MOJAVE RIVER WATERSHED

Water Quality Management Plan

For:

FORMER TRACK 17486

PARCEL 1: APN 3134-021-05-0-000
PARCEL 2: APN 3134-021-02-0-000

Prepared for:

Bedford Opportunity Fund II, LLC

212 S. Palm Ave., Suite 200

Alhambra, CA, 91801

(626) 282-3100

Prepared by:

Ludwig Engineering Associates, Inc.

109 East Third Street

San Bernardino, CA, 82410

(909) 884-8217

Submittal Date: September 29, 2021

Revision No. and Date: Insert No and Current Revision Date

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Revision No. and Date: Insert No and Current Revision Date

Revision No. and Date: Insert No and Current Revision Date

Revision No. and Date: Insert No and Current Revision Date

Final Approval Date:______________________

Project Owner's Certification

This Mojave River Watershed Water Quality Management Plan (WQMP) has been prepared for R.Y. Properties by Ludwig Engineering, Associates, Inc. The WQMP is intended to comply with the requirements of the City of Victorville and the Phase II Small MS4 General Permit for the Mojave River Watershed. 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 Phase II Small MS4 Permit and the intent of San Bernardino County (unincorporated areas of Phelan, Oak Hills, Spring Valley Lake and Victorville) and the incorporated cities of Hesperia and Victorville and the Town of Apple Valley. Once the undersigned transfers its interest in the property, its successors in interest and the city/county/town shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

Project Data

Permit/Application Number(s):		Grading Permit Number(s):	
Tract/Parcel Map Number(s):	PARCEL 1: APN 3134-021-05-0-000 PARCEL 2: APN 3134-021-02-0-000	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			

Owner's Signature

Owner Name: Bedford Opportunity Fund II, LLC

Title			
Company	R.Y Properties		
Address	212 S. Palm Ave. Alhambra, CA, 91801		
Email			
Telephone #	(626) 2882-3100		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):		Grading Permit Number(s):	
Tract/Parcel Map Number(s):	PARCEL 1: APN 3134-021-05-0-000 PARCEL 2: APN 3134-021-02-0-000	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of the California State Water Resources Control Board Order No. 2013-0001-DWQ.

Engineer: Jeff Ashbaker		PE Stamp Below
Title	Lead Engineer	
Company	Ludwig Engineering, Associates, Inc.	
Address	109 East Third Street, San Bernardino, CA, 92410	
Email	jashbaker@ludwigeng.com	
Telephone #	(909) 884-8217	
Signature		
Date		

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1. Site Plan and Drainage Plan

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3. Post Construction

4. Other Supporting Documentation.

Section I – Introduction

This WQMP template has been prepared specifically for the Phase II Small MS4 General Permit in the Mojave River Watershed. This location is within the jurisdiction of the Lahontan Regional Water Quality Control Board (LRWQCB). This document should not be confused with the WQMP template for the Santa Ana Phase I area of San Bernardino County.

WQMP preparers must refer to the MS4 Permit for the Mojave Watershed WQMP template and Technical Guidance (TGD) document found at: http://cms.sbcounty.gov/dpw/Land/NPDES.aspx to find pertinent arid region and Mojave River Watershed specific references and requirements.

Section 1 Discretionary Permit(s)

Form 1-1 Project Information

Project Name	Former Tract 17486				
Project Owner Contact Name:	Bedford Opportunity Fund II, LLC				
Mailing Address:	212 S. Palm Ave. Alhambra, CA, 91801	E-mail Address:		Telephone:	(626) 2882-3100
Permit/Application Number(s):		Tract/Parcel Map Number(s):	PARCEL 1: APN 3134-021-05-0-000 PARCEL 2: APN 3134-021-02-0-000		
Additional Information/ Comments:	The entire tract will be draining to two water quality basins to store the 2yr-24hr storm event, and mitigate the difference between the Pre and the Post 100yr volume runoff.				
Description of Project:	The Property is currently vacant and not in use. The project is bounded on the north by Tract no. 17090, on the East by Mesa View Drive, on the South by vacant land APN-313403102 and APN-31340310, and on the West by Vacant land APN-313402101 to APN-313402104. Proposed land use is Residential (R-1) development.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	Project requires WQMP due to a new development containing more than 5,000 sqaure feet of impervious surfaces.				

Section 2 Project Description

2.1 Project Information

The WQMP shall provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

2.1.1 Project Sizing Categorization

If the Project is greater than 5,000 square feet, and not on the excluded list as found on Section 1.4 of the TGD, the Project is a Regulated Development Project.

If the Project is creating and/or replacing greater than 2,500 square feet but less than 5,000 square feet of impervious surface area, then it is considered a Site Design Only project. This criterion is applicable to all development types including detached single family homes that create and/or replace greater than 2,500 square feet of impervious area and are not part of a larger plan of development.

Form 2.1-1 Description of Proposed Project

<table>
<tr><td colspan="6">1 Regulated Development Project Category (Select all that apply):</td></tr>
<tr><td colspan="2">☒ #1 New development involving the creation of 5,000 ft^2 or more of impervious surface collectively over entire site</td><td colspan="2">☐ #2 Significant re-development involving the addition or replacement of 5,000 ft^2 or more of impervious surface on an already developed site</td><td>☐ #3 Road Project – any road, sidewalk, or bicycle lane project that creates greater than 5,000 square feet of contiguous impervious surface</td><td>☐ #4 LUPs – linear underground/overhead projects that has a discrete location with 5,000 sq. ft. or more new constructed impervious surface</td></tr>
<tr><td colspan="6">☐ Site Design Only (Project Total Square Feet > 2,500 but < 5,000 sq.ft.) Will require source control Site Design Measures. Use the “PCMP” Template. Do not use this WQMP Template.</td></tr>
<tr><td>2 Project Area (ft2):</td><td>1,090,963</td><td>3 Number of Dwelling Units:</td><td>110</td><td>4 SIC Code:</td><td>1521</td></tr>
<tr><td colspan="6">5 Is Project going to be phased? Yes ☐ No ☒ If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.</td></tr>
</table>

2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

Form 2.2-1 Property Ownership/Management

Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:

Owner (listed below) will be soley responsible for all BMP's Operation & Maintenance as specified in Section 5 of this report. Each individual homeowner will be responsible for management and maintenance of down-spouts, drainage swales, and all storm drain features within their property.

Bedford Opportunity Fund II, LLC
Contact:
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Alhambra, CA, 91801

Phone: (626) 282-3100

No stormwater infrastructure onsite is to be transferred to the City of Victorville.

2.3 Potential Stormwater Pollutants

Best Management Practices (BMP) measures for pollutant generating activities and sources shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment (or an equivalent manual). Pollutant generating activities must be considered when determining the overall pollutants of concern for the Project as presented in Form 2.3-1.

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-2 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern

Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	Sources include animal waste.
Nutrients - Phosphorous	E ☒	N ☐	Sources from urban runoff include fertilizers and eroded soils.
Nutrients - Nitrogen	E ☒	N ☐	Sources from urban runoff include fertilizers and eroded soils.
Noxious Aquatic Plants	E ☒	N ☐	Sources from urban runoff include fertilizers and eroded soils.
Sediment	E ☒	N ☐	Sources include eroded soils.
Metals	E ☐	N ☒	Not applicable.
Oil and Grease	E ☒	N ☐	Sources include petroleum hydrocarbon products, motor products from leaking vechicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.
Trash/Debris	E ☒	N ☐	Sources include paper, plastic, polystyrene packing foam, and aluminum materials.
Pesticides / Herbicides	E ☒	N ☐	Sources include fertizers and pest sprays
Organic Compounds	E ☒	N ☐	Sources include solvents and cleaning compounds.
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

Section 3 Site and Watershed Description

Describe the project site conditions that will facilitate the selection of BMPs through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed Drainage Management Areas (DMAs)) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site. ***If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet. A map presenting the DMAs must be included as an appendix to the WQMP document.***

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34°28'46.2"N	Longitude 117°24'37.9"W	Thomas Bros Map page

1 San Bernardino County climatic region: ☒ Desert

2 Does the site have more than one drainage area (DA): Yes☒ No☐ *If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached*

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 DMA C flows to DA1 DMA A	*Ex. Bioretention overflow to vegetated bioswale with 4' bottom width, 5:1 side slopes and bed slope of 0.01. Conveys runoff for 1000' through DMA 1 to existing catch basin on SE corner of property*
DA1 DMA A to Outlet 1	DA 1 DMA A flows to Infiltration basin in Lot B which overflows to Channel
DA1 DMA B to Outlet 1	DA 1 DMA B flows to infiltration trench which which overflows to Channel
DA2 to Outlet 2	DA 2 flows to Infiltration Basin in Lot C which overflows to Nyack Road

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft^2)	277,726			
2 Existing site impervious area (ft^2)	0			
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	2			
4 Hydrologic soil group *Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf*	A			
5 Longest flowpath length (ft)	990.9			
6 Longest flowpath slope (ft/ft)	0.012			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Undeveloped Fair			
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50%* ***Attach photos of site to support rating***	Fair			

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 2

For Drainage Area 2's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft²)	516,493			
2 Existing site impervious area (ft²)	0			
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	2			
4 Hydrologic soil group *Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf*	A			
5 Longest flowpath length (ft)	1050.1			
6 Longest flowpath slope (ft/ft)	0.013			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Undeveloped Fair			
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50%* ***Attach photos of site to support rating***	Fair			

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 3

For Drainage Area 3's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft²)	522,239			
2 Existing site impervious area (ft²)	0			
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	2			
4 Hydrologic soil group *Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf*	A			
5 Longest flowpath length (ft)	1016.3			
6 Longest flowpath slope (ft/ft)	0.015			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Undeveloped Fair			
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50%* ***Attach photos of site to support rating***	Fair			

Form 3-3 Watershed Description for Drainage Area	
Receiving waters Refer to SWRCB site: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	Mohave River (Upper Narrows to Lower Narrows to Below Lower Narrows)
Applicable TMDLs *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	Boron, Chloride, Dissolved Oxygen, Fluoride, MTBE, Nitrate, Nitrite, Phosphate, Phosphorous, Sulfates, Total Dissolved Solids
303(d) listed impairments *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	Fluoride, Sulfates, Total Dissolved Solids
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	Desert Tortoise habitat cat 2, Mojave Ground Squirrel
Hydromodification Assessment	☒ Yes *Complete Hydromodification Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-9 in submittal* ☐ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMPs and Site Design BMP Measures

The information and data in this section are required for both Regulated Development and Site Design Only Projects. Source Control BMPs and Site Design BMP Measures are the basis of site-specific pollution management.

4.1.1 Source Control BMPs

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

The identified list of source control BMPs correspond to the CASQA Stormwater BMP Handbook for New Development and Redevelopment.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	Project conditions of approval will require that the POA periodically provide environmental awareness education materials, made available by the municiapalities, to all members. Among other things, these materials will describe the use of chemicals (including household type) that shoukd be limeted to the property, with the discharge of wastes via hosing or other direct discharge to gutters, catch basins and storm drains. Educational materials available from the San Bernadino Stormwater Program and can be downloaded at: http://www.sbcountystormwater.org/gov_out.html
N2	Activity Restrictions	☒	☐	Owner shall control the discharge of the stormwater pollutants from this site through activity restrictions. Activities are to be limited to those allowed by the County of San Bernardino codes, regulations, and zoning ordinances.
N3	Landscape Management BMPs	☒	☐	Landscape plans will be consistent with the County of San Bernadino requirments for water conservation vegetation and drought tolerant vegetation will be utilized. The irrigation system will be inspected on a monthly basis for erosion and sediment buildup.
N4	BMP Maintenance	☒	☐	Maintenance of BMPs implemeneted at the project shall be performed at the frequency prescribed in this WQMP Form 5-1. Records of inspections and maintenance shall be maintained by the Owner and documented with the WQMP, and shall be available fro review upon request.
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous materials to be allowed for this projec
N6	Local Water Quality Ordinances	☐	☒	No Ordinances apply
N7	Spill Contingency Plan	☐	☒	Does not apply to this land use.
N8	Underground Storage Tank Compliance	☐	☒	Project does not feature underground storage tanks

Form 4.1-1 Non-Structural Source Control BMPs

N9	Hazardous Materials Disclosure Compliance	☐	☒	This project does not feature hazardous materials

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☐	☒	Does not apply to this land use.
N11	Litter/Debris Control Program	☒	☐	Property owner will implement a litter control program for common areas. Private waste receptacles will be place at the curb collection per local waste collection service provider.
N12	Employee Training	☒	☐	Employee training and education will be the responisbility of the owner
N13	Housekeeping of Loading Docks	☐	☒	This project does not feature loading docks.
N14	Catch Basin Inspection Program	☒	☐	Catch basin maintenance will be included in the Maintenance Covenant. Catch basins will be inspected visually on a monthly basis. The storm drain system will be inspected and cleaned prior to the start of the rainy season.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Private streets will be vacuum swept as waste accumulates as well as at least once prior to the start of the rainy season.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not a public agency project
N17	Comply with all other applicable NPDES permits	☐	☒	No other NPDES permits applicable to this project.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	Storm drain system stencilly and signage will be in conformance with SD-13
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	Project does not include outdoor material storage areas
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Public trash enclosures will be covered by lids and located away from storm drains in conformance with SD-32. Individual homeowners will be provided educational material for their private waste receptacles.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	Irrigation will be in conformance with SD-12. Irrigation system will be inspected and adjusted to prevent over watering.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	1" will be provided between top of curb/sidewalk and finish grade in landscape areas
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☐	☒	SIte contains no slopes or channels
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	Project does not include Dock Areas
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	Project does not include maintenace bays
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Project does not include vehicle wash arease
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	Project does not include outdoor processing areas

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Project does not include equipment wash areas
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	Project does not include fueling areas
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	Project does not include hillside landscaping
S14	Wash water control for food preparation areas	☐	☒	Project does not include food preparation areas
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	Project does not include community car wash racks

4.1.2 Site Design BMPs

As part of the planning phase of a project, the site design practices associated with new LID requirements in the Phase II Small MS4 Permit must be considered. Site design BMP measures can result in smaller Design Capture Volume (DCV) to be managed by both LID and hydromodification control BMPs by reducing runoff generation.

As is stated in the Permit, it is necessary to evaluate site conditions such as soil type(s), existing vegetation and flow paths will influence the overall site design.

Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Site Design Practices Checklist

Site Design Practices
If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets

Minimize impervious areas: Yes ☒ No ☐
Explanation: A large amount of permeable landscaping is included in the site design

Maximize natural infiltration capacity; Including improvement and maintenance of soil: ☒ No ☐
Yes Explanation: The site is proposing infiltration BMPs.

Preserve existing drainage patterns and time of concentration: Yes ☐ No ☒
Explanation: Site will be completely regraded to suit project purposes

Disconnect impervious areas. Including rerouting of rooftop drainage pipes to drain stormwater to storage or infiltration BMPs instead of to storm drain : Yes ☐ No ☒
Explanation: Impervious areas consist primarily of streets and sidewalks

Use of Porous Pavement.: Yes ☐ No ☒
Explanation: Porous pavements will not be utilized

Protect existing vegetation and sensitive areas: Yes ☐ No ☒
Explanation: Existing vegetation will be removed during grading operations

Re-vegetate disturbed areas. Including planting and preservation of drought tolerant vegetation. : Yes ☒ No ☐
Explanation: Some areas will be re-vegetated using drought tolerant plants

Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐
Explanation: Over-compaction will be avoided in inflitration areas

Utilize naturalized/rock-lined drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒
Explanation: Project does not include rock-lined drainage swales. Most runoff is carried by streets to infiltation area

Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐
Explanation: Over-compaction will be avoided in landscaped areas

Use of Rain Barrels and Cisterns, Including the use of on-site water collection systems.: Yes ☐ No ☒
Explanation: No provisions for rain barrels are made on a project-wide basis. Owner may implement at their discretion

Stream Setbacks. Includes a specified distance from an adjacent steam: : Yes ☐ No ☒
Explanation: Stream setbacks do not apply to this projet

It is noted that, in the Phase II Small MS4 Permit, site design elements for green roofs and vegetative swales are required. Due to the local climatology in the Mojave River Watershed, proactive measures are taken to maximize the amount of drought tolerant vegetation. It is not practical in this region to have green roofs or vegetative swales. As part of site design the project proponent should utilize locally recommended vegetation types for landscaping. Typical landscaping recommendations are found in following local references:

San Bernardino County Special Districts:

Guide to High Desert Landscaping -
http://www.specialdistricts.org/Modules/ShowDocument.aspx?documentid=795

Recommended High-Desert Plants -
http://www.specialdistricts.org/modules/showdocument.aspx?documentid=553

Mojave Water Agency:

Desert Ranch: http://www.mojavewater.org/files/desertranchgardenprototype.pdf

Summertree: http://www.mojavewater.org/files/Summertree-Native-Plant-Brochure.pdf

Thornless Garden: http://www.mojavewater.org/files/thornlessgardenprototype.pdf

Mediterranean Garden: http://www.mojavewater.org/files/mediterraneangardenprototype.pdf

Lush and Efficient Garden: http://www.mojavewater.org/files/lushandefficientgardenprototype.pdf

Alliance for Water Awareness and Conservation (AWAC) outdoor tips – http://hdawac.org/save-outdoors.html

4.2 Treatment BMPs

After implementation and design of both Source Control BMPs and Site Design BMP measures, any remaining runoff from impervious DMAs must be directed to one or more on-site, treatment BMPs (LID or biotreatment) designed to infiltrate, evaportranspire, and/or bioretain the amount of runoff specified in Permit Section E.12.e (ii)(c) Numeric Sizing Criteria for Storm Water Retention and Treatment.

4.2.1 Project Specific Hydrology Characterization

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in Section E.12.e.ii.c and Section E.12.f of the Phase II Small MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection from hydromodification.

If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.

It is noted that in the Phase II Small MS4 Permit jurisdictions, the LID BMP Design Capture Volume criteria is based on the 2-year rain event. The hydromodification performance criterion is based on the 10-year rain event.

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), San Bernardino County requires use of the P_6 method (Form 4.2-1) For pre- and post-development hydrologic calculation, San Bernardino County requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for hydromodification performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)

1 Project area DA 1 (ft^2): 558,406	2 Imperviousness after applying preventative site design practices (Imp%): 58.0	3 Runoff Coefficient (Rc): _0.394 *$R_c = 0.858(Imp\%)^{\wedge3}-0.78(Imp\%)^{\wedge2}+0.774(Imp\%)+0.04$*

4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.399 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

5 Compute P_6, Mean 6-hr Precipitation (inches): 0.49

*P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Desert = 1.2371)*

6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*	24-hrs ☐ 48-hrs ☒

7 Compute design capture volume, DCV (ft^3): 17,775

*DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)*
Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2

SEE ATTACHED RATIONAL METHOD AND UNIT HYDROGRAPHS

Form 4.2-2 Summary of Hydromodification Assessment (DA 1)

Is the change in post- and pre- condition flows captured on-site? : Yes ☒ No ☐

If "Yes", then complete Hydromodification assessment of site hydrology for 10yr storm event using Forms 4.2-3 through 4.2-5 and insert results below *(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual- Addendum 1)*

If "No," then proceed to Section 4.3 BMP Selection and Sizing

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	1 23,082 *Form 4.2-3 Item 12*	2 28.22 *Form 4.2-4 Item 13*	3 9.83 *Form 4.2-5 Item 10*
Post-developed	4 53,884 *Form 4.2-3 Item 13*	5 12.45 *Form 4.2-* *4 Item 14*	6 16.76 *Form 4.2-* *5 Item 14*
Difference	*30,802* *Item 4 – Item 1*	8 *15.77* *Item 2 – Item 5*	9 *6.93* *Item 6 – Item 3*
Difference (as % of pre-developed)	10 *133%* *Item 7 / Item 1*	11 *56%* *Item 8 / Item 2*	12 *70%* *Item 9 / Item 3*

Form 4.2-3 Hydromodification Assessment for Runoff Volume (DA 1)

Weighted Curve Number Determination for: Pre-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								

5 Pre-Developed area-weighted CN:	**7** Pre-developed soil storage capacity, S (in): *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): I_a *= 0.2 * Item 7*
6 Post-Developed area-weighted CN:	**8** Post-developed soil storage capacity, S (in): *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): I_a *= 0.2 * Item 8*

11 Precipitation for 10 yr, 24 hr storm (in):
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3):
V_{pre} *=(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft^3):
V_{pre} *=(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

14 Volume Reduction needed to meet hydromodification requirement, (ft^3):
*Vhydro = (Item 13 * 0.95) – Item 12*

Form 4.2-4 Hydromodification Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA *(For projects using the Hydrology Manual complete the form below)*

Variables	Pre-developed DA1 *Use additional forms if there are more than 4 DMA*				Post-developed DA1 *Use additional forms if there are more than 4 DMA*			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*								
2 Change in elevation (ft)								
3 Slope (ft/ft), S_o *= Item 2 / Item 1*								
4 Land cover								
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*								
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*								
7 Cross-sectional area of channel (ft^2)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) $V_{fps} = (1.49 / \text{Item } 9) * (\text{Item } 7/\text{Item } 8)^{\wedge 0.67} * (\text{Item } 3)^{\wedge 0.5}$								
11 Travel time to outlet (min) $T_t = \text{Item } 6 / (\text{Item } 10 * 60)$								
12 Total time of concentration (min) $T_c = \text{Item } 5 + \text{Item } 11$								

13 Pre-developed time of concentration (min): *Minimum of Item 12 pre-developed DMA*

14 Post-developed time of concentration (min): *Minimum of Item 12 post-developed DMA*

15 Additional time of concentration needed to meet hydromodification requirement (min): $T_{C\text{-}Hydro} = (\text{Item } 13 * 0.95) – \text{Item } 14$

Form 4.2-5 Hydromodification Assessment for Peak Runoff (DA 1)

Compute peak runoff for pre- and post-developed conditions

Variables		Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.7 LOG Form 4.2-4 Item 5 /60)*							
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*							
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*							
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	*n/a*			*n/a*		
	DMA B		*n/a*			*n/a*	
	DMA C			*n/a*			*n/a*

8 Pre-developed Q_p at T_c for DMA A:

*Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*

9 Pre-developed Q_p at T_c for DMA B:

*Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*

10 Pre-developed Q_p at T_c for DMA C:

*Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*

10 Peak runoff from pre-developed condition confluence analysis (cfs): *Maximum of Item 8, 9, and 10 (including additional forms as needed)*

11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*

12 Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*

13 Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*

14 Peak runoff from post-developed condition confluence analysis (cfs): *Maximum of Item 11, 12, and 13 (including additional forms as needed)*

15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs): $Q_{p-hydro}$ = *(Item 14 * 0.95) – Item 10*

RATIONAL METHOD &

UNIT HYDROGRAPH HYDROLOGY

ONSITE POST-DEVELOPED

2-YEAR & 10-YEAR

STORM EVENTS

DRAINAGE AREA 1

```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
        Rational Hydrology Study        Date: 08/16/21
------------------------------------------------------------------------
2 Year Rational Analysis Post Development
Former Track 17486
Drainage Area 1
File: 17486Rat2PostA1.out
------------------------------------------------------------------------


Program License Serial Number 4070

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is     2.0
Computed rainfall intensity:
Storm year =     2.00   1 hour rainfall =     0.399 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 3



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       4.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.393(In/Hr)
Initial subarea data:
Initial area flow distance =   997.200(Ft.)
Top (of initial area) elevation =  3291.300(Ft.)
Bottom (of initial area) elevation =  3281.000(Ft.)
Difference in elevation =    10.300(Ft.)
Slope =    0.01033  s(%)=       1.03
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.369 min.
Rainfall intensity =      1.035(In/Hr) for a     2.0 year storm
```

```
Effective runoff coefficient used for area (Q=KCIA) is C = 0.559
Subarea runoff =      4.928(CFS)
Total initial stream area =        8.520(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.393(In/Hr)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        4.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      8.520(Ac.)
Runoff from this stream =      4.928(CFS)
Time of concentration =   15.37 min.
Rainfall intensity =     1.035(In/Hr)
Area averaged loss rate (Fm) =    0.3926(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        4.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.393(In/Hr)
Initial subarea data:
Initial area flow distance =   413.100(Ft.)
Top (of initial area) elevation =  3283.100(Ft.)
Bottom (of initial area) elevation =  3281.000(Ft.)
Difference in elevation =     2.100(Ft.)
Slope =    0.00508  s(%)=       0.51
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.449 min.
Rainfall intensity =      1.200(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.606
Subarea runoff =      2.012(CFS)
Total initial stream area =        2.770(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.393(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        4.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.770(Ac.)
Runoff from this stream =      2.012(CFS)
Time of concentration =   12.45 min.
Rainfall intensity =     1.200(In/Hr)
Area averaged loss rate (Fm) =    0.3926(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000
```

↑

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.393(In/Hr)
Initial subarea data:
Initial area flow distance =   794.100(Ft.)
Top (of initial area) elevation =  3283.100(Ft.)
Bottom (of initial area) elevation =  3277.200(Ft.)
Difference in elevation =     5.900(Ft.)
Slope =    0.00743  s(%)=       0.74
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.987 min.
Rainfall intensity =      1.054(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.565
Subarea runoff =      0.910(CFS)
Total initial stream area =       1.530(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.393(In/Hr)
```

↑

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      1.530(Ac.)
```

```
Runoff from this stream =      0.910(CFS)
Time of concentration =   14.99 min.
Rainfall intensity =     1.054(In/Hr)
Area averaged loss rate (Fm) =    0.3926(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1      4.93     8.520     15.37    0.393      1.035
2      2.01     2.770     12.45    0.393      1.200
3      0.91     1.530     14.99    0.393      1.054
Qmax(1) =
           1.000 *    1.000 *     4.928) +
           0.796 *    1.000 *     2.012) +
           0.972 *    1.000 *     0.910) + =       7.415
Qmax(2) =
           1.256 *    0.810 *     4.928) +
           1.000 *    1.000 *     2.012) +
           1.221 *    0.831 *     0.910) + =       7.949
Qmax(3) =
           1.029 *    0.975 *     4.928) +
           0.819 *    1.000 *     2.012) +
           1.000 *    1.000 *     0.910) + =       7.501

Total of 3 streams to confluence:
Flow rates before confluence point:
       4.928       2.012       0.910
Maximum flow rates at confluence using above data:
        7.415        7.949        7.501
Area of streams before confluence:
        8.520        2.770        1.530
Effective area values after confluence:
       12.820       10.942       12.608
Results of confluence:
Total flow rate =      7.949(CFS)
Time of concentration =    12.449 min.
Effective stream area after confluence =     10.942(Ac.)
Study area average Pervious fraction(Ap) =  0.500
Study area average soil loss rate(Fm) =    0.393(In/Hr)
Study area total (this main stream) =      12.82(Ac.)
End of computations, Total Study Area =           12.82 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.500
```

```
Area averaged SCS curve number =  32.0
```

```
        U n i t   H y d r o g r a p h   A n a l y s i s

        Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

                Study date  08/13/21


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
------------------------------------------------------------------------

San Bernardino County Synthetic Unit Hydrology Method
                Manual date - August 1986


Program License Serial Number 4070

---------------------------------------------------------------------
2 Year Unit Hydrograph Post Development
Former Track 17486
Drainage Area 1
File: 17486Hydr2PostA1.out
--------------------------------------------------------------------

        Storm Event Year = 2

        Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




Area averaged rainfall intensity isohyetal data:
        Sub-Area        Duration        Isohyetal
        (Ac.)            (hours)         (In)
Rainfall data for year 2
            12.82            1           0.40
--------------------------------------------------------------------
Rainfall data for year 2
            12.82            6           0.89
--------------------------------------------------------------------
Rainfall data for year 2
            12.82           24           1.64
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
******** Area-averaged max loss rate, Fm ********


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 32.0      52.0         12.82      1.000     0.785    0.420    0.330

Area-averaged adjusted loss rate Fm (In/Hr) =  0.330

********* Area-Averaged low loss rate fraction, Yb **********

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
     5.38   0.420         32.0      52.0       8.20     0.000
     7.44   0.580         98.0      98.0       0.20     0.865

Area-averaged catchment yield fraction, Y =  0.502
Area-averaged low loss fraction, Yb =  0.498
User entry of time of concentration  =   0.207 (hours)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =      12.82(Ac.)
Catchment Lag time =   0.166 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 50.2008
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.330(In/Hr)
Average low loss rate fraction (Yb) = 0.498 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall =  0.189(In)
Computed peak 30-minute rainfall =  0.324(In)
Specified peak 1-hour rainfall =  0.399(In)
Computed peak 3-hour rainfall =  0.650(In)
Specified peak 6-hour rainfall =  0.885(In)
Specified peak 24-hour rainfall =  1.640(In)


Rainfall depth area reduction factors:
Using a total area of      12.82(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999     Adjusted rainfall =  0.189(In)
30-minute factor = 0.999    Adjusted rainfall =  0.324(In)
1-hour factor = 0.999       Adjusted rainfall =  0.399(In)
3-hour factor = 1.000       Adjusted rainfall =  0.650(In)
6-hour factor = 1.000       Adjusted rainfall =  0.885(In)
24-hour factor = 1.000      Adjusted rainfall =  1.640(In)
---------------------------------------------------------------------

                        U n i t  H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
Interval          'S' Graph          Unit Hydrograph
Number            Mean values             ((CFS))
---------------------------------------------------------------------
                (K =       155.04 (CFS))

  1                3.989                    6.184
  2               30.749                   41.489
  3               60.742                   46.502
  4               73.911                   20.417
  5               81.558                   11.856
  6               86.696                    7.967
  7               90.250                    5.510
  8               92.844                    4.021
  9               94.808                    3.045
 10               96.299                    2.312
 11               97.388                    1.687
 12               98.073                    1.063
 13               98.630                    0.863
 14               99.232                    0.933
 15               99.674                    0.686
 16              100.000                    0.505
---------------------------------------------------------------------
Peak Unit   Adjusted mass rainfall  Unit rainfall
Number              (In)                (In)
  1              0.1892               0.1892
  2              0.2330               0.0437
  3              0.2631               0.0301
  4              0.2868               0.0237
  5              0.3067               0.0199
  6              0.3239               0.0172
  7              0.3392               0.0153
  8              0.3531               0.0139
  9              0.3658               0.0127
 10              0.3775               0.0117
 11              0.3885               0.0110
 12              0.3988               0.0103
 13              0.4132               0.0145
 14              0.4271               0.0139
 15              0.4404               0.0133
 16              0.4532               0.0128
 17              0.4656               0.0124
 18              0.4776               0.0120
 19              0.4893               0.0116
 20              0.5006               0.0113
 21              0.5115               0.0110
 22              0.5222               0.0107
 23              0.5327               0.0104
 24              0.5429               0.0102
 25              0.5528               0.0100
 26              0.5626               0.0097
```

27	0.5721	0.0095
28	0.5814	0.0093
29	0.5906	0.0092
30	0.5996	0.0090
31	0.6084	0.0088
32	0.6170	0.0087
33	0.6255	0.0085
34	0.6339	0.0084
35	0.6421	0.0082
36	0.6502	0.0081
37	0.6582	0.0080
38	0.6661	0.0079
39	0.6738	0.0077
40	0.6814	0.0076
41	0.6889	0.0075
42	0.6964	0.0074
43	0.7037	0.0073
44	0.7109	0.0072
45	0.7181	0.0071
46	0.7251	0.0071
47	0.7321	0.0070
48	0.7390	0.0069
49	0.7458	0.0068
50	0.7525	0.0067
51	0.7592	0.0067
52	0.7657	0.0066
53	0.7723	0.0065
54	0.7787	0.0064
55	0.7851	0.0064
56	0.7914	0.0063
57	0.7976	0.0063
58	0.8038	0.0062
59	0.8100	0.0061
60	0.8161	0.0061
61	0.8221	0.0060
62	0.8280	0.0060
63	0.8339	0.0059
64	0.8398	0.0059
65	0.8456	0.0058
66	0.8514	0.0058
67	0.8571	0.0057
68	0.8628	0.0057
69	0.8684	0.0056
70	0.8739	0.0056
71	0.8795	0.0055
72	0.8850	0.0055
73	0.8904	0.0054
74	0.8958	0.0054
75	0.9012	0.0054
76	0.9065	0.0053

77	0.9118	0.0053
78	0.9171	0.0053
79	0.9223	0.0052
80	0.9274	0.0052
81	0.9326	0.0051
82	0.9377	0.0051
83	0.9428	0.0051
84	0.9478	0.0050
85	0.9528	0.0050
86	0.9578	0.0050
87	0.9627	0.0049
88	0.9676	0.0049
89	0.9725	0.0049
90	0.9773	0.0048
91	0.9822	0.0048
92	0.9870	0.0048
93	0.9917	0.0048
94	0.9964	0.0047
95	1.0011	0.0047
96	1.0058	0.0047
97	1.0105	0.0046
98	1.0151	0.0046
99	1.0197	0.0046
100	1.0243	0.0046
101	1.0288	0.0045
102	1.0333	0.0045
103	1.0378	0.0045
104	1.0423	0.0045
105	1.0467	0.0044
106	1.0512	0.0044
107	1.0556	0.0044
108	1.0599	0.0044
109	1.0643	0.0044
110	1.0686	0.0043
111	1.0730	0.0043
112	1.0772	0.0043
113	1.0815	0.0043
114	1.0858	0.0042
115	1.0900	0.0042
116	1.0942	0.0042
117	1.0984	0.0042
118	1.1026	0.0042
119	1.1067	0.0041
120	1.1108	0.0041
121	1.1149	0.0041
122	1.1190	0.0041
123	1.1231	0.0041
124	1.1272	0.0041
125	1.1312	0.0040
126	1.1352	0.0040

127	1.1392	0.0040
128	1.1432	0.0040
129	1.1472	0.0040
130	1.1511	0.0039
131	1.1550	0.0039
132	1.1590	0.0039
133	1.1629	0.0039
134	1.1667	0.0039
135	1.1706	0.0039
136	1.1745	0.0039
137	1.1783	0.0038
138	1.1821	0.0038
139	1.1859	0.0038
140	1.1897	0.0038
141	1.1935	0.0038
142	1.1972	0.0038
143	1.2010	0.0037
144	1.2047	0.0037
145	1.2084	0.0037
146	1.2121	0.0037
147	1.2158	0.0037
148	1.2195	0.0037
149	1.2231	0.0037
150	1.2268	0.0036
151	1.2304	0.0036
152	1.2340	0.0036
153	1.2376	0.0036
154	1.2412	0.0036
155	1.2448	0.0036
156	1.2484	0.0036
157	1.2519	0.0036
158	1.2555	0.0035
159	1.2590	0.0035
160	1.2625	0.0035
161	1.2660	0.0035
162	1.2695	0.0035
163	1.2730	0.0035
164	1.2765	0.0035
165	1.2799	0.0035
166	1.2834	0.0034
167	1.2868	0.0034
168	1.2902	0.0034
169	1.2937	0.0034
170	1.2971	0.0034
171	1.3004	0.0034
172	1.3038	0.0034
173	1.3072	0.0034
174	1.3106	0.0034
175	1.3139	0.0033
176	1.3172	0.0033

177	1.3206	0.0033
178	1.3239	0.0033
179	1.3272	0.0033
180	1.3305	0.0033
181	1.3338	0.0033
182	1.3370	0.0033
183	1.3403	0.0033
184	1.3435	0.0033
185	1.3468	0.0032
186	1.3500	0.0032
187	1.3533	0.0032
188	1.3565	0.0032
189	1.3597	0.0032
190	1.3629	0.0032
191	1.3661	0.0032
192	1.3692	0.0032
193	1.3724	0.0032
194	1.3756	0.0032
195	1.3787	0.0032
196	1.3819	0.0031
197	1.3850	0.0031
198	1.3881	0.0031
199	1.3912	0.0031
200	1.3943	0.0031
201	1.3974	0.0031
202	1.4005	0.0031
203	1.4036	0.0031
204	1.4067	0.0031
205	1.4097	0.0031
206	1.4128	0.0031
207	1.4158	0.0030
208	1.4189	0.0030
209	1.4219	0.0030
210	1.4249	0.0030
211	1.4280	0.0030
212	1.4310	0.0030
213	1.4340	0.0030
214	1.4370	0.0030
215	1.4399	0.0030
216	1.4429	0.0030
217	1.4459	0.0030
218	1.4488	0.0030
219	1.4518	0.0030
220	1.4547	0.0029
221	1.4577	0.0029
222	1.4606	0.0029
223	1.4635	0.0029
224	1.4665	0.0029
225	1.4694	0.0029
226	1.4723	0.0029

227	1.4752	0.0029
228	1.4781	0.0029
229	1.4809	0.0029
230	1.4838	0.0029
231	1.4867	0.0029
232	1.4895	0.0029
233	1.4924	0.0029
234	1.4952	0.0028
235	1.4981	0.0028
236	1.5009	0.0028
237	1.5037	0.0028
238	1.5066	0.0028
239	1.5094	0.0028
240	1.5122	0.0028
241	1.5150	0.0028
242	1.5178	0.0028
243	1.5206	0.0028
244	1.5233	0.0028
245	1.5261	0.0028
246	1.5289	0.0028
247	1.5316	0.0028
248	1.5344	0.0028
249	1.5372	0.0028
250	1.5399	0.0027
251	1.5426	0.0027
252	1.5454	0.0027
253	1.5481	0.0027
254	1.5508	0.0027
255	1.5535	0.0027
256	1.5562	0.0027
257	1.5589	0.0027
258	1.5616	0.0027
259	1.5643	0.0027
260	1.5670	0.0027
261	1.5697	0.0027
262	1.5724	0.0027
263	1.5750	0.0027
264	1.5777	0.0027
265	1.5803	0.0027
266	1.5830	0.0027
267	1.5856	0.0026
268	1.5883	0.0026
269	1.5909	0.0026
270	1.5935	0.0026
271	1.5962	0.0026
272	1.5988	0.0026
273	1.6014	0.0026
274	1.6040	0.0026
275	1.6066	0.0026
276	1.6092	0.0026

```
277                1.6118               0.0026
278                1.6144               0.0026
279                1.6170               0.0026
280                1.6195               0.0026
281                1.6221               0.0026
282                1.6247               0.0026
283                1.6272               0.0026
284                1.6298               0.0026
285                1.6323               0.0026
286                1.6349               0.0025
287                1.6374               0.0025
288                1.6400               0.0025
----------------------------------------------------------------------
Unit                Unit            Unit                Effective
Period              Rainfall        Soil-Loss           Rainfall
(number)              (In)          (In)                   (In)
----------------------------------------------------------------------
  1                0.0025           0.0013                0.0013
  2                0.0025           0.0013                0.0013
  3                0.0026           0.0013                0.0013
  4                0.0026           0.0013                0.0013
  5                0.0026           0.0013                0.0013
  6                0.0026           0.0013                0.0013
  7                0.0026           0.0013                0.0013
  8                0.0026           0.0013                0.0013
  9                0.0026           0.0013                0.0013
 10                0.0026           0.0013                0.0013
 11                0.0026           0.0013                0.0013
 12                0.0026           0.0013                0.0013
 13                0.0026           0.0013                0.0013
 14                0.0026           0.0013                0.0013
 15                0.0026           0.0013                0.0013
 16                0.0027           0.0013                0.0013
 17                0.0027           0.0013                0.0013
 18                0.0027           0.0013                0.0013
 19                0.0027           0.0013                0.0013
 20                0.0027           0.0013                0.0013
 21                0.0027           0.0013                0.0014
 22                0.0027           0.0013                0.0014
 23                0.0027           0.0014                0.0014
 24                0.0027           0.0014                0.0014
 25                0.0027           0.0014                0.0014
 26                0.0027           0.0014                0.0014
 27                0.0028           0.0014                0.0014
 28                0.0028           0.0014                0.0014
 29                0.0028           0.0014                0.0014
 30                0.0028           0.0014                0.0014
 31                0.0028           0.0014                0.0014
 32                0.0028           0.0014                0.0014
 33                0.0028           0.0014                0.0014
```

34	0.0028	0.0014	0.0014
35	0.0028	0.0014	0.0014
36	0.0028	0.0014	0.0014
37	0.0028	0.0014	0.0014
38	0.0029	0.0014	0.0014
39	0.0029	0.0014	0.0014
40	0.0029	0.0014	0.0014
41	0.0029	0.0014	0.0014
42	0.0029	0.0014	0.0015
43	0.0029	0.0015	0.0015
44	0.0029	0.0015	0.0015
45	0.0029	0.0015	0.0015
46	0.0029	0.0015	0.0015
47	0.0030	0.0015	0.0015
48	0.0030	0.0015	0.0015
49	0.0030	0.0015	0.0015
50	0.0030	0.0015	0.0015
51	0.0030	0.0015	0.0015
52	0.0030	0.0015	0.0015
53	0.0030	0.0015	0.0015
54	0.0030	0.0015	0.0015
55	0.0030	0.0015	0.0015
56	0.0031	0.0015	0.0015
57	0.0031	0.0015	0.0015
58	0.0031	0.0015	0.0015
59	0.0031	0.0015	0.0016
60	0.0031	0.0015	0.0016
61	0.0031	0.0016	0.0016
62	0.0031	0.0016	0.0016
63	0.0032	0.0016	0.0016
64	0.0032	0.0016	0.0016
65	0.0032	0.0016	0.0016
66	0.0032	0.0016	0.0016
67	0.0032	0.0016	0.0016
68	0.0032	0.0016	0.0016
69	0.0032	0.0016	0.0016
70	0.0032	0.0016	0.0016
71	0.0033	0.0016	0.0016
72	0.0033	0.0016	0.0016
73	0.0033	0.0016	0.0017
74	0.0033	0.0016	0.0017
75	0.0033	0.0017	0.0017
76	0.0033	0.0017	0.0017
77	0.0034	0.0017	0.0017
78	0.0034	0.0017	0.0017
79	0.0034	0.0017	0.0017
80	0.0034	0.0017	0.0017
81	0.0034	0.0017	0.0017
82	0.0034	0.0017	0.0017
83	0.0035	0.0017	0.0017

84	0.0035	0.0017	0.0017
85	0.0035	0.0017	0.0018
86	0.0035	0.0017	0.0018
87	0.0035	0.0018	0.0018
88	0.0035	0.0018	0.0018
89	0.0036	0.0018	0.0018
90	0.0036	0.0018	0.0018
91	0.0036	0.0018	0.0018
92	0.0036	0.0018	0.0018
93	0.0036	0.0018	0.0018
94	0.0037	0.0018	0.0018
95	0.0037	0.0018	0.0018
96	0.0037	0.0018	0.0019
97	0.0037	0.0019	0.0019
98	0.0037	0.0019	0.0019
99	0.0038	0.0019	0.0019
100	0.0038	0.0019	0.0019
101	0.0038	0.0019	0.0019
102	0.0038	0.0019	0.0019
103	0.0039	0.0019	0.0019
104	0.0039	0.0019	0.0019
105	0.0039	0.0020	0.0020
106	0.0039	0.0020	0.0020
107	0.0040	0.0020	0.0020
108	0.0040	0.0020	0.0020
109	0.0040	0.0020	0.0020
110	0.0040	0.0020	0.0020
111	0.0041	0.0020	0.0020
112	0.0041	0.0020	0.0021
113	0.0041	0.0021	0.0021
114	0.0041	0.0021	0.0021
115	0.0042	0.0021	0.0021
116	0.0042	0.0021	0.0021
117	0.0042	0.0021	0.0021
118	0.0043	0.0021	0.0021
119	0.0043	0.0021	0.0022
120	0.0043	0.0022	0.0022
121	0.0044	0.0022	0.0022
122	0.0044	0.0022	0.0022
123	0.0044	0.0022	0.0022
124	0.0045	0.0022	0.0022
125	0.0045	0.0023	0.0023
126	0.0045	0.0023	0.0023
127	0.0046	0.0023	0.0023
128	0.0046	0.0023	0.0023
129	0.0047	0.0023	0.0023
130	0.0047	0.0023	0.0024
131	0.0048	0.0024	0.0024
132	0.0048	0.0024	0.0024
133	0.0048	0.0024	0.0024

134	0.0049	0.0024	0.0024
135	0.0049	0.0025	0.0025
136	0.0050	0.0025	0.0025
137	0.0050	0.0025	0.0025
138	0.0051	0.0025	0.0025
139	0.0051	0.0026	0.0026
140	0.0052	0.0026	0.0026
141	0.0053	0.0026	0.0026
142	0.0053	0.0026	0.0027
143	0.0054	0.0027	0.0027
144	0.0054	0.0027	0.0027
145	0.0055	0.0027	0.0028
146	0.0055	0.0028	0.0028
147	0.0056	0.0028	0.0028
148	0.0057	0.0028	0.0028
149	0.0058	0.0029	0.0029
150	0.0058	0.0029	0.0029
151	0.0059	0.0029	0.0030
152	0.0060	0.0030	0.0030
153	0.0061	0.0030	0.0030
154	0.0061	0.0031	0.0031
155	0.0063	0.0031	0.0031
156	0.0063	0.0031	0.0032
157	0.0064	0.0032	0.0032
158	0.0065	0.0032	0.0033
159	0.0067	0.0033	0.0033
160	0.0067	0.0034	0.0034
161	0.0069	0.0034	0.0035
162	0.0070	0.0035	0.0035
163	0.0071	0.0036	0.0036
164	0.0072	0.0036	0.0036
165	0.0074	0.0037	0.0037
166	0.0075	0.0037	0.0038
167	0.0077	0.0039	0.0039
168	0.0079	0.0039	0.0039
169	0.0081	0.0040	0.0041
170	0.0082	0.0041	0.0041
171	0.0085	0.0042	0.0043
172	0.0087	0.0043	0.0043
173	0.0090	0.0045	0.0045
174	0.0092	0.0046	0.0046
175	0.0095	0.0047	0.0048
176	0.0097	0.0049	0.0049
177	0.0102	0.0051	0.0051
178	0.0104	0.0052	0.0052
179	0.0110	0.0055	0.0055
180	0.0113	0.0056	0.0057
181	0.0120	0.0060	0.0060
182	0.0124	0.0062	0.0062
183	0.0133	0.0066	0.0067

184	0.0139	0.0069	0.0070
185	0.0103	0.0051	0.0052
186	0.0110	0.0055	0.0055
187	0.0127	0.0063	0.0064
188	0.0139	0.0069	0.0070
189	0.0172	0.0086	0.0086
190	0.0199	0.0099	0.0100
191	0.0301	0.0150	0.0151
192	0.0437	0.0218	0.0219
193	0.1892	0.0275	0.1617
194	0.0237	0.0118	0.0119
195	0.0153	0.0076	0.0077
196	0.0117	0.0059	0.0059
197	0.0145	0.0072	0.0073
198	0.0128	0.0064	0.0064
199	0.0116	0.0058	0.0058
200	0.0107	0.0053	0.0054
201	0.0100	0.0050	0.0050
202	0.0093	0.0047	0.0047
203	0.0088	0.0044	0.0044
204	0.0084	0.0042	0.0042
205	0.0080	0.0040	0.0040
206	0.0076	0.0038	0.0038
207	0.0073	0.0037	0.0037
208	0.0071	0.0035	0.0035
209	0.0068	0.0034	0.0034
210	0.0066	0.0033	0.0033
211	0.0064	0.0032	0.0032
212	0.0062	0.0031	0.0031
213	0.0060	0.0030	0.0030
214	0.0059	0.0029	0.0029
215	0.0057	0.0028	0.0029
216	0.0056	0.0028	0.0028
217	0.0054	0.0027	0.0027
218	0.0053	0.0027	0.0027
219	0.0052	0.0026	0.0026
220	0.0051	0.0025	0.0026
221	0.0050	0.0025	0.0025
222	0.0049	0.0024	0.0025
223	0.0048	0.0024	0.0024
224	0.0047	0.0024	0.0024
225	0.0046	0.0023	0.0023
226	0.0046	0.0023	0.0023
227	0.0045	0.0022	0.0023
228	0.0044	0.0022	0.0022
229	0.0044	0.0022	0.0022
230	0.0043	0.0021	0.0022
231	0.0042	0.0021	0.0021
232	0.0042	0.0021	0.0021
233	0.0041	0.0020	0.0021

234	0.0041	0.0020	0.0020
235	0.0040	0.0020	0.0020
236	0.0039	0.0020	0.0020
237	0.0039	0.0019	0.0020
238	0.0039	0.0019	0.0019
239	0.0038	0.0019	0.0019
240	0.0038	0.0019	0.0019
241	0.0037	0.0019	0.0019
242	0.0037	0.0018	0.0018
243	0.0036	0.0018	0.0018
244	0.0036	0.0018	0.0018
245	0.0036	0.0018	0.0018
246	0.0035	0.0018	0.0018
247	0.0035	0.0017	0.0017
248	0.0034	0.0017	0.0017
249	0.0034	0.0017	0.0017
250	0.0034	0.0017	0.0017
251	0.0033	0.0017	0.0017
252	0.0033	0.0017	0.0017
253	0.0033	0.0016	0.0016
254	0.0033	0.0016	0.0016
255	0.0032	0.0016	0.0016
256	0.0032	0.0016	0.0016
257	0.0032	0.0016	0.0016
258	0.0031	0.0016	0.0016
259	0.0031	0.0016	0.0016
260	0.0031	0.0015	0.0015
261	0.0031	0.0015	0.0015
262	0.0030	0.0015	0.0015
263	0.0030	0.0015	0.0015
264	0.0030	0.0015	0.0015
265	0.0030	0.0015	0.0015
266	0.0029	0.0015	0.0015
267	0.0029	0.0015	0.0015
268	0.0029	0.0014	0.0015
269	0.0029	0.0014	0.0014
270	0.0029	0.0014	0.0014
271	0.0028	0.0014	0.0014
272	0.0028	0.0014	0.0014
273	0.0028	0.0014	0.0014
274	0.0028	0.0014	0.0014
275	0.0028	0.0014	0.0014
276	0.0027	0.0014	0.0014
277	0.0027	0.0014	0.0014
278	0.0027	0.0013	0.0014
279	0.0027	0.0013	0.0013
280	0.0027	0.0013	0.0013
281	0.0027	0.0013	0.0013
282	0.0026	0.0013	0.0013
283	0.0026	0.0013	0.0013

```
      284              0.0026           0.0013              0.0013
      285              0.0026           0.0013              0.0013
      286              0.0026           0.0013              0.0013
      287              0.0026           0.0013              0.0013
      288              0.0025           0.0013              0.0013
      --------------------------------------------------------------------
      --------------------------------------------------------------------
      Total soil rain loss =      0.75(In)
      Total effective rainfall =      0.89(In)
      Peak flow rate in flood hydrograph =      8.91(CFS)
      ---------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R   S T O R M
                     R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5      0.0001      0.01  Q         |         |         |         |
  0+10      0.0005      0.06  Q         |         |         |         |
  0+15      0.0013      0.12  Q         |         |         |         |
  0+20      0.0023      0.15  Q         |         |         |         |
  0+25      0.0034      0.16  Q         |         |         |         |
  0+30      0.0046      0.17  Q         |         |         |         |
  0+35      0.0058      0.18  Q         |         |         |         |
  0+40      0.0071      0.19  Q         |         |         |         |
  0+45      0.0084      0.19  Q         |         |         |         |
  0+50      0.0098      0.19  Q         |         |         |         |
  0+55      0.0111      0.20  Q         |         |         |         |
  1+ 0      0.0125      0.20  Q         |         |         |         |
  1+ 5      0.0139      0.20  Q         |         |         |         |
  1+10      0.0152      0.20  Q         |         |         |         |
  1+15      0.0166      0.20  Q         |         |         |         |
  1+20      0.0181      0.20  Q         |         |         |         |
  1+25      0.0195      0.21  Q         |         |         |         |
  1+30      0.0209      0.21  Q         |         |         |         |
  1+35      0.0223      0.21  Q         |         |         |         |
  1+40      0.0237      0.21  Q         |         |         |         |
  1+45      0.0252      0.21  QV        |         |         |         |
  1+50      0.0266      0.21  QV        |         |         |         |
  1+55      0.0280      0.21  QV        |         |         |         |
  2+ 0      0.0295      0.21  QV        |         |         |         |
  2+ 5      0.0309      0.21  QV        |         |         |         |
  2+10      0.0324      0.21  QV        |         |         |         |
  2+15      0.0338      0.21  QV        |         |         |         |
  2+20      0.0353      0.21  QV        |         |         |         |
  2+25      0.0368      0.21  QV        |         |         |         |
  2+30      0.0382      0.21  QV        |         |         |         |
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2+35       0.0397      0.21  QV        |         |         |         |
2+40       0.0412      0.22  QV        |         |         |         |
2+45       0.0427      0.22  QV        |         |         |         |
2+50       0.0442      0.22  QV        |         |         |         |
2+55       0.0457      0.22  QV        |         |         |         |
3+ 0       0.0472      0.22  QV        |         |         |         |
3+ 5       0.0487      0.22  Q V       |         |         |         |
3+10       0.0502      0.22  Q V       |         |         |         |
3+15       0.0517      0.22  Q V       |         |         |         |
3+20       0.0532      0.22  Q V       |         |         |         |
3+25       0.0548      0.22  Q V       |         |         |         |
3+30       0.0563      0.22  Q V       |         |         |         |
3+35       0.0578      0.22  Q V       |         |         |         |
3+40       0.0594      0.22  Q V       |         |         |         |
3+45       0.0609      0.23  Q V       |         |         |         |
3+50       0.0625      0.23  Q V       |         |         |         |
3+55       0.0641      0.23  Q V       |         |         |         |
4+ 0       0.0656      0.23  Q V       |         |         |         |
4+ 5       0.0672      0.23  Q V       |         |         |         |
4+10       0.0688      0.23  Q V       |         |         |         |
4+15       0.0704      0.23  Q V       |         |         |         |
4+20       0.0720      0.23  Q  V      |         |         |         |
4+25       0.0736      0.23  Q  V      |         |         |         |
4+30       0.0752      0.23  Q  V      |         |         |         |
4+35       0.0768      0.23  Q  V      |         |         |         |
4+40       0.0784      0.24  Q  V      |         |         |         |
4+45       0.0800      0.24  Q  V      |         |         |         |
4+50       0.0817      0.24  Q  V      |         |         |         |
4+55       0.0833      0.24  Q  V      |         |         |         |
5+ 0       0.0849      0.24  Q  V      |         |         |         |
5+ 5       0.0866      0.24  Q  V      |         |         |         |
5+10       0.0883      0.24  Q  V      |         |         |         |
5+15       0.0899      0.24  Q  V      |         |         |         |
5+20       0.0916      0.24  Q  V      |         |         |         |
5+25       0.0933      0.24  Q  V      |         |         |         |
5+30       0.0950      0.24  Q  V      |         |         |         |
5+35       0.0967      0.25  Q   V     |         |         |         |
5+40       0.0984      0.25  Q   V     |         |         |         |
5+45       0.1001      0.25  Q   V     |         |         |         |
5+50       0.1018      0.25  Q   V     |         |         |         |
5+55       0.1035      0.25  |Q  V     |         |         |         |
6+ 0       0.1052      0.25  |Q  V     |         |         |         |
6+ 5       0.1070      0.25  |Q  V     |         |         |         |
6+10       0.1087      0.25  |Q  V     |         |         |         |
6+15       0.1105      0.25  |Q  V     |         |         |         |
6+20       0.1122      0.26  |Q  V     |         |         |         |
6+25       0.1140      0.26  |Q  V     |         |         |         |
6+30       0.1158      0.26  |Q  V     |         |         |         |
6+35       0.1176      0.26  |Q  V     |         |         |         |
6+40       0.1194      0.26  |Q   V    |         |         |         |
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 6+45       0.1212      0.26  |Q   V    |         |         |         |
 6+50       0.1230      0.26  |Q   V    |         |         |         |
 6+55       0.1248      0.26  |Q   V    |         |         |         |
 7+ 0       0.1267      0.27  |Q   V    |         |         |         |
 7+ 5       0.1285      0.27  |Q   V    |         |         |         |
 7+10       0.1304      0.27  |Q   V    |         |         |         |
 7+15       0.1322      0.27  |Q   V    |         |         |         |
 7+20       0.1341      0.27  |Q   V    |         |         |         |
 7+25       0.1360      0.27  |Q   V    |         |         |         |
 7+30       0.1379      0.27  |Q   V    |         |         |         |
 7+35       0.1398      0.28  |Q   V    |         |         |         |
 7+40       0.1417      0.28  |Q   V    |         |         |         |
 7+45       0.1436      0.28  |Q    V   |         |         |         |
 7+50       0.1455      0.28  |Q    V   |         |         |         |
 7+55       0.1475      0.28  |Q    V   |         |         |         |
 8+ 0       0.1494      0.28  |Q    V   |         |         |         |
 8+ 5       0.1514      0.29  |Q    V   |         |         |         |
 8+10       0.1533      0.29  |Q    V   |         |         |         |
 8+15       0.1553      0.29  |Q    V   |         |         |         |
 8+20       0.1573      0.29  |Q    V   |         |         |         |
 8+25       0.1593      0.29  |Q    V   |         |         |         |
 8+30       0.1614      0.29  |Q    V   |         |         |         |
 8+35       0.1634      0.30  |Q    V   |         |         |         |
 8+40       0.1654      0.30  |Q    V   |         |         |         |
 8+45       0.1675      0.30  |Q     V  |         |         |         |
 8+50       0.1696      0.30  |Q     V  |         |         |         |
 8+55       0.1716      0.30  |Q     V  |         |         |         |
 9+ 0       0.1737      0.30  |Q     V  |         |         |         |
 9+ 5       0.1758      0.31  |Q     V  |         |         |         |
 9+10       0.1780      0.31  |Q     V  |         |         |         |
 9+15       0.1801      0.31  |Q     V  |         |         |         |
 9+20       0.1823      0.31  |Q     V  |         |         |         |
 9+25       0.1844      0.31  |Q     V  |         |         |         |
 9+30       0.1866      0.32  |Q     V  |         |         |         |
 9+35       0.1888      0.32  |Q     V  |         |         |         |
 9+40       0.1910      0.32  |Q      V |         |         |         |
 9+45       0.1932      0.32  |Q      V |         |         |         |
 9+50       0.1955      0.33  |Q      V |         |         |         |
 9+55       0.1977      0.33  |Q      V |         |         |         |
10+ 0       0.2000      0.33  |Q      V |         |         |         |
10+ 5       0.2023      0.33  |Q      V |         |         |         |
10+10       0.2046      0.34  |Q      V |         |         |         |
10+15       0.2069      0.34  |Q      V |         |         |         |
10+20       0.2093      0.34  |Q      V |         |         |         |
10+25       0.2116      0.34  |Q      V |         |         |         |
10+30       0.2140      0.35  |Q       V|         |         |         |
10+35       0.2164      0.35  |Q       V|         |         |         |
10+40       0.2188      0.35  |Q       V|         |         |         |
10+45       0.2213      0.35  |Q       V|         |         |         |
10+50       0.2237      0.36  |Q       V|         |         |         |
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10+55       0.2262      0.36  |Q       V|         |         |         |
11+ 0       0.2287      0.36  |Q       V|         |         |         |
11+ 5       0.2313      0.37  |Q       V|         |         |         |
11+10       0.2338      0.37  |Q       V|         |         |         |
11+15       0.2364      0.37  |Q       V|         |         |         |
11+20       0.2390      0.38  |Q        V         |         |         |
11+25       0.2416      0.38  |Q        V         |         |         |
11+30       0.2442      0.38  |Q        V         |         |         |
11+35       0.2469      0.39  |Q        V         |         |         |
11+40       0.2496      0.39  |Q        V         |         |         |
11+45       0.2523      0.40  |Q        V         |         |         |
11+50       0.2551      0.40  |Q        V         |         |         |
11+55       0.2579      0.40  |Q        V         |         |         |
12+ 0       0.2607      0.41  |Q        V         |         |         |
12+ 5       0.2635      0.41  |Q        |V        |         |         |
12+10       0.2664      0.42  |Q        |V        |         |         |
12+15       0.2693      0.42  |Q        |V        |         |         |
12+20       0.2722      0.43  |Q        |V        |         |         |
12+25       0.2752      0.43  |Q        |V        |         |         |
12+30       0.2782      0.44  |Q        |V        |         |         |
12+35       0.2813      0.44  |Q        |V        |         |         |
12+40       0.2843      0.45  |Q        |V        |         |         |
12+45       0.2875      0.45  |Q        | V       |         |         |
12+50       0.2906      0.46  |Q        | V       |         |         |
12+55       0.2938      0.47  |Q        | V       |         |         |
13+ 0       0.2971      0.47  |Q        | V       |         |         |
13+ 5       0.3004      0.48  |Q        | V       |         |         |
13+10       0.3037      0.49  |Q        | V       |         |         |
13+15       0.3071      0.49  |Q        | V       |         |         |
13+20       0.3106      0.50  | Q       |  V      |         |         |
13+25       0.3141      0.51  | Q       |  V      |         |         |
13+30       0.3177      0.52  | Q       |  V      |         |         |
13+35       0.3213      0.53  | Q       |  V      |         |         |
13+40       0.3250      0.54  | Q       |  V      |         |         |
13+45       0.3287      0.55  | Q       |  V      |         |         |
13+50       0.3326      0.56  | Q       |   V     |         |         |
13+55       0.3365      0.57  | Q       |   V     |         |         |
14+ 0       0.3405      0.58  | Q       |   V     |         |         |
14+ 5       0.3445      0.59  | Q       |   V     |         |         |
14+10       0.3487      0.60  | Q       |   V     |         |         |
14+15       0.3529      0.62  | Q       |   V     |         |         |
14+20       0.3573      0.63  | Q       |    V    |         |         |
14+25       0.3617      0.65  | Q       |    V    |         |         |
14+30       0.3663      0.66  | Q       |    V    |         |         |
14+35       0.3710      0.68  | Q       |    V    |         |         |
14+40       0.3758      0.70  | Q       |    V    |         |         |
14+45       0.3808      0.72  | Q       |     V   |         |         |
14+50       0.3859      0.74  | Q       |     V   |         |         |
14+55       0.3912      0.77  |  Q      |     V   |         |         |
15+ 0       0.3967      0.80  |  Q      |     V   |         |         |
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15+ 5       0.4024      0.83  |  Q      |     V   |         |         |
15+10       0.4083      0.86  |  Q      |      V  |         |         |
15+15       0.4145      0.90  |  Q      |      V  |         |         |
15+20       0.4210      0.94  |  Q      |      V  |         |         |
15+25       0.4277      0.98  |  Q      |       V |         |         |
15+30       0.4342      0.94  |  Q      |       V |         |         |
15+35       0.4403      0.89  |  Q      |       V |         |         |
15+40       0.4466      0.92  |  Q      |       V |         |         |
15+45       0.4535      0.99  |  Q      |        V|         |         |
15+50       0.4611      1.11  |   Q     |        V|         |         |
15+55       0.4700      1.29  |    Q    |        V|         |         |
16+ 0       0.4814      1.66  |     Q   |         V         |         |
16+ 5       0.5027      3.10  |         | Q       |V        |         |
16+10       0.5608      8.43  |         |         |  V      |  Q      |
16+15       0.6221      8.91  |         |         |     V   |    Q    |
16+20       0.6549      4.75  |         |        Q|      V  |         |
16+25       0.6768      3.18  |         | Q       |       V |         |
16+30       0.6938      2.47  |        Q|         |        V|         |
16+35       0.7078      2.03  |       Q |         |        V|         |
16+40       0.7196      1.72  |     Q   |         |         V         |
16+45       0.7298      1.48  |    Q    |         |         V         |
16+50       0.7387      1.29  |    Q    |         |         |V        |
16+55       0.7465      1.13  |   Q     |         |         |V        |
17+ 0       0.7532      0.98  |  Q      |         |         |V        |
17+ 5       0.7594      0.90  |  Q      |         |         |V        |
17+10       0.7653      0.86  |  Q      |         |         | V       |
17+15       0.7707      0.78  |  Q      |         |         | V       |
17+20       0.7756      0.72  | Q       |         |         | V       |
17+25       0.7798      0.61  | Q       |         |         | V       |
17+30       0.7838      0.58  | Q       |         |         |  V      |
17+35       0.7876      0.56  | Q       |         |         |  V      |
17+40       0.7913      0.54  | Q       |         |         |  V      |
17+45       0.7949      0.52  | Q       |         |         |  V      |
17+50       0.7984      0.50  | Q       |         |         |  V      |
17+55       0.8017      0.49  |Q        |         |         |  V      |
18+ 0       0.8050      0.47  |Q        |         |         |  V      |
18+ 5       0.8081      0.46  |Q        |         |         |   V     |
18+10       0.8112      0.45  |Q        |         |         |   V     |
18+15       0.8142      0.44  |Q        |         |         |   V     |
18+20       0.8172      0.43  |Q        |         |         |   V     |
18+25       0.8200      0.42  |Q        |         |         |   V     |
18+30       0.8228      0.41  |Q        |         |         |   V     |
18+35       0.8256      0.40  |Q        |         |         |   V     |
18+40       0.8283      0.39  |Q        |         |         |   V     |
18+45       0.8309      0.38  |Q        |         |         |   V     |
18+50       0.8335      0.38  |Q        |         |         |    V    |
18+55       0.8360      0.37  |Q        |         |         |    V    |
19+ 0       0.8385      0.36  |Q        |         |         |    V    |
19+ 5       0.8410      0.36  |Q        |         |         |    V    |
19+10       0.8434      0.35  |Q        |         |         |    V    |
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19+15       0.8458      0.34  |Q        |         |         |    V    |
19+20       0.8481      0.34  |Q        |         |         |    V    |
19+25       0.8504      0.33  |Q        |         |         |    V    |
19+30       0.8527      0.33  |Q        |         |         |    V    |
19+35       0.8549      0.32  |Q        |         |         |     V   |
19+40       0.8571      0.32  |Q        |         |         |     V   |
19+45       0.8593      0.32  |Q        |         |         |     V   |
19+50       0.8614      0.31  |Q        |         |         |     V   |
19+55       0.8635      0.31  |Q        |         |         |     V   |
20+ 0       0.8656      0.30  |Q        |         |         |     V   |
20+ 5       0.8677      0.30  |Q        |         |         |     V   |
20+10       0.8697      0.30  |Q        |         |         |     V   |
20+15       0.8718      0.29  |Q        |         |         |     V   |
20+20       0.8737      0.29  |Q        |         |         |     V   |
20+25       0.8757      0.29  |Q        |         |         |     V   |
20+30       0.8777      0.28  |Q        |         |         |     V   |
20+35       0.8796      0.28  |Q        |         |         |      V  |
20+40       0.8815      0.28  |Q        |         |         |      V  |
20+45       0.8834      0.27  |Q        |         |         |      V  |
20+50       0.8852      0.27  |Q        |         |         |      V  |
20+55       0.8871      0.27  |Q        |         |         |      V  |
21+ 0       0.8889      0.27  |Q        |         |         |      V  |
21+ 5       0.8907      0.26  |Q        |         |         |      V  |
21+10       0.8925      0.26  |Q        |         |         |      V  |
21+15       0.8943      0.26  |Q        |         |         |      V  |
21+20       0.8961      0.26  |Q        |         |         |      V  |
21+25       0.8978      0.25  |Q        |         |         |      V  |
21+30       0.8995      0.25  |Q        |         |         |      V  |
21+35       0.9012      0.25  Q         |         |         |      V  |
21+40       0.9029      0.25  Q         |         |         |       V |
21+45       0.9046      0.24  Q         |         |         |       V |
21+50       0.9063      0.24  Q         |         |         |       V |
21+55       0.9079      0.24  Q         |         |         |       V |
22+ 0       0.9096      0.24  Q         |         |         |       V |
22+ 5       0.9112      0.24  Q         |         |         |       V |
22+10       0.9128      0.23  Q         |         |         |       V |
22+15       0.9144      0.23  Q         |         |         |       V |
22+20       0.9160      0.23  Q         |         |         |       V |
22+25       0.9176      0.23  Q         |         |         |       V |
22+30       0.9192      0.23  Q         |         |         |       V |
22+35       0.9207      0.23  Q         |         |         |       V |
22+40       0.9223      0.22  Q         |         |         |       V |
22+45       0.9238      0.22  Q         |         |         |       V |
22+50       0.9253      0.22  Q         |         |         |       V |
22+55       0.9268      0.22  Q         |         |         |        V|
23+ 0       0.9283      0.22  Q         |         |         |        V|
23+ 5       0.9298      0.22  Q         |         |         |        V|
23+10       0.9313      0.21  Q         |         |         |        V|
23+15       0.9328      0.21  Q         |         |         |        V|
23+20       0.9342      0.21  Q         |         |         |        V|
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   23+25        0.9357      0.21  Q         |         |         |        V|
   23+30        0.9371      0.21  Q         |         |         |        V|
   23+35        0.9386      0.21  Q         |         |         |        V|
   23+40        0.9400      0.21  Q         |         |         |        V|
   23+45        0.9414      0.21  Q         |         |         |        V|
   23+50        0.9428      0.20  Q         |         |         |        V|
   23+55        0.9442      0.20  Q         |         |         |        V|
   24+ 0        0.9456      0.20  Q         |         |         |        V|
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```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
        Rational Hydrology Study       Date: 08/16/21
------------------------------------------------------------------------
10 Year Rational Analysis Post Development
Former Track 17486
Drainage Area 1
File: 17486Rat10PostA1.out
------------------------------------------------------------------------


Program License Serial Number 4070

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
Computed rainfall intensity:
Storm year =    10.00   1 hour rainfall =     0.692 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 3



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       4.000
**** INITIAL AREA EVALUATION ****

______________________________________________________________________
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.393(In/Hr)
Initial subarea data:
Initial area flow distance =   997.200(Ft.)
Top (of initial area) elevation =  3291.300(Ft.)
Bottom (of initial area) elevation =  3281.000(Ft.)
Difference in elevation =    10.300(Ft.)
Slope =    0.01033  s(%)=       1.03
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.369 min.
Rainfall intensity =      1.795(In/Hr) for a    10.0 year storm
```

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Effective runoff coefficient used for area (Q=KCIA) is C = 0.703
Subarea runoff =     10.757(CFS)
Total initial stream area =        8.520(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.393(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        4.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      8.520(Ac.)
Runoff from this stream =     10.757(CFS)
Time of concentration =   15.37 min.
Rainfall intensity =     1.795(In/Hr)
Area averaged loss rate (Fm) =    0.3926(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        4.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.393(In/Hr)
Initial subarea data:
Initial area flow distance =   413.100(Ft.)
Top (of initial area) elevation =  3283.100(Ft.)
Bottom (of initial area) elevation =  3281.000(Ft.)
Difference in elevation =     2.100(Ft.)
Slope =    0.00508  s(%)=       0.51
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.449 min.
Rainfall intensity =      2.081(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.730
Subarea runoff =      4.209(CFS)
Total initial stream area =        2.770(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.393(In/Hr)
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        4.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.770(Ac.)
Runoff from this stream =      4.209(CFS)
Time of concentration =   12.45 min.
Rainfall intensity =     2.081(In/Hr)
Area averaged loss rate (Fm) =    0.3926(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.393(In/Hr)
Initial subarea data:
Initial area flow distance =   794.100(Ft.)
Top (of initial area) elevation =  3283.100(Ft.)
Bottom (of initial area) elevation =  3277.200(Ft.)
Difference in elevation =     5.900(Ft.)
Slope =    0.00743  s(%)=        0.74
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.987 min.
Rainfall intensity =      1.827(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.707
Subarea runoff =      1.976(CFS)
Total initial stream area =        1.530(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.393(In/Hr)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      1.530(Ac.)
```

```
Runoff from this stream =      1.976(CFS)
Time of concentration =   14.99 min.
Rainfall intensity =     1.827(In/Hr)
Area averaged loss rate (Fm) =    0.3926(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1     10.76     8.520     15.37    0.393      1.795
2      4.21     2.770     12.45    0.393      2.081
3      1.98     1.530     14.99    0.393      1.827
Qmax(1) =
           1.000 *    1.000 *    10.757) +
           0.831 *    1.000 *     4.209) +
           0.978 *    1.000 *     1.976) + =      16.186
Qmax(2) =
           1.203 *    0.810 *    10.757) +
           1.000 *    1.000 *     4.209) +
           1.177 *    0.831 *     1.976) + =      16.625
Qmax(3) =
           1.023 *    0.975 *    10.757) +
           0.850 *    1.000 *     4.209) +
           1.000 *    1.000 *     1.976) + =      16.280

Total of 3 streams to confluence:
Flow rates before confluence point:
      10.757       4.209       1.976
Maximum flow rates at confluence using above data:
       16.186       16.625       16.280
Area of streams before confluence:
        8.520        2.770        1.530
Effective area values after confluence:
       12.820       10.942       12.608
Results of confluence:
Total flow rate =     16.625(CFS)
Time of concentration =    12.449 min.
Effective stream area after confluence =     10.942(Ac.)
Study area average Pervious fraction(Ap) =  0.500
Study area average soil loss rate(Fm) =    0.393(In/Hr)
Study area total (this main stream) =      12.82(Ac.)
End of computations, Total Study Area =           12.82 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.500
```

```
Area averaged SCS curve number =  32.0
```

```
        U n i t   H y d r o g r a p h   A n a l y s i s

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                Study date  08/13/21


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
------------------------------------------------------------------------

San Bernardino County Synthetic Unit Hydrology Method
                Manual date - August 1986


Program License Serial Number 4070

---------------------------------------------------------------------
10 Year Unit Hydrograph Post Development
Former Track 17486
Drainage Area 1
File: 17486Hydr10PostA1.out
--------------------------------------------------------------------

        Storm Event Year = 10

        Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




Area averaged rainfall intensity isohyetal data:
        Sub-Area        Duration        Isohyetal
        (Ac.)            (hours)         (In)
Rainfall data for year 10
            12.82            1           0.69
--------------------------------------------------------------------
Rainfall data for year 10
            12.82            6           1.46
--------------------------------------------------------------------
Rainfall data for year 10
            12.82           24           2.97
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
******** Area-averaged max loss rate, Fm ********


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 32.0      52.0         12.82      1.000     0.785    0.420    0.330

Area-averaged adjusted loss rate Fm (In/Hr) =  0.330

********* Area-Averaged low loss rate fraction, Yb **********

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
     5.38   0.420         32.0      52.0       9.23     0.041
     7.44   0.580         98.0      98.0       0.20     0.922

Area-averaged catchment yield fraction, Y =  0.552
Area-averaged low loss fraction, Yb =  0.448
User entry of time of concentration  =   0.207 (hours)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =      12.82(Ac.)
Catchment Lag time =   0.166 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 50.2008
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.330(In/Hr)
Average low loss rate fraction (Yb) = 0.448 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall =  0.328(In)
Computed peak 30-minute rainfall =  0.562(In)
Specified peak 1-hour rainfall =  0.692(In)
Computed peak 3-hour rainfall =  1.094(In)
Specified peak 6-hour rainfall =  1.460(In)
Specified peak 24-hour rainfall =  2.970(In)


Rainfall depth area reduction factors:
Using a total area of      12.82(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999     Adjusted rainfall =  0.328(In)
30-minute factor = 0.999    Adjusted rainfall =  0.562(In)
1-hour factor = 0.999       Adjusted rainfall =  0.692(In)
3-hour factor = 1.000       Adjusted rainfall =  1.094(In)
6-hour factor = 1.000       Adjusted rainfall =  1.460(In)
24-hour factor = 1.000      Adjusted rainfall =  2.970(In)
---------------------------------------------------------------------

                       U n i t  H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
Interval          'S' Graph          Unit Hydrograph
Number            Mean values             ((CFS))
---------------------------------------------------------------------
                (K =      155.04 (CFS))

  1                3.989                   6.184
  2               30.749                  41.489
  3               60.742                  46.502
  4               73.911                  20.417
  5               81.558                  11.856
  6               86.696                   7.967
  7               90.250                   5.510
  8               92.844                   4.021
  9               94.808                   3.045
 10               96.299                   2.312
 11               97.388                   1.687
 12               98.073                   1.063
 13               98.630                   0.863
 14               99.232                   0.933
 15               99.674                   0.686
 16              100.000                   0.505
---------------------------------------------------------------------
Peak Unit   Adjusted mass rainfall  Unit rainfall
Number              (In)                (In)
  1              0.3282               0.3282
  2              0.4040               0.0759
  3              0.4563               0.0523
  4              0.4974               0.0411
  5              0.5318               0.0344
  6              0.5617               0.0299
  7              0.5883               0.0266
  8              0.6124               0.0240
  9              0.6344               0.0220
 10              0.6548               0.0204
 11              0.6738               0.0190
 12              0.6916               0.0178
 13              0.7151               0.0235
 14              0.7375               0.0225
 15              0.7591               0.0215
 16              0.7798               0.0207
 17              0.7997               0.0200
 18              0.8190               0.0193
 19              0.8377               0.0187
 20              0.8558               0.0181
 21              0.8734               0.0176
 22              0.8906               0.0171
 23              0.9072               0.0167
 24              0.9235               0.0163
 25              0.9393               0.0159
 26              0.9548               0.0155
```

27	0.9700	0.0152
28	0.9848	0.0148
29	0.9993	0.0145
30	1.0136	0.0142
31	1.0275	0.0140
32	1.0412	0.0137
33	1.0547	0.0135
34	1.0679	0.0132
35	1.0809	0.0130
36	1.0937	0.0128
37	1.1062	0.0126
38	1.1186	0.0124
39	1.1308	0.0122
40	1.1428	0.0120
41	1.1546	0.0118
42	1.1662	0.0117
43	1.1777	0.0115
44	1.1891	0.0113
45	1.2002	0.0112
46	1.2113	0.0110
47	1.2222	0.0109
48	1.2330	0.0108
49	1.2436	0.0106
50	1.2541	0.0105
51	1.2645	0.0104
52	1.2748	0.0103
53	1.2849	0.0102
54	1.2950	0.0100
55	1.3049	0.0099
56	1.3148	0.0098
57	1.3245	0.0097
58	1.3341	0.0096
59	1.3437	0.0095
60	1.3531	0.0094
61	1.3625	0.0094
62	1.3717	0.0093
63	1.3809	0.0092
64	1.3900	0.0091
65	1.3990	0.0090
66	1.4080	0.0089
67	1.4168	0.0089
68	1.4256	0.0088
69	1.4343	0.0087
70	1.4429	0.0086
71	1.4515	0.0086
72	1.4599	0.0085
73	1.4703	0.0104
74	1.4806	0.0103
75	1.4908	0.0102
76	1.5009	0.0101

77	1.5110	0.0101
78	1.5210	0.0100
79	1.5310	0.0100
80	1.5409	0.0099
81	1.5507	0.0098
82	1.5605	0.0098
83	1.5702	0.0097
84	1.5799	0.0097
85	1.5895	0.0096
86	1.5991	0.0096
87	1.6086	0.0095
88	1.6180	0.0094
89	1.6274	0.0094
90	1.6367	0.0093
91	1.6460	0.0093
92	1.6553	0.0092
93	1.6645	0.0092
94	1.6736	0.0091
95	1.6827	0.0091
96	1.6918	0.0091
97	1.7008	0.0090
98	1.7097	0.0090
99	1.7186	0.0089
100	1.7275	0.0089
101	1.7363	0.0088
102	1.7451	0.0088
103	1.7539	0.0087
104	1.7626	0.0087
105	1.7712	0.0087
106	1.7798	0.0086
107	1.7884	0.0086
108	1.7970	0.0085
109	1.8055	0.0085
110	1.8139	0.0085
111	1.8224	0.0084
112	1.8308	0.0084
113	1.8391	0.0084
114	1.8474	0.0083
115	1.8557	0.0083
116	1.8640	0.0082
117	1.8722	0.0082
118	1.8804	0.0082
119	1.8885	0.0081
120	1.8966	0.0081
121	1.9047	0.0081
122	1.9127	0.0080
123	1.9208	0.0080
124	1.9287	0.0080
125	1.9367	0.0080
126	1.9446	0.0079

127	1.9525	0.0079
128	1.9604	0.0079
129	1.9682	0.0078
130	1.9760	0.0078
131	1.9838	0.0078
132	1.9915	0.0077
133	1.9992	0.0077
134	2.0069	0.0077
135	2.0146	0.0077
136	2.0222	0.0076
137	2.0298	0.0076
138	2.0374	0.0076
139	2.0449	0.0075
140	2.0525	0.0075
141	2.0600	0.0075
142	2.0674	0.0075
143	2.0749	0.0074
144	2.0823	0.0074
145	2.0897	0.0074
146	2.0971	0.0074
147	2.1044	0.0073
148	2.1117	0.0073
149	2.1190	0.0073
150	2.1263	0.0073
151	2.1335	0.0072
152	2.1408	0.0072
153	2.1480	0.0072
154	2.1552	0.0072
155	2.1623	0.0072
156	2.1695	0.0071
157	2.1766	0.0071
158	2.1837	0.0071
159	2.1907	0.0071
160	2.1978	0.0070
161	2.2048	0.0070
162	2.2118	0.0070
163	2.2188	0.0070
164	2.2257	0.0070
165	2.2327	0.0069
166	2.2396	0.0069
167	2.2465	0.0069
168	2.2534	0.0069
169	2.2603	0.0069
170	2.2671	0.0068
171	2.2739	0.0068
172	2.2807	0.0068
173	2.2875	0.0068
174	2.2943	0.0068
175	2.3010	0.0067
176	2.3077	0.0067

177	2.3144	0.0067
178	2.3211	0.0067
179	2.3278	0.0067
180	2.3345	0.0067
181	2.3411	0.0066
182	2.3477	0.0066
183	2.3543	0.0066
184	2.3609	0.0066
185	2.3675	0.0066
186	2.3740	0.0065
187	2.3805	0.0065
188	2.3870	0.0065
189	2.3935	0.0065
190	2.4000	0.0065
191	2.4065	0.0065
192	2.4129	0.0064
193	2.4194	0.0064
194	2.4258	0.0064
195	2.4322	0.0064
196	2.4385	0.0064
197	2.4449	0.0064
198	2.4513	0.0063
199	2.4576	0.0063
200	2.4639	0.0063
201	2.4702	0.0063
202	2.4765	0.0063
203	2.4828	0.0063
204	2.4890	0.0063
205	2.4953	0.0062
206	2.5015	0.0062
207	2.5077	0.0062
208	2.5139	0.0062
209	2.5201	0.0062
210	2.5263	0.0062
211	2.5324	0.0062
212	2.5386	0.0061
213	2.5447	0.0061
214	2.5508	0.0061
215	2.5569	0.0061
216	2.5630	0.0061
217	2.5691	0.0061
218	2.5751	0.0061
219	2.5812	0.0060
220	2.5872	0.0060
221	2.5932	0.0060
222	2.5992	0.0060
223	2.6052	0.0060
224	2.6112	0.0060
225	2.6172	0.0060
226	2.6231	0.0060

227	2.6290	0.0059
228	2.6350	0.0059
229	2.6409	0.0059
230	2.6468	0.0059
231	2.6527	0.0059
232	2.6586	0.0059
233	2.6644	0.0059
234	2.6703	0.0059
235	2.6761	0.0058
236	2.6819	0.0058
237	2.6878	0.0058
238	2.6936	0.0058
239	2.6993	0.0058
240	2.7051	0.0058
241	2.7109	0.0058
242	2.7167	0.0058
243	2.7224	0.0057
244	2.7281	0.0057
245	2.7339	0.0057
246	2.7396	0.0057
247	2.7453	0.0057
248	2.7509	0.0057
249	2.7566	0.0057
250	2.7623	0.0057
251	2.7679	0.0057
252	2.7736	0.0056
253	2.7792	0.0056
254	2.7848	0.0056
255	2.7905	0.0056
256	2.7961	0.0056
257	2.8016	0.0056
258	2.8072	0.0056
259	2.8128	0.0056
260	2.8184	0.0056
261	2.8239	0.0055
262	2.8294	0.0055
263	2.8350	0.0055
264	2.8405	0.0055
265	2.8460	0.0055
266	2.8515	0.0055
267	2.8570	0.0055
268	2.8624	0.0055
269	2.8679	0.0055
270	2.8734	0.0055
271	2.8788	0.0054
272	2.8843	0.0054
273	2.8897	0.0054
274	2.8951	0.0054
275	2.9005	0.0054
276	2.9059	0.0054

```
277              2.9113               0.0054
278              2.9167               0.0054
279              2.9220               0.0054
280              2.9274               0.0054
281              2.9328               0.0054
282              2.9381               0.0053
283              2.9434               0.0053
284              2.9487               0.0053
285              2.9541               0.0053
286              2.9594               0.0053
287              2.9647               0.0053
288              2.9700               0.0053
----------------------------------------------------------------------
Unit              Unit             Unit              Effective
Period            Rainfall         Soil-Loss         Rainfall
(number)            (In)           (In)                 (In)
----------------------------------------------------------------------
  1              0.0053            0.0024              0.0029
  2              0.0053            0.0024              0.0029
  3              0.0053            0.0024              0.0029
  4              0.0053            0.0024              0.0029
  5              0.0053            0.0024              0.0029
  6              0.0054            0.0024              0.0030
  7              0.0054            0.0024              0.0030
  8              0.0054            0.0024              0.0030
  9              0.0054            0.0024              0.0030
 10              0.0054            0.0024              0.0030
 11              0.0054            0.0024              0.0030
 12              0.0054            0.0024              0.0030
 13              0.0055            0.0024              0.0030
 14              0.0055            0.0024              0.0030
 15              0.0055            0.0025              0.0030
 16              0.0055            0.0025              0.0030
 17              0.0055            0.0025              0.0030
 18              0.0055            0.0025              0.0031
 19              0.0055            0.0025              0.0031
 20              0.0056            0.0025              0.0031
 21              0.0056            0.0025              0.0031
 22              0.0056            0.0025              0.0031
 23              0.0056            0.0025              0.0031
 24              0.0056            0.0025              0.0031
 25              0.0056            0.0025              0.0031
 26              0.0057            0.0025              0.0031
 27              0.0057            0.0025              0.0031
 28              0.0057            0.0025              0.0031
 29              0.0057            0.0026              0.0032
 30              0.0057            0.0026              0.0032
 31              0.0057            0.0026              0.0032
 32              0.0058            0.0026              0.0032
 33              0.0058            0.0026              0.0032
```

34	0.0058	0.0026	0.0032
35	0.0058	0.0026	0.0032
36	0.0058	0.0026	0.0032
37	0.0059	0.0026	0.0032
38	0.0059	0.0026	0.0032
39	0.0059	0.0026	0.0033
40	0.0059	0.0026	0.0033
41	0.0059	0.0027	0.0033
42	0.0059	0.0027	0.0033
43	0.0060	0.0027	0.0033
44	0.0060	0.0027	0.0033
45	0.0060	0.0027	0.0033
46	0.0060	0.0027	0.0033
47	0.0060	0.0027	0.0033
48	0.0061	0.0027	0.0033
49	0.0061	0.0027	0.0034
50	0.0061	0.0027	0.0034
51	0.0061	0.0027	0.0034
52	0.0061	0.0028	0.0034
53	0.0062	0.0028	0.0034
54	0.0062	0.0028	0.0034
55	0.0062	0.0028	0.0034
56	0.0062	0.0028	0.0034
57	0.0063	0.0028	0.0035
58	0.0063	0.0028	0.0035
59	0.0063	0.0028	0.0035
60	0.0063	0.0028	0.0035
61	0.0063	0.0028	0.0035
62	0.0064	0.0029	0.0035
63	0.0064	0.0029	0.0035
64	0.0064	0.0029	0.0035
65	0.0064	0.0029	0.0036
66	0.0065	0.0029	0.0036
67	0.0065	0.0029	0.0036
68	0.0065	0.0029	0.0036
69	0.0065	0.0029	0.0036
70	0.0066	0.0029	0.0036
71	0.0066	0.0030	0.0036
72	0.0066	0.0030	0.0037
73	0.0067	0.0030	0.0037
74	0.0067	0.0030	0.0037
75	0.0067	0.0030	0.0037
76	0.0067	0.0030	0.0037
77	0.0068	0.0030	0.0037
78	0.0068	0.0030	0.0037
79	0.0068	0.0031	0.0038
80	0.0068	0.0031	0.0038
81	0.0069	0.0031	0.0038
82	0.0069	0.0031	0.0038
83	0.0069	0.0031	0.0038

84	0.0070	0.0031	0.0038
85	0.0070	0.0031	0.0039
86	0.0070	0.0031	0.0039
87	0.0071	0.0032	0.0039
88	0.0071	0.0032	0.0039
89	0.0071	0.0032	0.0039
90	0.0072	0.0032	0.0040
91	0.0072	0.0032	0.0040
92	0.0072	0.0032	0.0040
93	0.0073	0.0033	0.0040
94	0.0073	0.0033	0.0040
95	0.0073	0.0033	0.0041
96	0.0074	0.0033	0.0041
97	0.0074	0.0033	0.0041
98	0.0074	0.0033	0.0041
99	0.0075	0.0034	0.0041
100	0.0075	0.0034	0.0042
101	0.0076	0.0034	0.0042
102	0.0076	0.0034	0.0042
103	0.0077	0.0034	0.0042
104	0.0077	0.0034	0.0042
105	0.0077	0.0035	0.0043
106	0.0078	0.0035	0.0043
107	0.0078	0.0035	0.0043
108	0.0079	0.0035	0.0043
109	0.0079	0.0035	0.0044
110	0.0080	0.0036	0.0044
111	0.0080	0.0036	0.0044
112	0.0080	0.0036	0.0044
113	0.0081	0.0036	0.0045
114	0.0081	0.0036	0.0045
115	0.0082	0.0037	0.0045
116	0.0082	0.0037	0.0046
117	0.0083	0.0037	0.0046
118	0.0084	0.0037	0.0046
119	0.0084	0.0038	0.0047
120	0.0085	0.0038	0.0047
121	0.0085	0.0038	0.0047
122	0.0086	0.0038	0.0047
123	0.0087	0.0039	0.0048
124	0.0087	0.0039	0.0048
125	0.0088	0.0039	0.0048
126	0.0088	0.0040	0.0049
127	0.0089	0.0040	0.0049
128	0.0090	0.0040	0.0049
129	0.0091	0.0041	0.0050
130	0.0091	0.0041	0.0050
131	0.0092	0.0041	0.0051
132	0.0092	0.0041	0.0051
133	0.0093	0.0042	0.0052

134	0.0094	0.0042	0.0052
135	0.0095	0.0043	0.0052
136	0.0096	0.0043	0.0053
137	0.0097	0.0043	0.0053
138	0.0097	0.0044	0.0054
139	0.0098	0.0044	0.0054
140	0.0099	0.0044	0.0055
141	0.0100	0.0045	0.0055
142	0.0101	0.0045	0.0056
143	0.0102	0.0046	0.0056
144	0.0103	0.0046	0.0057
145	0.0085	0.0038	0.0047
146	0.0086	0.0038	0.0047
147	0.0087	0.0039	0.0048
148	0.0088	0.0039	0.0048
149	0.0089	0.0040	0.0049
150	0.0090	0.0040	0.0050
151	0.0092	0.0041	0.0051
152	0.0093	0.0042	0.0051
153	0.0094	0.0042	0.0052
154	0.0095	0.0043	0.0053
155	0.0097	0.0044	0.0054
156	0.0098	0.0044	0.0054
157	0.0100	0.0045	0.0055
158	0.0102	0.0046	0.0056
159	0.0104	0.0047	0.0057
160	0.0105	0.0047	0.0058
161	0.0108	0.0048	0.0059
162	0.0109	0.0049	0.0060
163	0.0112	0.0050	0.0062
164	0.0113	0.0051	0.0063
165	0.0117	0.0052	0.0064
166	0.0118	0.0053	0.0065
167	0.0122	0.0055	0.0067
168	0.0124	0.0055	0.0068
169	0.0128	0.0057	0.0071
170	0.0130	0.0058	0.0072
171	0.0135	0.0060	0.0074
172	0.0137	0.0061	0.0076
173	0.0142	0.0064	0.0079
174	0.0145	0.0065	0.0080
175	0.0152	0.0068	0.0084
176	0.0155	0.0069	0.0086
177	0.0163	0.0073	0.0090
178	0.0167	0.0075	0.0092
179	0.0176	0.0079	0.0097
180	0.0181	0.0081	0.0100
181	0.0193	0.0086	0.0107
182	0.0200	0.0089	0.0110
183	0.0215	0.0096	0.0119

184	0.0225	0.0101	0.0124
185	0.0178	0.0080	0.0098
186	0.0190	0.0085	0.0105
187	0.0220	0.0099	0.0122
188	0.0240	0.0108	0.0133
189	0.0299	0.0134	0.0165
190	0.0344	0.0154	0.0190
191	0.0523	0.0234	0.0288
192	0.0759	0.0275	0.0484
193	0.3282	0.0275	0.3007
194	0.0411	0.0184	0.0227
195	0.0266	0.0119	0.0147
196	0.0204	0.0091	0.0112
197	0.0235	0.0105	0.0130
198	0.0207	0.0093	0.0114
199	0.0187	0.0084	0.0103
200	0.0171	0.0077	0.0094
201	0.0159	0.0071	0.0088
202	0.0148	0.0066	0.0082
203	0.0140	0.0063	0.0077
204	0.0132	0.0059	0.0073
205	0.0126	0.0056	0.0069
206	0.0120	0.0054	0.0066
207	0.0115	0.0051	0.0063
208	0.0110	0.0049	0.0061
209	0.0106	0.0048	0.0059
210	0.0103	0.0046	0.0057
211	0.0099	0.0045	0.0055
212	0.0096	0.0043	0.0053
213	0.0094	0.0042	0.0052
214	0.0091	0.0041	0.0050
215	0.0089	0.0040	0.0049
216	0.0086	0.0039	0.0048
217	0.0104	0.0046	0.0057
218	0.0101	0.0045	0.0056
219	0.0100	0.0045	0.0055
220	0.0098	0.0044	0.0054
221	0.0096	0.0043	0.0053
222	0.0094	0.0042	0.0052
223	0.0093	0.0042	0.0051
224	0.0091	0.0041	0.0050
225	0.0090	0.0040	0.0050
226	0.0089	0.0040	0.0049
227	0.0087	0.0039	0.0048
228	0.0086	0.0039	0.0048
229	0.0085	0.0038	0.0047
230	0.0084	0.0038	0.0046
231	0.0083	0.0037	0.0046
232	0.0082	0.0037	0.0045
233	0.0081	0.0036	0.0045

234	0.0080	0.0036	0.0044
235	0.0079	0.0035	0.0044
236	0.0078	0.0035	0.0043
237	0.0077	0.0035	0.0043
238	0.0076	0.0034	0.0042
239	0.0075	0.0034	0.0042
240	0.0075	0.0033	0.0041
241	0.0074	0.0033	0.0041
242	0.0073	0.0033	0.0040
243	0.0072	0.0032	0.0040
244	0.0072	0.0032	0.0040
245	0.0071	0.0032	0.0039
246	0.0070	0.0032	0.0039
247	0.0070	0.0031	0.0039
248	0.0069	0.0031	0.0038
249	0.0069	0.0031	0.0038
250	0.0068	0.0030	0.0038
251	0.0067	0.0030	0.0037
252	0.0067	0.0030	0.0037
253	0.0066	0.0030	0.0037
254	0.0066	0.0029	0.0036
255	0.0065	0.0029	0.0036
256	0.0065	0.0029	0.0036
257	0.0064	0.0029	0.0035
258	0.0064	0.0029	0.0035
259	0.0063	0.0028	0.0035
260	0.0063	0.0028	0.0035
261	0.0062	0.0028	0.0034
262	0.0062	0.0028	0.0034
263	0.0062	0.0028	0.0034
264	0.0061	0.0027	0.0034
265	0.0061	0.0027	0.0034
266	0.0060	0.0027	0.0033
267	0.0060	0.0027	0.0033
268	0.0060	0.0027	0.0033
269	0.0059	0.0026	0.0033
270	0.0059	0.0026	0.0032
271	0.0058	0.0026	0.0032
272	0.0058	0.0026	0.0032
273	0.0058	0.0026	0.0032
274	0.0057	0.0026	0.0032
275	0.0057	0.0026	0.0031
276	0.0057	0.0025	0.0031
277	0.0056	0.0025	0.0031
278	0.0056	0.0025	0.0031
279	0.0056	0.0025	0.0031
280	0.0055	0.0025	0.0031
281	0.0055	0.0025	0.0030
282	0.0055	0.0025	0.0030
283	0.0054	0.0024	0.0030

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      284                0.0054           0.0024              0.0030
      285                0.0054           0.0024              0.0030
      286                0.0054           0.0024              0.0030
      287                0.0053           0.0024              0.0029
      288                0.0053           0.0024              0.0029
      --------------------------------------------------------------------
      --------------------------------------------------------------------
      Total soil rain loss =      1.20(In)
      Total effective rainfall =      1.77(In)
      Peak flow rate in flood hydrograph =     16.76(CFS)
      ---------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R    S T O R M
                     R u n o f f      H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5       0.0001      0.02  Q         |         |         |         |
  0+10       0.0011      0.14  Q         |         |         |         |
  0+15       0.0030      0.28  Q         |         |         |         |
  0+20       0.0053      0.34  Q         |         |         |         |
  0+25       0.0078      0.37  Q         |         |         |         |
  0+30       0.0106      0.40  Q         |         |         |         |
  0+35       0.0134      0.41  Q         |         |         |         |
  0+40       0.0163      0.42  Q         |         |         |         |
  0+45       0.0193      0.43  Q         |         |         |         |
  0+50       0.0224      0.44  Q         |         |         |         |
  0+55       0.0255      0.45  Q         |         |         |         |
  1+ 0       0.0286      0.45  Q         |         |         |         |
  1+ 5       0.0317      0.46  Q         |         |         |         |
  1+10       0.0349      0.46  Q         |         |         |         |
  1+15       0.0381      0.46  Q         |         |         |         |
  1+20       0.0413      0.47  Q         |         |         |         |
  1+25       0.0445      0.47  Q         |         |         |         |
  1+30       0.0478      0.47  QV        |         |         |         |
  1+35       0.0510      0.47  QV        |         |         |         |
  1+40       0.0543      0.47  QV        |         |         |         |
  1+45       0.0575      0.47  QV        |         |         |         |
  1+50       0.0608      0.47  QV        |         |         |         |
  1+55       0.0641      0.48  QV        |         |         |         |
  2+ 0       0.0674      0.48  QV        |         |         |         |
  2+ 5       0.0707      0.48  QV        |         |         |         |
  2+10       0.0740      0.48  QV        |         |         |         |
  2+15       0.0773      0.48  QV        |         |         |         |
  2+20       0.0806      0.48  QV        |         |         |         |
  2+25       0.0839      0.48  QV        |         |         |         |
  2+30       0.0873      0.49  QV        |         |         |         |
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2+35       0.0906      0.49  QV        |         |         |         |
2+40       0.0940      0.49  QV        |         |         |         |
2+45       0.0974      0.49  Q V       |         |         |         |
2+50       0.1008      0.49  Q V       |         |         |         |
2+55       0.1042      0.49  Q V       |         |         |         |
3+ 0       0.1076      0.49  Q V       |         |         |         |
3+ 5       0.1110      0.50  Q V       |         |         |         |
3+10       0.1144      0.50  Q V       |         |         |         |
3+15       0.1179      0.50  Q V       |         |         |         |
3+20       0.1213      0.50  |QV       |         |         |         |
3+25       0.1248      0.50  |QV       |         |         |         |
3+30       0.1282      0.50  |QV       |         |         |         |
3+35       0.1317      0.51  |QV       |         |         |         |
3+40       0.1352      0.51  |QV       |         |         |         |
3+45       0.1387      0.51  |QV       |         |         |         |
3+50       0.1422      0.51  |Q V      |         |         |         |
3+55       0.1458      0.51  |Q V      |         |         |         |
4+ 0       0.1493      0.51  |Q V      |         |         |         |
4+ 5       0.1528      0.52  |Q V      |         |         |         |
4+10       0.1564      0.52  |Q V      |         |         |         |
4+15       0.1600      0.52  |Q V      |         |         |         |
4+20       0.1636      0.52  |Q V      |         |         |         |
4+25       0.1672      0.52  |Q V      |         |         |         |
4+30       0.1708      0.52  |Q V      |         |         |         |
4+35       0.1744      0.53  |Q V      |         |         |         |
4+40       0.1780      0.53  |Q V      |         |         |         |
4+45       0.1817      0.53  |Q V      |         |         |         |
4+50       0.1853      0.53  |Q V      |         |         |         |
4+55       0.1890      0.53  |Q  V     |         |         |         |
5+ 0       0.1927      0.54  |Q  V     |         |         |         |
5+ 5       0.1964      0.54  |Q  V     |         |         |         |
5+10       0.2001      0.54  |Q  V     |         |         |         |
5+15       0.2038      0.54  |Q  V     |         |         |         |
5+20       0.2076      0.54  |Q  V     |         |         |         |
5+25       0.2113      0.55  |Q  V     |         |         |         |
5+30       0.2151      0.55  |Q  V     |         |         |         |
5+35       0.2189      0.55  |Q  V     |         |         |         |
5+40       0.2227      0.55  |Q  V     |         |         |         |
5+45       0.2265      0.55  |Q  V     |         |         |         |
5+50       0.2303      0.56  |Q  V     |         |         |         |
5+55       0.2342      0.56  |Q  V     |         |         |         |
6+ 0       0.2380      0.56  |Q   V    |         |         |         |
6+ 5       0.2419      0.56  |Q   V    |         |         |         |
6+10       0.2458      0.56  |Q   V    |         |         |         |
6+15       0.2497      0.57  |Q   V    |         |         |         |
6+20       0.2536      0.57  |Q   V    |         |         |         |
6+25       0.2576      0.57  |Q   V    |         |         |         |
6+30       0.2615      0.57  |Q   V    |         |         |         |
6+35       0.2655      0.58  |Q   V    |         |         |         |
6+40       0.2695      0.58  |Q   V    |         |         |         |
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 6+45       0.2735      0.58  |Q   V    |         |         |         |
 6+50       0.2775      0.58  |Q   V    |         |         |         |
 6+55       0.2815      0.59  |Q   V    |         |         |         |
 7+ 0       0.2856      0.59  |Q    V   |         |         |         |
 7+ 5       0.2896      0.59  |Q    V   |         |         |         |
 7+10       0.2937      0.59  |Q    V   |         |         |         |
 7+15       0.2978      0.60  |Q    V   |         |         |         |
 7+20       0.3020      0.60  |Q    V   |         |         |         |
 7+25       0.3061      0.60  |Q    V   |         |         |         |
 7+30       0.3103      0.60  |Q    V   |         |         |         |
 7+35       0.3145      0.61  |Q    V   |         |         |         |
 7+40       0.3187      0.61  |Q    V   |         |         |         |
 7+45       0.3229      0.61  |Q    V   |         |         |         |
 7+50       0.3271      0.62  |Q    V   |         |         |         |
 7+55       0.3314      0.62  |Q     V  |         |         |         |
 8+ 0       0.3357      0.62  |Q     V  |         |         |         |
 8+ 5       0.3400      0.63  |Q     V  |         |         |         |
 8+10       0.3443      0.63  |Q     V  |         |         |         |
 8+15       0.3487      0.63  |Q     V  |         |         |         |
 8+20       0.3531      0.63  |Q     V  |         |         |         |
 8+25       0.3574      0.64  |Q     V  |         |         |         |
 8+30       0.3619      0.64  |Q     V  |         |         |         |
 8+35       0.3663      0.64  |Q     V  |         |         |         |
 8+40       0.3708      0.65  |Q     V  |         |         |         |
 8+45       0.3753      0.65  |Q     V  |         |         |         |
 8+50       0.3798      0.66  |Q      V |         |         |         |
 8+55       0.3843      0.66  |Q      V |         |         |         |
 9+ 0       0.3889      0.66  |Q      V |         |         |         |
 9+ 5       0.3935      0.67  |Q      V |         |         |         |
 9+10       0.3981      0.67  |Q      V |         |         |         |
 9+15       0.4027      0.67  |Q      V |         |         |         |
 9+20       0.4074      0.68  |Q      V |         |         |         |
 9+25       0.4121      0.68  |Q      V |         |         |         |
 9+30       0.4168      0.69  |Q      V |         |         |         |
 9+35       0.4215      0.69  |Q      V |         |         |         |
 9+40       0.4263      0.69  |Q       V|         |         |         |
 9+45       0.4311      0.70  |Q       V|         |         |         |
 9+50       0.4360      0.70  |Q       V|         |         |         |
 9+55       0.4408      0.71  |Q       V|         |         |         |
10+ 0       0.4458      0.71  |Q       V|         |         |         |
10+ 5       0.4507      0.72  |Q       V|         |         |         |
10+10       0.4557      0.72  |Q       V|         |         |         |
10+15       0.4607      0.73  |Q       V|         |         |         |
10+20       0.4657      0.73  |Q       V|         |         |         |
10+25       0.4708      0.74  |Q       V|         |         |         |
10+30       0.4759      0.74  |Q        V         |         |         |
10+35       0.4810      0.75  |Q        V         |         |         |
10+40       0.4862      0.75  |Q        V         |         |         |
10+45       0.4914      0.76  |Q        V         |         |         |
10+50       0.4966      0.76  |Q        V         |         |         |
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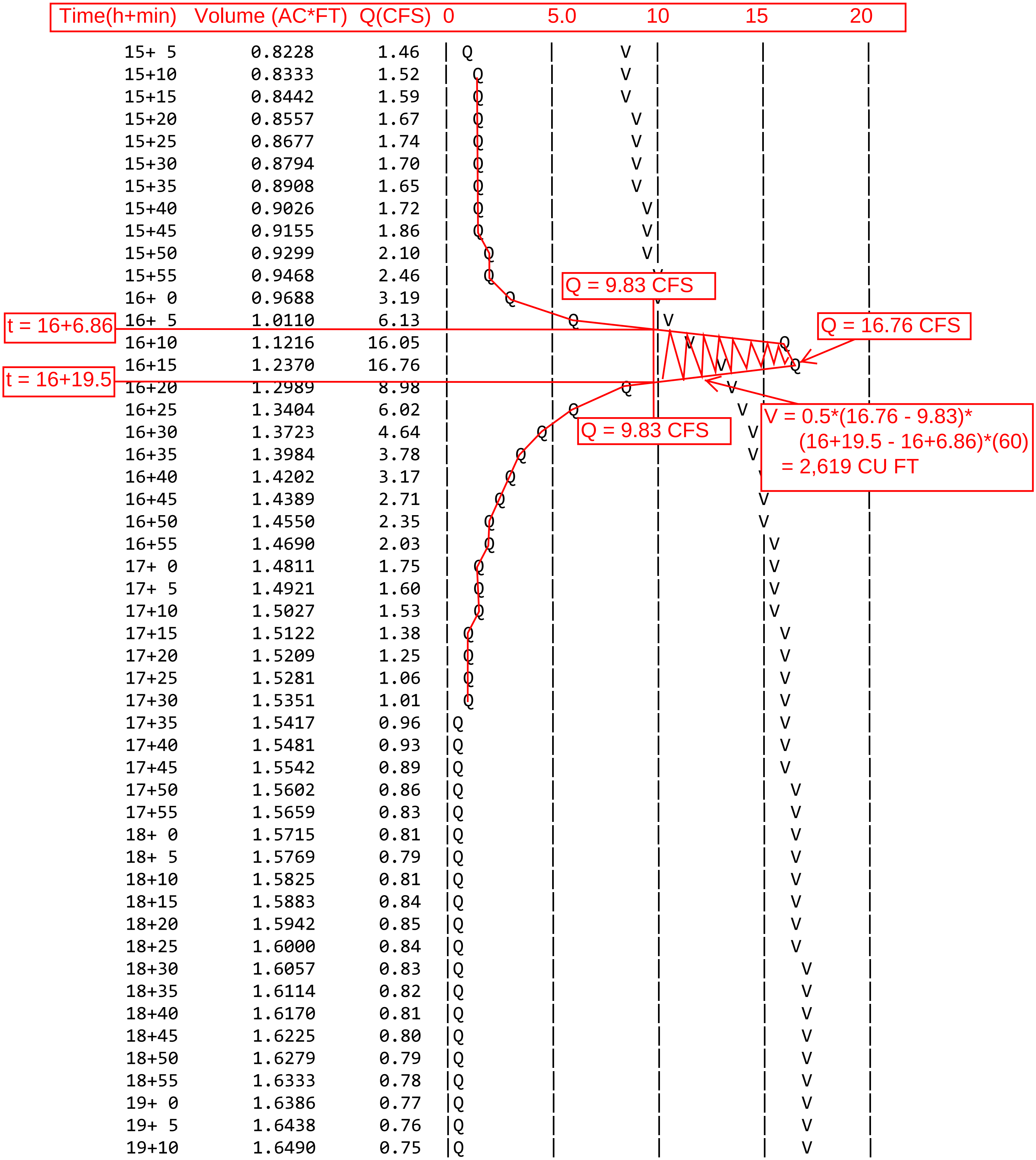
10+55       0.5019      0.77  |Q        V         |         |         |
11+ 0       0.5073      0.77  |Q        V         |         |         |
11+ 5       0.5126      0.78  |Q        V         |         |         |
11+10       0.5181      0.79  |Q        V         |         |         |
11+15       0.5235      0.79  |Q        |V        |         |         |
11+20       0.5290      0.80  |Q        |V        |         |         |
11+25       0.5346      0.81  |Q        |V        |         |         |
11+30       0.5402      0.81  |Q        |V        |         |         |
11+35       0.5458      0.82  |Q        |V        |         |         |
11+40       0.5515      0.83  |Q        |V        |         |         |
11+45       0.5573      0.83  |Q        |V        |         |         |
11+50       0.5630      0.84  |Q        |V        |         |         |
11+55       0.5689      0.85  |Q        | V       |         |         |
12+ 0       0.5748      0.86  |Q        | V       |         |         |
12+ 5       0.5807      0.86  |Q        | V       |         |         |
12+10       0.5864      0.82  |Q        | V       |         |         |
12+15       0.5918      0.78  |Q        | V       |         |         |
12+20       0.5971      0.77  |Q        | V       |         |         |
12+25       0.6023      0.77  |Q        | V       |         |         |
12+30       0.6076      0.77  |Q        | V       |         |         |
12+35       0.6129      0.77  |Q        |  V      |         |         |
12+40       0.6183      0.78  |Q        |  V      |         |         |
12+45       0.6237      0.78  |Q        |  V      |         |         |
12+50       0.6291      0.79  |Q        |  V      |         |         |
12+55       0.6346      0.80  |Q        |  V      |         |         |
13+ 0       0.6402      0.81  |Q        |  V      |         |         |
13+ 5       0.6459      0.82  |Q        |  V      |         |         |
13+10       0.6516      0.83  |Q        |  V      |         |         |
13+15       0.6575      0.85  |Q        |  V      |         |         |
13+20       0.6634      0.86  |Q        |   V     |         |         |
13+25       0.6694      0.87  |Q        |   V     |         |         |
13+30       0.6755      0.89  |Q        |   V     |         |         |
13+35       0.6818      0.91  |Q        |   V     |         |         |
13+40       0.6881      0.92  |Q        |   V     |         |         |
13+45       0.6946      0.94  |Q        |   V     |         |         |
13+50       0.7012      0.96  |Q        |   V     |         |         |
13+55       0.7079      0.98  |Q        |    V    |         |         |
14+ 0       0.7148      1.00  |Q        |    V    |         |         |
14+ 5       0.7218      1.02  | Q       |    V    |         |         |
14+10       0.7290      1.04  | Q       |    V    |         |         |
14+15       0.7364      1.07  | Q       |    V    |         |         |
14+20       0.7439      1.10  | Q       |    V    |         |         |
14+25       0.7517      1.12  | Q       |    V    |         |         |
14+30       0.7596      1.15  | Q       |     V   |         |         |
14+35       0.7678      1.19  | Q       |     V   |         |         |
14+40       0.7762      1.22  | Q       |     V   |         |         |
14+45       0.7849      1.26  | Q       |     V   |         |         |
14+50       0.7939      1.30  | Q       |     V   |         |         |
14+55       0.8032      1.35  | Q       |      V  |         |         |
15+ 0       0.8128      1.40  | Q       |      V  |         |         |
```



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15+ 5        0.8228         1.46  | Q       |      V  |         |         |
15+10        0.8333         1.52  |  Q      |      V  |         |         |
15+15        0.8442         1.59  |  Q      |      V  |         |         |
15+20        0.8557         1.67  |  Q      |       V |         |         |
15+25        0.8677         1.74  |  Q      |       V |         |         |
15+30        0.8794         1.70  |  Q      |       V |         |         |
15+35        0.8908         1.65  |  Q      |       V |         |         |
15+40        0.9026         1.72  |  Q      |        V|         |         |
15+45        0.9155         1.86  |  Q      |        V|         |         |
15+50        0.9299         2.10  |   Q     |        V|         |         |
15+55        0.9468         2.46  |   Q     |         V         |         |
16+ 0        0.9688         3.19  |     Q   |         V         |         |
16+ 5        1.0110         6.13  |         | Q       |V        |         |
16+10        1.1216        16.05  |         |         |  V      | Q       |
16+15        1.2370        16.76  |         |         |     V   |  Q      |
16+20        1.2989         8.98  |         |      Q  |      V  |         |
16+25        1.3404         6.02  |         | Q       |       V |         |
16+30        1.3723         4.64  |        Q|         |        V|         |
16+35        1.3984         3.78  |      Q  |         |        V|         |
16+40        1.4202         3.17  |     Q   |         |         V         |
16+45        1.4389         2.71  |    Q    |         |         V         |
16+50        1.4550         2.35  |   Q     |         |         V         |
16+55        1.4690         2.03  |   Q     |         |         |V        |
17+ 0        1.4811         1.75  |  Q      |         |         |V        |
17+ 5        1.4921         1.60  |  Q      |         |         |V        |
17+10        1.5027         1.53  |  Q      |         |         |V        |
17+15        1.5122         1.38  | Q       |         |         | V       |
17+20        1.5209         1.25  | Q       |         |         | V       |
17+25        1.5281         1.06  | Q       |         |         | V       |
17+30        1.5351         1.01  | Q       |         |         | V       |
17+35        1.5417         0.96  |Q        |         |         | V       |
17+40        1.5481         0.93  |Q        |         |         | V       |
17+45        1.5542         0.89  |Q        |         |         | V       |
17+50        1.5602         0.86  |Q        |         |         |  V      |
17+55        1.5659         0.83  |Q        |         |         |  V      |
18+ 0        1.5715         0.81  |Q        |         |         |  V      |
18+ 5        1.5769         0.79  |Q        |         |         |  V      |
18+10        1.5825         0.81  |Q        |         |         |  V      |
18+15        1.5883         0.84  |Q        |         |         |  V      |
18+20        1.5942         0.85  |Q        |         |         |  V      |
18+25        1.6000         0.84  |Q        |         |         |  V      |
18+30        1.6057         0.83  |Q        |         |         |   V     |
18+35        1.6114         0.82  |Q        |         |         |   V     |
18+40        1.6170         0.81  |Q        |         |         |   V     |
18+45        1.6225         0.80  |Q        |         |         |   V     |
18+50        1.6279         0.79  |Q        |         |         |   V     |
18+55        1.6333         0.78  |Q        |         |         |   V     |
19+ 0        1.6386         0.77  |Q        |         |         |   V     |
19+ 5        1.6438         0.76  |Q        |         |         |   V     |
19+10        1.6490         0.75  |Q        |         |         |   V     |
```

V = 0.5*(16.76 - 9.83)*
(16+19.5 - 16+6.86)*(60)
= 2,619 CU FT

```
19+15       1.6541      0.74  |Q        |         |         |    V    |
19+20       1.6591      0.73  |Q        |         |         |    V    |
19+25       1.6640      0.72  |Q        |         |         |    V    |
19+30       1.6689      0.71  |Q        |         |         |    V    |
19+35       1.6737      0.70  |Q        |         |         |    V    |
19+40       1.6785      0.69  |Q        |         |         |    V    |
19+45       1.6832      0.68  |Q        |         |         |    V    |
19+50       1.6879      0.68  |Q        |         |         |    V    |
19+55       1.6925      0.67  |Q        |         |         |    V    |
20+ 0       1.6970      0.66  |Q        |         |         |     V   |
20+ 5       1.7015      0.65  |Q        |         |         |     V   |
20+10       1.7060      0.65  |Q        |         |         |     V   |
20+15       1.7104      0.64  |Q        |         |         |     V   |
20+20       1.7148      0.63  |Q        |         |         |     V   |
20+25       1.7191      0.63  |Q        |         |         |     V   |
20+30       1.7234      0.62  |Q        |         |         |     V   |
20+35       1.7276      0.61  |Q        |         |         |     V   |
20+40       1.7318      0.61  |Q        |         |         |     V   |
20+45       1.7359      0.60  |Q        |         |         |     V   |
20+50       1.7401      0.60  |Q        |         |         |     V   |
20+55       1.7441      0.59  |Q        |         |         |      V  |
21+ 0       1.7482      0.59  |Q        |         |         |      V  |
21+ 5       1.7522      0.58  |Q        |         |         |      V  |
21+10       1.7562      0.58  |Q        |         |         |      V  |
21+15       1.7601      0.57  |Q        |         |         |      V  |
21+20       1.7640      0.57  |Q        |         |         |      V  |
21+25       1.7679      0.56  |Q        |         |         |      V  |
21+30       1.7718      0.56  |Q        |         |         |      V  |
21+35       1.7756      0.55  |Q        |         |         |      V  |
21+40       1.7794      0.55  |Q        |         |         |      V  |
21+45       1.7831      0.55  |Q        |         |         |      V  |
21+50       1.7869      0.54  |Q        |         |         |      V  |
21+55       1.7906      0.54  |Q        |         |         |      V  |
22+ 0       1.7943      0.53  |Q        |         |         |       V |
22+ 5       1.7979      0.53  |Q        |         |         |       V |
22+10       1.8015      0.53  |Q        |         |         |       V |
22+15       1.8051      0.52  |Q        |         |         |       V |
22+20       1.8087      0.52  |Q        |         |         |       V |
22+25       1.8123      0.52  |Q        |         |         |       V |
22+30       1.8158      0.51  |Q        |         |         |       V |
22+35       1.8193      0.51  |Q        |         |         |       V |
22+40       1.8228      0.51  |Q        |         |         |       V |
22+45       1.8263      0.50  |Q        |         |         |       V |
22+50       1.8297      0.50  Q         |         |         |       V |
22+55       1.8331      0.50  Q         |         |         |       V |
23+ 0       1.8365      0.49  Q         |         |         |       V |
23+ 5       1.8399      0.49  Q         |         |         |        V|
23+10       1.8433      0.49  Q         |         |         |        V|
23+15       1.8466      0.48  Q         |         |         |        V|
23+20       1.8499      0.48  Q         |         |         |        V|
```

```
   23+25        1.8532      0.48  Q          |          |          |        V|
   23+30        1.8565      0.48  Q          |          |          |        V|
   23+35        1.8598      0.47  Q          |          |          |        V|
   23+40        1.8630      0.47  Q          |          |          |        V|
   23+45        1.8663      0.47  Q          |          |          |        V|
   23+50        1.8695      0.47  Q          |          |          |        V|
   23+55        1.8727      0.46  Q          |          |          |        V|
   24+ 0        1.8758      0.46  Q          |          |          |        V|
-----------------------------------------------------------------------
```

RATIONAL METHOD &

UNIT HYDROGRAPH HYDROLOGY

ONSITE PRE-DEVELOPED

10-YEAR

STORM EVENTS

DRAINAGE AREA 1

```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
        Rational Hydrology Study       Date: 08/13/21
------------------------------------------------------------------------
10 Year Rational Analysis Pre Development
Former Track 17846
Drainage Area 2
File: 17486Rat10PreA2.out
------------------------------------------------------------------------


Program License Serial Number 4070

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
Computed rainfall intensity:
Storm year =    10.00   1 hour rainfall =     0.692 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 3



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Initial subarea data:
Initial area flow distance =   708.700(Ft.)
Top (of initial area) elevation =  3293.000(Ft.)
Bottom (of initial area) elevation =  3284.000(Ft.)
Difference in elevation =     9.000(Ft.)
Slope =    0.01270  s(%)=       1.27
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   23.347 min.
Rainfall intensity =      1.340(In/Hr) for a    10.0 year storm
```

```
Effective runoff coefficient used for area (Q=KCIA) is C = 0.542
Subarea runoff =      5.123(CFS)
Total initial stream area =        7.050(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.532(In/Hr)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.172(Ft.), Average velocity =   1.167(Ft/s)
        ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.43
        2             60.04              0.00
        3            150.00              0.43
Manning's 'N' friction factor =   0.030
-----------------------------------------------------------------
Sub-Channel flow  =      6.013(CFS)
  '     '        flow top width =     59.949(Ft.)
  '     '    velocity=    1.167(Ft/s)
  '     '        area =      5.151(Sq.Ft)
  '     '        Froude number =     0.702

Upstream point elevation =  3284.000(Ft.)
Downstream point elevation =  3279.000(Ft.)
Flow length =   341.400(Ft.)
Travel time  =    4.87 min.
Time of concentration =   28.22 min.
Depth of flow =   0.172(Ft.)
Average velocity =   1.167(Ft/s)
Total irregular channel flow =     6.013(CFS)
Irregular channel normal depth above invert elev. =   0.172(Ft.)
Average velocity of channel(s) =   1.167(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Rainfall intensity =      1.173(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
```

```
rational method)(Q=KCIA) is C = 0.492
Subarea runoff =      1.717(CFS) for    4.810(Ac.)
Total runoff =      6.840(CFS)
Effective area this stream =       11.86(Ac.)
Total Study Area (Main Stream No. 1) =       11.86(Ac.)
Area averaged Fm value =    0.532(In/Hr)
Depth of flow =   0.180(Ft.), Average velocity =   1.205(Ft/s)
End of computations, Total Study Area =           11.86 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  50.0
```

```
        U n i t   H y d r o g r a p h   A n a l y s i s

        Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

                Study date  08/13/21

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
------------------------------------------------------------------------

San Bernardino County Synthetic Unit Hydrology Method
                Manual date - August 1986


Program License Serial Number 4070

---------------------------------------------------------------------
10 Year Unit Hydrograph Pre Development For HCOC
Former Track 17486
Drainage Area 2
File: 17486Hydr10PreA2.out
--------------------------------------------------------------------

        Storm Event Year = 10

        Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




Area averaged rainfall intensity isohyetal data:
        Sub-Area        Duration        Isohyetal
        (Ac.)            (hours)         (In)
Rainfall data for year 10
            12.82            1           0.69
--------------------------------------------------------------------
Rainfall data for year 10
            12.82            6           1.46
--------------------------------------------------------------------
Rainfall data for year 10
            12.82           24           2.97
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
******** Area-averaged max loss rate, Fm ********


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 50.0      70.0         12.82      1.000     0.532    1.000    0.532

Area-averaged adjusted loss rate Fm (In/Hr) =  0.532

********* Area-Averaged low loss rate fraction, Yb **********

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
    12.82   1.000         50.0      70.0       4.29     0.235

Area-averaged catchment yield fraction, Y =  0.235
Area-averaged low loss fraction, Yb =  0.765
User entry of time of concentration  =   0.470 (hours)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =      12.82(Ac.)
Catchment Lag time =   0.376 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 22.1631
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.532(In/Hr)
Average low loss rate fraction (Yb) = 0.765 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall =  0.328(In)
Computed peak 30-minute rainfall =  0.562(In)
Specified peak 1-hour rainfall =  0.692(In)
Computed peak 3-hour rainfall =  1.094(In)
Specified peak 6-hour rainfall =  1.460(In)
Specified peak 24-hour rainfall =  2.970(In)


Rainfall depth area reduction factors:
Using a total area of      12.82(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999     Adjusted rainfall =  0.328(In)
30-minute factor = 0.999    Adjusted rainfall =  0.562(In)
1-hour factor = 0.999       Adjusted rainfall =  0.692(In)
3-hour factor = 1.000       Adjusted rainfall =  1.094(In)
6-hour factor = 1.000       Adjusted rainfall =  1.460(In)
24-hour factor = 1.000      Adjusted rainfall =  2.970(In)
---------------------------------------------------------------------

                        U n i t  H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Interval          'S' Graph          Unit Hydrograph
```

```
Number            Mean values             ((CFS))
---------------------------------------------------------------------
                (K =       155.04 (CFS))

  1                1.144                   1.773
  2                5.352                   6.524
  3               14.320                  13.904
  4               33.220                  29.303
  5               49.513                  25.262
  6               59.996                  16.253
  7               66.895                  10.696
  8               72.193                   8.213
  9               76.330                   6.414
 10               79.692                   5.213
 11               82.427                   4.240
 12               84.758                   3.614
 13               86.834                   3.219
 14               88.588                   2.721
 15               89.977                   2.153
 16               91.234                   1.949
 17               92.353                   1.735
 18               93.366                   1.570
 19               94.240                   1.356
 20               94.994                   1.169
 21               95.705                   1.102
 22               96.289                   0.906
 23               96.848                   0.867
 24               97.275                   0.662
 25               97.671                   0.614
 26               97.952                   0.435
 27               98.173                   0.344
 28               98.414                   0.373
 29               98.680                   0.412
 30               98.946                   0.412
 31               99.212                   0.412
 32               99.467                   0.395
 33               99.627                   0.248
 34               99.765                   0.215
 35               99.904                   0.215
 36              100.000                   0.149
---------------------------------------------------------------------
Peak Unit   Adjusted mass rainfall  Unit rainfall
Number              (In)                (In)
  1              0.3282                0.3282
  2              0.4040                0.0759
  3              0.4563                0.0523
  4              0.4974                0.0411
  5              0.5318                0.0344
  6              0.5617                0.0299
  7              0.5883                0.0266
```

8	0.6124	0.0240
9	0.6344	0.0220
10	0.6548	0.0204
11	0.6738	0.0190
12	0.6916	0.0178
13	0.7151	0.0235
14	0.7375	0.0225
15	0.7591	0.0215
16	0.7798	0.0207
17	0.7997	0.0200
18	0.8190	0.0193
19	0.8377	0.0187
20	0.8558	0.0181
21	0.8734	0.0176
22	0.8906	0.0171
23	0.9072	0.0167
24	0.9235	0.0163
25	0.9393	0.0159
26	0.9548	0.0155
27	0.9700	0.0152
28	0.9848	0.0148
29	0.9993	0.0145
30	1.0136	0.0142
31	1.0275	0.0140
32	1.0412	0.0137
33	1.0547	0.0135
34	1.0679	0.0132
35	1.0809	0.0130
36	1.0937	0.0128
37	1.1062	0.0126
38	1.1186	0.0124
39	1.1308	0.0122
40	1.1428	0.0120
41	1.1546	0.0118
42	1.1662	0.0117
43	1.1777	0.0115
44	1.1891	0.0113
45	1.2002	0.0112
46	1.2113	0.0110
47	1.2222	0.0109
48	1.2330	0.0108
49	1.2436	0.0106
50	1.2541	0.0105
51	1.2645	0.0104
52	1.2748	0.0103
53	1.2849	0.0102
54	1.2950	0.0100
55	1.3049	0.0099
56	1.3148	0.0098
57	1.3245	0.0097

58	1.3341	0.0096
59	1.3437	0.0095
60	1.3531	0.0094
61	1.3625	0.0094
62	1.3717	0.0093
63	1.3809	0.0092
64	1.3900	0.0091
65	1.3990	0.0090
66	1.4080	0.0089
67	1.4168	0.0089
68	1.4256	0.0088
69	1.4343	0.0087
70	1.4429	0.0086
71	1.4515	0.0086
72	1.4599	0.0085
73	1.4703	0.0104
74	1.4806	0.0103
75	1.4908	0.0102
76	1.5009	0.0101
77	1.5110	0.0101
78	1.5210	0.0100
79	1.5310	0.0100
80	1.5409	0.0099
81	1.5507	0.0098
82	1.5605	0.0098
83	1.5702	0.0097
84	1.5799	0.0097
85	1.5895	0.0096
86	1.5991	0.0096
87	1.6086	0.0095
88	1.6180	0.0094
89	1.6274	0.0094
90	1.6367	0.0093
91	1.6460	0.0093
92	1.6553	0.0092
93	1.6645	0.0092
94	1.6736	0.0091
95	1.6827	0.0091
96	1.6918	0.0091
97	1.7008	0.0090
98	1.7097	0.0090
99	1.7186	0.0089
100	1.7275	0.0089
101	1.7363	0.0088
102	1.7451	0.0088
103	1.7539	0.0087
104	1.7626	0.0087
105	1.7712	0.0087
106	1.7798	0.0086
107	1.7884	0.0086

108	1.7970	0.0085
109	1.8055	0.0085
110	1.8139	0.0085
111	1.8224	0.0084
112	1.8308	0.0084
113	1.8391	0.0084
114	1.8474	0.0083
115	1.8557	0.0083
116	1.8640	0.0082
117	1.8722	0.0082
118	1.8804	0.0082
119	1.8885	0.0081
120	1.8966	0.0081
121	1.9047	0.0081
122	1.9127	0.0080
123	1.9208	0.0080
124	1.9287	0.0080
125	1.9367	0.0080
126	1.9446	0.0079
127	1.9525	0.0079
128	1.9604	0.0079
129	1.9682	0.0078
130	1.9760	0.0078
131	1.9838	0.0078
132	1.9915	0.0077
133	1.9992	0.0077
134	2.0069	0.0077
135	2.0146	0.0077
136	2.0222	0.0076
137	2.0298	0.0076
138	2.0374	0.0076
139	2.0449	0.0075
140	2.0525	0.0075
141	2.0600	0.0075
142	2.0674	0.0075
143	2.0749	0.0074
144	2.0823	0.0074
145	2.0897	0.0074
146	2.0971	0.0074
147	2.1044	0.0073
148	2.1117	0.0073
149	2.1190	0.0073
150	2.1263	0.0073
151	2.1335	0.0072
152	2.1408	0.0072
153	2.1480	0.0072
154	2.1552	0.0072
155	2.1623	0.0072
156	2.1695	0.0071
157	2.1766	0.0071

158	2.1837	0.0071
159	2.1907	0.0071
160	2.1978	0.0070
161	2.2048	0.0070
162	2.2118	0.0070
163	2.2188	0.0070
164	2.2257	0.0070
165	2.2327	0.0069
166	2.2396	0.0069
167	2.2465	0.0069
168	2.2534	0.0069
169	2.2603	0.0069
170	2.2671	0.0068
171	2.2739	0.0068
172	2.2807	0.0068
173	2.2875	0.0068
174	2.2943	0.0068
175	2.3010	0.0067
176	2.3077	0.0067
177	2.3144	0.0067
178	2.3211	0.0067
179	2.3278	0.0067
180	2.3345	0.0067
181	2.3411	0.0066
182	2.3477	0.0066
183	2.3543	0.0066
184	2.3609	0.0066
185	2.3675	0.0066
186	2.3740	0.0065
187	2.3805	0.0065
188	2.3870	0.0065
189	2.3935	0.0065
190	2.4000	0.0065
191	2.4065	0.0065
192	2.4129	0.0064
193	2.4194	0.0064
194	2.4258	0.0064
195	2.4322	0.0064
196	2.4385	0.0064
197	2.4449	0.0064
198	2.4513	0.0063
199	2.4576	0.0063
200	2.4639	0.0063
201	2.4702	0.0063
202	2.4765	0.0063
203	2.4828	0.0063
204	2.4890	0.0063
205	2.4953	0.0062
206	2.5015	0.0062
207	2.5077	0.0062

208	2.5139	0.0062
209	2.5201	0.0062
210	2.5263	0.0062
211	2.5324	0.0062
212	2.5386	0.0061
213	2.5447	0.0061
214	2.5508	0.0061
215	2.5569	0.0061
216	2.5630	0.0061
217	2.5691	0.0061
218	2.5751	0.0061
219	2.5812	0.0060
220	2.5872	0.0060
221	2.5932	0.0060
222	2.5992	0.0060
223	2.6052	0.0060
224	2.6112	0.0060
225	2.6172	0.0060
226	2.6231	0.0060
227	2.6290	0.0059
228	2.6350	0.0059
229	2.6409	0.0059
230	2.6468	0.0059
231	2.6527	0.0059
232	2.6586	0.0059
233	2.6644	0.0059
234	2.6703	0.0059
235	2.6761	0.0058
236	2.6819	0.0058
237	2.6878	0.0058
238	2.6936	0.0058
239	2.6993	0.0058
240	2.7051	0.0058
241	2.7109	0.0058
242	2.7167	0.0058
243	2.7224	0.0057
244	2.7281	0.0057
245	2.7339	0.0057
246	2.7396	0.0057
247	2.7453	0.0057
248	2.7509	0.0057
249	2.7566	0.0057
250	2.7623	0.0057
251	2.7679	0.0057
252	2.7736	0.0056
253	2.7792	0.0056
254	2.7848	0.0056
255	2.7905	0.0056
256	2.7961	0.0056
257	2.8016	0.0056

```
258              2.8072               0.0056
259              2.8128               0.0056
260              2.8184               0.0056
261              2.8239               0.0055
262              2.8294               0.0055
263              2.8350               0.0055
264              2.8405               0.0055
265              2.8460               0.0055
266              2.8515               0.0055
267              2.8570               0.0055
268              2.8624               0.0055
269              2.8679               0.0055
270              2.8734               0.0055
271              2.8788               0.0054
272              2.8843               0.0054
273              2.8897               0.0054
274              2.8951               0.0054
275              2.9005               0.0054
276              2.9059               0.0054
277              2.9113               0.0054
278              2.9167               0.0054
279              2.9220               0.0054
280              2.9274               0.0054
281              2.9328               0.0054
282              2.9381               0.0053
283              2.9434               0.0053
284              2.9487               0.0053
285              2.9541               0.0053
286              2.9594               0.0053
287              2.9647               0.0053
288              2.9700               0.0053
--------------------------------------------------------------------
Unit              Unit            Unit              Effective
Period            Rainfall        Soil-Loss         Rainfall
(number)            (In)          (In)                 (In)
--------------------------------------------------------------------
  1              0.0053           0.0040              0.0012
  2              0.0053           0.0041              0.0012
  3              0.0053           0.0041              0.0012
  4              0.0053           0.0041              0.0013
  5              0.0053           0.0041              0.0013
  6              0.0054           0.0041              0.0013
  7              0.0054           0.0041              0.0013
  8              0.0054           0.0041              0.0013
  9              0.0054           0.0041              0.0013
 10              0.0054           0.0041              0.0013
 11              0.0054           0.0042              0.0013
 12              0.0054           0.0042              0.0013
 13              0.0055           0.0042              0.0013
 14              0.0055           0.0042              0.0013
```

15	0.0055	0.0042	0.0013
16	0.0055	0.0042	0.0013
17	0.0055	0.0042	0.0013
18	0.0055	0.0042	0.0013
19	0.0055	0.0042	0.0013
20	0.0056	0.0043	0.0013
21	0.0056	0.0043	0.0013
22	0.0056	0.0043	0.0013
23	0.0056	0.0043	0.0013
24	0.0056	0.0043	0.0013
25	0.0056	0.0043	0.0013
26	0.0057	0.0043	0.0013
27	0.0057	0.0043	0.0013
28	0.0057	0.0044	0.0013
29	0.0057	0.0044	0.0013
30	0.0057	0.0044	0.0013
31	0.0057	0.0044	0.0013
32	0.0058	0.0044	0.0014
33	0.0058	0.0044	0.0014
34	0.0058	0.0044	0.0014
35	0.0058	0.0044	0.0014
36	0.0058	0.0045	0.0014
37	0.0059	0.0045	0.0014
38	0.0059	0.0045	0.0014
39	0.0059	0.0045	0.0014
40	0.0059	0.0045	0.0014
41	0.0059	0.0045	0.0014
42	0.0059	0.0045	0.0014
43	0.0060	0.0046	0.0014
44	0.0060	0.0046	0.0014
45	0.0060	0.0046	0.0014
46	0.0060	0.0046	0.0014
47	0.0060	0.0046	0.0014
48	0.0061	0.0046	0.0014
49	0.0061	0.0047	0.0014
50	0.0061	0.0047	0.0014
51	0.0061	0.0047	0.0014
52	0.0061	0.0047	0.0014
53	0.0062	0.0047	0.0014
54	0.0062	0.0047	0.0015
55	0.0062	0.0048	0.0015
56	0.0062	0.0048	0.0015
57	0.0063	0.0048	0.0015
58	0.0063	0.0048	0.0015
59	0.0063	0.0048	0.0015
60	0.0063	0.0048	0.0015
61	0.0063	0.0049	0.0015
62	0.0064	0.0049	0.0015
63	0.0064	0.0049	0.0015
64	0.0064	0.0049	0.0015

65	0.0064	0.0049	0.0015
66	0.0065	0.0049	0.0015
67	0.0065	0.0050	0.0015
68	0.0065	0.0050	0.0015
69	0.0065	0.0050	0.0015
70	0.0066	0.0050	0.0015
71	0.0066	0.0050	0.0016
72	0.0066	0.0051	0.0016
73	0.0067	0.0051	0.0016
74	0.0067	0.0051	0.0016
75	0.0067	0.0051	0.0016
76	0.0067	0.0051	0.0016
77	0.0068	0.0052	0.0016
78	0.0068	0.0052	0.0016
79	0.0068	0.0052	0.0016
80	0.0068	0.0052	0.0016
81	0.0069	0.0053	0.0016
82	0.0069	0.0053	0.0016
83	0.0069	0.0053	0.0016
84	0.0070	0.0053	0.0016
85	0.0070	0.0054	0.0016
86	0.0070	0.0054	0.0017
87	0.0071	0.0054	0.0017
88	0.0071	0.0054	0.0017
89	0.0071	0.0055	0.0017
90	0.0072	0.0055	0.0017
91	0.0072	0.0055	0.0017
92	0.0072	0.0055	0.0017
93	0.0073	0.0056	0.0017
94	0.0073	0.0056	0.0017
95	0.0073	0.0056	0.0017
96	0.0074	0.0056	0.0017
97	0.0074	0.0057	0.0017
98	0.0074	0.0057	0.0017
99	0.0075	0.0057	0.0018
100	0.0075	0.0058	0.0018
101	0.0076	0.0058	0.0018
102	0.0076	0.0058	0.0018
103	0.0077	0.0059	0.0018
104	0.0077	0.0059	0.0018
105	0.0077	0.0059	0.0018
106	0.0078	0.0059	0.0018
107	0.0078	0.0060	0.0018
108	0.0079	0.0060	0.0018
109	0.0079	0.0061	0.0019
110	0.0080	0.0061	0.0019
111	0.0080	0.0061	0.0019
112	0.0080	0.0062	0.0019
113	0.0081	0.0062	0.0019
114	0.0081	0.0062	0.0019

115	0.0082	0.0063	0.0019
116	0.0082	0.0063	0.0019
117	0.0083	0.0064	0.0020
118	0.0084	0.0064	0.0020
119	0.0084	0.0064	0.0020
120	0.0085	0.0065	0.0020
121	0.0085	0.0065	0.0020
122	0.0086	0.0066	0.0020
123	0.0087	0.0066	0.0020
124	0.0087	0.0067	0.0020
125	0.0088	0.0067	0.0021
126	0.0088	0.0068	0.0021
127	0.0089	0.0068	0.0021
128	0.0090	0.0069	0.0021
129	0.0091	0.0069	0.0021
130	0.0091	0.0070	0.0021
131	0.0092	0.0070	0.0022
132	0.0092	0.0071	0.0022
133	0.0093	0.0071	0.0022
134	0.0094	0.0072	0.0022
135	0.0095	0.0073	0.0022
136	0.0096	0.0073	0.0022
137	0.0097	0.0074	0.0023
138	0.0097	0.0074	0.0023
139	0.0098	0.0075	0.0023
140	0.0099	0.0076	0.0023
141	0.0100	0.0077	0.0024
142	0.0101	0.0077	0.0024
143	0.0102	0.0078	0.0024
144	0.0103	0.0079	0.0024
145	0.0085	0.0065	0.0020
146	0.0086	0.0065	0.0020
147	0.0087	0.0067	0.0020
148	0.0088	0.0067	0.0021
149	0.0089	0.0068	0.0021
150	0.0090	0.0069	0.0021
151	0.0092	0.0070	0.0022
152	0.0093	0.0071	0.0022
153	0.0094	0.0072	0.0022
154	0.0095	0.0073	0.0022
155	0.0097	0.0074	0.0023
156	0.0098	0.0075	0.0023
157	0.0100	0.0077	0.0024
158	0.0102	0.0078	0.0024
159	0.0104	0.0080	0.0024
160	0.0105	0.0080	0.0025
161	0.0108	0.0082	0.0025
162	0.0109	0.0083	0.0026
163	0.0112	0.0086	0.0026
164	0.0113	0.0087	0.0027

165	0.0117	0.0089	0.0027
166	0.0118	0.0090	0.0028
167	0.0122	0.0093	0.0029
168	0.0124	0.0095	0.0029
169	0.0128	0.0098	0.0030
170	0.0130	0.0099	0.0031
171	0.0135	0.0103	0.0032
172	0.0137	0.0105	0.0032
173	0.0142	0.0109	0.0033
174	0.0145	0.0111	0.0034
175	0.0152	0.0116	0.0036
176	0.0155	0.0119	0.0036
177	0.0163	0.0124	0.0038
178	0.0167	0.0128	0.0039
179	0.0176	0.0135	0.0041
180	0.0181	0.0139	0.0043
181	0.0193	0.0148	0.0045
182	0.0200	0.0153	0.0047
183	0.0215	0.0165	0.0051
184	0.0225	0.0172	0.0053
185	0.0178	0.0136	0.0042
186	0.0190	0.0145	0.0045
187	0.0220	0.0169	0.0052
188	0.0240	0.0184	0.0056
189	0.0299	0.0229	0.0070
190	0.0344	0.0263	0.0081
191	0.0523	0.0400	0.0123
192	0.0759	0.0444	0.0315
193	0.3282	0.0444	0.2838
194	0.0411	0.0315	0.0097
195	0.0266	0.0203	0.0062
196	0.0204	0.0156	0.0048
197	0.0235	0.0180	0.0055
198	0.0207	0.0158	0.0049
199	0.0187	0.0143	0.0044
200	0.0171	0.0131	0.0040
201	0.0159	0.0121	0.0037
202	0.0148	0.0113	0.0035
203	0.0140	0.0107	0.0033
204	0.0132	0.0101	0.0031
205	0.0126	0.0096	0.0030
206	0.0120	0.0092	0.0028
207	0.0115	0.0088	0.0027
208	0.0110	0.0084	0.0026
209	0.0106	0.0081	0.0025
210	0.0103	0.0079	0.0024
211	0.0099	0.0076	0.0023
212	0.0096	0.0074	0.0023
213	0.0094	0.0072	0.0022
214	0.0091	0.0070	0.0021

215	0.0089	0.0068	0.0021
216	0.0086	0.0066	0.0020
217	0.0104	0.0079	0.0024
218	0.0101	0.0078	0.0024
219	0.0100	0.0076	0.0023
220	0.0098	0.0075	0.0023
221	0.0096	0.0074	0.0023
222	0.0094	0.0072	0.0022
223	0.0093	0.0071	0.0022
224	0.0091	0.0070	0.0021
225	0.0090	0.0069	0.0021
226	0.0089	0.0068	0.0021
227	0.0087	0.0067	0.0021
228	0.0086	0.0066	0.0020
229	0.0085	0.0065	0.0020
230	0.0084	0.0064	0.0020
231	0.0083	0.0063	0.0019
232	0.0082	0.0063	0.0019
233	0.0081	0.0062	0.0019
234	0.0080	0.0061	0.0019
235	0.0079	0.0060	0.0019
236	0.0078	0.0060	0.0018
237	0.0077	0.0059	0.0018
238	0.0076	0.0058	0.0018
239	0.0075	0.0058	0.0018
240	0.0075	0.0057	0.0018
241	0.0074	0.0057	0.0017
242	0.0073	0.0056	0.0017
243	0.0072	0.0055	0.0017
244	0.0072	0.0055	0.0017
245	0.0071	0.0054	0.0017
246	0.0070	0.0054	0.0017
247	0.0070	0.0053	0.0016
248	0.0069	0.0053	0.0016
249	0.0069	0.0052	0.0016
250	0.0068	0.0052	0.0016
251	0.0067	0.0052	0.0016
252	0.0067	0.0051	0.0016
253	0.0066	0.0051	0.0016
254	0.0066	0.0050	0.0015
255	0.0065	0.0050	0.0015
256	0.0065	0.0050	0.0015
257	0.0064	0.0049	0.0015
258	0.0064	0.0049	0.0015
259	0.0063	0.0048	0.0015
260	0.0063	0.0048	0.0015
261	0.0062	0.0048	0.0015
262	0.0062	0.0047	0.0015
263	0.0062	0.0047	0.0014
264	0.0061	0.0047	0.0014

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      265              0.0061           0.0046              0.0014
      266              0.0060           0.0046              0.0014
      267              0.0060           0.0046              0.0014
      268              0.0060           0.0046              0.0014
      269              0.0059           0.0045              0.0014
      270              0.0059           0.0045              0.0014
      271              0.0058           0.0045              0.0014
      272              0.0058           0.0044              0.0014
      273              0.0058           0.0044              0.0014
      274              0.0057           0.0044              0.0013
      275              0.0057           0.0044              0.0013
      276              0.0057           0.0043              0.0013
      277              0.0056           0.0043              0.0013
      278              0.0056           0.0043              0.0013
      279              0.0056           0.0043              0.0013
      280              0.0055           0.0042              0.0013
      281              0.0055           0.0042              0.0013
      282              0.0055           0.0042              0.0013
      283              0.0054           0.0042              0.0013
      284              0.0054           0.0041              0.0013
      285              0.0054           0.0041              0.0013
      286              0.0054           0.0041              0.0013
      287              0.0053           0.0041              0.0013
      288              0.0053           0.0041              0.0012
      --------------------------------------------------------------------
      --------------------------------------------------------------------
      Total soil rain loss =      2.05(In)
      Total effective rainfall =      0.92(In)
      Peak flow rate in flood hydrograph =      9.83(CFS)
      ---------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         24 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0000      0.00  Q         |         |         |         |
  0+10       0.0001      0.01  Q         |         |         |         |
  0+15       0.0003      0.03  Q         |         |         |         |
  0+20       0.0007      0.06  Q         |         |         |         |
  0+25       0.0014      0.10  Q         |         |         |         |
  0+30       0.0022      0.12  Q         |         |         |         |
  0+35       0.0031      0.13  Q         |         |         |         |
  0+40       0.0040      0.14  Q         |         |         |         |
  0+45       0.0051      0.15  Q         |         |         |         |
  0+50       0.0061      0.16  Q         |         |         |         |
  0+55       0.0072      0.16  Q         |         |         |         |
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1+ 0       0.0084      0.17  Q         |         |         |         |
1+ 5       0.0095      0.17  Q         |         |         |         |
1+10       0.0107      0.17  Q         |         |         |         |
1+15       0.0120      0.18  Q         |         |         |         |
1+20       0.0132      0.18  Q         |         |         |         |
1+25       0.0145      0.18  Q         |         |         |         |
1+30       0.0157      0.19  Q         |         |         |         |
1+35       0.0170      0.19  Q         |         |         |         |
1+40       0.0183      0.19  Q         |         |         |         |
1+45       0.0197      0.19  Q         |         |         |         |
1+50       0.0210      0.19  Q         |         |         |         |
1+55       0.0223      0.19  Q         |         |         |         |
2+ 0       0.0237      0.20  Q         |         |         |         |
2+ 5       0.0250      0.20  QV        |         |         |         |
2+10       0.0264      0.20  QV        |         |         |         |
2+15       0.0278      0.20  QV        |         |         |         |
2+20       0.0291      0.20  QV        |         |         |         |
2+25       0.0305      0.20  QV        |         |         |         |
2+30       0.0319      0.20  QV        |         |         |         |
2+35       0.0333      0.20  QV        |         |         |         |
2+40       0.0347      0.20  QV        |         |         |         |
2+45       0.0362      0.21  QV        |         |         |         |
2+50       0.0376      0.21  QV        |         |         |         |
2+55       0.0390      0.21  QV        |         |         |         |
3+ 0       0.0404      0.21  QV        |         |         |         |
3+ 5       0.0419      0.21  QV        |         |         |         |
3+10       0.0433      0.21  QV        |         |         |         |
3+15       0.0448      0.21  QV        |         |         |         |
3+20       0.0462      0.21  QV        |         |         |         |
3+25       0.0477      0.21  QV        |         |         |         |
3+30       0.0491      0.21  Q V       |         |         |         |
3+35       0.0506      0.21  Q V       |         |         |         |
3+40       0.0521      0.21  Q V       |         |         |         |
3+45       0.0535      0.21  Q V       |         |         |         |
3+50       0.0550      0.21  Q V       |         |         |         |
3+55       0.0565      0.22  Q V       |         |         |         |
4+ 0       0.0580      0.22  Q V       |         |         |         |
4+ 5       0.0595      0.22  Q V       |         |         |         |
4+10       0.0610      0.22  Q V       |         |         |         |
4+15       0.0625      0.22  Q V       |         |         |         |
4+20       0.0640      0.22  Q V       |         |         |         |
4+25       0.0655      0.22  Q V       |         |         |         |
4+30       0.0670      0.22  Q V       |         |         |         |
4+35       0.0685      0.22  Q V       |         |         |         |
4+40       0.0701      0.22  Q V       |         |         |         |
4+45       0.0716      0.22  Q V       |         |         |         |
4+50       0.0731      0.22  Q V       |         |         |         |
4+55       0.0747      0.22  Q  V      |         |         |         |
5+ 0       0.0762      0.22  Q  V      |         |         |         |
5+ 5       0.0778      0.23  Q  V      |         |         |         |
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5+10       0.0794      0.23  Q  V      |         |         |         |
5+15       0.0809      0.23  Q  V      |         |         |         |
5+20       0.0825      0.23  Q  V      |         |         |         |
5+25       0.0841      0.23  Q  V      |         |         |         |
5+30       0.0857      0.23  Q  V      |         |         |         |
5+35       0.0872      0.23  Q  V      |         |         |         |
5+40       0.0888      0.23  Q  V      |         |         |         |
5+45       0.0904      0.23  Q  V      |         |         |         |
5+50       0.0920      0.23  Q  V      |         |         |         |
5+55       0.0937      0.23  Q  V      |         |         |         |
6+ 0       0.0953      0.24  Q  V      |         |         |         |
6+ 5       0.0969      0.24  Q  V      |         |         |         |
6+10       0.0985      0.24  Q   V     |         |         |         |
6+15       0.1002      0.24  Q   V     |         |         |         |
6+20       0.1018      0.24  Q   V     |         |         |         |
6+25       0.1035      0.24  Q   V     |         |         |         |
6+30       0.1051      0.24  Q   V     |         |         |         |
6+35       0.1068      0.24  Q   V     |         |         |         |
6+40       0.1085      0.24  Q   V     |         |         |         |
6+45       0.1101      0.24  Q   V     |         |         |         |
6+50       0.1118      0.24  Q   V     |         |         |         |
6+55       0.1135      0.25  Q   V     |         |         |         |
7+ 0       0.1152      0.25  Q   V     |         |         |         |
7+ 5       0.1169      0.25  Q   V     |         |         |         |
7+10       0.1186      0.25  Q   V     |         |         |         |
7+15       0.1204      0.25  Q   V     |         |         |         |
7+20       0.1221      0.25  |Q  V     |         |         |         |
7+25       0.1238      0.25  |Q   V    |         |         |         |
7+30       0.1256      0.25  |Q   V    |         |         |         |
7+35       0.1273      0.25  |Q   V    |         |         |         |
7+40       0.1291      0.26  |Q   V    |         |         |         |
7+45       0.1308      0.26  |Q   V    |         |         |         |
7+50       0.1326      0.26  |Q   V    |         |         |         |
7+55       0.1344      0.26  |Q   V    |         |         |         |
8+ 0       0.1362      0.26  |Q   V    |         |         |         |
8+ 5       0.1380      0.26  |Q   V    |         |         |         |
8+10       0.1398      0.26  |Q   V    |         |         |         |
8+15       0.1416      0.26  |Q   V    |         |         |         |
8+20       0.1435      0.27  |Q   V    |         |         |         |
8+25       0.1453      0.27  |Q   V    |         |         |         |
8+30       0.1471      0.27  |Q    V   |         |         |         |
8+35       0.1490      0.27  |Q    V   |         |         |         |
8+40       0.1509      0.27  |Q    V   |         |         |         |
8+45       0.1527      0.27  |Q    V   |         |         |         |
8+50       0.1546      0.27  |Q    V   |         |         |         |
8+55       0.1565      0.28  |Q    V   |         |         |         |
9+ 0       0.1584      0.28  |Q    V   |         |         |         |
9+ 5       0.1603      0.28  |Q    V   |         |         |         |
9+10       0.1623      0.28  |Q    V   |         |         |         |
9+15       0.1642      0.28  |Q    V   |         |         |         |
```

```
 9+20       0.1661      0.28  |Q    V   |         |         |         |
 9+25       0.1681      0.28  |Q    V   |         |         |         |
 9+30       0.1701      0.29  |Q    V   |         |         |         |
 9+35       0.1720      0.29  |Q     V  |         |         |         |
 9+40       0.1740      0.29  |Q     V  |         |         |         |
 9+45       0.1760      0.29  |Q     V  |         |         |         |
 9+50       0.1781      0.29  |Q     V  |         |         |         |
 9+55       0.1801      0.29  |Q     V  |         |         |         |
10+ 0       0.1821      0.30  |Q     V  |         |         |         |
10+ 5       0.1842      0.30  |Q     V  |         |         |         |
10+10       0.1862      0.30  |Q     V  |         |         |         |
10+15       0.1883      0.30  |Q     V  |         |         |         |
10+20       0.1904      0.30  |Q     V  |         |         |         |
10+25       0.1925      0.31  |Q     V  |         |         |         |
10+30       0.1946      0.31  |Q     V  |         |         |         |
10+35       0.1968      0.31  |Q      V |         |         |         |
10+40       0.1989      0.31  |Q      V |         |         |         |
10+45       0.2011      0.31  |Q      V |         |         |         |
10+50       0.2033      0.32  |Q      V |         |         |         |
10+55       0.2055      0.32  |Q      V |         |         |         |
11+ 0       0.2077      0.32  |Q      V |         |         |         |
11+ 5       0.2099      0.32  |Q      V |         |         |         |
11+10       0.2122      0.33  |Q      V |         |         |         |
11+15       0.2144      0.33  |Q      V |         |         |         |
11+20       0.2167      0.33  |Q      V |         |         |         |
11+25       0.2190      0.33  |Q      V |         |         |         |
11+30       0.2213      0.34  |Q       V|         |         |         |
11+35       0.2236      0.34  |Q       V|         |         |         |
11+40       0.2260      0.34  |Q       V|         |         |         |
11+45       0.2284      0.34  |Q       V|         |         |         |
11+50       0.2308      0.35  |Q       V|         |         |         |
11+55       0.2332      0.35  |Q       V|         |         |         |
12+ 0       0.2356      0.35  |Q       V|         |         |         |
12+ 5       0.2381      0.36  |Q       V|         |         |         |
12+10       0.2405      0.36  |Q       V|         |         |         |
12+15       0.2429      0.35  |Q       V|         |         |         |
12+20       0.2453      0.34  |Q        V         |         |         |
12+25       0.2476      0.34  |Q        V         |         |         |
12+30       0.2499      0.33  |Q        V         |         |         |
12+35       0.2522      0.33  |Q        V         |         |         |
12+40       0.2545      0.33  |Q        V         |         |         |
12+45       0.2567      0.33  |Q        V         |         |         |
12+50       0.2590      0.33  |Q        V         |         |         |
12+55       0.2614      0.34  |Q        V         |         |         |
13+ 0       0.2637      0.34  |Q        V         |         |         |
13+ 5       0.2660      0.34  |Q        V         |         |         |
13+10       0.2684      0.35  |Q        V         |         |         |
13+15       0.2708      0.35  |Q        |V        |         |         |
13+20       0.2733      0.35  |Q        |V        |         |         |
13+25       0.2757      0.36  |Q        |V        |         |         |
```

```
Time(h+min)  Volume (AC*FT)  Q(CFS)  0        2.5       5.0       7.5       10
13+30       0.2782      0.36  |Q        |V        |         |         |
13+35       0.2808      0.37  |Q        |V        |         |         |
13+40       0.2834      0.37  |Q        |V        |         |         |
13+45       0.2860      0.38  |Q        |V        |         |         |
13+50       0.2886      0.39  |Q        |V        |         |         |
13+55       0.2913      0.39  |Q        |V        |         |         |
14+ 0       0.2941      0.40  |Q        | V       |         |         |
14+ 5       0.2969      0.41  |Q        | V       |         |         |
14+10       0.2998      0.42  |Q        | V       |         |         |
14+15       0.3027      0.42  |Q        | V       |         |         |
14+20       0.3057      0.43  |Q        | V       |         |         |
14+25       0.3087      0.44  |Q        | V       |         |         |
14+30       0.3119      0.45  |Q        | V       |         |         |
14+35       0.3151      0.47  |Q        | V       |         |         |
14+40       0.3184      0.48  |Q        | V       |         |         |
14+45       0.3217      0.49  |Q        |  V      |         |         |
14+50       0.3252      0.50  | Q       |  V      |         |         |
14+55       0.3288      0.52  | Q       |  V      |         |         |
15+ 0       0.3325      0.54  | Q       |  V      |         |         |
15+ 5       0.3363      0.56  | Q       |  V      |         |         |
15+10       0.3403      0.58  | Q       |  V      |         |         |
15+15       0.3444      0.60  | Q       |   V     |         |         |
15+20       0.3487      0.62  | Q       |   V     |         |         |
15+25       0.3532      0.65  | Q       |   V     |         |         |
15+30       0.3578      0.67  | Q       |   V     |         |         |
15+35       0.3625      0.69  | Q       |   V     |         |         |
15+40       0.3672      0.68  | Q       |   V     |         |         |
15+45       0.3720      0.70  | Q       |    V    |         |         |
15+50       0.3771      0.73  | Q       |    V    |         |         |
15+55       0.3826      0.80  |  Q      |    V    |         |         |
16+ 0       0.3891      0.94  |  Q      |    V    |         |         |
16+ 5       0.4005      1.66  |     Q   |     V   |         |         |
16+10       0.4230      3.27  |         |  Q   V  |         |         |
16+15       0.4622      5.69  |         |       V | Q       |         |
16+20       0.5299      9.83  |         |         |V        |        Q|
16+25       0.5885      8.50  |         |         |   V     |  Q      |
16+30       0.6286      5.82  |         |         |  Q V    |         |
16+35       0.6571      4.14  |         |     Q   |     V   |         |
16+40       0.6802      3.35  |         |  Q      |      V  |         |
16+45       0.6993      2.78  |         |Q        |       V |         |
16+50       0.7157      2.37  |        Q|         |        V|         |
16+55       0.7297      2.04  |       Q |         |        V|         |
17+ 0       0.7422      1.81  |      Q  |         |         V         |
17+ 5       0.7536      1.65  |     Q   |         |         V         |
17+10       0.7636      1.46  |    Q    |         |         |V        |
17+15       0.7723      1.26  |    Q    |         |         |V        |
17+20       0.7804      1.17  |   Q     |         |         |V        |
17+25       0.7878      1.08  |   Q     |         |         | V       |
17+30       0.7948      1.00  |   Q     |         |         | V       |
17+35       0.8011      0.92  |  Q      |         |         | V       |
```

Q = 9.83 CFS

```
17+40       0.8069      0.84  |  Q      |         |         | V       |
17+45       0.8124      0.80  |  Q      |         |         |  V      |
17+50       0.8174      0.72  | Q       |         |         |  V      |
17+55       0.8221      0.69  | Q       |         |         |  V      |
18+ 0       0.8263      0.62  | Q       |         |         |  V      |
18+ 5       0.8304      0.58  | Q       |         |         |  V      |
18+10       0.8340      0.52  | Q       |         |         |   V     |
18+15       0.8374      0.49  |Q        |         |         |   V     |
18+20       0.8408      0.50  | Q       |         |         |   V     |
18+25       0.8443      0.51  | Q       |         |         |   V     |
18+30       0.8479      0.51  | Q       |         |         |   V     |
18+35       0.8513      0.51  | Q       |         |         |   V     |
18+40       0.8547      0.49  |Q        |         |         |   V     |
18+45       0.8578      0.44  |Q        |         |         |    V    |
18+50       0.8607      0.43  |Q        |         |         |    V    |
18+55       0.8636      0.42  |Q        |         |         |    V    |
19+ 0       0.8663      0.39  |Q        |         |         |    V    |
19+ 5       0.8687      0.34  |Q        |         |         |    V    |
19+10       0.8710      0.34  |Q        |         |         |    V    |
19+15       0.8733      0.33  |Q        |         |         |    V    |
19+20       0.8755      0.33  |Q        |         |         |    V    |
19+25       0.8778      0.32  |Q        |         |         |    V    |
19+30       0.8799      0.32  |Q        |         |         |    V    |
19+35       0.8821      0.31  |Q        |         |         |    V    |
19+40       0.8842      0.31  |Q        |         |         |     V   |
19+45       0.8863      0.31  |Q        |         |         |     V   |
19+50       0.8884      0.30  |Q        |         |         |     V   |
19+55       0.8905      0.30  |Q        |         |         |     V   |
20+ 0       0.8925      0.29  |Q        |         |         |     V   |
20+ 5       0.8945      0.29  |Q        |         |         |     V   |
20+10       0.8965      0.29  |Q        |         |         |     V   |
20+15       0.8984      0.28  |Q        |         |         |     V   |
20+20       0.9004      0.28  |Q        |         |         |     V   |
20+25       0.9023      0.28  |Q        |         |         |     V   |
20+30       0.9042      0.28  |Q        |         |         |     V   |
20+35       0.9061      0.27  |Q        |         |         |     V   |
20+40       0.9079      0.27  |Q        |         |         |      V  |
20+45       0.9098      0.27  |Q        |         |         |      V  |
20+50       0.9116      0.26  |Q        |         |         |      V  |
20+55       0.9134      0.26  |Q        |         |         |      V  |
21+ 0       0.9152      0.26  |Q        |         |         |      V  |
21+ 5       0.9170      0.26  |Q        |         |         |      V  |
21+10       0.9187      0.25  |Q        |         |         |      V  |
21+15       0.9205      0.25  |Q        |         |         |      V  |
21+20       0.9222      0.25  |Q        |         |         |      V  |
21+25       0.9239      0.25  Q         |         |         |      V  |
21+30       0.9256      0.25  Q         |         |         |      V  |
21+35       0.9273      0.24  Q         |         |         |      V  |
21+40       0.9289      0.24  Q         |         |         |      V  |
21+45       0.9306      0.24  Q         |         |         |      V  |
```

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   21+50       0.9322       0.24  Q         |         |         |       V |
   21+55       0.9339       0.24  Q         |         |         |       V |
   22+ 0       0.9355       0.23  Q         |         |         |       V |
   22+ 5       0.9371       0.23  Q         |         |         |       V |
   22+10       0.9387       0.23  Q         |         |         |       V |
   22+15       0.9402       0.23  Q         |         |         |       V |
   22+20       0.9418       0.23  Q         |         |         |       V |
   22+25       0.9434       0.23  Q         |         |         |       V |
   22+30       0.9449       0.22  Q         |         |         |       V |
   22+35       0.9465       0.22  Q         |         |         |       V |
   22+40       0.9480       0.22  Q         |         |         |       V |
   22+45       0.9495       0.22  Q         |         |         |       V |
   22+50       0.9510       0.22  Q         |         |         |       V |
   22+55       0.9525       0.22  Q         |         |         |       V |
   23+ 0       0.9540       0.22  Q         |         |         |       V |
   23+ 5       0.9554       0.21  Q         |         |         |       V |
   23+10       0.9569       0.21  Q         |         |         |        V|
   23+15       0.9584       0.21  Q         |         |         |        V|
   23+20       0.9598       0.21  Q         |         |         |        V|
   23+25       0.9613       0.21  Q         |         |         |        V|
   23+30       0.9627       0.21  Q         |         |         |        V|
   23+35       0.9641       0.21  Q         |         |         |        V|
   23+40       0.9655       0.21  Q         |         |         |        V|
   23+45       0.9669       0.20  Q         |         |         |        V|
   23+50       0.9683       0.20  Q         |         |         |        V|
   23+55       0.9697       0.20  Q         |         |         |        V|
   24+ 0       0.9711       0.20  Q         |         |         |        V|
-----------------------------------------------------------------------
```

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 2)

[1] Project area DA 2 (ft^2): 532,562

[2] Imperviousness after applying preventative site design practices (Imp%): 60.0

[3] Runoff Coefficient (Rc): _0.409

$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$

[4] Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.399 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

[5] Compute P_6, Mean 6-hr Precipitation (inches): 0.49

*P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Desert = 1.2371)*

[6] Drawdown Rate

Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.

24-hrs ☐
48-hrs ☒

7.** Compute design capture volume, DCV (ft3):* ***17,585

*DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963) Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*

SEE ATTACHED RATIONAL METHOD AND UNIT HYDROGRAPHS

Form 4.2-2 Summary of Hydromodification Assessment (DA 2)

Is the change in post- and pre- condition flows captured on-site? : Yes ☒ No ☐

If "Yes", then complete Hydromodification assessment of site hydrology for 10yr storm event using Forms 4.2-3 through 4.2-5 and insert results below *(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual- Addendum 1)*

If "No," then proceed to Section 4.3 BMP Selection and Sizing

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	[1] 22,878 *Form 4.2-3 Item 12*	[2] 26.05 *Form 4.2-4 Item 13*	[3] 10.22 *Form 4.2-5 Item 10*
Post-developed	[4] 52,2446 *Form 4.2-3 Item 13*	[5] 12.99 *Form 4.2-4 Item 14*	[6] 16.35 *Form 4.2-5 Item 14*
Difference	[7] *29,568* *Item 4 – Item 1*	[8] *13.06* *Item 2 – Item 5*	[9] *6.13* *Item 6 – Item 3*
Difference (as % of pre-developed)	[10] *129%* *Item 7 / Item 1*	[11] *50%* *Item 8 / Item 2*	[12] *60%* *Item 9 / Item 3*

Form 4.2-3 Hydromodification Assessment for Runoff Volume (DA 2)

Weighted Curve Number Determination for: Pre-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								

5 Pre-Developed area-weighted CN:	**7** Pre-developed soil storage capacity, S (in): *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN:	**8** Post-developed soil storage capacity, S (in): *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): *I_a = 0.2 * Item 8*

11 Precipitation for 10 yr, 24 hr storm (in):
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

14 Volume Reduction needed to meet hydromodification requirement, (ft^3):
*Vhydro = (Item 13 * 0.95) – Item 12*

Form 4.2-4 Hydromodification Assessment for Time of Concentration (D A 2)

Compute time of concentration for pre and post developed conditions for each DA *(For projects using the Hydrology Manual complete the form below)*

Variables	Pre-developed DA1 *Use additional forms if there are more than 4 DMA*				Post-developed DA1 *Use additional forms if there are more than 4 DMA*			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*								
2 Change in elevation (ft)								
3 Slope (ft/ft), *S_o = Item 2 / Item 1*								
4 Land cover								
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*								
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*								
7 Cross-sectional area of channel (ft^2)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) V_{fps} = (1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5								
11 Travel time to outlet (min) T_t = Item 6 / (Item 10 * 60)								
12 Total time of concentration (min) T_c = Item 5 + Item 11								

13 Pre-developed time of concentration (min): *Minimum of Item 12 pre-developed DMA*

14 Post-developed time of concentration (min): *Minimum of Item 12 post-developed DMA*

15 Additional time of concentration needed to meet hydromodification requirement (min): *$T_{C-Hydro}$ = (Item 13 * 0.95) – Item 14*

Form 4.2-5 Hydromodification Assessment for Peak Runoff (DA 2)

Compute peak runoff for pre- and post-developed conditions							
Variables		Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.7 LOG Form 4.2-4 Item 5 /60)*							
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*							
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*							
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	*n/a*			*n/a*		
	DMA B		*n/a*			*n/a*	
	DMA C			*n/a*			*n/a*

8 Pre-developed Q_p at T_c for DMA A: *Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	9 Pre-developed Q_p at T_c for DMA B: *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	10 Pre-developed Q_p at T_c for DMA C: *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*

10 Peak runoff from pre-developed condition confluence analysis (cfs): *Maximum of Item 8, 9, and 10 (including additional forms as needed)*

11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*	12 Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*	13 Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*

14 Peak runoff from post-developed condition confluence analysis (cfs): *Maximum of Item 11, 12, and 13 (including additional forms as needed)*

15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs): $Q_{p-hydro}$ *= (Item 14 * 0.95) – Item 10*

RATIONAL METHOD &
UNIT HYDROGRAPH HYDROLOGY
ONSITE POST-DEVELOPED

2-YEAR & 10-YEAR
STORM EVENTS

DRAINAGE AREA 2

```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
        Rational Hydrology Study        Date: 08/16/21
------------------------------------------------------------------------
2 Year Rational Analysis Post Development
Former Track 17486
Drainage Area 2
File: 17486Rat2PostA2.out
------------------------------------------------------------------------


Program License Serial Number 4070

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is     2.0
Computed rainfall intensity:
Storm year =     2.00   1 hour rainfall =     0.399 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 3



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       5.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.393(In/Hr)
Initial subarea data:
Initial area flow distance =   997.200(Ft.)
Top (of initial area) elevation =  3291.300(Ft.)
Bottom (of initial area) elevation =  3281.000(Ft.)
Difference in elevation =    10.300(Ft.)
Slope =    0.01033  s(%)=       1.03
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.369 min.
Rainfall intensity =      1.035(In/Hr) for a     2.0 year storm
```

```
Effective runoff coefficient used for area (Q=KCIA) is C = 0.559
Subarea runoff =      4.471(CFS)
Total initial stream area =        7.730(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.393(In/Hr)
↑


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        5.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.730(Ac.)
Runoff from this stream =      4.471(CFS)
Time of concentration =   15.37 min.
Rainfall intensity =     1.035(In/Hr)
Area averaged loss rate (Fm) =    0.3926(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000
↑


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        5.000
**** INITIAL AREA EVALUATION ****

RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.393(In/Hr)
Initial subarea data:
Initial area flow distance =   443.400(Ft.)
Top (of initial area) elevation =  3283.100(Ft.)
Bottom (of initial area) elevation =  3281.000(Ft.)
Difference in elevation =     2.100(Ft.)
Slope =    0.00474  s(%)=       0.47
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.989 min.
Rainfall intensity =      1.165(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.597
Subarea runoff =      3.127(CFS)
Total initial stream area =        4.500(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.393(In/Hr)
↑
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       5.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      4.500(Ac.)
Runoff from this stream =      3.127(CFS)
Time of concentration =   12.99 min.
Rainfall intensity =     1.165(In/Hr)
Area averaged loss rate (Fm) =    0.3926(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1      4.47     7.730     15.37    0.393      1.035
2      3.13     4.500     12.99    0.393      1.165
Qmax(1) =
           1.000 *    1.000 *     4.471) +
           0.832 *    1.000 *     3.127) + =       7.073
Qmax(2) =
           1.201 *    0.845 *     4.471) +
           1.000 *    1.000 *     3.127) + =       7.666

Total of 2 streams to confluence:
Flow rates before confluence point:
       4.471       3.127
Maximum flow rates at confluence using above data:
        7.073        7.666
Area of streams before confluence:
        7.730        4.500
Effective area values after confluence:
       12.230       11.033
Results of confluence:
Total flow rate =      7.666(CFS)
Time of concentration =    12.989 min.
Effective stream area after confluence =     11.033(Ac.)
Study area average Pervious fraction(Ap) =  0.500
Study area average soil loss rate(Fm) =    0.393(In/Hr)
Study area total (this main stream) =      12.23(Ac.)
End of computations, Total Study Area =          12.23 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.500
```

```
Area averaged SCS curve number =  32.0
```

```
        U n i t   H y d r o g r a p h   A n a l y s i s

        Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

                Study date  08/13/21

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
------------------------------------------------------------------------

San Bernardino County Synthetic Unit Hydrology Method
                Manual date - August 1986


Program License Serial Number 4070

---------------------------------------------------------------------
2 Year Unit Hydrograph Post Development
Former Track 17486
Drainage Area 2
File: 17486Hydr2PostA2.out
--------------------------------------------------------------------

        Storm Event Year = 2

        Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




Area averaged rainfall intensity isohyetal data:
        Sub-Area        Duration        Isohyetal
        (Ac.)            (hours)         (In)
Rainfall data for year 2
            12.23            1           0.40
--------------------------------------------------------------------
Rainfall data for year 2
            12.23            6           0.89
--------------------------------------------------------------------
Rainfall data for year 2
            12.23           24           1.64
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
******** Area-averaged max loss rate, Fm ********


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 32.0      52.0         12.23      1.000     0.785    0.397    0.312

Area-averaged adjusted loss rate Fm (In/Hr) =  0.312

********* Area-Averaged low loss rate fraction, Yb **********

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
     4.86   0.397         32.0      52.0       8.20     0.000
     7.37   0.603         98.0      98.0       0.20     0.865

Area-averaged catchment yield fraction, Y =  0.521
Area-averaged low loss fraction, Yb =  0.479
User entry of time of concentration  =   0.217 (hours)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =      12.23(Ac.)
Catchment Lag time =   0.173 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 48.1139
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.312(In/Hr)
Average low loss rate fraction (Yb) = 0.479 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall =  0.189(In)
Computed peak 30-minute rainfall =  0.324(In)
Specified peak 1-hour rainfall =  0.399(In)
Computed peak 3-hour rainfall =  0.650(In)
Specified peak 6-hour rainfall =  0.885(In)
Specified peak 24-hour rainfall =  1.640(In)


Rainfall depth area reduction factors:
Using a total area of      12.23(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999     Adjusted rainfall =  0.189(In)
30-minute factor = 0.999    Adjusted rainfall =  0.324(In)
1-hour factor = 0.999       Adjusted rainfall =  0.399(In)
3-hour factor = 1.000       Adjusted rainfall =  0.650(In)
6-hour factor = 1.000       Adjusted rainfall =  0.885(In)
24-hour factor = 1.000      Adjusted rainfall =  1.640(In)
---------------------------------------------------------------------

                       U n i t  H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
Interval          'S' Graph          Unit Hydrograph
Number            Mean values             ((CFS))
---------------------------------------------------------------------
                (K =      147.91 (CFS))

  1                3.719                   5.500
  2               28.282                  36.331
  3               58.794                  45.129
  4               72.457                  20.208
  5               80.398                  11.746
  6               85.662                   7.786
  7               89.432                   5.576
  8               92.102                   3.950
  9               94.181                   3.075
 10               95.760                   2.335
 11               96.964                   1.780
 12               97.797                   1.233
 13               98.328                   0.785
 14               98.894                   0.838
 15               99.444                   0.812
 16               99.786                   0.506
 17              100.000                   0.316
---------------------------------------------------------------------
Peak Unit   Adjusted mass rainfall  Unit rainfall
Number              (In)                (In)
  1              0.1892               0.1892
  2              0.2330               0.0437
  3              0.2631               0.0301
  4              0.2868               0.0237
  5              0.3067               0.0199
  6              0.3239               0.0172
  7              0.3392               0.0153
  8              0.3531               0.0139
  9              0.3658               0.0127
 10              0.3775               0.0117
 11              0.3885               0.0110
 12              0.3988               0.0103
 13              0.4132               0.0145
 14              0.4271               0.0139
 15              0.4404               0.0133
 16              0.4532               0.0128
 17              0.4656               0.0124
 18              0.4776               0.0120
 19              0.4893               0.0116
 20              0.5006               0.0113
 21              0.5116               0.0110
 22              0.5223               0.0107
 23              0.5327               0.0104
 24              0.5429               0.0102
 25              0.5528               0.0100
```

26	0.5626	0.0097
27	0.5721	0.0095
28	0.5814	0.0093
29	0.5906	0.0092
30	0.5996	0.0090
31	0.6084	0.0088
32	0.6170	0.0087
33	0.6255	0.0085
34	0.6339	0.0084
35	0.6421	0.0082
36	0.6502	0.0081
37	0.6582	0.0080
38	0.6661	0.0079
39	0.6738	0.0077
40	0.6814	0.0076
41	0.6889	0.0075
42	0.6964	0.0074
43	0.7037	0.0073
44	0.7109	0.0072
45	0.7181	0.0071
46	0.7251	0.0071
47	0.7321	0.0070
48	0.7390	0.0069
49	0.7458	0.0068
50	0.7525	0.0067
51	0.7592	0.0067
52	0.7657	0.0066
53	0.7723	0.0065
54	0.7787	0.0064
55	0.7851	0.0064
56	0.7914	0.0063
57	0.7977	0.0063
58	0.8038	0.0062
59	0.8100	0.0061
60	0.8161	0.0061
61	0.8221	0.0060
62	0.8280	0.0060
63	0.8340	0.0059
64	0.8398	0.0059
65	0.8456	0.0058
66	0.8514	0.0058
67	0.8571	0.0057
68	0.8628	0.0057
69	0.8684	0.0056
70	0.8739	0.0056
71	0.8795	0.0055
72	0.8850	0.0055
73	0.8904	0.0054
74	0.8958	0.0054
75	0.9012	0.0054

76	0.9065	0.0053
77	0.9118	0.0053
78	0.9171	0.0053
79	0.9223	0.0052
80	0.9274	0.0052
81	0.9326	0.0051
82	0.9377	0.0051
83	0.9428	0.0051
84	0.9478	0.0050
85	0.9528	0.0050
86	0.9578	0.0050
87	0.9627	0.0049
88	0.9676	0.0049
89	0.9725	0.0049
90	0.9774	0.0048
91	0.9822	0.0048
92	0.9870	0.0048
93	0.9917	0.0048
94	0.9964	0.0047
95	1.0012	0.0047
96	1.0058	0.0047
97	1.0105	0.0046
98	1.0151	0.0046
99	1.0197	0.0046
100	1.0243	0.0046
101	1.0288	0.0045
102	1.0333	0.0045
103	1.0378	0.0045
104	1.0423	0.0045
105	1.0467	0.0044
106	1.0512	0.0044
107	1.0556	0.0044
108	1.0600	0.0044
109	1.0643	0.0044
110	1.0686	0.0043
111	1.0730	0.0043
112	1.0772	0.0043
113	1.0815	0.0043
114	1.0858	0.0042
115	1.0900	0.0042
116	1.0942	0.0042
117	1.0984	0.0042
118	1.1026	0.0042
119	1.1067	0.0041
120	1.1108	0.0041
121	1.1149	0.0041
122	1.1190	0.0041
123	1.1231	0.0041
124	1.1272	0.0041
125	1.1312	0.0040

126	1.1352	0.0040
127	1.1392	0.0040
128	1.1432	0.0040
129	1.1472	0.0040
130	1.1511	0.0039
131	1.1550	0.0039
132	1.1590	0.0039
133	1.1629	0.0039
134	1.1667	0.0039
135	1.1706	0.0039
136	1.1745	0.0039
137	1.1783	0.0038
138	1.1821	0.0038
139	1.1859	0.0038
140	1.1897	0.0038
141	1.1935	0.0038
142	1.1972	0.0038
143	1.2010	0.0037
144	1.2047	0.0037
145	1.2084	0.0037
146	1.2121	0.0037
147	1.2158	0.0037
148	1.2195	0.0037
149	1.2231	0.0037
150	1.2268	0.0036
151	1.2304	0.0036
152	1.2340	0.0036
153	1.2377	0.0036
154	1.2412	0.0036
155	1.2448	0.0036
156	1.2484	0.0036
157	1.2519	0.0036
158	1.2555	0.0035
159	1.2590	0.0035
160	1.2625	0.0035
161	1.2660	0.0035
162	1.2695	0.0035
163	1.2730	0.0035
164	1.2765	0.0035
165	1.2799	0.0035
166	1.2834	0.0034
167	1.2868	0.0034
168	1.2902	0.0034
169	1.2937	0.0034
170	1.2971	0.0034
171	1.3004	0.0034
172	1.3038	0.0034
173	1.3072	0.0034
174	1.3106	0.0034
175	1.3139	0.0033

176	1.3172	0.0033
177	1.3206	0.0033
178	1.3239	0.0033
179	1.3272	0.0033
180	1.3305	0.0033
181	1.3338	0.0033
182	1.3370	0.0033
183	1.3403	0.0033
184	1.3435	0.0033
185	1.3468	0.0032
186	1.3500	0.0032
187	1.3533	0.0032
188	1.3565	0.0032
189	1.3597	0.0032
190	1.3629	0.0032
191	1.3661	0.0032
192	1.3692	0.0032
193	1.3724	0.0032
194	1.3756	0.0032
195	1.3787	0.0032
196	1.3819	0.0031
197	1.3850	0.0031
198	1.3881	0.0031
199	1.3912	0.0031
200	1.3943	0.0031
201	1.3974	0.0031
202	1.4005	0.0031
203	1.4036	0.0031
204	1.4067	0.0031
205	1.4097	0.0031
206	1.4128	0.0031
207	1.4158	0.0030
208	1.4189	0.0030
209	1.4219	0.0030
210	1.4249	0.0030
211	1.4280	0.0030
212	1.4310	0.0030
213	1.4340	0.0030
214	1.4370	0.0030
215	1.4399	0.0030
216	1.4429	0.0030
217	1.4459	0.0030
218	1.4488	0.0030
219	1.4518	0.0030
220	1.4547	0.0029
221	1.4577	0.0029
222	1.4606	0.0029
223	1.4635	0.0029
224	1.4665	0.0029
225	1.4694	0.0029

226	1.4723	0.0029
227	1.4752	0.0029
228	1.4781	0.0029
229	1.4809	0.0029
230	1.4838	0.0029
231	1.4867	0.0029
232	1.4895	0.0029
233	1.4924	0.0029
234	1.4952	0.0028
235	1.4981	0.0028
236	1.5009	0.0028
237	1.5037	0.0028
238	1.5066	0.0028
239	1.5094	0.0028
240	1.5122	0.0028
241	1.5150	0.0028
242	1.5178	0.0028
243	1.5206	0.0028
244	1.5233	0.0028
245	1.5261	0.0028
246	1.5289	0.0028
247	1.5316	0.0028
248	1.5344	0.0028
249	1.5372	0.0028
250	1.5399	0.0027
251	1.5426	0.0027
252	1.5454	0.0027
253	1.5481	0.0027
254	1.5508	0.0027
255	1.5535	0.0027
256	1.5562	0.0027
257	1.5589	0.0027
258	1.5616	0.0027
259	1.5643	0.0027
260	1.5670	0.0027
261	1.5697	0.0027
262	1.5724	0.0027
263	1.5750	0.0027
264	1.5777	0.0027
265	1.5803	0.0027
266	1.5830	0.0027
267	1.5856	0.0026
268	1.5883	0.0026
269	1.5909	0.0026
270	1.5935	0.0026
271	1.5962	0.0026
272	1.5988	0.0026
273	1.6014	0.0026
274	1.6040	0.0026
275	1.6066	0.0026

```
276              1.6092              0.0026
277              1.6118              0.0026
278              1.6144              0.0026
279              1.6170              0.0026
280              1.6195              0.0026
281              1.6221              0.0026
282              1.6247              0.0026
283              1.6272              0.0026
284              1.6298              0.0026
285              1.6324              0.0026
286              1.6349              0.0025
287              1.6374              0.0025
288              1.6400              0.0025
---------------------------------------------------------------------
Unit              Unit            Unit              Effective
Period            Rainfall        Soil-Loss         Rainfall
(number)            (In)          (In)                 (In)
---------------------------------------------------------------------
  1              0.0025           0.0012              0.0013
  2              0.0025           0.0012              0.0013
  3              0.0026           0.0012              0.0013
  4              0.0026           0.0012              0.0013
  5              0.0026           0.0012              0.0013
  6              0.0026           0.0012              0.0013
  7              0.0026           0.0012              0.0013
  8              0.0026           0.0012              0.0013
  9              0.0026           0.0012              0.0014
 10              0.0026           0.0012              0.0014
 11              0.0026           0.0013              0.0014
 12              0.0026           0.0013              0.0014
 13              0.0026           0.0013              0.0014
 14              0.0026           0.0013              0.0014
 15              0.0026           0.0013              0.0014
 16              0.0027           0.0013              0.0014
 17              0.0027           0.0013              0.0014
 18              0.0027           0.0013              0.0014
 19              0.0027           0.0013              0.0014
 20              0.0027           0.0013              0.0014
 21              0.0027           0.0013              0.0014
 22              0.0027           0.0013              0.0014
 23              0.0027           0.0013              0.0014
 24              0.0027           0.0013              0.0014
 25              0.0027           0.0013              0.0014
 26              0.0027           0.0013              0.0014
 27              0.0028           0.0013              0.0014
 28              0.0028           0.0013              0.0014
 29              0.0028           0.0013              0.0014
 30              0.0028           0.0013              0.0014
 31              0.0028           0.0013              0.0015
 32              0.0028           0.0013              0.0015
```

33	0.0028	0.0013	0.0015
34	0.0028	0.0013	0.0015
35	0.0028	0.0014	0.0015
36	0.0028	0.0014	0.0015
37	0.0028	0.0014	0.0015
38	0.0029	0.0014	0.0015
39	0.0029	0.0014	0.0015
40	0.0029	0.0014	0.0015
41	0.0029	0.0014	0.0015
42	0.0029	0.0014	0.0015
43	0.0029	0.0014	0.0015
44	0.0029	0.0014	0.0015
45	0.0029	0.0014	0.0015
46	0.0029	0.0014	0.0015
47	0.0030	0.0014	0.0015
48	0.0030	0.0014	0.0015
49	0.0030	0.0014	0.0016
50	0.0030	0.0014	0.0016
51	0.0030	0.0014	0.0016
52	0.0030	0.0014	0.0016
53	0.0030	0.0014	0.0016
54	0.0030	0.0015	0.0016
55	0.0030	0.0015	0.0016
56	0.0031	0.0015	0.0016
57	0.0031	0.0015	0.0016
58	0.0031	0.0015	0.0016
59	0.0031	0.0015	0.0016
60	0.0031	0.0015	0.0016
61	0.0031	0.0015	0.0016
62	0.0031	0.0015	0.0016
63	0.0032	0.0015	0.0016
64	0.0032	0.0015	0.0016
65	0.0032	0.0015	0.0017
66	0.0032	0.0015	0.0017
67	0.0032	0.0015	0.0017
68	0.0032	0.0015	0.0017
69	0.0032	0.0015	0.0017
70	0.0032	0.0016	0.0017
71	0.0033	0.0016	0.0017
72	0.0033	0.0016	0.0017
73	0.0033	0.0016	0.0017
74	0.0033	0.0016	0.0017
75	0.0033	0.0016	0.0017
76	0.0033	0.0016	0.0017
77	0.0034	0.0016	0.0018
78	0.0034	0.0016	0.0018
79	0.0034	0.0016	0.0018
80	0.0034	0.0016	0.0018
81	0.0034	0.0016	0.0018
82	0.0034	0.0016	0.0018

83	0.0035	0.0017	0.0018
84	0.0035	0.0017	0.0018
85	0.0035	0.0017	0.0018
86	0.0035	0.0017	0.0018
87	0.0035	0.0017	0.0018
88	0.0035	0.0017	0.0018
89	0.0036	0.0017	0.0019
90	0.0036	0.0017	0.0019
91	0.0036	0.0017	0.0019
92	0.0036	0.0017	0.0019
93	0.0036	0.0017	0.0019
94	0.0037	0.0018	0.0019
95	0.0037	0.0018	0.0019
96	0.0037	0.0018	0.0019
97	0.0037	0.0018	0.0019
98	0.0037	0.0018	0.0020
99	0.0038	0.0018	0.0020
100	0.0038	0.0018	0.0020
101	0.0038	0.0018	0.0020
102	0.0038	0.0018	0.0020
103	0.0039	0.0019	0.0020
104	0.0039	0.0019	0.0020
105	0.0039	0.0019	0.0020
106	0.0039	0.0019	0.0021
107	0.0040	0.0019	0.0021
108	0.0040	0.0019	0.0021
109	0.0040	0.0019	0.0021
110	0.0040	0.0019	0.0021
111	0.0041	0.0019	0.0021
112	0.0041	0.0020	0.0021
113	0.0041	0.0020	0.0022
114	0.0041	0.0020	0.0022
115	0.0042	0.0020	0.0022
116	0.0042	0.0020	0.0022
117	0.0042	0.0020	0.0022
118	0.0043	0.0020	0.0022
119	0.0043	0.0021	0.0022
120	0.0043	0.0021	0.0023
121	0.0044	0.0021	0.0023
122	0.0044	0.0021	0.0023
123	0.0044	0.0021	0.0023
124	0.0045	0.0021	0.0023
125	0.0045	0.0022	0.0024
126	0.0045	0.0022	0.0024
127	0.0046	0.0022	0.0024
128	0.0046	0.0022	0.0024
129	0.0047	0.0022	0.0024
130	0.0047	0.0023	0.0025
131	0.0048	0.0023	0.0025
132	0.0048	0.0023	0.0025

133	0.0048	0.0023	0.0025
134	0.0049	0.0023	0.0025
135	0.0049	0.0024	0.0026
136	0.0050	0.0024	0.0026
137	0.0050	0.0024	0.0026
138	0.0051	0.0024	0.0026
139	0.0051	0.0025	0.0027
140	0.0052	0.0025	0.0027
141	0.0053	0.0025	0.0027
142	0.0053	0.0025	0.0028
143	0.0054	0.0026	0.0028
144	0.0054	0.0026	0.0028
145	0.0055	0.0026	0.0029
146	0.0055	0.0026	0.0029
147	0.0056	0.0027	0.0029
148	0.0057	0.0027	0.0030
149	0.0058	0.0028	0.0030
150	0.0058	0.0028	0.0030
151	0.0059	0.0028	0.0031
152	0.0060	0.0029	0.0031
153	0.0061	0.0029	0.0032
154	0.0061	0.0029	0.0032
155	0.0063	0.0030	0.0033
156	0.0063	0.0030	0.0033
157	0.0064	0.0031	0.0034
158	0.0065	0.0031	0.0034
159	0.0067	0.0032	0.0035
160	0.0067	0.0032	0.0035
161	0.0069	0.0033	0.0036
162	0.0070	0.0033	0.0036
163	0.0071	0.0034	0.0037
164	0.0072	0.0035	0.0038
165	0.0074	0.0036	0.0039
166	0.0075	0.0036	0.0039
167	0.0077	0.0037	0.0040
168	0.0079	0.0038	0.0041
169	0.0081	0.0039	0.0042
170	0.0082	0.0039	0.0043
171	0.0085	0.0041	0.0044
172	0.0087	0.0041	0.0045
173	0.0090	0.0043	0.0047
174	0.0092	0.0044	0.0048
175	0.0095	0.0046	0.0050
176	0.0097	0.0047	0.0051
177	0.0102	0.0049	0.0053
178	0.0104	0.0050	0.0054
179	0.0110	0.0053	0.0057
180	0.0113	0.0054	0.0059
181	0.0120	0.0057	0.0063
182	0.0124	0.0059	0.0065

183	0.0133	0.0064	0.0069
184	0.0139	0.0066	0.0072
185	0.0103	0.0049	0.0054
186	0.0110	0.0052	0.0057
187	0.0127	0.0061	0.0066
188	0.0139	0.0066	0.0072
189	0.0172	0.0083	0.0090
190	0.0199	0.0095	0.0104
191	0.0301	0.0144	0.0157
192	0.0437	0.0209	0.0228
193	0.1892	0.0260	0.1632
194	0.0237	0.0113	0.0124
195	0.0153	0.0073	0.0080
196	0.0117	0.0056	0.0061
197	0.0145	0.0069	0.0075
198	0.0128	0.0061	0.0067
199	0.0116	0.0056	0.0061
200	0.0107	0.0051	0.0056
201	0.0100	0.0048	0.0052
202	0.0093	0.0045	0.0049
203	0.0088	0.0042	0.0046
204	0.0084	0.0040	0.0044
205	0.0080	0.0038	0.0042
206	0.0076	0.0037	0.0040
207	0.0073	0.0035	0.0038
208	0.0071	0.0034	0.0037
209	0.0068	0.0033	0.0035
210	0.0066	0.0032	0.0034
211	0.0064	0.0031	0.0033
212	0.0062	0.0030	0.0032
213	0.0060	0.0029	0.0031
214	0.0059	0.0028	0.0031
215	0.0057	0.0027	0.0030
216	0.0056	0.0027	0.0029
217	0.0054	0.0026	0.0028
218	0.0053	0.0025	0.0028
219	0.0052	0.0025	0.0027
220	0.0051	0.0024	0.0027
221	0.0050	0.0024	0.0026
222	0.0049	0.0023	0.0026
223	0.0048	0.0023	0.0025
224	0.0047	0.0023	0.0025
225	0.0046	0.0022	0.0024
226	0.0046	0.0022	0.0024
227	0.0045	0.0022	0.0023
228	0.0044	0.0021	0.0023
229	0.0044	0.0021	0.0023
230	0.0043	0.0021	0.0022
231	0.0042	0.0020	0.0022
232	0.0042	0.0020	0.0022

233	0.0041	0.0020	0.0021
234	0.0041	0.0019	0.0021
235	0.0040	0.0019	0.0021
236	0.0039	0.0019	0.0021
237	0.0039	0.0019	0.0020
238	0.0039	0.0018	0.0020
239	0.0038	0.0018	0.0020
240	0.0038	0.0018	0.0020
241	0.0037	0.0018	0.0019
242	0.0037	0.0018	0.0019
243	0.0036	0.0017	0.0019
244	0.0036	0.0017	0.0019
245	0.0036	0.0017	0.0019
246	0.0035	0.0017	0.0018
247	0.0035	0.0017	0.0018
248	0.0034	0.0016	0.0018
249	0.0034	0.0016	0.0018
250	0.0034	0.0016	0.0018
251	0.0033	0.0016	0.0017
252	0.0033	0.0016	0.0017
253	0.0033	0.0016	0.0017
254	0.0033	0.0016	0.0017
255	0.0032	0.0015	0.0017
256	0.0032	0.0015	0.0017
257	0.0032	0.0015	0.0017
258	0.0031	0.0015	0.0016
259	0.0031	0.0015	0.0016
260	0.0031	0.0015	0.0016
261	0.0031	0.0015	0.0016
262	0.0030	0.0015	0.0016
263	0.0030	0.0014	0.0016
264	0.0030	0.0014	0.0016
265	0.0030	0.0014	0.0015
266	0.0029	0.0014	0.0015
267	0.0029	0.0014	0.0015
268	0.0029	0.0014	0.0015
269	0.0029	0.0014	0.0015
270	0.0029	0.0014	0.0015
271	0.0028	0.0014	0.0015
272	0.0028	0.0013	0.0015
273	0.0028	0.0013	0.0015
274	0.0028	0.0013	0.0015
275	0.0028	0.0013	0.0014
276	0.0027	0.0013	0.0014
277	0.0027	0.0013	0.0014
278	0.0027	0.0013	0.0014
279	0.0027	0.0013	0.0014
280	0.0027	0.0013	0.0014
281	0.0027	0.0013	0.0014
282	0.0026	0.0013	0.0014

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      283              0.0026           0.0013             0.0014
      284              0.0026           0.0012             0.0014
      285              0.0026           0.0012             0.0014
      286              0.0026           0.0012             0.0013
      287              0.0026           0.0012             0.0013
      288              0.0025           0.0012             0.0013
      --------------------------------------------------------------------
      --------------------------------------------------------------------
      Total soil rain loss =      0.72(In)
      Total effective rainfall =      0.92(In)
      Peak flow rate in flood hydrograph =      8.74(CFS)
      ---------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R    S T O R M
                     R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0001      0.01  Q        |         |         |         |
  0+10       0.0004      0.06  Q        |         |         |         |
  0+15       0.0012      0.12  Q        |         |         |         |
  0+20       0.0022      0.14  Q        |         |         |         |
  0+25       0.0033      0.16  Q        |         |         |         |
  0+30       0.0045      0.17  Q        |         |         |         |
  0+35       0.0057      0.18  Q        |         |         |         |
  0+40       0.0069      0.18  Q        |         |         |         |
  0+45       0.0082      0.19  Q        |         |         |         |
  0+50       0.0095      0.19  Q        |         |         |         |
  0+55       0.0109      0.19  Q        |         |         |         |
  1+ 0       0.0122      0.20  Q        |         |         |         |
  1+ 5       0.0136      0.20  Q        |         |         |         |
  1+10       0.0149      0.20  Q        |         |         |         |
  1+15       0.0163      0.20  Q        |         |         |         |
  1+20       0.0177      0.20  Q        |         |         |         |
  1+25       0.0191      0.20  Q        |         |         |         |
  1+30       0.0205      0.20  Q        |         |         |         |
  1+35       0.0219      0.20  Q        |         |         |         |
  1+40       0.0234      0.21  Q        |         |         |         |
  1+45       0.0248      0.21  QV       |         |         |         |
  1+50       0.0262      0.21  QV       |         |         |         |
  1+55       0.0276      0.21  QV       |         |         |         |
  2+ 0       0.0290      0.21  QV       |         |         |         |
  2+ 5       0.0305      0.21  QV       |         |         |         |
  2+10       0.0319      0.21  QV       |         |         |         |
  2+15       0.0334      0.21  QV       |         |         |         |
  2+20       0.0348      0.21  QV       |         |         |         |
  2+25       0.0363      0.21  QV       |         |         |         |
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2+30       0.0377      0.21  QV        |         |         |         |
2+35       0.0392      0.21  QV        |         |         |         |
2+40       0.0407      0.21  QV        |         |         |         |
2+45       0.0421      0.21  QV        |         |         |         |
2+50       0.0436      0.21  QV        |         |         |         |
2+55       0.0451      0.22  QV        |         |         |         |
3+ 0       0.0466      0.22  QV        |         |         |         |
3+ 5       0.0481      0.22  Q V       |         |         |         |
3+10       0.0496      0.22  Q V       |         |         |         |
3+15       0.0511      0.22  Q V       |         |         |         |
3+20       0.0526      0.22  Q V       |         |         |         |
3+25       0.0541      0.22  Q V       |         |         |         |
3+30       0.0556      0.22  Q V       |         |         |         |
3+35       0.0572      0.22  Q V       |         |         |         |
3+40       0.0587      0.22  Q V       |         |         |         |
3+45       0.0602      0.22  Q V       |         |         |         |
3+50       0.0618      0.22  Q V       |         |         |         |
3+55       0.0633      0.23  Q V       |         |         |         |
4+ 0       0.0649      0.23  Q V       |         |         |         |
4+ 5       0.0665      0.23  Q V       |         |         |         |
4+10       0.0680      0.23  Q V       |         |         |         |
4+15       0.0696      0.23  Q V       |         |         |         |
4+20       0.0712      0.23  Q  V      |         |         |         |
4+25       0.0728      0.23  Q  V      |         |         |         |
4+30       0.0744      0.23  Q  V      |         |         |         |
4+35       0.0760      0.23  Q  V      |         |         |         |
4+40       0.0776      0.23  Q  V      |         |         |         |
4+45       0.0792      0.23  Q  V      |         |         |         |
4+50       0.0808      0.23  Q  V      |         |         |         |
4+55       0.0824      0.24  Q  V      |         |         |         |
5+ 0       0.0840      0.24  Q  V      |         |         |         |
5+ 5       0.0857      0.24  Q  V      |         |         |         |
5+10       0.0873      0.24  Q  V      |         |         |         |
5+15       0.0890      0.24  Q  V      |         |         |         |
5+20       0.0906      0.24  Q  V      |         |         |         |
5+25       0.0923      0.24  Q  V      |         |         |         |
5+30       0.0940      0.24  Q   V     |         |         |         |
5+35       0.0957      0.24  Q   V     |         |         |         |
5+40       0.0973      0.24  Q   V     |         |         |         |
5+45       0.0990      0.25  Q   V     |         |         |         |
5+50       0.1007      0.25  Q   V     |         |         |         |
5+55       0.1024      0.25  Q   V     |         |         |         |
6+ 0       0.1042      0.25  Q   V     |         |         |         |
6+ 5       0.1059      0.25  |Q  V     |         |         |         |
6+10       0.1076      0.25  |Q  V     |         |         |         |
6+15       0.1094      0.25  |Q  V     |         |         |         |
6+20       0.1111      0.25  |Q  V     |         |         |         |
6+25       0.1129      0.26  |Q  V     |         |         |         |
6+30       0.1146      0.26  |Q  V     |         |         |         |
6+35       0.1164      0.26  |Q  V     |         |         |         |
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 6+40       0.1182      0.26  |Q   V    |         |         |         |
 6+45       0.1200      0.26  |Q   V    |         |         |         |
 6+50       0.1218      0.26  |Q   V    |         |         |         |
 6+55       0.1236      0.26  |Q   V    |         |         |         |
 7+ 0       0.1254      0.26  |Q   V    |         |         |         |
 7+ 5       0.1272      0.27  |Q   V    |         |         |         |
 7+10       0.1291      0.27  |Q   V    |         |         |         |
 7+15       0.1309      0.27  |Q   V    |         |         |         |
 7+20       0.1327      0.27  |Q   V    |         |         |         |
 7+25       0.1346      0.27  |Q   V    |         |         |         |
 7+30       0.1365      0.27  |Q   V    |         |         |         |
 7+35       0.1384      0.27  |Q   V    |         |         |         |
 7+40       0.1403      0.27  |Q   V    |         |         |         |
 7+45       0.1422      0.28  |Q    V   |         |         |         |
 7+50       0.1441      0.28  |Q    V   |         |         |         |
 7+55       0.1460      0.28  |Q    V   |         |         |         |
 8+ 0       0.1479      0.28  |Q    V   |         |         |         |
 8+ 5       0.1499      0.28  |Q    V   |         |         |         |
 8+10       0.1518      0.28  |Q    V   |         |         |         |
 8+15       0.1538      0.29  |Q    V   |         |         |         |
 8+20       0.1558      0.29  |Q    V   |         |         |         |
 8+25       0.1578      0.29  |Q    V   |         |         |         |
 8+30       0.1598      0.29  |Q    V   |         |         |         |
 8+35       0.1618      0.29  |Q    V   |         |         |         |
 8+40       0.1638      0.29  |Q    V   |         |         |         |
 8+45       0.1659      0.30  |Q     V  |         |         |         |
 8+50       0.1679      0.30  |Q     V  |         |         |         |
 8+55       0.1700      0.30  |Q     V  |         |         |         |
 9+ 0       0.1721      0.30  |Q     V  |         |         |         |
 9+ 5       0.1741      0.30  |Q     V  |         |         |         |
 9+10       0.1762      0.31  |Q     V  |         |         |         |
 9+15       0.1784      0.31  |Q     V  |         |         |         |
 9+20       0.1805      0.31  |Q     V  |         |         |         |
 9+25       0.1826      0.31  |Q     V  |         |         |         |
 9+30       0.1848      0.31  |Q     V  |         |         |         |
 9+35       0.1870      0.32  |Q     V  |         |         |         |
 9+40       0.1892      0.32  |Q      V |         |         |         |
 9+45       0.1914      0.32  |Q      V |         |         |         |
 9+50       0.1936      0.32  |Q      V |         |         |         |
 9+55       0.1958      0.32  |Q      V |         |         |         |
10+ 0       0.1981      0.33  |Q      V |         |         |         |
10+ 5       0.2004      0.33  |Q      V |         |         |         |
10+10       0.2026      0.33  |Q      V |         |         |         |
10+15       0.2049      0.33  |Q      V |         |         |         |
10+20       0.2073      0.34  |Q      V |         |         |         |
10+25       0.2096      0.34  |Q      V |         |         |         |
10+30       0.2120      0.34  |Q       V|         |         |         |
10+35       0.2143      0.35  |Q       V|         |         |         |
10+40       0.2167      0.35  |Q       V|         |         |         |
10+45       0.2192      0.35  |Q       V|         |         |         |
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10+50       0.2216      0.35  |Q       V|         |         |         |
10+55       0.2241      0.36  |Q       V|         |         |         |
11+ 0       0.2265      0.36  |Q       V|         |         |         |
11+ 5       0.2290      0.36  |Q       V|         |         |         |
11+10       0.2316      0.37  |Q       V|         |         |         |
11+15       0.2341      0.37  |Q       V|         |         |         |
11+20       0.2367      0.37  |Q        V         |         |         |
11+25       0.2393      0.38  |Q        V         |         |         |
11+30       0.2419      0.38  |Q        V         |         |         |
11+35       0.2445      0.38  |Q        V         |         |         |
11+40       0.2472      0.39  |Q        V         |         |         |
11+45       0.2499      0.39  |Q        V         |         |         |
11+50       0.2526      0.40  |Q        V         |         |         |
11+55       0.2554      0.40  |Q        V         |         |         |
12+ 0       0.2582      0.40  |Q        |V        |         |         |
12+ 5       0.2610      0.41  |Q        |V        |         |         |
12+10       0.2638      0.41  |Q        |V        |         |         |
12+15       0.2667      0.42  |Q        |V        |         |         |
12+20       0.2696      0.42  |Q        |V        |         |         |
12+25       0.2726      0.43  |Q        |V        |         |         |
12+30       0.2756      0.43  |Q        |V        |         |         |
12+35       0.2786      0.44  |Q        |V        |         |         |
12+40       0.2816      0.44  |Q        | V       |         |         |
12+45       0.2847      0.45  |Q        | V       |         |         |
12+50       0.2879      0.46  |Q        | V       |         |         |
12+55       0.2910      0.46  |Q        | V       |         |         |
13+ 0       0.2943      0.47  |Q        | V       |         |         |
13+ 5       0.2975      0.47  |Q        | V       |         |         |
13+10       0.3008      0.48  |Q        | V       |         |         |
13+15       0.3042      0.49  |Q        | V       |         |         |
13+20       0.3076      0.50  |Q        |  V      |         |         |
13+25       0.3111      0.50  | Q       |  V      |         |         |
13+30       0.3146      0.51  | Q       |  V      |         |         |
13+35       0.3182      0.52  | Q       |  V      |         |         |
13+40       0.3219      0.53  | Q       |  V      |         |         |
13+45       0.3256      0.54  | Q       |  V      |         |         |
13+50       0.3294      0.55  | Q       |   V     |         |         |
13+55       0.3332      0.56  | Q       |   V     |         |         |
14+ 0       0.3372      0.57  | Q       |   V     |         |         |
14+ 5       0.3412      0.58  | Q       |   V     |         |         |
14+10       0.3453      0.60  | Q       |   V     |         |         |
14+15       0.3495      0.61  | Q       |   V     |         |         |
14+20       0.3538      0.62  | Q       |    V    |         |         |
14+25       0.3582      0.64  | Q       |    V    |         |         |
14+30       0.3627      0.66  | Q       |    V    |         |         |
14+35       0.3674      0.67  | Q       |    V    |         |         |
14+40       0.3721      0.69  | Q       |    V    |         |         |
14+45       0.3770      0.71  | Q       |     V   |         |         |
14+50       0.3821      0.74  | Q       |     V   |         |         |
14+55       0.3873      0.76  |  Q      |     V   |         |         |
```

```
15+ 0       0.3927      0.79  |  Q      |     V   |         |         |
15+ 5       0.3984      0.82  |  Q      |      V  |         |         |
15+10       0.4042      0.85  |  Q      |      V  |         |         |
15+15       0.4103      0.89  |  Q      |      V  |         |         |
15+20       0.4168      0.93  |  Q      |      V  |         |         |
15+25       0.4234      0.97  |  Q      |       V |         |         |
15+30       0.4298      0.93  |  Q      |       V |         |         |
15+35       0.4359      0.88  |  Q      |       V |         |         |
15+40       0.4422      0.91  |  Q      |       V |         |         |
15+45       0.4489      0.98  |  Q      |        V|         |         |
15+50       0.4564      1.09  |   Q     |        V|         |         |
15+55       0.4651      1.27  |    Q    |        V|         |         |
16+ 0       0.4762      1.61  |     Q   |         V         |         |
16+ 5       0.4965      2.94  |         |Q        |V        |         |
16+10       0.5493      7.68  |         |         |  V      Q         |
16+15       0.6095      8.74  |         |         |     V   |   Q     |
16+20       0.6421      4.74  |         |       Q |      V  |         |
16+25       0.6641      3.18  |         | Q       |       V |         |
16+30       0.6809      2.45  |        Q|         |        V|         |
16+35       0.6950      2.05  |       Q |         |        V|         |
16+40       0.7068      1.71  |     Q   |         |         V         |
16+45       0.7171      1.49  |    Q    |         |         V         |
16+50       0.7260      1.30  |    Q    |         |         V         |
16+55       0.7339      1.15  |   Q     |         |         |V        |
17+ 0       0.7408      1.00  |   Q     |         |         |V        |
17+ 5       0.7469      0.89  |  Q      |         |         |V        |
17+10       0.7528      0.85  |  Q      |         |         | V       |
17+15       0.7583      0.81  |  Q      |         |         | V       |
17+20       0.7633      0.72  | Q       |         |         | V       |
17+25       0.7678      0.66  | Q       |         |         | V       |
17+30       0.7718      0.58  | Q       |         |         | V       |
17+35       0.7757      0.56  | Q       |         |         |  V      |
17+40       0.7793      0.54  | Q       |         |         |  V      |
17+45       0.7829      0.52  | Q       |         |         |  V      |
17+50       0.7864      0.50  | Q       |         |         |  V      |
17+55       0.7897      0.48  |Q        |         |         |  V      |
18+ 0       0.7929      0.47  |Q        |         |         |  V      |
18+ 5       0.7961      0.46  |Q        |         |         |  V      |
18+10       0.7992      0.45  |Q        |         |         |   V     |
18+15       0.8022      0.43  |Q        |         |         |   V     |
18+20       0.8051      0.42  |Q        |         |         |   V     |
18+25       0.8079      0.41  |Q        |         |         |   V     |
18+30       0.8107      0.41  |Q        |         |         |   V     |
18+35       0.8134      0.40  |Q        |         |         |   V     |
18+40       0.8161      0.39  |Q        |         |         |   V     |
18+45       0.8187      0.38  |Q        |         |         |   V     |
18+50       0.8213      0.37  |Q        |         |         |    V    |
18+55       0.8238      0.37  |Q        |         |         |    V    |
19+ 0       0.8263      0.36  |Q        |         |         |    V    |
19+ 5       0.8288      0.35  |Q        |         |         |    V    |
```

```
19+10       0.8312      0.35  |Q        |         |         |    V    |
19+15       0.8335      0.34  |Q        |         |         |    V    |
19+20       0.8358      0.34  |Q        |         |         |    V    |
19+25       0.8381      0.33  |Q        |         |         |    V    |
19+30       0.8404      0.33  |Q        |         |         |    V    |
19+35       0.8426      0.32  |Q        |         |         |    V    |
19+40       0.8448      0.32  |Q        |         |         |     V   |
19+45       0.8470      0.31  |Q        |         |         |     V   |
19+50       0.8491      0.31  |Q        |         |         |     V   |
19+55       0.8512      0.31  |Q        |         |         |     V   |
20+ 0       0.8533      0.30  |Q        |         |         |     V   |
20+ 5       0.8553      0.30  |Q        |         |         |     V   |
20+10       0.8574      0.29  |Q        |         |         |     V   |
20+15       0.8594      0.29  |Q        |         |         |     V   |
20+20       0.8613      0.29  |Q        |         |         |     V   |
20+25       0.8633      0.28  |Q        |         |         |     V   |
20+30       0.8652      0.28  |Q        |         |         |     V   |
20+35       0.8671      0.28  |Q        |         |         |      V  |
20+40       0.8690      0.27  |Q        |         |         |      V  |
20+45       0.8709      0.27  |Q        |         |         |      V  |
20+50       0.8728      0.27  |Q        |         |         |      V  |
20+55       0.8746      0.27  |Q        |         |         |      V  |
21+ 0       0.8764      0.26  |Q        |         |         |      V  |
21+ 5       0.8782      0.26  |Q        |         |         |      V  |
21+10       0.8800      0.26  |Q        |         |         |      V  |
21+15       0.8817      0.26  |Q        |         |         |      V  |
21+20       0.8835      0.25  |Q        |         |         |      V  |
21+25       0.8852      0.25  |Q        |         |         |      V  |
21+30       0.8869      0.25  Q         |         |         |      V  |
21+35       0.8886      0.25  Q         |         |         |      V  |
21+40       0.8903      0.24  Q         |         |         |       V |
21+45       0.8920      0.24  Q         |         |         |       V |
21+50       0.8937      0.24  Q         |         |         |       V |
21+55       0.8953      0.24  Q         |         |         |       V |
22+ 0       0.8969      0.24  Q         |         |         |       V |
22+ 5       0.8985      0.23  Q         |         |         |       V |
22+10       0.9001      0.23  Q         |         |         |       V |
22+15       0.9017      0.23  Q         |         |         |       V |
22+20       0.9033      0.23  Q         |         |         |       V |
22+25       0.9049      0.23  Q         |         |         |       V |
22+30       0.9064      0.23  Q         |         |         |       V |
22+35       0.9080      0.22  Q         |         |         |       V |
22+40       0.9095      0.22  Q         |         |         |       V |
22+45       0.9110      0.22  Q         |         |         |       V |
22+50       0.9125      0.22  Q         |         |         |       V |
22+55       0.9140      0.22  Q         |         |         |        V|
23+ 0       0.9155      0.22  Q         |         |         |        V|
23+ 5       0.9170      0.21  Q         |         |         |        V|
23+10       0.9185      0.21  Q         |         |         |        V|
23+15       0.9199      0.21  Q         |         |         |        V|
```

```
   23+20       0.9214      0.21  Q         |         |         |        V|
   23+25       0.9228      0.21  Q         |         |         |        V|
   23+30       0.9243      0.21  Q         |         |         |        V|
   23+35       0.9257      0.21  Q         |         |         |        V|
   23+40       0.9271      0.21  Q         |         |         |        V|
   23+45       0.9285      0.20  Q         |         |         |        V|
   23+50       0.9299      0.20  Q         |         |         |        V|
   23+55       0.9313      0.20  Q         |         |         |        V|
   24+ 0       0.9327      0.20  Q         |         |         |        V|
-----------------------------------------------------------------------
```

```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
        Rational Hydrology Study        Date: 08/13/21
------------------------------------------------------------------------
10 Year Rational Analysis Post Development
Former Track 17486
Drainage Area 2
File: 17486Rat10PostA2.out
------------------------------------------------------------------------


Program License Serial Number 4070

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
Computed rainfall intensity:
Storm year =    10.00   1 hour rainfall =     0.692 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 3



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       4.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.393(In/Hr)
Initial subarea data:
Initial area flow distance =   997.200(Ft.)
Top (of initial area) elevation =  3291.300(Ft.)
Bottom (of initial area) elevation =  3281.000(Ft.)
Difference in elevation =    10.300(Ft.)
Slope =    0.01033  s(%)=       1.03
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.369 min.
Rainfall intensity =      1.795(In/Hr) for a    10.0 year storm
```

```
        Effective runoff coefficient used for area (Q=KCIA) is C = 0.703
        Subarea runoff =      9.759(CFS)
        Total initial stream area =        7.730(Ac.)
        Pervious area fraction = 0.500
        Initial area Fm value =    0.393(In/Hr)
↑


        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
        Process from Point/Station        1.000 to Point/Station        4.000
        **** CONFLUENCE OF MINOR STREAMS ****

        ______________________________________________________________________
        Along Main Stream number: 1 in normal stream number 1
        Stream flow area =      7.730(Ac.)
        Runoff from this stream =      9.759(CFS)
        Time of concentration =   15.37 min.
        Rainfall intensity =     1.795(In/Hr)
        Area averaged loss rate (Fm) =    0.3926(In/Hr)
        Area averaged Pervious ratio (Ap) = 0.5000
↑


        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
        Process from Point/Station        2.000 to Point/Station        4.000
        **** INITIAL AREA EVALUATION ****

        ______________________________________________________________________
        RESIDENTIAL(5 - 7 dwl/acre)
        Decimal fraction soil group A = 1.000
        Decimal fraction soil group B = 0.000
        Decimal fraction soil group C = 0.000
        Decimal fraction soil group D = 0.000
        SCS curve number for soil(AMC 2)  = 32.00
        Adjusted SCS curve number for AMC 3 = 52.00
        Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.393(In/Hr)
        Initial subarea data:
        Initial area flow distance =   443.400(Ft.)
        Top (of initial area) elevation =  3283.100(Ft.)
        Bottom (of initial area) elevation =  3281.000(Ft.)
        Difference in elevation =     2.100(Ft.)
        Slope =    0.00474  s(%)=       0.47
        TC = k(0.389)*[(length^3)/(elevation change)]^0.2
        Initial area time of concentration =   12.989 min.
        Rainfall intensity =      2.020(In/Hr) for a    10.0 year storm
        Effective runoff coefficient used for area (Q=KCIA) is C = 0.725
        Subarea runoff =      6.590(CFS)
        Total initial stream area =        4.500(Ac.)
        Pervious area fraction = 0.500
        Initial area Fm value =    0.393(In/Hr)
↑
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       4.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      4.500(Ac.)
Runoff from this stream =      6.590(CFS)
Time of concentration =   12.99 min.
Rainfall intensity =     2.020(In/Hr)
Area averaged loss rate (Fm) =    0.3926(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000
Summary of stream data:

Stream Flow rate    Area    TC      Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)



1      9.76     7.730     15.37    0.393      1.795
2      6.59     4.500     12.99    0.393      2.020
Qmax(1) =
           1.000 *    1.000 *     9.759) +
           0.862 *    1.000 *     6.590) + =      15.441
Qmax(2) =
           1.160 *    0.845 *     9.759) +
           1.000 *    1.000 *     6.590) + =      16.158

Total of 2 streams to confluence:
Flow rates before confluence point:
       9.759       6.590
Maximum flow rates at confluence using above data:
       15.441       16.158
Area of streams before confluence:
        7.730        4.500
Effective area values after confluence:
       12.230       11.033
Results of confluence:
Total flow rate =     16.158(CFS)
Time of concentration =    12.989 min.
Effective stream area after confluence =     11.033(Ac.)
Study area average Pervious fraction(Ap) =  0.500
Study area average soil loss rate(Fm) =    0.393(In/Hr)
Study area total (this main stream) =      12.23(Ac.)
End of computations, Total Study Area =          12.23 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.500
```

```
Area averaged SCS curve number =  32.0
```

```
        U n i t   H y d r o g r a p h   A n a l y s i s

        Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

                Study date  08/30/21

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
------------------------------------------------------------------------

San Bernardino County Synthetic Unit Hydrology Method
                Manual date - August 1986


Program License Serial Number 4070

---------------------------------------------------------------------
10 Year Unit Hydrograph Post Development
Former Track 17486
Drainage Area 2
File: 17486Hydr10PostA2.out
--------------------------------------------------------------------

        Storm Event Year = 10

        Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




Area averaged rainfall intensity isohyetal data:
        Sub-Area        Duration        Isohyetal
        (Ac.)            (hours)         (In)
Rainfall data for year 10
            12.23           1           0.69
--------------------------------------------------------------------
Rainfall data for year 10
            12.23           6           1.46
--------------------------------------------------------------------
Rainfall data for year 10
            12.23          24           2.97
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
******** Area-averaged max loss rate, Fm ********


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 32.0      52.0         12.23      1.000     0.785    0.400    0.314

Area-averaged adjusted loss rate Fm (In/Hr) =  0.314

********* Area-Averaged low loss rate fraction, Yb **********

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
     4.89   0.400         32.0      52.0       9.23     0.041
     7.34   0.600         98.0      98.0       0.20     0.922

Area-averaged catchment yield fraction, Y =  0.570
Area-averaged low loss fraction, Yb =  0.430
User entry of time of concentration  =   0.217 (hours)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =      12.23(Ac.)
Catchment Lag time =   0.173 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 48.1139
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.314(In/Hr)
Average low loss rate fraction (Yb) = 0.430 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall =  0.328(In)
Computed peak 30-minute rainfall =  0.562(In)
Specified peak 1-hour rainfall =  0.692(In)
Computed peak 3-hour rainfall =  1.094(In)
Specified peak 6-hour rainfall =  1.460(In)
Specified peak 24-hour rainfall =  2.970(In)


Rainfall depth area reduction factors:
Using a total area of      12.23(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999     Adjusted rainfall =  0.328(In)
30-minute factor = 0.999    Adjusted rainfall =  0.562(In)
1-hour factor = 0.999       Adjusted rainfall =  0.692(In)
3-hour factor = 1.000       Adjusted rainfall =  1.094(In)
6-hour factor = 1.000       Adjusted rainfall =  1.460(In)
24-hour factor = 1.000      Adjusted rainfall =  2.970(In)
---------------------------------------------------------------------

                       U n i t  H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
Interval          'S' Graph          Unit Hydrograph
Number            Mean values             ((CFS))
---------------------------------------------------------------------
                (K =       147.91 (CFS))

  1                3.719                   5.500
  2               28.282                  36.331
  3               58.794                  45.129
  4               72.457                  20.208
  5               80.398                  11.746
  6               85.662                   7.786
  7               89.432                   5.576
  8               92.102                   3.950
  9               94.181                   3.075
 10               95.760                   2.335
 11               96.964                   1.780
 12               97.797                   1.233
 13               98.328                   0.785
 14               98.894                   0.838
 15               99.444                   0.812
 16               99.786                   0.506
 17              100.000                   0.316
---------------------------------------------------------------------
Peak Unit   Adjusted mass rainfall  Unit rainfall
Number              (In)                (In)
  1              0.3282               0.3282
  2              0.4040               0.0759
  3              0.4563               0.0523
  4              0.4974               0.0411
  5              0.5319               0.0344
  6              0.5618               0.0299
  7              0.5883               0.0266
  8              0.6124               0.0240
  9              0.6344               0.0220
 10              0.6548               0.0204
 11              0.6738               0.0190
 12              0.6916               0.0178
 13              0.7151               0.0235
 14              0.7375               0.0225
 15              0.7591               0.0215
 16              0.7798               0.0207
 17              0.7998               0.0200
 18              0.8191               0.0193
 19              0.8377               0.0187
 20              0.8559               0.0181
 21              0.8735               0.0176
 22              0.8906               0.0171
 23              0.9072               0.0167
 24              0.9235               0.0163
 25              0.9393               0.0159
```

26	0.9548	0.0155
27	0.9700	0.0152
28	0.9848	0.0148
29	0.9993	0.0145
30	1.0136	0.0142
31	1.0275	0.0140
32	1.0412	0.0137
33	1.0547	0.0135
34	1.0679	0.0132
35	1.0809	0.0130
36	1.0937	0.0128
37	1.1062	0.0126
38	1.1186	0.0124
39	1.1308	0.0122
40	1.1428	0.0120
41	1.1546	0.0118
42	1.1662	0.0117
43	1.1777	0.0115
44	1.1891	0.0113
45	1.2002	0.0112
46	1.2113	0.0110
47	1.2222	0.0109
48	1.2330	0.0108
49	1.2436	0.0106
50	1.2541	0.0105
51	1.2645	0.0104
52	1.2748	0.0103
53	1.2850	0.0102
54	1.2950	0.0100
55	1.3049	0.0099
56	1.3148	0.0098
57	1.3245	0.0097
58	1.3341	0.0096
59	1.3437	0.0095
60	1.3531	0.0094
61	1.3625	0.0094
62	1.3717	0.0093
63	1.3809	0.0092
64	1.3900	0.0091
65	1.3990	0.0090
66	1.4080	0.0089
67	1.4168	0.0089
68	1.4256	0.0088
69	1.4343	0.0087
70	1.4429	0.0086
71	1.4515	0.0086
72	1.4599	0.0085
73	1.4703	0.0104
74	1.4806	0.0103
75	1.4908	0.0102

76	1.5009	0.0101
77	1.5110	0.0101
78	1.5211	0.0100
79	1.5310	0.0100
80	1.5409	0.0099
81	1.5507	0.0098
82	1.5605	0.0098
83	1.5702	0.0097
84	1.5799	0.0097
85	1.5895	0.0096
86	1.5991	0.0096
87	1.6086	0.0095
88	1.6180	0.0094
89	1.6274	0.0094
90	1.6367	0.0093
91	1.6460	0.0093
92	1.6553	0.0092
93	1.6645	0.0092
94	1.6736	0.0091
95	1.6827	0.0091
96	1.6918	0.0091
97	1.7008	0.0090
98	1.7097	0.0090
99	1.7186	0.0089
100	1.7275	0.0089
101	1.7363	0.0088
102	1.7451	0.0088
103	1.7539	0.0087
104	1.7626	0.0087
105	1.7712	0.0087
106	1.7798	0.0086
107	1.7884	0.0086
108	1.7970	0.0085
109	1.8055	0.0085
110	1.8139	0.0085
111	1.8224	0.0084
112	1.8308	0.0084
113	1.8391	0.0084
114	1.8474	0.0083
115	1.8557	0.0083
116	1.8640	0.0082
117	1.8722	0.0082
118	1.8804	0.0082
119	1.8885	0.0081
120	1.8966	0.0081
121	1.9047	0.0081
122	1.9128	0.0080
123	1.9208	0.0080
124	1.9288	0.0080
125	1.9367	0.0080

126	1.9446	0.0079
127	1.9525	0.0079
128	1.9604	0.0079
129	1.9682	0.0078
130	1.9760	0.0078
131	1.9838	0.0078
132	1.9915	0.0077
133	1.9992	0.0077
134	2.0069	0.0077
135	2.0146	0.0077
136	2.0222	0.0076
137	2.0298	0.0076
138	2.0374	0.0076
139	2.0449	0.0075
140	2.0525	0.0075
141	2.0600	0.0075
142	2.0674	0.0075
143	2.0749	0.0074
144	2.0823	0.0074
145	2.0897	0.0074
146	2.0971	0.0074
147	2.1044	0.0073
148	2.1117	0.0073
149	2.1190	0.0073
150	2.1263	0.0073
151	2.1336	0.0072
152	2.1408	0.0072
153	2.1480	0.0072
154	2.1552	0.0072
155	2.1623	0.0072
156	2.1695	0.0071
157	2.1766	0.0071
158	2.1837	0.0071
159	2.1907	0.0071
160	2.1978	0.0070
161	2.2048	0.0070
162	2.2118	0.0070
163	2.2188	0.0070
164	2.2258	0.0070
165	2.2327	0.0069
166	2.2396	0.0069
167	2.2465	0.0069
168	2.2534	0.0069
169	2.2603	0.0069
170	2.2671	0.0068
171	2.2739	0.0068
172	2.2807	0.0068
173	2.2875	0.0068
174	2.2943	0.0068
175	2.3010	0.0067

176	2.3077	0.0067
177	2.3144	0.0067
178	2.3211	0.0067
179	2.3278	0.0067
180	2.3345	0.0067
181	2.3411	0.0066
182	2.3477	0.0066
183	2.3543	0.0066
184	2.3609	0.0066
185	2.3675	0.0066
186	2.3740	0.0065
187	2.3805	0.0065
188	2.3870	0.0065
189	2.3935	0.0065
190	2.4000	0.0065
191	2.4065	0.0065
192	2.4129	0.0064
193	2.4194	0.0064
194	2.4258	0.0064
195	2.4322	0.0064
196	2.4386	0.0064
197	2.4449	0.0064
198	2.4513	0.0063
199	2.4576	0.0063
200	2.4639	0.0063
201	2.4702	0.0063
202	2.4765	0.0063
203	2.4828	0.0063
204	2.4890	0.0063
205	2.4953	0.0062
206	2.5015	0.0062
207	2.5077	0.0062
208	2.5139	0.0062
209	2.5201	0.0062
210	2.5263	0.0062
211	2.5324	0.0062
212	2.5386	0.0061
213	2.5447	0.0061
214	2.5508	0.0061
215	2.5569	0.0061
216	2.5630	0.0061
217	2.5691	0.0061
218	2.5751	0.0061
219	2.5812	0.0060
220	2.5872	0.0060
221	2.5932	0.0060
222	2.5992	0.0060
223	2.6052	0.0060
224	2.6112	0.0060
225	2.6172	0.0060

226	2.6231	0.0060
227	2.6290	0.0059
228	2.6350	0.0059
229	2.6409	0.0059
230	2.6468	0.0059
231	2.6527	0.0059
232	2.6586	0.0059
233	2.6644	0.0059
234	2.6703	0.0059
235	2.6761	0.0058
236	2.6819	0.0058
237	2.6878	0.0058
238	2.6936	0.0058
239	2.6994	0.0058
240	2.7051	0.0058
241	2.7109	0.0058
242	2.7167	0.0058
243	2.7224	0.0057
244	2.7281	0.0057
245	2.7339	0.0057
246	2.7396	0.0057
247	2.7453	0.0057
248	2.7510	0.0057
249	2.7566	0.0057
250	2.7623	0.0057
251	2.7679	0.0057
252	2.7736	0.0056
253	2.7792	0.0056
254	2.7848	0.0056
255	2.7905	0.0056
256	2.7961	0.0056
257	2.8016	0.0056
258	2.8072	0.0056
259	2.8128	0.0056
260	2.8184	0.0056
261	2.8239	0.0055
262	2.8294	0.0055
263	2.8350	0.0055
264	2.8405	0.0055
265	2.8460	0.0055
266	2.8515	0.0055
267	2.8570	0.0055
268	2.8624	0.0055
269	2.8679	0.0055
270	2.8734	0.0055
271	2.8788	0.0054
272	2.8843	0.0054
273	2.8897	0.0054
274	2.8951	0.0054
275	2.9005	0.0054

```
276              2.9059               0.0054
277              2.9113               0.0054
278              2.9167               0.0054
279              2.9220               0.0054
280              2.9274               0.0054
281              2.9328               0.0054
282              2.9381               0.0053
283              2.9434               0.0053
284              2.9488               0.0053
285              2.9541               0.0053
286              2.9594               0.0053
287              2.9647               0.0053
288              2.9700               0.0053
---------------------------------------------------------------------
Unit              Unit            Unit              Effective
Period            Rainfall        Soil-Loss         Rainfall
(number)            (In)          (In)                 (In)
---------------------------------------------------------------------
  1              0.0053           0.0023              0.0030
  2              0.0053           0.0023              0.0030
  3              0.0053           0.0023              0.0030
  4              0.0053           0.0023              0.0030
  5              0.0053           0.0023              0.0030
  6              0.0054           0.0023              0.0030
  7              0.0054           0.0023              0.0031
  8              0.0054           0.0023              0.0031
  9              0.0054           0.0023              0.0031
 10              0.0054           0.0023              0.0031
 11              0.0054           0.0023              0.0031
 12              0.0054           0.0023              0.0031
 13              0.0055           0.0023              0.0031
 14              0.0055           0.0024              0.0031
 15              0.0055           0.0024              0.0031
 16              0.0055           0.0024              0.0031
 17              0.0055           0.0024              0.0031
 18              0.0055           0.0024              0.0031
 19              0.0055           0.0024              0.0032
 20              0.0056           0.0024              0.0032
 21              0.0056           0.0024              0.0032
 22              0.0056           0.0024              0.0032
 23              0.0056           0.0024              0.0032
 24              0.0056           0.0024              0.0032
 25              0.0056           0.0024              0.0032
 26              0.0057           0.0024              0.0032
 27              0.0057           0.0024              0.0032
 28              0.0057           0.0024              0.0032
 29              0.0057           0.0025              0.0033
 30              0.0057           0.0025              0.0033
 31              0.0057           0.0025              0.0033
 32              0.0058           0.0025              0.0033
```

33	0.0058	0.0025	0.0033
34	0.0058	0.0025	0.0033
35	0.0058	0.0025	0.0033
36	0.0058	0.0025	0.0033
37	0.0059	0.0025	0.0033
38	0.0059	0.0025	0.0033
39	0.0059	0.0025	0.0034
40	0.0059	0.0025	0.0034
41	0.0059	0.0026	0.0034
42	0.0059	0.0026	0.0034
43	0.0060	0.0026	0.0034
44	0.0060	0.0026	0.0034
45	0.0060	0.0026	0.0034
46	0.0060	0.0026	0.0034
47	0.0060	0.0026	0.0034
48	0.0061	0.0026	0.0035
49	0.0061	0.0026	0.0035
50	0.0061	0.0026	0.0035
51	0.0061	0.0026	0.0035
52	0.0061	0.0026	0.0035
53	0.0062	0.0027	0.0035
54	0.0062	0.0027	0.0035
55	0.0062	0.0027	0.0035
56	0.0062	0.0027	0.0035
57	0.0063	0.0027	0.0036
58	0.0063	0.0027	0.0036
59	0.0063	0.0027	0.0036
60	0.0063	0.0027	0.0036
61	0.0063	0.0027	0.0036
62	0.0064	0.0027	0.0036
63	0.0064	0.0028	0.0036
64	0.0064	0.0028	0.0037
65	0.0064	0.0028	0.0037
66	0.0065	0.0028	0.0037
67	0.0065	0.0028	0.0037
68	0.0065	0.0028	0.0037
69	0.0065	0.0028	0.0037
70	0.0066	0.0028	0.0037
71	0.0066	0.0028	0.0038
72	0.0066	0.0028	0.0038
73	0.0067	0.0029	0.0038
74	0.0067	0.0029	0.0038
75	0.0067	0.0029	0.0038
76	0.0067	0.0029	0.0038
77	0.0068	0.0029	0.0039
78	0.0068	0.0029	0.0039
79	0.0068	0.0029	0.0039
80	0.0068	0.0029	0.0039
81	0.0069	0.0030	0.0039
82	0.0069	0.0030	0.0039

83	0.0069	0.0030	0.0040
84	0.0070	0.0030	0.0040
85	0.0070	0.0030	0.0040
86	0.0070	0.0030	0.0040
87	0.0071	0.0030	0.0040
88	0.0071	0.0031	0.0040
89	0.0071	0.0031	0.0041
90	0.0072	0.0031	0.0041
91	0.0072	0.0031	0.0041
92	0.0072	0.0031	0.0041
93	0.0073	0.0031	0.0041
94	0.0073	0.0031	0.0042
95	0.0073	0.0032	0.0042
96	0.0074	0.0032	0.0042
97	0.0074	0.0032	0.0042
98	0.0074	0.0032	0.0042
99	0.0075	0.0032	0.0043
100	0.0075	0.0032	0.0043
101	0.0076	0.0033	0.0043
102	0.0076	0.0033	0.0043
103	0.0077	0.0033	0.0044
104	0.0077	0.0033	0.0044
105	0.0077	0.0033	0.0044
106	0.0078	0.0033	0.0044
107	0.0078	0.0034	0.0045
108	0.0079	0.0034	0.0045
109	0.0079	0.0034	0.0045
110	0.0080	0.0034	0.0045
111	0.0080	0.0034	0.0046
112	0.0080	0.0035	0.0046
113	0.0081	0.0035	0.0046
114	0.0081	0.0035	0.0046
115	0.0082	0.0035	0.0047
116	0.0082	0.0035	0.0047
117	0.0083	0.0036	0.0047
118	0.0084	0.0036	0.0048
119	0.0084	0.0036	0.0048
120	0.0085	0.0036	0.0048
121	0.0085	0.0037	0.0049
122	0.0086	0.0037	0.0049
123	0.0087	0.0037	0.0049
124	0.0087	0.0037	0.0050
125	0.0088	0.0038	0.0050
126	0.0088	0.0038	0.0050
127	0.0089	0.0038	0.0051
128	0.0090	0.0039	0.0051
129	0.0091	0.0039	0.0052
130	0.0091	0.0039	0.0052
131	0.0092	0.0040	0.0052
132	0.0092	0.0040	0.0053

133	0.0093	0.0040	0.0053
134	0.0094	0.0040	0.0054
135	0.0095	0.0041	0.0054
136	0.0096	0.0041	0.0054
137	0.0097	0.0042	0.0055
138	0.0097	0.0042	0.0055
139	0.0098	0.0042	0.0056
140	0.0099	0.0043	0.0056
141	0.0100	0.0043	0.0057
142	0.0101	0.0043	0.0057
143	0.0102	0.0044	0.0058
144	0.0103	0.0044	0.0059
145	0.0085	0.0037	0.0048
146	0.0086	0.0037	0.0049
147	0.0087	0.0037	0.0050
148	0.0088	0.0038	0.0050
149	0.0089	0.0038	0.0051
150	0.0090	0.0039	0.0051
151	0.0092	0.0039	0.0052
152	0.0093	0.0040	0.0053
153	0.0094	0.0041	0.0054
154	0.0095	0.0041	0.0054
155	0.0097	0.0042	0.0055
156	0.0098	0.0042	0.0056
157	0.0100	0.0043	0.0057
158	0.0102	0.0044	0.0058
159	0.0104	0.0045	0.0059
160	0.0105	0.0045	0.0060
161	0.0108	0.0046	0.0061
162	0.0109	0.0047	0.0062
163	0.0112	0.0048	0.0064
164	0.0113	0.0049	0.0065
165	0.0117	0.0050	0.0066
166	0.0118	0.0051	0.0067
167	0.0122	0.0052	0.0069
168	0.0124	0.0053	0.0070
169	0.0128	0.0055	0.0073
170	0.0130	0.0056	0.0074
171	0.0135	0.0058	0.0077
172	0.0137	0.0059	0.0078
173	0.0142	0.0061	0.0081
174	0.0145	0.0062	0.0083
175	0.0152	0.0065	0.0086
176	0.0155	0.0067	0.0088
177	0.0163	0.0070	0.0093
178	0.0167	0.0072	0.0095
179	0.0176	0.0076	0.0100
180	0.0181	0.0078	0.0103
181	0.0193	0.0083	0.0110
182	0.0200	0.0086	0.0114

183	0.0215	0.0093	0.0123
184	0.0225	0.0097	0.0128
185	0.0178	0.0077	0.0102
186	0.0190	0.0082	0.0108
187	0.0220	0.0095	0.0125
188	0.0240	0.0103	0.0137
189	0.0299	0.0129	0.0170
190	0.0344	0.0148	0.0196
191	0.0523	0.0225	0.0298
192	0.0759	0.0262	0.0497
193	0.3282	0.0262	0.3020
194	0.0411	0.0177	0.0234
195	0.0266	0.0114	0.0151
196	0.0204	0.0088	0.0116
197	0.0235	0.0101	0.0134
198	0.0207	0.0089	0.0118
199	0.0187	0.0080	0.0106
200	0.0171	0.0074	0.0097
201	0.0159	0.0068	0.0090
202	0.0148	0.0064	0.0084
203	0.0140	0.0060	0.0080
204	0.0132	0.0057	0.0075
205	0.0126	0.0054	0.0072
206	0.0120	0.0052	0.0068
207	0.0115	0.0049	0.0065
208	0.0110	0.0048	0.0063
209	0.0106	0.0046	0.0061
210	0.0103	0.0044	0.0059
211	0.0099	0.0043	0.0057
212	0.0096	0.0041	0.0055
213	0.0094	0.0040	0.0053
214	0.0091	0.0039	0.0052
215	0.0089	0.0038	0.0050
216	0.0086	0.0037	0.0049
217	0.0104	0.0045	0.0059
218	0.0101	0.0044	0.0058
219	0.0100	0.0043	0.0057
220	0.0098	0.0042	0.0056
221	0.0096	0.0041	0.0055
222	0.0094	0.0041	0.0054
223	0.0093	0.0040	0.0053
224	0.0091	0.0039	0.0052
225	0.0090	0.0039	0.0051
226	0.0089	0.0038	0.0051
227	0.0087	0.0038	0.0050
228	0.0086	0.0037	0.0049
229	0.0085	0.0037	0.0048
230	0.0084	0.0036	0.0048
231	0.0083	0.0036	0.0047
232	0.0082	0.0035	0.0047

233	0.0081	0.0035	0.0046
234	0.0080	0.0034	0.0045
235	0.0079	0.0034	0.0045
236	0.0078	0.0034	0.0044
237	0.0077	0.0033	0.0044
238	0.0076	0.0033	0.0043
239	0.0075	0.0032	0.0043
240	0.0075	0.0032	0.0043
241	0.0074	0.0032	0.0042
242	0.0073	0.0032	0.0042
243	0.0072	0.0031	0.0041
244	0.0072	0.0031	0.0041
245	0.0071	0.0031	0.0041
246	0.0070	0.0030	0.0040
247	0.0070	0.0030	0.0040
248	0.0069	0.0030	0.0039
249	0.0069	0.0030	0.0039
250	0.0068	0.0029	0.0039
251	0.0067	0.0029	0.0038
252	0.0067	0.0029	0.0038
253	0.0066	0.0029	0.0038
254	0.0066	0.0028	0.0037
255	0.0065	0.0028	0.0037
256	0.0065	0.0028	0.0037
257	0.0064	0.0028	0.0037
258	0.0064	0.0027	0.0036
259	0.0063	0.0027	0.0036
260	0.0063	0.0027	0.0036
261	0.0062	0.0027	0.0036
262	0.0062	0.0027	0.0035
263	0.0062	0.0026	0.0035
264	0.0061	0.0026	0.0035
265	0.0061	0.0026	0.0035
266	0.0060	0.0026	0.0034
267	0.0060	0.0026	0.0034
268	0.0060	0.0026	0.0034
269	0.0059	0.0025	0.0034
270	0.0059	0.0025	0.0033
271	0.0058	0.0025	0.0033
272	0.0058	0.0025	0.0033
273	0.0058	0.0025	0.0033
274	0.0057	0.0025	0.0033
275	0.0057	0.0025	0.0032
276	0.0057	0.0024	0.0032
277	0.0056	0.0024	0.0032
278	0.0056	0.0024	0.0032
279	0.0056	0.0024	0.0032
280	0.0055	0.0024	0.0032
281	0.0055	0.0024	0.0031
282	0.0055	0.0024	0.0031

```
      283              0.0054           0.0023              0.0031
      284              0.0054           0.0023              0.0031
      285              0.0054           0.0023              0.0031
      286              0.0054           0.0023              0.0031
      287              0.0053           0.0023              0.0030
      288              0.0053           0.0023              0.0030
      --------------------------------------------------------------------
      --------------------------------------------------------------------
      Total soil rain loss =      1.16(In)
      Total effective rainfall =      1.81(In)
      Peak flow rate in flood hydrograph =     16.35(CFS)
      ---------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R   S T O R M
                     R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5       0.0001      0.02  Q         |         |         |         |
  0+10       0.0010      0.13  Q         |         |         |         |
  0+15       0.0028      0.26  Q         |         |         |         |
  0+20       0.0050      0.32  Q         |         |         |         |
  0+25       0.0075      0.36  Q         |         |         |         |
  0+30       0.0101      0.38  Q         |         |         |         |
  0+35       0.0129      0.40  Q         |         |         |         |
  0+40       0.0158      0.41  Q         |         |         |         |
  0+45       0.0187      0.43  Q         |         |         |         |
  0+50       0.0217      0.43  Q         |         |         |         |
  0+55       0.0247      0.44  Q         |         |         |         |
  1+ 0       0.0278      0.44  Q         |         |         |         |
  1+ 5       0.0309      0.45  Q         |         |         |         |
  1+10       0.0340      0.45  Q         |         |         |         |
  1+15       0.0371      0.46  Q         |         |         |         |
  1+20       0.0403      0.46  Q         |         |         |         |
  1+25       0.0434      0.46  Q         |         |         |         |
  1+30       0.0466      0.46  QV        |         |         |         |
  1+35       0.0498      0.46  QV        |         |         |         |
  1+40       0.0530      0.46  QV        |         |         |         |
  1+45       0.0562      0.47  QV        |         |         |         |
  1+50       0.0594      0.47  QV        |         |         |         |
  1+55       0.0627      0.47  QV        |         |         |         |
  2+ 0       0.0659      0.47  QV        |         |         |         |
  2+ 5       0.0691      0.47  QV        |         |         |         |
  2+10       0.0724      0.47  QV        |         |         |         |
  2+15       0.0757      0.47  QV        |         |         |         |
  2+20       0.0789      0.48  QV        |         |         |         |
  2+25       0.0822      0.48  QV        |         |         |         |
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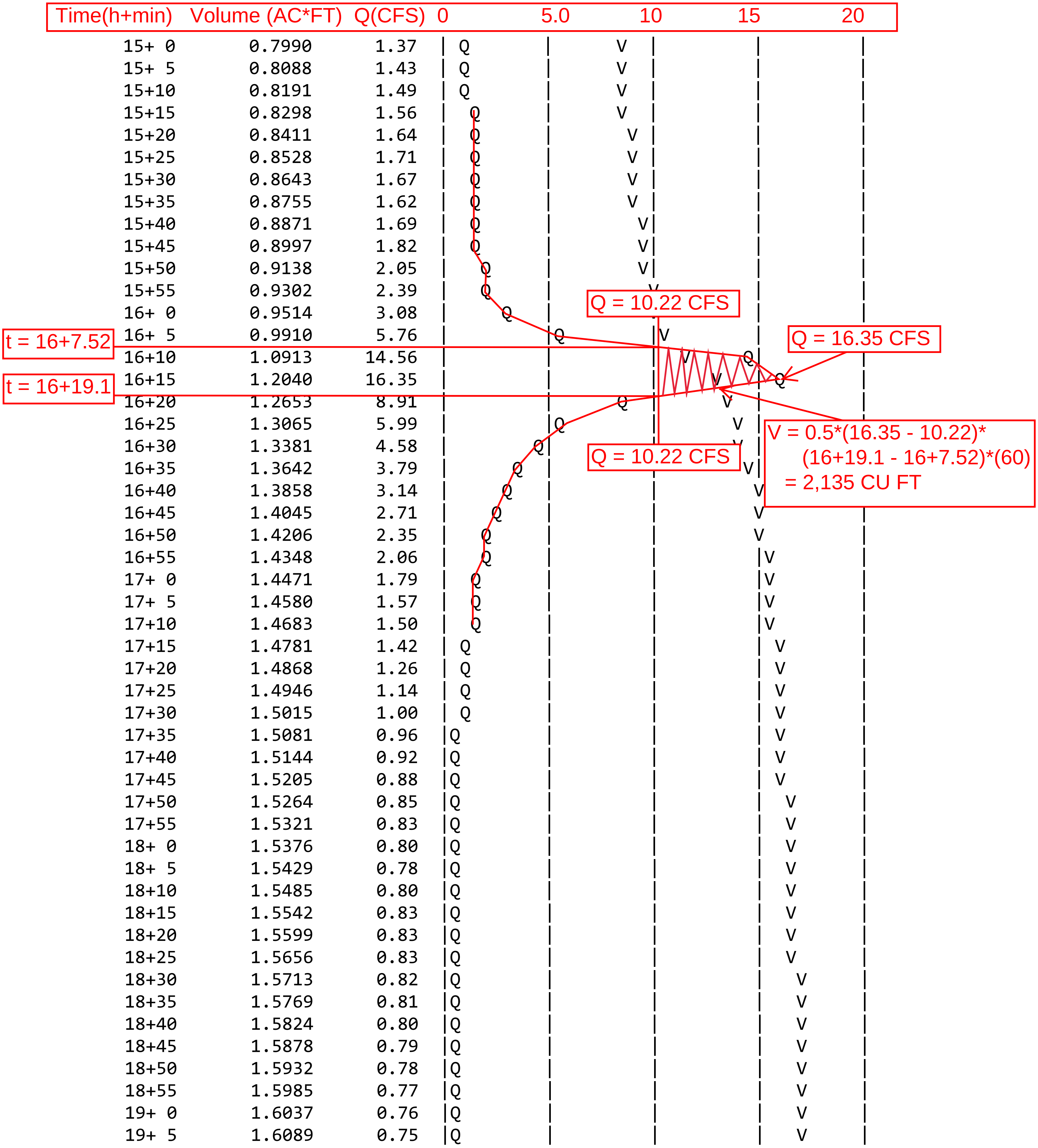
2+30       0.0855      0.48  QV         |         |         |         |
2+35       0.0888      0.48  QV         |         |         |         |
2+40       0.0921      0.48  QV         |         |         |         |
2+45       0.0954      0.48  Q V        |         |         |         |
2+50       0.0988      0.48  Q V        |         |         |         |
2+55       0.1021      0.49  Q V        |         |         |         |
3+ 0       0.1055      0.49  Q V        |         |         |         |
3+ 5       0.1088      0.49  Q V        |         |         |         |
3+10       0.1122      0.49  Q V        |         |         |         |
3+15       0.1156      0.49  Q V        |         |         |         |
3+20       0.1190      0.49  Q V        |         |         |         |
3+25       0.1224      0.49  Q V        |         |         |         |
3+30       0.1258      0.50  Q V        |         |         |         |
3+35       0.1292      0.50  Q V        |         |         |         |
3+40       0.1327      0.50  Q V        |         |         |         |
3+45       0.1361      0.50  |QV        |         |         |         |
3+50       0.1396      0.50  |Q V       |         |         |         |
3+55       0.1430      0.50  |Q V       |         |         |         |
4+ 0       0.1465      0.51  |Q V       |         |         |         |
4+ 5       0.1500      0.51  |Q V       |         |         |         |
4+10       0.1535      0.51  |Q V       |         |         |         |
4+15       0.1570      0.51  |Q V       |         |         |         |
4+20       0.1606      0.51  |Q V       |         |         |         |
4+25       0.1641      0.51  |Q V       |         |         |         |
4+30       0.1677      0.52  |Q V       |         |         |         |
4+35       0.1712      0.52  |Q V       |         |         |         |
4+40       0.1748      0.52  |Q V       |         |         |         |
4+45       0.1784      0.52  |Q V       |         |         |         |
4+50       0.1820      0.52  |Q V       |         |         |         |
4+55       0.1856      0.52  |Q  V      |         |         |         |
5+ 0       0.1892      0.53  |Q  V      |         |         |         |
5+ 5       0.1929      0.53  |Q  V      |         |         |         |
5+10       0.1965      0.53  |Q  V      |         |         |         |
5+15       0.2002      0.53  |Q  V      |         |         |         |
5+20       0.2039      0.53  |Q  V      |         |         |         |
5+25       0.2076      0.54  |Q  V      |         |         |         |
5+30       0.2113      0.54  |Q  V      |         |         |         |
5+35       0.2150      0.54  |Q  V      |         |         |         |
5+40       0.2187      0.54  |Q  V      |         |         |         |
5+45       0.2225      0.54  |Q  V      |         |         |         |
5+50       0.2263      0.55  |Q  V      |         |         |         |
5+55       0.2300      0.55  |Q  V      |         |         |         |
6+ 0       0.2338      0.55  |Q   V     |         |         |         |
6+ 5       0.2377      0.55  |Q   V     |         |         |         |
6+10       0.2415      0.56  |Q   V     |         |         |         |
6+15       0.2453      0.56  |Q   V     |         |         |         |
6+20       0.2492      0.56  |Q   V     |         |         |         |
6+25       0.2530      0.56  |Q   V     |         |         |         |
6+30       0.2569      0.56  |Q   V     |         |         |         |
6+35       0.2608      0.57  |Q   V     |         |         |         |
```

```
 6+40      0.2648      0.57 |Q   V    |         |         |         |
 6+45      0.2687      0.57 |Q   V    |         |         |         |
 6+50      0.2727      0.57 |Q   V    |         |         |         |
 6+55      0.2766      0.58 |Q   V    |         |         |         |
 7+ 0      0.2806      0.58 |Q    V   |         |         |         |
 7+ 5      0.2846      0.58 |Q    V   |         |         |         |
 7+10      0.2887      0.58 |Q    V   |         |         |         |
 7+15      0.2927      0.59 |Q    V   |         |         |         |
 7+20      0.2968      0.59 |Q    V   |         |         |         |
 7+25      0.3008      0.59 |Q    V   |         |         |         |
 7+30      0.3049      0.60 |Q    V   |         |         |         |
 7+35      0.3090      0.60 |Q    V   |         |         |         |
 7+40      0.3132      0.60 |Q    V   |         |         |         |
 7+45      0.3173      0.60 |Q    V   |         |         |         |
 7+50      0.3215      0.61 |Q    V   |         |         |         |
 7+55      0.3257      0.61 |Q     V  |         |         |         |
 8+ 0      0.3299      0.61 |Q     V  |         |         |         |
 8+ 5      0.3342      0.62 |Q     V  |         |         |         |
 8+10      0.3384      0.62 |Q     V  |         |         |         |
 8+15      0.3427      0.62 |Q     V  |         |         |         |
 8+20      0.3470      0.62 |Q     V  |         |         |         |
 8+25      0.3513      0.63 |Q     V  |         |         |         |
 8+30      0.3557      0.63 |Q     V  |         |         |         |
 8+35      0.3600      0.63 |Q     V  |         |         |         |
 8+40      0.3644      0.64 |Q     V  |         |         |         |
 8+45      0.3689      0.64 |Q     V  |         |         |         |
 8+50      0.3733      0.64 |Q      V |         |         |         |
 8+55      0.3778      0.65 |Q      V |         |         |         |
 9+ 0      0.3822      0.65 |Q      V |         |         |         |
 9+ 5      0.3868      0.66 |Q      V |         |         |         |
 9+10      0.3913      0.66 |Q      V |         |         |         |
 9+15      0.3959      0.66 |Q      V |         |         |         |
 9+20      0.4005      0.67 |Q      V |         |         |         |
 9+25      0.4051      0.67 |Q      V |         |         |         |
 9+30      0.4097      0.67 |Q      V |         |         |         |
 9+35      0.4144      0.68 |Q      V |         |         |         |
 9+40      0.4191      0.68 |Q       V|         |         |         |
 9+45      0.4238      0.69 |Q       V|         |         |         |
 9+50      0.4286      0.69 |Q       V|         |         |         |
 9+55      0.4334      0.70 |Q       V|         |         |         |
10+ 0      0.4382      0.70 |Q       V|         |         |         |
10+ 5      0.4431      0.70 |Q       V|         |         |         |
10+10      0.4479      0.71 |Q       V|         |         |         |
10+15      0.4529      0.71 |Q       V|         |         |         |
10+20      0.4578      0.72 |Q       V|         |         |         |
10+25      0.4628      0.72 |Q        V         |         |         |
10+30      0.4678      0.73 |Q        V         |         |         |
10+35      0.4729      0.73 |Q        V         |         |         |
10+40      0.4780      0.74 |Q        V         |         |         |
10+45      0.4831      0.74 |Q        V         |         |         |
```

```
10+50       0.4883      0.75  |Q        V         |         |         |
10+55       0.4935      0.76  |Q        V         |         |         |
11+ 0       0.4987      0.76  |Q        V         |         |         |
11+ 5       0.5040      0.77  |Q        V         |         |         |
11+10       0.5093      0.77  |Q        |V        |         |         |
11+15       0.5147      0.78  |Q        |V        |         |         |
11+20       0.5201      0.79  |Q        |V        |         |         |
11+25       0.5256      0.79  |Q        |V        |         |         |
11+30       0.5311      0.80  |Q        |V        |         |         |
11+35       0.5366      0.81  |Q        |V        |         |         |
11+40       0.5422      0.81  |Q        |V        |         |         |
11+45       0.5479      0.82  |Q        |V        |         |         |
11+50       0.5536      0.83  |Q        |V        |         |         |
11+55       0.5593      0.84  |Q        | V       |         |         |
12+ 0       0.5651      0.84  |Q        | V       |         |         |
12+ 5       0.5709      0.85  |Q        | V       |         |         |
12+10       0.5765      0.81  |Q        | V       |         |         |
12+15       0.5819      0.77  |Q        | V       |         |         |
12+20       0.5871      0.76  |Q        | V       |         |         |
12+25       0.5923      0.75  |Q        | V       |         |         |
12+30       0.5975      0.76  |Q        | V       |         |         |
12+35       0.6027      0.76  |Q        |  V      |         |         |
12+40       0.6080      0.76  |Q        |  V      |         |         |
12+45       0.6133      0.77  |Q        |  V      |         |         |
12+50       0.6186      0.78  |Q        |  V      |         |         |
12+55       0.6241      0.79  |Q        |  V      |         |         |
13+ 0       0.6296      0.80  |Q        |  V      |         |         |
13+ 5       0.6351      0.81  |Q        |  V      |         |         |
13+10       0.6408      0.82  |Q        |  V      |         |         |
13+15       0.6465      0.83  |Q        |   V     |         |         |
13+20       0.6523      0.85  |Q        |   V     |         |         |
13+25       0.6583      0.86  |Q        |   V     |         |         |
13+30       0.6643      0.87  |Q        |   V     |         |         |
13+35       0.6704      0.89  |Q        |   V     |         |         |
13+40       0.6766      0.91  |Q        |   V     |         |         |
13+45       0.6830      0.92  |Q        |   V     |         |         |
13+50       0.6895      0.94  |Q        |   V     |         |         |
13+55       0.6961      0.96  |Q        |    V    |         |         |
14+ 0       0.7028      0.98  |Q        |    V    |         |         |
14+ 5       0.7097      1.00  | Q       |    V    |         |         |
14+10       0.7168      1.02  | Q       |    V    |         |         |
14+15       0.7240      1.05  | Q       |    V    |         |         |
14+20       0.7314      1.08  | Q       |    V    |         |         |
14+25       0.7390      1.10  | Q       |     V   |         |         |
14+30       0.7468      1.13  | Q       |     V   |         |         |
14+35       0.7549      1.16  | Q       |     V   |         |         |
14+40       0.7631      1.20  | Q       |     V   |         |         |
14+45       0.7716      1.24  | Q       |     V   |         |         |
14+50       0.7804      1.28  | Q       |     V   |         |         |
14+55       0.7895      1.32  | Q       |      V  |         |         |
```



```
Time(h+min)  Volume (AC*FT)  Q(CFS)  0         5.0       10        15        20
15+ 0       0.7990       1.37 | Q       |      V  |         |         |
15+ 5       0.8088       1.43 | Q       |      V  |         |         |
15+10       0.8191       1.49 | Q       |      V  |         |         |
15+15       0.8298       1.56 |  Q      |      V  |         |         |
15+20       0.8411       1.64 |  Q      |       V |         |         |
15+25       0.8528       1.71 |  Q      |       V |         |         |
15+30       0.8643       1.67 |  Q      |       V |         |         |
15+35       0.8755       1.62 |  Q      |       V |         |         |
15+40       0.8871       1.69 |  Q      |        V|         |         |
15+45       0.8997       1.82 |  Q      |        V|         |         |
15+50       0.9138       2.05 |   Q     |        V|         |         |
15+55       0.9302       2.39 |   Q     |         V         |         |
16+ 0       0.9514       3.08 |     Q   |         V         |         |
16+ 5       0.9910       5.76 |         |Q        |V        |         |
16+10       1.0913      14.56 |         |         |  V     Q|         |
16+15       1.2040      16.35 |         |         |     V   | Q       |
16+20       1.2653       8.91 |         |      Q  |      V  |         |
16+25       1.3065       5.99 |         |Q        |       V |         |
16+30       1.3381       4.58 |        Q|         |       V |         |
16+35       1.3642       3.79 |      Q  |         |        V|         |
16+40       1.3858       3.14 |     Q   |         |         V         |
16+45       1.4045       2.71 |    Q    |         |         V         |
16+50       1.4206       2.35 |   Q     |         |         V         |
16+55       1.4348       2.06 |   Q     |         |         |V        |
17+ 0       1.4471       1.79 |  Q      |         |         |V        |
17+ 5       1.4580       1.57 |  Q      |         |         |V        |
17+10       1.4683       1.50 |  Q      |         |         |V        |
17+15       1.4781       1.42 | Q       |         |         | V       |
17+20       1.4868       1.26 | Q       |         |         | V       |
17+25       1.4946       1.14 | Q       |         |         | V       |
17+30       1.5015       1.00 | Q       |         |         | V       |
17+35       1.5081       0.96 |Q        |         |         | V       |
17+40       1.5144       0.92 |Q        |         |         | V       |
17+45       1.5205       0.88 |Q        |         |         | V       |
17+50       1.5264       0.85 |Q        |         |         |  V      |
17+55       1.5321       0.83 |Q        |         |         |  V      |
18+ 0       1.5376       0.80 |Q        |         |         |  V      |
18+ 5       1.5429       0.78 |Q        |         |         |  V      |
18+10       1.5485       0.80 |Q        |         |         |  V      |
18+15       1.5542       0.83 |Q        |         |         |  V      |
18+20       1.5599       0.83 |Q        |         |         |  V      |
18+25       1.5656       0.83 |Q        |         |         |  V      |
18+30       1.5713       0.82 |Q        |         |         |   V     |
18+35       1.5769       0.81 |Q        |         |         |   V     |
18+40       1.5824       0.80 |Q        |         |         |   V     |
18+45       1.5878       0.79 |Q        |         |         |   V     |
18+50       1.5932       0.78 |Q        |         |         |   V     |
18+55       1.5985       0.77 |Q        |         |         |   V     |
19+ 0       1.6037       0.76 |Q        |         |         |   V     |
19+ 5       1.6089       0.75 |Q        |         |         |   V     |
```

Q = 10.22 CFS

t = 16+7.52

Q = 16.35 CFS

t = 16+19.1

Q = 10.22 CFS

V = 0.5*(16.35 - 10.22)*
(16+19.1 - 16+7.52)*(60)
= 2,135 CU FT

```
19+10       1.6139      0.74  |Q        |         |         |   V     |
19+15       1.6190      0.73  |Q        |         |         |    V    |
19+20       1.6239      0.72  |Q        |         |         |    V    |
19+25       1.6288      0.71  |Q        |         |         |    V    |
19+30       1.6336      0.70  |Q        |         |         |    V    |
19+35       1.6384      0.69  |Q        |         |         |    V    |
19+40       1.6431      0.68  |Q        |         |         |    V    |
19+45       1.6477      0.67  |Q        |         |         |    V    |
19+50       1.6523      0.67  |Q        |         |         |    V    |
19+55       1.6569      0.66  |Q        |         |         |    V    |
20+ 0       1.6613      0.65  |Q        |         |         |    V    |
20+ 5       1.6658      0.64  |Q        |         |         |     V   |
20+10       1.6702      0.64  |Q        |         |         |     V   |
20+15       1.6745      0.63  |Q        |         |         |     V   |
20+20       1.6788      0.62  |Q        |         |         |     V   |
20+25       1.6831      0.62  |Q        |         |         |     V   |
20+30       1.6873      0.61  |Q        |         |         |     V   |
20+35       1.6915      0.61  |Q        |         |         |     V   |
20+40       1.6956      0.60  |Q        |         |         |     V   |
20+45       1.6997      0.59  |Q        |         |         |     V   |
20+50       1.7038      0.59  |Q        |         |         |     V   |
20+55       1.7078      0.58  |Q        |         |         |     V   |
21+ 0       1.7118      0.58  |Q        |         |         |      V  |
21+ 5       1.7157      0.57  |Q        |         |         |      V  |
21+10       1.7196      0.57  |Q        |         |         |      V  |
21+15       1.7235      0.56  |Q        |         |         |      V  |
21+20       1.7274      0.56  |Q        |         |         |      V  |
21+25       1.7312      0.56  |Q        |         |         |      V  |
21+30       1.7350      0.55  |Q        |         |         |      V  |
21+35       1.7388      0.55  |Q        |         |         |      V  |
21+40       1.7425      0.54  |Q        |         |         |      V  |
21+45       1.7462      0.54  |Q        |         |         |      V  |
21+50       1.7499      0.53  |Q        |         |         |      V  |
21+55       1.7535      0.53  |Q        |         |         |      V  |
22+ 0       1.7572      0.53  |Q        |         |         |       V |
22+ 5       1.7608      0.52  |Q        |         |         |       V |
22+10       1.7643      0.52  |Q        |         |         |       V |
22+15       1.7679      0.52  |Q        |         |         |       V |
22+20       1.7714      0.51  |Q        |         |         |       V |
22+25       1.7749      0.51  |Q        |         |         |       V |
22+30       1.7784      0.51  |Q        |         |         |       V |
22+35       1.7819      0.50  |Q        |         |         |       V |
22+40       1.7853      0.50  Q         |         |         |       V |
22+45       1.7887      0.50  Q         |         |         |       V |
22+50       1.7921      0.49  Q         |         |         |       V |
22+55       1.7955      0.49  Q         |         |         |       V |
23+ 0       1.7988      0.49  Q         |         |         |       V |
23+ 5       1.8022      0.48  Q         |         |         |        V|
23+10       1.8055      0.48  Q         |         |         |        V|
23+15       1.8088      0.48  Q         |         |         |        V|
```

```
   23+20       1.8120      0.47  Q           |           |           |         V|
   23+25       1.8153      0.47  Q           |           |           |         V|
   23+30       1.8185      0.47  Q           |           |           |         V|
   23+35       1.8217      0.47  Q           |           |           |         V|
   23+40       1.8249      0.46  Q           |           |           |         V|
   23+45       1.8281      0.46  Q           |           |           |         V|
   23+50       1.8313      0.46  Q           |           |           |         V|
   23+55       1.8344      0.46  Q           |           |           |         V|
   24+ 0       1.8375      0.45  Q           |           |           |         V|
-----------------------------------------------------------------------
```

RATIONAL METHOD &

UNIT HYDROGRAPH HYDROLOGY

ONSITE PRE-DEVELOPED

10-YEAR

STORM EVENTS

DRAINAGE AREA 2

```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
        Rational Hydrology Study        Date: 08/13/21
------------------------------------------------------------------------
10 Year Rational Analysis Pre Development
Former Track 17846
Drainage Area 3
File: 17486Rat10PreA3.out
------------------------------------------------------------------------


Program License Serial Number 4070

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
Computed rainfall intensity:
Storm year =    10.00   1 hour rainfall =     0.692 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 3



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Initial subarea data:
Initial area flow distance =   584.200(Ft.)
Top (of initial area) elevation =  3293.000(Ft.)
Bottom (of initial area) elevation =  3284.000(Ft.)
Difference in elevation =     9.000(Ft.)
Slope =    0.01541  s(%)=       1.54
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   20.792 min.
Rainfall intensity =      1.453(In/Hr) for a    10.0 year storm
```

```
Effective runoff coefficient used for area (Q=KCIA) is C = 0.570
Subarea runoff =      4.598(CFS)
Total initial stream area =        5.550(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.532(In/Hr)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station       3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.227(Ft.), Average velocity =   1.369(Ft/s)
        ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.91
        2             84.67              0.00
        3            158.70              0.91
Manning's 'N' friction factor =   0.030
-----------------------------------------------------------------
Sub-Channel flow  =      6.163(CFS)
  '     '        flow top width =     39.624(Ft.)
  '     '    velocity=    1.369(Ft/s)
  '     '        area =      4.501(Sq.Ft)
  '     '        Froude number =     0.716

Upstream point elevation =  3284.000(Ft.)
Downstream point elevation =  3278.000(Ft.)
Flow length =   432.100(Ft.)
Travel time  =    5.26 min.
Time of concentration =   26.05 min.
Depth of flow =   0.227(Ft.)
Average velocity =   1.369(Ft/s)
Total irregular channel flow =     6.163(CFS)
Irregular channel normal depth above invert elev. =   0.227(Ft.)
Average velocity of channel(s) =   1.369(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Rainfall intensity =      1.241(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
```

```
rational method)(Q=KCIA) is C = 0.514
Subarea runoff =      3.046(CFS) for    6.440(Ac.)
Total runoff =      7.644(CFS)
Effective area this stream =       11.99(Ac.)
Total Study Area (Main Stream No. 1) =       11.99(Ac.)
Area averaged Fm value =    0.532(In/Hr)
Depth of flow =   0.246(Ft.), Average velocity =   1.445(Ft/s)
End of computations, Total Study Area =           11.99 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  50.0
```

```
        U n i t   H y d r o g r a p h   A n a l y s i s

        Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

                Study date  08/13/21

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
------------------------------------------------------------------------

San Bernardino County Synthetic Unit Hydrology Method
                Manual date - August 1986


Program License Serial Number 4070

---------------------------------------------------------------------
10 Year Unit Hydrograph Pre Development for HCOC
Former Track 17486
Drainage Area 3
File: 17486Hydr10PreA3.out
--------------------------------------------------------------------

        Storm Event Year = 10

        Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




Area averaged rainfall intensity isohyetal data:
        Sub-Area        Duration        Isohyetal
        (Ac.)            (hours)         (In)
Rainfall data for year 10
            12.23           1           0.69
--------------------------------------------------------------------
Rainfall data for year 10
            12.23           6           1.46
--------------------------------------------------------------------
Rainfall data for year 10
            12.23          24           2.97
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
******** Area-averaged max loss rate, Fm ********


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 50.0      70.0         12.23      1.000     0.532    1.000    0.532

Area-averaged adjusted loss rate Fm (In/Hr) =  0.532

********* Area-Averaged low loss rate fraction, Yb **********

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
    12.23   1.000         50.0      70.0       4.29     0.235

Area-averaged catchment yield fraction, Y =  0.235
Area-averaged low loss fraction, Yb =  0.765
User entry of time of concentration  =   0.434 (hours)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =      12.23(Ac.)
Catchment Lag time =   0.347 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 24.0015
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.532(In/Hr)
Average low loss rate fraction (Yb) = 0.765 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall =  0.328(In)
Computed peak 30-minute rainfall =  0.562(In)
Specified peak 1-hour rainfall =  0.692(In)
Computed peak 3-hour rainfall =  1.094(In)
Specified peak 6-hour rainfall =  1.460(In)
Specified peak 24-hour rainfall =  2.970(In)


Rainfall depth area reduction factors:
Using a total area of      12.23(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999     Adjusted rainfall =  0.328(In)
30-minute factor = 0.999    Adjusted rainfall =  0.562(In)
1-hour factor = 0.999       Adjusted rainfall =  0.692(In)
3-hour factor = 1.000       Adjusted rainfall =  1.094(In)
6-hour factor = 1.000       Adjusted rainfall =  1.460(In)
24-hour factor = 1.000      Adjusted rainfall =  2.970(In)
---------------------------------------------------------------------

                        U n i t  H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Interval          'S' Graph          Unit Hydrograph
```

```
Number            Mean values             ((CFS))
---------------------------------------------------------------------
                (K =       147.91 (CFS))

  1                1.277                   1.888
  2                6.132                   7.182
  3               17.650                  17.036
  4               38.652                  31.062
  5               53.964                  22.648
  6               63.407                  13.967
  7               69.899                   9.602
  8               74.854                   7.329
  9               78.782                   5.809
 10               81.885                   4.590
 11               84.469                   3.821
 12               86.741                   3.361
 13               88.641                   2.810
 14               90.131                   2.203
 15               91.473                   1.984
 16               92.650                   1.742
 17               93.712                   1.570
 18               94.581                   1.286
 19               95.391                   1.198
 20               96.069                   1.003
 21               96.690                   0.919
 22               97.189                   0.737
 23               97.620                   0.638
 24               97.940                   0.474
 25               98.180                   0.355
 26               98.444                   0.391
 27               98.732                   0.426
 28               99.021                   0.426
 29               99.309                   0.426
 30               99.548                   0.355
 31               99.700                   0.225
 32               99.850                   0.222
 33              100.000                   0.221
---------------------------------------------------------------------
Peak Unit   Adjusted mass rainfall  Unit rainfall
Number              (In)                (In)
  1              0.3282               0.3282
  2              0.4040               0.0759
  3              0.4563               0.0523
  4              0.4974               0.0411
  5              0.5319               0.0344
  6              0.5618               0.0299
  7              0.5883               0.0266
  8              0.6124               0.0240
  9              0.6344               0.0220
 10              0.6548               0.0204
```

11	0.6738	0.0190
12	0.6916	0.0178
13	0.7151	0.0235
14	0.7375	0.0225
15	0.7591	0.0215
16	0.7798	0.0207
17	0.7998	0.0200
18	0.8191	0.0193
19	0.8377	0.0187
20	0.8559	0.0181
21	0.8735	0.0176
22	0.8906	0.0171
23	0.9072	0.0167
24	0.9235	0.0163
25	0.9393	0.0159
26	0.9548	0.0155
27	0.9700	0.0152
28	0.9848	0.0148
29	0.9993	0.0145
30	1.0136	0.0142
31	1.0275	0.0140
32	1.0412	0.0137
33	1.0547	0.0135
34	1.0679	0.0132
35	1.0809	0.0130
36	1.0937	0.0128
37	1.1062	0.0126
38	1.1186	0.0124
39	1.1308	0.0122
40	1.1428	0.0120
41	1.1546	0.0118
42	1.1662	0.0117
43	1.1777	0.0115
44	1.1891	0.0113
45	1.2002	0.0112
46	1.2113	0.0110
47	1.2222	0.0109
48	1.2330	0.0108
49	1.2436	0.0106
50	1.2541	0.0105
51	1.2645	0.0104
52	1.2748	0.0103
53	1.2850	0.0102
54	1.2950	0.0100
55	1.3049	0.0099
56	1.3148	0.0098
57	1.3245	0.0097
58	1.3341	0.0096
59	1.3437	0.0095
60	1.3531	0.0094

61	1.3625	0.0094
62	1.3717	0.0093
63	1.3809	0.0092
64	1.3900	0.0091
65	1.3990	0.0090
66	1.4080	0.0089
67	1.4168	0.0089
68	1.4256	0.0088
69	1.4343	0.0087
70	1.4429	0.0086
71	1.4515	0.0086
72	1.4599	0.0085
73	1.4703	0.0104
74	1.4806	0.0103
75	1.4908	0.0102
76	1.5009	0.0101
77	1.5110	0.0101
78	1.5211	0.0100
79	1.5310	0.0100
80	1.5409	0.0099
81	1.5507	0.0098
82	1.5605	0.0098
83	1.5702	0.0097
84	1.5799	0.0097
85	1.5895	0.0096
86	1.5991	0.0096
87	1.6086	0.0095
88	1.6180	0.0094
89	1.6274	0.0094
90	1.6367	0.0093
91	1.6460	0.0093
92	1.6553	0.0092
93	1.6645	0.0092
94	1.6736	0.0091
95	1.6827	0.0091
96	1.6918	0.0091
97	1.7008	0.0090
98	1.7097	0.0090
99	1.7186	0.0089
100	1.7275	0.0089
101	1.7363	0.0088
102	1.7451	0.0088
103	1.7539	0.0087
104	1.7626	0.0087
105	1.7712	0.0087
106	1.7798	0.0086
107	1.7884	0.0086
108	1.7970	0.0085
109	1.8055	0.0085
110	1.8139	0.0085

111	1.8224	0.0084
112	1.8308	0.0084
113	1.8391	0.0084
114	1.8474	0.0083
115	1.8557	0.0083
116	1.8640	0.0082
117	1.8722	0.0082
118	1.8804	0.0082
119	1.8885	0.0081
120	1.8966	0.0081
121	1.9047	0.0081
122	1.9128	0.0080
123	1.9208	0.0080
124	1.9288	0.0080
125	1.9367	0.0080
126	1.9446	0.0079
127	1.9525	0.0079
128	1.9604	0.0079
129	1.9682	0.0078
130	1.9760	0.0078
131	1.9838	0.0078
132	1.9915	0.0077
133	1.9992	0.0077
134	2.0069	0.0077
135	2.0146	0.0077
136	2.0222	0.0076
137	2.0298	0.0076
138	2.0374	0.0076
139	2.0449	0.0075
140	2.0525	0.0075
141	2.0600	0.0075
142	2.0674	0.0075
143	2.0749	0.0074
144	2.0823	0.0074
145	2.0897	0.0074
146	2.0971	0.0074
147	2.1044	0.0073
148	2.1117	0.0073
149	2.1190	0.0073
150	2.1263	0.0073
151	2.1336	0.0072
152	2.1408	0.0072
153	2.1480	0.0072
154	2.1552	0.0072
155	2.1623	0.0072
156	2.1695	0.0071
157	2.1766	0.0071
158	2.1837	0.0071
159	2.1907	0.0071
160	2.1978	0.0070

161	2.2048	0.0070
162	2.2118	0.0070
163	2.2188	0.0070
164	2.2258	0.0070
165	2.2327	0.0069
166	2.2396	0.0069
167	2.2465	0.0069
168	2.2534	0.0069
169	2.2603	0.0069
170	2.2671	0.0068
171	2.2739	0.0068
172	2.2807	0.0068
173	2.2875	0.0068
174	2.2943	0.0068
175	2.3010	0.0067
176	2.3077	0.0067
177	2.3144	0.0067
178	2.3211	0.0067
179	2.3278	0.0067
180	2.3345	0.0067
181	2.3411	0.0066
182	2.3477	0.0066
183	2.3543	0.0066
184	2.3609	0.0066
185	2.3675	0.0066
186	2.3740	0.0065
187	2.3805	0.0065
188	2.3870	0.0065
189	2.3935	0.0065
190	2.4000	0.0065
191	2.4065	0.0065
192	2.4129	0.0064
193	2.4194	0.0064
194	2.4258	0.0064
195	2.4322	0.0064
196	2.4386	0.0064
197	2.4449	0.0064
198	2.4513	0.0063
199	2.4576	0.0063
200	2.4639	0.0063
201	2.4702	0.0063
202	2.4765	0.0063
203	2.4828	0.0063
204	2.4890	0.0063
205	2.4953	0.0062
206	2.5015	0.0062
207	2.5077	0.0062
208	2.5139	0.0062
209	2.5201	0.0062
210	2.5263	0.0062

211	2.5324	0.0062
212	2.5386	0.0061
213	2.5447	0.0061
214	2.5508	0.0061
215	2.5569	0.0061
216	2.5630	0.0061
217	2.5691	0.0061
218	2.5751	0.0061
219	2.5812	0.0060
220	2.5872	0.0060
221	2.5932	0.0060
222	2.5992	0.0060
223	2.6052	0.0060
224	2.6112	0.0060
225	2.6172	0.0060
226	2.6231	0.0060
227	2.6290	0.0059
228	2.6350	0.0059
229	2.6409	0.0059
230	2.6468	0.0059
231	2.6527	0.0059
232	2.6586	0.0059
233	2.6644	0.0059
234	2.6703	0.0059
235	2.6761	0.0058
236	2.6819	0.0058
237	2.6878	0.0058
238	2.6936	0.0058
239	2.6994	0.0058
240	2.7051	0.0058
241	2.7109	0.0058
242	2.7167	0.0058
243	2.7224	0.0057
244	2.7281	0.0057
245	2.7339	0.0057
246	2.7396	0.0057
247	2.7453	0.0057
248	2.7510	0.0057
249	2.7566	0.0057
250	2.7623	0.0057
251	2.7679	0.0057
252	2.7736	0.0056
253	2.7792	0.0056
254	2.7848	0.0056
255	2.7905	0.0056
256	2.7961	0.0056
257	2.8016	0.0056
258	2.8072	0.0056
259	2.8128	0.0056
260	2.8184	0.0056

```
261              2.8239               0.0055
262              2.8294               0.0055
263              2.8350               0.0055
264              2.8405               0.0055
265              2.8460               0.0055
266              2.8515               0.0055
267              2.8570               0.0055
268              2.8624               0.0055
269              2.8679               0.0055
270              2.8734               0.0055
271              2.8788               0.0054
272              2.8843               0.0054
273              2.8897               0.0054
274              2.8951               0.0054
275              2.9005               0.0054
276              2.9059               0.0054
277              2.9113               0.0054
278              2.9167               0.0054
279              2.9220               0.0054
280              2.9274               0.0054
281              2.9328               0.0054
282              2.9381               0.0053
283              2.9434               0.0053
284              2.9488               0.0053
285              2.9541               0.0053
286              2.9594               0.0053
287              2.9647               0.0053
288              2.9700               0.0053
---------------------------------------------------------------------
Unit              Unit            Unit              Effective
Period            Rainfall        Soil-Loss         Rainfall
(number)            (In)          (In)                 (In)
---------------------------------------------------------------------
  1              0.0053           0.0040              0.0012
  2              0.0053           0.0041              0.0012
  3              0.0053           0.0041              0.0012
  4              0.0053           0.0041              0.0013
  5              0.0053           0.0041              0.0013
  6              0.0054           0.0041              0.0013
  7              0.0054           0.0041              0.0013
  8              0.0054           0.0041              0.0013
  9              0.0054           0.0041              0.0013
 10              0.0054           0.0041              0.0013
 11              0.0054           0.0042              0.0013
 12              0.0054           0.0042              0.0013
 13              0.0055           0.0042              0.0013
 14              0.0055           0.0042              0.0013
 15              0.0055           0.0042              0.0013
 16              0.0055           0.0042              0.0013
 17              0.0055           0.0042              0.0013
```

18	0.0055	0.0042	0.0013
19	0.0055	0.0042	0.0013
20	0.0056	0.0043	0.0013
21	0.0056	0.0043	0.0013
22	0.0056	0.0043	0.0013
23	0.0056	0.0043	0.0013
24	0.0056	0.0043	0.0013
25	0.0056	0.0043	0.0013
26	0.0057	0.0043	0.0013
27	0.0057	0.0043	0.0013
28	0.0057	0.0044	0.0013
29	0.0057	0.0044	0.0013
30	0.0057	0.0044	0.0013
31	0.0057	0.0044	0.0013
32	0.0058	0.0044	0.0014
33	0.0058	0.0044	0.0014
34	0.0058	0.0044	0.0014
35	0.0058	0.0044	0.0014
36	0.0058	0.0045	0.0014
37	0.0059	0.0045	0.0014
38	0.0059	0.0045	0.0014
39	0.0059	0.0045	0.0014
40	0.0059	0.0045	0.0014
41	0.0059	0.0045	0.0014
42	0.0059	0.0045	0.0014
43	0.0060	0.0046	0.0014
44	0.0060	0.0046	0.0014
45	0.0060	0.0046	0.0014
46	0.0060	0.0046	0.0014
47	0.0060	0.0046	0.0014
48	0.0061	0.0046	0.0014
49	0.0061	0.0047	0.0014
50	0.0061	0.0047	0.0014
51	0.0061	0.0047	0.0014
52	0.0061	0.0047	0.0014
53	0.0062	0.0047	0.0014
54	0.0062	0.0047	0.0015
55	0.0062	0.0048	0.0015
56	0.0062	0.0048	0.0015
57	0.0063	0.0048	0.0015
58	0.0063	0.0048	0.0015
59	0.0063	0.0048	0.0015
60	0.0063	0.0048	0.0015
61	0.0063	0.0049	0.0015
62	0.0064	0.0049	0.0015
63	0.0064	0.0049	0.0015
64	0.0064	0.0049	0.0015
65	0.0064	0.0049	0.0015
66	0.0065	0.0049	0.0015
67	0.0065	0.0050	0.0015

68	0.0065	0.0050	0.0015
69	0.0065	0.0050	0.0015
70	0.0066	0.0050	0.0015
71	0.0066	0.0050	0.0016
72	0.0066	0.0051	0.0016
73	0.0067	0.0051	0.0016
74	0.0067	0.0051	0.0016
75	0.0067	0.0051	0.0016
76	0.0067	0.0051	0.0016
77	0.0068	0.0052	0.0016
78	0.0068	0.0052	0.0016
79	0.0068	0.0052	0.0016
80	0.0068	0.0052	0.0016
81	0.0069	0.0053	0.0016
82	0.0069	0.0053	0.0016
83	0.0069	0.0053	0.0016
84	0.0070	0.0053	0.0016
85	0.0070	0.0054	0.0016
86	0.0070	0.0054	0.0017
87	0.0071	0.0054	0.0017
88	0.0071	0.0054	0.0017
89	0.0071	0.0055	0.0017
90	0.0072	0.0055	0.0017
91	0.0072	0.0055	0.0017
92	0.0072	0.0055	0.0017
93	0.0073	0.0056	0.0017
94	0.0073	0.0056	0.0017
95	0.0073	0.0056	0.0017
96	0.0074	0.0056	0.0017
97	0.0074	0.0057	0.0017
98	0.0074	0.0057	0.0017
99	0.0075	0.0057	0.0018
100	0.0075	0.0058	0.0018
101	0.0076	0.0058	0.0018
102	0.0076	0.0058	0.0018
103	0.0077	0.0059	0.0018
104	0.0077	0.0059	0.0018
105	0.0077	0.0059	0.0018
106	0.0078	0.0059	0.0018
107	0.0078	0.0060	0.0018
108	0.0079	0.0060	0.0018
109	0.0079	0.0061	0.0019
110	0.0080	0.0061	0.0019
111	0.0080	0.0061	0.0019
112	0.0080	0.0062	0.0019
113	0.0081	0.0062	0.0019
114	0.0081	0.0062	0.0019
115	0.0082	0.0063	0.0019
116	0.0082	0.0063	0.0019
117	0.0083	0.0064	0.0020

118	0.0084	0.0064	0.0020
119	0.0084	0.0064	0.0020
120	0.0085	0.0065	0.0020
121	0.0085	0.0065	0.0020
122	0.0086	0.0066	0.0020
123	0.0087	0.0066	0.0020
124	0.0087	0.0067	0.0020
125	0.0088	0.0067	0.0021
126	0.0088	0.0068	0.0021
127	0.0089	0.0068	0.0021
128	0.0090	0.0069	0.0021
129	0.0091	0.0069	0.0021
130	0.0091	0.0070	0.0021
131	0.0092	0.0070	0.0022
132	0.0092	0.0071	0.0022
133	0.0093	0.0071	0.0022
134	0.0094	0.0072	0.0022
135	0.0095	0.0073	0.0022
136	0.0096	0.0073	0.0022
137	0.0097	0.0074	0.0023
138	0.0097	0.0074	0.0023
139	0.0098	0.0075	0.0023
140	0.0099	0.0076	0.0023
141	0.0100	0.0077	0.0024
142	0.0101	0.0077	0.0024
143	0.0102	0.0078	0.0024
144	0.0103	0.0079	0.0024
145	0.0085	0.0065	0.0020
146	0.0086	0.0065	0.0020
147	0.0087	0.0067	0.0020
148	0.0088	0.0067	0.0021
149	0.0089	0.0068	0.0021
150	0.0090	0.0069	0.0021
151	0.0092	0.0070	0.0022
152	0.0093	0.0071	0.0022
153	0.0094	0.0072	0.0022
154	0.0095	0.0073	0.0022
155	0.0097	0.0074	0.0023
156	0.0098	0.0075	0.0023
157	0.0100	0.0077	0.0024
158	0.0102	0.0078	0.0024
159	0.0104	0.0080	0.0024
160	0.0105	0.0080	0.0025
161	0.0108	0.0082	0.0025
162	0.0109	0.0083	0.0026
163	0.0112	0.0086	0.0026
164	0.0113	0.0087	0.0027
165	0.0117	0.0089	0.0027
166	0.0118	0.0090	0.0028
167	0.0122	0.0093	0.0029

168	0.0124	0.0095	0.0029
169	0.0128	0.0098	0.0030
170	0.0130	0.0099	0.0031
171	0.0135	0.0103	0.0032
172	0.0137	0.0105	0.0032
173	0.0142	0.0109	0.0033
174	0.0145	0.0111	0.0034
175	0.0152	0.0116	0.0036
176	0.0155	0.0119	0.0036
177	0.0163	0.0124	0.0038
178	0.0167	0.0128	0.0039
179	0.0176	0.0135	0.0041
180	0.0181	0.0139	0.0043
181	0.0193	0.0148	0.0045
182	0.0200	0.0153	0.0047
183	0.0215	0.0165	0.0051
184	0.0225	0.0172	0.0053
185	0.0178	0.0136	0.0042
186	0.0190	0.0145	0.0045
187	0.0220	0.0169	0.0052
188	0.0240	0.0184	0.0056
189	0.0299	0.0229	0.0070
190	0.0344	0.0263	0.0081
191	0.0523	0.0400	0.0123
192	0.0759	0.0444	0.0315
193	0.3282	0.0444	0.2838
194	0.0411	0.0315	0.0097
195	0.0266	0.0203	0.0062
196	0.0204	0.0156	0.0048
197	0.0235	0.0180	0.0055
198	0.0207	0.0158	0.0049
199	0.0187	0.0143	0.0044
200	0.0171	0.0131	0.0040
201	0.0159	0.0121	0.0037
202	0.0148	0.0113	0.0035
203	0.0140	0.0107	0.0033
204	0.0132	0.0101	0.0031
205	0.0126	0.0096	0.0030
206	0.0120	0.0092	0.0028
207	0.0115	0.0088	0.0027
208	0.0110	0.0084	0.0026
209	0.0106	0.0081	0.0025
210	0.0103	0.0079	0.0024
211	0.0099	0.0076	0.0023
212	0.0096	0.0074	0.0023
213	0.0094	0.0072	0.0022
214	0.0091	0.0070	0.0021
215	0.0089	0.0068	0.0021
216	0.0086	0.0066	0.0020
217	0.0104	0.0079	0.0024

218	0.0101	0.0078	0.0024
219	0.0100	0.0076	0.0023
220	0.0098	0.0075	0.0023
221	0.0096	0.0074	0.0023
222	0.0094	0.0072	0.0022
223	0.0093	0.0071	0.0022
224	0.0091	0.0070	0.0021
225	0.0090	0.0069	0.0021
226	0.0089	0.0068	0.0021
227	0.0087	0.0067	0.0021
228	0.0086	0.0066	0.0020
229	0.0085	0.0065	0.0020
230	0.0084	0.0064	0.0020
231	0.0083	0.0063	0.0019
232	0.0082	0.0063	0.0019
233	0.0081	0.0062	0.0019
234	0.0080	0.0061	0.0019
235	0.0079	0.0060	0.0019
236	0.0078	0.0060	0.0018
237	0.0077	0.0059	0.0018
238	0.0076	0.0058	0.0018
239	0.0075	0.0058	0.0018
240	0.0075	0.0057	0.0018
241	0.0074	0.0057	0.0017
242	0.0073	0.0056	0.0017
243	0.0072	0.0055	0.0017
244	0.0072	0.0055	0.0017
245	0.0071	0.0054	0.0017
246	0.0070	0.0054	0.0017
247	0.0070	0.0053	0.0016
248	0.0069	0.0053	0.0016
249	0.0069	0.0052	0.0016
250	0.0068	0.0052	0.0016
251	0.0067	0.0052	0.0016
252	0.0067	0.0051	0.0016
253	0.0066	0.0051	0.0016
254	0.0066	0.0050	0.0015
255	0.0065	0.0050	0.0015
256	0.0065	0.0050	0.0015
257	0.0064	0.0049	0.0015
258	0.0064	0.0049	0.0015
259	0.0063	0.0048	0.0015
260	0.0063	0.0048	0.0015
261	0.0062	0.0048	0.0015
262	0.0062	0.0047	0.0015
263	0.0062	0.0047	0.0014
264	0.0061	0.0047	0.0014
265	0.0061	0.0046	0.0014
266	0.0060	0.0046	0.0014
267	0.0060	0.0046	0.0014

```
      268              0.0060           0.0046              0.0014
      269              0.0059           0.0045              0.0014
      270              0.0059           0.0045              0.0014
      271              0.0058           0.0045              0.0014
      272              0.0058           0.0044              0.0014
      273              0.0058           0.0044              0.0014
      274              0.0057           0.0044              0.0013
      275              0.0057           0.0044              0.0013
      276              0.0057           0.0043              0.0013
      277              0.0056           0.0043              0.0013
      278              0.0056           0.0043              0.0013
      279              0.0056           0.0043              0.0013
      280              0.0055           0.0042              0.0013
      281              0.0055           0.0042              0.0013
      282              0.0055           0.0042              0.0013
      283              0.0054           0.0042              0.0013
      284              0.0054           0.0041              0.0013
      285              0.0054           0.0041              0.0013
      286              0.0054           0.0041              0.0013
      287              0.0053           0.0041              0.0013
      288              0.0053           0.0041              0.0012
      --------------------------------------------------------------------
      --------------------------------------------------------------------
      Total soil rain loss =      2.05(In)
      Total effective rainfall =      0.92(In)
      Peak flow rate in flood hydrograph =     10.22(CFS)
      ---------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R    S T O R M
                     R u n o f f      H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5      0.0000      0.00  Q         |         |         |         |
  0+10      0.0001      0.01  Q         |         |         |         |
  0+15      0.0003      0.03  Q         |         |         |         |
  0+20      0.0008      0.07  Q         |         |         |         |
  0+25      0.0015      0.10  Q         |         |         |         |
  0+30      0.0023      0.12  Q         |         |         |         |
  0+35      0.0032      0.13  Q         |         |         |         |
  0+40      0.0041      0.14  Q         |         |         |         |
  0+45      0.0051      0.15  Q         |         |         |         |
  0+50      0.0062      0.15  Q         |         |         |         |
  0+55      0.0073      0.16  Q         |         |         |         |
  1+ 0      0.0084      0.16  Q         |         |         |         |
  1+ 5      0.0095      0.17  Q         |         |         |         |
  1+10      0.0107      0.17  Q         |         |         |         |
```

```
1+15       0.0119      0.17  Q          |         |         |         |
1+20       0.0131      0.17  Q          |         |         |         |
1+25       0.0143      0.18  Q          |         |         |         |
1+30       0.0155      0.18  Q          |         |         |         |
1+35       0.0168      0.18  Q          |         |         |         |
1+40       0.0181      0.18  Q          |         |         |         |
1+45       0.0193      0.18  Q          |         |         |         |
1+50       0.0206      0.19  Q          |         |         |         |
1+55       0.0219      0.19  Q          |         |         |         |
2+ 0       0.0232      0.19  Q          |         |         |         |
2+ 5       0.0245      0.19  QV         |         |         |         |
2+10       0.0258      0.19  QV         |         |         |         |
2+15       0.0271      0.19  QV         |         |         |         |
2+20       0.0284      0.19  QV         |         |         |         |
2+25       0.0298      0.19  QV         |         |         |         |
2+30       0.0311      0.19  QV         |         |         |         |
2+35       0.0325      0.20  QV         |         |         |         |
2+40       0.0338      0.20  QV         |         |         |         |
2+45       0.0352      0.20  QV         |         |         |         |
2+50       0.0365      0.20  QV         |         |         |         |
2+55       0.0379      0.20  QV         |         |         |         |
3+ 0       0.0393      0.20  QV         |         |         |         |
3+ 5       0.0406      0.20  QV         |         |         |         |
3+10       0.0420      0.20  QV         |         |         |         |
3+15       0.0434      0.20  QV         |         |         |         |
3+20       0.0448      0.20  QV         |         |         |         |
3+25       0.0462      0.20  QV         |         |         |         |
3+30       0.0476      0.20  Q V        |         |         |         |
3+35       0.0490      0.20  Q V        |         |         |         |
3+40       0.0504      0.20  Q V        |         |         |         |
3+45       0.0518      0.20  Q V        |         |         |         |
3+50       0.0532      0.21  Q V        |         |         |         |
3+55       0.0546      0.21  Q V        |         |         |         |
4+ 0       0.0560      0.21  Q V        |         |         |         |
4+ 5       0.0575      0.21  Q V        |         |         |         |
4+10       0.0589      0.21  Q V        |         |         |         |
4+15       0.0603      0.21  Q V        |         |         |         |
4+20       0.0618      0.21  Q V        |         |         |         |
4+25       0.0632      0.21  Q V        |         |         |         |
4+30       0.0647      0.21  Q V        |         |         |         |
4+35       0.0661      0.21  Q V        |         |         |         |
4+40       0.0676      0.21  Q V        |         |         |         |
4+45       0.0691      0.21  Q V        |         |         |         |
4+50       0.0705      0.21  Q  V       |         |         |         |
4+55       0.0720      0.21  Q  V       |         |         |         |
5+ 0       0.0735      0.21  Q  V       |         |         |         |
5+ 5       0.0750      0.22  Q  V       |         |         |         |
5+10       0.0765      0.22  Q  V       |         |         |         |
5+15       0.0780      0.22  Q  V       |         |         |         |
5+20       0.0795      0.22  Q  V       |         |         |         |
```

```
5+25       0.0810      0.22  Q  V      |         |         |         |
5+30       0.0825      0.22  Q  V      |         |         |         |
5+35       0.0840      0.22  Q  V      |         |         |         |
5+40       0.0855      0.22  Q  V      |         |         |         |
5+45       0.0870      0.22  Q  V      |         |         |         |
5+50       0.0886      0.22  Q  V      |         |         |         |
5+55       0.0901      0.22  Q  V      |         |         |         |
6+ 0       0.0917      0.22  Q  V      |         |         |         |
6+ 5       0.0932      0.23  Q  V      |         |         |         |
6+10       0.0948      0.23  Q   V     |         |         |         |
6+15       0.0963      0.23  Q   V     |         |         |         |
6+20       0.0979      0.23  Q   V     |         |         |         |
6+25       0.0995      0.23  Q   V     |         |         |         |
6+30       0.1011      0.23  Q   V     |         |         |         |
6+35       0.1027      0.23  Q   V     |         |         |         |
6+40       0.1043      0.23  Q   V     |         |         |         |
6+45       0.1059      0.23  Q   V     |         |         |         |
6+50       0.1075      0.23  Q   V     |         |         |         |
6+55       0.1091      0.23  Q   V     |         |         |         |
7+ 0       0.1107      0.24  Q   V     |         |         |         |
7+ 5       0.1124      0.24  Q   V     |         |         |         |
7+10       0.1140      0.24  Q   V     |         |         |         |
7+15       0.1156      0.24  Q   V     |         |         |         |
7+20       0.1173      0.24  Q    V    |         |         |         |
7+25       0.1190      0.24  Q    V    |         |         |         |
7+30       0.1206      0.24  Q    V    |         |         |         |
7+35       0.1223      0.24  Q    V    |         |         |         |
7+40       0.1240      0.24  Q    V    |         |         |         |
7+45       0.1257      0.25  Q    V    |         |         |         |
7+50       0.1274      0.25  Q    V    |         |         |         |
7+55       0.1291      0.25  Q    V    |         |         |         |
8+ 0       0.1308      0.25  Q    V    |         |         |         |
8+ 5       0.1325      0.25  Q    V    |         |         |         |
8+10       0.1342      0.25  Q    V    |         |         |         |
8+15       0.1360      0.25  Q    V    |         |         |         |
8+20       0.1377      0.25  Q    V    |         |         |         |
8+25       0.1395      0.26  Q    V    |         |         |         |
8+30       0.1413      0.26  Q     V   |         |         |         |
8+35       0.1430      0.26  Q     V   |         |         |         |
8+40       0.1448      0.26  Q     V   |         |         |         |
8+45       0.1466      0.26  Q     V   |         |         |         |
8+50       0.1484      0.26  Q     V   |         |         |         |
8+55       0.1502      0.26  Q     V   |         |         |         |
9+ 0       0.1520      0.26  Q     V   |         |         |         |
9+ 5       0.1539      0.27  Q     V   |         |         |         |
9+10       0.1557      0.27  Q     V   |         |         |         |
9+15       0.1576      0.27  Q     V   |         |         |         |
9+20       0.1594      0.27  Q     V   |         |         |         |
9+25       0.1613      0.27  Q     V   |         |         |         |
9+30       0.1632      0.27  Q     V   |         |         |         |
```

```
 9+35       0.1651      0.28  Q      V  |         |         |         |
 9+40       0.1670      0.28  Q      V  |         |         |         |
 9+45       0.1689      0.28  Q      V  |         |         |         |
 9+50       0.1708      0.28  Q      V  |         |         |         |
 9+55       0.1728      0.28  Q      V  |         |         |         |
10+ 0       0.1747      0.28  Q      V  |         |         |         |
10+ 5       0.1767      0.29  Q      V  |         |         |         |
10+10       0.1787      0.29  Q      V  |         |         |         |
10+15       0.1806      0.29  Q      V  |         |         |         |
10+20       0.1827      0.29  Q      V  |         |         |         |
10+25       0.1847      0.29  Q      V  |         |         |         |
10+30       0.1867      0.29  Q      V  |         |         |         |
10+35       0.1887      0.30  Q       V |         |         |         |
10+40       0.1908      0.30  Q       V |         |         |         |
10+45       0.1929      0.30  Q       V |         |         |         |
10+50       0.1950      0.30  Q       V |         |         |         |
10+55       0.1971      0.31  Q       V |         |         |         |
11+ 0       0.1992      0.31  Q       V |         |         |         |
11+ 5       0.2013      0.31  Q       V |         |         |         |
11+10       0.2035      0.31  Q       V |         |         |         |
11+15       0.2056      0.31  Q       V |         |         |         |
11+20       0.2078      0.32  Q       V |         |         |         |
11+25       0.2100      0.32  Q       V |         |         |         |
11+30       0.2122      0.32  Q        V|         |         |         |
11+35       0.2145      0.32  Q        V|         |         |         |
11+40       0.2167      0.33  Q        V|         |         |         |
11+45       0.2190      0.33  Q        V|         |         |         |
11+50       0.2213      0.33  Q        V|         |         |         |
11+55       0.2236      0.34  Q        V|         |         |         |
12+ 0       0.2259      0.34  Q        V|         |         |         |
12+ 5       0.2283      0.34  Q        V|         |         |         |
12+10       0.2306      0.34  Q        V|         |         |         |
12+15       0.2329      0.34  Q        V|         |         |         |
12+20       0.2352      0.33  Q         V         |         |         |
12+25       0.2374      0.32  Q         V         |         |         |
12+30       0.2395      0.32  Q         V         |         |         |
12+35       0.2417      0.32  Q         V         |         |         |
12+40       0.2439      0.32  Q         V         |         |         |
12+45       0.2461      0.32  Q         V         |         |         |
12+50       0.2483      0.32  Q         V         |         |         |
12+55       0.2505      0.32  Q         V         |         |         |
13+ 0       0.2527      0.32  Q         V         |         |         |
13+ 5       0.2549      0.33  Q         V         |         |         |
13+10       0.2572      0.33  Q         |V        |         |         |
13+15       0.2595      0.33  Q         |V        |         |         |
13+20       0.2619      0.34  Q         |V        |         |         |
13+25       0.2642      0.34  Q         |V        |         |         |
13+30       0.2666      0.35  Q         |V        |         |         |
13+35       0.2691      0.35  Q         |V        |         |         |
13+40       0.2715      0.36  Q         |V        |         |         |
```

Time(h+min) Volume (AC*FT) Q(CFS) 0 5.0 10 15 20

```
13+45       0.2740      0.36  Q         |V        |         |         |
13+50       0.2766      0.37  Q         |V        |         |         |
13+55       0.2792      0.38  Q         |V        |         |         |
14+ 0       0.2818      0.38  Q         | V       |         |         |
14+ 5       0.2845      0.39  Q         | V       |         |         |
14+10       0.2873      0.40  Q         | V       |         |         |
14+15       0.2901      0.41  Q         | V       |         |         |
14+20       0.2930      0.42  Q         | V       |         |         |
14+25       0.2959      0.43  Q         | V       |         |         |
14+30       0.2989      0.44  Q         | V       |         |         |
14+35       0.3020      0.45  Q         | V       |         |         |
14+40       0.3052      0.46  Q         |  V      |         |         |
14+45       0.3084      0.47  Q         |  V      |         |         |
14+50       0.3118      0.49  Q         |  V      |         |         |
14+55       0.3153      0.50  |Q        |  V      |         |         |
15+ 0       0.3188      0.52  |Q        |  V      |         |         |
15+ 5       0.3225      0.54  |Q        |  V      |         |         |
15+10       0.3264      0.56  |Q        |  V      |         |         |
15+15       0.3304      0.58  |Q        |   V     |         |         |
15+20       0.3345      0.60  |Q        |   V     |         |         |
15+25       0.3388      0.63  |Q        |   V     |         |         |
15+30       0.3433      0.65  |Q        |   V     |         |         |
15+35       0.3479      0.66  |Q        |   V     |         |         |
15+40       0.3524      0.66  |Q        |    V    |         |         |
15+45       0.3570      0.67  |Q        |    V    |         |         |
15+50       0.3619      0.71  |Q        |    V    |         |         |
15+55       0.3673      0.79  |Q        |    V    |         |         |
16+ 0       0.3738      0.93  |Q        |    V    |         |         |
16+ 5       0.3855      1.70  |  Q      |     V   |         |         |
16+10       0.4096      3.51  |      Q  |      V  |         |         |
16+15       0.4548      6.56  |         |  Q     V|         |         |
16+20       0.5252     10.22  |         |         Q V       |         |
16+25       0.5780      7.68  |         |    Q    |   V     |         |
16+30       0.6132      5.10  |         Q         |     V   |         |
16+35       0.6391      3.76  |      Q  |         |      V  |         |
16+40       0.6600      3.05  |     Q   |         |       V |         |
16+45       0.6776      2.55  |    Q    |         |       V |         |
16+50       0.6923      2.14  |   Q     |         |        V|         |
16+55       0.7052      1.87  |  Q      |         |         V         |
17+ 0       0.7168      1.69  |  Q      |         |         V         |
17+ 5       0.7270      1.48  | Q       |         |         |V        |
17+10       0.7358      1.27  | Q       |         |         |V        |
17+15       0.7438      1.17  | Q       |         |         |V        |
17+20       0.7512      1.07  | Q       |         |         | V       |
17+25       0.7580      0.99  |Q        |         |         | V       |
17+30       0.7641      0.89  |Q        |         |         | V       |
17+35       0.7699      0.83  |Q        |         |         | V       |
17+40       0.7751      0.76  |Q        |         |         |  V      |
17+45       0.7800      0.71  |Q        |         |         |  V      |
17+50       0.7844      0.64  |Q        |         |         |  V      |
```

Q = 10.22 CFS

```
17+55       0.7885      0.59  |Q        |         |         |  V      |
18+ 0       0.7921      0.53  |Q        |         |         |  V      |
18+ 5       0.7955      0.48  Q         |         |         |   V     |
18+10       0.7988      0.49  Q         |         |         |   V     |
18+15       0.8022      0.49  Q         |         |         |   V     |
18+20       0.8056      0.50  Q         |         |         |   V     |
18+25       0.8090      0.49  Q         |         |         |   V     |
18+30       0.8122      0.47  Q         |         |         |   V     |
18+35       0.8151      0.43  Q         |         |         |   V     |
18+40       0.8180      0.42  Q         |         |         |   V     |
18+45       0.8208      0.41  Q         |         |         |    V    |
18+50       0.8232      0.34  Q         |         |         |    V    |
18+55       0.8255      0.33  Q         |         |         |    V    |
19+ 0       0.8277      0.33  Q         |         |         |    V    |
19+ 5       0.8299      0.32  Q         |         |         |    V    |
19+10       0.8321      0.32  Q         |         |         |    V    |
19+15       0.8343      0.31  Q         |         |         |    V    |
19+20       0.8364      0.31  Q         |         |         |    V    |
19+25       0.8385      0.30  Q         |         |         |    V    |
19+30       0.8406      0.30  Q         |         |         |    V    |
19+35       0.8426      0.30  Q         |         |         |     V   |
19+40       0.8447      0.29  Q         |         |         |     V   |
19+45       0.8466      0.29  Q         |         |         |     V   |
19+50       0.8486      0.29  Q         |         |         |     V   |
19+55       0.8506      0.28  Q         |         |         |     V   |
20+ 0       0.8525      0.28  Q         |         |         |     V   |
20+ 5       0.8544      0.28  Q         |         |         |     V   |
20+10       0.8563      0.27  Q         |         |         |     V   |
20+15       0.8581      0.27  Q         |         |         |     V   |
20+20       0.8599      0.27  Q         |         |         |     V   |
20+25       0.8618      0.26  Q         |         |         |     V   |
20+30       0.8636      0.26  Q         |         |         |     V   |
20+35       0.8653      0.26  Q         |         |         |      V  |
20+40       0.8671      0.26  Q         |         |         |      V  |
20+45       0.8689      0.25  Q         |         |         |      V  |
20+50       0.8706      0.25  Q         |         |         |      V  |
20+55       0.8723      0.25  Q         |         |         |      V  |
21+ 0       0.8740      0.25  Q         |         |         |      V  |
21+ 5       0.8757      0.24  Q         |         |         |      V  |
21+10       0.8773      0.24  Q         |         |         |      V  |
21+15       0.8790      0.24  Q         |         |         |      V  |
21+20       0.8806      0.24  Q         |         |         |      V  |
21+25       0.8823      0.24  Q         |         |         |      V  |
21+30       0.8839      0.23  Q         |         |         |      V  |
21+35       0.8855      0.23  Q         |         |         |      V  |
21+40       0.8870      0.23  Q         |         |         |      V  |
21+45       0.8886      0.23  Q         |         |         |       V |
21+50       0.8902      0.23  Q         |         |         |       V |
21+55       0.8917      0.22  Q         |         |         |       V |
22+ 0       0.8933      0.22  Q         |         |         |       V |
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   22+ 5        0.8948       0.22  Q         |         |         |       V |
   22+10        0.8963       0.22  Q         |         |         |       V |
   22+15        0.8978       0.22  Q         |         |         |       V |
   22+20        0.8993       0.22  Q         |         |         |       V |
   22+25        0.9008       0.21  Q         |         |         |       V |
   22+30        0.9022       0.21  Q         |         |         |       V |
   22+35        0.9037       0.21  Q         |         |         |       V |
   22+40        0.9051       0.21  Q         |         |         |       V |
   22+45        0.9066       0.21  Q         |         |         |       V |
   22+50        0.9080       0.21  Q         |         |         |       V |
   22+55        0.9094       0.21  Q         |         |         |       V |
   23+ 0        0.9108       0.20  Q         |         |         |       V |
   23+ 5        0.9122       0.20  Q         |         |         |        V|
   23+10        0.9136       0.20  Q         |         |         |        V|
   23+15        0.9150       0.20  Q         |         |         |        V|
   23+20        0.9164       0.20  Q         |         |         |        V|
   23+25        0.9177       0.20  Q         |         |         |        V|
   23+30        0.9191       0.20  Q         |         |         |        V|
   23+35        0.9205       0.20  Q         |         |         |        V|
   23+40        0.9218       0.20  Q         |         |         |        V|
   23+45        0.9231       0.19  Q         |         |         |        V|
   23+50        0.9245       0.19  Q         |         |         |        V|
   23+55        0.9258       0.19  Q         |         |         |        V|
   24+ 0        0.9271       0.19  Q         |         |         |        V|
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4.3 BMP Selection and Sizing

Complete the following forms for each project site DA to document that the proposed treatment (LID/Bioretention) BMPs conform to the project DCV developed to meet performance criteria specified in the Phase II Small MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the Phase II Small MS4 Permit (see Section 5.3 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design Measures (Form 4.3-2)
- Retention and Infiltration BMPs (Form 4.3-3) or
- Biotreatment BMPs (Form 4.3-4).

Please note that the selected BMPs may also be used as dual purpose for on-site, hydromodification mitigation and management.

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is “Yes,” provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Form 4.3-2 to determine the feasibility of applicable Site Design BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable Site Design BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of site design, retention and/or infiltration BMPs is unable to mitigate the entire DCV, then the remainder of the volume-based performance criteria that cannot be achieved with site design, retention and/or infiltration BMPs must be managed through biotreatment BMPs. If biotreatment BMPs are used, then they must be sized to provide equivalent effectiveness based on Template Section 4.3.4.

4.3.1 Exceptions to Requirements for Bioretention Facilities

Contingent on a demonstration that use of bioretention or a facility of equivalent effectiveness is infeasible, other types of biotreatment or media filters (such as tree-box-type biofilters or in-vault media filters) may be used for the following categories of Regulated Projects:

1) Projects creating or replacing an acre or less of impervious area, and located in a designated pedestrian-oriented commercial district (i.e., smart growth projects), and having at least 85% of the entire project site covered by permanent structures;

2) Facilities receiving runoff solely from existing (pre-project) impervious areas; and

3) Historic sites, structures or landscapes that cannot alter their original configuration in order to maintain their historic integrity.

Form 4.3-1 Infiltration BMP Feasibility (DA 1 & 2)

Feasibility Criterion – Complete evaluation for each DA on the Project Site

[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒
Refer to Section 5.3.2.1 of the TGD for WQMP

If Yes, Provide basis: (attach)

[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒
(Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):

- The location is less than 50 feet away from slopes steeper than 15 percent
- The location is less than ten feet from building foundations or an alternative setback.
- A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.

If Yes, Provide basis: (attach)

[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒
See Section 3.5 of the TGD for WQMP and WAP

If Yes, Provide basis: (attach)

[7] Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒
If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Selection and Evaluation of Biotreatment BMP.
If no, then proceed to Item 8 below.

[8] Any answer from Item 4 through Item 6 is "Yes": Yes ☐ No ☒
If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Site Design BMP.
If no, then proceed to Item 9, below.

[9] All answers to Item 1 through Item 6 are "No":
Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP.
Proceed to Form 4.3-2, Site Design BMPs.

4.3.2 Site Design BMP

Section E.12.e. of the Small Phase II MS4 Permit emphasizes the use of LID preventative measures; and the use of Site Design Measures reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable Site Design Measures shall be provided except where they are mutually exclusive with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of Site Design BMPs. If a project cannot feasibly meet BMP sizing requirements or cannot fully address hydromodification, feasibility of all applicable Site Design BMPs must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design BMP. Refer to Section 5.4 in the TGD for more detailed guidance.

Form 4.3-2 Site Design BMPs (DA 1&2)

1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ _If yes, complete Items 2-5; If no, proceed to Item 6_	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type _(Use additional forms for more BMPs)_
2 Total impervious area draining to pervious area (ft^2)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) _V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff_			
5 Sum of retention volume achieved from impervious area dispersion (ft^3): 0 $V_{retention}$ _=Sum of Item 4 for all BMPs_			
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒ _If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14_	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type _(Use additional forms for more BMPs)_
7 Ponding surface area (ft^2)			
8 Ponding depth (ft) (min. 0.5 ft.)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft) (min. 1 ft.)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) $V_{retention}$ _= (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)_			
13 Runoff volume retention from on-lot infiltration (ft^3): 0 $V_{retention}$ _=Sum of Item 12 for all BMPs_			

Form 4.3-2 cont. Site Design BMPs (DA 1&2)

14 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 14-18. If no, proceed to Item 19*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Number of Street Trees			
16 Average canopy cover over impervious area (ft^2)			
17 Runoff volume retention from street trees (ft^3) *$V_{retention}$ = Item 15 * Item 16 * (0.05/12) assume runoff retention of 0.05 inches*			

18 Runoff volume retention from street tree BMPs (ft^3): 0 *$V_{retention}$ = Sum of Item 17 for all BMPs*

19 Total Retention Volume from Site Design BMPs: 0 *Sum of Items 5, 13 and 18*

4.3.3 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix C of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

4.3.3.1 Allowed Variations for Special Site Conditions

The bioretention system design parameters of this Section may be adjusted for the following special site conditions:

1) Facilities located within 10 feet of structures or other potential geotechnical hazards established by the geotechnical expert for the project may incorporate an impervious cutoff wall between the bioretention facility and the structure or other geotechnical hazard.

2) Facilities with documented high concentrations of pollutants in underlying soil or groundwater, facilities located where infiltration could contribute to a geotechnical hazard, and facilities located on elevated plazas or other structures may incorporate an impervious liner and may locate the underdrain discharge at the bottom of the subsurface drainage/storage layer (this configuration is commonly known as a “flow-through planter”).

3) Facilities located in areas of high groundwater, highly infiltrative soils or where connection of underdrain to a surface drain or to a subsurface storm drain are infeasible, may omit the underdrain.

4) Facilities serving high-risk areas such as fueling stations, truck stops, auto repairs, and heavy industrial sites may be required to provide adequate pretreatment to address pollutants of concern unless these high-risk areas are isolated from storm water runoff or bioretention areas with no chance of spill migration.

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Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design BMP (ft^3): 17,775 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item19*

BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA A BMP Type Infiltration Basin	DA 1 DMA B BMP Type Infiltration Trench	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods*	5.95	5.95	
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	4.38	4.38	
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	1.36	1.36	
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48	48	
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	4	0	
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	4	0	
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	5,004	2,144	
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0	1	
10 Amended soil porosity	0.3	0.3	
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0	2	
12 Gravel porosity	0.4	0.4	
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3	3	
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	21,715	3,087	
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*			

16 Total Retention Volume from LID Infiltration BMPs: 24,802 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 140% *Retention% = Item 16 / Form 4.2-1 Item 7*

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 2)

1 Remaining LID DCV not met by site design BMP (ft^3): 17,585 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item19*

BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 2 BMP Type Infiltration Basin	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods*	5.95		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	4.38		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	1.36		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	4		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	4		
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	5,240		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0		
10 Amended soil porosity	0.3		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0		
12 Gravel porosity	0		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	22,740		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	0		

16 Total Retention Volume from LID Infiltration BMPs: 22,740

17 Fraction of DCV achieved with infiltration BMP: 129% *Retention% = Item 16 / Form 4.2-1 Item 7*

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-4 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV. Biotreatment computations are included as follows:

- Use Form 4.3-5 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-6 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-7 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-4 Selection and Evaluation of Biotreatment BMP (DA 1&2)

1 Remaining LID DCV not met by site design , or infiltration, BMP for potential biotreatment (ft³): *Form 4.2-1 Item 7 - Form 4.3-2 Item 19 – Form 4.3-3 Item 16*	List pollutants of concern *Copy from Form 2.3-1.*

2 Biotreatment BMP Selected	Volume-based biotreatment *Use Forms 4.3-5 and 4.3-6 to compute treated volume*	Flow-based biotreatment *Use Form 4.3-7 to compute treated flow*
(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)	☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment

3 Volume biotreated in volume based biotreatment BMP (ft³): *Form 4.3-5 Item 15 + Form 4.3-6 Item 13*	4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft³): *Item 1 – Item 3*	5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % *Item 4 / Item 1*

6 Flow-based biotreatment BMP capacity provided (cfs): *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)*

7 Metrics for MEP determination:

- Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐ *If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.*

Form 4.3-5 Volume Based Biotreatment (DA 1&2) – Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*			
2 Amended soil infiltration rate *Typical ~ 5.0*			
3 Amended soil infiltration safety factor *Typical ~ 2.0*			
4 Amended soil design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*			
5 Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1*			
6 Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12 * Item 4 * Item 5) or Item 6*			
8 Amended soil surface area (ft^2)			
9 Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Amended soil porosity, *n*			
11 Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
12 Gravel porosity, *n*			
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*			
14 Biotreated Volume (ft^3) *$V_{biotreated}$ = Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*			

15 Total biotreated volume from bioretention and/or planter box with underdrains BMP:
Sum of Item 14 for all volume-based BMPs included in this form

Form 4.3-6 Volume Based Biotreatment (DA 1&2) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type *Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (E.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.*	DA DMA BMP Type		DA DMA BMP Type *(Use additional forms for more BMPs)*	
	Forebay	Basin	Forebay	Basin
^{1} Pollutants addressed with BMP forebay and basin *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*				
^{2} Bottom width (ft)				
^{3} Bottom length (ft)				
^{4} Bottom area (ft^2) A_{bottom} *= Item 2 * Item 3*				
^{5} Side slope (ft/ft)				
^{6} Depth of storage (ft)				
^{7} Water surface area (ft^2) $A_{surface}$ *=(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))*				
^{8} Storage volume (ft^3) *For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details* V *=Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]*				
^{9} Drawdown Time (hrs) *Copy Item 6 from Form 2.1*				
^{10} Outflow rate (cfs) Q_{BMP} *= (Item* $8_{forebay}$ *+ Item* 8_{basin}*) / (Item 9 * 3600)*				
^{11} Duration of design storm event (hrs)				
^{12} Biotreated Volume (ft^3) $V_{biotreated}$ *= (Item* $8_{forebay}$ *+ Item* 8_{basin}*) +(Item 10 * Item 11 * 3600)*				
^{13} Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : *(Sum of Item 12 for all BMP included in plan)*				

Form 4.3-7 Flow Based Biotreatment (DA 1&2)

Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
[1] Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5*			
[2] Flow depth for water quality treatment (ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
[3] Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
[4] Manning's roughness coefficient			
[5] Bottom width (ft) b_w = (Form 4.3-5 Item 6 * Item 4) / (1.49 * Item $2^{\wedge 1.67}$ * Item $3^{\wedge 0.5}$)			
[6] Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
[7] Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item* $2^{\wedge 2}$*)*			
[8] Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*			
[9] Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
[10] Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*			
[11] Water surface area at water quality flow depth (ft^2) SA_{top} = (Item 5 + (2 * Item 2 * Item 6)) * Item 10			

4.3.5 Conformance Summary

Complete Form 4.3-8 to demonstrate how on-site LID DCV is met with proposed site design, infiltration, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)

1 Total LID DCV for the Project DA-1 (ft^3): 17,775 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design BMP (ft^3): 0 *Copy Item18 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 24,802 *Copy Item 16 in Form 4.3-3*

4 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-4*

5 Flow capacity provided by flow based biotreatment BMP (cfs): 0 *Copy Item 6 in Form 4.3-4*

6 LID BMP performance criteria are achieved if answer to any of the following is “Yes”:

- Full retention of LID DCV with site design or infiltration BMP: Yes ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☒
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized
- On-site retention and infiltration is determined to be infeasible; therefore biotreatment BMP provides biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☒
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

7 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of Site Design, retention and infiltration, , and biotreatment BMPs provide less than full LID DCV capture: ☐
  Checked yes if Form 4.3-4 Item 7is checked yes, Form 4.3-4 Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} *= (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%*

- Facilities, or a combination of facilities, of a different design than in Section E.12.e.(ii)(f) may be permitted if all of the following Phase II Small MS4 General Permit 2013-0001-DWQ 55 February 5, 2013 measures of equivalent effectiveness are demonstrated:
  1) Equal or greater amount of runoff infiltrated or evapotranspired; ☐
  2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment; ☐
  3) Equal or greater protection against shock loadings and spills; ☐
  4) Equal or greater accessibility and ease of inspection and maintenance. ☐

4.3.6 Hydromodification Control BMP

Use Form 4.3-9 to compute the remaining runoff volume retention, after Site Design BMPs are implemented, needed to address hydromodification, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential hydromodification. Describe the proposed hydromodification treatment control BMP. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-9 Hydromodification Control BMPs (DA 1)

1 Volume reduction needed for hydromodification performance criteria (ft³): 2,619 FROM HYDROGRAPH ANALYSIS *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	2 On-site retention with site design and infiltration, BMP (ft³): 7,027 REMAINDER FROM FORM 4.3-8 (DA-1) *Form 4.3-8 Items 2, 3, and 4. Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving hydromodification volume reduction*
3 Remaining volume for hydromodification volume capture (ft³): 0 *Item 1 – Item 2*	4 Volume capture provided by incorporating additional on-site BMPs (ft³): 0

5 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☒

If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site BMP ☒
- Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐

6 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☒

If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site retention BMPs ☒

4.3.5 Conformance Summary

Complete Form 4.3-8 to demonstrate how on-site LID DCV is met with proposed site design, infiltration, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (DA 2)

1 Total LID DCV for the Project DA-2 (ft^3): 17,585 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design BMP (ft^3): 0 *Copy Item18 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 22,740 *Copy Item 16 in Form 4.3-3*

4 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-4*

5 Flow capacity provided by flow based biotreatment BMP (cfs): 0 *Copy Item 6 in Form 4.3-4*

6 LID BMP performance criteria are achieved if answer to any of the following is “Yes”:

- Full retention of LID DCV with site design or infiltration BMP: Yes ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☒
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized
- On-site retention and infiltration is determined to be infeasible; therefore biotreatment BMP provides biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☒
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

7 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of Site Design, retention and infiltration, , and biotreatment BMPs provide less than full LID DCV capture: ☐
  *Checked yes if Form 4.3-4 Item 7is checked yes, Form 4.3-4 Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} = (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%*

- Facilities, or a combination of facilities, of a different design than in Section E.12.e.(ii)(f) may be permitted if all of the following Phase II Small MS4 General Permit 2013-0001-DWQ 55 February 5, 2013 measures of equivalent effectiveness are demonstrated:
  1) Equal or greater amount of runoff infiltrated or evapotranspired; ☐
  2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment; ☐
  3) Equal or greater protection against shock loadings and spills; ☐
  4) Equal or greater accessibility and ease of inspection and maintenance. ☐

4.3.6 Hydromodification Control BMP

Use Form 4.3-9 to compute the remaining runoff volume retention, after Site Design BMPs are implemented, needed to address hydromodification, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential hydromodification. Describe the proposed hydromodification treatment control BMP. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-9 Hydromodification Control BMPs (DA 2)

1 Volume reduction needed for hydromodification performance criteria (ft3):

2,135 FROM HYDROGRAPH ANALYSIS

*(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*

2 On-site retention with site design and infiltration, BMP (ft^3):

5,155 REMAINDER FROM FROM 4.3-8 (DA-2)

Form 4.3-8 Items 2, 3, and 4. Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving hydromodification volume reduction

3 Remaining volume for hydromodification volume capture (ft^3): 0 *Item 1 – Item 2*

4 Volume capture provided by incorporating additional on-site BMPs (ft^3): 0

5 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☒

If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site BMP ☒
- Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐

6 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☒

If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site retention BMPs ☒

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance.

Alternative Designs — Facilities, or a combination of facilities, of a different design than in Permit Section E.12.e.(ii)(f) may be permitted if all of the following measures of equivalent effectiveness are demonstrated:

1) Equal or greater amount of runoff infiltrated or evapotranspired;

2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment;

3) Equal or greater protection against shock loadings and spills;

4) Equal or greater accessibility and ease of inspection and maintenance.

The Project Proponent will need to obtain written approval for an alternative design from the Lahontan Regional Water Board Executive Officer (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMPs included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and a Maintenance Agreement. The Maintenance Agreement must also be attached to the WQMP.

Note that at time of Project construction completion, the Maintenance Agreement must be completed, signed, notarized and submitted to the County Stormwater Department

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Infiltration Basin	Owner	Maintain vegetation as needed	Ongoing, before annual storms and following rainfall events
Infiltration Basin (cont)	Owner	Remove debris and litter form entire basin to minimize clogging and improve aesthetics	Ongoing, before annual storms and following rainfall events
Infiltration Basin (cont)	Owner	Check for obvious problems & repair as needed. Address odor, insects, and overgrowth issues associated with stagnant or standing water in basin bottom. There should be no long-term ponding water.	Ongoing, before annual storms and following rainfall events
Infiltration Basin (cont)	Owner	Inspection of hydraulic and structural facilities. Examine the inlet for blockage, the embankment integrity, as well as damage to any structural element.	Annually. If possible schedule these inspections within 72 hours after significant rainfall.

Infiltration Basin (cont)	Owner	Check basin depth for sediment build up and reduced total capacity. Scrape bottom as needed and remove sediment.	Annually. If possible schedule these inspections within 72 hours after significant rainfall.
Infiltration Basin (cont)	Owner	Verify the basin bottom is allowing acceptable infiltration. Use disc or other method to aerate basin bottom only if there is actual significant loss of infiltrative capacity, rather than on a routine basis.	Annually. If possible schedule these inspections within 72 hours after significant rainfall.
Infiltration Trench	Owner	Remove trash and debris. Check for damage and surface standing water. Contact manufacturer for repair recommendations if trench becomes clogged.	Annually, before and after significant rainfall

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

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

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

6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

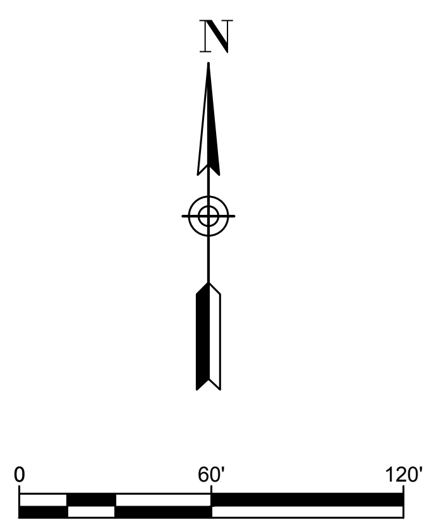
6.3 Post Construction

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction – C,C&R's & Lease Agreements

Attachment 1 - Site Plan and Drainage Plan



LEGEND

🟦	DRAINAGE AREAS
🟥	SITE BOUNDARY
→	FLOW LINE
▨	PROPOSED CONCRETE PAVING AREAS
■	PROPOSED A/C PAVING AREAS
🟦	PROPOSED STRUCTURES
🟩	PROPOSED LANDSCAPING AREAS
DA - 1	INDICATES DRAINAGE AREA NUMBER
6.5 AC	INDICATES ACREAGE OF DRAINAGE AREA
80% IMP.	INDICATES PERCENTAGE OF IMPERVIOUS AREA

DA - 1 COVER INFORMATION:

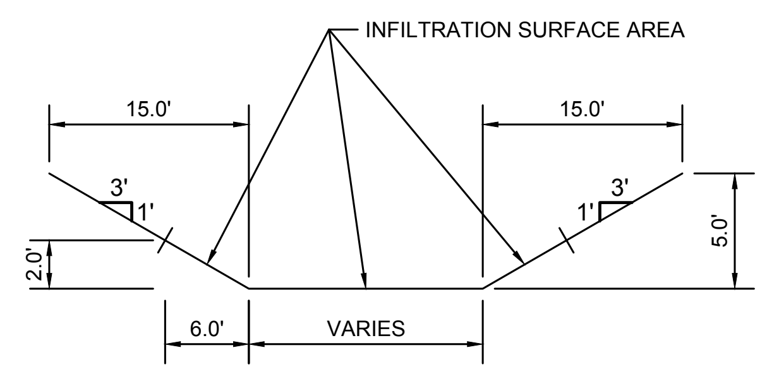
COVER TYPE:	QTY.
ROOF:	199,229 SF.
CONCRETE:	50,695 SF.
ASPHALT:	74,185 SF.
LANDSCAPING:	234,293 SF.
TOTAL:	558,406 S.F.
%IMPERVIOUS:	58.0%
DCV:	17,775 CU.FT.
HCOC:	2,619 CU. FT.
TOTAL:	20,394 CU. FT.
LOT B BASIN VOL.:	20,049 CU. FT.
INFILTRATION TRENCH VOL.:	2,573 CU.FT.

DA - 2 COVER INFORMATION:

COVER TYPE:	QTY.
ROOF:	191,443 SF
CONCRETE:	51,225 SF.
ASPHALT:	77,063 SF.
LANDSCAPING:	212,831 SF.
TOTAL:	532,562 S.F.
%IMPERVIOUS:	60.0%
DCV:	17,585 CU.FT.
HCOC:	2,135 CU. FT.
TOTAL:	19,720 CU. FT.
LOT C BASIN VOL.:	20,909 CU. FT.

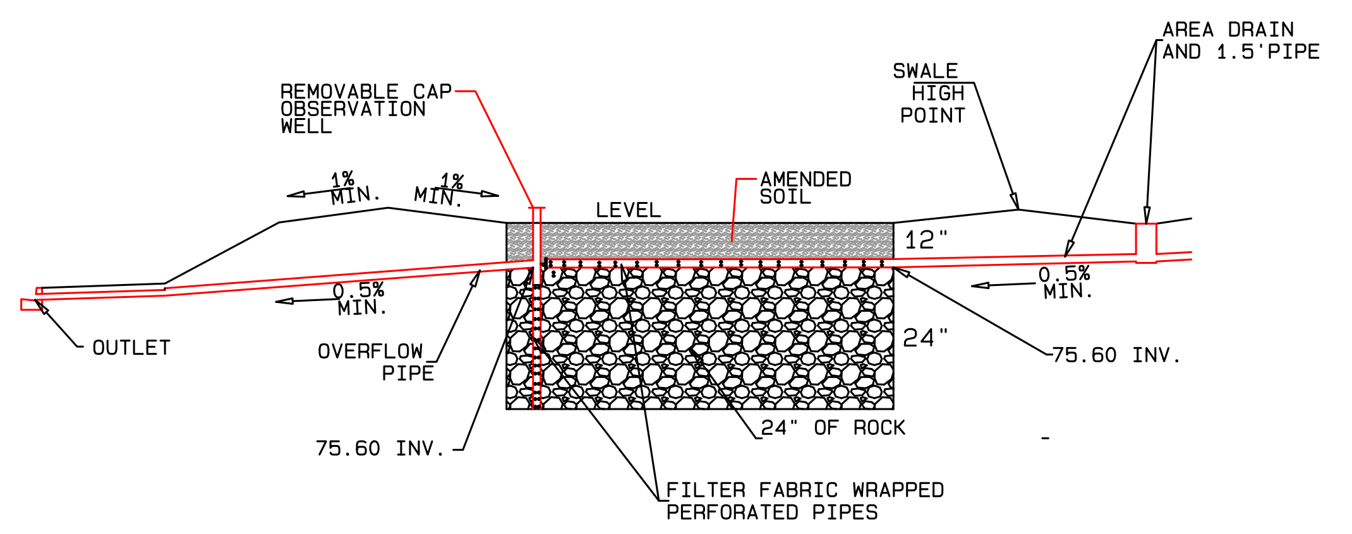
PROPOSED TREATMENT CONTROL BMP'S:

1	INFILTRATION BASIN
2	INFILTRATION TRENCH



INFILTRATION BASIN

N.T.S.



INFILTRATION TRENCH

N.T.S.

PLOT DATE: September 29, 2021

REV.	DESCRIPTION	DATE	BY

Ludwig Engineering ASSOCIATES, INC.
Civil Engineering • Surveying • Planning

109 East Third Street
San Bernardino, CA 92410
Phone: 909-884-8217
Fax: 909-889-0153

5890 Hwy. 95, Ste. B
Fort Mohave, AZ 88426
Phone: 928-768-1857
Fax: 928-768-7086

15252 Seneca Rd.
Victorville, CA 92392
Phone: 760-951-7676
Fax: 760-241-0573

2126 McCulloch Blvd., Ste. 8
Lake Havasu City, AZ 86403
Phone: 928-680-6060
Fax: 928-854-6530

CITY OF VICTORVILLE
WQMP MAP
FROMER TRACK 17486

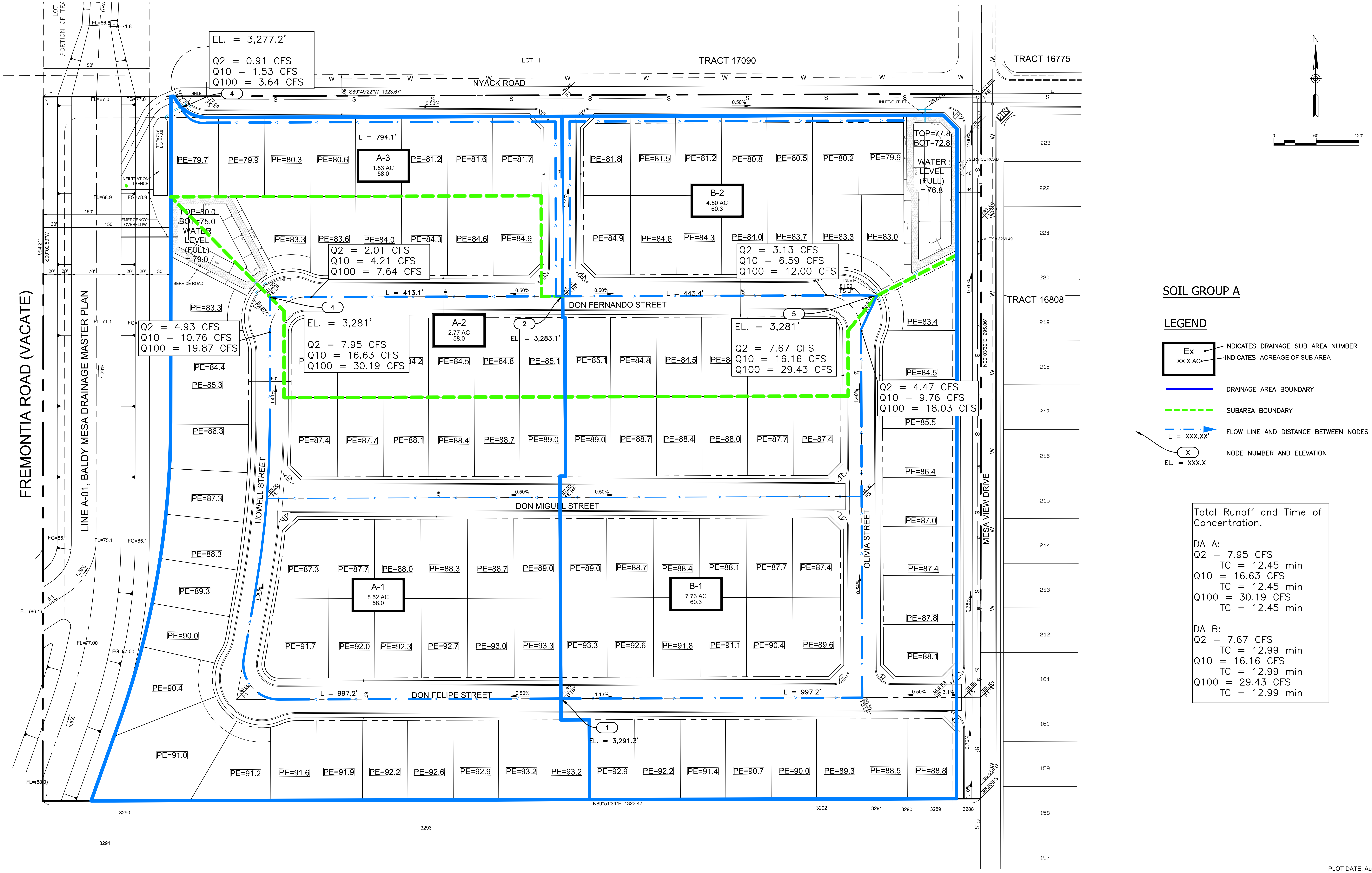
CLIENT:
R.Y. PROPERTIES
212 S. PALM AVE. ALHAMBRA, CA, 91801

DESIGNED BY:	DRAWN BY:	CHECKED BY:
MR	MR	JA

SCALE
1" = 60'

SHEET
1
OF
1

PLOT STYLE: NCS US Standard.stb   PROJECT LOCATION & NAME: V:\plans\TR. 17486 (RY Properties)\engineering\wqmp\TR17486_WQMP_110_Lots.dwg   PLOT TIME: Wednesday, September 29, 2021 1:55:40 PM   LAYOUT: WQMP



Total Runoff and Time of Concentration.

DA A:
Q2 = 7.95 CFS
TC = 12.45 min
Q10 = 16.63 CFS
TC = 12.45 min
Q100 = 30.19 CFS
TC = 12.45 min

DA B:
Q2 = 7.67 CFS
TC = 12.99 min
Q10 = 16.16 CFS
TC = 12.99 min
Q100 = 29.43 CFS
TC = 12.99 min

PLOT DATE: August 31, 2021

REV.	DESCRIPTION	DATE	BY

Ludwig Engineering
ASSOCIATES, INC.
Civil Engineering • Surveying • Planning
109 East Third Street
San Bernardino, CA 92410
Phone: 909-884-8217
Fax: 909-889-0153
5890 Hwy. 95, Ste. B
Fort Mohave, AZ 88426
Phone: 928-768-1857
Fax: 928-768-7086
15252 Seneca Rd.
Victorville, CA 92392
Phone: 760-951-7676
Fax: 760-241-0573
2126 McCulloch Blvd., Ste. 8
Lake Havasu City, AZ 86403
Phone: 928-680-6060
Fax: 928-854-6530

CITY OF VICTORVILLE
DRAINAGE MAP POST DEVELOPMENT
FORMER TRACK 17486

CLIENT:
R.Y. PROPERTIES
212 S. PALM AVE, ALHAMBRA, CA, 91801

DESIGNED BY: MR
DRAWN BY: MR
CHECKED BY: JA

SCALE
1" = 60'

SHEET
1
OF
1

PROJECT LOCATION & NAME: V:\plans\TR 17486 (RY Properties)\engineering\drainage\acad\17486_Drainage_110 Lots.dwg PLOT TIME: Tuesday, August 31, 2021 4:12:38 PM LAYOUT: Drainage Post

PLOT STYLE: Ludwig.stb

Total Runoff and Time of Concentration.

DA A:
Q2 = 0..904 CFS
TC = 27.42 min
Q10 = 4.34 CFS
TC = 24.66 min
Q100 = 9.67 CFS
TC = 23.46 min

DA B:
Q2 = 1.52 CFS
TC = 30.18 min
Q10 = 6.84 CFS
TC = 28.22 min
Q100 = 15.59 CFS
TC = 27.35 min

DA C:
Q2 = 1.56 CFS
TC = 28.18 min
Q10 = 7.64 CFS
TC = 26.05 min
Q100 = 17.07 CFS
TC = 25.13 min

PLOT DATE: August 31, 2021

REV.	DESCRIPTION	DATE	BY

Ludwig Engineering
ASSOCIATES, INC.
Civil Engineering • Surveying • Planning

109 East Third Street
San Bernardino, CA 92410
Phone: 909-884-8217
Fax: 909-889-0153

5890 Hwy. 95, Ste. B
Fort Mohave, AZ 88426
Phone: 928-768-1857
Fax: 928-768-7086

15252 Seneca Rd.
Victorville, CA 92392
Phone: 760-951-7676
Fax: 760-241-0573

2126 McCulloch Blvd., Ste. 8
Lake Havasu City, AZ 86403
Phone: 928-680-6060
Fax: 928-854-6530

CITY OF VICTORVILLE
DRAINAGE PRE-DEVELOPMENT
FORMER TRACK 17486

CLIENT:
R.Y. PROPERTIES
212 S. PALM AVE. ALHAMBRA, CA, 91801

DESIGNED BY: MR
DRAWN BY: MR
CHECKED BY: JA

SCALE
1" = 60'

SHEET
1
OF
1

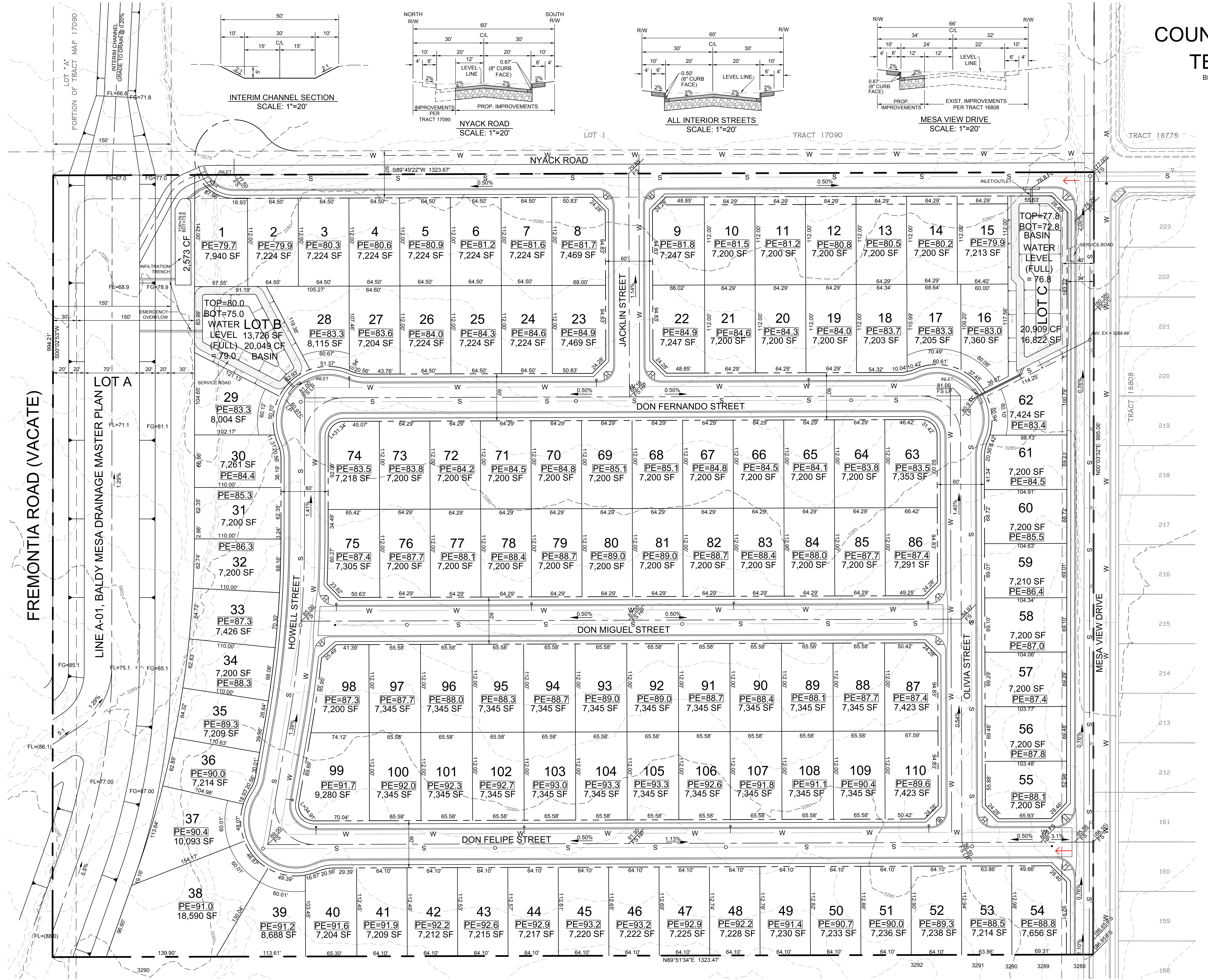
PLOT STYLE: NCS US Standard.stb PROJECT LOCATION & NAME: V:\plans\TR. 17486 (RY Properties)\engineering\drainage\acad\17486_Drainage_110 Lots.dwg PLOT TIME: Tuesday, August 31, 2021 2:17:45 PM LAYOUT: Drainage Pre

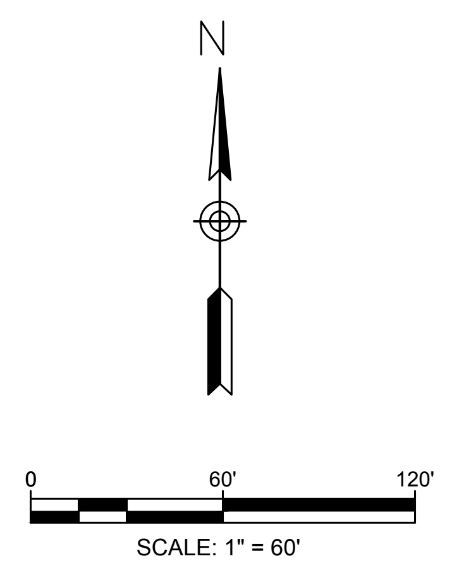
IN THE CITY OF VICTORVILLE, COUNTY OF SAN BERNARDINO, CALIFORNIA

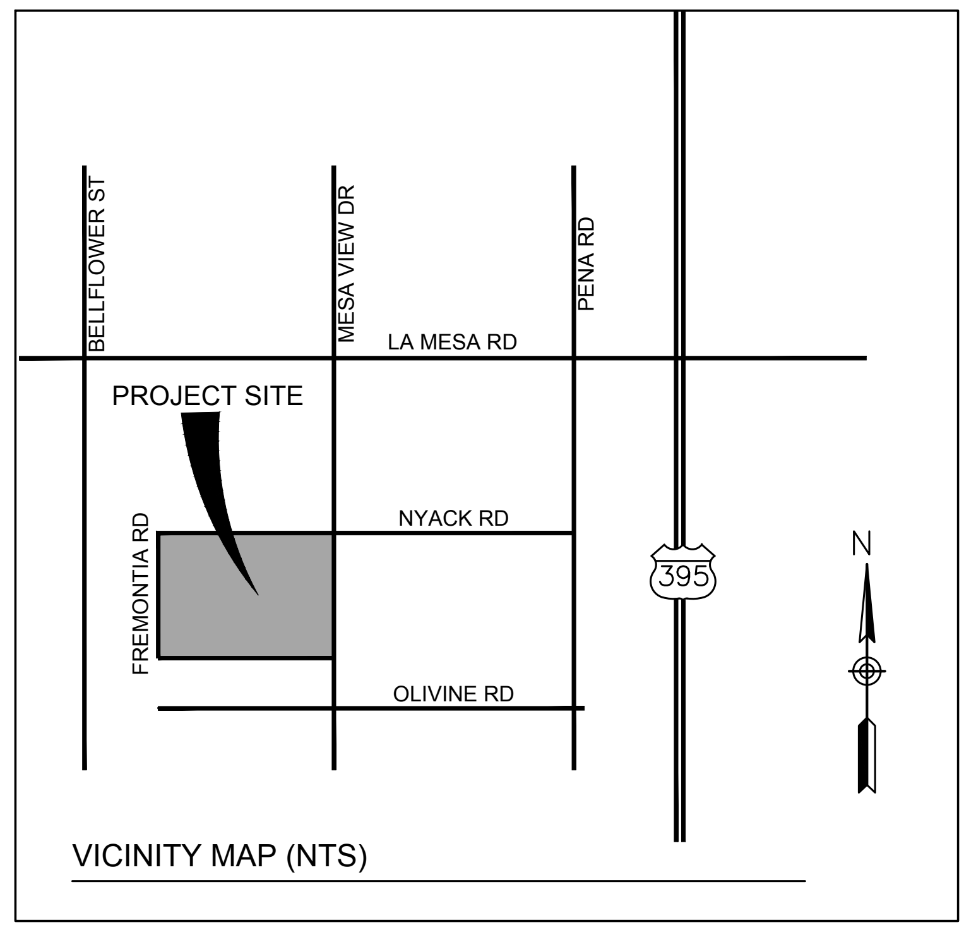
TENTATIVE TRACT MAP NO. 20454

BEING A SUBDIVISION OF PARCELS 1 THROUGH 3, INCLUSIVE OF PARCEL MAP 2188, AS PER MAP
RECORDED IN BOOK 19 OF PARCEL MAPS, PAGE 2

LUDWIG ENGINEERING JUNE 2021







VICINITY MAP (NTS)

OWNER/DEVELOPER

BEDFORD OPPORTUNITY FUND II, LLC
212 S. PALM AVE., SUITE 200
ALHAMBRA, CA 91801
(626)282-3100

ENGINEER

LUDWIG ENGINEERING ASSOCIATES, INC.
109 E. THIRD STREET
SAN BERNARDINO, CA 92410
(909) 884-8217

ASSESSOR'S PARCEL NO.

PARCEL 1: APN 3134-021-05-0-000, 3134-021-06-0-000 AND 3134-021-07-0-000
PARCEL 2: APN 3134-021-02-0-000

ZONING & LAND USE

R-1 (SINGLE-FAMILY RESIDENTIAL)

GENERAL PLAN DESIGNATION

LOW DENSITY RESIDENTIAL

SERVICES

ELECTRICITY	SOUTH. CALIFORNIA EDISON COMPANY 12353 HESPERIA ROAD VICTORVILLE, CA 92392
WATER	VICTORVILLE VALLEY WATER DISTRICT 17185 YUMA STREET VICTORVILLE, CA 92392-5887
SEWER	CITY OF VICTORVILLE 14343 CIVIC DRIVE VICTORVILLE, CA 92392
GAS	SOUTHWEST GAS COMPANY 14950 CIRCLE DRIVE VICTORVILLE, CA 92392
TELEPHONE	VERIZON 16071 MOJAVE DRIVE VICTORVILLE, CA. 92392

AREAS

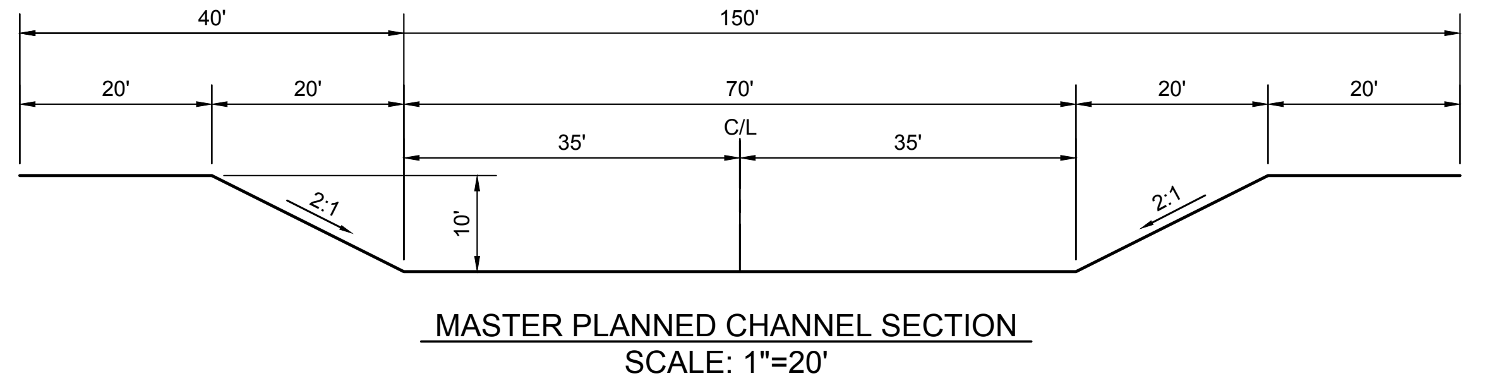
TOTAL ACREAGE: APPROX. 30.22 AC
TOTAL NUMBERED LOTS: 110
UNITS PER ACRE GROSS RES.: 3.64
MINIMUM LOT SIZE RES.: 7,200 SF
TOTAL LETTERED LOTS: 3 (LOT "A" EASEMENT FOR DRAINAGE PURPOSES, LOT B & C RETENTION BASINS)

NOTES

- THIS TRACT CONTAINS 5,644 L.F. OF NEW STREETS.
- UNLESS OTHERWISE INDICATED THE SURROUNDING LAND USE IS "VACANT".
- CONTOUR SOURCE: SAN BERNARDINO COUNTY 2014 LiDAR (NAVD 88) LOWERED TO PROJECT LOCATION FOR (NGVD 29)
- DEVELOPMENT OF SITE WILL HAVE MINIMAL EFFECT ON EXISTING DRAINAGE PATTERNS. STORM WATER RUNOFF WILL FOLLOW EXISTING AND NATURAL DRAINAGE COURSES OR BE CARRIED IN PROPOSED STREETS AND DRAINAGE FACILITIES AS INDICATED ON THE MAP AND OUTLINED IN ACCOMPANYING DRAINAGE STUDY.
- EARTHWORK WILL BE BALANCED ON SITE.

ESTIMATED EARTHWORK QUANTITY: RAW CUT: 76,422 CY RAW FILL: 38,669 CY

- IMPROVEMENTS ARE PER TYPICAL SUBDIVISION AND ARE TO BE BUILT ACCORDING TO CITY OF VICTORVILLE STANDARDS.
- SETBACKS: 20' - FRONT & REAR
  10' - STREET SIDE YARD
  5' - SIDE YARD
- THIS IS A CALCULATED MAP. LOT CLOSURES ARE AVAILABLE. THE DEVELOPER REQUESTS REVIEW FOR COMPLIANCE WITH CURRENT CODES AND POLICIES WITH REGARD TO GEOMETRICS.
- SECONDARY ACCESS TO BE PROVIDED WHERE NECESSARY.
- XX.X INDICATES PAD ELEVATION.



MASTER PLANNED CHANNEL SECTION
SCALE: 1"=20'

LEGEND AND ABBREVIATIONS

▬ ▬ ▬	TRACT BOUNDARY	(80.0)	EXIST. ELEVATIONS	FS	FINISHED SURFACE
— (3280) —	EXIST. CONTOURS			FL	FLOW LINE
— — w —	EXIST. WATER	80.0	PROP. ELEVATIONS	PE	PAD ELEVATION
— — s —	EXIST. SEWER			GB	GRADE BREAK
—— w ——	PROP. WATER	←	FIRE ACCESS TO SITE	HP	HIGH POINT
—— s ——	PROP. SEWER			LP	LOW POINT
		☐	PROP. CATCH BASIN	SF	SQUARE FOOT

REV.	DESCRIPTION	DATE	BY

Ludwig Engineering ASSOCIATES, INC.
Civil Engineering • Surveying • Planning

109 East Third Street
San Bernardino, CA 92410
Phone: 909-884-8217
Fax: 909-889-0153

5890 Hwy. 95, Ste. B
Fort Mohave, AZ 88426
Phone: 928-768-1857
Fax: 928-768-7086

15252 Seneca Rd.
Victorville, CA 92392
Phone: 760-951-7676
Fax: 760-241-0573

2126 McCulloch Blvd., Ste. 8
Lake Havasu City, AZ 86403
Phone: 928-680-6060
Fax: 928-854-6530

CITY OF VICTORVILLE

FORMER TRACT 17486

CLIENT:
RY PROPERTIES
212 S. PALM AVE. ALHAMBRA, CA 91801

SCALE 1" = 60'

SHEET 1 OF 1

DESIGNED BY: KH
DRAWN BY: KH
CHECKED BY: JA

VICINITY MAP

Attachment 2 - Electronic Data Submittal

This is a digital submittal. A separate electronic copy will not be provided.

Attachment 3 - Post Construction

Maintenance Agreement will be signed and notarized when requested by the reviewing agency.

Attachment 4 - Other Supporting Documentation

Track 17486

Looking Northwest from Mesa View Drive and Olivine Road

Track 17486

Looking Southwest from Mesa View Drive and Nyack Road

Track 17486

Looking West from Mesa View Drive

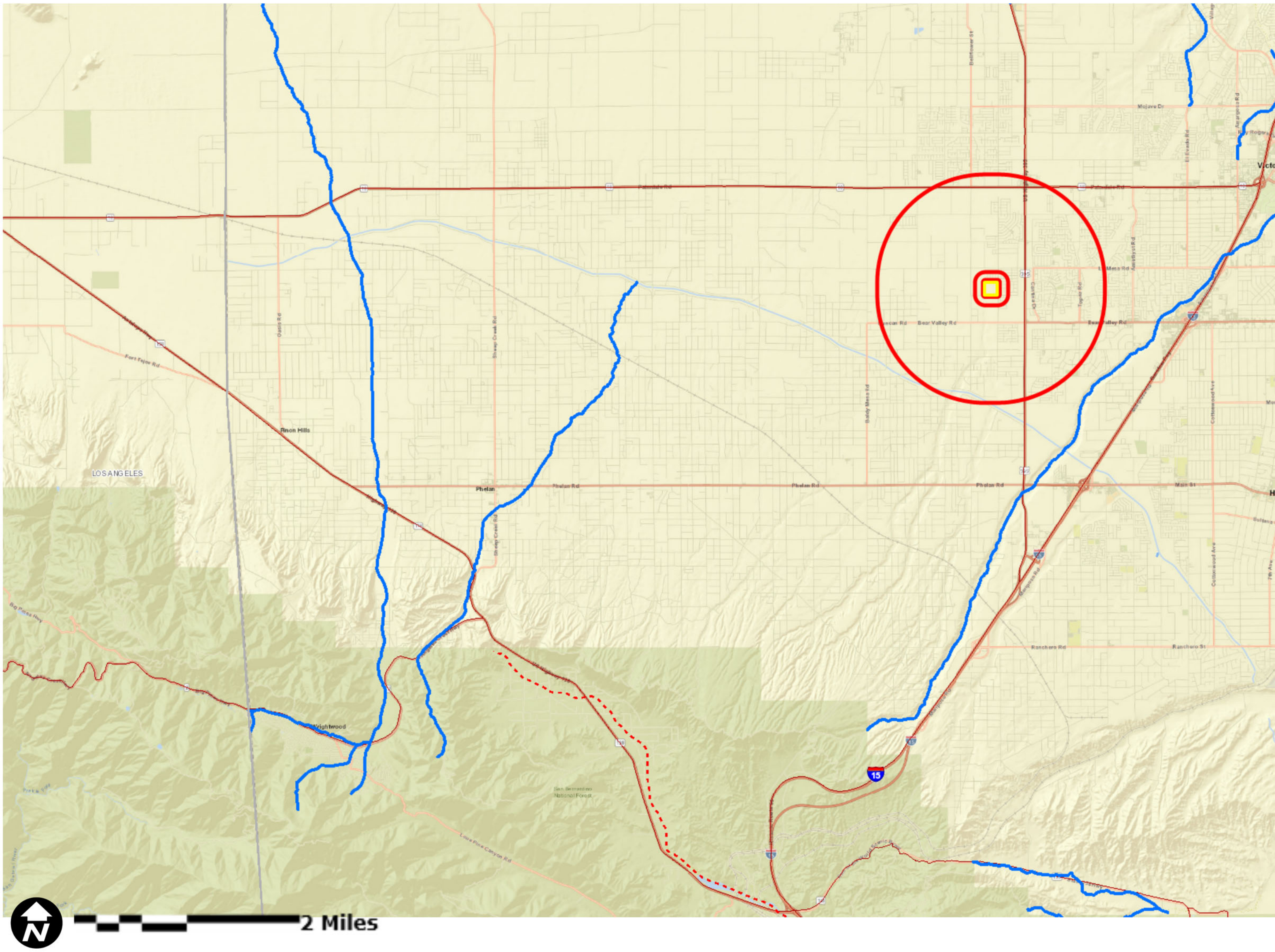
Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)

1 Project Area DA # (sq ft)	**2** Imperviousness after applying preventative site design practices (Impervious %)	**3** Runoff Coefficient (Rc)
558406	58.04	0.394
4 Determine 1-hour rainfall depth for a 2-year return period P2yr-1hr (in) *click for hyperlink*		0.399
Climate Region (C1)	(Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)	1.2371
5 Compute P_6, Mean 6-hr Precipitation (in)		0.49
6 Drawdown Rate (hours) *(48 hours typical)*		48 ▾
7 Compute design capture volume, DCV (cubic feet) *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		**17775.20**

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 2)

1 Project Area DA # (sq ft)	**2** Imperviousness after applying preventative site design practices (Impervious %)	**3** Runoff Coefficient (Rc)
532562	60	0.409

4 Determine 1-hour rainfall depth for a 2-year return period P2yr-1hr (in) *click for hyperlink*		0.399
Climate Region (C1)	(Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)	1.2371
5 Compute P_6, Mean 6-hr Precipitation (in)		0.49
6 Drawdown Rate (hours) *(48 hours typical)*		48 ▾
7 Compute design capture volume, DCV (cubic feet) *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		**17584.65**



Site Address: permitrack.sbcounty.gov/wap

WQMP Project Report

County of San Bernardino Stormwater Program

Santa Ana River Watershed Geodatabase

Tuesday, August 10, 2021

Note: The information provided in this report and on the Stormwater Geodatabase for the County of San Bernardino Stormwater Program is intended to provide basic guidance in the preparation of the applicant's Water Quality Management Plan (WQMP) and should not be relied upon without independent verification.

Project Site Parcel Number(s):	313402108, 313402105, 313402107, 313402106
Project Site Acreage:	36.114
HCOC Exempt Area:	No
Closest Receiving Waters: **(Applicant to verify based on local drainage facilities and topography.)**	**System Number** - See Note **Facility Name** - See Note **Owner** - See Note
Closest channel segment's susceptibility to Hydromodification:	See Note
Highest downstream hydromodification susceptibility:	See Note
Is this drainage segment subject to TMDLs?	See Note
Are there downstream drainage segments subject to TMDLs?	See Note
Is this drainage segment a 303d listed stream?	See Note
Are there 303d listed streams downstream?	See Note
Are there unlined downstream waterbodies?	See Note
Project Site Onsite Soil Group(s):	A
Environmentally Sensitive Areas within 200':	DESERT TORTOISE HABITAT CAT 2
Groundwater Depth (FT):	No data available
Parcels with potential septic tanks within 1000':	No
Known Groundwater Contamination Plumes within 1000':	No
Studies and Reports Related to Project Site:	

Note: No drainage facilities located within 2 miles of site.

Figure ADD-1
Antecedent Moisture Condition (AMC)

5-day Rainfall - NOAA Atlas 14 (50% of Total Rainfall Prior to Peak)*

*1/2 (11-day - 1-day) =
1/2 (([10-day] + (1/10 ([20-day] - [10-day]))) - [1-day])

NOAA Atlas 14, Volume 6, Version 2
Location name: Victorville, California, USA*
Latitude: 34.48°, Longitude: -117.4103°
Elevation: 3286.6 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.078** (0.064-0.095)	**0.112** (0.093-0.137)	**0.158** (0.130-0.194)	**0.195** (0.159-0.241)	**0.245** (0.194-0.314)	**0.284** (0.220-0.371)	**0.324** (0.244-0.433)	**0.364** (0.267-0.501)	**0.419** (0.295-0.601)	**0.462** (0.314-0.685)
10-min	**0.111** (0.092-0.136)	**0.161** (0.133-0.197)	**0.226** (0.186-0.278)	**0.279** (0.228-0.346)	**0.352** (0.278-0.450)	**0.407** (0.315-0.532)	**0.464** (0.350-0.621)	**0.522** (0.383-0.718)	**0.601** (0.423-0.862)	**0.662** (0.450-0.982)
15-min	**0.135** (0.111-0.165)	**0.195** (0.161-0.238)	**0.274** (0.225-0.336)	**0.338** (0.276-0.418)	**0.425** (0.336-0.544)	**0.493** (0.381-0.643)	**0.561** (0.424-0.751)	**0.631** (0.464-0.869)	**0.727** (0.512-1.04)	**0.800** (0.544-1.19)
30-min	**0.204** (0.169-0.249)	**0.295** (0.243-0.361)	**0.414** (0.341-0.508)	**0.511** (0.418-0.632)	**0.643** (0.508-0.823)	**0.745** (0.576-0.973)	**0.849** (0.641-1.14)	**0.955** (0.701-1.31)	**1.10** (0.774-1.58)	**1.21** (0.824-1.80)
60-min	**0.276** (0.228-0.337)	**0.399** (0.330-0.488)	**0.561** (0.462-0.688)	**0.692** (0.565-0.856)	**0.871** (0.688-1.11)	**1.01** (0.781-1.32)	**1.15** (0.868-1.54)	**1.29** (0.949-1.78)	**1.49** (1.05-2.13)	**1.64** (1.12-2.43)
2-hr	**0.388** (0.321-0.474)	**0.528** (0.436-0.646)	**0.718** (0.591-0.881)	**0.878** (0.717-1.09)	**1.10** (0.872-1.41)	**1.28** (0.993-1.68)	**1.47** (1.11-1.97)	**1.67** (1.23-2.30)	**1.95** (1.37-2.79)	**2.17** (1.48-3.22)
3-hr	**0.488** (0.403-0.596)	**0.652** (0.538-0.797)	**0.878** (0.723-1.08)	**1.07** (0.875-1.33)	**1.35** (1.07-1.73)	**1.57** (1.22-2.05)	**1.81** (1.37-2.42)	**2.07** (1.52-2.85)	**2.43** (1.71-3.49)	**2.73** (1.86-4.05)
6-hr	**0.669** (0.553-0.817)	**0.885** (0.731-1.08)	**1.19** (0.980-1.46)	**1.46** (1.19-1.80)	**1.85** (1.46-2.36)	**2.17** (1.68-2.83)	**2.51** (1.90-3.36)	**2.89** (2.12-3.98)	**3.45** (2.43-4.94)	**3.91** (2.66-5.80)
12-hr	**0.834** (0.690-1.02)	**1.15** (0.949-1.41)	**1.60** (1.31-1.96)	**1.98** (1.62-2.45)	**2.55** (2.02-3.26)	**3.02** (2.34-3.95)	**3.53** (2.67-4.73)	**4.09** (3.00-5.63)	**4.90** (3.45-7.03)	**5.58** (3.80-8.29)
24-hr	**1.14** (1.01-1.31)	**1.64** (1.46-1.89)	**2.35** (2.08-2.72)	**2.97** (2.60-3.46)	**3.87** (3.28-4.66)	**4.61** (3.83-5.67)	**5.41** (4.38-6.81)	**6.29** (4.95-8.14)	**7.56** (5.72-10.2)	**8.62** (6.30-12.0)
2-day	**1.23** (1.09-1.41)	**1.76** (1.56-2.02)	**2.51** (2.22-2.90)	**3.17** (2.77-3.69)	**4.13** (3.50-4.98)	**4.94** (4.10-6.07)	**5.82** (4.71-7.33)	**6.78** (5.34-8.78)	**8.20** (6.20-11.1)	**9.39** (6.86-13.1)
3-day	**1.31** (1.16-1.51)	**1.86** (1.65-2.14)	**2.64** (2.33-3.05)	**3.33** (2.92-3.88)	**4.34** (3.68-5.23)	**5.19** (4.31-6.38)	**6.12** (4.96-7.71)	**7.14** (5.63-9.25)	**8.65** (6.54-11.7)	**9.92** (7.24-13.9)
4-day	**1.41** (1.25-1.63)	**1.99** (1.76-2.30)	**2.82** (2.49-3.26)	**3.55** (3.11-4.14)	**4.63** (3.92-5.58)	**5.53** (4.59-6.80)	**6.51** (5.27-8.20)	**7.59** (5.98-9.84)	**9.19** (6.95-12.4)	**10.5** (7.69-14.7)
7-day	**1.54** (1.36-1.77)	**2.15** (1.90-2.47)	**3.01** (2.66-3.48)	**3.77** (3.31-4.40)	**4.89** (4.14-5.89)	**5.81** (4.82-7.15)	**6.81** (5.52-8.58)	**7.91** (6.23-10.2)	**9.52** (7.19-12.8)	**10.9** (7.93-15.2)
10-day	**1.64** (1.46-1.89)	**2.28** (2.02-2.63)	**3.19** (2.82-3.69)	**3.98** (3.49-4.64)	**5.14** (4.36-6.19)	**6.10** (5.06-7.50)	**7.13** (5.78-8.98)	**8.26** (6.51-10.7)	**9.90** (7.48-13.4)	**11.3** (8.23-15.7)
20-day	**1.99** (1.77-2.30)	**2.75** (2.44-3.17)	**3.82** (3.37-4.41)	**4.75** (4.16-5.53)	**6.11** (5.18-7.36)	**7.22** (6.00-8.88)	**8.42** (6.82-10.6)	**9.73** (7.66-12.6)	**11.6** (8.77-15.7)	**13.2** (9.61-18.4)
30-day	**2.34** (2.07-2.69)	**3.20** (2.83-3.68)	**4.41** (3.90-5.10)	**5.47** (4.79-6.38)	**7.02** (5.95-8.45)	**8.29** (6.88-10.2)	**9.65** (7.82-12.2)	**11.1** (8.76-14.4)	**13.2** (10.0-17.9)	**15.0** (10.9-20.9)
45-day	**2.75** (2.44-3.16)	**3.71** (3.28-4.27)	**5.07** (4.48-5.86)	**6.26** (5.48-7.29)	**8.00** (6.78-9.63)	**9.43** (7.82-11.6)	**11.0** (8.87-13.8)	**12.6** (9.93-16.3)	**15.0** (11.3-20.2)	**16.9** (12.4-23.6)
60-day	**3.10** (2.75-3.56)	**4.12** (3.65-4.75)	**5.58** (4.93-6.45)	**6.85** (6.00-7.98)	**8.72** (7.39-10.5)	**10.3** (8.51-12.6)	**11.9** (9.64-15.0)	**13.7** (10.8-17.7)	**16.2** (12.3-21.9)	**18.3** (13.4-25.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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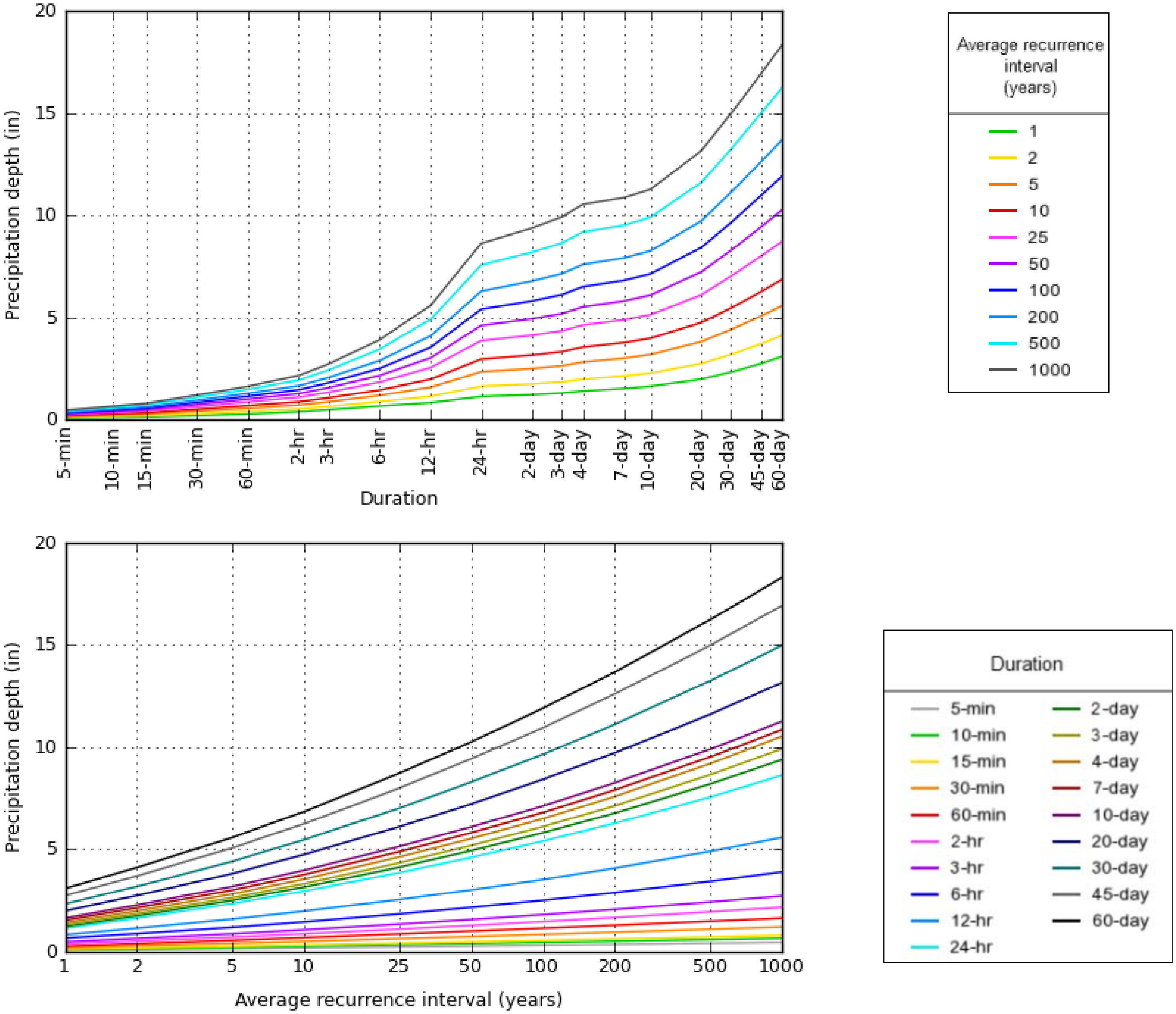
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 34.4800°, Longitude: -117.4103°



NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Thu Aug 5 17:53:58 2021

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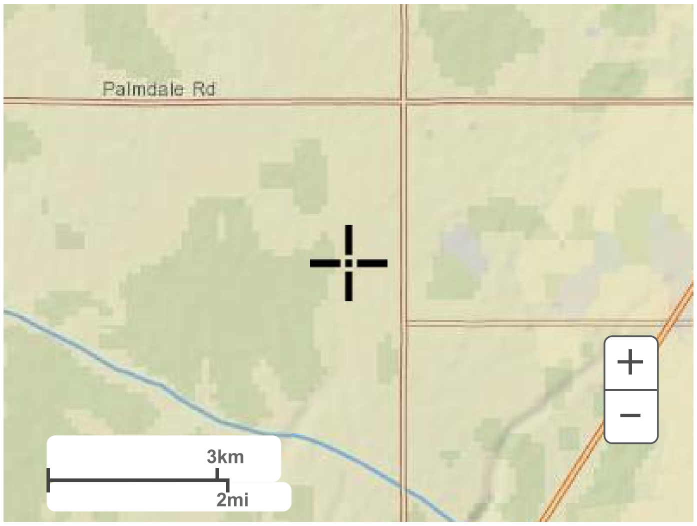
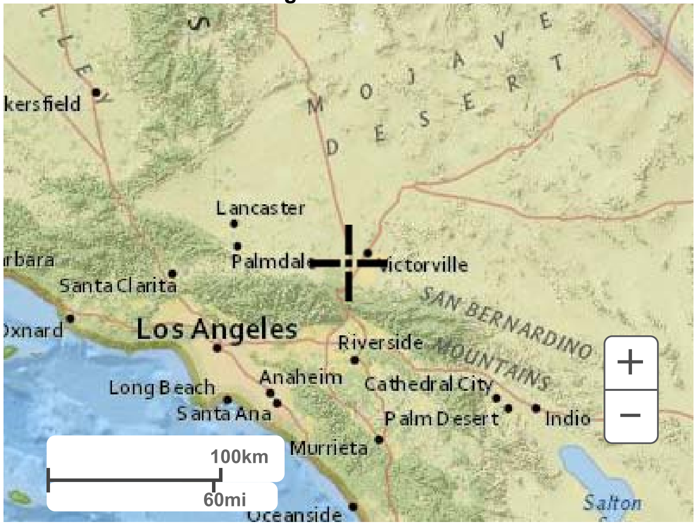
Maps & aerials

Small scale terrain



Large scale terrain



Large scale map

Large scale aerial

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[National Water Center](#)
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

[Disclaimer](#)

Worksheet H: Factor of Safety and Design Infiltration Rate and 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	3	0.75
		Predominant soil texture	0.25	1	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	3	0.75
		Level of pretreatment/ expected sediment loads	0.25	3	0.75
		Redundancy	0.25	3	0.75
		Compaction during construction	0.25	1	0.25
		Design Safety Factor, $S_B = \Sigma p$			2.5

Combined Safety Factor, $S_{TOT} = S_A \times S_B$	4.38
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)	5.95
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT} \times K_M$	1.36

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

A field exploration was conducted by Zeiser Kling Consultants, Inc. in March 2005 and consisted of excavating eight exploratory borings to depths of 6.5 to 55.25 ft. This exploration did not encounter any groundwater.

Infiltration rate was determined from a NRCS Custom Soil Resource Report.

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

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for
San Bernardino County, California, Mojave River Area

August 6, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:2,690 if printed on A portrait (8.5" x 11") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
Area of Interest (AOI)

Soils
Soil Map Unit Polygons
Soil Map Unit Lines
Soil Map Unit Points

Special Point Features
Blowout
Borrow Pit
Clay Spot
Closed Depression
Gravel Pit
Gravelly Spot
Landfill
Lava Flow
Marsh or swamp
Mine or Quarry
Miscellaneous Water
Perennial Water
Rock Outcrop
Saline Spot
Sandy Spot
Severely Eroded Spot
Sinkhole
Slide or Slip
Sodic Spot
Spoil Area
Stony Spot
Very Stony Spot
Wet Spot
Other
Special Line Features

Water Features
Streams and Canals

Transportation
Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background
Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 12, May 27, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 26, 2019—Jul 8, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
112	CAJON SAND, 0 TO 2 PERCENT SLOPES	33.3	100.0%
Totals for Area of Interest		**33.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Bernardino County, California, Mojave River Area

112—CAJON SAND, 0 TO 2 PERCENT SLOPES

Map Unit Setting

National map unit symbol: hkrj
Elevation: 1,800 to 3,200 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 180 to 290 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Cajon and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cajon

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite sources

Typical profile

H1 - 0 to 7 inches: sand
H2 - 7 to 25 inches: sand
H3 - 25 to 45 inches: gravelly sand
H4 - 45 to 60 inches: stratified sand to loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R030XF012CA - Sandy
Hydric soil rating: No

Minor Components

Helendale

Percent of map unit: 5 percent

Manet

Percent of map unit: 5 percent
Landform: Playas
Hydric soil rating: Yes

Kimberlina

Percent of map unit: 5 percent

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Site Design & Landscape Planning SD-10

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

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Designing New Installations

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

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.

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

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

Conserve Natural Areas during Landscape Planning

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

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.

- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.

- Promote natural vegetation by using parking lot islands and other landscaped areas.

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.

- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

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

Protection of Slopes and Channels during Landscape Design

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

Redeveloping Existing Installations

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

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

Other Resources

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

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

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

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

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

Efficient Irrigation SD-12

Design Objectives

☑ Maximize Infiltration

☑ Provide Retention

☑ Slow Runoff

Minimize Impervious Land Coverage

Prohibit Dumping of Improper Materials

Contain Pollutants

Collect and Convey

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Other Resources

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

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

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

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

Storm Drain Signage SD-13

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Placement

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

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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

Trash Storage Areas SD-32

Description

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

Approach

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

Design Objectives

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

Suitable Applications

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

Design Considerations

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

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

Designing New Installations

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

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

- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Other Resources

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

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

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

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Trash Storage Areas SD-32

Design Objectives

Maximize Infiltration

Provide Retention

Slow Runoff

Minimize Impervious Land Coverage

Prohibit Dumping of Improper Materials

☑ Contain Pollutants

Collect and Convey

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

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

Designing New Installations

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

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

- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Other Resources

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

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

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

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

Waste Handling & Disposal SC-34

Objectives

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

Description

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

Targeted Constituents

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

Approach

Pollution Prevention

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

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Suggested Protocols

General

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.

- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.

- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.

- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.

- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.

- Transfer waste from damaged containers into safe containers.

- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

Controlling Litter

- Post “No Littering” signs and enforce anti-litter laws.

- Provide a sufficient number of litter receptacles for the facility.

- Clean out and cover litter receptacles frequently to prevent spillage.

Waste Collection

- Keep waste collection areas clean.

- Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.

- Secure solid waste containers; containers must be closed tightly when not in use.

- Do not fill waste containers with washout water or any other liquid.

- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc., may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

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

Good Housekeeping

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

Chemical/Hazardous Wastes

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

Run-on/Runoff Prevention

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

Inspection

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

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

Training

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

Spill Response and Prevention

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

Other Considerations (Limitations and Regulations)

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

Requirements

Costs

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

Maintenance

- None except for maintaining equipment for material tracking program.

Supplemental Information

Further Detail of the BMP

Land Treatment System

Minimize runoff of polluted stormwater from land application by:

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

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

Examples

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

References and Resources

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

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

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

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

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

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

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

Building & Grounds Maintenance SC-41

Objectives

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

Targeted Constituents

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

Description

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

Approach

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

Pollution Prevention

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

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

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

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

Landscaping Activities

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

Building Repair, Remodeling, and Construction

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

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.

- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures when soils are exposed.

- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.

- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.

- Do not use pesticides if rain is expected.

- Do not mix or prepare pesticides for application near storm drains.

- Use the minimum amount needed for the job.

- Calibrate fertilizer distributors to avoid excessive application.

- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.

- Apply pesticides only when wind speeds are low.

- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.

- Irrigate slowly to prevent runoff and then only as much as is needed.

- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.

- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.

- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

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

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.

- Train employees and contractors in proper techniques for spill containment and cleanup.

- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.

- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.

- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.

- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.

- Clean up spills immediately.

Other Considerations

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

Requirements

Costs

- Cost will vary depending on the type and size of facility.

- Overall costs should be low in comparison to other BMPs.

Maintenance

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

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

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

References and Resources

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

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

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

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

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

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

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

Parking/Storage Area Maintenance SC-43

Description

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

Approach

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

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)

- Keep accurate maintenance logs to evaluate BMP implementation.

Objectives

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

Targeted Constituents

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

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Suggested Protocols

General

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

Controlling Litter

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

Surface Cleaning

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

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

Surface Repair

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

Inspection

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

Training

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

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

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

Requirements

Costs

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

Maintenance

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

Supplemental Information

Further Detail of the BMP

Surface Repair

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

References and Resources

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

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

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

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

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

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

Landscape Maintenance SC-73

Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

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

Description

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

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.

- Choose low water using flowers, trees, shrubs, and groundcover.

- Consider alternative landscaping techniques such as naturescaping and xeriscaping.

- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

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

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.

- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.

- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.

- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.

- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).

- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.

- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.

- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

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

Irrigation

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

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
    - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
    - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
    - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
    - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
    - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
    - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
    - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).

- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).

- Do not mix or prepare pesticides for application near storm drains.

- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.

- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.

- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.

- Calibrate fertilizer and pesticide application equipment to avoid excessive application.

- Periodically test soils for determining proper fertilizer use.

- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.

- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).

- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.

- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

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

- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.

- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.

- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

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

- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup

- Have spill cleanup materials readily available and in a know in location

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.

- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.

- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

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

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

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

Contractors and Other Pesticide Users

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

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Drainage System Maintenance SC-74

Photo Credit: Geoff Brosseau

Objectives

- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

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

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Description

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

Approach

Suggested Protocols

Catch Basins/Inlet Structures

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

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

Storm Drain Conveyance System

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

Pump Stations

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

Open Channel

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

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

Illicit Connections and Discharges

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

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, “midnight dumping” from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post “No Dumping” signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).

- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.

- Only properly trained individuals are allowed to handle hazardous materials/wastes.

- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.

- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.

- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

Spill Response and Prevention

- Refer to SC-11, Prevention, Control & Cleanup

- Have spill cleanup materials readily available and in a known location.

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.

- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.

- Regulations may include adoption of substantial penalties for illegal dumping and disposal.

- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

- Private property access rights may be needed to track illegal discharges up gradient.

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

Requirements

Costs

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

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

Maintenance

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

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

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

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

Supplemental Information

Further Detail of the BMP

Storm Drain flushing

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

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

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

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

Flow Management

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

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

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

Stream Corridor Planning

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

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

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

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

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

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

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

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

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

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

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

Examples

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

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

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

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Infiltration Trench

TC-10

Design Considerations

- Accumulation of Metals
- Clogged Soil Outlet Structures
- Vegetation/Landscape Maintenance

Description

An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. Runoff is stored in the void space between the stones and infiltrates through the bottom and into the soil matrix. Infiltration trenches perform well for removal of fine sediment and associated pollutants. Pretreatment using buffer strips, swales, or detention basins is important for limiting amounts of coarse sediment entering the trench which can clog and render the trench ineffective.

California Experience

Caltrans constructed two infiltration trenches at highway maintenance stations in Southern California. Of these, one failed to operate to the design standard because of average soil infiltration rates lower than that measured in the single infiltration test. This highlights the critical need for appropriate evaluation of the site. Once in operation, little maintenance was required at either site.

Advantages

- Provides 100% reduction in the load discharged to surface waters.
- An important benefit of infiltration trenches is the approximation of pre-development hydrology during which a significant portion of the average annual rainfall runoff is infiltrated rather than flushed directly to creeks.
- If the water quality volume is adequately sized, infiltration trenches can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

Targeted Constituents

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

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

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- As an underground BMP, trenches are unobtrusive and have little impact of site aesthetics.

Limitations

- Have a high failure rate if soil and subsurface conditions are not suitable.
- May not be appropriate for industrial sites or locations where spills may occur.
- The maximum contributing area to an individual infiltration practice should generally be less than 5 acres.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.
- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- Upstream drainage area must be completely stabilized before construction.
- Difficult to restore functioning of infiltration trenches once clogged.

Design and Sizing Guidelines

- Provide pretreatment for infiltration trenches in order to reduce the sediment load. Pretreatment refers to design features that provide settling of large particles before runoff reaches a management practice, easing the long-term maintenance burden. Pretreatment is important for all structural stormwater management practices, but it is particularly important for infiltration practices. To ensure that pretreatment mechanisms are effective, designers should incorporate practices such as grassed swales, vegetated filter strips, detention, or a plunge pool in series.
- Specify locally available trench rock that is 1.5 to 2.5 inches in diameter.
- Determine the trench volume by assuming the WQV will fill the void space based on the computed porosity of the rock matrix (normally about 35%).
- Determine the bottom surface area needed to drain the trench within 72 hr by dividing the WQV by the infiltration rate.

$$d = \frac{WQV + RFV}{SA}$$

- Calculate trench depth using the following equation:

where:

D = Trench depth

WQV = Water quality volume

RFV = Rock fill volume

SA = Surface area of the trench bottom

- The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).
- Provide observation well to allow observation of drain time.
- May include a horizontal layer of filter fabric just below the surface of the trench to retain sediment and reduce the potential for clogging.

Construction/Inspection Considerations

Stabilize the entire area draining to the facility before construction begins. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction. Stabilize the entire contributing drainage area before allowing any runoff to enter once construction is complete.

Performance

Infiltration trenches eliminate the discharge of the water quality volume to surface receiving waters and consequently can be considered to have 100% removal of all pollutants within this volume. Transport of some of these constituents to groundwater is likely, although the attenuation in the soil and subsurface layers will be substantial for many constituents.

Infiltration trenches can be expected to remove up to 90 percent of sediments, metals, coliform bacteria and organic matter, and up to 60 percent of phosphorus and nitrogen in the infiltrated runoff (Schueler, 1992). Biochemical oxygen demand (BOD) removal is estimated to be between 70 to 80 percent. Lower removal rates for nitrate, chlorides and soluble metals should be expected, especially in sandy soils (Schueler, 1992). Pollutant removal efficiencies may be improved by using washed aggregate and adding organic matter and loam to the subsoil. The stone aggregate should be washed to remove dirt and fines before placement in the trench. The addition of organic material and loam to the trench subsoil may enhance metals removal through adsorption.

Siting Criteria

The use of infiltration trenches may be limited by a number of factors, including type of native soils, climate, and location of groundwater table. Site characteristics, such as excessive slope of the drainage area, fine-grained soil types, and proximate location of the water table and bedrock, may preclude the use of infiltration trenches. Generally, infiltration trenches are not suitable for areas with relatively impermeable soils containing clay and silt or in areas with fill.

As with any infiltration BMP, the potential for groundwater contamination must be carefully considered, especially if the groundwater is used for human consumption or agricultural purposes. The infiltration trench is not suitable for sites that use or store chemicals or hazardous materials unless hazardous and toxic materials are prevented from entering the trench. In these areas, other BMPs that do not allow interaction with the groundwater should be considered.

The potential for spills can be minimized by aggressive pollution prevention measures. Many municipalities and industries have developed comprehensive spill prevention control and countermeasure (SPCC) plans. These plans should be modified to include the infiltration trench and the contributing drainage area. For example, diversion structures can be used to prevent spills from entering the infiltration trench. Because of the potential to contaminate groundwater, extensive site investigation must be undertaken early in the site planning process to establish site suitability for the installation of an infiltration trench.

Longevity can be increased by careful geotechnical evaluation prior to construction and by designing and implementing an inspection and maintenance plan. Soil infiltration rates and the water table depth should be evaluated to ensure that conditions are satisfactory for proper operation of an infiltration trench. Pretreatment structures, such as a vegetated buffer strip or water quality inlet, can increase longevity by removing sediments, hydrocarbons, and other materials that may clog the trench. Regular maintenance, including the replacement of clogged aggregate, will also increase the effectiveness and life of the trench.

Evaluation of the viability of a particular site is the same as for infiltration basins and includes:

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

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

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

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

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

Secondary Screening Based on Site Geotechnical Investigation

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

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

- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.
- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Maintenance

Infiltration trenches required the least maintenance of any of the BMPs evaluated in the Caltrans study, with approximately 17 field hours spent on the operation and maintenance of each site. Inspection of the infiltration trench was the largest field activity, requiring approximately 8 hr/yr.

In addition to reduced water quality performance, clogged infiltration trenches with surface standing water can become a nuisance due to mosquito breeding. If the trench takes more than 72 hours to drain, then the rock fill should be removed and all dimensions of the trench should be increased by 2 inches to provide a fresh surface for infiltration.

Cost

Construction Cost

Infiltration trenches are somewhat expensive, when compared to other stormwater practices, in terms of cost per area treated. Typical construction costs, including contingency and design costs, are about \$5 per ft^3 of stormwater treated (SWRPC, 1991; Brown and Schueler, 1997). Actual construction costs may be much higher. The average construction cost of two infiltration trenches installed by Caltrans in southern California was about \$50/ft^3; however, these were constructed as retrofit installations.

Infiltration trenches typically consume about 2 to 3 percent of the site draining to them, which is relatively small. In addition, infiltration trenches can fit into thin, linear areas. Thus, they can generally fit into relatively unusable portions of a site.

Maintenance Cost

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly sited or maintained, infiltration trenches have a high failure rate. In general, maintenance costs for infiltration trenches are estimated at between 5 percent and 20 percent of the construction cost. More realistic values are probably closer to the 20-percent range, to ensure long-term functionality of the practice.

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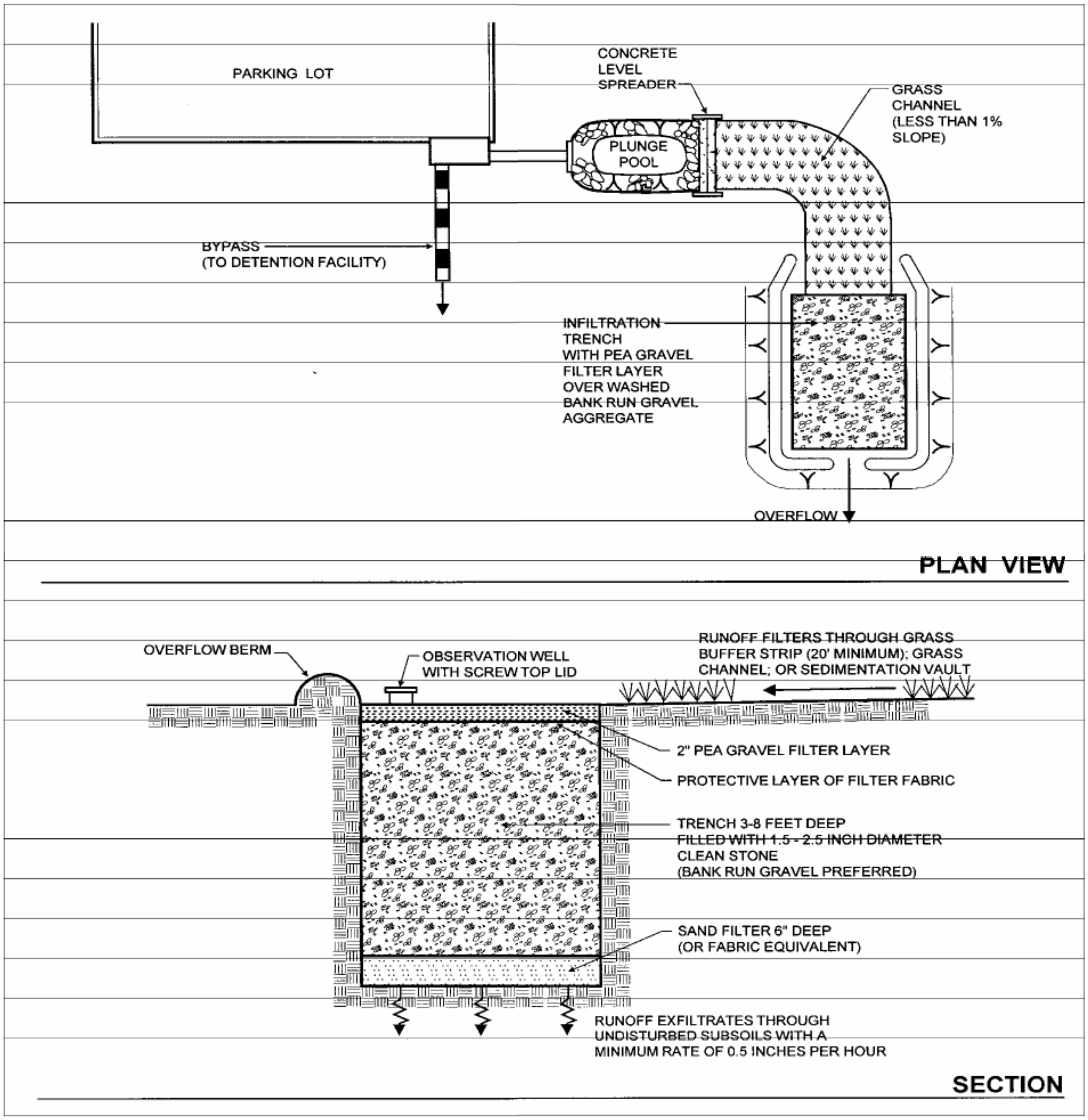
PARKING LOT
CONCRETE LEVEL SPREADER
GRASS CHANNEL (LESS THAN 1% SLOPE)
PLUNGE POOL
BYPASS (TO DETENTION FACILITY)
INFILTRATION TRENCH WITH PEA GRAVEL FILTER LAYER OVER WASHED BANK RUN GRAVEL AGGREGATE
OVERFLOW
PLAN VIEW
OVERFLOW BERM
OBSERVATION WELL WITH SCREW TOP LID
RUNOFF FILTERS THROUGH GRASS BUFFER STRIP (20' MINIMUM); GRASS CHANNEL; OR SEDIMENTATION VAULT
2" PEA GRAVEL FILTER LAYER
PROTECTIVE LAYER OF FILTER FABRIC
TRENCH 3-8 FEET DEEP FILLED WITH 1.5 - 2.5 INCH DIAMETER CLEAN STONE (BANK RUN GRAVEL PREFERRED)
SAND FILTER 6" DEEP (OR FABRIC EQUIVALENT)
RUNOFF EXFILTRATES THROUGH UNDISTURBED SUBSOILS WITH A MINIMUM RATE OF 0.5 INCHES PER HOUR
SECTION

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

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

Limitations

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

Design and Sizing Guidelines

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

Construction/Inspection Considerations

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

Performance

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

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

Siting Criteria

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

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

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

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

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

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

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

Secondary Screening Based on Site Geotechnical Investigation

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

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

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

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

Additional Design Guidelines

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

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

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

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

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

where A = Basin invert area (m^2)

WQV = water quality volume (m^3)

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

t = drawdown time (48 hr)

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

Maintenance

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

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

Cost

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

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

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

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Stormwater Pollution Prevention

Best Management Practices for Homeowner's Associations, Property Managers and Property Owners

San
Bernardino
County
STORMWATER PROGRAM

Your Guide To Maintaining Water Friendly Standards In Your Community

sbcountystormwater.org

Big Bear · Chino · Chino Hills · Colton · Fontana · Grand Terrace · Highland · Loma Linda · Montclair · Ontario · Rancho Cucamonga
Redlands · Rialto · San Bernardino · San Bernardino County · San Bernardino County Flood Control District · Upland · Yucaipa

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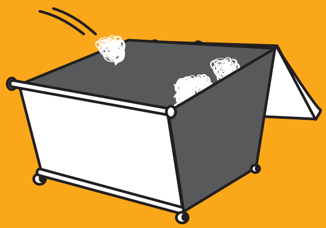
COMMERCIAL TRASH ENCLOSURES

FOLLOW THESE **REQUIREMENTS** TO **KEEP OUR WATERWAYS CLEAN**

Trash enclosures, such as those found in commercial and apartment complexes, typically contain materials that are intended to find their way to a landfill or a recycling facility. **These materials are NOT meant to go into our local lakes and rivers.**

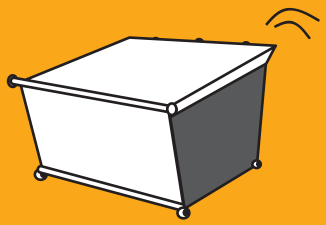
PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

PUT TRASH INSIDE



Place trash inside the bin (preferably in sealed bags)

CLOSE THE LID



Prevent rain from entering the bin in order to avoid leakage of polluted water runoff

KEEP TOXICS OUT

- Paint
- Grease, fats and used oils
- Batteries, electronics and fluorescent lights

SOME ADDITIONAL GUIDELINES, INCLUDE

✓ **SWEEP FREQUENTLY**

Sweep trash enclosure areas frequently, instead of hosing them down, to prevent polluted water from flowing into the streets and storm drains.

✓ **FIX LEAKS**

Address trash bin leaks immediately by using dry clean up methods and report to your waste hauler to receive a replacement.

✓ **CONSTRUCT ROOF**

Construct a solid cover roof over the existing trash enclosure structure to prevent rainwater from coming into contact with trash and garbage. Check with your local City/County for Building Codes.

In San Bernardino County, stormwater pollution is caused by food waste, landscape waste, chemicals and other debris that are washed into storm drains and end up in our waterways - untreated! You can be part of the solution by maintaining a water-friendly trash enclosure.

THANK YOU FOR HELPING TO KEEP SAN BERNARDINO COUNTY CLEAN AND HEALTHY!

San Bernardino County STORMWATER PROGRAM

In the event of a spill or discharge to a storm drain or waterway, contact San Bernadino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

sbcountystormwater.org

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HAZARDOUS WASTE

CESQG PROGRAM

Conditionally Exempt Small Quantity Generator

WHAT IS A CESQG?

Businesses that generate 27 gallons or 220 lbs. of hazardous waste, or 2.2 lbs. of extremely hazardous waste per month are called "Conditionally Exempt Small Quantity Generators," or CESQGs. San Bernardino County Household Hazardous Program provides waste management services to CESQG businesses. The most common CESQGs in San Bernardino County are painters, print shops, auto shops, builders, agricultural operators and property managers, but there are many others. When you call, be ready to describe the types and amounts of waste your business generates in a typical month. If you generate hazardous waste on a regular basis, you must:

- Register with San Bernardino County Fire Department (909) 386-8401 as a hazardous waste generator.
- To obtain an EPA ID# and application form from the State visit www.dtsc.ca.gov.
- Manage hazardous waste in accordance with all applicable local, state and federal laws and regulations.

HOW DO I GET SERVICE?

To arrange an appointment for the CESQG Program, call 1-800-OILY CAT or 909-382-5401. Be ready to describe the type and amount of hazardous waste your business is ready to dispose of, and the types and size(s) of containers that the waste is in.

Waste Type and Cost

There is a small handling fee involved in the collection of hazardous waste from your business. Disposal costs depend on the type of waste.

Aerosols	$1.29/lb.
Automobile motor oil	$.73/gal.
Anti-freeze	$1.57/gal.
Contaminated oil	$4.48/gal.
Car batteries	$.62/ea.
Corrosive liquids, solids	$2.80/lb.
Flammable solids, liquids	$1.57/lb.
Latex Paint	$.73/lb.
Mercury	$10.08/lb.
NiCad/Alkaline Batteries	$2.13/lb.
Oil Base Paints	$1.00/lb.
Oil Filters	$.56/ea.
Oxidizers	$9.63/lb.
PCB Ballasts	$5.94/lb.
Pesticides (most)	$2.91/lb.
Photofixer, developer	$4.31/gal.
Television & Monitors	$11.20/ea.
Additional Handling	$138.00/hr.

Rates subject to change without notice

WE CANNOT ACCEPT

- Radioactives
- Water reactives
- Explosives
- Compressed gas cylinders
- Medical or biohazardous waste
- Asbestos
- Remediation wastes

HAZARDOUS WASTE

WHY IS THE FIRE DEPARTMENT COLLECTING HAZARDOUS WASTE?

Small Quantity Generators often have difficulty disposing of small quantities of hazardous waste. Hazardous waste companies usually have a minimum amount of waste that they will pick up, or charge a minimum fee for service. Typically, the minimum fee exceeds the cost of disposal for the hazardous waste. This leaves the small quantity generator in a difficult situation. Some respond by storing hazardous waste until it becomes economical for the hazardous waste transporter to pick it up, putting the business out of compliance by exceeding regulatory accumulation time limits. Other businesses simply store their hazardous wastes indefinitely, creating an unsafe work environment and exceeding accumulation time limits. Yet other businesses attempt to illegally dispose of their waste at household hazardous waste collection facilities. These facilities are not legally permitted to accept commercial wastes, nor are prepared to provide legal documentation for commercial hazardous waste disposal. In answer to the problems identified above, the San Bernardino County Fire Department Household Hazardous Program instituted the Conditionally Exempt Small Quantity Generator Program.

PAYMENT FOR SERVICES

The CESQG Program will prepare an invoice for your business at the time of service. You can pay at the time of service with cash or a check, or you can mail your payment to the Fire Department within 30 days. Please note that we do not accept credit card payments. The preferred method of payment is to handle payment at time of service. Additional charges may apply for accounts not paid within 30 days.

ARE THERE ANY OTHER WAYS THAT I CAN SAVE MONEY ON HAZARDOUS WASTE DISPOSAL?

Yes! First, start by reducing the amount of waste that you produce by changing processes or process chemicals, at your business. Next, examine if there is a way that you can recycle your waste back into your processes. Network with similar businesses or trade associations for waste minimization and pollution prevention solutions.

WHAT IF YOUR BUSINESS DOES NOT QUALIFY?

Call the San Bernardino County Fire Department Field Services Division for assistance with hazardous waste management at 909-386-8401. If you reduce the amount of waste you generate each month to 27 gallons or less, you may qualify in the future.

WHAT HAPPENS TO YOUR HAZARDOUS WASTE?

Hazardous waste collected by the CESQG Program is transported to a state permitted processing facility in San Bernardino. The waste is further processed at this point and packaged for off-site recycling (oil filters, oil, latex paint, antifreeze, and batteries) or destructive incineration (pesticides, corrosives, flammables, oil based paint).

San Bernardino County Fire Department
CESQG Program
2824 East "W" Street
San Bernardino, CA 92415-0799
Phone: 909-382-5401
Fax: 909-382-5413
www.sbcfire.org/hazmat/hhw.asp
Email: jschwab@sbcfire.org

WORKING OUTDOORS & HANDLING SPILLS

WHEN WORKING OUTDOORS USE THE 3Cs

CUANDO TRABAJE AL AIRE LIBRE UTILICE LAS 3Cs

CONTROL | CONTROL

Locate the nearest storm drain and ensure nothing can enter or be discharged into it.

Ubique el desagüe de aguas pluviales más cercano y asegúrese de que nada pueda ingresar a éste ni descargarse en él.

CONTAIN | CONTENER

Isolate your area to prevent material from potentially flowing or being blown away.

Aísle su área para evitar que el material pueda discurrirse o ser llevado por el viento.

CAPTURE | CAPTURAR

Sweep up debris and place it in the trash. Clean up spills with an absorbent material (e.g. kitty litter) or vacuum with a Wet-Vac and dispose of properly.

Recoja los restos y colóquelos en la basura. Limpie los derrames con un material absorbente (como la arena para gatos) o aspírelos con una Wet-Vac (aspiradora de humedad) y deséchelos correctamente.

In the event of a spill or discharge to a storm drain or waterway, contact San Bernadino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

sbcountystormwater.org

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COMMERCIAL LANDSCAPE

DISCHARGE TO THE STORM DRAIN, **ACCIDENTAL OR NOT**, COULD LEAD TO ENFORCEMENT ACTIONS, WHICH COULD INCLUDE FINES.

Follow the best practices below to **prevent water pollution from landscaping activities.**

RECYCLE YARD WASTE

- ✓ Recycle leaves, grass clippings and other yard waste.
- ✓ Do not blow, sweep, rake or hose yard waste into the street or catch basin.
- ✓ **Try grasscycling:** the natural recycling of grass by leaving clippings on the lawn when mowing.

For more information, please visit: **www.calrecycle.ca.gov/organics/grasscycling**

USE FERTILIZERS, HERBICIDES AND PESTICIDES SAFELY

- ✓ Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural and non-toxic alternatives as often as possible.
- ✓ If you must use chemical fertilizers, herbicides or pesticides:
  - Spot apply, rather than blanketing entire areas.
  - Avoid applying near curbs and driveways, and **never** before a rain.
  - Apply fertilizers as needed: when plants could best use it and when the potential runoff would be low.
  - Follow the manufacturer's instructions carefully—this will not only give the best results, but will save money.

USE WATER WISELY

- ✓ Control the amount of water and direction of sprinklers. Sprinklers should only be on long enough to allow water to soak into the ground, but not so long as to cause runoff.
- ✓ Periodically inspect, fix leaks and realign sprinkler heads.
- ✓ Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.

! HOMEOWNERS

KEEP THESE TIPS IN MIND WHEN HIRING PROFESSIONAL LANDSCAPERS AND REMIND AS NECESSARY.

Leftover pesticides, fertilizers, and herbicides contaminate landfills and should be disposed of through a Hazardous Waste Facility.

For more information on proper disposal call,

(909) 382-5401 or 1-800-OILY CAT.

*FREE for San Bernardino County residents only. Businesses can call for cost inquiries and to schedule an appointment.

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SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

Pollutants on sidewalks and other pedestrian traffic areas and plazas are typically due to littering and vehicle use. Fountain water containing chlorine and copperbased algaecides is toxic to aquatic life. Proper inspection, cleaning, and repair of pedestrian areas and HOA owned surfaces and structures can reduce pollutant runoff from these areas. Maintaining these areas may involve one or more of the following activities:

1. **Surface Cleaning**
2. **Graffiti Cleaning**
3. **Sidewalk Repair**
4. **Controlling Litter**
5. **Fountain Maintenance**

POLLUTION PREVENTION:

Pollution prevention measures have been considered and incorporated in the model procedures. Implementation of these measures may be more effective and reduce or eliminate the need to implement other more complicated or costly procedures. Possible pollution prevention measures for sidewalk, plaza, and fountain maintenance and cleaning include:

- Use dry cleaning methods whenever practical for surface cleaning activities.
- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal).
- Once per year, educate HOA staff and tenants on pollution prevention measures.

MODEL PROCEDURES:

1. Surface Cleaning

Discharges of wash water to the storm water drainage system from cleaning or hosing of impervious surfaces is prohibited.

Sidewalks, Plazas

✓ Use dry methods (e.g. sweeping, backpack blowers, vacuuming) whenever practical to clean sidewalks and plazas rather than hosing, pressure washing, or steam cleaning. DO NOT sweep or blow material into curb; use devices that contain the materials.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

Parking Areas, Driveways, Drive-thru

✓ Parking facilities should be swept/vacuumed on a regular basis. Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

✓ Sweep all parking lots at least once before the onset of the wet season.

✓ Use absorbents to pick up oil; then dry sweep.

✓ Appropriately dispose of spilled materials and absorbents.

OPTIONAL:

- Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc.

Building Surfaces, Decks, etc., without loose paint

✓ Use high-pressure water, no soap.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

Unpainted Building Surfaces, Wood Decks, etc.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

✓ Use biodegradable cleaning agents to remove deposits.

✓ Make sure pH is between 6.5 and 8.5 THEN discharge to landscaping (if cold water without a cleaning agent) otherwise dispose of properly.

2. Graffiti Cleaning

Graffiti Removal

✓ Avoid graffiti abatement activities during rain events.

✓ When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal in the Roads, Streets, and Highway Operation and Maintenance procedure sheet.

✓ Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.

✓ Note that care should be taken when disposing of waste since it may need to be disposed of as hazardous waste.

OPTIONAL:

- Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).

3. Sidewalk Repair

Surface Removal and Repair

✓ Schedule surface removal activities for dry weather if possible.

✓ Avoid creating excess dust when breaking asphalt or concrete.

✓ Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up material.

✓ Designate an area for clean up and proper disposal of excess materials.

✓ Remove and recycle as much of the broken pavement as possible.

✓ When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains shovel or vacuum the slurry, remove from site and dispose of properly.

✓ Always dry sweep first to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Discharge wash water to landscaping, pump to the sanitary sewer if permitted to do so or contain and dispose of properly.

Concrete Installation and Repair

✓ Avoid mixing excess amounts of fresh concrete or cement mortar on-site. Only mix what is needed for the job.

✓ Wash concrete trucks off-site or in designated areas on-site, such that there is no discharge of concrete wash water into storm drain inlets, open ditches, streets, or other storm water conveyance structures. (See Concrete Waste Management BMP WM – 8)

SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

✓ Store dry and wet concrete materials under cover, protected from rainfall and runoff and away from drainage areas. After job is complete remove temporary stockpiles (asphalt materials, sand, etc.) and other materials as soon as possible.

✓ Return leftover materials to the transit mixer. Dispose of small amounts of excess concrete, grout, and mortar in the trash.

✓ When washing concrete to remove fine particles and expose the aggregate, contain the wash water for proper disposal.

✓ Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stock pile, or dispose in the trash.

✓ Protect applications of fresh concrete from rainfall and runoff until the material has hardened.

4. Litter Control

✓ Enforce anti-litter laws.

✓ Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.

✓ Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow.

OPTIONAL:

- Post “No Littering” signs.

5. Fountain Maintenance

✓ Do not use copper-based algaecides. Control algae with chlorine or other alternatives, such as sodium bromide.

✓ Allow chlorine to dissipate for a few days and then recycle/reuse water by draining it gradually onto a landscaped area. Water must be tested prior to discharge to ensure that chlorine is not present (concentration must be less than 0.1 ppm).

✓ Contact local agency for approval to drain into sewer or storm drain.

✓ Avoid mixing excess amounts of fresh concrete or cement mortar on-site. Only mix what is needed for the job.

EQUIPMENT MAINTENANCE & REPAIR

Vehicle or equipment maintenance has the potential to be a significant source of stormwater pollution. Engine repair and service (parts cleaning, spilled fuel, oil, etc.), replacement of fluids, and outdoor equipment storage and parking (dripping engines) can all contaminate stormwater. Conducting the following activities in a controlled manner will reduce the potential for stormwater contamination:

1. **General Maintenance and Repair**
2. **Vehicle and Machine Repair**
3. **Waste Handling/Disposal**

Related vehicle maintenance activities are covered under the following program headings in this manual: "Vehicle and Equipment Cleaning", "Vehicle and Equipment Storage", and "Vehicle Fueling".

POLLUTION PREVENTION:

Pollution prevention measures have been considered and incorporated in the model procedures. Implementation of these measures may be more effective and reduce or eliminate the need to implement other more complicated or costly procedures. Possible pollution prevention measures for equipment maintenance and repair include:

- Review maintenance activities to verify that they minimize the amount of pollutants discharged to receiving waters. Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Minimize use of solvents. Clean parts without using solvents whenever possible. Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.
- Once per year, educate HOA staff and tenants on pollution prevention measures.

EQUIPMENT MAINTENANCE & REPAIR

MODEL PROCEDURES:

1. General Maintenance and Repair

General Guidelines

> ➔ *Note: Permission must be obtained for any discharge of wash water to the sanitary sewer from the local sewering agency.*

- ✓ Review maintenance activities to verify that they minimize the amount of pollutants discharged to receiving waters. Keep accurate maintenance logs to evaluate materials removed and improvements made.
- ✓ Regularly inspect vehicles and equipment for leaks.
- ✓ Move activity indoors or cover repair area with a permanent roof if feasible.
- ✓ Minimize contact of stormwater with outside operations through berming the local sewering and drainage routing.
- ✓ Place curbs around the immediate boundaries of the process equipment.
- ✓ Clean yard storm drain inlets regularly and stencil them.

Good Housekeeping

- ✓ Avoid hosing down work areas. If work areas are washed and if discharge to the sanitary sewer is allowed, treat water with an appropriate treatment device (e.g. clarifier) before discharging. If discharge to the sanitary sewer is not permitted, pump water to a tank and dispose of properly.
- ✓ Collect leaking or dripping fluids in drip pans or container. Fluids are easier to recycle or dispose of properly if kept separate.
- ✓ Keep a drip pan under the vehicle while you unclip hoses, unscrew filters, any discharge of or remove other parts. Place a drip pan under any vehicle that might leak while you work on it to keep splatters or drips off the shop floor.
- ✓ Educate employees on proper handling and disposal of engine fluids.
- ✓ Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- ✓ Do not pour liquid waste to floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.
- ✓ Post signs at sinks and stencil outdoor storm drain inlets.

2. Vehicle Repair

General Guidelines

- ✓ Perform vehicle fluid removal or changing inside of a building or in a contained covered area, where feasible, to prevent the run-on of stormwater and the runoff of spills.
- ✓ Regularly inspect vehicles and equipment for leaks, and repair as needed.

✓ Use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.

✓ Immediately drain all fluids from wrecked vehicles. Ensure that the drain pan or drip pan is large enough to contain drained fluids (e.g. larger pans are needed to contain antifreeze, which may gush from some vehicles).

✓ Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.

✓ Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.

✓ Oil filters disposed of in trash cans or dumpsters can leak oil. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

✓ Store cracked batteries in a non-leaking secondary container and dispose of properly at recycling facilities or at County hazardous waste disposal site.

Vehicle Leak and Spill Control

✓ Use absorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.

✓ Place a stockpile of spill cleanup materials where it will be readily accessible.

✓ Sweep floor using dry absorbent material.

3. Machine Repair

✓ Keep equipment clean; don't allow excessive build-up of oil or grease.

✓ Minimize use of solvents.

✓ Use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.

✓ Perform major equipment repairs at the corporation yard, when practical.

✓ Following good housekeeping measures in Vehicle Repair section.

4. Waste Handling/Disposal

Waste Reduction

✓ Prevent spills and drips of solvents and cleansers to the shop floor.

✓ Do liquid cleaning at a centralized station so the solvents and residues stay in one area. Recycle liquid cleaners when feasible.

✓ Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse.

OPTIONAL:

- If possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:

  -Use non-caustic detergents instead of caustic cleaning for parts cleaning.

  -Use a water-based cleaning service and have tank cleaned. Use detergent-based or water-based cleaning systems in place of organic solvent degreasers.

  -Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.

  -Choose cleaning agents that can be recycled.

Recycling

OPTIONAL:

- Separate wastes for easier recycling. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents separate from non-chlorinated solvents.

- Label and track the recycling of waste material (e.g. used oil, spent solvents, batteries).

- Purchase recycled products to support the market for recycled materials.

LIMITATIONS:

Space and time limitations may preclude all work being conducted indoors. It may not be possible to contain and clean up spills from vehicles/equipment brought on-site after working hours. Dry floor cleaning methods may not be sufficient for some spills – see spill prevention and control procedures sheet. Identification of engine leaks may require some use of solvents.

POOL MAINTENANCE

Pool chemicals and filter solids, when discharged to the City streets, gutters or storm drans, DO NOT GET TREATED before reaching the Santa Ana River. Chlorine, acid cleaning chemicals and metal-based algaecides used in pools can kill beneficial organisms in the food chain and pollute our drinking water.

When emptying your swimming pool, spa or fountain, please use one of the following best management practices to prevent water pollution:

- Reuse the water as landscape irrigation
- Empty the water into the sewer between midnight and 6:00 am
- Remove solids and floating debris and dispose of in the trash, de-chlorinate the water to a chlorine residual = 0, wait 24 hours, then discharge the water to the street or storm drain
- Try not to use metal-based algaecides (i.e. copper sulfate) in your pool or spa. If you have, empty your pool or spa into the sewer. *Prior to discharging pool water into the sanitary sewer system, contact your local agency.*
- If the pool contains algae and mosquito larvae, discharge the water to the sewer

When acid cleaning or other chemical cleaning:

- Neutralize the pool water to pH of 6.5 to 8.5, then discharge to the sewer

For swimming pool and spa filter backwash:

- Dispose of solids into trash bag, then wash filter into a landscape area
- Settle, dispose of solids in trash and discharge water to the sewer, never to the storm drain

» For Residents

*The following is a preview of the information we have available to residents. For more fact sheets, visit **sbcountystormwater.org***

Household Hazardous Waste Center Locations

TOO TOXIC TO TRASH

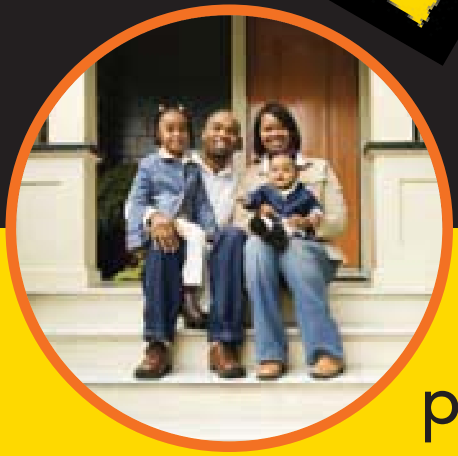
Dispose of your **HOUSEHOLD HAZARDOUS WASTE** (HHW) at a **FREE** HHW Center near you. Examples of items collected: pesticides, fertilizers, paints, cleaners, antifreeze, batteries, motor oil, oil filters, and electronic waste.

SERVICE AREA	LOCATION	DAYS OPEN	HOURS
Big Bear Lake (does not accept E-waste)	42040 Garstin Dr. (cross: Big Bear Blvd.)	Saturdays	9 a.m. - 2 p.m.
Chino	5050 Schaefer Ave. (cross: 4th St.)	2nd & 4th Sat.	8 a.m. - 1 p.m.
Fontana (Fontana residents only)	16454 Orange Way (cross: Cypress Ave.) Note: Provide a trash bill and a driver's license as proof of residency.	Saturdays	8 a.m. - 12 p.m.
Ontario	1430 S. Cucamonga Ave. (cross: Belmont St.)	Fri. & Sat.	9 a.m. - 2 p.m.
Rancho Cucamonga	8794 Lion Street. (Off 9th St, between Vineyard and Hellman)	Saturdays	8 a.m. - 12 p.m.
Redlands	500 Kansas St. (cross: Park Ave.)	Saturdays	9:30 a.m. - 12:30 p.m.
Rialto (does not accept E-waste)	246 Willow Ave. (cross: Rialto Ave.)	2nd & 4th Fri. & Sat.	8 a.m. - 12 p.m.
San Bernardino	2824 East 'W' St., 302 (cross: Victoria Ave.)	Mon. – Fri.	9 a.m. - 4 p.m.
Upland	1370 N. Benson Ave. (cross: 14th St.)	Saturdays	9 a.m. - 2 p.m.

To report illegal dumping, call (877) WASTE18
or visit sbcountystormwater.org

Artwork Courtesy of the City of Los Angeles Stormwater Program. Printed on recycled paper.

TAKE ONE



WE DID IT OURSELVES AND WE DID IT RIGHT

When painting your home, protect your family and community.

- **PAINTS** that are water-based are less toxic and should be used whenever possible.
- **BRUSHES** with water-based paint should be washed in the sink. Those with oil-based paint should be cleaned with paint thinner.
- **SAFELY** dispose of unwanted paint and paint thinner. The County of San Bernardino offers 9 HHW Centers that accept paint and other household hazardous waste from residents FREE of charge. For a list of acceptable materials, location information, and hours of operation call 1-800-OILY CAT.

In the event of a spill or discharge to a storm drain or waterway, contact San Bernadino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

VEHICLE MAINTENANCE

Oil, grease, anti-freeze and other toxic automotive fluids often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Cleaning Auto Parts

Scrape parts with a wire brush or use a bake oven rather than liquid cleaners. Arrange drip pans, drying racks and drain boards so that fluids are directed back into the parts washer or the fluid holding tank. Do not wash parts or equipment in a sink, parking lot, driveway or street.

Storing Hazardous Waste

Keep your liquid waste segregated. Many fluids can be recycled via hazardous waste disposal companies if they are not mixed. Store all materials under cover with spill containment or inside to prevent contamination of rainwater runoff.

Preventing Leaks and Spills

Conduct all vehicle maintenance inside of a garage. Place drip pans underneath vehicle to capture fluids. Use absorbent materials instead of water to clean work areas.

Cleaning Spills

Use dry methods for spill cleanup (sweeping, absorbent materials). To report accidental spills into the street or storm drain call (877) WASTE18 or 911.

Proper Disposal of Hazardous Waste

Dispose of household hazardous waste by taking it to your nearest household hazardous waste center. For more information, call 1-800-OILY CAT or check out sbcountystormwater.org/Disposal.html

FREE

DOGGIE WASTE BAGS

Remember to pick up after your pet every time to keep San Bernardino County clean and healthy!

To RECEIVE your

FREE CONTAINER

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sbcountystormwater.org/dog

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