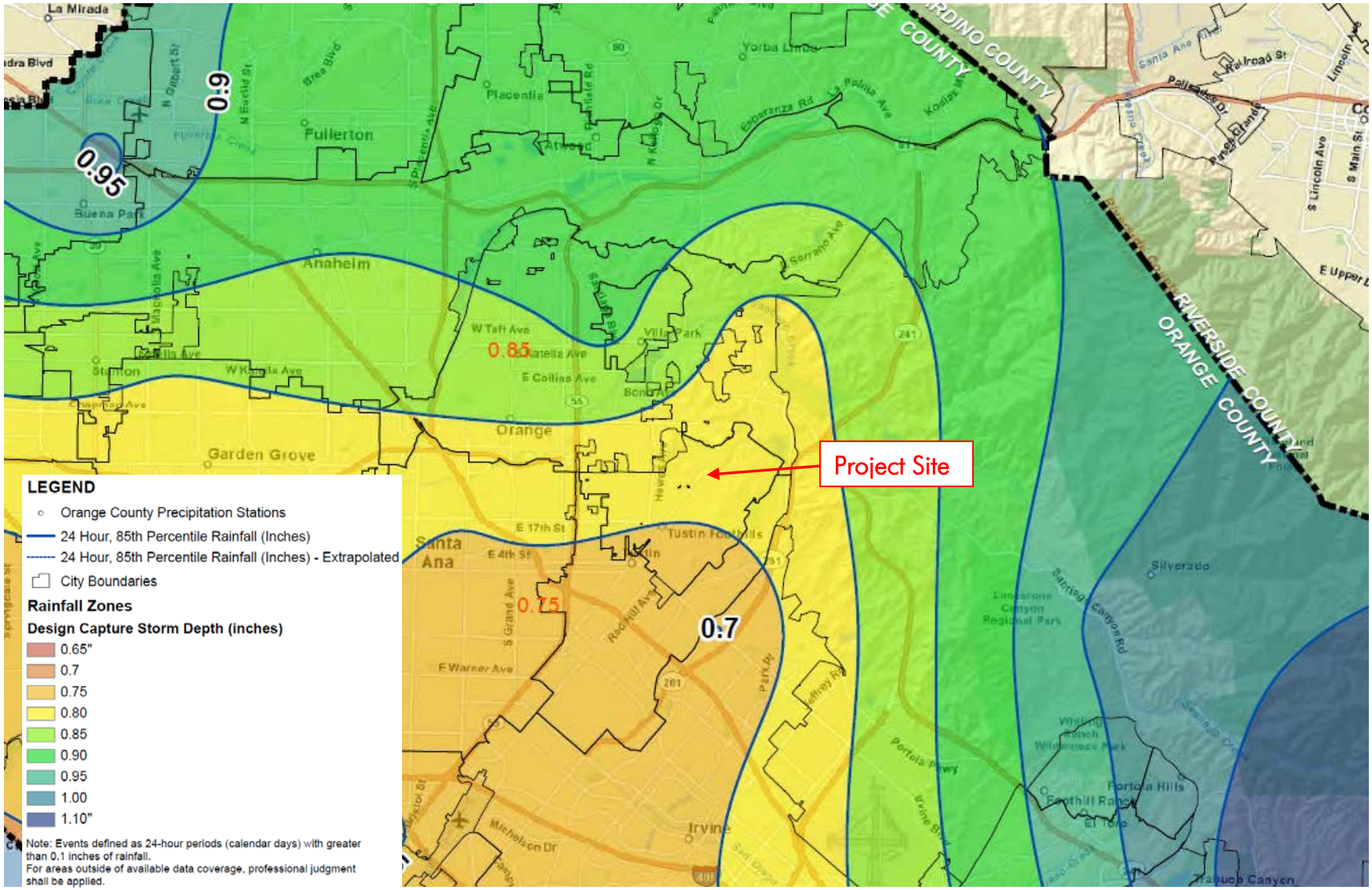
EXHIBIT 3
PROPOSED CONDITION HYDROLOGY MAP (ONSITE)
CRAWFORD PARK
S. CRAWFORD CANYON RD. & NEWPORT BLVD.
TUSTIN, CALIFORNIA 92782

HYDROLOGY MAP FOR CRAWFORD PARK – OFF-SITE

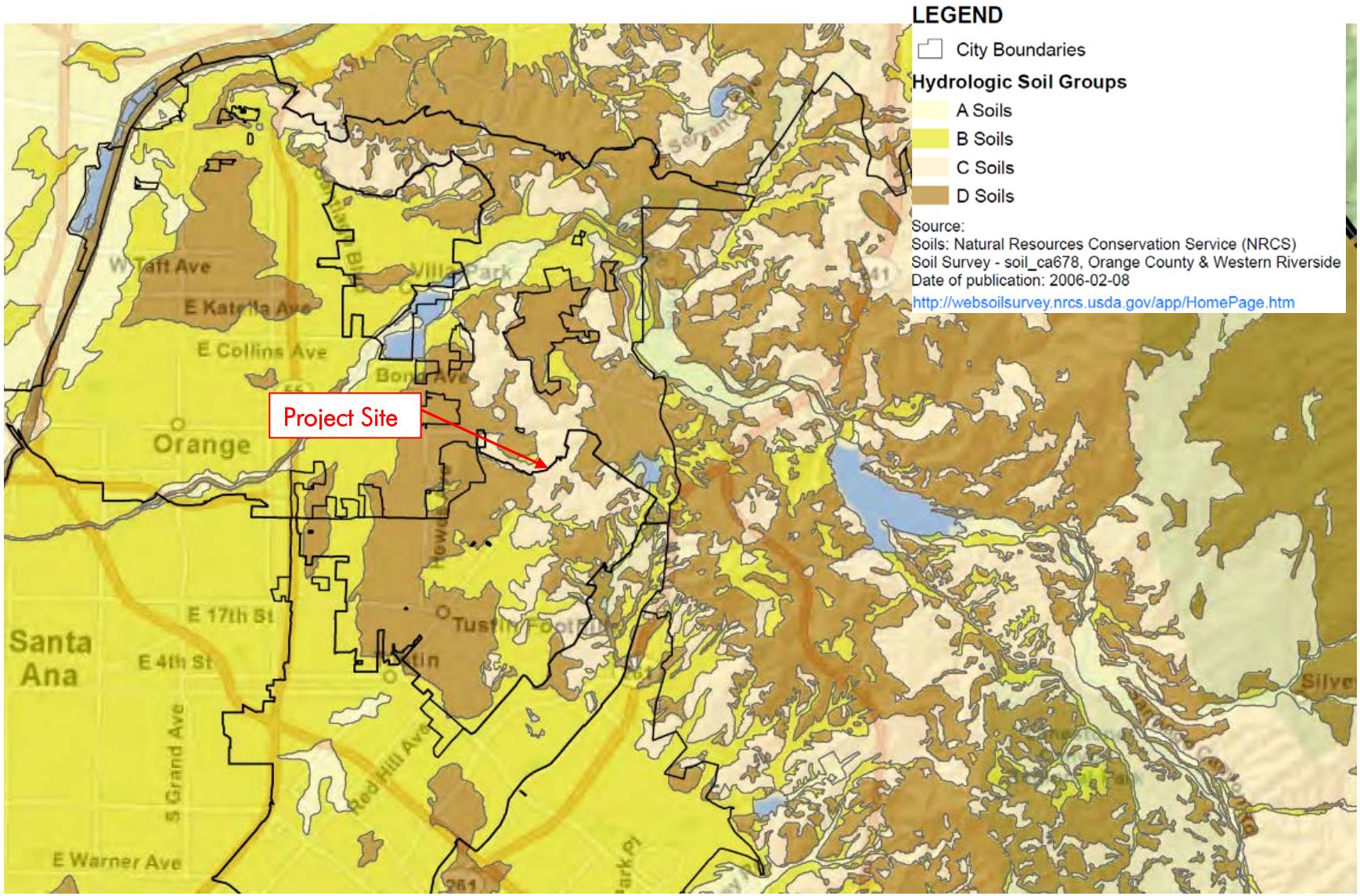
PLOTTED BY: Gary Guan DATE: Nov. 16, 2020 09:26:20 AM FILE: F:\1140\Engineering\SY_Hydrology\Crawford Park Proposed Hydrology – Onsite.dwg

Attachment D

Supporting Project Information



Source: County of Orange TGD – Figure XVI-1 Rainfall Zones



Source: County of Orange TGD – Figure XVI-2a NRCS Hydrologic Soils Group Map

Attachment E

Operation and Maintenance Plan

OPERATIONS AND MAINTENANCE (O&M) PLAN
WATER QUALITY MANAGEMENT PLAN
FOR
CRAWFORD CANYON PARK
COUNTY OF ORANGE, CALIFORNIA

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			
No	N1. Education for Property Owners, Tenants and Occupants Not applicable to public park project.		
Yes	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 County for facility users and maintenance staff. Restrictions include prohibited activities within park property that have the potential to impact water quality, such as illegal dumping of wastes, proper clean up and disposal of pet wastes, proper disposal of litter and trash, and prohibiting wash down of the park's paved areas.	Ongoing	OC Parks
Yes	N3. Common Area Landscape Management Maintenance shall be consistent with County requirements; any fertilizer and/or pesticide usages shall be consistent with County and manufacturer guidelines for use of fertilizers and pesticides. 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.	Monthly and as needed	OC Parks

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	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, as prescribed per WQMP.	OC Parks
No	N5. Title 22 CCR Compliance Not applicable to residential projects.		
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 Litter patrol, violations investigation, reporting and other litter control activities shall be performed in conjunction with landscape maintenance activities.	Ongoing patrols. Weekly (minimum) pick up and removal. Monthly inspections with landscaping maintenance.	OC Parks

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** All employees and any contractors will require training to ensure that employees are aware of maintenance activities that may result in pollutants reaching the storm drain. Training will include, but not limited to, spoil clean up procedures, proper waste disposal, housekeeping practices, etc.	Upon hire and annually thereafter	OC Parks
No	**N13. Housekeeping of Loading Docks** Not in project scope.		
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 facilities inspected and maintained within a 2-year period.	Annually	OC Parks
Yes	**N15. Street Sweeping Private Streets and Parking Lots** Project streets and parking areas shall be vacuum swept at a minimum, twice per month basis, consistent with County schedules.	Twice per month	OC Parks
Structural Source Control BMPs			
Yes	**S1. Provide Storm Drain System Stenciling 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-stenciled as soon as possible.	Annually	OC Parks

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	**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.		
Yes	**S4. Use Efficient Irrigation Systems and Landscape Design** 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	OC Parks
Yes	**S5. Protect Slopes and Channels** The project's landscaped slopes shall be inspected for adequate vegetation cover, vegetation health and signs of erosion. Dead or dying vegetation shall be replaced as needed. Signs of erosion and concentrated flow areas shall be noted and repaired as needed.	Monthly	OC Parks
No	**S6. Loading Dock Areas** None proposed		
No	**S7. Maintenance Bays and Docks** 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
No	S8. Vehicle Wash Areas Not applicable. None proposed.		
No	S9. Outdoor Processing Areas Not applicable. No outdoor processing onsite.		
No	S10. Equipment Wash Areas Not applicable. No wash areas onsite.		
No	S11. Fueling Areas Not applicable. No fueling areas onsite.		
Yes	S12. Site Design and Landscape Planning (Hillside Landscaping) Hillside areas that are disturbed by the project shall be re-vegetated with deep-rooted, drought tolerant plant species selected for erosion control and consistent with County requirements.	Monthly	OC Parks
No	S13. Wash Water Controls for Food Preparation Areas Not applicable. No food service facility proposed.		
No	S14. Community Car Wash Racks Not applicable. No community car wash areas onsite.		
Hydrologic Source Controls			
HSC BMP #1 HSC-2 Impervious Area Dispersion Inspect for standing water and that water infiltrates into underlying soil completely. Remove accumulated sediment or repair eroded areas as needed.		After qualifying storm events of 0.5" or greater and monthly with landscaping maintenance	OC Parks

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
HSC BMP #2	**INF-6 Permeable Pavement (Grasscrete)** Inspect for oil spills, dead vegetation, soil level within modules and stability. Remove/repairs as needed based on inspections. Trim vegetation as needed to maintain desired height.	Monthly with landscaping maintenance	OC Parks
Low Impact Development BMPs			
Infiltration BMP #1	INF-3 Bioretention with no underdrains Conduct general inspection and maintenance per routine landscaping maintenance activities. Inspect surface area for debris, trash and vegetation accumulation. Inspect for general plant health. Inspect for sediment, build up on planting surface and in area drain inlet. Inspect for sediment or debris clogging inlet. Clean/repair items as necessary. Inspect for standing water after rain event of 0.5 inches or greater, based on 48-hr draw down time. Remove vegetation, permeable soil and drain rock. Replace in kind. Check sub-drain pipe and inlet. Repair if necessary.	Monthly Every 5 to 7 years, or as needed	OC Parks
Biotreatment BMP #2	**BIO-7 Proprietary Biotreatment -** Inspect unit for accumulated debris and sediment and plant health; remove trash; trim vegetation. Remove sediment, replace mulch (if included), replace media as needed.	2-4 weeks during rainy season or after significant events. Frequency to be customized after 1-2 years observation.	OC Parks

Required Permits

No additional permits are necessary for the operation and maintenane of the proposed BMPs.

Forms to Record BMP Implementation, Maintenance, and Inspection

The form that will be used to record implementation, maintenance, and inspection of BMPs is attached.

Recordkeeping

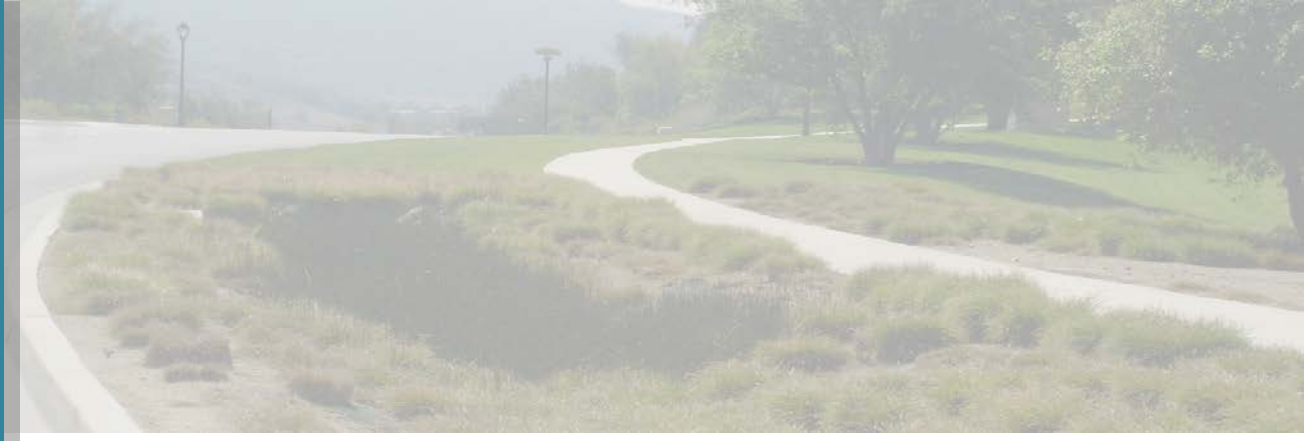
All records must be maintained for at least five (5) years and must be made available for review upon request.

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



W.O. 3644-10X