MOJAVE RIVER WATERSHED

Preliminary

Water Quality Management Plan

For:

~~Space Center Expansion Phase 2 Flag~~

APN: 3090-571-~~14~~

PARCEL 4 OF PARCEL MAP 16201 MB 202 PAGE 67 TO 70

CASE NO. XXXX-XXX

Prepared for:

BRE Space Paxbello, LLC

3401 Etiwanda Ave., Leasing office

Jurupa Valley, CA 91752

(951) 685-5221

Prepared by:

David Evans & Associates

18484 Outer Hwy 18N Suite 225

Apple Valley, CA 92307

(760) 524-9100

Submittal Date: May 2023

Revision No. 1 Date: Insert Current Revision Date

Revision No. and Date: Insert Current Revision Date

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Final Approval Date:______________________

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Project Owner's Certification

This Mojave River Watershed Water Quality Management Plan (WQMP) has been prepared for BRE Space Paxbello, LLC by David Evans & Associates. 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 4, PM 16201 Bk 202, Pages 67 to 70	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 3090-571-17

Owner's Signature			
Owner Name: Britton Winterer			
Title	Managing Director		
Company	BRE Space Paxbello LLC		
Address	3401 Etiwanda Avenue Jurupa Valley, CA 91752		
Email	bwinterer@linklogistics.com		
Telephone #	(212) 297-1096		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):		Grading Permit Number(s):	
Tract/Parcel Map Number(s):	Parcel 4, PM 16201 Bk 202, Pages 67 to 70	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 3090-571-17

"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 State of California Water Resources Control Board Order No. 2013-0001-DWQ.

Engineer: Bret Thorpe, PE		PE Stamp Below
Title	Project Manager	
Company	David Evans & Associates	
Address	18484 Outer Highway 18N Suite 225	
Email	bthorpe@deainc.com	
Telephone #	760-524-9107	
Signature		
Date		

Table of Contents

Forms

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. 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 Phase II Small MS4 General Permit (Mojave Watershed) WQMP Technical Guidance 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 II – Executive Summary

This preliminary Water Quality Management Plan demonstrates that the site does cause hydro modification and that the proposed basin with a capacity of 74,000 cubic feet (cf) has more than enough capacity to mitigate the Design Capture volume of 23,190 cf, and the pre vs post 10 year volume of 18,774 cf. Therefore, the basin has more than enough capacity to mitigate the storm water runoff and provide for the LID BMP's.

Because the basin is so large, it is believed it will also mitigate the Q peak and the Time of Concentration increase with room to spare. A unit hydrograph analysis is needed for the basin to demonstrate this and this will be provided in the Final WQMP Report.

Section 1 Discretionary Permit(s)

<table>
<tr><th colspan="6">Form 1-1 Project Information</th></tr>
<tr><td colspan="2">Project Name</td><td colspan="4">~~Space Center Expansion Flag Lot~~</td></tr>
<tr><td colspan="2">Project Owner Contact Name:</td><td colspan="4">Graham Tingler</td></tr>
<tr><td>Mailing Address:</td><td>3401 Etiwanda Ave., Leasing office, Jurupa Valley, CA 91752</td><td>E-mail Address:</td><td></td><td>Telephone:</td><td>(951) 685-5221</td></tr>
<tr><td colspan="2">Permit/Application Number(s):</td><td></td><td>Tract/Parcel Map Number(s):</td><td colspan="2">Parcel 4 of Parcel Map 16201</td></tr>
<tr><td colspan="2">Additional Information/
Comments:</td><td colspan="4"></td></tr>
<tr><td colspan="2">Description of Project:</td><td colspan="4">Construction of approximately 438,200 sf of pavement with 202 parking stalls for trucks located northeast of the intersection of Nisqualli Road and Enterprise Way.</td></tr>
<tr><td colspan="2">Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.</td><td colspan="4">The project site is vacant and lies east of Enterprise Way and is surrounded by industrial businesses on the north, west and south sides of the property and a railway owned by BNSF that runs around the north and east side of the site. The project will install 202 parking stalls with associated pavement areas, a forty-foot-wide drive aisle, and utilities such as water and drainage infrastructure such as storm drainpipes and inlets. The property is currently about 438,000 square feet of undeveloped land with utilities that serves the existing site. The project is in the City of Victorville, CA east of ~~the intersection of~~ Enterprise Way ~~Nutro Way at the end of an access road for Nutro Way~~. The project area of study is 10.06 acres that include the area bounded by the property lines of the site along with the private driveway entrance south of the project. In addition to the proposed improvements, the project area will have a dual-purpose detention/infiltration basin located on the north side of the property, which will be utilized to trat the projects drainage for the 2-year design storm. Proposed storm drain inlets located on the site will contain a Bioclean Filter Insert for the purpose of pretreatment. Please refer to the enclosed report and WQMP Site Plan in Appendix A</td></tr>
</table>

Section 2 Project Description

2.1 Project Information

This section of the WQMP should 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.

The site currently will have a proposed detention basin with a capacity of 74,000 Cubic Feet (CF). Therefore, the proposed capacity can more than handle the Design Capture Volume of 23,190 CF and mitigate the Hydromodification mitigation. See the referenced drainage study in Appendix E

2.1.1 Project Sizing Catagorization

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.

<table>
<tr><th colspan="6">Form 2.1-1 Description of Proposed Project</th></tr>
<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 ft² 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 ft² 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 LID BMPs and other LIP requirements. See County “PCMP” Template. Do not use this WQMP Template.</td></tr>
<tr><td>2 Project Area (ft2):</td><td>438,200</td><td>3 Number of Dwelling Units:</td><td>NA</td><td>4 SIC Code:</td><td></td></tr>
</table>

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.*

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 storm water facilities:
The property is privately owned and as part of the operation of the facility, there is a maintenance crew that maintains the grounds and building. The maintenance organization will also assume the responsibilities of the BMP maintenance and storm water detention basin and storm drain.

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 ☒	Bacteria and Viruses are ubiquitous microorganisms that thrive under certain environmental conditions. Their proliferation is typically cause by the transport of animal or human fecal wastes from the watershed. Water, containing excessive bacteria and viruses, can alter the aquatic habitat and create a harmful environment for humans and aquatic life. Also, the decomposition of excess organic waste causes increased growth of undesirable organisms in the water. This pollutant is not expected.
Nutrients - Phosphorous	E ☒	N ☐	Nutrients are inorganic substances, such as nitrogen and phosphorus. Excessive discharge of nutrients to water bodies and streams causes eutrophication, where aquatic plants and algae growth can lead to excessive decay of organic matter in the water body, loss of oxygen in the water, release of toxins in sediment, and the eventual death of aquatic organisms. Primary sources of nutrients in urban runoff are fertilizers and eroded soils.
Nutrients - Nitrogen	E ☒	N ☐	
Noxious Aquatic Plants	E ☐	N ☒	Not expected as these plants do not survive in dry washes.
Sediment	E ☒	N ☐	Sediments are solid materials that are eroded from the land surface. Sediments can increase turbidity, clog fish gills, reduce spawning habitat, lower young aquatic organisms survival rates, smother bottom dwelling organisms, and suppress aquatic vegetation growth.
Metals	E ☒	N ☐	The primary source of metal pollution in stormwater is typically commercially available metals and metal products. Metals of concern include cadmium, chromium, copper, lead, mercury, and zinc. Lead and chromium have been used as corrosion inhibitors in primer coatings and cooling tower systems. Metals are also raw material components in non-metal products such as fuels, adhesives, paints, and other coatings. At low concentrations naturally occurring in soil, metals may not be toxic. However, at higher concentrations, certain metals can be toxic to aquatic life. Humans can be impacted from contaminated groundwater resources, and bioaccumulation of metals in fish and shellfish. Environmental concerns, regarding the potential for release of metals to the environment, have already led to restricted metal usage in certain applications
Oil and Grease	E ☒	N ☐	Oil and grease in water bodies decreases the aesthetic value of the water body, as well as the water quality. Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids
Trash/Debris	E ☒	N ☐	Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are general waste products on the landscape. The presence of trash and debris may have a significant impact on the recreational value of a water body and aquatic habitat. Trash impacts water quality by increasing biochemical oxygen demand.
Pesticides / Herbicides	E ☒	N ☐	Pesticides (including herbicides) are chemical compounds commonly used to control nuisance growth or prevalence of organisms. Relatively low levels of the active component of pesticides can result in conditions of aquatic toxicity. Excessive or improper application of a pesticide may result in runoff containing toxic levels of its active ingredient

Organic Compounds	E ☒	N ☐	Organic compounds are carbon-based. Commercially available or naturally occurring organic compounds are found in pesticides, solvents, and hydrocarbons. Organic compounds can, at certain concentrations, indirectly or directly constitute a hazard to life or health. When rinsing off objects, toxic levels of solvents and cleaning compounds can be discharged to storm drains. Dirt, grease, and grime retained in the cleaning fluid or rinse water may also adsorb levels of organic compounds that are harmful or hazardous to aquatic life
Other: Oxygen-Demanding Substances	E ☐	N ☒	This category includes biodegradable organic material as well as chemicals that react with dissolved oxygen in water to form other compounds. Proteins, carbohydrates, and fats are examples of biodegradable organic compounds. Compounds such as ammonia and hydrogen sulfide are examples of oxygen-demanding compounds. The oxygen demand of a substance can lead to depletion of dissolved oxygen in a water body and possibly the development of septic conditions. A reduction of dissolved oxygen is detrimental to aquatic life and can generate hazardous compounds such as hydrogen sulfides.
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

Section 3 Site and Watershed Description

Describe the project site conditions that will facilitate the selection of BMP 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 34d 29m 20s	Longitude -117d 17m 1s	Thomas Bros Map page 4386 G-4
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*			

See the WQMP site plan in Appendix A.	
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	
DA1 DMA B to Outlet 1	
DA2 to Outlet 2	

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A			
1 DMA drainage area (ft^2)	438,200			
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*	C			

5 Longest flowpath length (ft)	710			
6 Longest flowpath slope (ft/ft)	0.017			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	91			
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*	poor			

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1 (use only as needed for additional DMA w/in DA 1)

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA E	DMA F	DMA G	DMA H
1 DMA drainage area (ft^2)				
2 Existing site impervious area (ft^2)				
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*				
4 Hydrologic soil group *County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf*				
5 Longest flowpath length (ft)				
6 Longest flowpath slope (ft/ft)				
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*				
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*				

Form 3-3 Watershed Description for Drainage Area	
Receiving waters Refer to CWRCB site: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	Mojave River (Mojave Forks Reservoir outlet to Upper Narrows)
Applicable TMDLs *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	None
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*	None
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 and Site Design BMPs

The information and data in this section are required for both Regulated Development and Site Design Only Projects. Source Control and Site Design BMPs 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	☒	☐	The owner will familiarize themselves with the contents and requirements of this WQMP.
N2	Activity Restrictions	☒	☐	No outside washing of trucks.
N3	Landscape Management BMPs	☒	☐	Pesticides and fertilizers shall be applied by a State Licensed Applicator.
N4	BMP Maintenance	☒	☐	BMP Maintenance shall be implemented by the use of an Operation and Maintenance Plan which will designate responsible parties to Manage the BMPs. It also defines training and duties, and operating schedule. Also, by Maintenance agreements with the local Agency.
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	NA
N6	Local Water Quality Ordinances	☒	☐	The project will have to demonstrate it complies with the local water ordinances prior to permits.
N7	Spill Contingency Plan	☒	☐	Owner to familiarize themselves and instruct the Employees on the Spill Contingency Plan. A copy shall be available in the warehouse at all times.
N8	Underground Storage Tank Compliance	☐	☒	No underground storage tanks.
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One: Included	Check One: Not Applicable	Describe BMP Implementation OR, if not applicable, state reason
N10	Uniform Fire Code Implementation	☒	☐	Compliance with article 80 of the UFC.
N11	Litter/Debris Control Program	☒	☐	The owner shall implement a trash management and litter control procedures to be included in the O & M Plan.
N12	Employee Training	☒	☐	Owner shall be responsible for the maintenance and shall provide BMP training and educational programs and materials to the employees.
N13	Housekeeping of Loading Docks	☐	☒	No Loading Docks on Site
N14	Catch Basin Inspection Program	☒	☐	The owner shall have all the drainage facilities cleaned and maintained on an annual basis. Cleaning should take place in the late summer or early fall prior to the rainy season.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Streets and parking lots are required to be swept on a regular frequency based on usage and field observations of waste accumulation, using a vacuum assisted sweeper. At a minimum all paved areas shall be swept, in late summer or early fall, prior to the start of rainy season.
N16	Other Non-structural Measures for Public Agency Projects	☐	☐	
N17	Comply with all other applicable NPDES permits	☐	☐	

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 stenciling with language such as “No dumping-flows to river” shall be provided at all the catch basins and a sign provided at the basin with language and /or graphical icons to discourage illegal dumping.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Any trash storage areas shall be per the City of Victorville requirements with sloid roofs and on an impervious surface designed not to run-on from adjoining areas.
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)	☒	☐	The project shall employ the City of Victorville water efficient landscape ordinance using timing and application methods of irrigation water to minimize the runoff of excess irrigation and the use drought tolerant plants and wood mulches.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	All landscaped areas shall be finished graded at a minimum of 1-2 inches below top of curb or sidewalk.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	Slopes to have permanent stabilization per the erosion control plan as soon as possible. Does not apply to the borrow pit area.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	No loading docks on site.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	No maintenance bays.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No vehicle washing
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No 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)	☐	☒	No equipment wash areas.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling areas.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No hillside areas.
S14	Wash water control for food preparation areas	☐	☒	No food preparation.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	No wash areas.

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 BMPs can result in smaller 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: The project paves only what is needed for the flag lot and drive aisle and the rest is left native to help to minimize the impervious areas to the maximum extent possible.
Maximize natural infiltration capacity; Including improvement and maintenance of soil: Yes ☒ No ☐ Explanation: The flag lot will drain to the proposed infiltration/detention basin on site where infiltration will take place.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: The site currently drains to the north and east and after development it still will drain to the north and east.
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: Site will drain to the proposed detention basin.
Use of Porous Pavement.: Yes ☐ No ☒ Explanation: Not recommended with the use of heavy trucks.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: No sensitive areas and existing vegetation is sparse and of little value.
Re-vegetate disturbed areas. Including planting and preservation of drought tolerant vegetation. : Yes ☐ No ☒ Explanation: There is no re-vegetation areas on site.

Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: There is no compaction under the bottom of the infiltration system.
Utilize naturalized/rock-lined drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Not practical and the basin will serve the same purpose.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐ Explanation: This will be done to the maximum extent possible.
Use of Rain Barrels and Cisterns, Including the use of on-site water collection systems.: Yes ☐ No ☒ Explanation: Not practical in a warehouse type application and the storm water runs to the basin for infiltration.
Stream Setbacks. Includes a specified distance from an adjacent steam: : Yes ☐ No ☒ Explanation: No streams.

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 and Site Design BMPs, 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 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): 438,200	2 Imperviousness after applying preventative site design practices (Imp%): 90%	3 Runoff Coefficient (Rc): 0.73028 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.358 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.443 *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): 23,190 *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*		

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 46,628 *Form 4.2-3 Item 12*	2 31.12 *Form 4.2-4 Item 13*	3 7.40 *Form 4.2-5 Item 10*
Post-developed	4 64,634 *Form 4.2-3 Item 13*	5 17.35 *Form 4.2-4 Item 14*	6 12.76 *Form 4.2-5 Item 14*
Difference	7 *18,006* *Item 4 – Item 1*	8 *13.77* *Item 2 – Item 5*	9 *5.36* *Item 6 – Item 3*
Difference (as % of pre-developed)	10 *39%* *Item 7 / Item 1*	11 *44%* *Item 8 / Item 2*	12 *72%* *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): 2.23
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3): 42,628
*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): 64,634
*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 hydro modification requirement, (ft^3): 18,774
*Vhydro = (Item 13 * 0.95) – Item 12*

NOTE: Refer to Appendix E for hydro-modification calculations (Rational and Unit Hydrograph Method.)

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*			
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): 31.12 *Minimum of Item 12 pre-developed DMA*

14 Post-developed time of concentration (min): 17.35 *Minimum of Item 12 post-developed DMA*

15 Additional time of concentration needed to meet hydromodification requirement (min): 12.21 $T_{C\text{-}Hydro}$ *= (Item 13 * 0.95) – Item 14*

NOTE: Refer to Appendix E for hydro-modification calculations (Rational and Unit Hydrograph Method.)

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)*		
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*							
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*							
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						
	DMA B						
	DMA C						

8 Pre-developed Q_p at T_c for DMA A:	9 Pre-developed Q_p at T_c for DMA B:	10 Pre-developed Q_p at T_c for DMA C:
*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 $7_{DMAA/3}$]*	*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 $7_{DMAB/3}$]*	*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): 7.40 *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): 12.76 *Maximum of Item 11, 12, and 13 (including additional forms as needed)*

15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs): 4.72 *$Q_{p-hydro}$ = (Item 14 * 0.95) – Item 10*

NOTE: Refer to Appendix E for hydro-modification calculations (10-Year 24 Hr.)

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 BMPs (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)
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 BMPs reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable Site Design 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)

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): *$V_{retention}$ =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): *$V_{retention}$ =Sum of Item 12 for all BMPs*			

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

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): *$V_{retention}$ = 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 additional treatment to address pollutants of concern unless these high-risk areas are isolated from storm water runoff or bioretention areas with little 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): 23,190 *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 DMA BMP Type	DA 1 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*	2.5		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	4.5		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.56		
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*	1.33		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	1.33		
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*	17,433		
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*	n/a		
10 Amended soil porosity	n/a		
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*	n/a		
12 Gravel porosity	n/a		
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))]*	41,161		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	n/a		

16 Total Retention Volume from LID Infiltration BMPs: 41,161 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 177% *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)		
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 *(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)*	Volume-based biotreatment *Use Forms 4.3-5 and 4.3-6 to compute treated volume* ☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	Flow-based biotreatment *Use Form 4.3-7 to compute treated flow* ☐ 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) – 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) – 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)

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 $2^{1.67}$ * Item $3^{0.5}$)*			
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 2^2)*			
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): 23,190 *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): 41,161 *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 (ft^3): 14,774.3 *(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): 41,161 *Sum of 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): -26,132.7 *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site BMPs (ft^3):

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
Basin	Owner	Inspect Basin for trash, buildup of sediment and weeds. Clean out weeds and trash, remove sediment build up.	Once yearly prior to rainy season
Storm drain	Owner	Inspect catch basins, check for illicit dumping or spills, Inspect storm drain for trash and sediment. Clean if necessary. Refresh stenciling if needed	Once yearly prior to rainy season
Parking lot sweeping	Owner	Inspect for spills, oil drips and trash. Clean any spills, oil immediately. Inspect for accumulation of dirt/dust. Sweep parking as needed.	Monthly
Catch Basin & Inlet Filter	Owner	Inspect catchment area for excessive sediment, trash, and/ or debris accumulation on surface. Inspect inlet for excessive sediment, trash, and/ or debris accumulation. Litter leaves and debris should be removed from inlet to reduce risk of outlet clogging. Change the insert filter as needed.	Annually, and after heavy rain

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

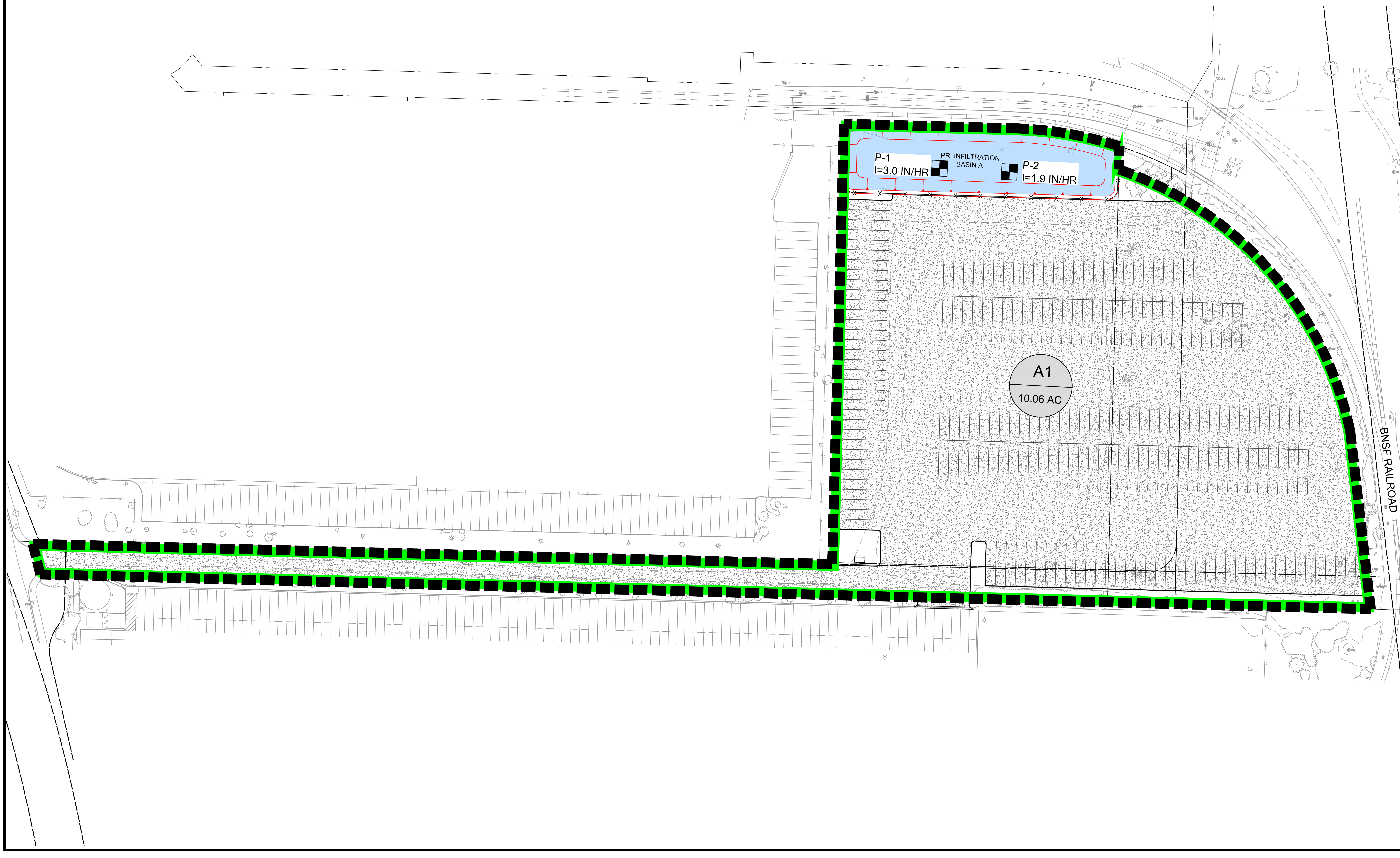
APPENDIX A

MAP LEGEND

- D / 0.18 AC — DMA ID / ACREAGE
- DRAINGE AREA BOUNDARY
- DRAINAGE AREA BOUNDARY DRAINING TO BASIN (10.06 ACRES)
- PROPOSED CATCH BASIN WITH FILTER INSERT
- PR. INFILTRATION BASIN
- INFILTRATION TEST LOCATION PER GEOTECHNICAL STUDY.

N

60 0 60 120
scale 1"= 60' feet



DAVID EVANS AND ASSOCIATES INC.
18484 OUTER HWY 18N SUITE 225
APPLE VALLEY, CA 92307
Phone: 760.524.9100

SPACE CENTER EXPANSION
HYDROLOGY EXHIBIT

SPACE CENTER EXPANSION FLAG LOT

WQMP SITE PLAN

VICTORVILLE CA

CHECKED BY: CHECKED BY
DESIGNED BY: MBEC
DRAWN BY: MBEC

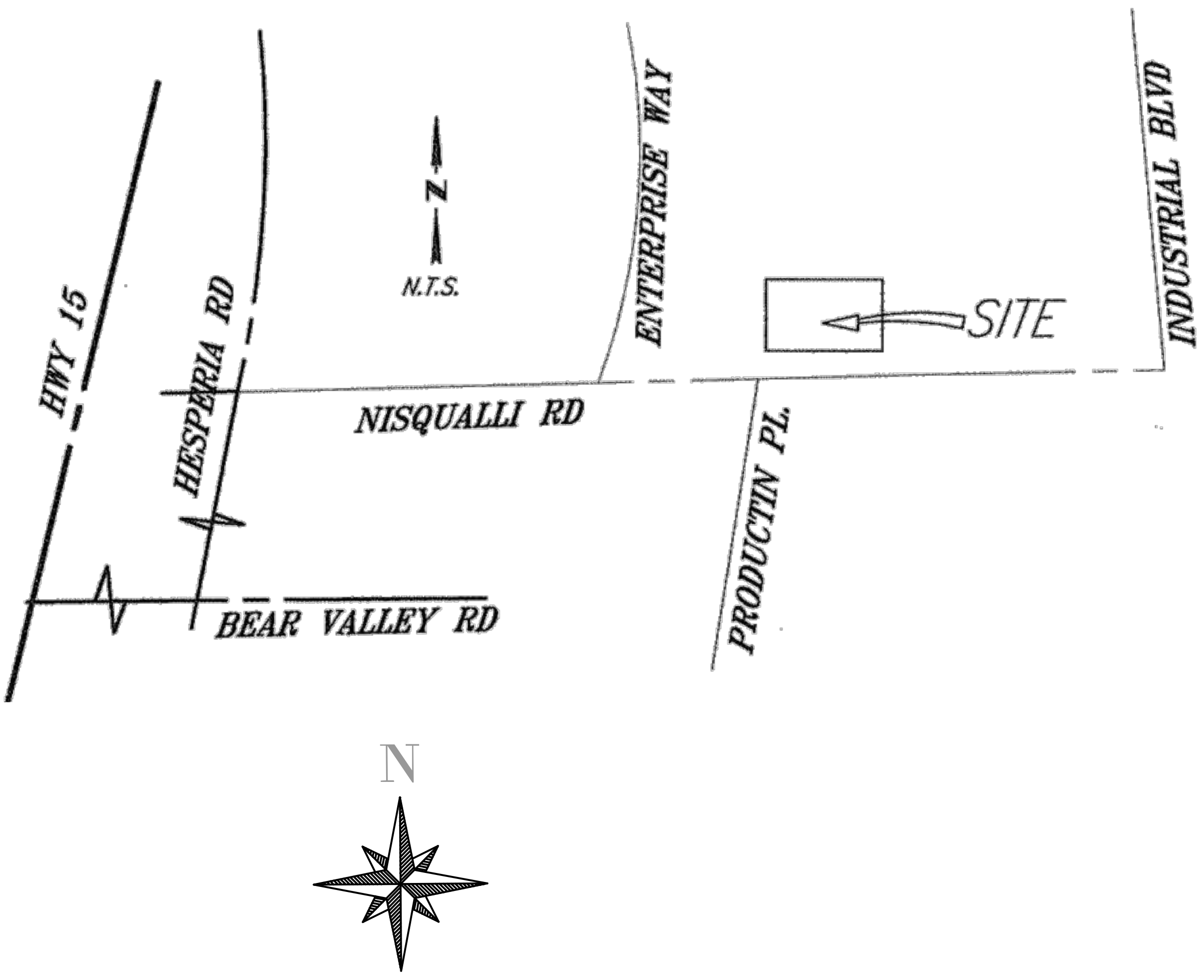
FIRST SUBMITTAL DATE: 08/09/2021

PROJECT NO.
SPACBRES0001

SHEET NO.
1 OF 1

Plot Date: 1/17/2023 11:14 AM By: Jose Aguilar
Save Date: 1/17/2023 11:12 AM By: Jfa File: P:\S\SPACBRES0001\0600INFO\0670Reports\Phase 2 Flag\WQMP\Exhibit\WQMP_Site_Plan_Exhibit.dwg

APPENDIX B



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Apple Valley, CA 92307
Phone: 760.524.9100

VICINITY MAP

CITY OF VICTORVILLE

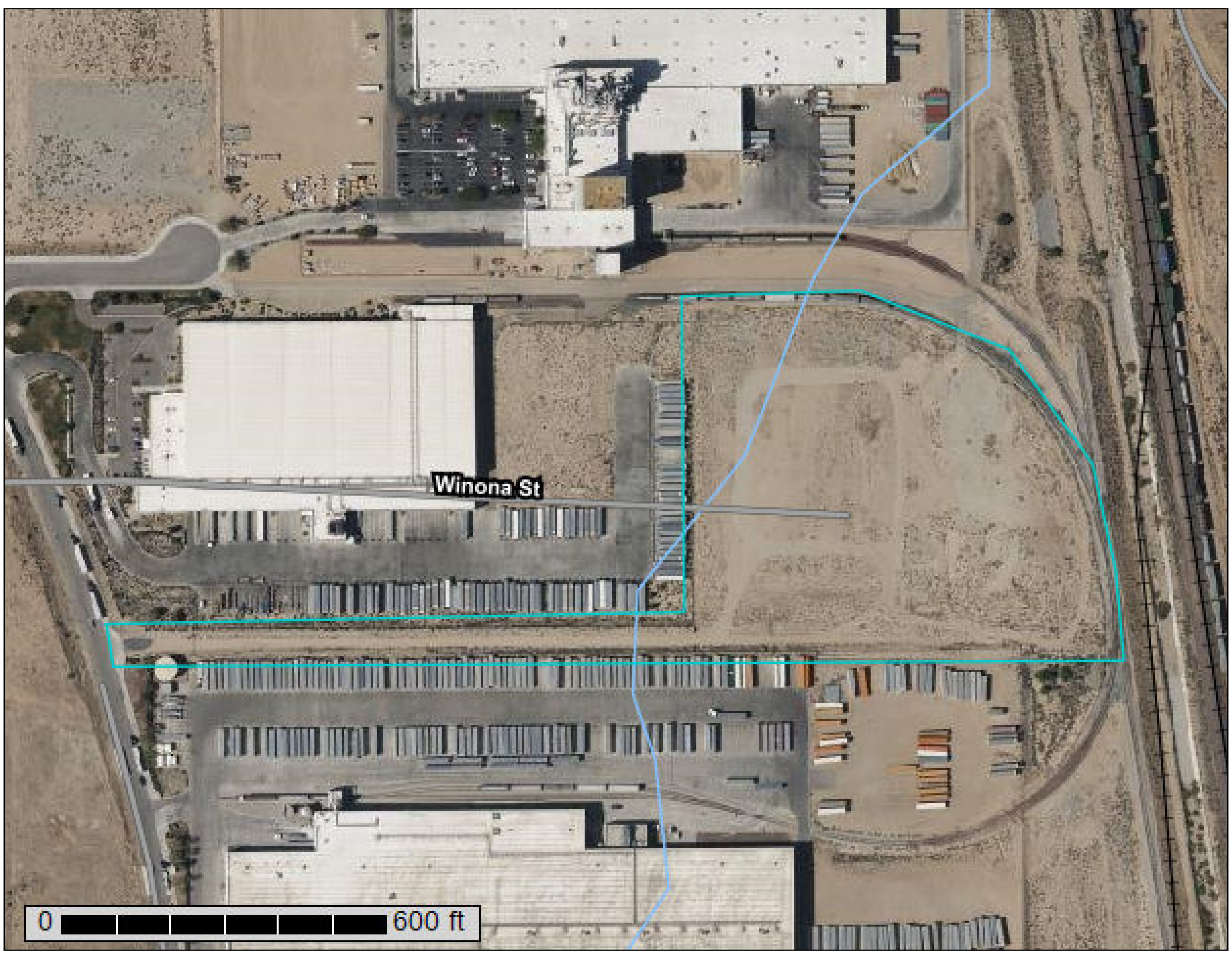
APPENDIX C

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



January 11, 2023

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 alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

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.

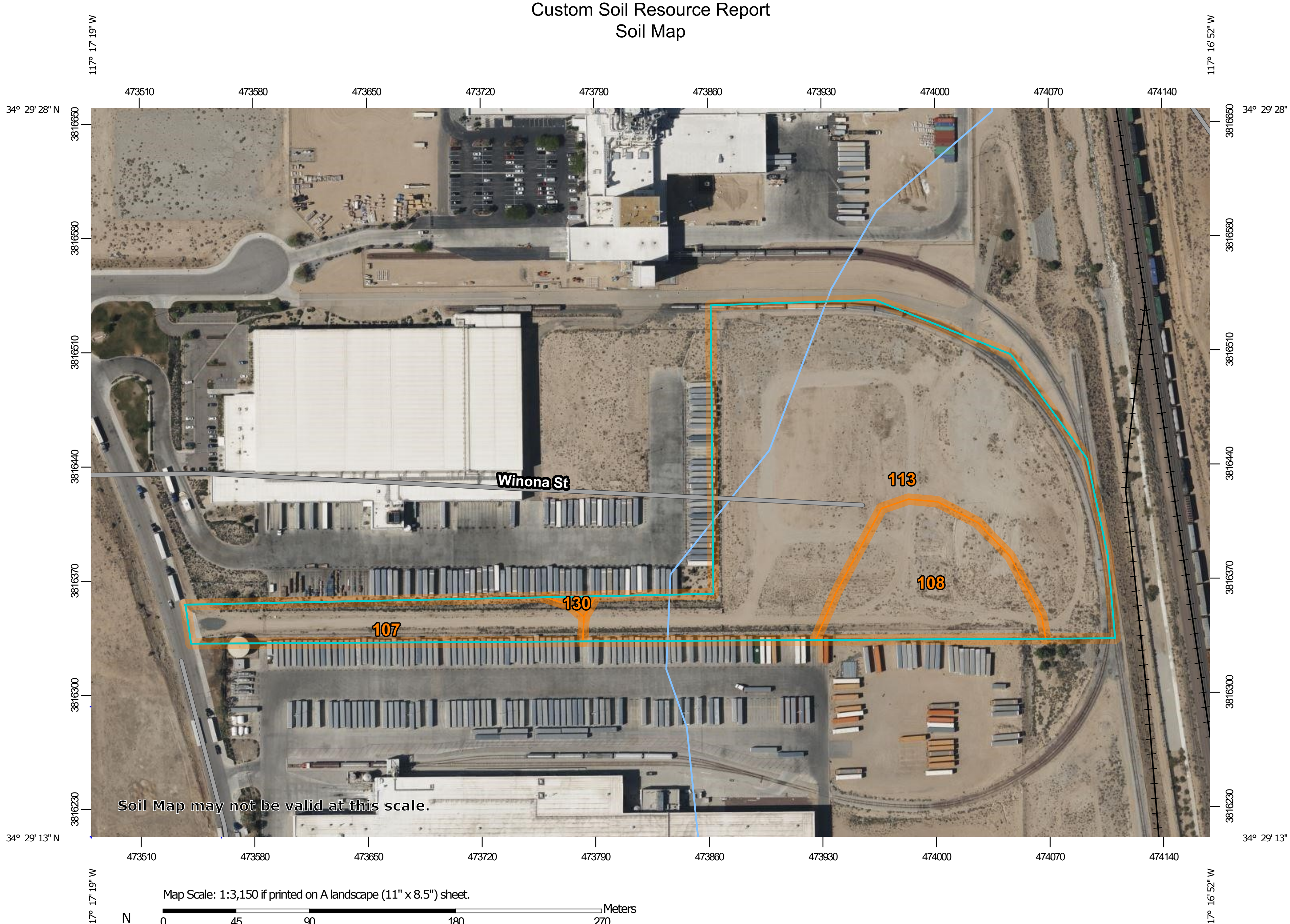
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree 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: 1:3,150 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 45, 90, 180, 270

Feet: 0, 150, 300, 600, 900

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 14, Sep 1, 2022

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

Date(s) aerial images were photographed: Mar 17, 2022—Jun 12, 2022

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
107	BRYMAN LOAMY FINE SAND, 5 TO 9 PERCENT SLOPES	1.5	11.6%
108	BRYMAN LOAMY FINE SAND, 9 TO 15 PERCENT SLOPES	2.1	15.8%
113	CAJON SAND, 2 TO 9 PERCENT SLOPES	9.5	72.3%
130	HAPLARGIDS-CALCIORTHIDS COMPLEX, 15 TO 50 PERCENT SLOPES	0.0	0.3%
Totals for Area of Interest		**13.2**	**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

107—BRYMAN LOAMY FINE SAND, 5 TO 9 PERCENT SLOPES

Map Unit Setting

National map unit symbol: hkrc
Elevation: 3,000 to 3,200 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 59 to 63 degrees F
Frost-free period: 180 to 280 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Bryman

Setting

Landform: Fan remnants
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite sources

Typical profile

H1 - 0 to 9 inches: loamy fine sand
H2 - 9 to 39 inches: sandy clay loam
H3 - 39 to 60 inches: loamy sand

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.9 inches)

Interpretive groups

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

Minor Components

Cajon

Percent of map unit: 5 percent
Hydric soil rating: No

Helendale

Percent of map unit: 5 percent
Hydric soil rating: No

Bryman, sloping

Percent of map unit: 5 percent
Hydric soil rating: No

108—BRYMAN LOAMY FINE SAND, 9 TO 15 PERCENT SLOPES

Map Unit Setting

National map unit symbol: hkrd
Elevation: 3,000 to 3,200 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 59 to 63 degrees F
Frost-free period: 180 to 280 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Bryman

Setting

Landform: Fan remnants
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite sources

Typical profile

H1 - 0 to 9 inches: loamy fine sand
H2 - 9 to 39 inches: sandy clay loam
H3 - 39 to 60 inches: loamy sand

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: R030XF012CA - Sandy
Hydric soil rating: No

Minor Components

Helendale

Percent of map unit: 3 percent
Hydric soil rating: No

Bryman, steep

Percent of map unit: 3 percent

Cajon

Percent of map unit: 3 percent
Hydric soil rating: No

Lavic

Percent of map unit: 3 percent
Hydric soil rating: No

Bryman, gravelly surface

Percent of map unit: 3 percent
Hydric soil rating: No

113—CAJON SAND, 2 TO 9 PERCENT SLOPES

Map Unit Setting

National map unit symbol: hkrk
Elevation: 1,800 to 3,500 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 59 to 68 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 mixed sources

Typical profile

A - 0 to 6 inches: sand
C1 - 6 to 25 inches: sand
C2 - 25 to 60 inches: gravelly sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
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 supply, 0 to 60 inches: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R030XF012CA - Sandy
Hydric soil rating: No

Minor Components

Helendale

Percent of map unit: 5 percent
Landform: Alluvial fans
Hydric soil rating: No

Kimberlina

Percent of map unit: 5 percent
Landform: Alluvial fans
Hydric soil rating: No

Cajon, gravelly surface

Percent of map unit: 5 percent
Landform: Alluvial fans

130—HAPLARGIDS-CALCIORTHIDS COMPLEX, 15 TO 50 PERCENT SLOPES

Map Unit Setting

National map unit symbol: hks3
Elevation: 2,600 to 4,100 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 59 to 63 degrees F
Frost-free period: 180 to 280 days

Farmland classification: Not prime farmland

Map Unit Composition

Haplargids and similar soils: 50 percent
Minor components: 50 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Haplargids

Setting

Landform: Fan remnants
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Alluvium derived from granite sources

Typical profile

H1 - 0 to 60 inches: variable

Properties and qualities

Slope: 15 to 50 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydric soil rating: No

Minor Components

Calciorthids

Percent of map unit: 25 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

Unnamed soils

Percent of map unit: 10 percent
Hydric soil rating: No

Badland

Percent of map unit: 5 percent
Hydric soil rating: No

Cajon

Percent of map unit: 5 percent
Hydric soil rating: No

Bryman

Percent of map unit: 3 percent
Hydric soil rating: No

Mohave varient, s

Percent of map unit: 2 percent

Hydric soil rating: No

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GEOTECHNICAL
PROFESSIONALS INC.

GEOTECHNICAL INVESTIGATION
PROPOSED TRAILER LOT EXPANSION
17486 NISQUALLI ROAD
VICTORVILLE, CALIFORNIA

Prepared for:
BRE Space Paxbello, LLC
3401 Etiwanda Avenue
Jurupa Valley, California 91752

Prepared by:
Geotechnical Professionals Inc.
5736 Corporate Avenue
Cypress, California 90630
(714) 220-2211

Project No. 3149.I

January 4, 2022

GEOTECHNICAL PROFESSIONALS INC.

January 4, 2023

BRE Space Paxbello LLC
3401 Etiwanda Avenue
Jurupa Valley, California 91752

Attention: Taline Agopian
Senior Project Manager, Development

Subject: Report of Geotechnical Investigation
Proposed Trailer Lot Expansion
17486 Nisqualli Road
Victorville, California
GPI Project No. 3149.I

Dear Taline:

Transmitted herewith is our report of geotechnical investigation for the subject project. The report presents the results of our evaluation of the subsurface conditions at the site and recommendations for design and construction.

We appreciate the opportunity of offering our services on this project and look forward to seeing the project through its successful completion. Please contact us if you have questions regarding our report or need further assistance.

Very truly yours,
Geotechnical Professionals Inc.

Patrick McGervey, P.E.
Project Engineer

Paul R. Schade, G.E.
Principal

Distribution: Addressee (PDF)
Tom Cruikshank, Link Logistics

5736 Corporate Avenue • Cypress, CA 90630 • (714) 220-2211 , FAX (714) 220-2122

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1.0 INTRODUCTION

1.1 GENERAL

This report presents the results of a geotechnical investigation performed by Geotechnical Professionals Inc. (GPI) for the proposed trailer lot expansion at the subject site in Victorville, California. The site location is shown on the Site Location Map, Figure 1.

1.2 PROJECT DESCRIPTION

The proposed project will consist of a new paved trailer parking lot and drives across the approximately 8.3-acre site. There will also be a new guard shack building located at the southwest corner of the new parking lot. Floor slabs for the guard shack will be supported on-grade. The project will also include storm water infiltration systems, and landscaping on the remainder of the site.

Proposed finished elevations were not available at the time of preparing this report, however grades are anticipated to be predominately within 2 to 4 feet of existing grades. The finished grades for the proposed guard shack are anticipated to be within 2 to 4 feet of existing grades. Based on similar past projects, we assume that maximum wall loads will be on the order of 2 kips per lineal foot (dead plus live loads).

Our recommendations are based upon the above structural and finish grade information. We should be notified if the actual loads and/or grades differ or change during the project design to either confirm or modify our recommendations. Also, when the project grading and foundation plans become available, we should be provided with copies for review and comment.

1.3 PURPOSE OF INVESTIGATION

The primary purpose of this investigation and report is to provide an evaluation of the existing geotechnical conditions at the site as they relate to the design and construction of the proposed development. More specifically, this investigation was aimed at providing geotechnical recommendations for earthwork, and design of foundations and pavements.

2.0 SCOPE OF WORK

Our scope of work included subsurface exploration, field infiltration testing, laboratory testing, engineering analysis and the preparation of this report.

Our subsurface exploration consisted of six hollow stem auger borings and two infiltration test wells. The borings were performed to depths of approximately 4 to 26 feet below existing grade and the percolation wells were installed at depths of 10 to 12 feet below existing grades. Boring B-6 was refused on concrete prior to reaching its desired depth of 5 feet. A description of field procedures and logs of the borings are presented in the attached Appendix A. The procedures and results of the infiltration tests are discussed in this report. The approximate locations of the subsurface explorations are shown on the Site Plan, Figure 2.

Laboratory testing was performed on selected representative samples as an aid in soil classification and to evaluate the engineering properties of the soils. The geotechnical laboratory testing program included determinations of moisture content and dry density, grain size analyses, R-value and maximum density. R-value testing was performed by Geo-Logic under subcontract to GPI. Their test results are presented Appendix B. Corrosivity testing was performed as part of a previous investigation of the adjacent site by others (CHJ, 2016). The results of their testing have been incorporated in this report.

Engineering evaluations were performed to provide earthwork criteria, foundation design parameters, and assessments of seismic hazards. The results of our evaluations are presented in the remainder of the report.

3.0 SITE CONDITIONS

3.1 SURFACE CONDITIONS

The site is bound to the north, west, and east by three different industrial/distribution buildings with associated surface trailer parking, and west of local rail spurs adjacent to a drainage channel and rail tracks. The site is predominately vacant with pockets of brush. Stockpiles of soil on the order of 5 feet high are in the southeast corner of the site that are likely associated with the previous cogeneration facility that (based on historical images) appears to have been deconstructed in 2015.

In general, the site slopes gently downward from south to north with a change in ground surface elevation from about Elevation +2902 feet to +2894 feet across the site.

3.2 SUBSURFACE SOIL CONDITIONS

Our field investigation disclosed a subsurface profile consisting of fill soils overlying natural soils. Detailed descriptions of the conditions encountered are shown on the Log of Borings in Appendix A.

We encountered undocumented fills to approximately 2 to 5 feet below existing grade in the explorations. The fill materials encountered consisted of medium dense, dry to slightly moist silty sands and sands with varying amount of gravel. The deeper fill soils were predominately associated with the existing unpaved entrance drive along the southern property line at the site. Limited areas may have deeper undocumented fill soils in the vicinity of the previous cogeneration plant (near boring B-6) in the southeastern corner of the site.

The natural soils consist predominately of silty sand with varying amounts of gravel and possible cobbles to a depth of approximately 13 to 15 feet where we encountered layered clayey sands, silty sands, and gravelly sands. In general, the native soils were dense to very dense and very stiff to hard. The natural soils have moderate to high strength and low compressibility characteristics.

Groundwater was not encountered in our explorations drilled to a maximum depth of 26 feet below ground surface. Published data by the California Department of Water Resources indicates groundwater is deeper than 100 feet below the ground surface.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 OVERVIEW

Based on the results of our investigation, it is our opinion that from a geotechnical viewpoint it is feasible to develop the site as proposed, provided the geotechnical constraints discussed below are mitigated. The most significant geotechnical issues that will affect the design and construction of the proposed building are as follows:

- Undocumented fills were reported to depths of up to 2 to 5 feet below existing grade in the vicinity of the proposed guard shack building. The fill soils are not considered to be suitable for direct support of foundations or floor slabs without remedial earthwork. For the proposed guard shack, we recommend removal and recompaction of the fill and a portion of the upper low-density natural soils to provide uniform support for the planned foundations and floor slab.

- Current moisture contents of the upper soils are generally well below the optimum moisture content so that moisture conditioning (wetting) will be required.

- The upper on-site soils are predominantly dry to slightly moist, medium dense silty sands and sands with silt. As such, the soils are considered to be susceptible to caving in open cuts and excavations. Care should be taken to maintain support of the soils and structures left in-place adjacent to planned excavations.

Our recommendations related to the geotechnical aspects of the development of the site are presented in the subsequent sections of this report.

4.2 SEISMIC DESIGN

4.2.1 General

The site is in a seismically active area of Southern California and is likely to be subjected to strong ground shaking due to earthquakes on nearby faults.

We assume the seismic design of the proposed development will be in accordance with the 2022 California Building Code (CBC) criteria. Based on the results of our investigation, a Site Class D may be used for the seismic design of the proposed building.

4.2.2 Strong Ground Motion Potential

Based on published information (geohazards.usgs.gov), the most significant fault in the proximity of the site is the San Andreas (San Bernardino N.), which is located about 18 miles from the site.

During the life of the project, the site will likely be subject to strong ground motions due to earthquakes on nearby faults. Based on the USGS website (earthquake.usgs.gov), we computed that the site could be subjected to a peak ground acceleration (PGA_M) of 0.55g for a mean magnitude 7.0 earthquake. This acceleration has been computed using the mapped Maximum Considered Geometric Mean peak ground acceleration from the ASCE 7-16 (for 2022 CBC) and a site coefficient (F_{PGA}) based on Site Class. The predominant earthquake magnitude was determined using a 2-percent probability of exceedance in a 50-year period, or an average return period of 2,475 years. The structural design will need to incorporate measures to mitigate the effects of strong ground motion.

The corresponding seismic design parameters from the CBC are as follows:

2022 CBC:

S_S = 1.20g	$S_{MS} = F_a * S_S$ = 1.22g	S_{DS} = 2/3 * S_{MS} = 0.82g
S_1 = 0.46g	$S_{M1} = F_V * S_1$ = 0.85g	S_{D1} = 2/3 * S_{M1} = 0.56g

The above seismic code values should be confirmed by the Project Structural Engineer using the value above and the pertinent internet website and tables from the building code. The Project Structural Engineer should also evaluate the period of the proposed structure with respect to the T_S value above when reviewing whether a site-specific response analysis will be requested.

4.2.3 Potential for Ground Rupture

There are no known active faults crossing or projecting through the site. The site is not located in an Alquist-Priolo Earthquake Fault Zone. Therefore, ground rupture at this site due to faulting is considered unlikely.

4.2.4 Liquefaction and Seismic Settlement

The site is not located within a zone identified as having a potential for liquefaction by the State, as the quadrangle has not yet been assessed. Additionally, the site is not located in a zone identified as having a potential for liquefaction by the County. Due to the deep historic groundwater levels, we do not anticipate liquefaction induced settlement to negatively impact the site.

Seismic ground subsidence, not related to liquefaction, occurs when loose, granular soils above the groundwater are densified during strong earthquake shaking. Based on our analyses, we estimate a potential dry seismic settlement of less than ¼-inch. The differential seismic settlement is estimated to be less than ¼-inch across a span of 60 feet.

4.3 EARTHWORK

The earthwork for the planned improvements is anticipated to consist of clearing and excavation of undocumented fill and upper natural soils, subgrade preparation, and the placement and compaction of fill.

4.3.1 Clearing

Prior to grading, performing excavations or constructing the proposed improvements, the areas to be developed should be stripped of vegetation and cleared of debris. Buried obstructions, such as abandoned utilities, and tree roots should be removed from areas to be developed. Deleterious material generated during the clearing operation should be removed from the site. Existing vegetation should not be mixed into the soils.

Although not encountered in our explorations, if cesspools or septic systems are encountered, they should be removed in their entirety. The resulting excavation should be backfilled with properly compacted fill soils. As an alternative, cesspools can be backfilled with lean sand-cement slurry. At the conclusion of the clearing operations, a representative of GPI should observe and accept the site prior to further grading.

4.3.2 Excavations

Excavations at this site will include removals of undocumented fill and disturbed and low-density natural soils, footing excavations, and trenching for proposed utility lines.

Building Pad, Pavements and Minor Structures

To provide uniform support for the planned building, prior to placement of fills or construction of the building, the existing fill and a portion of the upper natural soils within the proposed building pad should be removed and replaced as properly compacted fill. For planning purposes, removals for the building pad should extend to a depth of 3 feet below existing grades and at least 2 feet below the base of foundations, whichever is deeper.

Removals below minor structures, such as free-standing walls and trash enclosures, should extend to a depth of 2 feet below existing grade or 1 foot below the base of the foundation, whichever is deeper. For pavement and flatwork subgrade, removals should extend at least 1 foot below existing grades or the proposed subgrade, whichever is deeper.

The actual depths of removals should be determined in the field during grading by GPI. The soils exposed at the base of the overexcavation should be processed in place as described in the “Subgrade Preparation” section of this report.

Excavation of the soils at the site should be readily achieved using conventional methods. The contractor should determine the best method for removal based on the subsurface conditions outlined herein.

Lateral Limits

The Project Surveyor should accurately stake the corners of the areas to be overexcavated in the field. Where space is available, the base of the excavations should extend laterally at least 5 feet beyond the building lines or edge of foundations, or a minimum distance equal to the depth of overexcavation/compaction below finish grade (i.e., a 1:1 projection below the top outside edge of footings), whichever is greater. Building lines include the footprint of the building and other foundation supported improvements, such as canopies and attached site walls.

Existing Utilities

Where not removed by the aforementioned excavations, existing utility trench backfill should be removed and replaced as properly compacted fill within the building pad. The limits of removal should be confirmed in the field. We recommend known utilities be shown on the grading plan.

Caving Potential and Cuts

The sandy soils at the site are expected to have a moderate to severe caving potential when exposed in open cuts. We recommend the following maximum slope inclinations for temporary excavations:

Excavation Height (ft)	Slope (h:v)
<3	Vertical
<8	¾:1
<15	1:1

If cuts greater than 15 feet are planned, we should be contacted to provide further recommendations. The allowable slope inclinations are measured from the toe to the top of the cut. Even at these inclinations, some raveling should be anticipated. The exposed slope face should be kept moist (but not saturated) during construction to reduce local sloughing. Surcharge loads should not be permitted within a horizontal distance equal to the height of cut from the top of the excavation or 5 feet from the top of the slopes, whichever is greater, unless the cut is properly shored. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of adjacent existing site facilities should be properly shored to maintain support of adjacent elements. Excavations and shoring systems should meet the minimum requirements given in the State of California Occupational Safety and Health Standards.

Slot Cuts

Deeper removals along property lines or adjacent to existing improvements will require shoring or slot cuts. Recommendations for shoring are provided in the “Retaining Structures” section of the report. Removals that will undermine existing adjacent pavements or hardscape may utilize “ABC” slot cuts to depths not greater than 8 feet. Unsurcharged slot cuts up to 8 feet in height should not be wider than 6. Unsurcharged slot cuts up to 6 feet in height should not be wider than 8 feet. The slot cuts should be backfilled to finished grade prior to excavation of the adjacent four slots (two on each side of the excavated slot). We can provide slot widths for other slot heights if required. A test slot should be performed prior to production slots to confirm the stability of the planned cuts.

4.3.3 Subgrade Preparation

After the recommended cuts and removals are performed and prior to placing fills or construction of the proposed improvements, the subgrade soils should be scarified to a depth of 12 inches, moisture conditioned, and compacted to at least 90 percent of the maximum dry density, determined in accordance with ASTM D1557. Moisture conditioning (wetting) of the on-site soils anticipated.

4.3.4 Material for Fill

The upper on-site soils are, in general, suitable for use as compacted fill with some moisture conditioning being required. Although not encountered in our explorations, expansive clayey soils (E.I. greater than 50) were encountered in prior nearby investigations at the site and should not be used as fill within the upper 2 feet below the proposed building pad, or within the upper 1 foot below concrete flatwork subgrade.

Imported fill material should be predominately granular (contain no more than 40 percent fines - portion passing No. 200 sieve) and non-expansive (E.I. of 20 or less). GPI should be provided with a sample (at least 50 pounds) and notified of the location of soils proposed for import at least 72 hours prior to importing. Each proposed import source should be sampled, tested and accepted for use prior to delivery of the soils to the site. Soils imported prior to acceptance by GPI may be rejected if not suitable.

Both imported and existing on-site soils to be used as fill should be free of debris and pieces larger than 8 inches in greatest dimension (3 inches if placed within the depth of the planned footings). If on-site concrete is crushed to be re-used in compacted fill, we recommend the material be crushed to 3-inch minus in size and blended with the on-site soils prior to use.

In backfill areas where mechanical compaction of soil backfill is impractical due to space constraints, sand-cement slurry may be substituted for compacted backfill. The slurry should contain two sacks of cement per cubic yard and have a maximum slump of 5 inches.

If open-graded rock is used as backfill, the material should be placed in lifts and mechanically densified. Open-graded rock should be separated from the on-site soils by a suitable filter fabric (Mirafi 140N or equivalent).

4.3.5 Placement and Compaction of Fills

Fill soils should be placed in horizontal lifts, moisture-conditioned, and mechanically compacted to densities equal to at least 90 percent of the maximum dry density, determined in accordance with ASTM D1557. Fills within one foot of the subgrade pavement areasggregate base material should be compacted to a relative compaction of at least 95 percent. The optimum lift thickness will depend on the compaction equipment used and can best be determined in the field.

The following uncompacted lift thickness can be used as preliminary guidelines.

Plate compactors	4-6 inches
Small vibratory or static rollers (5-ton±) or track equipment	6-9 inches
Scrapers, Heavy loaders, and large vibratory rollers	9-12 inches

The maximum lift thickness should not be greater than 12 inches and each lift should be thoroughly compacted and accepted prior to subsequent lifts.

In general, on-site soils should be placed at moisture contents of 1 to 3 percent over the optimum moisture content. Current moisture contents of the upper soils are predominately slightly below optimum moisture content. Some moisture conditioning (wetting) will be required. Compacted fills should not be allowed to dry out prior to covering. If the fills are allowed to dry out prior to covering, additional moisture conditioning and processing will be required. A representative of GPI should observe and test the finished subgrade within 24 hours of concrete placement for floor slabs and hardscape.

4.3.6 Shrinkage and Subsidence

Shrinkage is the loss of soil volume caused by compaction of fills to a higher density than before grading. Subsidence is the settlement of in-place subgrade soils caused by loads generated by large earthmoving equipment. For earthwork volume estimating purposes, an average shrinkage value of 2 to 7 percent may be assumed for the surficial soils. Subsidence is expected to be less than 0.1 feet. These values are estimates only and exclude losses due to removal of vegetation or debris. Actual shrinkage and subsidence will depend on the types of earthmoving equipment used and should be determined during grading.

4.3.7 Trench/Wall Backfill

Utility trench backfill consisting of the on-site materials or imported soil, or wall backfill consisting of granular material should be mechanically compacted in lifts. Lift thickness should not exceed those values given in the "Placement and Compaction of Fills" section of this report. Moisture conditioning (wetting) of the on-site soils will be required prior to re-use as backfill. Jetting or flooding of backfill materials should not be permitted. A representative of GPI should observe and test trench and wall backfill as they are placed.

4.4 FOUNDATIONS

4.4.1 Foundation Type

As discussed previously, the proposed structures can be supported on conventional spread footings founded in the properly compacted fill.

4.4.2 Allowable Bearing Pressures

Based on the shear strength and elastic settlement characteristics of the natural and recompacted on-site soils, a static allowable net bearing pressure of up to 2,500 pounds per square foot (psf) may be used for both continuous footings and isolated column footings for the proposed building. These bearing pressures are for dead-plus-live-loads, and may be increased one-third for short-term, transient, wind and seismic loading. The actual bearing pressure used may be less than the value presented above and can be based on economics and structural loads to determine the minimum width for footings as discussed below. The maximum edge pressures induced by eccentric loading or overturning moments should not be allowed to exceed these recommended values.

For minor structures, such as site walls and trash enclosures, we recommend a maximum allowable bearing capacity of 1,500 pounds per square foot be used with minimum footing widths and depths of 18 inches.

4.4.3 Minimum Footing Width and Embedment

The following minimum footing widths and embedments are recommended for the corresponding allowable bearing pressure.

STATIC BEARING PRESSURE (psf)	MINIMUM FOOTING WIDTH (inches)	MINIMUM FOOTING* EMBEDMENT (inches)
2,500	24	24
2,000	24	18
1,500	18	18

* Refers to minimum depth below lowest adjacent grade at the time of foundation construction.

A minimum footing depth of 18 inches should be used even if the actual bearing pressure is less than 1,500 psf.

4.4.4 Estimated Settlements

Total static settlement of continuous wall footings (up to 2 kips per lineal foot) is expected to be on the order of ½ to ¾-inch. Differential static settlement between similarly loaded column footings or along a 60-foot span of a continuous footing is expected to be on the order of ½-inch or less. The majority of the settlement will occur immediately upon load application.

The potential for seismic settlement was addressed in a previous section of this report and should be referred to in evaluating the potential total settlements.

The above estimates are based on the assumption that the recommended earthwork will be performed and that the footings will be sized in accordance with our recommendations.

4.4.5 Lateral Load Resistance

Soil resistance to lateral loads will be provided by a combination of frictional resistance between the bottom of footings and underlying soils and by passive soil pressures acting against the embedded sides of the footings. For frictional resistance, a coefficient of friction of 0.35 may be used for design. In addition, an allowable lateral bearing pressure equal to an equivalent fluid weight of 300 pounds per cubic foot may be used, provided the footings are poured tight against compacted fill. These values may be used in combination without reduction.

4.4.6 Foundation Inspection

Prior to placement of concrete and reinforcing steel, a representative of GPI should observe and approve foundation excavations.

4.5 BUILDING FLOOR SLABS

Slab-on-grade floors should be supported on granular, non-expansive (EI $\leq$ 20), compacted soils as discussed in the "Placement and Compaction of Fills" section. There is not a geotechnical requirement for slab reinforcing based on the non-expansive characteristics of the on-site soils.

A vapor/moisture retarder should be placed under slabs that are to be covered with moisture-sensitive floor coverings (parquet, vinyl tile, etc.) or will be storing moisture sensitive supplies. Currently, common practice is to use a 15-mil polyolefin product such as Stego Wrap for this purpose. The need for a sand layer with the vapor barrier is not a geotechnical issue and is a decision for the Project Architect.

It should be noted that the material used as a vapor retarder is only one of several factors affecting the prevention of moisture accumulation under floor coverings. Other factors include maintaining a low water to cement ratio for the concrete used for the floor slab, effective sealing of joints and edges (particularly pipe penetrations), and excess moisture in the concrete. The manufacturer of the floor coverings should be consulted for establishing acceptable criteria for the condition of floor surface prior to placing moisture-sensitive floor coverings.

4.6 RETAINING STRUCTURES

Based on information available to us at this time, retaining walls are not planned at the site, however we have included the following recommendations for walls or shoring less than 6 feet in height. We recommend that walls be backfilled with granular soils (less than 40 percent passing the No. 200 sieve), which are readily available on site.

Active earth pressures can be used for designing cantilevered walls or shoring that can yield laterally at least ½-percent of the wall height under the imposed loads. For level, drained backfill, derived from granular, non-expansive soils, a lateral pressure of an equivalent fluid weighing of 35 pounds per cubic foot may be used. This value can also be used for design of temporary cantilevered shoring.

At-rest pressures should be used for restrained walls that remain rigid enough to be essentially non-yielding. For select, non-expansive, level, drained backfill, a lateral pressure of an equivalent fluid weighing 60 pounds per cubic foot can be used.

The recommended pressures are based on the assumption that the supported earth will be fully drained, preventing the build-up of hydrostatic pressures. For traditional backfilled retaining walls, a drain consisting of perforated pipe and 1 cubic foot of gravel per lineal foot, wrapped in filter fabric should be used. The fabric (non-woven filter fabric, Mirafi 140N or equivalent) should be lapped at the top.

Walls subject to surcharge loads should be designed for an additional uniform lateral pressure equal to one-third and one-half the anticipated surcharge pressure for unrestrained and restrained walls, respectively.

The Structural Engineer should specify the use of select, granular wall backfill on the plans. Wall footings should be designed as discussed in the “Foundations” section.

4.7 PAVEMENTS

A test on the near-surface soils resulted in an R-value of 56. To account for variability of the on-site soils, an R-value of 40 was used for the preliminary design. Based on the subgrade soils anticipated, we recommend the following pavement sections for the various levels of traffic (traffic indices) anticipated:

ASPHALT CONCRETE PAVEMENT

PAVEMENT AREA	TRAFFIC INDEX	SECTION THICKNESS (inches)	
		ASPHALT CONCRETE	AGGREGATE BASE COURSE
Auto Parking/Drives	4/5	3	4

PORTLAND CEMENT CONCRETE PAVEMENT

PAVEMENT AREA	TRAFFIC INDEX	SECTION THICKNESS (inches)	
		f'c = 3,500 psi PCC	f'c = 4,000 psi PCC
Auto Parking/Drives	4/5	5.5	5.0
Truck Areas	6	6.0	5.5
	7	6.5	6.0
	8	6.5	6.5

The Project Civil Engineer should select the appropriate traffic index for the pavement based on the anticipated traffic usage. For design purposes, the following traffic indices correspond to the following number of heavy (five axle) truck trips per day for a 20-year design life:

Traffic Index	Heavy Truck Trips/Day
4	0
5	1
6	3
7	11
8	35

The concrete used for paving should have a compressive strength at least equivalent to the design compressive strength at the time pavement is subjected to traffic. We do not recommend using concrete with a compressive strength of less than 3,500 psi. Based on the soils encountered in our explorations, reinforcing of the concrete pavements is not required from a geotechnical standpoint. Joint patterns and details should be determined by the Project Civil Engineer. Aggregate base is not considered to be required beneath portland cement concrete.

The pavement subgrade and aggregate base course should be compacted to at least 95 percent of the maximum dry density (ASTM D1557). Aggregate base should conform to the requirements of Section 26 of the California Department of Transportation Standard Specifications for Class II Aggregate Base (three-quarter inch maximum) or Section 200-2 of the Standard Specifications for Public Works Construction (Green Book) for untreated base materials (except Processed Miscellaneous Base).

The above recommendations assume that the base course and compacted subgrade will be properly drained. The design of paved areas should incorporate measures to prevent moisture build-up within the base course, which can otherwise lead to premature pavement failure. For example, curbing adjacent to landscaped areas should be deep enough to act as a barrier to infiltration of irrigation water into the adjacent base course.

4.8 CORROSION

Laboratory testing performed by others (CHJ, 2016) for the adjacent site development indicates that the near surface soils exhibit a soluble sulfate content of 241 mg/kg. For the 2022 CBC, foundation concrete should conform to the requirements outlined in ACI 318, Section 4.3 for Category S0 levels of soluble sulfate exposure from the on-site soils. Chloride levels in the on-site soils are found to be 246 mg/kg. For concrete exposed to soil moisture, such as footings and floor slabs, we recommend a chloride Category C1.

Resistivity testing indicates that they are severely corrosive to buried ferrous metals. Soil corrosion with regards to foundation concrete was addressed in a prior section of this report. GPI does not practice corrosion protection engineering. If corrosion protection recommendations are required, a corrosion engineer such as HDR should be consulted to provide recommendations to protect these elements from corrosion.

4.9 DRAINAGE

Positive surface gradients should be provided adjacent to structures so as to direct surface water run-off and roof drainage away from foundations and slabs toward suitable discharge facilities. Long-term ponding of surface water should not be allowed on pavements or adjacent to buildings.

4.10 INFILTRATION TESTING

Test wells P-1 and P-2 were installed in boreholes drilled using truck-mounted hollow-stem auger drill equipment at preliminary infiltration basin locations provided by the Project Civil Engineer. The locations of the test wells are shown on Figure 2. The wells consisted of 2-inch diameter PVC casing installed in an 8-inch diameter borehole. The casing was perforated in the lower 2 feet of the wells. Packing material around the slotted sections of the well casing consisted of #3 sand. The test wells were constructed to depths of approximately 10 to 12 feet below existing grade in order to test the soils near the bottom of the proposed infiltration basin being considered at the time our field work was conducted. The infiltration testing was performed in general accordance with the San Bernardino County guidelines for borehole infiltration tests.

The measured infiltration rates were calculated using the drop in water level over the test increment time. The final measured rates for each well, corrected as indicated above, are presented in the following table and should be used with an appropriate factor of safety.

Infiltration Test Results Summary

TEST WELL	APPROXIMATE DEPTH OF TEST WELL (feet)	CORRECTED INFILTRATION RATE (in./hr.)
P-1	10	3.0
P-2	12	1.9

The Civil Engineer should evaluate the feasibility of surface infiltration using the rates provided above. Additional factors of safety in computing the design infiltration rate of the proposed infiltration BMP should be determined by the project Civil Engineer.

It should also be noted that the infiltration rates are for clean, clear water and do not include effects of sediment, fines, dissolved solids or other debris, as these materials will significantly reduce the infiltration rates of the subsurface soils. Prior to infiltration, water should be cleaned of sediment or other deleterious materials to help reduce the potential for clogging and reduced percolation rates. Should fines or suspended solids be permitted to enter the basin, reduced infiltration rates will result.

4.11 GEOTECHNICAL OBSERVATION AND TESTING

We recommend that a representative of GPI observe earthwork during construction to confirm that the recommendations provided in our report are applicable during construction. The earthwork activities include grading, compaction of fills, subgrade preparation, pavement construction and foundation excavations. Sufficient in-place field density tests should be performed during fill placement and in-place compaction to evaluate the overall compaction of the soils. Soils that do not meet minimum compaction requirements should be reworked and tested prior to placement of additional fill. If conditions are different than expected, we should be afforded the opportunity to provide an alternate recommendation based on the actual conditions encountered.

5.0 LIMITATIONS

This report, exploration logs, and other materials resulting from GPI's efforts were prepared exclusively for BRE Space Paxbello LLC. and their consultants in designing the proposed development. The report is not intended to be suitable for reuse on extensions or modifications of the project or for use on projects other than the currently proposed development, as it may not contain sufficient or appropriate information for such uses. If this report or portions of this report are provided to contractors or included in specifications, it should be understood that they are provided for information only. This report cannot be utilized by another entity without the express written permission of GPI.

Soil deposits may vary in type, strength, and many other important properties between points of exploration due to non-uniformity of the geologic formations or to man-made cut and fill operations. While we cannot evaluate the consistency of the properties of materials in areas not explored, the conclusions drawn in this report are based on the assumption that the data obtained in the field and laboratory are reasonably representative of field conditions and are conducive to interpolation and extrapolation.

Furthermore, our recommendations were developed with the assumption that a proper level of field observation and construction review will be provided by GPI during grading, excavation, and foundation construction. If field conditions during construction appear to be different than is indicated in this report, we should be notified immediately so that we may assess the impact of such conditions on our recommendations. If others perform the construction phase services, they must accept full responsibility for all geotechnical aspects of the project, including this report.

Our investigation and evaluations were performed using generally accepted engineering approaches and principles available at this time and the degree of care and skill ordinarily exercised under similar circumstances by reputable geotechnical engineers practicing in this area. No other representation, either express or implied, is included or intended in our report.

Respectfully submitted,
Geotechnical Professionals Inc.

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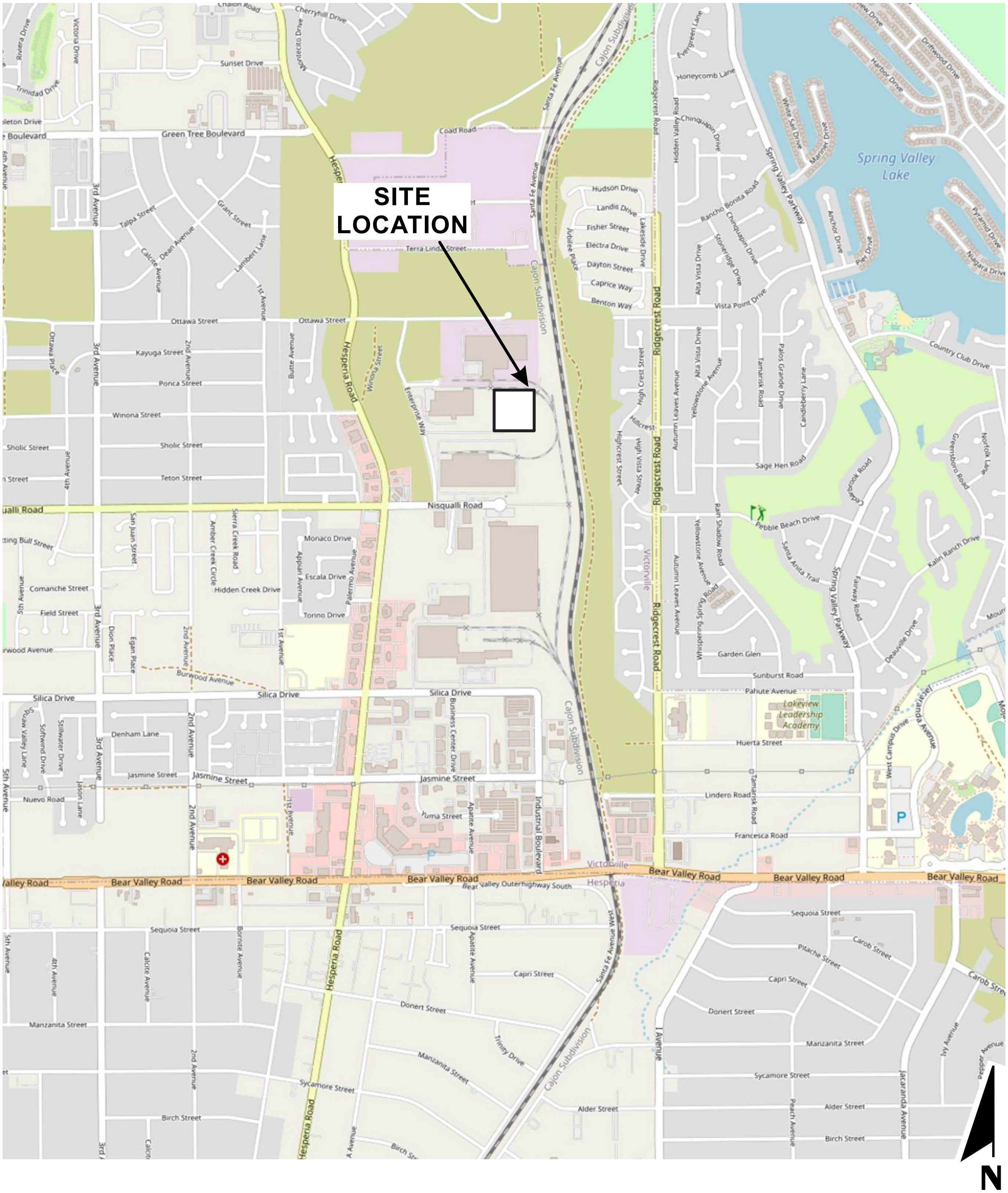


0 2000 4000 FEET

BASE MAP REPRODUCED FROM CALTOPO © 2022

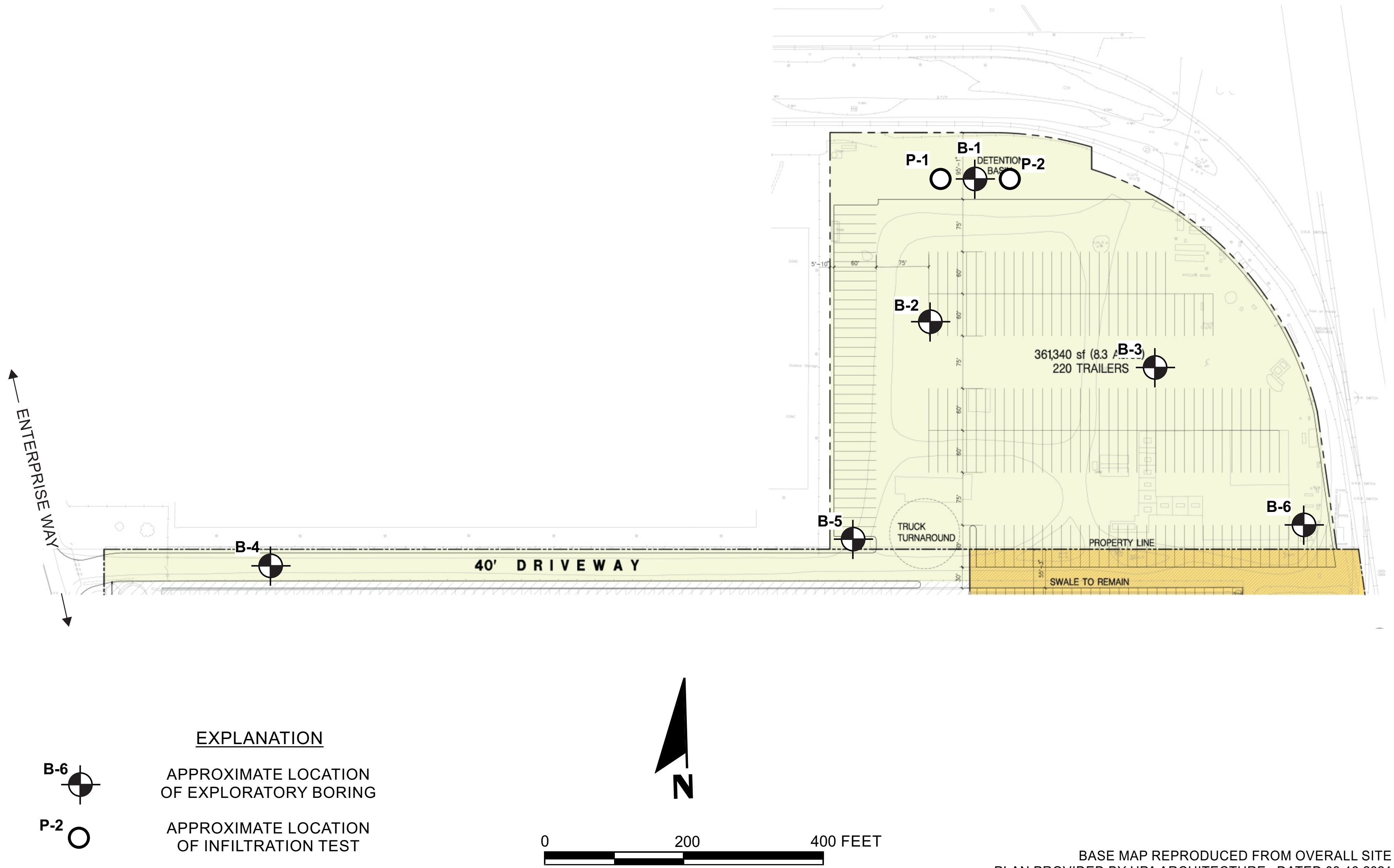
GPI GEOTECHNICAL PROFESSIONALS, INC.

BRE SPACE VICTORVILLE

GPI PROJECT NO.: 3149.I	SCALE: 1" = 2000'

SITE LOCATION MAP

FIGURE 1



EXPLANATION

B-6 APPROXIMATE LOCATION OF EXPLORATORY BORING

P-2 APPROXIMATE LOCATION OF INFILTRATION TEST

BASE MAP REPRODUCED FROM OVERALL SITE PLAN PROVIDED BY HPA ARCHITECTURE : DATED 08-16-2021

GEOTECHNICAL PROFESSIONALS, INC.

BRE SPACE - TRAILER LOT EXPANSION

GPI PROJECT NO.: 3149.I

SCALE: 1" = 200'

SITE PLAN

FIGURE 2

APPENDIX A

EXPLORATORY BORINGS

The subsurface conditions for the site were investigated by drilling and sampling 6 exploratory borings. The borings were advanced to depths of 4 to 26 feet below the existing ground surface. The approximate locations of the explorations are shown on the Site Plan, Figure 2.

The exploratory borings were drilled using truck-mounted hollow-stem auger drill equipment. Relatively undisturbed samples were obtained using a brass-ring lined sampler (ASTM D3550). The brass-rings have an inside diameter of 2.42 inches. The ring samples were driven into the soil by a 140-pound hammer dropping 30 inches. The number of blows needed to drive the sampler into the soil was recorded as the penetration resistance.

At selected locations, disturbed samples were obtained using a split-spoon sampler by means of the Standard Penetration Test (SPT, ASTM D 6066). The spoon sampler was driven into the soil by a 140-pound hammer dropping 30 inches, employing the “free-fall” hammer described above. After an initial seating drive of 6 inches, the number of blows needed to drive the sampler into the soil a depth of 12 inches was recorded as the penetration resistance. These values are the raw uncorrected blow counts.

The field explorations for the investigation were performed under the continuous technical supervision of GPI's representative, who visually inspected the site, maintained detailed logs of the borings, classified the soils encountered, and obtained relatively undisturbed samples for examination and laboratory testing. The soils encountered in the borings were classified in the field and through further examination in the laboratory in accordance with the Unified Soils Classification System. Detailed logs of the borings are presented in Figures A-1 through A-6 in this appendix. Upon completion of the sampling of hollow-stem auger borings, the holes were backfilled with the excavated soils.

The boring locations were laid out in the field by measuring from existing site features. Ground surface elevations at the exploration locations were estimated from the ALTA Land Title Survey by David Evans and Associates dated December 13, 2022.

MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)	DESCRIPTION OF SUBSURFACE MATERIALS	ELEVATION (FEET)
				0	Fill: **GRAVELY SAND (GP)** brown, moist, trace silt	2900
8.2	112	67	D		Natural: **GRAVELY SAND (GP)** brown, moist, dense, trace silt	
7.1	116	50	D	5		2895
3.6	113	74	D		@ 7 feet, slightly moist	
2.9	117	80	D	10	**SANDY SILT (ML)** brown, dry, hard	2890
7.3		33	S		**SILTY SAND (SM)** brown, slightly moist, dense, with gravel	
6.2	114	72	D	15	**CLAYEY SAND (SC)** brown, moist, dense, with gravel @ 15 feet, trace cobbles	2885
14.0		19	S		@ 17.5 feet, dark brown, very moist, medium dense	
3.4	113	50/3"	D	20	**SILTY SAND (SM)** brown, dry to slightly moist, very dense, with gravel	2880
3.8		49	S		**GRAVELY SAND (GP)** brown, slightly moist, dense, with silt	
10.6	102	60	D	25	**SILTY SAND (SM)** brown, moist, dense	2875
					Total Depth 26 feet	

This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

SAMPLE TYPES
- C Rock Core
- S Standard Split Spoon
- D Drive Sample
- B Bulk Sample
- T Tube Sample

DATE DRILLED:
12-8-22

EQUIPMENT USED:
8 " HOLLOW STEM AUGER

GROUNDWATER LEVEL (ft):
NOT ENCOUNTERED

GPI

PROJECT NO.: 3149.I

BRE VICTORVILLE

LOG OF BORING NO. B-1

FIGURE A-1

	MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)	DESCRIPTION OF SUBSURFACE MATERIALS This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	ELEVATION (FEET)
					0	Fill: **SILTY SAND (SM)** brown, slightly moist, with gravel	
	4.6	111	37	D		Natural: **SILTY SAND (SM)** brown, moist, medium dense	2900
	2.9	117	77	D	5	@ 5 feet, dry	
						Total depth 6 feet	

SAMPLE TYPES
- C Rock Core
- S Standard Split Spoon
- D Drive Sample
- B Bulk Sample
- T Tube Sample

DATE DRILLED:
12-8-22

EQUIPMENT USED:
8 " HOLLOW STEM AUGER

GROUNDWATER LEVEL (ft):
NOT ENCOUNTERED

GPI

PROJECT NO.: 3149.I

BRE VICTORVILLE

LOG OF BORING NO. B-2

FIGURE A-2

	MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)		*DESCRIPTION OF SUBSURFACE MATERIALS*	ELEVATION (FEET)
							This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	
					0		Fill: **SILTY SAND (SM)** brown, moist, with gravel	2910
	3.2	114	47	D			Natural: **SILTY SAND (SM)** brown, dry to slightly moist, dense	
	6.2	106	65	D	5		@ 5 feet, slightly moist	2905
							Total Depth 6 feet	

SAMPLE TYPES
- C Rock Core
- S Standard Split Spoon
- D Drive Sample
- B Bulk Sample
- T Tube Sample

DATE DRILLED:
12-8-22

EQUIPMENT USED:
8 " HOLLOW STEM AUGER

GROUNDWATER LEVEL (ft):
NOT ENCOUNTERED

GPI

PROJECT NO.: 3149.I

BRE VICTORVILLE

LOG OF BORING NO. B-3

FIGURE A-3

	MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)	DESCRIPTION OF SUBSURFACE MATERIALS	ELEVATION (FEET)
						This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	
					0	Fill: **SAND (SP)** brown, slightly moist, with gravel	
	3.6	99	27	D		@ 2 feet, medium dense	
							2910
					5		
	3.0	99	39	D		Natural: **SILTY SAND (SM)** brown, dry to slightly moist, medium dense, with gravel	
						Total Depth 6 feet	

SAMPLE TYPES
- C Rock Core
- S Standard Split Spoon
- D Drive Sample
- B Bulk Sample
- T Tube Sample

DATE DRILLED: 12-8-22

EQUIPMENT USED: 8 " HOLLOW STEM AUGER

GROUNDWATER LEVEL (ft): NOT ENCOUNTERED

PROJECT NO.: 3149.I

BRE VICTORVILLE

LOG OF BORING NO. B-4

FIGURE A-4

	MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)	DESCRIPTION OF SUBSURFACE MATERIALS	ELEVATION (FEET)
					0	Fill: **SILTY SAND (SM)** brown, moist, with gravel	
	7.9	118	70	D		Natural: **SILTY SAND (SM)** brown, moist, dense	
							2900
	2.8	108	50/5"	D	5	@ 5 feet, dry, very dense	
	4.4	117	50/6"	D		@ 7 feet, dry to slightly moist	
							2895
	6.9	116	79	D	10	@ 10 feet, slightly moist	
							2890
	6.4	96	62	D	15	**CLAYEY SAND (SC)** brown, slightly moist, dense, with gravel	
							2885
	5.8	102	30	D	20	**SILTY SAND (SM)** brown, slightly moist, medium dense	
						CLAYEY SAND (SC) brown, slightly moist, medium dense, with gravel	
						Total Depth 21 feet	

This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

SAMPLE TYPES
- C Rock Core
- S Standard Split Spoon
- D Drive Sample
- B Bulk Sample
- T Tube Sample

DATE DRILLED: 12-8-22

EQUIPMENT USED: 8 " HOLLOW STEM AUGER

GROUNDWATER LEVEL (ft): NOT ENCOUNTERED

GPI

PROJECT NO.: 3149.I

BRE VICTORVILLE

LOG OF BORING NO. B-5

MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)		*DESCRIPTION OF SUBSURFACE MATERIALS* This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	ELEVATION (FEET)
			B	0		Fill: **SILTY SAND (SM)** brown, moist, with gravel	2910
						Total Depth 4 feet	

SAMPLE TYPES
- C Rock Core
- S Standard Split Spoon
- D Drive Sample
- B Bulk Sample
- T Tube Sample

DATE DRILLED:
12-8-22

EQUIPMENT USED:
8 " HOLLOW STEM AUGER

GROUNDWATER LEVEL (ft):
NOT ENCOUNTERED

GPI

PROJECT NO.: 3149.I

BRE VICTORVILLE

LOG OF BORING NO. B-6

FIGURE A-6

APPENDIX B

LABORATORY TESTS

INTRODUCTION

Representative undisturbed soil samples and bulk samples were carefully packaged in the field and sealed to prevent moisture loss. The samples were then transported to our Cypress office for examination and testing assignments. Laboratory tests were performed on selected representative samples as an aid in classifying the soils and to evaluate the physical properties of the soils affecting foundation design and construction procedures. Detailed descriptions of the laboratory tests are presented below under the appropriate test headings. Test results are presented in the figures that follow.

MOISTURE CONTENT AND DRY DENSITY

Moisture content and dry density were determined from a number of the ring samples from the borings. The samples were first trimmed to obtain volume and wet weight and then were dried in accordance with ASTM D2216. After drying, the weight of each sample was measured, and moisture content and dry density were calculated. Moisture content and dry density values are presented on the boring logs in Appendix A.

PERCENTAGE PASSING NO. 200 SIEVE

Select soil samples were dried, weighed, soaked in water until individual soil particles were separated, and then washed on the No. 200 sieve. That portion of the material retained on the No. 200 sieve was oven-dried and weighed to determine the percentage of the material passing the No. 200 sieve. For select samples, the retained material was then run through a standard set of sieves in accordance with ASTM D6913 to classify the coarse fraction of representative sample. A summary of the percentages passing the No. 200 sieve is presented below. The grain size distribution data obtained from the full sieve analyses are presented in Figure B-1.

BORING NO.	DEPTH (ft)	SOIL DESCRIPTION	PERCENT PASSING No. 200 SIEVE
B-1	10	Sandy Silt (ML)	59
B-1	15	Clayey Sand (SC)	14
B-3	0-5	Silty Sand (SM)	17

COMPACTION TEST

Maximum dry density/optimum moisture tests were performed in accordance with ASTM D1557 on select representative bulk samples of the site soils. The samples were first screened through the No. 4 sieve and the sample retained was weighed to determine the material retained on the No. 4 sieve. The amount retained was used to determine the rock corrected maximum dry density in accordance with ASTM D 1557 specifications. The test results for the screened (passing No. 4 sieve) and rock-corrected sample are as follows:

BORING NO.	DEPTH (ft)	SOIL DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)
B-10	0-5	Silty Sand (SM)	132	8.0
		Silty Sand (SM) with rock correction	135	8.0

R-VALUE

Suitability of the near-surface soils for pavement was evaluated by conducting an R-value test. The test was performed in accordance with ASTM D 2844 by GeoLogic Associates (GLA) under subcontract to GPI. The result of the test is as follows:

TEST PIT NO.	DEPTH (ft)	SOIL DESCRIPTION	R-VALUE BY EXUDATION
B-3	0 – 5	Silty Sand (SM)	56

APPENDIX D

NOAA Atlas 14, Volume 6, Version 2
Location name: Victorville, California, USA*
Latitude: 34.489°, Longitude: -117.2836°
Elevation: 2892.87 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	0.090 (0.075-0.111)	0.126 (0.104-0.154)	0.176 (0.144-0.216)	0.218 (0.178-0.270)	0.279 (0.220-0.357)	0.329 (0.255-0.430)	0.383 (0.289-0.512)	0.440 (0.323-0.606)	0.523 (0.369-0.751)	0.592 (0.403-0.878)
10-min	0.130 (0.107-0.159)	0.181 (0.149-0.221)	0.252 (0.207-0.309)	0.313 (0.255-0.387)	0.400 (0.316-0.512)	0.472 (0.365-0.616)	0.548 (0.414-0.734)	0.631 (0.463-0.869)	0.750 (0.528-1.08)	0.848 (0.577-1.26)
15-min	0.157 (0.130-0.192)	0.219 (0.180-0.268)	0.304 (0.250-0.374)	0.378 (0.308-0.468)	0.484 (0.382-0.619)	0.571 (0.441-0.746)	0.663 (0.501-0.888)	0.763 (0.560-1.05)	0.907 (0.639-1.30)	1.03 (0.698-1.52)
30-min	0.213 (0.176-0.260)	0.296 (0.245-0.363)	0.413 (0.340-0.507)	0.513 (0.418-0.635)	0.657 (0.518-0.840)	0.774 (0.599-1.01)	0.900 (0.679-1.20)	1.03 (0.760-1.43)	1.23 (0.867-1.77)	1.39 (0.947-2.07)
60-min	0.257 (0.212-0.314)	0.358 (0.295-0.438)	0.498 (0.410-0.612)	0.618 (0.505-0.766)	0.792 (0.625-1.01)	0.934 (0.722-1.22)	1.09 (0.819-1.45)	1.25 (0.917-1.72)	1.49 (1.05-2.13)	1.68 (1.14-2.49)
2-hr	0.362 (0.299-0.443)	0.488 (0.402-0.597)	0.661 (0.544-0.812)	0.809 (0.660-1.00)	1.02 (0.806-1.31)	1.19 (0.922-1.56)	1.37 (1.04-1.84)	1.57 (1.15-2.16)	1.85 (1.30-2.65)	2.07 (1.41-3.08)
3-hr	0.437 (0.361-0.535)	0.582 (0.480-0.713)	0.781 (0.643-0.959)	0.951 (0.776-1.18)	1.19 (0.941-1.53)	1.39 (1.07-1.81)	1.59 (1.20-2.13)	1.81 (1.33-2.49)	2.12 (1.50-3.05)	2.37 (1.62-3.52)
6-hr	0.596 (0.492-0.729)	0.788 (0.650-0.965)	1.05 (0.863-1.29)	1.27 (1.03-1.57)	1.58 (1.25-2.02)	1.83 (1.41-2.39)	2.09 (1.58-2.80)	2.37 (1.74-3.25)	2.75 (1.94-3.95)	3.07 (2.09-4.55)
12-hr	0.766 (0.632-0.936)	1.02 (0.843-1.25)	1.37 (1.13-1.68)	1.66 (1.35-2.05)	2.06 (1.62-2.63)	2.37 (1.84-3.10)	2.70 (2.04-3.62)	3.05 (2.24-4.20)	3.53 (2.49-5.06)	3.91 (2.66-5.81)
24-hr	1.00 (0.887-1.15)	1.36 (1.20-1.57)	1.84 (1.62-2.12)	2.23 (1.95-2.60)	2.77 (2.35-3.34)	3.20 (2.66-3.93)	3.64 (2.95-4.58)	4.10 (3.23-5.31)	4.73 (3.58-6.38)	5.23 (3.82-7.31)
2-day	1.16 (1.03-1.33)	1.60 (1.41-1.84)	2.18 (1.93-2.52)	2.66 (2.33-3.10)	3.33 (2.82-4.01)	3.85 (3.19-4.73)	4.39 (3.55-5.52)	4.95 (3.90-6.41)	5.72 (4.33-7.72)	6.34 (4.63-8.85)
3-day	1.26 (1.12-1.45)	1.75 (1.55-2.01)	2.40 (2.12-2.78)	2.94 (2.58-3.43)	3.69 (3.13-4.44)	4.27 (3.55-5.25)	4.88 (3.95-6.14)	5.51 (4.34-7.14)	6.38 (4.83-8.62)	7.08 (5.17-9.89)
4-day	1.34 (1.19-1.54)	1.86 (1.65-2.15)	2.57 (2.27-2.96)	3.14 (2.75-3.66)	3.94 (3.34-4.74)	4.56 (3.79-5.61)	5.21 (4.22-6.56)	5.88 (4.63-7.61)	6.81 (5.15-9.19)	7.55 (5.51-10.5)
7-day	1.45 (1.29-1.67)	2.00 (1.77-2.31)	2.74 (2.42-3.17)	3.35 (2.94-3.91)	4.19 (3.55-5.05)	4.85 (4.02-5.96)	5.52 (4.47-6.95)	6.22 (4.90-8.06)	7.19 (5.43-9.70)	7.95 (5.80-11.1)
10-day	1.53 (1.36-1.77)	2.11 (1.87-2.43)	2.88 (2.54-3.33)	3.52 (3.08-4.10)	4.39 (3.72-5.29)	5.08 (4.21-6.24)	5.78 (4.68-7.28)	6.51 (5.13-8.43)	7.51 (5.68-10.1)	8.30 (6.07-11.6)
20-day	1.76 (1.56-2.02)	2.43 (2.16-2.81)	3.34 (2.95-3.86)	4.10 (3.59-4.78)	5.15 (4.37-6.20)	5.98 (4.96-7.35)	6.83 (5.53-8.60)	7.72 (6.08-10.00)	8.95 (6.76-12.1)	9.91 (7.24-13.8)
30-day	1.99 (1.76-2.29)	2.77 (2.45-3.19)	3.83 (3.38-4.43)	4.72 (4.14-5.50)	5.98 (5.07-7.20)	6.98 (5.79-8.58)	8.01 (6.49-10.1)	9.10 (7.17-11.8)	10.6 (8.02-14.3)	11.8 (8.62-16.5)
45-day	2.33 (2.07-2.68)	3.26 (2.88-3.75)	4.54 (4.01-5.24)	5.64 (4.94-6.57)	7.21 (6.11-8.68)	8.47 (7.03-10.4)	9.80 (7.94-12.3)	11.2 (8.84-14.5)	13.2 (9.99-17.8)	14.8 (10.8-20.7)
60-day	2.55 (2.26-2.93)	3.55 (3.15-4.09)	4.97 (4.39-5.75)	6.21 (5.44-7.23)	8.00 (6.78-9.63)	9.47 (7.86-11.6)	11.0 (8.94-13.9)	12.7 (10.0-16.5)	15.1 (11.4-20.4)	17.1 (12.5-23.9)

[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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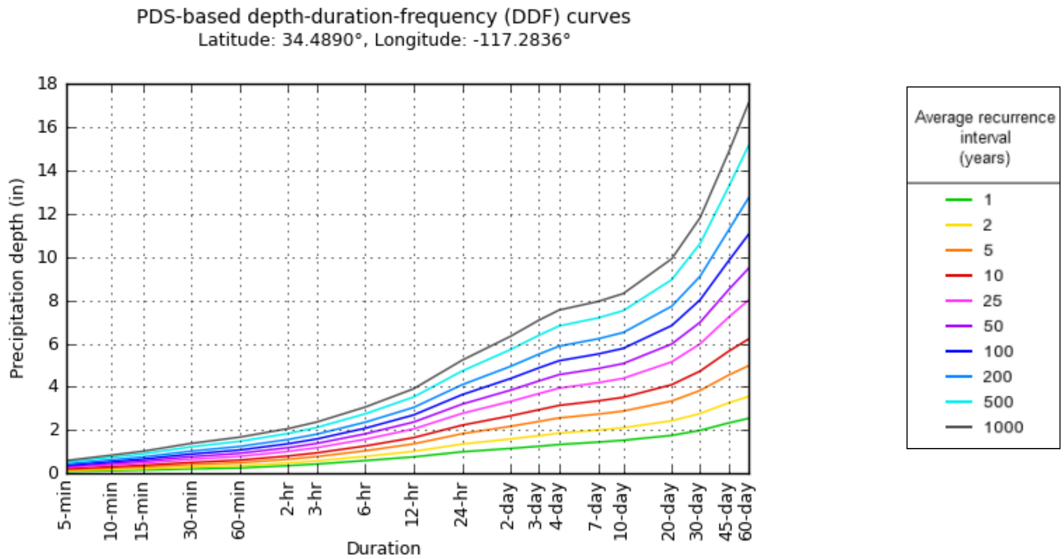
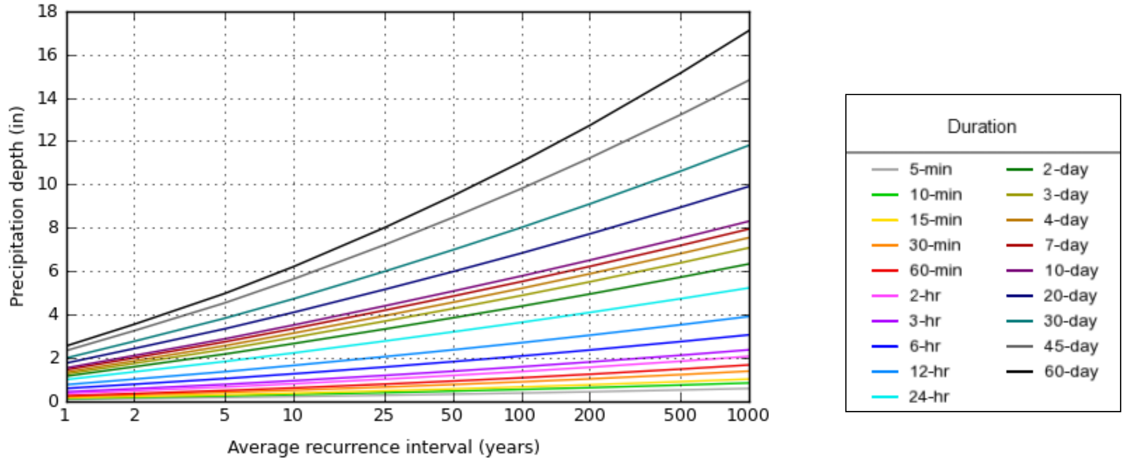
PF graphical





NOAA Atlas 14, Volume 6, Version 2 Created (GMT): Wed Jan 11 19:53:29 2023

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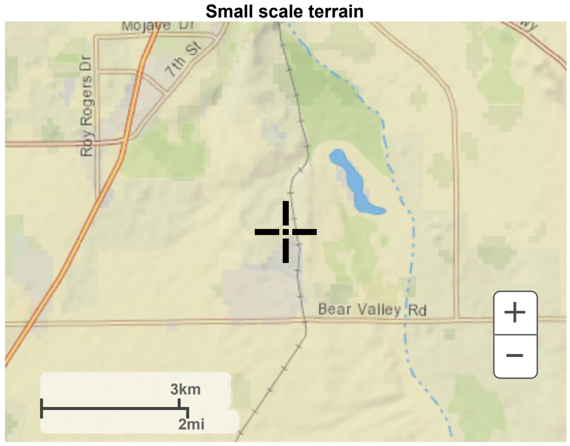
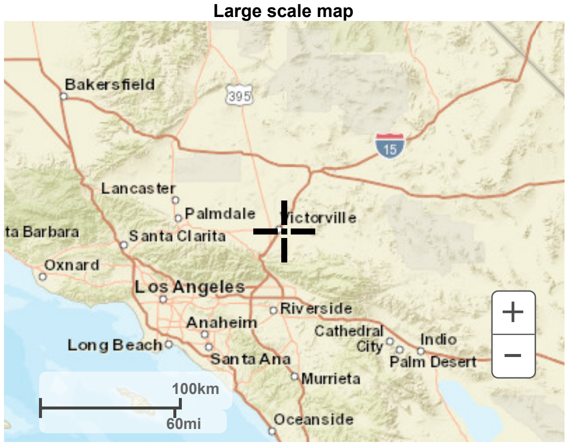
Maps & aerials

Small scale terrain

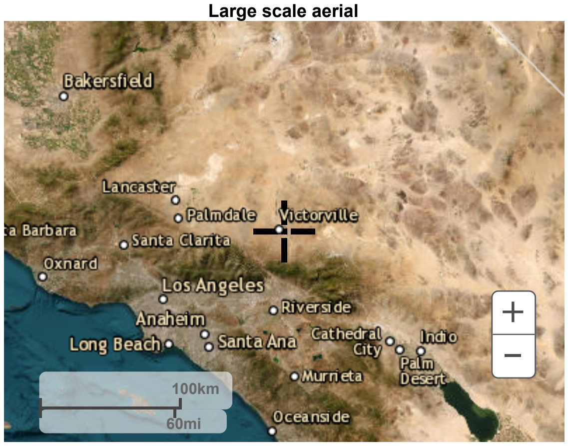


Large scale terrain

Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Infiltration Rate Factor of Safety Calculation Summary

Tributary Area A1, A2, & A3 to Infiltration Basin A (10.06 Acres)

Factor Category		Factor Description	Assigned Weight (w)	Factor Value $(v)^2$	Product (p) p=w*v
A	Suitability Assesment	Soil Assesment Methods	0.25	1	0.25
		Predominant Soil Texture	0.25	3	0.75
		Site Soil Variability	0.25	3	0.75
		Depth to Groundwater / Impervious Layer	0.25	1	0.25
		Suitability Assessment Safety Factor = Σp			2.00
B	Design	Tributary Area Size	0.25	3	0.75
		Level of Pretreatment / Expected Sediment Loads	0.25	3	0.75
		Redundancy*	0.25	2	0.50
		Compaction During Construction	0.25	1	0.25
		Design Safety Factor SB = Σp			2.25
Calculated Safety Factor					4.50
Minimum Allowable Safety Factor					2.00
Safety Factor Applied					4.50

Table VII.4: Design Related Considerations for Infiltration Facility Safety Factors

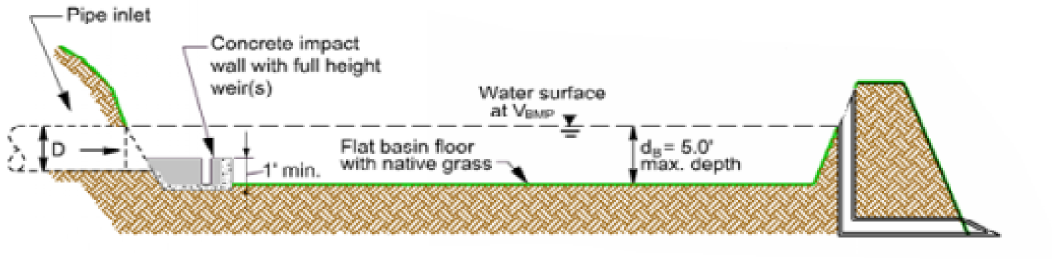
Consideration	High Concern	Medium Concern	Low Concern
Tributary area size	Greater than 10 acres.	Greater than 2 acres but less than 10 acres.	2 acres or less.
Level of pretreatment/ expected influent sediment loads	Pretreatment from gross solids removal devices only, such as hydrodynamic separators, racks and screens AND tributary area includes landscaped areas, steep slopes, high traffic areas, or any other areas expected to produce high sediment, trash, or debris loads.	Good pretreatment with BMPs that mitigate coarse sediments such as vegetated swales AND influent sediment loads from the tributary area are expected to be relatively low (e.g., low traffic, mild slopes, disconnected impervious areas, etc.).	Excellent pretreatment with BMPs that mitigate fine sediments such as bioretention or media filtration OR sedimentation or facility only treats runoff from relatively clean surfaces, such as rooftops.
Redundancy of treatment	No redundancy in BMP treatment train.	Medium redundancy, other BMPs available in treatment train to maintain at least 50% of function of facility in event of failure.	High redundancy, multiple components capable of operating independently and in parallel, maintaining at least 90% of facility functionality in event of failure.
Compaction during construction	Construction of facility on a compacted site or elevated probability of unintended/ indirect compaction.	Medium probability of unintended/ indirect compaction.	Heavy equipment actively prohibited from infiltration areas during construction and low probability of unintended/ indirect compaction.
Assessment methods (see explanation below)	Use of soil survey maps or simple texture analysis to estimate short-term infiltration rates	Direct measurement of ≥ 20 percent of infiltration area with localized infiltration measurement methods (e.g., infiltrometer)	Direct measurement of ≥ 50 percent of infiltration area with localized infiltration measurement methods or Use of extensive test pit infiltration measurement methods
Texture Class	Silty and clayey soils with significant fines	Loamy soils	Granular to slightly loamy soils
Site soil variability	Highly variable soils indicated from site assessment or limited soil borings collected during site assessment	Soil borings/test pits indicate moderately homogeneous soils	Multiple soil borings/test pits indicate relatively homogeneous soils
Depth to groundwater/ impervious layer	<5 ft below facility bottom	5-10 ft below facility bottom	>10 below facility bottom

Infiltration Basin (Per TGD for San Bernardino County, pg 58)

Facility Name: BMP A

Legend

Proposed Dimensions
Calculated Values
Input Variables



Typical Section

Variables

FS	4.5	
Field Infiltration (in/hr):	2.5	
P_{design} (in/hr)	0.56	(see Worksheet H)
SA_{inf} (ft^2)	17,433.0	
T_{fill} (hrs)	3	(3 for default)
$T_{drawdown}$ (hrs)	48	(48 for default)
DCV (ft^3)	23,190	

Calculations

V_{ret} (ft^3)	41,161	Vret > DCV Therefore, Adequate for Design
DCV (ft^3)	23,190	

Location of First Orifice, Minimum:	1.33

Where:

$V_{ret}=P_{design}/12*SA_{inf}*(T_{drawdown}+T_{fill})$

P_{design} = Design percolation Rate (in/hr),divided by safety factor of 2.19. Refer to Percolation Report in Attachment E.

SA_{inf} = Infiltration surface area (ft^2)

T_{fill} = Duration of storm when infiltration is occurring as basin is filling (hrs), default is 3 hours

$T_{drawdown}$ = Drawdown time for stored runoff (hrs), default is 48 hours

(Equations per Table 5-4 in San Bernardino County TGD, pg 61)

APPENDIX E

Excerpt from Project Hydrology Report

Unit Hydrograph Summary Table					
Area ID	**Acreage (ac)**	**$Q_{100\text{-Yr }24\text{-Hr}}$ (cfs)**	**$Vol_{100\text{-Yr }24\text{-Hr}}$ (acft)**	**$Q_{10\text{-Yr }24\text{-Hr}}$ (cfs)**	**$Vol_{10\text{-Yr }24\text{-Hr}}$ (acft)**
Existing Condition					
Ex. Area A	10.06	***15.5***	2.0	***7.4***	1.0
Developed Condition					
Dev. Area A	10.06	24.0	2.6	12.8	1.5
Mitigated Condition					
Mit. Total:	10.06	***7.1***	2.6	***4.7***	1.5

Rational Method Summary Table							
Area ID	**Acreage (ac)**	**Q_2 (cfs)**	**TC_{2yr} (min)**	**Q_{10} (cfs)**	**TC_{10yr} (min)**	**Q_{100} (cfs)**	**TC_{100yr} (min)**
Existing Condition	10.06	2.4	34.8	6.5	31.1	14.2	28.51
Proposed Condition	10.06	6.6	19.0	12.7	17.4	24.2	16.0

MAP LEGEND

100.00 249.97 FS NODE DESIGNATION

D / 0.18 AC — DMA ID / ACREAGE

DRAINGE AREA BOUNDARY

L=200' FLOW LENGTH / FLOW LINE

DRAINAGE AREA BOUNDARY FOR UNIT HYDROGRAPH ANALYSIS (10.06 ACRES)

DIRECTION OF FLOW

N

60 0 60 120 scale feet 1"= 60'

Hydrology Summary Table			2 Year				10 Year				100 Year			
Flow Type	Node	Area (ac)	Q (cfs)	TC (min)	Cum. Tc (min)	Cumm Q (cfs)	Q (cfs)	TC (min)	Cum. Tc (min)	Cum Q (cfs)	Q (cfs)	TC (min)	Cum. Tc (min)	Cum Q (cfs)
Initial Area	100-101	0.50	0.30	15.50	15.50	0.30	0.60	15.50	15.50	0.60	1.15	15.50	15.50	1.15
Improved Channel Flow	101-102	0.50	0.04	10.50	26.00	0.34	0.21	8.75	24.25	0.81	0.54	7.36	22.86	1.69
Improved Channel Flow	102-103	9.06	2.01	8.76	34.76	2.35	5.65	6.87	31.12	6.46	12.52	5.65	28.51	14.21
Confluence Main Stream	100-103	10.06	-	-	34.76	2.35	-	-	31.12	6.46	-	-	28.51	14.21

DAVID EVANS AND ASSOCIATES INC.
41951 Remington Avenue
Temecula, CA 92590
Phone: 951.294.9300

SPACE CENTER EXPANSION HYDROLOGY EXHIBIT

SPACE CENTER EXPANSION FLAG LOT

EXISTING CONDITION HYDROLOGY MAP

CITY OF VICTORVILLE CALIFORNIA

SUBMITTAL STATUS

CHECKED BY: CHECKED BY
DESIGNED BY: JFA
DRAWN BY: JFA

FIRST SUBMITTAL DATE: XXX

PROJECT NO.
SPACBRES0002

SHEET NO.
1 OF 1

Plot Date: 1/16/2023 8:50 AM By: Jose Aguilar
Save Date: 1/13/2023 4:08 PM By: Jfa File: P:\S\SPACBRES0001\0600INFO\0670Reports\Phase 2 Flag\Hydrology Report\CAD\B_1_Existing Condition Hydrology Exhibit.dwg

MAP LEGEND

100.00 249.97 FS NODE DESIGNATION

D 0.18 AC — DMA ID / ACREAGE

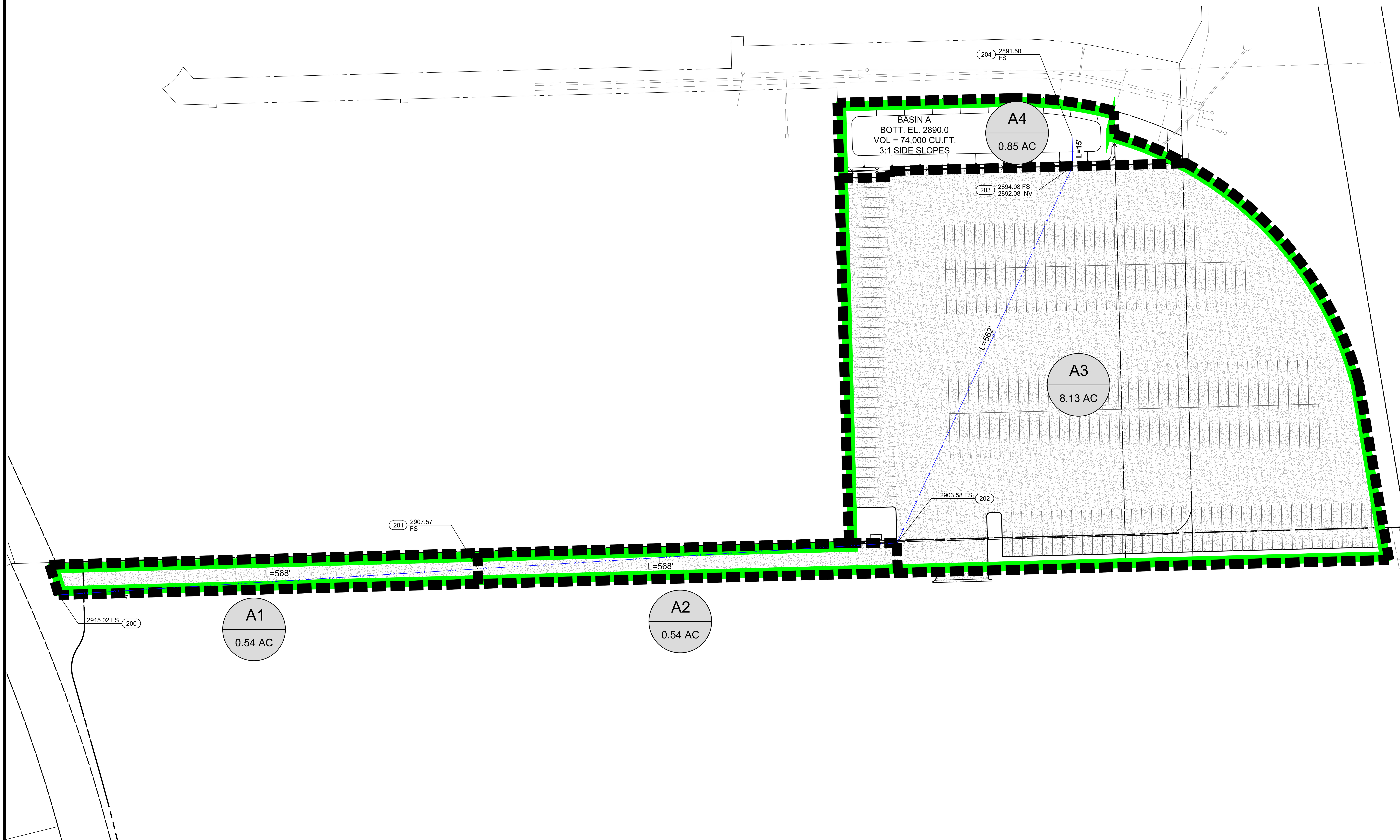
DRAINGE AREA BOUNDARY

DRAINAGE AREA BOUNDARY DRAINING TO BASIN (10.06 ACRES)

L=200' FLOW LENGTH / FLOW LINE

60 0 60 120 scale 1"= 60' feet

Hydrology Summary Table			2 Year				10 Year				100 Year			
Flow Type	Node	Area (ac)	Q (cfs)	TC (min)	Cum. Tc (min)	Cumm Q (cfs)	Q (cfs)	TC (min)	Cum. Tc (min)	Cum Q (cfs)	Q (cfs)	TC (min)	Cum. Tc (min)	Cum Q (cfs)
Initial Area	200-201	0.54	0.62	9.14	9.14	0.62	1.09	9.15	9.15	1.09	1.95	9.14	9.14	1.95
Street Flow	201-202	0.54	0.21	6.63	15.77	0.83	0.45	5.72	14.87	1.54	0.92	4.94	14.09	2.87
Improved Channel Flow	202-203	8.13	5.39	3.08	18.86	6.22	10.25	2.40	17.27	11.80	19.51	1.88	15.96	22.37
Pipe Flow	203-204	-	-	0.09	18.95	6.22	-	0.08	17.35	11.80	-	0.06	16.03	22.37
SubArea Flow	204-204	0.85	0.39	-	18.95	6.61	0.89	-	17.35	12.68	1.83	-	16.03	24.21
Confluence Main Stream	200-204	-	-	-	18.95	6.61	-	-	17.35	12.68	-	-	16.03	24.21



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DAVID EVANS AND ASSOCIATES INC.
18484 OUTER HWY 18N
APPLE VALLEY, CA 92307
Phone: 760.524.9100

SPACE CENTER EXPANSION HYDROLOGY EXHIBIT

SPACE CENTER EXPANSION FLAG LOT

DEVELOPED CONDITION HYDROLOGY MAP

CITY OF VICTORVILLE CALIFORNIA

SUBMITTAL STATUS

CHECKED BY: CHECKED BY
DESIGNED BY: JFA
DRAWN BY: JFA

FIRST SUBMITTAL DATE: XXXX

PROJECT NO.
SPACBRES0001

SHEET NO.
1 OF 1

```
              San Bernardino County Rational Hydrology Program

                 (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2014 Version 9.0
       Rational Hydrology Study        Date: 01/13/23
------------------------------------------------------------------------
Space Center Expansion Project Phase 2 Flag
Existing Condition for Area A (A1-A3)
10 Year Design Storm Frequency
Refer to Appendix B Existing Condition Hydrology Map
------------------------------------------------------------------------


Program License Serial Number 6385

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

------------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
Computed rainfall intensity:
Storm year =    10.00   1 hour rainfall =     0.618 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Initial subarea data:
Initial area flow distance =   518.000(Ft.)
Top (of initial area) elevation =  2912.620(Ft.)
Bottom (of initial area) elevation =  2906.430(Ft.)
Difference in elevation =     6.190(Ft.)
Slope =    0.01195  s(%)=       1.19
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.503 min.
Rainfall intensity =      1.594(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.750
Subarea runoff =      0.598(CFS)
Total initial stream area =        0.500(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.265(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.272(Ft.), Average velocity =   0.987(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00               5.00
       2             50.00               0.00
       3            100.00               5.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      0.730(CFS)
  '     '     flow top width =      5.440(Ft.)
  '     '    velocity=    0.987(Ft/s)
  '     '     area =      0.740(Sq.Ft)
  '     '     Froude number =     0.472

Upstream point elevation =  2906.430(Ft.)
Downstream point elevation =  2902.400(Ft.)
Flow length =   518.000(Ft.)
Travel time  =    8.75 min.
Time of concentration =   24.25 min.
Depth of flow =   0.272(Ft.)
Average velocity =   0.987(Ft/s)
Total irregular channel flow =     0.730(CFS)
Irregular channel normal depth above invert elev. =   0.272(Ft.)
Average velocity of channel(s) =   0.987(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Rainfall intensity =      1.165(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.695
Subarea runoff =      0.212(CFS) for    0.500(Ac.)
Total runoff =      0.810(CFS)
Effective area this stream =        1.00(Ac.)
Total Study Area (Main Stream No. 1) =        1.00(Ac.)
Area averaged Fm value =    0.265(In/Hr)
Depth of flow =   0.283(Ft.), Average velocity =   1.013(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.470(Ft.), Average velocity =   1.663(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00               5.00
       2             50.00               0.00
       3            100.00               5.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      3.666(CFS)
  '     '     flow top width =      9.392(Ft.)
  '     '    velocity=    1.663(Ft/s)
  '     '     area =      2.205(Sq.Ft)
  '     '     Froude number =     0.605
```

```
Upstream point elevation =  2902.400(Ft.)
Downstream point elevation =  2895.100(Ft.)
Flow length =   685.000(Ft.)
Travel time  =    6.87 min.
Time of concentration =   31.12 min.
Depth of flow =   0.470(Ft.)
Average velocity =   1.663(Ft/s)
Total irregular channel flow =     3.666(CFS)
Irregular channel normal depth above invert elev. =   0.470(Ft.)
Average velocity of channel(s) =   1.663(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Rainfall intensity =      0.979(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.656
Subarea runoff =      5.650(CFS) for    9.060(Ac.)
Total runoff =      6.460(CFS)
Effective area this stream =       10.06(Ac.)
Total Study Area (Main Stream No. 1) =       10.06(Ac.)
Area averaged Fm value =    0.265(In/Hr)
Depth of flow =   0.581(Ft.), Average velocity =   1.916(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     10.060(Ac.)
Runoff from this stream =      6.460(CFS)
Time of concentration =   31.12 min.
Rainfall intensity =     0.979(In/Hr)
Area averaged loss rate (Fm) =    0.2651(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Program is now starting with Main Stream No. 2
End of computations, Total Study Area =          10.06 (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 =  86.0
```

```
              San Bernardino County Rational Hydrology Program

                  (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2014 Version 9.0
      Rational Hydrology Study        Date: 01/13/23
------------------------------------------------------------------------
Space Center Expansion Project Phase 2 Flag
Existing Condition for Area A (A1 to A3)
100 Year Design Storm Frequency
Refer to Appendix B Existing Condition Hydrology Map
------------------------------------------------------------------------


Program License Serial Number 6385

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

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.090 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Initial subarea data:
Initial area flow distance =   518.000(Ft.)
Top (of initial area) elevation =  2912.620(Ft.)
Bottom (of initial area) elevation =  2906.430(Ft.)
Difference in elevation =     6.190(Ft.)
Slope =    0.01195  s(%)=       1.19
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.503 min.
Rainfall intensity =      2.811(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.815
Subarea runoff =      1.146(CFS)
Total initial stream area =        0.500(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.265(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.352(Ft.), Average velocity =   1.173(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              5.00
       2             50.00              0.00
       3            100.00              5.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      1.458(CFS)
  '     '     flow top width =      7.050(Ft.)
  '     '    velocity=    1.173(Ft/s)
  '     '     area =      1.242(Sq.Ft)
  '     '     Froude number =     0.493

Upstream point elevation =  2906.430(Ft.)
Downstream point elevation =  2902.400(Ft.)
Flow length =   518.000(Ft.)
Travel time  =    7.36 min.
Time of concentration =   22.86 min.
Depth of flow =   0.352(Ft.)
Average velocity =   1.173(Ft/s)
Total irregular channel flow =     1.458(CFS)
Irregular channel normal depth above invert elev. =   0.352(Ft.)
Average velocity of channel(s) =   1.173(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Rainfall intensity =      2.142(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.789
Subarea runoff =      0.543(CFS) for    0.500(Ac.)
Total runoff =      1.689(CFS)
Effective area this stream =        1.00(Ac.)
Total Study Area (Main Stream No. 1) =        1.00(Ac.)
Area averaged Fm value =    0.265(In/Hr)
Depth of flow =   0.372(Ft.), Average velocity =   1.217(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.629(Ft.), Average velocity =   2.021(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              5.00
       2             50.00              0.00
       3            100.00              5.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      8.001(CFS)
  '     '     flow top width =     12.585(Ft.)
  '     '    velocity=    2.021(Ft/s)
  '     '     area =      3.959(Sq.Ft)
  '     '     Froude number =     0.635
```

```
Upstream point elevation =  2902.400(Ft.)
Downstream point elevation =  2895.100(Ft.)
Flow length =   685.000(Ft.)
Travel time  =    5.65 min.
Time of concentration =   28.51 min.
Depth of flow =   0.629(Ft.)
Average velocity =   2.021(Ft/s)
Total irregular channel flow =     8.001(CFS)
Irregular channel normal depth above invert elev. =   0.629(Ft.)
Average velocity of channel(s) =   2.021(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Rainfall intensity =      1.835(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.770
Subarea runoff =     12.524(CFS) for    9.060(Ac.)
Total runoff =     14.213(CFS)
Effective area this stream =       10.06(Ac.)
Total Study Area (Main Stream No. 1) =       10.06(Ac.)
Area averaged Fm value =    0.265(In/Hr)
Depth of flow =   0.781(Ft.), Average velocity =   2.333(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     10.060(Ac.)
Runoff from this stream =     14.213(CFS)
Time of concentration =   28.51 min.
Rainfall intensity =     1.835(In/Hr)
Area averaged loss rate (Fm) =    0.2651(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Program is now starting with Main Stream No. 2
End of computations, Total Study Area =          10.06 (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 =  86.0
```

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              San Bernardino County Rational Hydrology Program

                  (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2014 Version 9.0
      Rational Hydrology Study        Date: 01/13/23
------------------------------------------------------------------------
Space Center Expansion Project Phase 2 Flag
Developed Condition for Area A1 to A3
10 Year Design Storm Frequency
Please Refer to Appendix B Developed Condition Hydrology Map
------------------------------------------------------------------------


Program License Serial Number 6385

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

------------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
Computed rainfall intensity:
Storm year =    10.00   1 hour rainfall =     0.618 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   568.000(Ft.)
Top (of initial area) elevation =  2915.010(Ft.)
Bottom (of initial area) elevation =  2907.570(Ft.)
Difference in elevation =     7.440(Ft.)
Slope =    0.01310  s(%)=       1.31
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.145 min.
Rainfall intensity =      2.306(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.879
Subarea runoff =      1.094(CFS)
Total initial stream area =        0.540(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  2907.570(Ft.)
End of street segment elevation =  2903.580(Ft.)
Length of street segment  =   568.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
```

```
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =   0.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   3.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   0.000(Ft.)
Gutter hike from flowline =  0.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      1.362(CFS)
Depth of flow =   0.181(Ft.), Average velocity =   1.654(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   9.072(Ft.)
Flow velocity =   1.65(Ft/s)
Travel time =    5.72 min.     TC =   14.87  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      1.641(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.870
Subarea runoff =      0.448(CFS) for    0.540(Ac.)
Total runoff =      1.542(CFS)
Effective area this stream =        1.08(Ac.)
Total Study Area (Main Stream No. 1) =        1.08(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Street flow at end of street =      1.542(CFS)
Half street flow at end of street =      1.542(CFS)
Depth of flow =   0.190(Ft.), Average velocity =   1.706(Ft/s)
Flow width (from curb towards crown)=   9.505(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      203.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  2903.580(Ft.)
Downstream point elevation =  2894.080(Ft.)
Channel length thru subarea  =   562.000(Ft.)
Channel base width  =   10.000(Ft.)
Slope or 'Z' of left channel bank =   0.000
Slope or 'Z' of right channel bank =   0.000
Estimated mean flow rate at midpoint of channel =      6.715(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =      6.715(CFS)
Depth of flow =   0.172(Ft.), Average velocity =   3.898(Ft/s)
Channel flow top width =   10.000(Ft.)
Flow Velocity =    3.90(Ft/s)
Travel time  =    2.40 min.
Time of concentration =   17.27 min.
Critical depth =      0.242(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
```

```
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      1.478(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.867
Subarea runoff =     10.253(CFS) for    8.130(Ac.)
Total runoff =     11.795(CFS)
Effective area this stream =        9.21(Ac.)
Total Study Area (Main Stream No. 1) =        9.21(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.243(Ft.), Average velocity =   4.857(Ft/s)
Critical depth =      0.352(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      204.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  2892.080(Ft.)
Downstream point/station elevation =  2891.500(Ft.)
Pipe length  =    40.00(Ft.)   Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =    11.795(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =    11.795(CFS)
Normal flow depth in pipe =   12.87(In.)
Flow top width inside pipe =   16.25(In.)
Critical Depth =   15.67(In.)
Pipe flow velocity =      8.72(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =    17.35 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      204.000 to Point/Station      204.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Time of concentration =    17.35 min.
Rainfall intensity =      1.473(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.856
Subarea runoff =      0.886(CFS) for    0.850(Ac.)
Total runoff =     12.681(CFS)
Effective area this stream =       10.06(Ac.)
Total Study Area (Main Stream No. 1) =       10.06(Ac.)
Area averaged Fm value =    0.073(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      204.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
```

```
Stream flow area =     10.060(Ac.)
Runoff from this stream =     12.681(CFS)
Time of concentration =   17.35 min.
Rainfall intensity =     1.473(In/Hr)
Area averaged loss rate (Fm) =    0.0726(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1760
Summary of stream data:

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


1     12.68    10.060     17.35    0.073      1.473
Qmax(1) =
          1.000 *    1.000 *    12.681) + =      12.681

Total of 1 main streams to confluence:
Flow rates before confluence point:
      13.681
Maximum flow rates at confluence using above data:
       12.681
Area of streams before confluence:
       10.060
Effective area values after confluence:
       10.060


Results of confluence:
Total flow rate =     12.681(CFS)
Time of concentration =    17.346 min.
Effective stream area after confluence  =     10.060(Ac.)
Study area average Pervious fraction(Ap) =  0.176
Study area average soil loss rate(Fm) =    0.073(In/Hr)
Study area total =      10.06(Ac.)
End of computations, Total Study Area =           10.06 (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) = 0.176
Area averaged SCS curve number =  70.4
```

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              San Bernardino County Rational Hydrology Program

                  (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2014 Version 9.0
      Rational Hydrology Study        Date: 01/13/23
------------------------------------------------------------------------
Space Center Expansion Project Phase 2 Flag
Developed Condition for Area A1 to A3
100 Year Design Storm Frequency
Please Refer to Appendix B Developed Condition Hydrology map
------------------------------------------------------------------------


Program License Serial Number 6385

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

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.090 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   568.000(Ft.)
Top (of initial area) elevation =  2915.020(Ft.)
Bottom (of initial area) elevation =  2907.570(Ft.)
Difference in elevation =     7.450(Ft.)
Slope =    0.01312  s(%)=       1.31
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.142 min.
Rainfall intensity =      4.068(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.888
Subarea runoff =      1.950(CFS)
Total initial stream area =        0.540(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  2907.570(Ft.)
End of street segment elevation =  2903.580(Ft.)
Length of street segment  =   568.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
```

```
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =   0.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   3.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   0.000(Ft.)
Gutter hike from flowline =  0.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.445(CFS)
Depth of flow =   0.226(Ft.), Average velocity =   1.915(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  11.300(Ft.)
Flow velocity =   1.91(Ft/s)
Travel time =    4.94 min.     TC =   14.09  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      3.006(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.884
Subarea runoff =      0.918(CFS) for    0.540(Ac.)
Total runoff =      2.869(CFS)
Effective area this stream =        1.08(Ac.)
Total Study Area (Main Stream No. 1) =        1.08(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Street flow at end of street =      2.869(CFS)
Half street flow at end of street =      2.869(CFS)
Depth of flow =   0.240(Ft.), Average velocity =   1.993(Ft/s)
Flow width (from curb towards crown)=  11.997(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      203.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  2903.580(Ft.)
Downstream point elevation =  2894.080(Ft.)
Channel length thru subarea  =   562.000(Ft.)
Channel base width  =   10.000(Ft.)
Slope or 'Z' of left channel bank =   0.000
Slope or 'Z' of right channel bank =   0.000
Estimated mean flow rate at midpoint of channel =     12.658(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =     12.658(CFS)
Depth of flow =   0.254(Ft.), Average velocity =   4.992(Ft/s)
Channel flow top width =   10.000(Ft.)
Flow Velocity =    4.99(Ft/s)
Travel time  =    1.88 min.
Time of concentration =   15.96 min.
Critical depth =      0.367(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
```

```
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      2.754(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.882
Subarea runoff =     19.506(CFS) for    8.130(Ac.)
Total runoff =     22.374(CFS)
Effective area this stream =        9.21(Ac.)
Total Study Area (Main Stream No. 1) =        9.21(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.360(Ft.), Average velocity =   6.220(Ft/s)
Critical depth =      0.539(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      204.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  2892.080(Ft.)
Downstream point/station elevation =  2891.500(Ft.)
Pipe length  =    40.00(Ft.)   Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =    22.374(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    22.374(CFS)
Normal flow depth in pipe =   15.63(In.)
Flow top width inside pipe =   22.87(In.)
Critical Depth =   20.23(In.)
Pipe flow velocity =     10.33(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =    16.03 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      204.000 to Point/Station      204.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Time of concentration =    16.03 min.
Rainfall intensity =      2.746(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.876
Subarea runoff =      1.834(CFS) for    0.850(Ac.)
Total runoff =     24.208(CFS)
Effective area this stream =       10.06(Ac.)
Total Study Area (Main Stream No. 1) =       10.06(Ac.)
Area averaged Fm value =    0.073(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      204.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
```

Stream flow area = 10.060(Ac.)
Runoff from this stream = 24.208(CFS)
Time of concentration = 16.03 min.
Rainfall intensity = 2.746(In/Hr)
Area averaged loss rate (Fm) = 0.0726(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1760
Summary of stream data:

Stream No.	Flow rate (CFS)	Area (Ac.)	TC (min)	Fm (In/Hr)	Rainfall Intensity (In/Hr)
1	24.21	10.060	16.03	0.073	2.746

Qmax(1) =
1.000 * 1.000 * 24.208) + = 24.208

Total of 1 main streams to confluence:
Flow rates before confluence point:
25.208
Maximum flow rates at confluence using above data:
24.208
Area of streams before confluence:
10.060
Effective area values after confluence:
10.060

Results of confluence:
Total flow rate = 24.208(CFS)
Time of concentration = 16.026 min.
Effective stream area after confluence = 10.060(Ac.)
Study area average Pervious fraction(Ap) = 0.176
Study area average soil loss rate(Fm) = 0.073(In/Hr)
Study area total = 10.06(Ac.)
End of computations, Total Study Area = 10.06 (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) = 0.176
Area averaged SCS curve number = 70.4

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

Study date 01/13/23

++

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

Program License Serial Number 6385

Space Center Expansion Project Phase 2 Flag
Existing Condition Area A1 to A3
10 Year 24 Hour Storm Event
Please Refer to Appendix B Existing Condition Hydrology Map

Storm Event Year = 10

Antecedent Moisture Condition = 2

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 (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 10		
10.06	1	0.62
Rainfall data for year 10		
10.06	6	1.27
Rainfall data for year 10		
10.06	24	2.23

+++

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

SCS curve No.(AMCII)	SCS curve NO.(AMC 2)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
86.0	86.0	10.06	1.000	0.265	1.000	0.265

Area-averaged adjusted loss rate Fm (In/Hr) = 0.265

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

Area   Area   SCS CN   SCS CN   S   Pervious

```
 (Ac.)      Fract         (AMC2)    (AMC2)           Yield Fr
    10.06   1.000         86.0      86.0       1.63     0.460

Area-averaged catchment yield fraction, Y =  0.460
Area-averaged low loss fraction, Yb =  0.540
User entry of time of concentration  =   0.519 (hours)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =      10.06(Ac.)
Catchment Lag time =   0.415 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 20.0706
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.265(In/Hr)
Average low loss rate fraction (Yb) = 0.540 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall =  0.293(In)
Computed peak 30-minute rainfall =  0.502(In)
Specified peak 1-hour rainfall =  0.618(In)
Computed peak 3-hour rainfall =  0.961(In)
Specified peak 6-hour rainfall =  1.270(In)
Specified peak 24-hour rainfall =  2.230(In)


Rainfall depth area reduction factors:
Using a total area of      10.06(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.293(In)
30-minute factor = 1.000    Adjusted rainfall =  0.502(In)
1-hour factor = 1.000       Adjusted rainfall =  0.618(In)
3-hour factor = 1.000       Adjusted rainfall =  0.961(In)
6-hour factor = 1.000       Adjusted rainfall =  1.270(In)
24-hour factor = 1.000      Adjusted rainfall =  2.230(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 =       121.66 (CFS))

  1                0.997                  1.213
  2                4.530                  4.298
  3               11.349                  8.296
  4               26.366                 18.271
  5               43.523                 20.873
  6               55.189                 14.194
  7               62.955                  9.448
  8               68.573                  6.835
  9               73.097                  5.504
 10               76.723                  4.411
 11               79.718                  3.644
 12               82.217                  3.041
 13               84.360                  2.607
 14               86.297                  2.357
 15               87.981                  2.049
 16               89.366                  1.684
 17               90.544                  1.433
 18               91.644                  1.338
 19               92.619                  1.186
 20               93.520                  1.097
 21               94.289                  0.936
 22               94.972                  0.830
```

23	95.627	0.797
24	96.163	0.652
25	96.684	0.634
26	97.112	0.521
27	97.474	0.440
28	97.806	0.405
29	98.020	0.260
30	98.221	0.244
31	98.446	0.273
32	98.687	0.293
33	98.928	0.293
34	99.168	0.293
35	99.408	0.292
36	99.578	0.207
37	99.704	0.153
38	99.829	0.153
39	100.000	0.076

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.2931	0.2931
2	0.3609	0.0678
3	0.4075	0.0467
4	0.4443	0.0367
5	0.4750	0.0308
6	0.5017	0.0267
7	0.5255	0.0237
8	0.5470	0.0215
9	0.5666	0.0197
10	0.5848	0.0182
11	0.6018	0.0170
12	0.6177	0.0159
13	0.6379	0.0202
14	0.6572	0.0193
15	0.6757	0.0185
16	0.6935	0.0178
17	0.7106	0.0171
18	0.7272	0.0165
19	0.7432	0.0160
20	0.7587	0.0155
21	0.7737	0.0150
22	0.7883	0.0146
23	0.8026	0.0142
24	0.8164	0.0139
25	0.8299	0.0135
26	0.8431	0.0132
27	0.8560	0.0129
28	0.8687	0.0126
29	0.8810	0.0124
30	0.8931	0.0121
31	0.9050	0.0119
32	0.9166	0.0116
33	0.9280	0.0114
34	0.9392	0.0112
35	0.9503	0.0110
36	0.9611	0.0108
37	0.9717	0.0106
38	0.9822	0.0105
39	0.9925	0.0103
40	1.0027	0.0102
41	1.0127	0.0100
42	1.0225	0.0099
43	1.0323	0.0097

44	1.0418	0.0096
45	1.0513	0.0095
46	1.0606	0.0093
47	1.0698	0.0092
48	1.0789	0.0091
49	1.0879	0.0090
50	1.0968	0.0089
51	1.1056	0.0088
52	1.1142	0.0087
53	1.1228	0.0086
54	1.1313	0.0085
55	1.1396	0.0084
56	1.1479	0.0083
57	1.1561	0.0082
58	1.1642	0.0081
59	1.1723	0.0080
60	1.1802	0.0079
61	1.1881	0.0079
62	1.1959	0.0078
63	1.2036	0.0077
64	1.2112	0.0076
65	1.2188	0.0076
66	1.2263	0.0075
67	1.2337	0.0074
68	1.2411	0.0074
69	1.2484	0.0073
70	1.2557	0.0072
71	1.2628	0.0072
72	1.2700	0.0071
73	1.2771	0.0071
74	1.2842	0.0071
75	1.2912	0.0070
76	1.2982	0.0070
77	1.3051	0.0069
78	1.3119	0.0069
79	1.3187	0.0068
80	1.3255	0.0068
81	1.3322	0.0067
82	1.3388	0.0067
83	1.3454	0.0066
84	1.3520	0.0066
85	1.3585	0.0065
86	1.3650	0.0065
87	1.3714	0.0064
88	1.3778	0.0064
89	1.3841	0.0063
90	1.3904	0.0063
91	1.3967	0.0063
92	1.4029	0.0062
93	1.4091	0.0062
94	1.4152	0.0061
95	1.4213	0.0061
96	1.4273	0.0061
97	1.4334	0.0060
98	1.4394	0.0060
99	1.4453	0.0059
100	1.4512	0.0059
101	1.4571	0.0059
102	1.4629	0.0058
103	1.4687	0.0058
104	1.4745	0.0058
105	1.4803	0.0057
106	1.4860	0.0057

107	1.4916	0.0057
108	1.4973	0.0056
109	1.5029	0.0056
110	1.5085	0.0056
111	1.5140	0.0056
112	1.5196	0.0055
113	1.5251	0.0055
114	1.5305	0.0055
115	1.5360	0.0054
116	1.5414	0.0054
117	1.5468	0.0054
118	1.5521	0.0054
119	1.5574	0.0053
120	1.5627	0.0053
121	1.5680	0.0053
122	1.5733	0.0052
123	1.5785	0.0052
124	1.5837	0.0052
125	1.5889	0.0052
126	1.5940	0.0051
127	1.5991	0.0051
128	1.6042	0.0051
129	1.6093	0.0051
130	1.6144	0.0051
131	1.6194	0.0050
132	1.6244	0.0050
133	1.6294	0.0050
134	1.6344	0.0050
135	1.6393	0.0049
136	1.6442	0.0049
137	1.6491	0.0049
138	1.6540	0.0049
139	1.6589	0.0049
140	1.6637	0.0048
141	1.6685	0.0048
142	1.6733	0.0048
143	1.6781	0.0048
144	1.6828	0.0048
145	1.6876	0.0047
146	1.6923	0.0047
147	1.6970	0.0047
148	1.7017	0.0047
149	1.7063	0.0047
150	1.7110	0.0046
151	1.7156	0.0046
152	1.7202	0.0046
153	1.7248	0.0046
154	1.7294	0.0046
155	1.7339	0.0046
156	1.7385	0.0045
157	1.7430	0.0045
158	1.7475	0.0045
159	1.7520	0.0045
160	1.7564	0.0045
161	1.7609	0.0044
162	1.7653	0.0044
163	1.7697	0.0044
164	1.7741	0.0044
165	1.7785	0.0044
166	1.7829	0.0044
167	1.7872	0.0044
168	1.7916	0.0043
169	1.7959	0.0043

170	1.8002	0.0043
171	1.8045	0.0043
172	1.8088	0.0043
173	1.8130	0.0043
174	1.8173	0.0042
175	1.8215	0.0042
176	1.8257	0.0042
177	1.8299	0.0042
178	1.8341	0.0042
179	1.8383	0.0042
180	1.8425	0.0042
181	1.8466	0.0042
182	1.8508	0.0041
183	1.8549	0.0041
184	1.8590	0.0041
185	1.8631	0.0041
186	1.8672	0.0041
187	1.8712	0.0041
188	1.8753	0.0041
189	1.8793	0.0040
190	1.8834	0.0040
191	1.8874	0.0040
192	1.8914	0.0040
193	1.8954	0.0040
194	1.8994	0.0040
195	1.9034	0.0040
196	1.9073	0.0040
197	1.9113	0.0039
198	1.9152	0.0039
199	1.9191	0.0039
200	1.9230	0.0039
201	1.9269	0.0039
202	1.9308	0.0039
203	1.9347	0.0039
204	1.9386	0.0039
205	1.9424	0.0039
206	1.9462	0.0038
207	1.9501	0.0038
208	1.9539	0.0038
209	1.9577	0.0038
210	1.9615	0.0038
211	1.9653	0.0038
212	1.9691	0.0038
213	1.9728	0.0038
214	1.9766	0.0038
215	1.9803	0.0037
216	1.9841	0.0037
217	1.9878	0.0037
218	1.9915	0.0037
219	1.9952	0.0037
220	1.9989	0.0037
221	2.0026	0.0037
222	2.0063	0.0037
223	2.0099	0.0037
224	2.0136	0.0037
225	2.0172	0.0036
226	2.0209	0.0036
227	2.0245	0.0036
228	2.0281	0.0036
229	2.0317	0.0036
230	2.0353	0.0036
231	2.0389	0.0036
232	2.0425	0.0036

233	2.0461	0.0036
234	2.0496	0.0036
235	2.0532	0.0036
236	2.0567	0.0035
237	2.0603	0.0035
238	2.0638	0.0035
239	2.0673	0.0035
240	2.0708	0.0035
241	2.0743	0.0035
242	2.0778	0.0035
243	2.0813	0.0035
244	2.0848	0.0035
245	2.0882	0.0035
246	2.0917	0.0035
247	2.0951	0.0034
248	2.0986	0.0034
249	2.1020	0.0034
250	2.1054	0.0034
251	2.1089	0.0034
252	2.1123	0.0034
253	2.1157	0.0034
254	2.1191	0.0034
255	2.1224	0.0034
256	2.1258	0.0034
257	2.1292	0.0034
258	2.1325	0.0034
259	2.1359	0.0034
260	2.1392	0.0033
261	2.1426	0.0033
262	2.1459	0.0033
263	2.1492	0.0033
264	2.1525	0.0033
265	2.1559	0.0033
266	2.1592	0.0033
267	2.1624	0.0033
268	2.1657	0.0033
269	2.1690	0.0033
270	2.1723	0.0033
271	2.1755	0.0033
272	2.1788	0.0033
273	2.1821	0.0032
274	2.1853	0.0032
275	2.1885	0.0032
276	2.1918	0.0032
277	2.1950	0.0032
278	2.1982	0.0032
279	2.2014	0.0032
280	2.2046	0.0032
281	2.2078	0.0032
282	2.2110	0.0032
283	2.2142	0.0032
284	2.2173	0.0032
285	2.2205	0.0032
286	2.2237	0.0032
287	2.2268	0.0032
288	2.2300	0.0031

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0031	0.0017	0.0014
2	0.0032	0.0017	0.0015

3	0.0032	0.0017	0.0015
4	0.0032	0.0017	0.0015
5	0.0032	0.0017	0.0015
6	0.0032	0.0017	0.0015
7	0.0032	0.0017	0.0015
8	0.0032	0.0017	0.0015
9	0.0032	0.0017	0.0015
10	0.0032	0.0017	0.0015
11	0.0032	0.0018	0.0015
12	0.0033	0.0018	0.0015
13	0.0033	0.0018	0.0015
14	0.0033	0.0018	0.0015
15	0.0033	0.0018	0.0015
16	0.0033	0.0018	0.0015
17	0.0033	0.0018	0.0015
18	0.0033	0.0018	0.0015
19	0.0033	0.0018	0.0015
20	0.0033	0.0018	0.0015
21	0.0034	0.0018	0.0015
22	0.0034	0.0018	0.0016
23	0.0034	0.0018	0.0016
24	0.0034	0.0018	0.0016
25	0.0034	0.0018	0.0016
26	0.0034	0.0018	0.0016
27	0.0034	0.0019	0.0016
28	0.0034	0.0019	0.0016
29	0.0035	0.0019	0.0016
30	0.0035	0.0019	0.0016
31	0.0035	0.0019	0.0016
32	0.0035	0.0019	0.0016
33	0.0035	0.0019	0.0016
34	0.0035	0.0019	0.0016
35	0.0035	0.0019	0.0016
36	0.0035	0.0019	0.0016
37	0.0036	0.0019	0.0016
38	0.0036	0.0019	0.0016
39	0.0036	0.0019	0.0017
40	0.0036	0.0019	0.0017
41	0.0036	0.0020	0.0017
42	0.0036	0.0020	0.0017
43	0.0036	0.0020	0.0017
44	0.0037	0.0020	0.0017
45	0.0037	0.0020	0.0017
46	0.0037	0.0020	0.0017
47	0.0037	0.0020	0.0017
48	0.0037	0.0020	0.0017
49	0.0037	0.0020	0.0017
50	0.0037	0.0020	0.0017
51	0.0038	0.0020	0.0017
52	0.0038	0.0020	0.0017
53	0.0038	0.0020	0.0017
54	0.0038	0.0021	0.0018
55	0.0038	0.0021	0.0018
56	0.0038	0.0021	0.0018
57	0.0039	0.0021	0.0018
58	0.0039	0.0021	0.0018
59	0.0039	0.0021	0.0018
60	0.0039	0.0021	0.0018
61	0.0039	0.0021	0.0018
62	0.0039	0.0021	0.0018
63	0.0040	0.0021	0.0018
64	0.0040	0.0021	0.0018
65	0.0040	0.0022	0.0018

66	0.0040	0.0022	0.0019
67	0.0040	0.0022	0.0019
68	0.0041	0.0022	0.0019
69	0.0041	0.0022	0.0019
70	0.0041	0.0022	0.0019
71	0.0041	0.0022	0.0019
72	0.0041	0.0022	0.0019
73	0.0042	0.0022	0.0019
74	0.0042	0.0023	0.0019
75	0.0042	0.0023	0.0019
76	0.0042	0.0023	0.0019
77	0.0042	0.0023	0.0020
78	0.0043	0.0023	0.0020
79	0.0043	0.0023	0.0020
80	0.0043	0.0023	0.0020
81	0.0043	0.0023	0.0020
82	0.0044	0.0023	0.0020
83	0.0044	0.0024	0.0020
84	0.0044	0.0024	0.0020
85	0.0044	0.0024	0.0020
86	0.0044	0.0024	0.0020
87	0.0045	0.0024	0.0021
88	0.0045	0.0024	0.0021
89	0.0045	0.0024	0.0021
90	0.0046	0.0025	0.0021
91	0.0046	0.0025	0.0021
92	0.0046	0.0025	0.0021
93	0.0046	0.0025	0.0021
94	0.0047	0.0025	0.0021
95	0.0047	0.0025	0.0022
96	0.0047	0.0025	0.0022
97	0.0048	0.0026	0.0022
98	0.0048	0.0026	0.0022
99	0.0048	0.0026	0.0022
100	0.0048	0.0026	0.0022
101	0.0049	0.0026	0.0022
102	0.0049	0.0026	0.0023
103	0.0049	0.0027	0.0023
104	0.0050	0.0027	0.0023
105	0.0050	0.0027	0.0023
106	0.0050	0.0027	0.0023
107	0.0051	0.0027	0.0023
108	0.0051	0.0028	0.0023
109	0.0051	0.0028	0.0024
110	0.0052	0.0028	0.0024
111	0.0052	0.0028	0.0024
112	0.0052	0.0028	0.0024
113	0.0053	0.0029	0.0024
114	0.0053	0.0029	0.0025
115	0.0054	0.0029	0.0025
116	0.0054	0.0029	0.0025
117	0.0055	0.0029	0.0025
118	0.0055	0.0030	0.0025
119	0.0056	0.0030	0.0026
120	0.0056	0.0030	0.0026
121	0.0056	0.0030	0.0026
122	0.0057	0.0031	0.0026
123	0.0057	0.0031	0.0026
124	0.0058	0.0031	0.0027
125	0.0058	0.0032	0.0027
126	0.0059	0.0032	0.0027
127	0.0059	0.0032	0.0027
128	0.0060	0.0032	0.0028

129	0.0061	0.0033	0.0028
130	0.0061	0.0033	0.0028
131	0.0062	0.0033	0.0028
132	0.0062	0.0034	0.0029
133	0.0063	0.0034	0.0029
134	0.0063	0.0034	0.0029
135	0.0064	0.0035	0.0030
136	0.0065	0.0035	0.0030
137	0.0066	0.0035	0.0030
138	0.0066	0.0036	0.0030
139	0.0067	0.0036	0.0031
140	0.0068	0.0036	0.0031
141	0.0069	0.0037	0.0032
142	0.0069	0.0037	0.0032
143	0.0070	0.0038	0.0032
144	0.0071	0.0038	0.0033
145	0.0071	0.0038	0.0033
146	0.0072	0.0039	0.0033
147	0.0073	0.0039	0.0034
148	0.0074	0.0040	0.0034
149	0.0075	0.0040	0.0035
150	0.0076	0.0041	0.0035
151	0.0077	0.0042	0.0036
152	0.0078	0.0042	0.0036
153	0.0079	0.0043	0.0037
154	0.0080	0.0043	0.0037
155	0.0082	0.0044	0.0038
156	0.0083	0.0045	0.0038
157	0.0085	0.0046	0.0039
158	0.0086	0.0046	0.0039
159	0.0088	0.0047	0.0040
160	0.0089	0.0048	0.0041
161	0.0091	0.0049	0.0042
162	0.0092	0.0050	0.0042
163	0.0095	0.0051	0.0044
164	0.0096	0.0052	0.0044
165	0.0099	0.0053	0.0045
166	0.0100	0.0054	0.0046
167	0.0103	0.0056	0.0047
168	0.0105	0.0057	0.0048
169	0.0108	0.0058	0.0050
170	0.0110	0.0059	0.0051
171	0.0114	0.0062	0.0053
172	0.0116	0.0063	0.0054
173	0.0121	0.0065	0.0056
174	0.0124	0.0067	0.0057
175	0.0129	0.0070	0.0059
176	0.0132	0.0071	0.0061
177	0.0139	0.0075	0.0064
178	0.0142	0.0077	0.0066
179	0.0150	0.0081	0.0069
180	0.0155	0.0084	0.0071
181	0.0165	0.0089	0.0076
182	0.0171	0.0092	0.0079
183	0.0185	0.0100	0.0085
184	0.0193	0.0104	0.0089
185	0.0159	0.0086	0.0073
186	0.0170	0.0092	0.0078
187	0.0197	0.0106	0.0091
188	0.0215	0.0116	0.0099
189	0.0267	0.0144	0.0123
190	0.0308	0.0166	0.0142
191	0.0467	0.0221	0.0246

192	0.0678	0.0221	0.0457
193	0.2931	0.0221	0.2710
194	0.0367	0.0198	0.0169
195	0.0237	0.0128	0.0109
196	0.0182	0.0098	0.0084
197	0.0202	0.0109	0.0093
198	0.0178	0.0096	0.0082
199	0.0160	0.0086	0.0074
200	0.0146	0.0079	0.0067
201	0.0135	0.0073	0.0062
202	0.0126	0.0068	0.0058
203	0.0119	0.0064	0.0055
204	0.0112	0.0061	0.0052
205	0.0106	0.0057	0.0049
206	0.0102	0.0055	0.0047
207	0.0097	0.0052	0.0045
208	0.0093	0.0050	0.0043
209	0.0090	0.0048	0.0041
210	0.0087	0.0047	0.0040
211	0.0084	0.0045	0.0039
212	0.0081	0.0044	0.0037
213	0.0079	0.0042	0.0036
214	0.0076	0.0041	0.0035
215	0.0074	0.0040	0.0034
216	0.0072	0.0039	0.0033
217	0.0071	0.0038	0.0033
218	0.0070	0.0038	0.0032
219	0.0068	0.0037	0.0031
220	0.0067	0.0036	0.0031
221	0.0065	0.0035	0.0030
222	0.0064	0.0034	0.0029
223	0.0063	0.0034	0.0029
224	0.0061	0.0033	0.0028
225	0.0060	0.0032	0.0028
226	0.0059	0.0032	0.0027
227	0.0058	0.0031	0.0027
228	0.0057	0.0031	0.0026
229	0.0056	0.0030	0.0026
230	0.0055	0.0030	0.0025
231	0.0054	0.0029	0.0025
232	0.0054	0.0029	0.0025
233	0.0053	0.0028	0.0024
234	0.0052	0.0028	0.0024
235	0.0051	0.0028	0.0024
236	0.0051	0.0027	0.0023
237	0.0050	0.0027	0.0023
238	0.0049	0.0027	0.0023
239	0.0049	0.0026	0.0022
240	0.0048	0.0026	0.0022
241	0.0047	0.0026	0.0022
242	0.0047	0.0025	0.0022
243	0.0046	0.0025	0.0021
244	0.0046	0.0025	0.0021
245	0.0045	0.0024	0.0021
246	0.0045	0.0024	0.0021
247	0.0044	0.0024	0.0020
248	0.0044	0.0024	0.0020
249	0.0043	0.0023	0.0020
250	0.0043	0.0023	0.0020
251	0.0042	0.0023	0.0019
252	0.0042	0.0023	0.0019
253	0.0042	0.0022	0.0019
254	0.0041	0.0022	0.0019

255	0.0041	0.0022	0.0019
256	0.0040	0.0022	0.0019
257	0.0040	0.0022	0.0018
258	0.0040	0.0021	0.0018
259	0.0039	0.0021	0.0018
260	0.0039	0.0021	0.0018
261	0.0039	0.0021	0.0018
262	0.0038	0.0021	0.0018
263	0.0038	0.0020	0.0017
264	0.0038	0.0020	0.0017
265	0.0037	0.0020	0.0017
266	0.0037	0.0020	0.0017
267	0.0037	0.0020	0.0017
268	0.0036	0.0020	0.0017
269	0.0036	0.0019	0.0017
270	0.0036	0.0019	0.0016
271	0.0036	0.0019	0.0016
272	0.0035	0.0019	0.0016
273	0.0035	0.0019	0.0016
274	0.0035	0.0019	0.0016
275	0.0034	0.0019	0.0016
276	0.0034	0.0018	0.0016
277	0.0034	0.0018	0.0016
278	0.0034	0.0018	0.0016
279	0.0034	0.0018	0.0015
280	0.0033	0.0018	0.0015
281	0.0033	0.0018	0.0015
282	0.0033	0.0018	0.0015
283	0.0033	0.0018	0.0015
284	0.0032	0.0017	0.0015
285	0.0032	0.0017	0.0015
286	0.0032	0.0017	0.0015
287	0.0032	0.0017	0.0015
288	0.0032	0.0017	0.0015

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----------------------------------------------------------------------
----------------------------------------------------------------------
Total soil rain loss =      1.05(In)
Total effective rainfall =      1.18(In)
Peak flow rate in flood hydrograph =      7.40(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      0.0002      0.02  Q         |         |         |         |
  0+20      0.0005      0.05  Q         |         |         |         |
  0+25      0.0011      0.08  Q         |         |         |         |
  0+30      0.0017      0.10  Q         |         |         |         |
  0+35      0.0025      0.11  Q         |         |         |         |
  0+40      0.0033      0.12  Q         |         |         |         |
  0+45      0.0042      0.13  Q         |         |         |         |
  0+50      0.0052      0.14  Q         |         |         |         |
  0+55      0.0062      0.14  Q         |         |         |         |
  1+ 0      0.0072      0.15  Q         |         |         |         |
  1+ 5      0.0082      0.15  Q         |         |         |         |
  1+10      0.0093      0.16  Q         |         |         |         |
```

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 1+15        0.0104      0.16  Q         |         |         |         |
 1+20        0.0115      0.16  Q         |         |         |         |
 1+25        0.0127      0.16  Q         |         |         |         |
 1+30        0.0138      0.17  Q         |         |         |         |
 1+35        0.0150      0.17  Q         |         |         |         |
 1+40        0.0162      0.17  Q         |         |         |         |
 1+45        0.0174      0.17  Q         |         |         |         |
 1+50        0.0186      0.18  Q         |         |         |         |
 1+55        0.0198      0.18  Q         |         |         |         |
 2+ 0        0.0210      0.18  Q         |         |         |         |
 2+ 5        0.0223      0.18  Q         |         |         |         |
 2+10        0.0235      0.18  Q         |         |         |         |
 2+15        0.0248      0.18  QV        |         |         |         |
 2+20        0.0260      0.18  QV        |         |         |         |
 2+25        0.0273      0.19  QV        |         |         |         |
 2+30        0.0286      0.19  QV        |         |         |         |
 2+35        0.0299      0.19  QV        |         |         |         |
 2+40        0.0312      0.19  QV        |         |         |         |
 2+45        0.0325      0.19  QV        |         |         |         |
 2+50        0.0338      0.19  QV        |         |         |         |
 2+55        0.0351      0.19  QV        |         |         |         |
 3+ 0        0.0365      0.19  QV        |         |         |         |
 3+ 5        0.0378      0.19  QV        |         |         |         |
 3+10        0.0391      0.19  QV        |         |         |         |
 3+15        0.0405      0.20  QV        |         |         |         |
 3+20        0.0418      0.20  QV        |         |         |         |
 3+25        0.0432      0.20  QV        |         |         |         |
 3+30        0.0445      0.20  QV        |         |         |         |
 3+35        0.0459      0.20  QV        |         |         |         |
 3+40        0.0473      0.20  QV        |         |         |         |
 3+45        0.0486      0.20  QV        |         |         |         |
 3+50        0.0500      0.20  Q V       |         |         |         |
 3+55        0.0514      0.20  Q V       |         |         |         |
 4+ 0        0.0528      0.20  Q V       |         |         |         |
 4+ 5        0.0542      0.20  Q V       |         |         |         |
 4+10        0.0556      0.20  Q V       |         |         |         |
 4+15        0.0570      0.20  Q V       |         |         |         |
 4+20        0.0584      0.21  Q V       |         |         |         |
 4+25        0.0599      0.21  Q V       |         |         |         |
 4+30        0.0613      0.21  Q V       |         |         |         |
 4+35        0.0627      0.21  Q V       |         |         |         |
 4+40        0.0641      0.21  Q V       |         |         |         |
 4+45        0.0656      0.21  Q V       |         |         |         |
 4+50        0.0670      0.21  Q V       |         |         |         |
 4+55        0.0685      0.21  Q V       |         |         |         |
 5+ 0        0.0700      0.21  Q V       |         |         |         |
 5+ 5        0.0714      0.21  Q V       |         |         |         |
 5+10        0.0729      0.21  Q V       |         |         |         |
 5+15        0.0744      0.22  Q  V      |         |         |         |
 5+20        0.0759      0.22  Q  V      |         |         |         |
 5+25        0.0774      0.22  Q  V      |         |         |         |
 5+30        0.0789      0.22  Q  V      |         |         |         |
 5+35        0.0804      0.22  Q  V      |         |         |         |
 5+40        0.0819      0.22  Q  V      |         |         |         |
 5+45        0.0834      0.22  Q  V      |         |         |         |
 5+50        0.0849      0.22  Q  V      |         |         |         |
 5+55        0.0865      0.22  Q  V      |         |         |         |
 6+ 0        0.0880      0.22  Q  V      |         |         |         |
 6+ 5        0.0896      0.22  Q  V      |         |         |         |
 6+10        0.0911      0.23  Q  V      |         |         |         |
 6+15        0.0927      0.23  Q  V      |         |         |         |
 6+20        0.0943      0.23  Q  V      |         |         |         |
 6+25        0.0958      0.23  Q  V      |         |         |         |
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 6+30       0.0974      0.23   Q  V      |         |         |         |
 6+35       0.0990      0.23   Q   V     |         |         |         |
 6+40       0.1006      0.23   Q   V     |         |         |         |
 6+45       0.1022      0.23   Q   V     |         |         |         |
 6+50       0.1038      0.24   Q   V     |         |         |         |
 6+55       0.1055      0.24   Q   V     |         |         |         |
 7+ 0       0.1071      0.24   Q   V     |         |         |         |
 7+ 5       0.1088      0.24   Q   V     |         |         |         |
 7+10       0.1104      0.24   Q   V     |         |         |         |
 7+15       0.1121      0.24   Q   V     |         |         |         |
 7+20       0.1137      0.24   Q   V     |         |         |         |
 7+25       0.1154      0.24   Q   V     |         |         |         |
 7+30       0.1171      0.25   Q   V     |         |         |         |
 7+35       0.1188      0.25   Q   V     |         |         |         |
 7+40       0.1205      0.25   Q   V     |         |         |         |
 7+45       0.1222      0.25   Q   V     |         |         |         |
 7+50       0.1239      0.25   |Q   V    |         |         |         |
 7+55       0.1257      0.25   |Q   V    |         |         |         |
 8+ 0       0.1274      0.25   |Q   V    |         |         |         |
 8+ 5       0.1292      0.25   |Q   V    |         |         |         |
 8+10       0.1309      0.26   |Q   V    |         |         |         |
 8+15       0.1327      0.26   |Q   V    |         |         |         |
 8+20       0.1345      0.26   |Q   V    |         |         |         |
 8+25       0.1363      0.26   |Q   V    |         |         |         |
 8+30       0.1381      0.26   |Q   V    |         |         |         |
 8+35       0.1399      0.26   |Q   V    |         |         |         |
 8+40       0.1418      0.27   |Q   V    |         |         |         |
 8+45       0.1436      0.27   |Q   V    |         |         |         |
 8+50       0.1455      0.27   |Q   V    |         |         |         |
 8+55       0.1473      0.27   |Q   V    |         |         |         |
 9+ 0       0.1492      0.27   |Q    V   |         |         |         |
 9+ 5       0.1511      0.27   |Q    V   |         |         |         |
 9+10       0.1530      0.28   |Q    V   |         |         |         |
 9+15       0.1549      0.28   |Q    V   |         |         |         |
 9+20       0.1568      0.28   |Q    V   |         |         |         |
 9+25       0.1588      0.28   |Q    V   |         |         |         |
 9+30       0.1607      0.28   |Q    V   |         |         |         |
 9+35       0.1627      0.29   |Q    V   |         |         |         |
 9+40       0.1647      0.29   |Q    V   |         |         |         |
 9+45       0.1667      0.29   |Q    V   |         |         |         |
 9+50       0.1687      0.29   |Q    V   |         |         |         |
 9+55       0.1707      0.29   |Q    V   |         |         |         |
10+ 0       0.1728      0.30   |Q    V   |         |         |         |
10+ 5       0.1748      0.30   |Q     V  |         |         |         |
10+10       0.1769      0.30   |Q     V  |         |         |         |
10+15       0.1790      0.30   |Q     V  |         |         |         |
10+20       0.1811      0.31   |Q     V  |         |         |         |
10+25       0.1832      0.31   |Q     V  |         |         |         |
10+30       0.1853      0.31   |Q     V  |         |         |         |
10+35       0.1875      0.31   |Q     V  |         |         |         |
10+40       0.1897      0.32   |Q     V  |         |         |         |
10+45       0.1919      0.32   |Q     V  |         |         |         |
10+50       0.1941      0.32   |Q     V  |         |         |         |
10+55       0.1963      0.32   |Q     V  |         |         |         |
11+ 0       0.1985      0.33   |Q      V |         |         |         |
11+ 5       0.2008      0.33   |Q      V |         |         |         |
11+10       0.2031      0.33   |Q      V |         |         |         |
11+15       0.2054      0.34   |Q      V |         |         |         |
11+20       0.2078      0.34   |Q      V |         |         |         |
11+25       0.2101      0.34   |Q      V |         |         |         |
11+30       0.2125      0.35   |Q      V |         |         |         |
11+35       0.2149      0.35   |Q      V |         |         |         |
11+40       0.2173      0.35   |Q      V |         |         |         |
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11+45       0.2198      0.36  |Q      V |         |         |         |
11+50       0.2222      0.36  |Q      V |         |         |         |
11+55       0.2247      0.36  |Q       V|         |         |         |
12+ 0       0.2273      0.37  |Q       V|         |         |         |
12+ 5       0.2298      0.37  |Q       V|         |         |         |
12+10       0.2324      0.37  |Q       V|         |         |         |
12+15       0.2350      0.38  |Q       V|         |         |         |
12+20       0.2376      0.38  |Q       V|         |         |         |
12+25       0.2403      0.39  |Q       V|         |         |         |
12+30       0.2430      0.39  |Q       V|         |         |         |
12+35       0.2457      0.40  |Q       V|         |         |         |
12+40       0.2485      0.40  |Q        V         |         |         |
12+45       0.2513      0.40  |Q        V         |         |         |
12+50       0.2541      0.41  |Q        V         |         |         |
12+55       0.2569      0.42  |Q        V         |         |         |
13+ 0       0.2598      0.42  |Q        V         |         |         |
13+ 5       0.2628      0.43  |Q        V         |         |         |
13+10       0.2658      0.43  |Q        V         |         |         |
13+15       0.2688      0.44  |Q        V         |         |         |
13+20       0.2719      0.45  |Q        |V        |         |         |
13+25       0.2750      0.45  |Q        |V        |         |         |
13+30       0.2782      0.46  |Q        |V        |         |         |
13+35       0.2814      0.47  |Q        |V        |         |         |
13+40       0.2847      0.48  |Q        |V        |         |         |
13+45       0.2880      0.48  |Q        |V        |         |         |
13+50       0.2914      0.49  |Q        |V        |         |         |
13+55       0.2948      0.50  | Q       |V        |         |         |
14+ 0       0.2984      0.51  | Q       | V       |         |         |
14+ 5       0.3020      0.52  | Q       | V       |         |         |
14+10       0.3056      0.53  | Q       | V       |         |         |
14+15       0.3094      0.54  | Q       | V       |         |         |
14+20       0.3132      0.56  | Q       | V       |         |         |
14+25       0.3171      0.57  | Q       | V       |         |         |
14+30       0.3211      0.58  | Q       |  V      |         |         |
14+35       0.3253      0.60  | Q       |  V      |         |         |
14+40       0.3295      0.61  | Q       |  V      |         |         |
14+45       0.3338      0.63  | Q       |  V      |         |         |
14+50       0.3383      0.65  | Q       |  V      |         |         |
14+55       0.3429      0.67  | Q       |  V      |         |         |
15+ 0       0.3476      0.69  | Q       |   V     |         |         |
15+ 5       0.3526      0.71  | Q       |   V     |         |         |
15+10       0.3577      0.74  | Q       |   V     |         |         |
15+15       0.3630      0.77  |  Q      |   V     |         |         |
15+20       0.3685      0.80  |  Q      |   V     |         |         |
15+25       0.3742      0.84  |  Q      |    V    |         |         |
15+30       0.3802      0.87  |  Q      |    V    |         |         |
15+35       0.3864      0.89  |  Q      |    V    |         |         |
15+40       0.3926      0.91  |  Q      |    V    |         |         |
15+45       0.3990      0.92  |  Q      |     V   |         |         |
15+50       0.4056      0.97  |  Q      |     V   |         |         |
15+55       0.4129      1.06  |   Q     |     V   |         |         |
16+ 0       0.4213      1.23  |   Q     |      V  |         |         |
16+ 5       0.4336      1.79  |      Q  |      V  |         |         |
16+10       0.4537      2.91  |         |Q      V |         |         |
16+15       0.4836      4.35  |         |      Q V|         |         |
16+20       0.5315      6.96  |         |         |V     Q  |         |
16+25       0.5825      7.40  |         |         |  V     Q|         |
16+30       0.6201      5.46  |         |         |Q   V    |         |
16+35       0.6480      4.04  |         |     Q   |     V   |         |
16+40       0.6702      3.23  |         | Q       |      V  |         |
16+45       0.6894      2.78  |         |Q        |      V  |         |
16+50       0.7059      2.40  |        Q|         |       V |         |
16+55       0.7205      2.12  |       Q |         |        V|         |
```

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17+ 0       0.7334      1.88  |      Q  |         |        V|         |
17+ 5       0.7452      1.70  |     Q   |         |         V         |
17+10       0.7560      1.57  |     Q   |         |         V         |
17+15       0.7659      1.44  |    Q    |         |         |V        |
17+20       0.7748      1.29  |    Q    |         |         |V        |
17+25       0.7829      1.18  |   Q     |         |         |V        |
17+30       0.7906      1.12  |   Q     |         |         | V       |
17+35       0.7978      1.04  |   Q     |         |         | V       |
17+40       0.8046      0.98  |  Q      |         |         | V       |
17+45       0.8108      0.91  |  Q      |         |         | V       |
17+50       0.8167      0.86  |  Q      |         |         |  V      |
17+55       0.8224      0.82  |  Q      |         |         |  V      |
18+ 0       0.8276      0.76  |  Q      |         |         |  V      |
18+ 5       0.8326      0.73  | Q       |         |         |  V      |
18+10       0.8372      0.68  | Q       |         |         |  V      |
18+15       0.8416      0.63  | Q       |         |         |   V     |
18+20       0.8458      0.60  | Q       |         |         |   V     |
18+25       0.8496      0.55  | Q       |         |         |   V     |
18+30       0.8532      0.53  | Q       |         |         |   V     |
18+35       0.8569      0.53  | Q       |         |         |   V     |
18+40       0.8605      0.52  | Q       |         |         |   V     |
18+45       0.8640      0.51  | Q       |         |         |   V     |
18+50       0.8675      0.50  |Q        |         |         |    V    |
18+55       0.8708      0.49  |Q        |         |         |    V    |
19+ 0       0.8739      0.45  |Q        |         |         |    V    |
19+ 5       0.8769      0.43  |Q        |         |         |    V    |
19+10       0.8797      0.41  |Q        |         |         |    V    |
19+15       0.8823      0.38  |Q        |         |         |    V    |
19+20       0.8848      0.35  |Q        |         |         |    V    |
19+25       0.8871      0.34  |Q        |         |         |    V    |
19+30       0.8895      0.34  |Q        |         |         |     V   |
19+35       0.8917      0.33  |Q        |         |         |     V   |
19+40       0.8940      0.32  |Q        |         |         |     V   |
19+45       0.8962      0.32  |Q        |         |         |     V   |
19+50       0.8983      0.31  |Q        |         |         |     V   |
19+55       0.9004      0.31  |Q        |         |         |     V   |
20+ 0       0.9025      0.30  |Q        |         |         |     V   |
20+ 5       0.9046      0.30  |Q        |         |         |     V   |
20+10       0.9066      0.29  |Q        |         |         |     V   |
20+15       0.9086      0.29  |Q        |         |         |     V   |
20+20       0.9105      0.28  |Q        |         |         |     V   |
20+25       0.9125      0.28  |Q        |         |         |     V   |
20+30       0.9144      0.28  |Q        |         |         |      V  |
20+35       0.9162      0.27  |Q        |         |         |      V  |
20+40       0.9181      0.27  |Q        |         |         |      V  |
20+45       0.9199      0.27  |Q        |         |         |      V  |
20+50       0.9217      0.26  |Q        |         |         |      V  |
20+55       0.9235      0.26  |Q        |         |         |      V  |
21+ 0       0.9253      0.26  |Q        |         |         |      V  |
21+ 5       0.9270      0.25  |Q        |         |         |      V  |
21+10       0.9288      0.25  |Q        |         |         |      V  |
21+15       0.9305      0.25  Q         |         |         |      V  |
21+20       0.9322      0.24  Q         |         |         |      V  |
21+25       0.9338      0.24  Q         |         |         |      V  |
21+30       0.9355      0.24  Q         |         |         |      V  |
21+35       0.9371      0.24  Q         |         |         |      V  |
21+40       0.9387      0.23  Q         |         |         |       V |
21+45       0.9403      0.23  Q         |         |         |       V |
21+50       0.9419      0.23  Q         |         |         |       V |
21+55       0.9435      0.23  Q         |         |         |       V |
22+ 0       0.9450      0.23  Q         |         |         |       V |
22+ 5       0.9466      0.22  Q         |         |         |       V |
22+10       0.9481      0.22  Q         |         |         |       V |
```

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 22+15       0.9496      0.22  Q          |          |          |        V |
 22+20       0.9511      0.22  Q          |          |          |        V |
 22+25       0.9526      0.22  Q          |          |          |        V |
 22+30       0.9541      0.21  Q          |          |          |        V |
 22+35       0.9555      0.21  Q          |          |          |        V |
 22+40       0.9570      0.21  Q          |          |          |        V |
 22+45       0.9584      0.21  Q          |          |          |        V |
 22+50       0.9598      0.21  Q          |          |          |        V |
 22+55       0.9612      0.20  Q          |          |          |        V |
 23+ 0       0.9626      0.20  Q          |          |          |        V |
 23+ 5       0.9640      0.20  Q          |          |          |         V|
 23+10       0.9654      0.20  Q          |          |          |         V|
 23+15       0.9668      0.20  Q          |          |          |         V|
 23+20       0.9681      0.20  Q          |          |          |         V|
 23+25       0.9695      0.20  Q          |          |          |         V|
 23+30       0.9708      0.19  Q          |          |          |         V|
 23+35       0.9721      0.19  Q          |          |          |         V|
 23+40       0.9734      0.19  Q          |          |          |         V|
 23+45       0.9748      0.19  Q          |          |          |         V|
 23+50       0.9761      0.19  Q          |          |          |         V|
 23+55       0.9773      0.19  Q          |          |          |         V|
 24+ 0       0.9786      0.19  Q          |          |          |         V|
 24+ 5       0.9799      0.18  Q          |          |          |         V|
 24+10       0.9811      0.18  Q          |          |          |         V|
 24+15       0.9822      0.16  Q          |          |          |         V|
 24+20       0.9831      0.13  Q          |          |          |         V|
 24+25       0.9839      0.10  Q          |          |          |         V|
 24+30       0.9844      0.08  Q          |          |          |         V|
 24+35       0.9849      0.07  Q          |          |          |         V|
 24+40       0.9853      0.06  Q          |          |          |         V|
 24+45       0.9856      0.05  Q          |          |          |         V|
 24+50       0.9859      0.04  Q          |          |          |         V|
 24+55       0.9862      0.04  Q          |          |          |         V|
 25+ 0       0.9864      0.03  Q          |          |          |         V|
 25+ 5       0.9866      0.03  Q          |          |          |         V|
 25+10       0.9868      0.03  Q          |          |          |         V|
 25+15       0.9869      0.02  Q          |          |          |         V|
 25+20       0.9871      0.02  Q          |          |          |         V|
 25+25       0.9872      0.02  Q          |          |          |         V|
 25+30       0.9873      0.02  Q          |          |          |         V|
 25+35       0.9874      0.01  Q          |          |          |         V|
 25+40       0.9875      0.01  Q          |          |          |         V|
 25+45       0.9875      0.01  Q          |          |          |         V|
 25+50       0.9876      0.01  Q          |          |          |         V|
 25+55       0.9877      0.01  Q          |          |          |         V|
 26+ 0       0.9877      0.01  Q          |          |          |         V|
 26+ 5       0.9877      0.01  Q          |          |          |         V|
 26+10       0.9878      0.01  Q          |          |          |         V|
 26+15       0.9878      0.00  Q          |          |          |         V|
 26+20       0.9878      0.00  Q          |          |          |         V|
 26+25       0.9879      0.00  Q          |          |          |         V|
 26+30       0.9879      0.00  Q          |          |          |         V|
 26+35       0.9879      0.00  Q          |          |          |         V|
 26+40       0.9879      0.00  Q          |          |          |         V|
 26+45       0.9879      0.00  Q          |          |          |         V|
 26+50       0.9879      0.00  Q          |          |          |         V|
 26+55       0.9879      0.00  Q          |          |          |         V|
 27+ 0       0.9879      0.00  Q          |          |          |         V|
 27+ 5       0.9880      0.00  Q          |          |          |         V|
 27+10       0.9880      0.00  Q          |          |          |         V|
-----------------------------------------------------------------------
```

```
      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 - 2014, Version 9.0

             Study date  01/13/23

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

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


Program License Serial Number 6385

---------------------------------------------------------------------
Space Center Expansion Project Phase 2 Flag
Existing Condition Area A1 to A3
100 Year 24 Hour Storm Event
Please Refer to Appendix B Existing Condition Hydrology Map
--------------------------------------------------------------------

       Storm Event Year = 100

       Antecedent Moisture Condition = 2

 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 100
          10.06            1           1.09
--------------------------------------------------------------------
Rainfall data for year 100
          10.06            6           2.09
--------------------------------------------------------------------
Rainfall data for year 100
          10.06           24           3.64
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 2)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 86.0      86.0         10.06      1.000     0.265    1.000    0.265

Area-averaged adjusted loss rate Fm (In/Hr) =  0.265

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

Area       Area          SCS CN    SCS CN      S     Pervious
```

```
 (Ac.)      Fract         (AMC2)    (AMC2)           Yield Fr
    10.06   1.000         86.0      86.0       1.63     0.611

Area-averaged catchment yield fraction, Y =  0.611
Area-averaged low loss fraction, Yb =  0.389
User entry of time of concentration  =   0.475 (hours)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =      10.06(Ac.)
Catchment Lag time =   0.380 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 21.9298
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.265(In/Hr)
Average low loss rate fraction (Yb) = 0.389 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall =  0.517(In)
Computed peak 30-minute rainfall =  0.885(In)
Specified peak 1-hour rainfall =  1.090(In)
Computed peak 3-hour rainfall =  1.625(In)
Specified peak 6-hour rainfall =  2.090(In)
Specified peak 24-hour rainfall =  3.640(In)


Rainfall depth area reduction factors:
Using a total area of      10.06(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.517(In)
30-minute factor = 1.000    Adjusted rainfall =  0.885(In)
1-hour factor = 1.000       Adjusted rainfall =  1.089(In)
3-hour factor = 1.000       Adjusted rainfall =  1.625(In)
6-hour factor = 1.000       Adjusted rainfall =  2.090(In)
24-hour factor = 1.000      Adjusted rainfall =  3.640(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 =       121.66 (CFS))

  1               1.127                   1.371
  2               5.256                   5.024
  3              13.944                  10.570
  4              32.477                  22.548
  5              48.903                  19.985
  6              59.520                  12.916
  7              66.486                   8.476
  8              71.821                   6.490
  9              75.989                   5.071
 10              79.394                   4.143
 11              82.151                   3.353
 12              84.489                   2.846
 13              86.579                   2.542
 14              88.362                   2.169
 15              89.778                   1.722
 16              91.035                   1.530
 17              92.168                   1.379
 18              93.186                   1.237
 19              94.088                   1.097
 20              94.839                   0.915
 21              95.565                   0.883
 22              96.159                   0.723
```

23	96.725	0.689
24	97.176	0.549
25	97.571	0.480
26	97.892	0.390
27	98.111	0.267
28	98.340	0.278
29	98.600	0.317
30	98.863	0.320
31	99.126	0.320
32	99.389	0.320
33	99.579	0.232
34	99.717	0.167
35	99.854	0.167
36	100.000	0.083

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.5170	0.5170
2	0.6365	0.1195
3	0.7188	0.0823
4	0.7836	0.0648
5	0.8378	0.0543
6	0.8849	0.0471
7	0.9268	0.0419
8	0.9647	0.0379
9	0.9994	0.0347
10	1.0315	0.0321
11	1.0614	0.0299
12	1.0895	0.0281
13	1.1217	0.0322
14	1.1523	0.0306
15	1.1816	0.0293
16	1.2097	0.0281
17	1.2366	0.0270
18	1.2626	0.0260
19	1.2877	0.0251
20	1.3119	0.0242
21	1.3354	0.0235
22	1.3582	0.0228
23	1.3803	0.0221
24	1.4019	0.0215
25	1.4228	0.0210
26	1.4433	0.0204
27	1.4632	0.0199
28	1.4827	0.0195
29	1.5017	0.0190
30	1.5204	0.0186
31	1.5386	0.0182
32	1.5565	0.0179
33	1.5740	0.0175
34	1.5912	0.0172
35	1.6081	0.0169
36	1.6246	0.0166
37	1.6409	0.0163
38	1.6568	0.0160
39	1.6726	0.0157
40	1.6880	0.0155
41	1.7032	0.0152
42	1.7182	0.0150
43	1.7330	0.0148
44	1.7475	0.0145
45	1.7618	0.0143
46	1.7760	0.0141

47	1.7899	0.0139
48	1.8036	0.0137
49	1.8172	0.0136
50	1.8306	0.0134
51	1.8438	0.0132
52	1.8569	0.0131
53	1.8698	0.0129
54	1.8825	0.0127
55	1.8951	0.0126
56	1.9075	0.0124
57	1.9198	0.0123
58	1.9320	0.0122
59	1.9441	0.0120
60	1.9560	0.0119
61	1.9677	0.0118
62	1.9794	0.0117
63	1.9910	0.0115
64	2.0024	0.0114
65	2.0137	0.0113
66	2.0249	0.0112
67	2.0360	0.0111
68	2.0470	0.0110
69	2.0579	0.0109
70	2.0687	0.0108
71	2.0793	0.0107
72	2.0899	0.0106
73	2.1015	0.0116
74	2.1130	0.0115
75	2.1244	0.0114
76	2.1357	0.0113
77	2.1469	0.0112
78	2.1580	0.0111
79	2.1690	0.0110
80	2.1799	0.0109
81	2.1908	0.0109
82	2.2016	0.0108
83	2.2123	0.0107
84	2.2229	0.0106
85	2.2335	0.0106
86	2.2440	0.0105
87	2.2544	0.0104
88	2.2647	0.0103
89	2.2750	0.0103
90	2.2852	0.0102
91	2.2953	0.0101
92	2.3054	0.0101
93	2.3154	0.0100
94	2.3253	0.0099
95	2.3352	0.0099
96	2.3450	0.0098
97	2.3547	0.0097
98	2.3644	0.0097
99	2.3740	0.0096
100	2.3836	0.0096
101	2.3931	0.0095
102	2.4026	0.0095
103	2.4120	0.0094
104	2.4213	0.0093
105	2.4306	0.0093
106	2.4398	0.0092
107	2.4490	0.0092
108	2.4582	0.0091
109	2.4672	0.0091

110	2.4763	0.0090
111	2.4853	0.0090
112	2.4942	0.0089
113	2.5031	0.0089
114	2.5119	0.0088
115	2.5207	0.0088
116	2.5295	0.0088
117	2.5382	0.0087
118	2.5468	0.0087
119	2.5555	0.0086
120	2.5640	0.0086
121	2.5726	0.0085
122	2.5811	0.0085
123	2.5895	0.0084
124	2.5979	0.0084
125	2.6063	0.0084
126	2.6146	0.0083
127	2.6229	0.0083
128	2.6311	0.0082
129	2.6393	0.0082
130	2.6475	0.0082
131	2.6556	0.0081
132	2.6637	0.0081
133	2.6718	0.0081
134	2.6798	0.0080
135	2.6878	0.0080
136	2.6957	0.0080
137	2.7037	0.0079
138	2.7115	0.0079
139	2.7194	0.0078
140	2.7272	0.0078
141	2.7350	0.0078
142	2.7427	0.0077
143	2.7504	0.0077
144	2.7581	0.0077
145	2.7658	0.0076
146	2.7734	0.0076
147	2.7810	0.0076
148	2.7885	0.0076
149	2.7961	0.0075
150	2.8036	0.0075
151	2.8110	0.0075
152	2.8185	0.0074
153	2.8259	0.0074
154	2.8332	0.0074
155	2.8406	0.0073
156	2.8479	0.0073
157	2.8552	0.0073
158	2.8625	0.0073
159	2.8697	0.0072
160	2.8769	0.0072
161	2.8841	0.0072
162	2.8913	0.0072
163	2.8984	0.0071
164	2.9055	0.0071
165	2.9126	0.0071
166	2.9196	0.0071
167	2.9266	0.0070
168	2.9337	0.0070
169	2.9406	0.0070
170	2.9476	0.0070
171	2.9545	0.0069
172	2.9614	0.0069

173	2.9683	0.0069
174	2.9751	0.0069
175	2.9820	0.0068
176	2.9888	0.0068
177	2.9956	0.0068
178	3.0023	0.0068
179	3.0091	0.0067
180	3.0158	0.0067
181	3.0225	0.0067
182	3.0292	0.0067
183	3.0358	0.0067
184	3.0424	0.0066
185	3.0490	0.0066
186	3.0556	0.0066
187	3.0622	0.0066
188	3.0687	0.0065
189	3.0753	0.0065
190	3.0818	0.0065
191	3.0882	0.0065
192	3.0947	0.0065
193	3.1011	0.0064
194	3.1076	0.0064
195	3.1140	0.0064
196	3.1203	0.0064
197	3.1267	0.0064
198	3.1331	0.0063
199	3.1394	0.0063
200	3.1457	0.0063
201	3.1520	0.0063
202	3.1582	0.0063
203	3.1645	0.0062
204	3.1707	0.0062
205	3.1769	0.0062
206	3.1831	0.0062
207	3.1893	0.0062
208	3.1954	0.0062
209	3.2016	0.0061
210	3.2077	0.0061
211	3.2138	0.0061
212	3.2199	0.0061
213	3.2260	0.0061
214	3.2320	0.0061
215	3.2381	0.0060
216	3.2441	0.0060
217	3.2501	0.0060
218	3.2561	0.0060
219	3.2620	0.0060
220	3.2680	0.0060
221	3.2739	0.0059
222	3.2798	0.0059
223	3.2858	0.0059
224	3.2916	0.0059
225	3.2975	0.0059
226	3.3034	0.0059
227	3.3092	0.0058
228	3.3150	0.0058
229	3.3209	0.0058
230	3.3267	0.0058
231	3.3324	0.0058
232	3.3382	0.0058
233	3.3440	0.0058
234	3.3497	0.0057
235	3.3554	0.0057

236	3.3611	0.0057
237	3.3668	0.0057
238	3.3725	0.0057
239	3.3782	0.0057
240	3.3838	0.0057
241	3.3894	0.0056
242	3.3951	0.0056
243	3.4007	0.0056
244	3.4063	0.0056
245	3.4118	0.0056
246	3.4174	0.0056
247	3.4230	0.0056
248	3.4285	0.0055
249	3.4340	0.0055
250	3.4395	0.0055
251	3.4450	0.0055
252	3.4505	0.0055
253	3.4560	0.0055
254	3.4615	0.0055
255	3.4669	0.0054
256	3.4723	0.0054
257	3.4778	0.0054
258	3.4832	0.0054
259	3.4886	0.0054
260	3.4940	0.0054
261	3.4993	0.0054
262	3.5047	0.0054
263	3.5100	0.0053
264	3.5154	0.0053
265	3.5207	0.0053
266	3.5260	0.0053
267	3.5313	0.0053
268	3.5366	0.0053
269	3.5419	0.0053
270	3.5471	0.0053
271	3.5524	0.0053
272	3.5576	0.0052
273	3.5629	0.0052
274	3.5681	0.0052
275	3.5733	0.0052
276	3.5785	0.0052
277	3.5837	0.0052
278	3.5888	0.0052
279	3.5940	0.0052
280	3.5991	0.0052
281	3.6043	0.0051
282	3.6094	0.0051
283	3.6145	0.0051
284	3.6196	0.0051
285	3.6247	0.0051
286	3.6298	0.0051
287	3.6349	0.0051
288	3.6400	0.0051

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0051	0.0020	0.0031
2	0.0051	0.0020	0.0031
3	0.0051	0.0020	0.0031
4	0.0051	0.0020	0.0031
5	0.0051	0.0020	0.0031

6	0.0051	0.0020	0.0031
7	0.0052	0.0020	0.0032
8	0.0052	0.0020	0.0032
9	0.0052	0.0020	0.0032
10	0.0052	0.0020	0.0032
11	0.0052	0.0020	0.0032
12	0.0052	0.0020	0.0032
13	0.0053	0.0020	0.0032
14	0.0053	0.0021	0.0032
15	0.0053	0.0021	0.0032
16	0.0053	0.0021	0.0032
17	0.0053	0.0021	0.0033
18	0.0053	0.0021	0.0033
19	0.0054	0.0021	0.0033
20	0.0054	0.0021	0.0033
21	0.0054	0.0021	0.0033
22	0.0054	0.0021	0.0033
23	0.0054	0.0021	0.0033
24	0.0055	0.0021	0.0033
25	0.0055	0.0021	0.0034
26	0.0055	0.0021	0.0034
27	0.0055	0.0022	0.0034
28	0.0055	0.0022	0.0034
29	0.0056	0.0022	0.0034
30	0.0056	0.0022	0.0034
31	0.0056	0.0022	0.0034
32	0.0056	0.0022	0.0034
33	0.0057	0.0022	0.0035
34	0.0057	0.0022	0.0035
35	0.0057	0.0022	0.0035
36	0.0057	0.0022	0.0035
37	0.0057	0.0022	0.0035
38	0.0058	0.0022	0.0035
39	0.0058	0.0023	0.0035
40	0.0058	0.0023	0.0035
41	0.0058	0.0023	0.0036
42	0.0058	0.0023	0.0036
43	0.0059	0.0023	0.0036
44	0.0059	0.0023	0.0036
45	0.0059	0.0023	0.0036
46	0.0059	0.0023	0.0036
47	0.0060	0.0023	0.0036
48	0.0060	0.0023	0.0037
49	0.0060	0.0023	0.0037
50	0.0060	0.0024	0.0037
51	0.0061	0.0024	0.0037
52	0.0061	0.0024	0.0037
53	0.0061	0.0024	0.0037
54	0.0061	0.0024	0.0037
55	0.0062	0.0024	0.0038
56	0.0062	0.0024	0.0038
57	0.0062	0.0024	0.0038
58	0.0062	0.0024	0.0038
59	0.0063	0.0024	0.0038
60	0.0063	0.0025	0.0038
61	0.0063	0.0025	0.0039
62	0.0064	0.0025	0.0039
63	0.0064	0.0025	0.0039
64	0.0064	0.0025	0.0039
65	0.0065	0.0025	0.0039
66	0.0065	0.0025	0.0040
67	0.0065	0.0025	0.0040
68	0.0065	0.0025	0.0040

69	0.0066	0.0026	0.0040
70	0.0066	0.0026	0.0040
71	0.0067	0.0026	0.0041
72	0.0067	0.0026	0.0041
73	0.0067	0.0026	0.0041
74	0.0067	0.0026	0.0041
75	0.0068	0.0026	0.0041
76	0.0068	0.0027	0.0042
77	0.0069	0.0027	0.0042
78	0.0069	0.0027	0.0042
79	0.0069	0.0027	0.0042
80	0.0070	0.0027	0.0042
81	0.0070	0.0027	0.0043
82	0.0070	0.0027	0.0043
83	0.0071	0.0028	0.0043
84	0.0071	0.0028	0.0043
85	0.0072	0.0028	0.0044
86	0.0072	0.0028	0.0044
87	0.0072	0.0028	0.0044
88	0.0073	0.0028	0.0044
89	0.0073	0.0029	0.0045
90	0.0073	0.0029	0.0045
91	0.0074	0.0029	0.0045
92	0.0074	0.0029	0.0045
93	0.0075	0.0029	0.0046
94	0.0075	0.0029	0.0046
95	0.0076	0.0030	0.0046
96	0.0076	0.0030	0.0047
97	0.0077	0.0030	0.0047
98	0.0077	0.0030	0.0047
99	0.0078	0.0030	0.0048
100	0.0078	0.0030	0.0048
101	0.0079	0.0031	0.0048
102	0.0079	0.0031	0.0048
103	0.0080	0.0031	0.0049
104	0.0080	0.0031	0.0049
105	0.0081	0.0032	0.0049
106	0.0081	0.0032	0.0050
107	0.0082	0.0032	0.0050
108	0.0082	0.0032	0.0050
109	0.0083	0.0032	0.0051
110	0.0084	0.0033	0.0051
111	0.0084	0.0033	0.0052
112	0.0085	0.0033	0.0052
113	0.0086	0.0033	0.0052
114	0.0086	0.0034	0.0053
115	0.0087	0.0034	0.0053
116	0.0088	0.0034	0.0053
117	0.0088	0.0034	0.0054
118	0.0089	0.0035	0.0054
119	0.0090	0.0035	0.0055
120	0.0090	0.0035	0.0055
121	0.0091	0.0036	0.0056
122	0.0092	0.0036	0.0056
123	0.0093	0.0036	0.0057
124	0.0093	0.0036	0.0057
125	0.0095	0.0037	0.0058
126	0.0095	0.0037	0.0058
127	0.0096	0.0037	0.0059
128	0.0097	0.0038	0.0059
129	0.0098	0.0038	0.0060
130	0.0099	0.0038	0.0060
131	0.0100	0.0039	0.0061

132	0.0101	0.0039	0.0061
133	0.0102	0.0040	0.0062
134	0.0103	0.0040	0.0063
135	0.0104	0.0041	0.0064
136	0.0105	0.0041	0.0064
137	0.0106	0.0041	0.0065
138	0.0107	0.0042	0.0065
139	0.0109	0.0042	0.0066
140	0.0109	0.0043	0.0067
141	0.0111	0.0043	0.0068
142	0.0112	0.0044	0.0068
143	0.0114	0.0044	0.0070
144	0.0115	0.0045	0.0070
145	0.0106	0.0041	0.0065
146	0.0107	0.0042	0.0065
147	0.0109	0.0042	0.0066
148	0.0110	0.0043	0.0067
149	0.0112	0.0044	0.0068
150	0.0113	0.0044	0.0069
151	0.0115	0.0045	0.0070
152	0.0117	0.0045	0.0071
153	0.0119	0.0046	0.0073
154	0.0120	0.0047	0.0074
155	0.0123	0.0048	0.0075
156	0.0124	0.0048	0.0076
157	0.0127	0.0050	0.0078
158	0.0129	0.0050	0.0079
159	0.0132	0.0051	0.0081
160	0.0134	0.0052	0.0082
161	0.0137	0.0054	0.0084
162	0.0139	0.0054	0.0085
163	0.0143	0.0056	0.0087
164	0.0145	0.0057	0.0089
165	0.0150	0.0058	0.0091
166	0.0152	0.0059	0.0093
167	0.0157	0.0061	0.0096
168	0.0160	0.0062	0.0098
169	0.0166	0.0064	0.0101
170	0.0169	0.0066	0.0103
171	0.0175	0.0068	0.0107
172	0.0179	0.0070	0.0109
173	0.0186	0.0073	0.0114
174	0.0190	0.0074	0.0116
175	0.0199	0.0078	0.0122
176	0.0204	0.0080	0.0125
177	0.0215	0.0084	0.0131
178	0.0221	0.0086	0.0135
179	0.0235	0.0091	0.0143
180	0.0242	0.0094	0.0148
181	0.0260	0.0101	0.0159
182	0.0270	0.0105	0.0165
183	0.0293	0.0114	0.0179
184	0.0306	0.0119	0.0187
185	0.0281	0.0109	0.0171
186	0.0299	0.0116	0.0183
187	0.0347	0.0135	0.0212
188	0.0379	0.0147	0.0231
189	0.0471	0.0183	0.0288
190	0.0543	0.0211	0.0331
191	0.0823	0.0221	0.0602
192	0.1195	0.0221	0.0974
193	0.5170	0.0221	0.4949
194	0.0648	0.0221	0.0427

195	0.0419	0.0163	0.0256
196	0.0321	0.0125	0.0196
197	0.0322	0.0125	0.0197
198	0.0281	0.0109	0.0171
199	0.0251	0.0098	0.0153
200	0.0228	0.0089	0.0139
201	0.0210	0.0082	0.0128
202	0.0195	0.0076	0.0119
203	0.0182	0.0071	0.0111
204	0.0172	0.0067	0.0105
205	0.0163	0.0063	0.0099
206	0.0155	0.0060	0.0094
207	0.0148	0.0057	0.0090
208	0.0141	0.0055	0.0086
209	0.0136	0.0053	0.0083
210	0.0131	0.0051	0.0080
211	0.0126	0.0049	0.0077
212	0.0122	0.0047	0.0074
213	0.0118	0.0046	0.0072
214	0.0114	0.0044	0.0070
215	0.0111	0.0043	0.0068
216	0.0108	0.0042	0.0066
217	0.0116	0.0045	0.0071
218	0.0113	0.0044	0.0069
219	0.0110	0.0043	0.0067
220	0.0108	0.0042	0.0066
221	0.0106	0.0041	0.0064
222	0.0103	0.0040	0.0063
223	0.0101	0.0039	0.0062
224	0.0099	0.0039	0.0061
225	0.0097	0.0038	0.0060
226	0.0096	0.0037	0.0058
227	0.0094	0.0037	0.0057
228	0.0092	0.0036	0.0056
229	0.0091	0.0035	0.0055
230	0.0089	0.0035	0.0055
231	0.0088	0.0034	0.0054
232	0.0087	0.0034	0.0053
233	0.0085	0.0033	0.0052
234	0.0084	0.0033	0.0051
235	0.0083	0.0032	0.0051
236	0.0082	0.0032	0.0050
237	0.0081	0.0031	0.0049
238	0.0080	0.0031	0.0049
239	0.0078	0.0031	0.0048
240	0.0077	0.0030	0.0047
241	0.0076	0.0030	0.0047
242	0.0076	0.0029	0.0046
243	0.0075	0.0029	0.0046
244	0.0074	0.0029	0.0045
245	0.0073	0.0028	0.0045
246	0.0072	0.0028	0.0044
247	0.0071	0.0028	0.0044
248	0.0071	0.0027	0.0043
249	0.0070	0.0027	0.0043
250	0.0069	0.0027	0.0042
251	0.0068	0.0027	0.0042
252	0.0068	0.0026	0.0041
253	0.0067	0.0026	0.0041
254	0.0066	0.0026	0.0040
255	0.0066	0.0026	0.0040
256	0.0065	0.0025	0.0040
257	0.0064	0.0025	0.0039

258	0.0064	0.0025	0.0039
259	0.0063	0.0025	0.0039
260	0.0063	0.0024	0.0038
261	0.0062	0.0024	0.0038
262	0.0062	0.0024	0.0038
263	0.0061	0.0024	0.0037
264	0.0061	0.0024	0.0037
265	0.0060	0.0023	0.0037
266	0.0060	0.0023	0.0036
267	0.0059	0.0023	0.0036
268	0.0059	0.0023	0.0036
269	0.0058	0.0023	0.0035
270	0.0058	0.0022	0.0035
271	0.0057	0.0022	0.0035
272	0.0057	0.0022	0.0035
273	0.0056	0.0022	0.0034
274	0.0056	0.0022	0.0034
275	0.0056	0.0022	0.0034
276	0.0055	0.0021	0.0034
277	0.0055	0.0021	0.0033
278	0.0054	0.0021	0.0033
279	0.0054	0.0021	0.0033
280	0.0054	0.0021	0.0033
281	0.0053	0.0021	0.0033
282	0.0053	0.0021	0.0032
283	0.0053	0.0020	0.0032
284	0.0052	0.0020	0.0032
285	0.0052	0.0020	0.0032
286	0.0052	0.0020	0.0031
287	0.0051	0.0020	0.0031
288	0.0051	0.0020	0.0031

Total soil rain loss = 1.20(In)
Total effective rainfall = 2.44(In)
Peak flow rate in flood hydrograph = 15.54(CFS)

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24 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	5.0	10.0	15.0	20.0
0+ 5	0.0000	0.00	Q	|	|	|	|
0+10	0.0002	0.02	Q	|	|	|	|
0+15	0.0005	0.05	Q	|	|	|	|
0+20	0.0014	0.12	Q	|	|	|	|
0+25	0.0026	0.18	Q	|	|	|	|
0+30	0.0042	0.23	Q	|	|	|	|
0+35	0.0059	0.25	Q	|	|	|	|
0+40	0.0078	0.27	Q	|	|	|	|
0+45	0.0098	0.29	Q	|	|	|	|
0+50	0.0119	0.30	Q	|	|	|	|
0+55	0.0140	0.31	Q	|	|	|	|
1+ 0	0.0163	0.32	Q	|	|	|	|
1+ 5	0.0186	0.33	Q	|	|	|	|
1+10	0.0209	0.34	Q	|	|	|	|
1+15	0.0233	0.35	Q	|	|	|	|
1+20	0.0257	0.35	Q	|	|	|	|
1+25	0.0282	0.36	Q	|	|	|	|

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1+30       0.0307      0.36  Q         |         |         |         |
1+35       0.0333      0.37  Q         |         |         |         |
1+40       0.0358      0.37  Q         |         |         |         |
1+45       0.0384      0.38  Q         |         |         |         |
1+50       0.0410      0.38  Q         |         |         |         |
1+55       0.0437      0.38  Q         |         |         |         |
2+ 0       0.0463      0.39  Q         |         |         |         |
2+ 5       0.0490      0.39  Q         |         |         |         |
2+10       0.0517      0.39  QV        |         |         |         |
2+15       0.0544      0.39  QV        |         |         |         |
2+20       0.0571      0.40  QV        |         |         |         |
2+25       0.0599      0.40  QV        |         |         |         |
2+30       0.0627      0.40  QV        |         |         |         |
2+35       0.0654      0.40  QV        |         |         |         |
2+40       0.0682      0.41  QV        |         |         |         |
2+45       0.0710      0.41  QV        |         |         |         |
2+50       0.0739      0.41  QV        |         |         |         |
2+55       0.0767      0.41  QV        |         |         |         |
3+ 0       0.0795      0.41  QV        |         |         |         |
3+ 5       0.0824      0.42  QV        |         |         |         |
3+10       0.0853      0.42  QV        |         |         |         |
3+15       0.0881      0.42  QV        |         |         |         |
3+20       0.0910      0.42  QV        |         |         |         |
3+25       0.0939      0.42  QV        |         |         |         |
3+30       0.0969      0.42  QV        |         |         |         |
3+35       0.0998      0.42  QV        |         |         |         |
3+40       0.1027      0.43  Q V       |         |         |         |
3+45       0.1057      0.43  Q V       |         |         |         |
3+50       0.1086      0.43  Q V       |         |         |         |
3+55       0.1116      0.43  Q V       |         |         |         |
4+ 0       0.1146      0.43  Q V       |         |         |         |
4+ 5       0.1176      0.43  Q V       |         |         |         |
4+10       0.1206      0.44  Q V       |         |         |         |
4+15       0.1236      0.44  Q V       |         |         |         |
4+20       0.1266      0.44  Q V       |         |         |         |
4+25       0.1297      0.44  Q V       |         |         |         |
4+30       0.1327      0.44  Q V       |         |         |         |
4+35       0.1358      0.45  Q V       |         |         |         |
4+40       0.1389      0.45  Q V       |         |         |         |
4+45       0.1420      0.45  Q V       |         |         |         |
4+50       0.1451      0.45  Q V       |         |         |         |
4+55       0.1482      0.45  Q V       |         |         |         |
5+ 0       0.1513      0.46  Q V       |         |         |         |
5+ 5       0.1545      0.46  Q  V      |         |         |         |
5+10       0.1576      0.46  Q  V      |         |         |         |
5+15       0.1608      0.46  Q  V      |         |         |         |
5+20       0.1640      0.46  Q  V      |         |         |         |
5+25       0.1672      0.47  Q  V      |         |         |         |
5+30       0.1704      0.47  Q  V      |         |         |         |
5+35       0.1737      0.47  Q  V      |         |         |         |
5+40       0.1769      0.47  Q  V      |         |         |         |
5+45       0.1802      0.47  Q  V      |         |         |         |
5+50       0.1834      0.48  Q  V      |         |         |         |
5+55       0.1867      0.48  Q  V      |         |         |         |
6+ 0       0.1900      0.48  Q  V      |         |         |         |
6+ 5       0.1934      0.48  Q  V      |         |         |         |
6+10       0.1967      0.48  Q  V      |         |         |         |
6+15       0.2001      0.49  Q  V      |         |         |         |
6+20       0.2034      0.49  Q  V      |         |         |         |
6+25       0.2068      0.49  Q   V     |         |         |         |
6+30       0.2102      0.49  Q   V     |         |         |         |
6+35       0.2136      0.50  Q   V     |         |         |         |
6+40       0.2171      0.50  Q   V     |         |         |         |
```

```
  6+45      0.2205      0.50  |Q  V      |         |         |         |
  6+50      0.2240      0.50  |Q  V      |         |         |         |
  6+55      0.2275      0.51  |Q  V      |         |         |         |
  7+ 0      0.2310      0.51  |Q  V      |         |         |         |
  7+ 5      0.2345      0.51  |Q  V      |         |         |         |
  7+10      0.2381      0.52  |Q  V      |         |         |         |
  7+15      0.2417      0.52  |Q  V      |         |         |         |
  7+20      0.2452      0.52  |Q  V      |         |         |         |
  7+25      0.2489      0.52  |Q  V      |         |         |         |
  7+30      0.2525      0.53  |Q  V      |         |         |         |
  7+35      0.2561      0.53  |Q   V     |         |         |         |
  7+40      0.2598      0.53  |Q   V     |         |         |         |
  7+45      0.2635      0.54  |Q   V     |         |         |         |
  7+50      0.2672      0.54  |Q   V     |         |         |         |
  7+55      0.2709      0.54  |Q   V     |         |         |         |
  8+ 0      0.2747      0.54  |Q   V     |         |         |         |
  8+ 5      0.2784      0.55  |Q   V     |         |         |         |
  8+10      0.2822      0.55  |Q   V     |         |         |         |
  8+15      0.2860      0.55  |Q   V     |         |         |         |
  8+20      0.2899      0.56  |Q   V     |         |         |         |
  8+25      0.2937      0.56  |Q   V     |         |         |         |
  8+30      0.2976      0.56  |Q   V     |         |         |         |
  8+35      0.3015      0.57  |Q   V     |         |         |         |
  8+40      0.3055      0.57  |Q   V     |         |         |         |
  8+45      0.3094      0.58  |Q    V    |         |         |         |
  8+50      0.3134      0.58  |Q    V    |         |         |         |
  8+55      0.3174      0.58  |Q    V    |         |         |         |
  9+ 0      0.3215      0.59  |Q    V    |         |         |         |
  9+ 5      0.3255      0.59  |Q    V    |         |         |         |
  9+10      0.3296      0.59  |Q    V    |         |         |         |
  9+15      0.3338      0.60  |Q    V    |         |         |         |
  9+20      0.3379      0.60  |Q    V    |         |         |         |
  9+25      0.3421      0.61  |Q    V    |         |         |         |
  9+30      0.3463      0.61  |Q    V    |         |         |         |
  9+35      0.3505      0.62  |Q    V    |         |         |         |
  9+40      0.3548      0.62  |Q    V    |         |         |         |
  9+45      0.3591      0.62  |Q     V   |         |         |         |
  9+50      0.3634      0.63  |Q     V   |         |         |         |
  9+55      0.3678      0.63  |Q     V   |         |         |         |
 10+ 0      0.3722      0.64  |Q     V   |         |         |         |
 10+ 5      0.3766      0.64  |Q     V   |         |         |         |
 10+10      0.3811      0.65  |Q     V   |         |         |         |
 10+15      0.3856      0.65  |Q     V   |         |         |         |
 10+20      0.3901      0.66  |Q     V   |         |         |         |
 10+25      0.3947      0.66  |Q     V   |         |         |         |
 10+30      0.3993      0.67  |Q     V   |         |         |         |
 10+35      0.4040      0.67  |Q     V   |         |         |         |
 10+40      0.4086      0.68  |Q      V  |         |         |         |
 10+45      0.4134      0.69  |Q      V  |         |         |         |
 10+50      0.4181      0.69  |Q      V  |         |         |         |
 10+55      0.4230      0.70  |Q      V  |         |         |         |
 11+ 0      0.4278      0.70  |Q      V  |         |         |         |
 11+ 5      0.4327      0.71  |Q      V  |         |         |         |
 11+10      0.4376      0.72  |Q      V  |         |         |         |
 11+15      0.4426      0.72  |Q      V  |         |         |         |
 11+20      0.4477      0.73  |Q      V  |         |         |         |
 11+25      0.4528      0.74  |Q      V  |         |         |         |
 11+30      0.4579      0.75  |Q      V  |         |         |         |
 11+35      0.4631      0.75  |Q       V|         |         |         |
 11+40      0.4683      0.76  |Q       V|         |         |         |
 11+45      0.4736      0.77  |Q       V|         |         |         |
 11+50      0.4790      0.78  |Q       V|         |         |         |
 11+55      0.4844      0.78  |Q       V|         |         |         |
```

```
12+ 0       0.4898      0.79  |Q       V|         |         |         |
12+ 5       0.4953      0.80  |Q       V|         |         |         |
12+10       0.5009      0.81  |Q       V|         |         |         |
12+15       0.5065      0.81  |Q       V|         |         |         |
12+20       0.5120      0.80  |Q        V         |         |         |
12+25       0.5175      0.80  |Q        V         |         |         |
12+30       0.5231      0.80  |Q        V         |         |         |
12+35       0.5286      0.81  |Q        V         |         |         |
12+40       0.5342      0.81  |Q        V         |         |         |
12+45       0.5399      0.82  |Q        V         |         |         |
12+50       0.5456      0.83  |Q        V         |         |         |
12+55       0.5514      0.84  |Q        V         |         |         |
13+ 0       0.5573      0.85  |Q        V         |         |         |
13+ 5       0.5632      0.86  |Q        |V        |         |         |
13+10       0.5692      0.87  |Q        |V        |         |         |
13+15       0.5754      0.89  |Q        |V        |         |         |
13+20       0.5816      0.90  |Q        |V        |         |         |
13+25       0.5879      0.91  |Q        |V        |         |         |
13+30       0.5943      0.93  |Q        |V        |         |         |
13+35       0.6008      0.95  |Q        |V        |         |         |
13+40       0.6074      0.96  |Q        |V        |         |         |
13+45       0.6142      0.98  |Q        | V       |         |         |
13+50       0.6210      1.00  |Q        | V       |         |         |
13+55       0.6280      1.02  | Q       | V       |         |         |
14+ 0       0.6352      1.04  | Q       | V       |         |         |
14+ 5       0.6425      1.06  | Q       | V       |         |         |
14+10       0.6500      1.08  | Q       | V       |         |         |
14+15       0.6576      1.11  | Q       | V       |         |         |
14+20       0.6655      1.14  | Q       |  V      |         |         |
14+25       0.6735      1.16  | Q       |  V      |         |         |
14+30       0.6817      1.20  | Q       |  V      |         |         |
14+35       0.6902      1.23  | Q       |  V      |         |         |
14+40       0.6989      1.26  | Q       |  V      |         |         |
14+45       0.7078      1.30  | Q       |  V      |         |         |
14+50       0.7171      1.34  | Q       |   V     |         |         |
14+55       0.7266      1.39  | Q       |   V     |         |         |
15+ 0       0.7365      1.44  | Q       |   V     |         |         |
15+ 5       0.7468      1.49  | Q       |   V     |         |         |
15+10       0.7574      1.55  |  Q      |   V     |         |         |
15+15       0.7686      1.62  |  Q      |    V    |         |         |
15+20       0.7802      1.69  |  Q      |    V    |         |         |
15+25       0.7924      1.77  |  Q      |    V    |         |         |
15+30       0.8052      1.85  |  Q      |    V    |         |         |
15+35       0.8184      1.93  |  Q      |     V   |         |         |
15+40       0.8321      1.98  |  Q      |     V   |         |         |
15+45       0.8463      2.07  |   Q     |     V   |         |         |
15+50       0.8616      2.22  |   Q     |     V   |         |         |
15+55       0.8787      2.47  |   Q     |      V  |         |         |
16+ 0       0.8989      2.93  |    Q    |      V  |         |         |
16+ 5       0.9280      4.23  |       Q |       V |         |         |
16+10       0.9750      6.82  |         |  Q     V|         |         |
16+15       1.0456     10.25  |         |         Q         |         |
16+20       1.1527     15.54  |         |         | V       |Q        |
16+25       1.2482     13.87  |         |         |   V  Q  |         |
16+30       1.3177     10.08  |         |         Q    V    |         |
16+35       1.3697      7.55  |         |    Q    |     V   |         |
16+40       1.4129      6.27  |         | Q       |      V  |         |
16+45       1.4496      5.33  |         Q         |       V |         |
16+50       1.4816      4.65  |        Q|         |        V|         |
16+55       1.5097      4.07  |       Q |         |        V|         |
17+ 0       1.5349      3.65  |      Q  |         |         V         |
17+ 5       1.5579      3.34  |     Q   |         |         V         |
17+10       1.5787      3.02  |     Q   |         |         V         |
```

```
17+15       1.5971      2.68  |    Q    |         |         |V        |
17+20       1.6142      2.48  |   Q     |         |         |V        |
17+25       1.6301      2.31  |   Q     |         |         |V        |
17+30       1.6450      2.15  |   Q     |         |         | V       |
17+35       1.6588      2.00  |   Q     |         |         | V       |
17+40       1.6714      1.84  |  Q      |         |         | V       |
17+45       1.6835      1.75  |  Q      |         |         | V       |
17+50       1.6947      1.62  |  Q      |         |         |  V      |
17+55       1.7053      1.54  |  Q      |         |         |  V      |
18+ 0       1.7150      1.42  | Q       |         |         |  V      |
18+ 5       1.7242      1.33  | Q       |         |         |  V      |
18+10       1.7327      1.24  | Q       |         |         |  V      |
18+15       1.7407      1.16  | Q       |         |         |   V     |
18+20       1.7486      1.14  | Q       |         |         |   V     |
18+25       1.7564      1.14  | Q       |         |         |   V     |
18+30       1.7642      1.12  | Q       |         |         |   V     |
18+35       1.7717      1.10  | Q       |         |         |   V     |
18+40       1.7791      1.07  | Q       |         |         |   V     |
18+45       1.7859      1.00  |Q        |         |         |   V     |
18+50       1.7924      0.94  |Q        |         |         |    V    |
18+55       1.7987      0.91  |Q        |         |         |    V    |
19+ 0       1.8045      0.84  |Q        |         |         |    V    |
19+ 5       1.8099      0.79  |Q        |         |         |    V    |
19+10       1.8152      0.77  |Q        |         |         |    V    |
19+15       1.8203      0.75  |Q        |         |         |    V    |
19+20       1.8254      0.73  |Q        |         |         |    V    |
19+25       1.8303      0.72  |Q        |         |         |    V    |
19+30       1.8352      0.71  |Q        |         |         |    V    |
19+35       1.8400      0.69  |Q        |         |         |     V   |
19+40       1.8447      0.68  |Q        |         |         |     V   |
19+45       1.8493      0.67  |Q        |         |         |     V   |
19+50       1.8538      0.66  |Q        |         |         |     V   |
19+55       1.8583      0.65  |Q        |         |         |     V   |
20+ 0       1.8627      0.64  |Q        |         |         |     V   |
20+ 5       1.8670      0.63  |Q        |         |         |     V   |
20+10       1.8713      0.62  |Q        |         |         |     V   |
20+15       1.8755      0.61  |Q        |         |         |     V   |
20+20       1.8796      0.60  |Q        |         |         |     V   |
20+25       1.8837      0.59  |Q        |         |         |     V   |
20+30       1.8877      0.59  |Q        |         |         |     V   |
20+35       1.8917      0.58  |Q        |         |         |      V  |
20+40       1.8956      0.57  |Q        |         |         |      V  |
20+45       1.8995      0.56  |Q        |         |         |      V  |
20+50       1.9034      0.56  |Q        |         |         |      V  |
20+55       1.9072      0.55  |Q        |         |         |      V  |
21+ 0       1.9109      0.54  |Q        |         |         |      V  |
21+ 5       1.9146      0.54  |Q        |         |         |      V  |
21+10       1.9183      0.53  |Q        |         |         |      V  |
21+15       1.9219      0.53  |Q        |         |         |      V  |
21+20       1.9255      0.52  |Q        |         |         |      V  |
21+25       1.9290      0.51  |Q        |         |         |      V  |
21+30       1.9325      0.51  |Q        |         |         |      V  |
21+35       1.9360      0.50  |Q        |         |         |      V  |
21+40       1.9394      0.50  Q         |         |         |      V  |
21+45       1.9428      0.49  Q         |         |         |       V |
21+50       1.9462      0.49  Q         |         |         |       V |
21+55       1.9495      0.48  Q         |         |         |       V |
22+ 0       1.9528      0.48  Q         |         |         |       V |
22+ 5       1.9561      0.47  Q         |         |         |       V |
22+10       1.9593      0.47  Q         |         |         |       V |
22+15       1.9625      0.47  Q         |         |         |       V |
22+20       1.9657      0.46  Q         |         |         |       V |
22+25       1.9689      0.46  Q         |         |         |       V |
```

22+30	1.9720	0.45	Q	|	|	|	V |
22+35	1.9751	0.45	Q	|	|	|	V |
22+40	1.9782	0.45	Q	|	|	|	V |
22+45	1.9812	0.44	Q	|	|	|	V |
22+50	1.9842	0.44	Q	|	|	|	V |
22+55	1.9872	0.44	Q	|	|	|	V |
23+ 0	1.9902	0.43	Q	|	|	|	V |
23+ 5	1.9932	0.43	Q	|	|	|	V|
23+10	1.9961	0.43	Q	|	|	|	V|
23+15	1.9990	0.42	Q	|	|	|	V|
23+20	2.0019	0.42	Q	|	|	|	V|
23+25	2.0047	0.42	Q	|	|	|	V|
23+30	2.0076	0.41	Q	|	|	|	V|
23+35	2.0104	0.41	Q	|	|	|	V|
23+40	2.0132	0.41	Q	|	|	|	V|
23+45	2.0160	0.40	Q	|	|	|	V|
23+50	2.0188	0.40	Q	|	|	|	V|
23+55	2.0215	0.40	Q	|	|	|	V|
24+ 0	2.0242	0.40	Q	|	|	|	V|
24+ 5	2.0269	0.39	Q	|	|	|	V|
24+10	2.0294	0.37	Q	|	|	|	V|
24+15	2.0318	0.34	Q	|	|	|	V|
24+20	2.0336	0.26	Q	|	|	|	V|
24+25	2.0349	0.20	Q	|	|	|	V|
24+30	2.0360	0.16	Q	|	|	|	V|
24+35	2.0370	0.13	Q	|	|	|	V|
24+40	2.0377	0.11	Q	|	|	|	V|
24+45	2.0384	0.09	Q	|	|	|	V|
24+50	2.0389	0.08	Q	|	|	|	V|
24+55	2.0394	0.07	Q	|	|	|	V|
25+ 0	2.0398	0.06	Q	|	|	|	V|
25+ 5	2.0402	0.05	Q	|	|	|	V|
25+10	2.0405	0.05	Q	|	|	|	V|
25+15	2.0408	0.04	Q	|	|	|	V|
25+20	2.0410	0.03	Q	|	|	|	V|
25+25	2.0412	0.03	Q	|	|	|	V|
25+30	2.0414	0.03	Q	|	|	|	V|
25+35	2.0416	0.02	Q	|	|	|	V|
25+40	2.0417	0.02	Q	|	|	|	V|
25+45	2.0418	0.02	Q	|	|	|	V|
25+50	2.0419	0.01	Q	|	|	|	V|
25+55	2.0420	0.01	Q	|	|	|	V|
26+ 0	2.0421	0.01	Q	|	|	|	V|
26+ 5	2.0421	0.01	Q	|	|	|	V|
26+10	2.0422	0.01	Q	|	|	|	V|
26+15	2.0422	0.01	Q	|	|	|	V|
26+20	2.0423	0.01	Q	|	|	|	V|
26+25	2.0423	0.01	Q	|	|	|	V|
26+30	2.0423	0.00	Q	|	|	|	V|
26+35	2.0424	0.00	Q	|	|	|	V|
26+40	2.0424	0.00	Q	|	|	|	V|
26+45	2.0424	0.00	Q	|	|	|	V|
26+50	2.0424	0.00	Q	|	|	|	V|
26+55	2.0424	0.00	Q	|	|	|	V

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

Study date 01/13/23

++

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

Program License Serial Number 6385

Space Center Expansion Project Phase 2 FLag
Developed Condition Area A1 to A4
10 Year 24 Hour Storm Event
Please Refer to Appendix B Developed Condition Hydrology Map

Storm Event Year = 10

Antecedent Moisture Condition = 2

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 (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 10		
10.06	1	0.62
Rainfall data for year 10		
10.06	6	1.27
Rainfall data for year 10		
10.06	24	2.23

++

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

SCS curve No.(AMCII)	SCS curve NO.(AMC 2)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
70.4	70.4	10.06	1.000	0.526	0.176	0.093

Area-averaged adjusted loss rate Fm (In/Hr) = 0.093

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

Area Area SCS CN SCS CN S Pervious

```
 (Ac.)      Fract         (AMC2)    (AMC2)           Yield Fr
     1.77   0.176         70.4      70.4       4.20     0.155
     8.29   0.824         98.0      98.0       0.20     0.898

Area-averaged catchment yield fraction, Y =  0.767
Area-averaged low loss fraction, Yb =  0.233
User entry of time of concentration  =   0.289 (hours)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =      10.06(Ac.)
Catchment Lag time =   0.231 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 36.0438
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.093(In/Hr)
Average low loss rate fraction (Yb) = 0.233 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall =  0.293(In)
Computed peak 30-minute rainfall =  0.502(In)
Specified peak 1-hour rainfall =  0.618(In)
Computed peak 3-hour rainfall =  0.961(In)
Specified peak 6-hour rainfall =  1.270(In)
Specified peak 24-hour rainfall =  2.230(In)


Rainfall depth area reduction factors:
Using a total area of      10.06(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.293(In)
30-minute factor = 1.000    Adjusted rainfall =  0.502(In)
1-hour factor = 1.000       Adjusted rainfall =  0.618(In)
3-hour factor = 1.000       Adjusted rainfall =  0.961(In)
6-hour factor = 1.000       Adjusted rainfall =  1.270(In)
24-hour factor = 1.000      Adjusted rainfall =  2.230(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 =       121.66 (CFS))

  1               2.336                   2.843
  2              14.416                  14.696
  3              42.829                  34.568
  4              61.310                  22.485
  5              71.233                  12.072
  6              77.867                   8.071
  7              82.576                   5.730
  8              86.212                   4.423
  9              89.045                   3.446
 10              91.163                   2.577
 11              92.940                   2.162
 12              94.391                   1.765
 13              95.580                   1.446
 14              96.549                   1.179
 15              97.307                   0.923
 16              97.877                   0.693
 17              98.252                   0.456
 18              98.669                   0.508
 19              99.102                   0.526
 20              99.499                   0.484
 21              99.743                   0.296
```

22	100.000	0.148

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.2931	0.2931
2	0.3609	0.0678
3	0.4075	0.0467
4	0.4443	0.0367
5	0.4750	0.0308
6	0.5017	0.0267
7	0.5255	0.0237
8	0.5470	0.0215
9	0.5666	0.0197
10	0.5848	0.0182
11	0.6018	0.0170
12	0.6177	0.0159
13	0.6379	0.0202
14	0.6572	0.0193
15	0.6757	0.0185
16	0.6935	0.0178
17	0.7106	0.0171
18	0.7272	0.0165
19	0.7432	0.0160
20	0.7587	0.0155
21	0.7737	0.0150
22	0.7883	0.0146
23	0.8026	0.0142
24	0.8164	0.0139
25	0.8299	0.0135
26	0.8431	0.0132
27	0.8560	0.0129
28	0.8687	0.0126
29	0.8810	0.0124
30	0.8931	0.0121
31	0.9050	0.0119
32	0.9166	0.0116
33	0.9280	0.0114
34	0.9392	0.0112
35	0.9503	0.0110
36	0.9611	0.0108
37	0.9717	0.0106
38	0.9822	0.0105
39	0.9925	0.0103
40	1.0027	0.0102
41	1.0127	0.0100
42	1.0225	0.0099
43	1.0323	0.0097
44	1.0418	0.0096
45	1.0513	0.0095
46	1.0606	0.0093
47	1.0698	0.0092
48	1.0789	0.0091
49	1.0879	0.0090
50	1.0968	0.0089
51	1.1056	0.0088
52	1.1142	0.0087
53	1.1228	0.0086
54	1.1313	0.0085
55	1.1396	0.0084
56	1.1479	0.0083
57	1.1561	0.0082
58	1.1642	0.0081
59	1.1723	0.0080

60	1.1802	0.0079
61	1.1881	0.0079
62	1.1959	0.0078
63	1.2036	0.0077
64	1.2112	0.0076
65	1.2188	0.0076
66	1.2263	0.0075
67	1.2337	0.0074
68	1.2411	0.0074
69	1.2484	0.0073
70	1.2557	0.0072
71	1.2628	0.0072
72	1.2700	0.0071
73	1.2771	0.0071
74	1.2842	0.0071
75	1.2912	0.0070
76	1.2982	0.0070
77	1.3051	0.0069
78	1.3119	0.0069
79	1.3187	0.0068
80	1.3255	0.0068
81	1.3322	0.0067
82	1.3388	0.0067
83	1.3454	0.0066
84	1.3520	0.0066
85	1.3585	0.0065
86	1.3650	0.0065
87	1.3714	0.0064
88	1.3778	0.0064
89	1.3841	0.0063
90	1.3904	0.0063
91	1.3967	0.0063
92	1.4029	0.0062
93	1.4091	0.0062
94	1.4152	0.0061
95	1.4213	0.0061
96	1.4273	0.0061
97	1.4334	0.0060
98	1.4394	0.0060
99	1.4453	0.0059
100	1.4512	0.0059
101	1.4571	0.0059
102	1.4629	0.0058
103	1.4687	0.0058
104	1.4745	0.0058
105	1.4803	0.0057
106	1.4860	0.0057
107	1.4916	0.0057
108	1.4973	0.0056
109	1.5029	0.0056
110	1.5085	0.0056
111	1.5140	0.0056
112	1.5196	0.0055
113	1.5251	0.0055
114	1.5305	0.0055
115	1.5360	0.0054
116	1.5414	0.0054
117	1.5468	0.0054
118	1.5521	0.0054
119	1.5574	0.0053
120	1.5627	0.0053
121	1.5680	0.0053
122	1.5733	0.0052

123	1.5785	0.0052
124	1.5837	0.0052
125	1.5889	0.0052
126	1.5940	0.0051
127	1.5991	0.0051
128	1.6042	0.0051
129	1.6093	0.0051
130	1.6144	0.0051
131	1.6194	0.0050
132	1.6244	0.0050
133	1.6294	0.0050
134	1.6344	0.0050
135	1.6393	0.0049
136	1.6442	0.0049
137	1.6491	0.0049
138	1.6540	0.0049
139	1.6589	0.0049
140	1.6637	0.0048
141	1.6685	0.0048
142	1.6733	0.0048
143	1.6781	0.0048
144	1.6828	0.0048
145	1.6876	0.0047
146	1.6923	0.0047
147	1.6970	0.0047
148	1.7017	0.0047
149	1.7063	0.0047
150	1.7110	0.0046
151	1.7156	0.0046
152	1.7202	0.0046
153	1.7248	0.0046
154	1.7294	0.0046
155	1.7339	0.0046
156	1.7385	0.0045
157	1.7430	0.0045
158	1.7475	0.0045
159	1.7520	0.0045
160	1.7564	0.0045
161	1.7609	0.0044
162	1.7653	0.0044
163	1.7697	0.0044
164	1.7741	0.0044
165	1.7785	0.0044
166	1.7829	0.0044
167	1.7872	0.0044
168	1.7916	0.0043
169	1.7959	0.0043
170	1.8002	0.0043
171	1.8045	0.0043
172	1.8088	0.0043
173	1.8130	0.0043
174	1.8173	0.0042
175	1.8215	0.0042
176	1.8257	0.0042
177	1.8299	0.0042
178	1.8341	0.0042
179	1.8383	0.0042
180	1.8425	0.0042
181	1.8466	0.0042
182	1.8508	0.0041
183	1.8549	0.0041
184	1.8590	0.0041
185	1.8631	0.0041

186	1.8672	0.0041
187	1.8712	0.0041
188	1.8753	0.0041
189	1.8793	0.0040
190	1.8834	0.0040
191	1.8874	0.0040
192	1.8914	0.0040
193	1.8954	0.0040
194	1.8994	0.0040
195	1.9034	0.0040
196	1.9073	0.0040
197	1.9113	0.0039
198	1.9152	0.0039
199	1.9191	0.0039
200	1.9230	0.0039
201	1.9269	0.0039
202	1.9308	0.0039
203	1.9347	0.0039
204	1.9386	0.0039
205	1.9424	0.0039
206	1.9462	0.0038
207	1.9501	0.0038
208	1.9539	0.0038
209	1.9577	0.0038
210	1.9615	0.0038
211	1.9653	0.0038
212	1.9691	0.0038
213	1.9728	0.0038
214	1.9766	0.0038
215	1.9803	0.0037
216	1.9841	0.0037
217	1.9878	0.0037
218	1.9915	0.0037
219	1.9952	0.0037
220	1.9989	0.0037
221	2.0026	0.0037
222	2.0063	0.0037
223	2.0099	0.0037
224	2.0136	0.0037
225	2.0172	0.0036
226	2.0209	0.0036
227	2.0245	0.0036
228	2.0281	0.0036
229	2.0317	0.0036
230	2.0353	0.0036
231	2.0389	0.0036
232	2.0425	0.0036
233	2.0461	0.0036
234	2.0496	0.0036
235	2.0532	0.0036
236	2.0567	0.0035
237	2.0603	0.0035
238	2.0638	0.0035
239	2.0673	0.0035
240	2.0708	0.0035
241	2.0743	0.0035
242	2.0778	0.0035
243	2.0813	0.0035
244	2.0848	0.0035
245	2.0882	0.0035
246	2.0917	0.0035
247	2.0951	0.0034
248	2.0986	0.0034

249	2.1020	0.0034
250	2.1054	0.0034
251	2.1089	0.0034
252	2.1123	0.0034
253	2.1157	0.0034
254	2.1191	0.0034
255	2.1224	0.0034
256	2.1258	0.0034
257	2.1292	0.0034
258	2.1325	0.0034
259	2.1359	0.0034
260	2.1392	0.0033
261	2.1426	0.0033
262	2.1459	0.0033
263	2.1492	0.0033
264	2.1525	0.0033
265	2.1559	0.0033
266	2.1592	0.0033
267	2.1624	0.0033
268	2.1657	0.0033
269	2.1690	0.0033
270	2.1723	0.0033
271	2.1755	0.0033
272	2.1788	0.0033
273	2.1821	0.0032
274	2.1853	0.0032
275	2.1885	0.0032
276	2.1918	0.0032
277	2.1950	0.0032
278	2.1982	0.0032
279	2.2014	0.0032
280	2.2046	0.0032
281	2.2078	0.0032
282	2.2110	0.0032
283	2.2142	0.0032
284	2.2173	0.0032
285	2.2205	0.0032
286	2.2237	0.0032
287	2.2268	0.0032
288	2.2300	0.0031

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0031	0.0007	0.0024
2	0.0032	0.0007	0.0024
3	0.0032	0.0007	0.0024
4	0.0032	0.0007	0.0024
5	0.0032	0.0007	0.0024
6	0.0032	0.0007	0.0025
7	0.0032	0.0007	0.0025
8	0.0032	0.0007	0.0025
9	0.0032	0.0008	0.0025
10	0.0032	0.0008	0.0025
11	0.0032	0.0008	0.0025
12	0.0033	0.0008	0.0025
13	0.0033	0.0008	0.0025
14	0.0033	0.0008	0.0025
15	0.0033	0.0008	0.0025
16	0.0033	0.0008	0.0025
17	0.0033	0.0008	0.0025
18	0.0033	0.0008	0.0025

19	0.0033	0.0008	0.0026
20	0.0033	0.0008	0.0026
21	0.0034	0.0008	0.0026
22	0.0034	0.0008	0.0026
23	0.0034	0.0008	0.0026
24	0.0034	0.0008	0.0026
25	0.0034	0.0008	0.0026
26	0.0034	0.0008	0.0026
27	0.0034	0.0008	0.0026
28	0.0034	0.0008	0.0026
29	0.0035	0.0008	0.0027
30	0.0035	0.0008	0.0027
31	0.0035	0.0008	0.0027
32	0.0035	0.0008	0.0027
33	0.0035	0.0008	0.0027
34	0.0035	0.0008	0.0027
35	0.0035	0.0008	0.0027
36	0.0035	0.0008	0.0027
37	0.0036	0.0008	0.0027
38	0.0036	0.0008	0.0027
39	0.0036	0.0008	0.0028
40	0.0036	0.0008	0.0028
41	0.0036	0.0008	0.0028
42	0.0036	0.0008	0.0028
43	0.0036	0.0008	0.0028
44	0.0037	0.0009	0.0028
45	0.0037	0.0009	0.0028
46	0.0037	0.0009	0.0028
47	0.0037	0.0009	0.0028
48	0.0037	0.0009	0.0029
49	0.0037	0.0009	0.0029
50	0.0037	0.0009	0.0029
51	0.0038	0.0009	0.0029
52	0.0038	0.0009	0.0029
53	0.0038	0.0009	0.0029
54	0.0038	0.0009	0.0029
55	0.0038	0.0009	0.0029
56	0.0038	0.0009	0.0029
57	0.0039	0.0009	0.0030
58	0.0039	0.0009	0.0030
59	0.0039	0.0009	0.0030
60	0.0039	0.0009	0.0030
61	0.0039	0.0009	0.0030
62	0.0039	0.0009	0.0030
63	0.0040	0.0009	0.0030
64	0.0040	0.0009	0.0031
65	0.0040	0.0009	0.0031
66	0.0040	0.0009	0.0031
67	0.0040	0.0009	0.0031
68	0.0041	0.0009	0.0031
69	0.0041	0.0010	0.0031
70	0.0041	0.0010	0.0031
71	0.0041	0.0010	0.0032
72	0.0041	0.0010	0.0032
73	0.0042	0.0010	0.0032
74	0.0042	0.0010	0.0032
75	0.0042	0.0010	0.0032
76	0.0042	0.0010	0.0032
77	0.0042	0.0010	0.0033
78	0.0043	0.0010	0.0033
79	0.0043	0.0010	0.0033
80	0.0043	0.0010	0.0033
81	0.0043	0.0010	0.0033

82	0.0044	0.0010	0.0033
83	0.0044	0.0010	0.0034
84	0.0044	0.0010	0.0034
85	0.0044	0.0010	0.0034
86	0.0044	0.0010	0.0034
87	0.0045	0.0010	0.0034
88	0.0045	0.0010	0.0035
89	0.0045	0.0011	0.0035
90	0.0046	0.0011	0.0035
91	0.0046	0.0011	0.0035
92	0.0046	0.0011	0.0035
93	0.0046	0.0011	0.0036
94	0.0047	0.0011	0.0036
95	0.0047	0.0011	0.0036
96	0.0047	0.0011	0.0036
97	0.0048	0.0011	0.0036
98	0.0048	0.0011	0.0037
99	0.0048	0.0011	0.0037
100	0.0048	0.0011	0.0037
101	0.0049	0.0011	0.0037
102	0.0049	0.0011	0.0038
103	0.0049	0.0012	0.0038
104	0.0050	0.0012	0.0038
105	0.0050	0.0012	0.0038
106	0.0050	0.0012	0.0039
107	0.0051	0.0012	0.0039
108	0.0051	0.0012	0.0039
109	0.0051	0.0012	0.0040
110	0.0052	0.0012	0.0040
111	0.0052	0.0012	0.0040
112	0.0052	0.0012	0.0040
113	0.0053	0.0012	0.0041
114	0.0053	0.0012	0.0041
115	0.0054	0.0013	0.0041
116	0.0054	0.0013	0.0042
117	0.0055	0.0013	0.0042
118	0.0055	0.0013	0.0042
119	0.0056	0.0013	0.0043
120	0.0056	0.0013	0.0043
121	0.0056	0.0013	0.0043
122	0.0057	0.0013	0.0044
123	0.0057	0.0013	0.0044
124	0.0058	0.0013	0.0044
125	0.0058	0.0014	0.0045
126	0.0059	0.0014	0.0045
127	0.0059	0.0014	0.0046
128	0.0060	0.0014	0.0046
129	0.0061	0.0014	0.0046
130	0.0061	0.0014	0.0047
131	0.0062	0.0014	0.0047
132	0.0062	0.0014	0.0048
133	0.0063	0.0015	0.0048
134	0.0063	0.0015	0.0049
135	0.0064	0.0015	0.0049
136	0.0065	0.0015	0.0050
137	0.0066	0.0015	0.0050
138	0.0066	0.0015	0.0051
139	0.0067	0.0016	0.0051
140	0.0068	0.0016	0.0052
141	0.0069	0.0016	0.0053
142	0.0069	0.0016	0.0053
143	0.0070	0.0016	0.0054
144	0.0071	0.0016	0.0054

145	0.0071	0.0017	0.0055
146	0.0072	0.0017	0.0055
147	0.0073	0.0017	0.0056
148	0.0074	0.0017	0.0057
149	0.0075	0.0017	0.0058
150	0.0076	0.0018	0.0058
151	0.0077	0.0018	0.0059
152	0.0078	0.0018	0.0060
153	0.0079	0.0019	0.0061
154	0.0080	0.0019	0.0062
155	0.0082	0.0019	0.0063
156	0.0083	0.0019	0.0064
157	0.0085	0.0020	0.0065
158	0.0086	0.0020	0.0066
159	0.0088	0.0020	0.0067
160	0.0089	0.0021	0.0068
161	0.0091	0.0021	0.0070
162	0.0092	0.0021	0.0071
163	0.0095	0.0022	0.0073
164	0.0096	0.0022	0.0074
165	0.0099	0.0023	0.0076
166	0.0100	0.0023	0.0077
167	0.0103	0.0024	0.0079
168	0.0105	0.0024	0.0080
169	0.0108	0.0025	0.0083
170	0.0110	0.0026	0.0085
171	0.0114	0.0027	0.0088
172	0.0116	0.0027	0.0089
173	0.0121	0.0028	0.0093
174	0.0124	0.0029	0.0095
175	0.0129	0.0030	0.0099
176	0.0132	0.0031	0.0101
177	0.0139	0.0032	0.0106
178	0.0142	0.0033	0.0109
179	0.0150	0.0035	0.0115
180	0.0155	0.0036	0.0119
181	0.0165	0.0038	0.0127
182	0.0171	0.0040	0.0131
183	0.0185	0.0043	0.0142
184	0.0193	0.0045	0.0148
185	0.0159	0.0037	0.0122
186	0.0170	0.0039	0.0130
187	0.0197	0.0046	0.0151
188	0.0215	0.0050	0.0165
189	0.0267	0.0062	0.0205
190	0.0308	0.0072	0.0236
191	0.0467	0.0077	0.0390
192	0.0678	0.0077	0.0600
193	0.2931	0.0077	0.2854
194	0.0367	0.0077	0.0290
195	0.0237	0.0055	0.0182
196	0.0182	0.0042	0.0140
197	0.0202	0.0047	0.0155
198	0.0178	0.0041	0.0136
199	0.0160	0.0037	0.0123
200	0.0146	0.0034	0.0112
201	0.0135	0.0031	0.0104
202	0.0126	0.0029	0.0097
203	0.0119	0.0028	0.0091
204	0.0112	0.0026	0.0086
205	0.0106	0.0025	0.0082
206	0.0102	0.0024	0.0078
207	0.0097	0.0023	0.0075

208	0.0093	0.0022	0.0072
209	0.0090	0.0021	0.0069
210	0.0087	0.0020	0.0066
211	0.0084	0.0020	0.0064
212	0.0081	0.0019	0.0062
213	0.0079	0.0018	0.0060
214	0.0076	0.0018	0.0059
215	0.0074	0.0017	0.0057
216	0.0072	0.0017	0.0056
217	0.0071	0.0017	0.0055
218	0.0070	0.0016	0.0053
219	0.0068	0.0016	0.0052
220	0.0067	0.0015	0.0051
221	0.0065	0.0015	0.0050
222	0.0064	0.0015	0.0049
223	0.0063	0.0015	0.0048
224	0.0061	0.0014	0.0047
225	0.0060	0.0014	0.0046
226	0.0059	0.0014	0.0045
227	0.0058	0.0014	0.0045
228	0.0057	0.0013	0.0044
229	0.0056	0.0013	0.0043
230	0.0055	0.0013	0.0042
231	0.0054	0.0013	0.0042
232	0.0054	0.0012	0.0041
233	0.0053	0.0012	0.0040
234	0.0052	0.0012	0.0040
235	0.0051	0.0012	0.0039
236	0.0051	0.0012	0.0039
237	0.0050	0.0012	0.0038
238	0.0049	0.0011	0.0038
239	0.0049	0.0011	0.0037
240	0.0048	0.0011	0.0037
241	0.0047	0.0011	0.0036
242	0.0047	0.0011	0.0036
243	0.0046	0.0011	0.0035
244	0.0046	0.0011	0.0035
245	0.0045	0.0011	0.0035
246	0.0045	0.0010	0.0034
247	0.0044	0.0010	0.0034
248	0.0044	0.0010	0.0034
249	0.0043	0.0010	0.0033
250	0.0043	0.0010	0.0033
251	0.0042	0.0010	0.0032
252	0.0042	0.0010	0.0032
253	0.0042	0.0010	0.0032
254	0.0041	0.0010	0.0032
255	0.0041	0.0009	0.0031
256	0.0040	0.0009	0.0031
257	0.0040	0.0009	0.0031
258	0.0040	0.0009	0.0030
259	0.0039	0.0009	0.0030
260	0.0039	0.0009	0.0030
261	0.0039	0.0009	0.0030
262	0.0038	0.0009	0.0029
263	0.0038	0.0009	0.0029
264	0.0038	0.0009	0.0029
265	0.0037	0.0009	0.0029
266	0.0037	0.0009	0.0028
267	0.0037	0.0009	0.0028
268	0.0036	0.0008	0.0028
269	0.0036	0.0008	0.0028
270	0.0036	0.0008	0.0027

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    271             0.0036          0.0008            0.0027
    272             0.0035          0.0008            0.0027
    273             0.0035          0.0008            0.0027
    274             0.0035          0.0008            0.0027
    275             0.0034          0.0008            0.0026
    276             0.0034          0.0008            0.0026
    277             0.0034          0.0008            0.0026
    278             0.0034          0.0008            0.0026
    279             0.0034          0.0008            0.0026
    280             0.0033          0.0008            0.0026
    281             0.0033          0.0008            0.0025
    282             0.0033          0.0008            0.0025
    283             0.0033          0.0008            0.0025
    284             0.0032          0.0008            0.0025
    285             0.0032          0.0008            0.0025
    286             0.0032          0.0007            0.0025
    287             0.0032          0.0007            0.0024
    288             0.0032          0.0007            0.0024
    --------------------------------------------------------------------
    --------------------------------------------------------------------
    Total soil rain loss =      0.45(In)
    Total effective rainfall =      1.78(In)
    Peak flow rate in flood hydrograph =     12.76(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       0.0000      0.01  Q         |         |         |         |
  0+10       0.0003      0.04  Q         |         |         |         |
  0+15       0.0012      0.13  Q         |         |         |         |
  0+20       0.0025      0.18  Q         |         |         |         |
  0+25       0.0039      0.21  Q         |         |         |         |
  0+30       0.0055      0.23  Q         |         |         |         |
  0+35       0.0072      0.24  Q         |         |         |         |
  0+40       0.0089      0.26  Q         |         |         |         |
  0+45       0.0108      0.27  Q         |         |         |         |
  0+50       0.0126      0.27  Q         |         |         |         |
  0+55       0.0146      0.28  Q         |         |         |         |
  1+ 0       0.0165      0.28  Q         |         |         |         |
  1+ 5       0.0185      0.29  Q         |         |         |         |
  1+10       0.0205      0.29  Q         |         |         |         |
  1+15       0.0226      0.30  Q         |         |         |         |
  1+20       0.0246      0.30  Q         |         |         |         |
  1+25       0.0267      0.30  Q         |         |         |         |
  1+30       0.0287      0.30  Q         |         |         |         |
  1+35       0.0308      0.30  Q         |         |         |         |
  1+40       0.0330      0.31  Q         |         |         |         |
  1+45       0.0351      0.31  Q         |         |         |         |
  1+50       0.0372      0.31  Q         |         |         |         |
  1+55       0.0394      0.31  QV        |         |         |         |
  2+ 0       0.0415      0.31  QV        |         |         |         |
  2+ 5       0.0437      0.31  QV        |         |         |         |
  2+10       0.0458      0.31  QV        |         |         |         |
  2+15       0.0480      0.32  QV        |         |         |         |
  2+20       0.0502      0.32  QV        |         |         |         |
  2+25       0.0524      0.32  QV        |         |         |         |
  2+30       0.0546      0.32  QV        |         |         |         |
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2+35       0.0568      0.32  QV        |         |         |         |
2+40       0.0590      0.32  QV        |         |         |         |
2+45       0.0612      0.32  QV        |         |         |         |
2+50       0.0634      0.32  QV        |         |         |         |
2+55       0.0656      0.32  QV        |         |         |         |
3+ 0       0.0679      0.33  QV        |         |         |         |
3+ 5       0.0701      0.33  QV        |         |         |         |
3+10       0.0724      0.33  QV        |         |         |         |
3+15       0.0747      0.33  Q V       |         |         |         |
3+20       0.0769      0.33  Q V       |         |         |         |
3+25       0.0792      0.33  Q V       |         |         |         |
3+30       0.0815      0.33  Q V       |         |         |         |
3+35       0.0838      0.33  Q V       |         |         |         |
3+40       0.0861      0.34  Q V       |         |         |         |
3+45       0.0885      0.34  Q V       |         |         |         |
3+50       0.0908      0.34  Q V       |         |         |         |
3+55       0.0931      0.34  Q V       |         |         |         |
4+ 0       0.0955      0.34  Q V       |         |         |         |
4+ 5       0.0978      0.34  Q V       |         |         |         |
4+10       0.1002      0.34  Q V       |         |         |         |
4+15       0.1026      0.35  Q V       |         |         |         |
4+20       0.1050      0.35  Q V       |         |         |         |
4+25       0.1074      0.35  Q V       |         |         |         |
4+30       0.1098      0.35  Q V       |         |         |         |
4+35       0.1122      0.35  Q  V      |         |         |         |
4+40       0.1146      0.35  Q  V      |         |         |         |
4+45       0.1170      0.35  Q  V      |         |         |         |
4+50       0.1195      0.36  Q  V      |         |         |         |
4+55       0.1219      0.36  Q  V      |         |         |         |
5+ 0       0.1244      0.36  Q  V      |         |         |         |
5+ 5       0.1269      0.36  Q  V      |         |         |         |
5+10       0.1294      0.36  Q  V      |         |         |         |
5+15       0.1319      0.36  Q  V      |         |         |         |
5+20       0.1344      0.36  Q  V      |         |         |         |
5+25       0.1369      0.37  Q  V      |         |         |         |
5+30       0.1395      0.37  Q  V      |         |         |         |
5+35       0.1420      0.37  Q  V      |         |         |         |
5+40       0.1446      0.37  Q  V      |         |         |         |
5+45       0.1471      0.37  Q  V      |         |         |         |
5+50       0.1497      0.37  Q   V     |         |         |         |
5+55       0.1523      0.38  Q   V     |         |         |         |
6+ 0       0.1549      0.38  Q   V     |         |         |         |
6+ 5       0.1575      0.38  Q   V     |         |         |         |
6+10       0.1602      0.38  Q   V     |         |         |         |
6+15       0.1628      0.38  Q   V     |         |         |         |
6+20       0.1655      0.39  Q   V     |         |         |         |
6+25       0.1681      0.39  Q   V     |         |         |         |
6+30       0.1708      0.39  Q   V     |         |         |         |
6+35       0.1735      0.39  Q   V     |         |         |         |
6+40       0.1762      0.39  Q   V     |         |         |         |
6+45       0.1790      0.40  Q   V     |         |         |         |
6+50       0.1817      0.40  Q   V     |         |         |         |
6+55       0.1844      0.40  Q   V     |         |         |         |
7+ 0       0.1872      0.40  Q    V    |         |         |         |
7+ 5       0.1900      0.40  Q    V    |         |         |         |
7+10       0.1928      0.41  Q    V    |         |         |         |
7+15       0.1956      0.41  Q    V    |         |         |         |
7+20       0.1984      0.41  Q    V    |         |         |         |
7+25       0.2013      0.41  Q    V    |         |         |         |
7+30       0.2041      0.42  Q    V    |         |         |         |
7+35       0.2070      0.42  Q    V    |         |         |         |
7+40       0.2099      0.42  Q    V    |         |         |         |
7+45       0.2128      0.42  Q    V    |         |         |         |
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 7+50       0.2157      0.42  Q     V    |         |         |         |
 7+55       0.2187      0.43  Q     V    |         |         |         |
 8+ 0       0.2216      0.43  Q     V    |         |         |         |
 8+ 5       0.2246      0.43  Q      V   |         |         |         |
 8+10       0.2276      0.43  Q      V   |         |         |         |
 8+15       0.2306      0.44  Q      V   |         |         |         |
 8+20       0.2337      0.44  Q      V   |         |         |         |
 8+25       0.2367      0.44  Q      V   |         |         |         |
 8+30       0.2398      0.45  Q      V   |         |         |         |
 8+35       0.2429      0.45  Q      V   |         |         |         |
 8+40       0.2460      0.45  Q      V   |         |         |         |
 8+45       0.2491      0.45  Q      V   |         |         |         |
 8+50       0.2522      0.46  Q      V   |         |         |         |
 8+55       0.2554      0.46  Q      V   |         |         |         |
 9+ 0       0.2586      0.46  Q      V   |         |         |         |
 9+ 5       0.2618      0.47  Q       V  |         |         |         |
 9+10       0.2651      0.47  Q       V  |         |         |         |
 9+15       0.2683      0.47  Q       V  |         |         |         |
 9+20       0.2716      0.48  Q       V  |         |         |         |
 9+25       0.2749      0.48  Q       V  |         |         |         |
 9+30       0.2782      0.48  Q       V  |         |         |         |
 9+35       0.2816      0.49  Q       V  |         |         |         |
 9+40       0.2849      0.49  Q       V  |         |         |         |
 9+45       0.2883      0.49  Q       V  |         |         |         |
 9+50       0.2918      0.50  Q       V  |         |         |         |
 9+55       0.2952      0.50  |Q      V  |         |         |         |
10+ 0       0.2987      0.51  |Q       V |         |         |         |
10+ 5       0.3022      0.51  |Q       V |         |         |         |
10+10       0.3057      0.51  |Q       V |         |         |         |
10+15       0.3093      0.52  |Q       V |         |         |         |
10+20       0.3129      0.52  |Q       V |         |         |         |
10+25       0.3165      0.53  |Q       V |         |         |         |
10+30       0.3202      0.53  |Q       V |         |         |         |
10+35       0.3238      0.53  |Q       V |         |         |         |
10+40       0.3276      0.54  |Q       V |         |         |         |
10+45       0.3313      0.54  |Q       V |         |         |         |
10+50       0.3351      0.55  |Q       V |         |         |         |
10+55       0.3389      0.55  |Q        V|         |         |         |
11+ 0       0.3427      0.56  |Q        V|         |         |         |
11+ 5       0.3466      0.56  |Q        V|         |         |         |
11+10       0.3506      0.57  |Q        V|         |         |         |
11+15       0.3545      0.57  |Q        V|         |         |         |
11+20       0.3585      0.58  |Q        V|         |         |         |
11+25       0.3625      0.59  |Q        V|         |         |         |
11+30       0.3666      0.59  |Q        V|         |         |         |
11+35       0.3707      0.60  |Q        V|         |         |         |
11+40       0.3749      0.60  |Q         V         |         |         |
11+45       0.3791      0.61  |Q         V         |         |         |
11+50       0.3834      0.62  |Q         V         |         |         |
11+55       0.3877      0.62  |Q         V         |         |         |
12+ 0       0.3920      0.63  |Q         V         |         |         |
12+ 5       0.3964      0.64  |Q         V         |         |         |
12+10       0.4008      0.64  |Q         V         |         |         |
12+15       0.4053      0.65  |Q         V         |         |         |
12+20       0.4099      0.66  |Q         V         |         |         |
12+25       0.4144      0.67  |Q         |V        |         |         |
12+30       0.4191      0.67  |Q         |V        |         |         |
12+35       0.4238      0.68  |Q         |V        |         |         |
12+40       0.4285      0.69  |Q         |V        |         |         |
12+45       0.4333      0.70  |Q         |V        |         |         |
12+50       0.4382      0.71  |Q         |V        |         |         |
12+55       0.4432      0.72  |Q         |V        |         |         |
13+ 0       0.4482      0.73  |Q         | V       |         |         |
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13+ 5       0.4533      0.74  |Q        | V       |         |         |
13+10       0.4585      0.75  |Q        | V       |         |         |
13+15       0.4638      0.76  |Q        | V       |         |         |
13+20       0.4691      0.78  |Q        | V       |         |         |
13+25       0.4745      0.79  |Q        | V       |         |         |
13+30       0.4801      0.80  |Q        | V       |         |         |
13+35       0.4857      0.82  |Q        |  V      |         |         |
13+40       0.4914      0.83  |Q        |  V      |         |         |
13+45       0.4973      0.85  |Q        |  V      |         |         |
13+50       0.5032      0.86  |Q        |  V      |         |         |
13+55       0.5093      0.88  |Q        |  V      |         |         |
14+ 0       0.5155      0.90  |Q        |  V      |         |         |
14+ 5       0.5218      0.92  |Q        |  V      |         |         |
14+10       0.5283      0.94  |Q        |   V     |         |         |
14+15       0.5349      0.96  |Q        |   V     |         |         |
14+20       0.5417      0.99  |Q        |   V     |         |         |
14+25       0.5487      1.01  | Q       |   V     |         |         |
14+30       0.5559      1.04  | Q       |   V     |         |         |
14+35       0.5632      1.07  | Q       |    V    |         |         |
14+40       0.5708      1.10  | Q       |    V    |         |         |
14+45       0.5786      1.13  | Q       |    V    |         |         |
14+50       0.5866      1.17  | Q       |    V    |         |         |
14+55       0.5950      1.21  | Q       |    V    |         |         |
15+ 0       0.6036      1.25  | Q       |     V   |         |         |
15+ 5       0.6126      1.30  | Q       |     V   |         |         |
15+10       0.6220      1.36  | Q       |     V   |         |         |
15+15       0.6317      1.42  | Q       |     V   |         |         |
15+20       0.6420      1.49  | Q       |      V  |         |         |
15+25       0.6527      1.56  |  Q      |      V  |         |         |
15+30       0.6637      1.59  |  Q      |      V  |         |         |
15+35       0.6744      1.56  |  Q      |       V |         |         |
15+40       0.6854      1.59  |  Q      |       V |         |         |
15+45       0.6971      1.70  |  Q      |       V |         |         |
15+50       0.7100      1.87  |  Q      |        V|         |         |
15+55       0.7249      2.16  |   Q     |        V|         |         |
16+ 0       0.7433      2.68  |    Q    |        V|         |         |
16+ 5       0.7730      4.30  |       Q |         V         |         |
16+10       0.8284      8.05  |         |     Q   | V       |         |
16+15       0.9163     12.76  |         |         |   VQ    |         |
16+20       0.9799      9.22  |         |       Q |     V   |         |
16+25       1.0215      6.04  |         | Q       |      V  |         |
16+30       1.0532      4.61  |        Q|         |       V |         |
16+35       1.0794      3.80  |      Q  |         |       V |         |
16+40       1.1019      3.27  |     Q   |         |        V|         |
16+45       1.1213      2.83  |    Q    |         |         V         |
16+50       1.1382      2.44  |   Q     |         |         V         |
16+55       1.1533      2.20  |   Q     |         |         V         |
17+ 0       1.1669      1.97  |  Q      |         |         |V        |
17+ 5       1.1792      1.78  |  Q      |         |         |V        |
17+10       1.1903      1.62  |  Q      |         |         |V        |
17+15       1.2004      1.46  | Q       |         |         | V       |
17+20       1.2095      1.33  | Q       |         |         | V       |
17+25       1.2179      1.21  | Q       |         |         | V       |
17+30       1.2260      1.17  | Q       |         |         | V       |
17+35       1.2337      1.13  | Q       |         |         |  V      |
17+40       1.2411      1.06  | Q       |         |         |  V      |
17+45       1.2477      0.97  |Q        |         |         |  V      |
17+50       1.2538      0.88  |Q        |         |         |  V      |
17+55       1.2594      0.81  |Q        |         |         |  V      |
18+ 0       1.2648      0.78  |Q        |         |         |  V      |
18+ 5       1.2700      0.75  |Q        |         |         |   V     |
18+10       1.2750      0.73  |Q        |         |         |   V     |
18+15       1.2799      0.71  |Q        |         |         |   V     |
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18+20       1.2847      0.69  |Q         |         |         |   V     |
18+25       1.2893      0.67  |Q         |         |         |   V     |
18+30       1.2938      0.66  |Q         |         |         |   V     |
18+35       1.2983      0.64  |Q         |         |         |   V     |
18+40       1.3026      0.63  |Q         |         |         |   V     |
18+45       1.3068      0.61  |Q         |         |         |    V    |
18+50       1.3110      0.60  |Q         |         |         |    V    |
18+55       1.3150      0.59  |Q         |         |         |    V    |
19+ 0       1.3190      0.58  |Q         |         |         |    V    |
19+ 5       1.3229      0.57  |Q         |         |         |    V    |
19+10       1.3267      0.56  |Q         |         |         |    V    |
19+15       1.3305      0.55  |Q         |         |         |    V    |
19+20       1.3342      0.54  |Q         |         |         |    V    |
19+25       1.3378      0.53  |Q         |         |         |    V    |
19+30       1.3414      0.52  |Q         |         |         |    V    |
19+35       1.3449      0.51  |Q         |         |         |     V   |
19+40       1.3483      0.50  |Q         |         |         |     V   |
19+45       1.3517      0.49  Q          |         |         |     V   |
19+50       1.3551      0.49  Q          |         |         |     V   |
19+55       1.3584      0.48  Q          |         |         |     V   |
20+ 0       1.3617      0.47  Q          |         |         |     V   |
20+ 5       1.3649      0.47  Q          |         |         |     V   |
20+10       1.3681      0.46  Q          |         |         |     V   |
20+15       1.3712      0.45  Q          |         |         |     V   |
20+20       1.3743      0.45  Q          |         |         |     V   |
20+25       1.3773      0.44  Q          |         |         |     V   |
20+30       1.3803      0.44  Q          |         |         |      V  |
20+35       1.3833      0.43  Q          |         |         |      V  |
20+40       1.3863      0.43  Q          |         |         |      V  |
20+45       1.3892      0.42  Q          |         |         |      V  |
20+50       1.3921      0.42  Q          |         |         |      V  |
20+55       1.3949      0.41  Q          |         |         |      V  |
21+ 0       1.3977      0.41  Q          |         |         |      V  |
21+ 5       1.4005      0.40  Q          |         |         |      V  |
21+10       1.4033      0.40  Q          |         |         |      V  |
21+15       1.4060      0.40  Q          |         |         |      V  |
21+20       1.4087      0.39  Q          |         |         |      V  |
21+25       1.4113      0.39  Q          |         |         |      V  |
21+30       1.4140      0.38  Q          |         |         |      V  |
21+35       1.4166      0.38  Q          |         |         |      V  |
21+40       1.4192      0.38  Q          |         |         |       V |
21+45       1.4218      0.37  Q          |         |         |       V |
21+50       1.4243      0.37  Q          |         |         |       V |
21+55       1.4269      0.37  Q          |         |         |       V |
22+ 0       1.4294      0.36  Q          |         |         |       V |
22+ 5       1.4318      0.36  Q          |         |         |       V |
22+10       1.4343      0.36  Q          |         |         |       V |
22+15       1.4367      0.35  Q          |         |         |       V |
22+20       1.4391      0.35  Q          |         |         |       V |
22+25       1.4415      0.35  Q          |         |         |       V |
22+30       1.4439      0.35  Q          |         |         |       V |
22+35       1.4463      0.34  Q          |         |         |       V |
22+40       1.4486      0.34  Q          |         |         |       V |
22+45       1.4509      0.34  Q          |         |         |       V |
22+50       1.4532      0.33  Q          |         |         |       V |
22+55       1.4555      0.33  Q          |         |         |        V|
23+ 0       1.4578      0.33  Q          |         |         |        V|
23+ 5       1.4600      0.33  Q          |         |         |        V|
23+10       1.4623      0.32  Q          |         |         |        V|
23+15       1.4645      0.32  Q          |         |         |        V|
23+20       1.4667      0.32  Q          |         |         |        V|
23+25       1.4689      0.32  Q          |         |         |        V|
23+30       1.4710      0.32  Q          |         |         |        V|
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  23+35       1.4732      0.31  Q         |         |         |        V|
  23+40       1.4753      0.31  Q         |         |         |        V|
  23+45       1.4775      0.31  Q         |         |         |        V|
  23+50       1.4796      0.31  Q         |         |         |        V|
  23+55       1.4817      0.30  Q         |         |         |        V|
  24+ 0       1.4838      0.30  Q         |         |         |        V|
  24+ 5       1.4858      0.29  Q         |         |         |        V|
  24+10       1.4876      0.26  Q         |         |         |        V|
  24+15       1.4887      0.17  Q         |         |         |        V|
  24+20       1.4895      0.12  Q         |         |         |        V|
  24+25       1.4901      0.09  Q         |         |         |        V|
  24+30       1.4906      0.07  Q         |         |         |        V|
  24+35       1.4909      0.05  Q         |         |         |        V|
  24+40       1.4912      0.04  Q         |         |         |        V|
  24+45       1.4915      0.03  Q         |         |         |        V|
  24+50       1.4916      0.03  Q         |         |         |        V|
  24+55       1.4918      0.02  Q         |         |         |        V|
  25+ 0       1.4919      0.02  Q         |         |         |        V|
  25+ 5       1.4920      0.01  Q         |         |         |        V|
  25+10       1.4921      0.01  Q         |         |         |        V|
  25+15       1.4921      0.01  Q         |         |         |        V|
  25+20       1.4921      0.01  Q         |         |         |        V|
  25+25       1.4922      0.00  Q         |         |         |        V|
  25+30       1.4922      0.00  Q         |         |         |        V|
  25+35       1.4922      0.00  Q         |         |         |        V|
  25+40       1.4922      0.00  Q         |         |         |        V|
  25+45       1.4922      0.00  Q         |         |         |         V
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      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  01/13/23

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


Program License Serial Number 6385

--------------------------------------------------------------------
Space Center Expansion Project Phase 2 Flag
Developed Condition Area A1 to A4
100 Year 24 Hour Storm Event
Please Refer to Appendix B Developed Condition Hydrology Map
--------------------------------------------------------------------

      Storm Event Year = 100

      Antecedent Moisture Condition = 2

 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 100
          10.06           1           1.09
--------------------------------------------------------------------
Rainfall data for year 100
          10.06           6           2.09
--------------------------------------------------------------------
Rainfall data for year 100
          10.06          24           3.64
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 2)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 70.4       70.4         10.06      1.000     0.526    0.176    0.093

Area-averaged adjusted loss rate Fm (In/Hr) =  0.093

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

Area       Area          SCS CN    SCS CN      S     Pervious
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 (Ac.)       Fract         (AMC2)    (AMC2)           Yield Fr
     1.77   0.176         70.4      70.4       4.20     0.307
     8.29   0.824         98.0      98.0       0.20     0.936

Area-averaged catchment yield fraction, Y =  0.825
Area-averaged low loss fraction, Yb =  0.175
User entry of time of concentration  =   0.267 (hours)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =      10.06(Ac.)
Catchment Lag time =   0.214 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 39.0137
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.093(In/Hr)
Average low loss rate fraction (Yb) = 0.175 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall =  0.517(In)
Computed peak 30-minute rainfall =  0.885(In)
Specified peak 1-hour rainfall =  1.090(In)
Computed peak 3-hour rainfall =  1.625(In)
Specified peak 6-hour rainfall =  2.090(In)
Specified peak 24-hour rainfall =  3.640(In)


Rainfall depth area reduction factors:
Using a total area of      10.06(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.517(In)
30-minute factor = 1.000    Adjusted rainfall =  0.885(In)
1-hour factor = 1.000       Adjusted rainfall =  1.089(In)
3-hour factor = 1.000       Adjusted rainfall =  1.625(In)
6-hour factor = 1.000       Adjusted rainfall =  2.090(In)
24-hour factor = 1.000      Adjusted rainfall =  3.640(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 =       121.66 (CFS))

  1               2.641                   3.213
  2              17.590                  18.187
  3              47.691                  36.622
  4              64.621                  20.598
  5              73.961                  11.363
  6              80.187                   7.575
  7              84.606                   5.375
  8              88.070                   4.215
  9              90.562                   3.032
 10              92.579                   2.453
 11              94.215                   1.992
 12              95.521                   1.588
 13              96.574                   1.282
 14              97.380                   0.981
 15              97.956                   0.700
 16              98.362                   0.495
 17              98.825                   0.563
 18              99.293                   0.569
 19              99.636                   0.418
 20             100.000                   0.209
---------------------------------------------------------------------
```

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.5170	0.5170
2	0.6365	0.1195
3	0.7188	0.0823
4	0.7836	0.0648
5	0.8378	0.0543
6	0.8849	0.0471
7	0.9268	0.0419
8	0.9647	0.0379
9	0.9994	0.0347
10	1.0315	0.0321
11	1.0614	0.0299
12	1.0895	0.0281
13	1.1217	0.0322
14	1.1523	0.0306
15	1.1816	0.0293
16	1.2097	0.0281
17	1.2366	0.0270
18	1.2626	0.0260
19	1.2877	0.0251
20	1.3119	0.0242
21	1.3354	0.0235
22	1.3582	0.0228
23	1.3803	0.0221
24	1.4019	0.0215
25	1.4228	0.0210
26	1.4433	0.0204
27	1.4632	0.0199
28	1.4827	0.0195
29	1.5017	0.0190
30	1.5204	0.0186
31	1.5386	0.0182
32	1.5565	0.0179
33	1.5740	0.0175
34	1.5912	0.0172
35	1.6081	0.0169
36	1.6246	0.0166
37	1.6409	0.0163
38	1.6568	0.0160
39	1.6726	0.0157
40	1.6880	0.0155
41	1.7032	0.0152
42	1.7182	0.0150
43	1.7330	0.0148
44	1.7475	0.0145
45	1.7618	0.0143
46	1.7760	0.0141
47	1.7899	0.0139
48	1.8036	0.0137
49	1.8172	0.0136
50	1.8306	0.0134
51	1.8438	0.0132
52	1.8569	0.0131
53	1.8698	0.0129
54	1.8825	0.0127
55	1.8951	0.0126
56	1.9075	0.0124
57	1.9198	0.0123
58	1.9320	0.0122
59	1.9441	0.0120
60	1.9560	0.0119
61	1.9677	0.0118

62	1.9794	0.0117
63	1.9910	0.0115
64	2.0024	0.0114
65	2.0137	0.0113
66	2.0249	0.0112
67	2.0360	0.0111
68	2.0470	0.0110
69	2.0579	0.0109
70	2.0687	0.0108
71	2.0793	0.0107
72	2.0899	0.0106
73	2.1015	0.0116
74	2.1130	0.0115
75	2.1244	0.0114
76	2.1357	0.0113
77	2.1469	0.0112
78	2.1580	0.0111
79	2.1690	0.0110
80	2.1799	0.0109
81	2.1908	0.0109
82	2.2016	0.0108
83	2.2123	0.0107
84	2.2229	0.0106
85	2.2335	0.0106
86	2.2440	0.0105
87	2.2544	0.0104
88	2.2647	0.0103
89	2.2750	0.0103
90	2.2852	0.0102
91	2.2953	0.0101
92	2.3054	0.0101
93	2.3154	0.0100
94	2.3253	0.0099
95	2.3352	0.0099
96	2.3450	0.0098
97	2.3547	0.0097
98	2.3644	0.0097
99	2.3740	0.0096
100	2.3836	0.0096
101	2.3931	0.0095
102	2.4026	0.0095
103	2.4120	0.0094
104	2.4213	0.0093
105	2.4306	0.0093
106	2.4398	0.0092
107	2.4490	0.0092
108	2.4582	0.0091
109	2.4672	0.0091
110	2.4763	0.0090
111	2.4853	0.0090
112	2.4942	0.0089
113	2.5031	0.0089
114	2.5119	0.0088
115	2.5207	0.0088
116	2.5295	0.0088
117	2.5382	0.0087
118	2.5468	0.0087
119	2.5555	0.0086
120	2.5640	0.0086
121	2.5726	0.0085
122	2.5811	0.0085
123	2.5895	0.0084
124	2.5979	0.0084

125	2.6063	0.0084
126	2.6146	0.0083
127	2.6229	0.0083
128	2.6311	0.0082
129	2.6393	0.0082
130	2.6475	0.0082
131	2.6556	0.0081
132	2.6637	0.0081
133	2.6718	0.0081
134	2.6798	0.0080
135	2.6878	0.0080
136	2.6957	0.0080
137	2.7037	0.0079
138	2.7115	0.0079
139	2.7194	0.0078
140	2.7272	0.0078
141	2.7350	0.0078
142	2.7427	0.0077
143	2.7504	0.0077
144	2.7581	0.0077
145	2.7658	0.0076
146	2.7734	0.0076
147	2.7810	0.0076
148	2.7885	0.0076
149	2.7961	0.0075
150	2.8036	0.0075
151	2.8110	0.0075
152	2.8185	0.0074
153	2.8259	0.0074
154	2.8332	0.0074
155	2.8406	0.0073
156	2.8479	0.0073
157	2.8552	0.0073
158	2.8625	0.0073
159	2.8697	0.0072
160	2.8769	0.0072
161	2.8841	0.0072
162	2.8913	0.0072
163	2.8984	0.0071
164	2.9055	0.0071
165	2.9126	0.0071
166	2.9196	0.0071
167	2.9266	0.0070
168	2.9337	0.0070
169	2.9406	0.0070
170	2.9476	0.0070
171	2.9545	0.0069
172	2.9614	0.0069
173	2.9683	0.0069
174	2.9751	0.0069
175	2.9820	0.0068
176	2.9888	0.0068
177	2.9956	0.0068
178	3.0023	0.0068
179	3.0091	0.0067
180	3.0158	0.0067
181	3.0225	0.0067
182	3.0292	0.0067
183	3.0358	0.0067
184	3.0424	0.0066
185	3.0490	0.0066
186	3.0556	0.0066
187	3.0622	0.0066

188	3.0687	0.0065
189	3.0753	0.0065
190	3.0818	0.0065
191	3.0882	0.0065
192	3.0947	0.0065
193	3.1011	0.0064
194	3.1076	0.0064
195	3.1140	0.0064
196	3.1203	0.0064
197	3.1267	0.0064
198	3.1331	0.0063
199	3.1394	0.0063
200	3.1457	0.0063
201	3.1520	0.0063
202	3.1582	0.0063
203	3.1645	0.0062
204	3.1707	0.0062
205	3.1769	0.0062
206	3.1831	0.0062
207	3.1893	0.0062
208	3.1954	0.0062
209	3.2016	0.0061
210	3.2077	0.0061
211	3.2138	0.0061
212	3.2199	0.0061
213	3.2260	0.0061
214	3.2320	0.0061
215	3.2381	0.0060
216	3.2441	0.0060
217	3.2501	0.0060
218	3.2561	0.0060
219	3.2620	0.0060
220	3.2680	0.0060
221	3.2739	0.0059
222	3.2798	0.0059
223	3.2858	0.0059
224	3.2916	0.0059
225	3.2975	0.0059
226	3.3034	0.0059
227	3.3092	0.0058
228	3.3150	0.0058
229	3.3209	0.0058
230	3.3267	0.0058
231	3.3324	0.0058
232	3.3382	0.0058
233	3.3440	0.0058
234	3.3497	0.0057
235	3.3554	0.0057
236	3.3611	0.0057
237	3.3668	0.0057
238	3.3725	0.0057
239	3.3782	0.0057
240	3.3838	0.0057
241	3.3894	0.0056
242	3.3951	0.0056
243	3.4007	0.0056
244	3.4063	0.0056
245	3.4118	0.0056
246	3.4174	0.0056
247	3.4230	0.0056
248	3.4285	0.0055
249	3.4340	0.0055
250	3.4395	0.0055

251	3.4450	0.0055
252	3.4505	0.0055
253	3.4560	0.0055
254	3.4615	0.0055
255	3.4669	0.0054
256	3.4723	0.0054
257	3.4778	0.0054
258	3.4832	0.0054
259	3.4886	0.0054
260	3.4940	0.0054
261	3.4993	0.0054
262	3.5047	0.0054
263	3.5100	0.0053
264	3.5154	0.0053
265	3.5207	0.0053
266	3.5260	0.0053
267	3.5313	0.0053
268	3.5366	0.0053
269	3.5419	0.0053
270	3.5471	0.0053
271	3.5524	0.0053
272	3.5576	0.0052
273	3.5629	0.0052
274	3.5681	0.0052
275	3.5733	0.0052
276	3.5785	0.0052
277	3.5837	0.0052
278	3.5888	0.0052
279	3.5940	0.0052
280	3.5991	0.0052
281	3.6043	0.0051
282	3.6094	0.0051
283	3.6145	0.0051
284	3.6196	0.0051
285	3.6247	0.0051
286	3.6298	0.0051
287	3.6349	0.0051
288	3.6400	0.0051

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0051	0.0009	0.0042
2	0.0051	0.0009	0.0042
3	0.0051	0.0009	0.0042
4	0.0051	0.0009	0.0042
5	0.0051	0.0009	0.0042
6	0.0051	0.0009	0.0042
7	0.0052	0.0009	0.0043
8	0.0052	0.0009	0.0043
9	0.0052	0.0009	0.0043
10	0.0052	0.0009	0.0043
11	0.0052	0.0009	0.0043
12	0.0052	0.0009	0.0043
13	0.0053	0.0009	0.0043
14	0.0053	0.0009	0.0044
15	0.0053	0.0009	0.0044
16	0.0053	0.0009	0.0044
17	0.0053	0.0009	0.0044
18	0.0053	0.0009	0.0044
19	0.0054	0.0009	0.0044
20	0.0054	0.0009	0.0044

21	0.0054	0.0009	0.0045
22	0.0054	0.0009	0.0045
23	0.0054	0.0010	0.0045
24	0.0055	0.0010	0.0045
25	0.0055	0.0010	0.0045
26	0.0055	0.0010	0.0045
27	0.0055	0.0010	0.0046
28	0.0055	0.0010	0.0046
29	0.0056	0.0010	0.0046
30	0.0056	0.0010	0.0046
31	0.0056	0.0010	0.0046
32	0.0056	0.0010	0.0046
33	0.0057	0.0010	0.0047
34	0.0057	0.0010	0.0047
35	0.0057	0.0010	0.0047
36	0.0057	0.0010	0.0047
37	0.0057	0.0010	0.0047
38	0.0058	0.0010	0.0047
39	0.0058	0.0010	0.0048
40	0.0058	0.0010	0.0048
41	0.0058	0.0010	0.0048
42	0.0058	0.0010	0.0048
43	0.0059	0.0010	0.0048
44	0.0059	0.0010	0.0049
45	0.0059	0.0010	0.0049
46	0.0059	0.0010	0.0049
47	0.0060	0.0010	0.0049
48	0.0060	0.0010	0.0049
49	0.0060	0.0011	0.0050
50	0.0060	0.0011	0.0050
51	0.0061	0.0011	0.0050
52	0.0061	0.0011	0.0050
53	0.0061	0.0011	0.0051
54	0.0061	0.0011	0.0051
55	0.0062	0.0011	0.0051
56	0.0062	0.0011	0.0051
57	0.0062	0.0011	0.0051
58	0.0062	0.0011	0.0052
59	0.0063	0.0011	0.0052
60	0.0063	0.0011	0.0052
61	0.0063	0.0011	0.0052
62	0.0064	0.0011	0.0052
63	0.0064	0.0011	0.0053
64	0.0064	0.0011	0.0053
65	0.0065	0.0011	0.0053
66	0.0065	0.0011	0.0053
67	0.0065	0.0011	0.0054
68	0.0065	0.0011	0.0054
69	0.0066	0.0012	0.0054
70	0.0066	0.0012	0.0055
71	0.0067	0.0012	0.0055
72	0.0067	0.0012	0.0055
73	0.0067	0.0012	0.0055
74	0.0067	0.0012	0.0056
75	0.0068	0.0012	0.0056
76	0.0068	0.0012	0.0056
77	0.0069	0.0012	0.0057
78	0.0069	0.0012	0.0057
79	0.0069	0.0012	0.0057
80	0.0070	0.0012	0.0057
81	0.0070	0.0012	0.0058
82	0.0070	0.0012	0.0058
83	0.0071	0.0012	0.0058

84	0.0071	0.0012	0.0059
85	0.0072	0.0013	0.0059
86	0.0072	0.0013	0.0059
87	0.0072	0.0013	0.0060
88	0.0073	0.0013	0.0060
89	0.0073	0.0013	0.0060
90	0.0073	0.0013	0.0061
91	0.0074	0.0013	0.0061
92	0.0074	0.0013	0.0061
93	0.0075	0.0013	0.0062
94	0.0075	0.0013	0.0062
95	0.0076	0.0013	0.0063
96	0.0076	0.0013	0.0063
97	0.0077	0.0013	0.0063
98	0.0077	0.0013	0.0064
99	0.0078	0.0014	0.0064
100	0.0078	0.0014	0.0064
101	0.0079	0.0014	0.0065
102	0.0079	0.0014	0.0065
103	0.0080	0.0014	0.0066
104	0.0080	0.0014	0.0066
105	0.0081	0.0014	0.0067
106	0.0081	0.0014	0.0067
107	0.0082	0.0014	0.0068
108	0.0082	0.0014	0.0068
109	0.0083	0.0015	0.0069
110	0.0084	0.0015	0.0069
111	0.0084	0.0015	0.0070
112	0.0085	0.0015	0.0070
113	0.0086	0.0015	0.0071
114	0.0086	0.0015	0.0071
115	0.0087	0.0015	0.0072
116	0.0088	0.0015	0.0072
117	0.0088	0.0015	0.0073
118	0.0089	0.0016	0.0073
119	0.0090	0.0016	0.0074
120	0.0090	0.0016	0.0075
121	0.0091	0.0016	0.0075
122	0.0092	0.0016	0.0076
123	0.0093	0.0016	0.0077
124	0.0093	0.0016	0.0077
125	0.0095	0.0017	0.0078
126	0.0095	0.0017	0.0078
127	0.0096	0.0017	0.0079
128	0.0097	0.0017	0.0080
129	0.0098	0.0017	0.0081
130	0.0099	0.0017	0.0081
131	0.0100	0.0017	0.0082
132	0.0101	0.0018	0.0083
133	0.0102	0.0018	0.0084
134	0.0103	0.0018	0.0085
135	0.0104	0.0018	0.0086
136	0.0105	0.0018	0.0086
137	0.0106	0.0019	0.0088
138	0.0107	0.0019	0.0088
139	0.0109	0.0019	0.0090
140	0.0109	0.0019	0.0090
141	0.0111	0.0019	0.0092
142	0.0112	0.0020	0.0092
143	0.0114	0.0020	0.0094
144	0.0115	0.0020	0.0095
145	0.0106	0.0019	0.0087
146	0.0107	0.0019	0.0088

147	0.0109	0.0019	0.0090
148	0.0110	0.0019	0.0091
149	0.0112	0.0020	0.0092
150	0.0113	0.0020	0.0093
151	0.0115	0.0020	0.0095
152	0.0117	0.0020	0.0096
153	0.0119	0.0021	0.0098
154	0.0120	0.0021	0.0099
155	0.0123	0.0022	0.0102
156	0.0124	0.0022	0.0103
157	0.0127	0.0022	0.0105
158	0.0129	0.0023	0.0106
159	0.0132	0.0023	0.0109
160	0.0134	0.0023	0.0110
161	0.0137	0.0024	0.0113
162	0.0139	0.0024	0.0115
163	0.0143	0.0025	0.0118
164	0.0145	0.0025	0.0120
165	0.0150	0.0026	0.0124
166	0.0152	0.0027	0.0126
167	0.0157	0.0027	0.0130
168	0.0160	0.0028	0.0132
169	0.0166	0.0029	0.0137
170	0.0169	0.0029	0.0139
171	0.0175	0.0031	0.0145
172	0.0179	0.0031	0.0147
173	0.0186	0.0033	0.0154
174	0.0190	0.0033	0.0157
175	0.0199	0.0035	0.0165
176	0.0204	0.0036	0.0169
177	0.0215	0.0038	0.0178
178	0.0221	0.0039	0.0183
179	0.0235	0.0041	0.0194
180	0.0242	0.0042	0.0200
181	0.0260	0.0045	0.0214
182	0.0270	0.0047	0.0223
183	0.0293	0.0051	0.0242
184	0.0306	0.0054	0.0253
185	0.0281	0.0049	0.0232
186	0.0299	0.0052	0.0247
187	0.0347	0.0061	0.0286
188	0.0379	0.0066	0.0313
189	0.0471	0.0077	0.0394
190	0.0543	0.0077	0.0465
191	0.0823	0.0077	0.0746
192	0.1195	0.0077	0.1118
193	0.5170	0.0077	0.5093
194	0.0648	0.0077	0.0571
195	0.0419	0.0073	0.0346
196	0.0321	0.0056	0.0265
197	0.0322	0.0056	0.0266
198	0.0281	0.0049	0.0232
199	0.0251	0.0044	0.0207
200	0.0228	0.0040	0.0188
201	0.0210	0.0037	0.0173
202	0.0195	0.0034	0.0161
203	0.0182	0.0032	0.0151
204	0.0172	0.0030	0.0142
205	0.0163	0.0028	0.0134
206	0.0155	0.0027	0.0128
207	0.0148	0.0026	0.0122
208	0.0141	0.0025	0.0117
209	0.0136	0.0024	0.0112

210	0.0131	0.0023	0.0108
211	0.0126	0.0022	0.0104
212	0.0122	0.0021	0.0100
213	0.0118	0.0021	0.0097
214	0.0114	0.0020	0.0094
215	0.0111	0.0019	0.0092
216	0.0108	0.0019	0.0089
217	0.0116	0.0020	0.0095
218	0.0113	0.0020	0.0093
219	0.0110	0.0019	0.0091
220	0.0108	0.0019	0.0089
221	0.0106	0.0018	0.0087
222	0.0103	0.0018	0.0085
223	0.0101	0.0018	0.0084
224	0.0099	0.0017	0.0082
225	0.0097	0.0017	0.0080
226	0.0096	0.0017	0.0079
227	0.0094	0.0016	0.0078
228	0.0092	0.0016	0.0076
229	0.0091	0.0016	0.0075
230	0.0089	0.0016	0.0074
231	0.0088	0.0015	0.0073
232	0.0087	0.0015	0.0071
233	0.0085	0.0015	0.0070
234	0.0084	0.0015	0.0069
235	0.0083	0.0014	0.0068
236	0.0082	0.0014	0.0067
237	0.0081	0.0014	0.0066
238	0.0080	0.0014	0.0066
239	0.0078	0.0014	0.0065
240	0.0077	0.0014	0.0064
241	0.0076	0.0013	0.0063
242	0.0076	0.0013	0.0062
243	0.0075	0.0013	0.0062
244	0.0074	0.0013	0.0061
245	0.0073	0.0013	0.0060
246	0.0072	0.0013	0.0059
247	0.0071	0.0012	0.0059
248	0.0071	0.0012	0.0058
249	0.0070	0.0012	0.0058
250	0.0069	0.0012	0.0057
251	0.0068	0.0012	0.0056
252	0.0068	0.0012	0.0056
253	0.0067	0.0012	0.0055
254	0.0066	0.0012	0.0055
255	0.0066	0.0011	0.0054
256	0.0065	0.0011	0.0054
257	0.0064	0.0011	0.0053
258	0.0064	0.0011	0.0053
259	0.0063	0.0011	0.0052
260	0.0063	0.0011	0.0052
261	0.0062	0.0011	0.0051
262	0.0062	0.0011	0.0051
263	0.0061	0.0011	0.0050
264	0.0061	0.0011	0.0050
265	0.0060	0.0010	0.0050
266	0.0060	0.0010	0.0049
267	0.0059	0.0010	0.0049
268	0.0059	0.0010	0.0048
269	0.0058	0.0010	0.0048
270	0.0058	0.0010	0.0048
271	0.0057	0.0010	0.0047
272	0.0057	0.0010	0.0047

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    273              0.0056          0.0010            0.0047
    274              0.0056          0.0010            0.0046
    275              0.0056          0.0010            0.0046
    276              0.0055          0.0010            0.0045
    277              0.0055          0.0010            0.0045
    278              0.0054          0.0010            0.0045
    279              0.0054          0.0009            0.0045
    280              0.0054          0.0009            0.0044
    281              0.0053          0.0009            0.0044
    282              0.0053          0.0009            0.0044
    283              0.0053          0.0009            0.0043
    284              0.0052          0.0009            0.0043
    285              0.0052          0.0009            0.0043
    286              0.0052          0.0009            0.0042
    287              0.0051          0.0009            0.0042
    288              0.0051          0.0009            0.0042
    ---------------------------------------------------------------------
    ---------------------------------------------------------------------
    Total soil rain loss =      0.53(In)
    Total effective rainfall =      3.11(In)
    Peak flow rate in flood hydrograph =     23.99(CFS)
    ----------------------------------------------------------------------
    +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        24 - H O U R   S T O R M
                   R u n o f f     H y d r o g r a p h
    ---------------------------------------------------------------------
                Hydrograph in   5   Minute intervals ((CFS))

    ---------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        7.5      15.0      22.5      30.0
-----------------------------------------------------------------------
  0+ 5       0.0001      0.01  Q         |         |         |         |
  0+10       0.0007      0.09  Q         |         |         |         |
  0+15       0.0024      0.24  Q         |         |         |         |
  0+20       0.0046      0.33  Q         |         |         |         |
  0+25       0.0073      0.38  Q         |         |         |         |
  0+30       0.0101      0.41  Q         |         |         |         |
  0+35       0.0131      0.43  Q         |         |         |         |
  0+40       0.0162      0.45  Q         |         |         |         |
  0+45       0.0194      0.47  Q         |         |         |         |
  0+50       0.0227      0.48  Q         |         |         |         |
  0+55       0.0261      0.49  Q         |         |         |         |
  1+ 0       0.0295      0.50  Q         |         |         |         |
  1+ 5       0.0330      0.50  Q         |         |         |         |
  1+10       0.0365      0.51  Q         |         |         |         |
  1+15       0.0400      0.51  Q         |         |         |         |
  1+20       0.0436      0.52  Q         |         |         |         |
  1+25       0.0472      0.52  Q         |         |         |         |
  1+30       0.0508      0.53  Q         |         |         |         |
  1+35       0.0545      0.53  Q         |         |         |         |
  1+40       0.0582      0.53  Q         |         |         |         |
  1+45       0.0619      0.53  Q         |         |         |         |
  1+50       0.0655      0.54  QV        |         |         |         |
  1+55       0.0693      0.54  QV        |         |         |         |
  2+ 0       0.0730      0.54  QV        |         |         |         |
  2+ 5       0.0767      0.54  QV        |         |         |         |
  2+10       0.0805      0.54  QV        |         |         |         |
  2+15       0.0842      0.55  QV        |         |         |         |
  2+20       0.0880      0.55  QV        |         |         |         |
  2+25       0.0918      0.55  QV        |         |         |         |
  2+30       0.0956      0.55  QV        |         |         |         |
  2+35       0.0994      0.55  QV        |         |         |         |
  2+40       0.1032      0.56  QV        |         |         |         |
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2+45       0.1071      0.56  QV        |         |         |         |
2+50       0.1109      0.56  QV        |         |         |         |
2+55       0.1148      0.56  QV        |         |         |         |
3+ 0       0.1187      0.56  QV        |         |         |         |
3+ 5       0.1226      0.57  QV        |         |         |         |
3+10       0.1265      0.57  QV        |         |         |         |
3+15       0.1304      0.57  Q V       |         |         |         |
3+20       0.1344      0.57  Q V       |         |         |         |
3+25       0.1383      0.58  Q V       |         |         |         |
3+30       0.1423      0.58  Q V       |         |         |         |
3+35       0.1463      0.58  Q V       |         |         |         |
3+40       0.1503      0.58  Q V       |         |         |         |
3+45       0.1543      0.58  Q V       |         |         |         |
3+50       0.1584      0.59  Q V       |         |         |         |
3+55       0.1624      0.59  Q V       |         |         |         |
4+ 0       0.1665      0.59  Q V       |         |         |         |
4+ 5       0.1706      0.59  Q V       |         |         |         |
4+10       0.1747      0.60  Q V       |         |         |         |
4+15       0.1788      0.60  Q V       |         |         |         |
4+20       0.1829      0.60  Q V       |         |         |         |
4+25       0.1871      0.60  Q V       |         |         |         |
4+30       0.1913      0.61  Q V       |         |         |         |
4+35       0.1955      0.61  Q  V      |         |         |         |
4+40       0.1997      0.61  Q  V      |         |         |         |
4+45       0.2039      0.61  Q  V      |         |         |         |
4+50       0.2081      0.62  Q  V      |         |         |         |
4+55       0.2124      0.62  Q  V      |         |         |         |
5+ 0       0.2167      0.62  Q  V      |         |         |         |
5+ 5       0.2210      0.62  Q  V      |         |         |         |
5+10       0.2253      0.63  Q  V      |         |         |         |
5+15       0.2297      0.63  Q  V      |         |         |         |
5+20       0.2340      0.63  Q  V      |         |         |         |
5+25       0.2384      0.64  Q  V      |         |         |         |
5+30       0.2428      0.64  Q  V      |         |         |         |
5+35       0.2472      0.64  Q  V      |         |         |         |
5+40       0.2517      0.64  Q  V      |         |         |         |
5+45       0.2561      0.65  Q  V      |         |         |         |
5+50       0.2606      0.65  Q   V     |         |         |         |
5+55       0.2651      0.65  Q   V     |         |         |         |
6+ 0       0.2696      0.66  Q   V     |         |         |         |
6+ 5       0.2742      0.66  Q   V     |         |         |         |
6+10       0.2787      0.66  Q   V     |         |         |         |
6+15       0.2833      0.67  Q   V     |         |         |         |
6+20       0.2880      0.67  Q   V     |         |         |         |
6+25       0.2926      0.67  Q   V     |         |         |         |
6+30       0.2973      0.68  Q   V     |         |         |         |
6+35       0.3019      0.68  Q   V     |         |         |         |
6+40       0.3066      0.68  Q   V     |         |         |         |
6+45       0.3114      0.69  Q   V     |         |         |         |
6+50       0.3161      0.69  Q   V     |         |         |         |
6+55       0.3209      0.69  Q   V     |         |         |         |
7+ 0       0.3257      0.70  Q    V    |         |         |         |
7+ 5       0.3306      0.70  Q    V    |         |         |         |
7+10       0.3354      0.71  Q    V    |         |         |         |
7+15       0.3403      0.71  Q    V    |         |         |         |
7+20       0.3452      0.71  Q    V    |         |         |         |
7+25       0.3502      0.72  Q    V    |         |         |         |
7+30       0.3551      0.72  Q    V    |         |         |         |
7+35       0.3601      0.73  Q    V    |         |         |         |
7+40       0.3652      0.73  Q    V    |         |         |         |
7+45       0.3702      0.73  Q    V    |         |         |         |
7+50       0.3753      0.74  Q    V    |         |         |         |
7+55       0.3804      0.74  Q    V    |         |         |         |
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 8+ 0       0.3856      0.75  Q    V    |         |         |         |
 8+ 5       0.3907      0.75  |Q    V   |         |         |         |
 8+10       0.3960      0.76  |Q    V   |         |         |         |
 8+15       0.4012      0.76  |Q    V   |         |         |         |
 8+20       0.4065      0.77  |Q    V   |         |         |         |
 8+25       0.4118      0.77  |Q    V   |         |         |         |
 8+30       0.4171      0.78  |Q    V   |         |         |         |
 8+35       0.4225      0.78  |Q    V   |         |         |         |
 8+40       0.4279      0.79  |Q    V   |         |         |         |
 8+45       0.4333      0.79  |Q    V   |         |         |         |
 8+50       0.4388      0.80  |Q    V   |         |         |         |
 8+55       0.4443      0.80  |Q    V   |         |         |         |
 9+ 0       0.4499      0.81  |Q    V   |         |         |         |
 9+ 5       0.4555      0.81  |Q     V  |         |         |         |
 9+10       0.4611      0.82  |Q     V  |         |         |         |
 9+15       0.4668      0.82  |Q     V  |         |         |         |
 9+20       0.4725      0.83  |Q     V  |         |         |         |
 9+25       0.4782      0.84  |Q     V  |         |         |         |
 9+30       0.4840      0.84  |Q     V  |         |         |         |
 9+35       0.4899      0.85  |Q     V  |         |         |         |
 9+40       0.4958      0.85  |Q     V  |         |         |         |
 9+45       0.5017      0.86  |Q     V  |         |         |         |
 9+50       0.5076      0.87  |Q     V  |         |         |         |
 9+55       0.5137      0.87  |Q     V  |         |         |         |
10+ 0       0.5197      0.88  |Q     V  |         |         |         |
10+ 5       0.5258      0.89  |Q      V |         |         |         |
10+10       0.5320      0.89  |Q      V |         |         |         |
10+15       0.5382      0.90  |Q      V |         |         |         |
10+20       0.5445      0.91  |Q      V |         |         |         |
10+25       0.5508      0.92  |Q      V |         |         |         |
10+30       0.5571      0.92  |Q      V |         |         |         |
10+35       0.5636      0.93  |Q      V |         |         |         |
10+40       0.5700      0.94  |Q      V |         |         |         |
10+45       0.5766      0.95  |Q      V |         |         |         |
10+50       0.5832      0.96  |Q      V |         |         |         |
10+55       0.5898      0.97  |Q       V|         |         |         |
11+ 0       0.5965      0.98  |Q       V|         |         |         |
11+ 5       0.6033      0.98  |Q       V|         |         |         |
11+10       0.6102      0.99  |Q       V|         |         |         |
11+15       0.6171      1.00  |Q       V|         |         |         |
11+20       0.6241      1.01  |Q       V|         |         |         |
11+25       0.6311      1.02  |Q       V|         |         |         |
11+30       0.6382      1.03  |Q       V|         |         |         |
11+35       0.6454      1.05  |Q       V|         |         |         |
11+40       0.6527      1.06  |Q        V         |         |         |
11+45       0.6600      1.07  |Q        V         |         |         |
11+50       0.6675      1.08  |Q        V         |         |         |
11+55       0.6750      1.09  |Q        V         |         |         |
12+ 0       0.6826      1.10  |Q        V         |         |         |
12+ 5       0.6903      1.11  |Q        V         |         |         |
12+10       0.6979      1.11  |Q        V         |         |         |
12+15       0.7054      1.09  |Q        V         |         |         |
12+20       0.7129      1.09  |Q        V         |         |         |
12+25       0.7204      1.09  |Q        |V        |         |         |
12+30       0.7280      1.10  |Q        |V        |         |         |
12+35       0.7357      1.11  |Q        |V        |         |         |
12+40       0.7434      1.12  |Q        |V        |         |         |
12+45       0.7512      1.14  |Q        |V        |         |         |
12+50       0.7592      1.15  |Q        |V        |         |         |
12+55       0.7672      1.17  |Q        |V        |         |         |
13+ 0       0.7753      1.18  |Q        |V        |         |         |
13+ 5       0.7836      1.20  |Q        | V       |         |         |
13+10       0.7920      1.22  |Q        | V       |         |         |
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13+15       0.8006      1.24  |Q        | V       |         |         |
13+20       0.8093      1.26  |Q        | V       |         |         |
13+25       0.8181      1.28  |Q        | V       |         |         |
13+30       0.8271      1.31  |Q        | V       |         |         |
13+35       0.8363      1.33  |Q        | V       |         |         |
13+40       0.8456      1.36  |Q        | V       |         |         |
13+45       0.8552      1.39  |Q        |  V      |         |         |
13+50       0.8649      1.41  |Q        |  V      |         |         |
13+55       0.8749      1.45  |Q        |  V      |         |         |
14+ 0       0.8851      1.48  |Q        |  V      |         |         |
14+ 5       0.8955      1.51  | Q       |  V      |         |         |
14+10       0.9061      1.55  | Q       |  V      |         |         |
14+15       0.9171      1.59  | Q       |   V     |         |         |
14+20       0.9283      1.63  | Q       |   V     |         |         |
14+25       0.9399      1.68  | Q       |   V     |         |         |
14+30       0.9517      1.72  | Q       |   V     |         |         |
14+35       0.9640      1.78  | Q       |   V     |         |         |
14+40       0.9766      1.83  | Q       |    V    |         |         |
14+45       0.9896      1.89  | Q       |    V    |         |         |
14+50       1.0031      1.96  | Q       |    V    |         |         |
14+55       1.0171      2.03  | Q       |    V    |         |         |
15+ 0       1.0317      2.11  | Q       |    V    |         |         |
15+ 5       1.0468      2.20  | Q       |     V   |         |         |
15+10       1.0627      2.30  |  Q      |     V   |         |         |
15+15       1.0793      2.42  |  Q      |     V   |         |         |
15+20       1.0969      2.54  |  Q      |     V   |         |         |
15+25       1.1153      2.68  |  Q      |      V  |         |         |
15+30       1.1344      2.76  |  Q      |      V  |         |         |
15+35       1.1536      2.80  |  Q      |      V  |         |         |
15+40       1.1738      2.94  |  Q      |       V |         |         |
15+45       1.1959      3.20  |   Q     |       V |         |         |
15+50       1.2205      3.57  |   Q     |       V |         |         |
15+55       1.2495      4.21  |    Q    |        V|         |         |
16+ 0       1.2863      5.34  |      Q  |        V|         |         |
16+ 5       1.3456      8.62  |         |Q        V         |         |
16+10       1.4593     16.52  |         |         | Q       |         |
16+15       1.6246     23.99  |         |         |   V     |Q        |
16+20       1.7341     15.91  |         |         |Q    V   |         |
16+25       1.8075     10.65  |         |   Q     |      V  |         |
16+30       1.8635      8.13  |         Q         |       V |         |
16+35       1.9092      6.64  |       Q |         |        V|         |
16+40       1.9482      5.66  |      Q  |         |        V|         |
16+45       1.9809      4.76  |     Q   |         |         V         |
16+50       2.0097      4.17  |    Q    |         |         V         |
16+55       2.0351      3.69  |   Q     |         |         |V        |
17+ 0       2.0577      3.28  |   Q     |         |         |V        |
17+ 5       2.0778      2.93  |  Q      |         |         |V        |
17+10       2.0959      2.61  |  Q      |         |         | V       |
17+15       2.1119      2.34  |  Q      |         |         | V       |
17+20       2.1266      2.13  | Q       |         |         | V       |
17+25       2.1407      2.05  | Q       |         |         | V       |
17+30       2.1540      1.94  | Q       |         |         |  V      |
17+35       2.1662      1.76  | Q       |         |         |  V      |
17+40       2.1770      1.57  | Q       |         |         |  V      |
17+45       2.1867      1.40  |Q        |         |         |  V      |
17+50       2.1959      1.34  |Q        |         |         |  V      |
17+55       2.2048      1.29  |Q        |         |         |  V      |
18+ 0       2.2133      1.24  |Q        |         |         |   V     |
18+ 5       2.2216      1.20  |Q        |         |         |   V     |
18+10       2.2297      1.18  |Q        |         |         |   V     |
18+15       2.2378      1.17  |Q        |         |         |   V     |
18+20       2.2458      1.16  |Q        |         |         |   V     |
18+25       2.2536      1.14  |Q        |         |         |   V     |
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18+30       2.2613      1.12  |Q        |         |         |   V     |
18+35       2.2688      1.09  |Q        |         |         |   V     |
18+40       2.2762      1.07  |Q        |         |         |   V     |
18+45       2.2835      1.05  |Q        |         |         |    V    |
18+50       2.2905      1.03  |Q        |         |         |    V    |
18+55       2.2975      1.01  |Q        |         |         |    V    |
19+ 0       2.3043      0.99  |Q        |         |         |    V    |
19+ 5       2.3111      0.97  |Q        |         |         |    V    |
19+10       2.3177      0.96  |Q        |         |         |    V    |
19+15       2.3241      0.94  |Q        |         |         |    V    |
19+20       2.3305      0.93  |Q        |         |         |    V    |
19+25       2.3368      0.91  |Q        |         |         |    V    |
19+30       2.3429      0.90  |Q        |         |         |     V   |
19+35       2.3490      0.88  |Q        |         |         |     V   |
19+40       2.3550      0.87  |Q        |         |         |     V   |
19+45       2.3609      0.85  |Q        |         |         |     V   |
19+50       2.3667      0.84  |Q        |         |         |     V   |
19+55       2.3724      0.83  |Q        |         |         |     V   |
20+ 0       2.3780      0.82  |Q        |         |         |     V   |
20+ 5       2.3836      0.81  |Q        |         |         |     V   |
20+10       2.3891      0.80  |Q        |         |         |     V   |
20+15       2.3945      0.79  |Q        |         |         |     V   |
20+20       2.3998      0.78  |Q        |         |         |     V   |
20+25       2.4051      0.77  |Q        |         |         |     V   |
20+30       2.4103      0.76  |Q        |         |         |      V  |
20+35       2.4155      0.75  Q         |         |         |      V  |
20+40       2.4206      0.74  Q         |         |         |      V  |
20+45       2.4256      0.73  Q         |         |         |      V  |
20+50       2.4306      0.72  Q         |         |         |      V  |
20+55       2.4355      0.71  Q         |         |         |      V  |
21+ 0       2.4403      0.71  Q         |         |         |      V  |
21+ 5       2.4452      0.70  Q         |         |         |      V  |
21+10       2.4499      0.69  Q         |         |         |      V  |
21+15       2.4546      0.68  Q         |         |         |      V  |
21+20       2.4593      0.68  Q         |         |         |      V  |
21+25       2.4639      0.67  Q         |         |         |      V  |
21+30       2.4685      0.66  Q         |         |         |      V  |
21+35       2.4730      0.66  Q         |         |         |       V |
21+40       2.4775      0.65  Q         |         |         |       V |
21+45       2.4819      0.64  Q         |         |         |       V |
21+50       2.4863      0.64  Q         |         |         |       V |
21+55       2.4907      0.63  Q         |         |         |       V |
22+ 0       2.4950      0.63  Q         |         |         |       V |
22+ 5       2.4993      0.62  Q         |         |         |       V |
22+10       2.5035      0.62  Q         |         |         |       V |
22+15       2.5077      0.61  Q         |         |         |       V |
22+20       2.5119      0.61  Q         |         |         |       V |
22+25       2.5161      0.60  Q         |         |         |       V |
22+30       2.5202      0.60  Q         |         |         |       V |
22+35       2.5242      0.59  Q         |         |         |       V |
22+40       2.5283      0.59  Q         |         |         |       V |
22+45       2.5323      0.58  Q         |         |         |       V |
22+50       2.5363      0.58  Q         |         |         |       V |
22+55       2.5402      0.57  Q         |         |         |        V|
23+ 0       2.5441      0.57  Q         |         |         |        V|
23+ 5       2.5480      0.56  Q         |         |         |        V|
23+10       2.5519      0.56  Q         |         |         |        V|
23+15       2.5557      0.56  Q         |         |         |        V|
23+20       2.5595      0.55  Q         |         |         |        V|
23+25       2.5633      0.55  Q         |         |         |        V|
23+30       2.5670      0.54  Q         |         |         |        V|
23+35       2.5707      0.54  Q         |         |         |        V|
23+40       2.5744      0.54  Q         |         |         |        V|
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  23+45       2.5781      0.53  Q         |         |         |        V|
  23+50       2.5817      0.53  Q         |         |         |        V|
  23+55       2.5854      0.53  Q         |         |         |        V|
  24+ 0       2.5890      0.52  Q         |         |         |        V|
  24+ 5       2.5924      0.51  Q         |         |         |        V|
  24+10       2.5954      0.43  Q         |         |         |        V|
  24+15       2.5972      0.27  Q         |         |         |        V|
  24+20       2.5985      0.18  Q         |         |         |        V|
  24+25       2.5994      0.13  Q         |         |         |        V|
  24+30       2.6001      0.10  Q         |         |         |        V|
  24+35       2.6007      0.08  Q         |         |         |        V|
  24+40       2.6011      0.06  Q         |         |         |        V|
  24+45       2.6014      0.05  Q         |         |         |        V|
  24+50       2.6017      0.04  Q         |         |         |        V|
  24+55       2.6019      0.03  Q         |         |         |        V|
  25+ 0       2.6021      0.02  Q         |         |         |        V|
  25+ 5       2.6022      0.02  Q         |         |         |        V|
  25+10       2.6023      0.01  Q         |         |         |        V|
  25+15       2.6023      0.01  Q         |         |         |        V|
  25+20       2.6024      0.01  Q         |         |         |        V|
  25+25       2.6024      0.01  Q         |         |         |        V|
  25+30       2.6024      0.00  Q         |         |         |        V|
  25+35       2.6024      0.00  Q         |         |         |         V
----------------------------------------------------------------------
```

Stage-Storage-Discharge Table

DAVID EVANS AND ASSOCIATES INC.
18484 Outer Hwy 18N, Suite 225
Apple Valley, CA 92307

Basin A							
Interval	Elevation (Ft)	Depth (Ft)	Contour Area (Sqft)	Incremental Volume (Cuft)	Cummulative Volume (Cuft)	Cummulative Volume (Acft)	*Q_{Tot} (cfs)
1.0	2,890.00	-	17,433.44	N/A	-	-	-
2.0	2,890.50	0.50	18,572.21	9,001.41	9,001.41	0.21	-
3.0	2,891.00	1.00	19,731.51	9,575.93	18,577.34	0.43	-
4.0	2,891.50	1.50	20,911.34	10,160.71	28,738.06	0.66	-
5.0	2,892.00	2.00	22,111.71	10,755.76	39,493.82	0.91	5.10
7.0	2,892.50	2.50	23,332.61	4,666.52	50,854.90	1.17	7.23
8.0	2,893.00	3.00	24,574.03	11,976.66	62,831.56	1.44	8.85
9.0	2,893.50	3.50	25,836.00	12,602.51	75,434.06	1.73	15.30
10.0	2,894.00	4.00	27,118.49	13,238.62	88,672.69	2.04	20.43

Notes:

*Refer to Outlet Structure Stage-Discharge Table in Appendix E

Revised Infiltration Basin A - Composite Rating Table

DAVID EVANS AND ASSOCIATES INC.
18484 Outer Hwy 18N, Suite 225
Apple Valley, CA 92307

Elevation (ft)	Depth (ft)	3 Rectangular Orfice 3-6"x12" Flow (cfs)	3 Rectangular Orfice 3-6"x12" Flow (cfs)	Rectangular Weir Box (1.5'X1.5') Flow (cfs)	Total Flows (cfs)
2890.00	0.00	0.000	0.000	0.000	0.000
2890.50	0.50	0.000	0.000	0.000	0.000
2891.00	1.00	0.000	0.000	0.000	0.000
2891.50	1.50	0.000	0.000	0.000	0.000
2892.00	2.00	5.100	0.000	0.000	5.100
2892.50	2.50	7.230	0.000	0.000	7.230
2893.00	3.00	8.850	0.000	0.000	8.850
2893.50	3.50	10.200	5.100	0.000	15.300
2894.00	4.00	11.430	7.230	1.770	20.430

*Refer to Improvement Plans in Appendix G

```
                 FLOOD HYDROGRAPH ROUTING PROGRAM
         Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014
                        Study date: 01/16/23

----------------------------------------------------------------------

Space Center Expansion Project Phase 2 Flag
10 Year 24 Hour
Basin A
Please Refer to Appendix B Developed Condition Hydrology map
---------------------------------------------------------------------

Program License Serial Number 6385

---------------------------------------------------------------------
********************* HYDROGRAPH INFORMATION *********************

             From study/file name: UHDEV10YRPHASE2FLAG.rte
****************************HYDROGRAPH DATA****************************
             Number of intervals =   309
             Time interval =    5.0 (Min.)
             Maximum/Peak flow rate =       12.764 (CFS)
             Total volume =       1.492 (Ac.Ft)
       Status of hydrographs being held in storage
                  Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
       Peak (CFS)      0.000     0.000     0.000     0.000     0.000
       Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
***********************************************************************

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** RETARDING BASIN ROUTING ****
______________________________________________________________________

User entry of depth-outflow-storage data
---------------------------------------------------------------------
Total number of inflow hydrograph intervals = 309
Hydrograph time unit =  5.000 (Min.)
Initial depth in storage basin =   0.00(Ft.)
---------------------------------------------------------------------
---------------------------------------------------------------------
Initial basin depth =   0.00 (Ft.)
Initial basin storage =      0.00 (Ac.Ft)
Initial basin outflow =   0.00 (CFS)
----------------------------------------------------------------------
---------------------------------------------------------------------
Depth vs. Storage and Depth vs. Discharge data:
 Basin Depth  Storage    Outflow   (S-O*dt/2)   (S+O*dt/2)
     (Ft.)    (Ac.Ft)    (CFS)      (Ac.Ft)    (Ac.Ft)
----------------------------------------------------------------------
    0.000      0.000      0.000      0.000        0.000
    0.500      0.210      0.001      0.210        0.210
    1.000      0.430      0.001      0.430        0.430
    1.500      0.660      0.001      0.660        0.660
    2.000      0.910      5.100      0.892        0.928
    2.500      1.170      7.230      1.145        1.195
    3.000      1.440      8.850      1.410        1.470
```

3.500	1.730	15.300	1.677	1.783
4.000	2.040	20.430	1.970	2.110

Hydrograph Detention Basin Routing

Graph values: 'I'= unit inflow; 'O'=outflow at time shown

```
-----------------------------------------------------------------------
 Time   Inflow  Outflow    Storage                                 Depth
(Hours)  (CFS)   (CFS)     (Ac.Ft) .0        3.2    6.38    9.57   12.76 (Ft.)
 0.083    0.01    0.00      0.000  O        |       |       |       |      0.00
 0.167    0.04    0.00      0.000  O        |       |       |       |      0.00
 0.250    0.13    0.00      0.001  O        |       |       |       |      0.00
 0.333    0.18    0.00      0.002  O        |       |       |       |      0.00
 0.417    0.21    0.00      0.003  O        |       |       |       |      0.01
 0.500    0.23    0.00      0.005  O        |       |       |       |      0.01
 0.583    0.24    0.00      0.006  O        |       |       |       |      0.02
 0.667    0.26    0.00      0.008  O        |       |       |       |      0.02
 0.750    0.27    0.00      0.010  O        |       |       |       |      0.02
 0.833    0.27    0.00      0.012  O        |       |       |       |      0.03
 0.917    0.28    0.00      0.014  O        |       |       |       |      0.03
 1.000    0.28    0.00      0.016  O        |       |       |       |      0.04
 1.083    0.29    0.00      0.018  O        |       |       |       |      0.04
 1.167    0.29    0.00      0.020  O        |       |       |       |      0.05
 1.250    0.30    0.00      0.022  O        |       |       |       |      0.05
 1.333    0.30    0.00      0.024  O        |       |       |       |      0.06
 1.417    0.30    0.00      0.026  O        |       |       |       |      0.06
 1.500    0.30    0.00      0.028  O        |       |       |       |      0.07
 1.583    0.30    0.00      0.030  O        |       |       |       |      0.07
 1.667    0.31    0.00      0.032  O        |       |       |       |      0.08
 1.750    0.31    0.00      0.034  O        |       |       |       |      0.08
 1.833    0.31    0.00      0.036  O        |       |       |       |      0.09
 1.917    0.31    0.00      0.038  O        |       |       |       |      0.09
 2.000    0.31    0.00      0.040  O        |       |       |       |      0.10
 2.083    0.31    0.00      0.043  O        |       |       |       |      0.10
 2.167    0.31    0.00      0.045  O        |       |       |       |      0.11
 2.250    0.32    0.00      0.047  O        |       |       |       |      0.11
 2.333    0.32    0.00      0.049  O        |       |       |       |      0.12
 2.417    0.32    0.00      0.051  O        |       |       |       |      0.12
 2.500    0.32    0.00      0.053  O        |       |       |       |      0.13
 2.583    0.32    0.00      0.056  O        |       |       |       |      0.13
 2.667    0.32    0.00      0.058  O        |       |       |       |      0.14
 2.750    0.32    0.00      0.060  O        |       |       |       |      0.14
 2.833    0.32    0.00      0.062  O        |       |       |       |      0.15
 2.917    0.32    0.00      0.064  O        |       |       |       |      0.15
 3.000    0.33    0.00      0.067  O        |       |       |       |      0.16
 3.083    0.33    0.00      0.069  O        |       |       |       |      0.16
 3.167    0.33    0.00      0.071  O        |       |       |       |      0.17
 3.250    0.33    0.00      0.073  O        |       |       |       |      0.17
 3.333    0.33    0.00      0.076  O        |       |       |       |      0.18
 3.417    0.33    0.00      0.078  O        |       |       |       |      0.19
 3.500    0.33    0.00      0.080  O        |       |       |       |      0.19
 3.583    0.33    0.00      0.083  O        |       |       |       |      0.20
 3.667    0.34    0.00      0.085  O        |       |       |       |      0.20
 3.750    0.34    0.00      0.087  O        |       |       |       |      0.21
 3.833    0.34    0.00      0.090  O        |       |       |       |      0.21
 3.917    0.34    0.00      0.092  O        |       |       |       |      0.22
 4.000    0.34    0.00      0.094  O        |       |       |       |      0.22
 4.083    0.34    0.00      0.097  O        |       |       |       |      0.23
 4.167    0.34    0.00      0.099  O        |       |       |       |      0.24
 4.250    0.35    0.00      0.101  O        |       |       |       |      0.24
 4.333    0.35    0.00      0.104  O        |       |       |       |      0.25
 4.417    0.35    0.00      0.106  O        |       |       |       |      0.25
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4.500	0.35	0.00	0.108	O	0.26
4.583	0.35	0.00	0.111	O	0.26
4.667	0.35	0.00	0.113	O	0.27
4.750	0.35	0.00	0.116	O	0.28
4.833	0.36	0.00	0.118	O	0.28
4.917	0.36	0.00	0.121	O	0.29
5.000	0.36	0.00	0.123	O	0.29
5.083	0.36	0.00	0.126	O	0.30
5.167	0.36	0.00	0.128	O	0.30
5.250	0.36	0.00	0.131	O	0.31
5.333	0.36	0.00	0.133	O	0.32
5.417	0.37	0.00	0.136	O	0.32
5.500	0.37	0.00	0.138	O	0.33
5.583	0.37	0.00	0.141	O	0.33
5.667	0.37	0.00	0.143	O	0.34
5.750	0.37	0.00	0.146	O	0.35
5.833	0.37	0.00	0.148	O	0.35
5.917	0.38	0.00	0.151	O	0.36
6.000	0.38	0.00	0.153	O	0.37
6.083	0.38	0.00	0.156	O	0.37
6.167	0.38	0.00	0.159	O	0.38
6.250	0.38	0.00	0.161	O	0.38
6.333	0.39	0.00	0.164	O	0.39
6.417	0.39	0.00	0.167	O	0.40
6.500	0.39	0.00	0.169	O	0.40
6.583	0.39	0.00	0.172	O	0.41
6.667	0.39	0.00	0.175	O	0.42
6.750	0.40	0.00	0.177	O	0.42
6.833	0.40	0.00	0.180	O	0.43
6.917	0.40	0.00	0.183	OI	0.44
7.000	0.40	0.00	0.186	OI	0.44
7.083	0.40	0.00	0.188	OI	0.45
7.167	0.41	0.00	0.191	OI	0.46
7.250	0.41	0.00	0.194	OI	0.46
7.333	0.41	0.00	0.197	OI	0.47
7.417	0.41	0.00	0.200	OI	0.48
7.500	0.42	0.00	0.202	OI	0.48
7.583	0.42	0.00	0.205	OI	0.49
7.667	0.42	0.00	0.208	OI	0.50
7.750	0.42	0.00	0.211	OI	0.50
7.833	0.42	0.00	0.214	OI	0.51
7.917	0.43	0.00	0.217	OI	0.52
8.000	0.43	0.00	0.220	OI	0.52
8.083	0.43	0.00	0.223	OI	0.53
8.167	0.43	0.00	0.226	OI	0.54
8.250	0.44	0.00	0.229	OI	0.54
8.333	0.44	0.00	0.232	OI	0.55
8.417	0.44	0.00	0.235	OI	0.56
8.500	0.45	0.00	0.238	OI	0.56
8.583	0.45	0.00	0.241	OI	0.57
8.667	0.45	0.00	0.244	OI	0.58
8.750	0.45	0.00	0.247	OI	0.58
8.833	0.46	0.00	0.250	OI	0.59
8.917	0.46	0.00	0.253	OI	0.60
9.000	0.46	0.00	0.257	OI	0.61
9.083	0.47	0.00	0.260	OI	0.61
9.167	0.47	0.00	0.263	OI	0.62
9.250	0.47	0.00	0.266	OI	0.63
9.333	0.48	0.00	0.270	OI	0.64
9.417	0.48	0.00	0.273	OI	0.64
9.500	0.48	0.00	0.276	OI	0.65
9.583	0.49	0.00	0.279	OI	0.66
9.667	0.49	0.00	0.283	OI	0.67

9.750	0.49	0.00	0.286	OI	0.67
9.833	0.50	0.00	0.290	OI	0.68
9.917	0.50	0.00	0.293	OI	0.69
10.000	0.51	0.00	0.296	OI	0.70
10.083	0.51	0.00	0.300	OI	0.70
10.167	0.51	0.00	0.303	OI	0.71
10.250	0.52	0.00	0.307	OI	0.72
10.333	0.52	0.00	0.311	OI	0.73
10.417	0.53	0.00	0.314	OI	0.74
10.500	0.53	0.00	0.318	OI	0.75
10.583	0.53	0.00	0.321	OI	0.75
10.667	0.54	0.00	0.325	OI	0.76
10.750	0.54	0.00	0.329	OI	0.77
10.833	0.55	0.00	0.333	OI	0.78
10.917	0.55	0.00	0.336	OI	0.79
11.000	0.56	0.00	0.340	OI	0.80
11.083	0.56	0.00	0.344	OI	0.80
11.167	0.57	0.00	0.348	OI	0.81
11.250	0.57	0.00	0.352	OI	0.82
11.333	0.58	0.00	0.356	OI	0.83
11.417	0.59	0.00	0.360	OI	0.84
11.500	0.59	0.00	0.364	OI	0.85
11.583	0.60	0.00	0.368	OI	0.86
11.667	0.60	0.00	0.372	OI	0.87
11.750	0.61	0.00	0.376	OI	0.88
11.833	0.62	0.00	0.381	OI	0.89
11.917	0.62	0.00	0.385	OI	0.90
12.000	0.63	0.00	0.389	OI	0.91
12.083	0.64	0.00	0.394	OI	0.92
12.167	0.64	0.00	0.398	OI	0.93
12.250	0.65	0.00	0.402	OI	0.94
12.333	0.66	0.00	0.407	OI	0.95
12.417	0.67	0.00	0.411	OI	0.96
12.500	0.67	0.00	0.416	OI	0.97
12.583	0.68	0.00	0.421	OI	0.98
12.667	0.69	0.00	0.425	OI	0.99
12.750	0.70	0.00	0.430	OI	1.00
12.833	0.71	0.00	0.435	OI	1.01
12.917	0.72	0.00	0.440	OI	1.02
13.000	0.73	0.00	0.445	OI	1.03
13.083	0.74	0.00	0.450	OI	1.04
13.167	0.75	0.00	0.455	OI	1.05
13.250	0.76	0.00	0.460	OI	1.07
13.333	0.78	0.00	0.466	OI	1.08
13.417	0.79	0.00	0.471	OI	1.09
13.500	0.80	0.00	0.477	O I	1.10
13.583	0.82	0.00	0.482	O I	1.11
13.667	0.83	0.00	0.488	O I	1.13
13.750	0.85	0.00	0.494	O I	1.14
13.833	0.86	0.00	0.499	O I	1.15
13.917	0.88	0.00	0.505	O I	1.16
14.000	0.90	0.00	0.512	O I	1.18
14.083	0.92	0.00	0.518	O I	1.19
14.167	0.94	0.00	0.524	O I	1.20
14.250	0.96	0.00	0.531	O I	1.22
14.333	0.99	0.00	0.538	O I	1.23
14.417	1.01	0.00	0.544	O I	1.25
14.500	1.04	0.00	0.551	O I	1.26
14.583	1.07	0.00	0.559	O I	1.28
14.667	1.10	0.00	0.566	O I	1.30
14.750	1.13	0.00	0.574	O I	1.31
14.833	1.17	0.00	0.582	O I	1.33
14.917	1.21	0.00	0.590	O I	1.35

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15.000    1.25    0.00      0.598  O  I    |       |       |       |     1.37
15.083    1.30    0.00      0.607  O  I    |       |       |       |     1.39
15.167    1.36    0.00      0.616  O  I    |       |       |       |     1.41
15.250    1.42    0.00      0.626  O  I    |       |       |       |     1.43
15.333    1.49    0.00      0.636  O  I    |       |       |       |     1.45
15.417    1.56    0.00      0.646  O  I    |       |       |       |     1.47
15.500    1.59    0.00      0.657  O  I    |       |       |       |     1.49
15.583    1.56    0.16      0.668  O  I    |       |       |       |     1.52
15.667    1.59    0.34      0.677  O  I    |       |       |       |     1.53
15.750    1.70    0.51      0.685  |O  I   |       |       |       |     1.55
15.833    1.87    0.68      0.693  |O  I   |       |       |       |     1.57
15.917    2.16    0.86      0.702  | O  I  |       |       |       |     1.58
16.000    2.68    1.06      0.712  | O   I |       |       |       |     1.60
16.083    4.30    1.38      0.728  |  O    | I     |       |       |     1.64
16.167    8.05    2.01      0.758  |    O  |       |   I   |       |     1.70
16.250   12.76    3.11      0.813  |      O|       |       |       I     1.81
16.333    9.22    4.15      0.863  |       | O     |      I|       |     1.91
16.417    6.04    4.60      0.886  |       |  O   I|       |       |     1.95
16.500    4.61    4.70      0.890  |       |  O    |       |       |     1.96
16.583    3.80    4.63      0.887  |       |I O    |       |       |     1.95
16.667    3.27    4.49      0.880  |       I  O    |       |       |     1.94
16.750    2.83    4.30      0.871  |      I| O     |       |       |     1.92
16.833    2.44    4.08      0.860  |     I | O     |       |       |     1.90
16.917    2.20    3.85      0.849  |    I  |O      |       |       |     1.88
17.000    1.97    3.62      0.837  |   I   |O      |       |       |     1.85
17.083    1.78    3.39      0.826  |   I   O       |       |       |     1.83
17.167    1.62    3.17      0.815  |   I  O|       |       |       |     1.81
17.250    1.46    2.95      0.805  |  I   O|       |       |       |     1.79
17.333    1.33    2.75      0.795  |  I  O |       |       |       |     1.77
17.417    1.21    2.56      0.785  |  I  O |       |       |       |     1.75
17.500    1.17    2.38      0.777  | I  O  |       |       |       |     1.73
17.583    1.13    2.22      0.769  | I  O  |       |       |       |     1.72
17.667    1.06    2.07      0.761  | I  O  |       |       |       |     1.70
17.750    0.97    1.93      0.755  | I O   |       |       |       |     1.69
17.833    0.88    1.80      0.748  | I O   |       |       |       |     1.68
17.917    0.81    1.67      0.742  | I O   |       |       |       |     1.66
18.000    0.78    1.56      0.736  |I O    |       |       |       |     1.65
18.083    0.75    1.45      0.731  |I O    |       |       |       |     1.64
18.167    0.73    1.36      0.727  |I O    |       |       |       |     1.63
18.250    0.71    1.28      0.723  |I O    |       |       |       |     1.63
18.333    0.69    1.20      0.719  |I O    |       |       |       |     1.62
18.417    0.67    1.13      0.716  |IO     |       |       |       |     1.61
18.500    0.66    1.07      0.713  |IO     |       |       |       |     1.61
18.583    0.64    1.02      0.710  |IO     |       |       |       |     1.60
18.667    0.63    0.97      0.707  |IO     |       |       |       |     1.59
18.750    0.61    0.92      0.705  |IO     |       |       |       |     1.59
18.833    0.60    0.88      0.703  |IO     |       |       |       |     1.59
18.917    0.59    0.84      0.701  |IO     |       |       |       |     1.58
19.000    0.58    0.81      0.700  |IO     |       |       |       |     1.58
19.083    0.57    0.78      0.698  |O      |       |       |       |     1.58
19.167    0.56    0.75      0.697  |O      |       |       |       |     1.57
19.250    0.55    0.72      0.695  |O      |       |       |       |     1.57
19.333    0.54    0.70      0.694  |O      |       |       |       |     1.57
19.417    0.53    0.68      0.693  |O      |       |       |       |     1.57
19.500    0.52    0.66      0.692  |O      |       |       |       |     1.56
19.583    0.51    0.64      0.691  |O      |       |       |       |     1.56
19.667    0.50    0.62      0.690  |O      |       |       |       |     1.56
19.750    0.49    0.60      0.690  |O      |       |       |       |     1.56
19.833    0.49    0.59      0.689  |O      |       |       |       |     1.56
19.917    0.48    0.58      0.688  |O      |       |       |       |     1.56
20.000    0.47    0.56      0.688  |O      |       |       |       |     1.56
20.083    0.47    0.55      0.687  |O      |       |       |       |     1.55
20.167    0.46    0.54      0.686  |O      |       |       |       |     1.55
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20.250    0.45    0.53     0.686  |O       |       |       |       |     1.55
20.333    0.45    0.52     0.685  |O       |       |       |       |     1.55
20.417    0.44    0.51     0.685  |O       |       |       |       |     1.55
20.500    0.44    0.50     0.684  |O       |       |       |       |     1.55
20.583    0.43    0.49     0.684  |O       |       |       |       |     1.55
20.667    0.43    0.48     0.684  |O       |       |       |       |     1.55
20.750    0.42    0.48     0.683  |O       |       |       |       |     1.55
20.833    0.42    0.47     0.683  |O       |       |       |       |     1.55
20.917    0.41    0.46     0.683  |O       |       |       |       |     1.55
21.000    0.41    0.45     0.682  |O       |       |       |       |     1.54
21.083    0.40    0.45     0.682  |O       |       |       |       |     1.54
21.167    0.40    0.44     0.682  |O       |       |       |       |     1.54
21.250    0.40    0.44     0.681  IO       |       |       |       |     1.54
21.333    0.39    0.43     0.681  IO       |       |       |       |     1.54
21.417    0.39    0.43     0.681  IO       |       |       |       |     1.54
21.500    0.38    0.42     0.681  IO       |       |       |       |     1.54
21.583    0.38    0.42     0.680  IO       |       |       |       |     1.54
21.667    0.38    0.41     0.680  IO       |       |       |       |     1.54
21.750    0.37    0.41     0.680  IO       |       |       |       |     1.54
21.833    0.37    0.40     0.680  IO       |       |       |       |     1.54
21.917    0.37    0.40     0.679  O        |       |       |       |     1.54
22.000    0.36    0.39     0.679  O        |       |       |       |     1.54
22.083    0.36    0.39     0.679  O        |       |       |       |     1.54
22.167    0.36    0.38     0.679  O        |       |       |       |     1.54
22.250    0.35    0.38     0.679  O        |       |       |       |     1.54
22.333    0.35    0.38     0.678  O        |       |       |       |     1.54
22.417    0.35    0.37     0.678  O        |       |       |       |     1.54
22.500    0.35    0.37     0.678  O        |       |       |       |     1.54
22.583    0.34    0.37     0.678  O        |       |       |       |     1.54
22.667    0.34    0.36     0.678  O        |       |       |       |     1.54
22.750    0.34    0.36     0.678  O        |       |       |       |     1.54
22.833    0.33    0.36     0.677  O        |       |       |       |     1.53
22.917    0.33    0.35     0.677  O        |       |       |       |     1.53
23.000    0.33    0.35     0.677  O        |       |       |       |     1.53
23.083    0.33    0.35     0.677  O        |       |       |       |     1.53
23.167    0.32    0.34     0.677  O        |       |       |       |     1.53
23.250    0.32    0.34     0.677  O        |       |       |       |     1.53
23.333    0.32    0.34     0.677  O        |       |       |       |     1.53
23.417    0.32    0.34     0.676  O        |       |       |       |     1.53
23.500    0.32    0.33     0.676  O        |       |       |       |     1.53
23.583    0.31    0.33     0.676  O        |       |       |       |     1.53
23.667    0.31    0.33     0.676  O        |       |       |       |     1.53
23.750    0.31    0.33     0.676  O        |       |       |       |     1.53
23.833    0.31    0.32     0.676  O        |       |       |       |     1.53
23.917    0.30    0.32     0.676  O        |       |       |       |     1.53
24.000    0.30    0.32     0.676  O        |       |       |       |     1.53
24.083    0.29    0.32     0.675  O        |       |       |       |     1.53
24.167    0.26    0.31     0.675  O        |       |       |       |     1.53
24.250    0.17    0.30     0.675  O        |       |       |       |     1.53
24.333    0.12    0.28     0.674  O        |       |       |       |     1.53
24.417    0.09    0.25     0.672  O        |       |       |       |     1.52
24.500    0.07    0.23     0.671  O        |       |       |       |     1.52
24.583    0.05    0.21     0.670  O        |       |       |       |     1.52
24.667    0.04    0.19     0.669  O        |       |       |       |     1.52
24.750    0.03    0.17     0.668  O        |       |       |       |     1.52
24.833    0.03    0.15     0.667  O        |       |       |       |     1.51
24.917    0.02    0.13     0.666  O        |       |       |       |     1.51
25.000    0.02    0.12     0.666  O        |       |       |       |     1.51
25.083    0.01    0.10     0.665  O        |       |       |       |     1.51
25.167    0.01    0.09     0.664  O        |       |       |       |     1.51
25.250    0.01    0.08     0.664  O        |       |       |       |     1.51
25.333    0.01    0.07     0.663  O        |       |       |       |     1.51
25.417    0.00    0.06     0.663  O        |       |       |       |     1.51
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25.500	0.00	0.06	0.663	O	|	|	|	|	1.51
25.583	0.00	0.05	0.662	O	|	|	|	|	1.50
25.667	0.00	0.04	0.662	O	|	|	|	|	1.50
25.750	0.00	0.04	0.662	O	|	|	|	|	1.50
25.833	0.00	0.03	0.662	O	|	|	|	|	1.50
25.917	0.00	0.03	0.661	O	|	|	|	|	1.50
26.000	0.00	0.02	0.661	O	|	|	|	|	1.50
26.083	0.00	0.02	0.661	O	|	|	|	|	1.50
26.167	0.00	0.02	0.661	O	|	|	|	|	1.50
26.250	0.00	0.02	0.661	O	|	|	|	|	1.50
26.333	0.00	0.01	0.661	O	|	|	|	|	1.50
26.417	0.00	0.01	0.661	O	|	|	|	|	1.50
26.500	0.00	0.01	0.660	O	|	|	|	|	1.50
26.583	0.00	0.01	0.660	O	|	|	|	|	1.50
26.667	0.00	0.01	0.660	O	|	|	|	|	1.50
26.750	0.00	0.01	0.660	O	|	|	|	|	1.50
26.833	0.00	0.01	0.660	O	|	|	|	|	1.50
26.917	0.00	0.01	0.660	O	|	|	|	|	1.50
27.000	0.00	0.00	0.660	O	|	|	|	|	1.50
27.083	0.00	0.00	0.660	O	|	|	|	|	1.50
27.167	0.00	0.00	0.660	O	|	|	|	|	1.50
27.250	0.00	0.00	0.660	O	|	|	|	|	1.50
27.333	0.00	0.00	0.660	O	|	|	|	|	1.50
27.417	0.00	0.00	0.660	O	|	|	|	|	1.50
27.500	0.00	0.00	0.660	O	|	|	|	|	1.50
27.583	0.00	0.00	0.660	O	|	|	|	|	1.50
27.667	0.00	0.00	0.660	O	|	|	|	|	1.50
27.750	0.00	0.00	0.660	O	|	|	|	|	1.50
27.833	0.00	0.00	0.660	O	|	|	|	|	1.50
27.917	0.00	0.00	0.660	O	|	|	|	|	1.50

Remaining water in basin =   0.66 (Ac.Ft)

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***************************HYDROGRAPH DATA***************************
             Number of intervals =   335
             Time interval =    5.0 (Min.)
             Maximum/Peak flow rate =        4.699 (CFS)
             Total volume =       0.832 (Ac.Ft)
      Status of hydrographs being held in storage
                 Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
      Peak (CFS)      0.000     0.000     0.000     0.000     0.000
      Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
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FLOOD HYDROGRAPH ROUTING PROGRAM

Study date: 01/16/23

Space Center Expansion Project Phase 2 Flag
100 Year 24 Hour
Basin A
Please Refer to Appendix B Developed Condition Hydrology map

Program License Serial Number 6385

******************** HYDROGRAPH INFORMATION *********************

From study/file name: UHDEV100YRPHASE2FLAG.rte

**************************HYDROGRAPH DATA**************************

Number of intervals = 307
Time interval = 5.0 (Min.)
Maximum/Peak flow rate = 23.988 (CFS)
Total volume = 2.602 (Ac.Ft)

Status of hydrographs being held in storage

	Stream 1	Stream 2	Stream 3	Stream 4	Stream 5
Peak (CFS)	0.000	0.000	0.000	0.000	0.000
Vol (Ac.Ft)	0.000	0.000	0.000	0.000	0.000

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Process from Point/Station 100.000 to Point/Station 101.000

**** RETARDING BASIN ROUTING ****

User entry of depth-outflow-storage data

Total number of inflow hydrograph intervals = 307
Hydrograph time unit = 5.000 (Min.)
Initial depth in storage basin = 0.00(Ft.)

Initial basin depth = 0.00 (Ft.)
Initial basin storage = 0.00 (Ac.Ft)
Initial basin outflow = 0.00 (CFS)

Depth vs. Storage and Depth vs. Discharge data:

Basin Depth (Ft.)	Storage (Ac.Ft)	Outflow (CFS)	(S-O*dt/2) (Ac.Ft)	(S+O*dt/2) (Ac.Ft)
0.000	0.000	0.000	0.000	0.000
0.500	0.210	0.001	0.210	0.210
1.000	0.430	0.001	0.430	0.430
1.500	0.660	0.001	0.660	0.660
2.000	0.910	5.100	0.892	0.928
2.500	1.170	7.230	1.145	1.195
3.000	1.440	8.850	1.410	1.470

3.500	1.730	15.300	1.677	1.783
4.000	2.040	20.430	1.970	2.110

Hydrograph Detention Basin Routing

Graph values: 'I'= unit inflow; 'O'=outflow at time shown

Time (Hours)	Inflow (CFS)	Outflow (CFS)	Storage (Ac.Ft)	.0	6.0	11.99	17.99	23.99	Depth (Ft.)
0.083	0.01	0.00	0.000	O	|	|	|	|	0.00
0.167	0.09	0.00	0.000	O	|	|	|	|	0.00
0.250	0.24	0.00	0.002	O	|	|	|	|	0.00
0.333	0.33	0.00	0.004	O	|	|	|	|	0.01
0.417	0.38	0.00	0.006	O	|	|	|	|	0.01
0.500	0.41	0.00	0.009	O	|	|	|	|	0.02
0.583	0.43	0.00	0.012	O	|	|	|	|	0.03
0.667	0.45	0.00	0.015	O	|	|	|	|	0.03
0.750	0.47	0.00	0.018	O	|	|	|	|	0.04
0.833	0.48	0.00	0.021	O	|	|	|	|	0.05
0.917	0.49	0.00	0.024	O	|	|	|	|	0.06
1.000	0.50	0.00	0.028	O	|	|	|	|	0.07
1.083	0.50	0.00	0.031	O	|	|	|	|	0.07
1.167	0.51	0.00	0.035	O	|	|	|	|	0.08
1.250	0.51	0.00	0.038	O	|	|	|	|	0.09
1.333	0.52	0.00	0.042	O	|	|	|	|	0.10
1.417	0.52	0.00	0.045	O	|	|	|	|	0.11
1.500	0.53	0.00	0.049	O	|	|	|	|	0.12
1.583	0.53	0.00	0.053	O	|	|	|	|	0.13
1.667	0.53	0.00	0.056	O	|	|	|	|	0.13
1.750	0.53	0.00	0.060	O	|	|	|	|	0.14
1.833	0.54	0.00	0.064	O	|	|	|	|	0.15
1.917	0.54	0.00	0.067	O	|	|	|	|	0.16
2.000	0.54	0.00	0.071	O	|	|	|	|	0.17
2.083	0.54	0.00	0.075	O	|	|	|	|	0.18
2.167	0.54	0.00	0.079	O	|	|	|	|	0.19
2.250	0.55	0.00	0.082	O	|	|	|	|	0.20
2.333	0.55	0.00	0.086	O	|	|	|	|	0.20
2.417	0.55	0.00	0.090	O	|	|	|	|	0.21
2.500	0.55	0.00	0.094	O	|	|	|	|	0.22
2.583	0.55	0.00	0.097	O	|	|	|	|	0.23
2.667	0.56	0.00	0.101	O	|	|	|	|	0.24
2.750	0.56	0.00	0.105	O	|	|	|	|	0.25
2.833	0.56	0.00	0.109	O	|	|	|	|	0.26
2.917	0.56	0.00	0.113	O	|	|	|	|	0.27
3.000	0.56	0.00	0.117	O	|	|	|	|	0.28
3.083	0.57	0.00	0.121	O	|	|	|	|	0.29
3.167	0.57	0.00	0.124	O	|	|	|	|	0.30
3.250	0.57	0.00	0.128	O	|	|	|	|	0.31
3.333	0.57	0.00	0.132	O	|	|	|	|	0.32
3.417	0.58	0.00	0.136	O	|	|	|	|	0.32
3.500	0.58	0.00	0.140	O	|	|	|	|	0.33
3.583	0.58	0.00	0.144	O	|	|	|	|	0.34
3.667	0.58	0.00	0.148	O	|	|	|	|	0.35
3.750	0.58	0.00	0.152	O	|	|	|	|	0.36
3.833	0.59	0.00	0.156	O	|	|	|	|	0.37
3.917	0.59	0.00	0.160	O	|	|	|	|	0.38
4.000	0.59	0.00	0.164	O	|	|	|	|	0.39
4.083	0.59	0.00	0.168	O	|	|	|	|	0.40
4.167	0.60	0.00	0.173	O	|	|	|	|	0.41
4.250	0.60	0.00	0.177	O	|	|	|	|	0.42
4.333	0.60	0.00	0.181	O	|	|	|	|	0.43
4.417	0.60	0.00	0.185	O	|	|	|	|	0.44

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4.500    0.61    0.00      0.189  O        |        |        |        |      0.45
4.583    0.61    0.00      0.193  O        |        |        |        |      0.46
4.667    0.61    0.00      0.197  O        |        |        |        |      0.47
4.750    0.61    0.00      0.202  O        |        |        |        |      0.48
4.833    0.62    0.00      0.206  O        |        |        |        |      0.49
4.917    0.62    0.00      0.210  O        |        |        |        |      0.50
5.000    0.62    0.00      0.214  O        |        |        |        |      0.51
5.083    0.62    0.00      0.219  O        |        |        |        |      0.52
5.167    0.63    0.00      0.223  O        |        |        |        |      0.53
5.250    0.63    0.00      0.227  O        |        |        |        |      0.54
5.333    0.63    0.00      0.232  O        |        |        |        |      0.55
5.417    0.64    0.00      0.236  O        |        |        |        |      0.56
5.500    0.64    0.00      0.240  O        |        |        |        |      0.57
5.583    0.64    0.00      0.245  O        |        |        |        |      0.58
5.667    0.64    0.00      0.249  O        |        |        |        |      0.59
5.750    0.65    0.00      0.254  O        |        |        |        |      0.60
5.833    0.65    0.00      0.258  O        |        |        |        |      0.61
5.917    0.65    0.00      0.263  O        |        |        |        |      0.62
6.000    0.66    0.00      0.267  O        |        |        |        |      0.63
6.083    0.66    0.00      0.272  O        |        |        |        |      0.64
6.167    0.66    0.00      0.276  O        |        |        |        |      0.65
6.250    0.67    0.00      0.281  O        |        |        |        |      0.66
6.333    0.67    0.00      0.285  O        |        |        |        |      0.67
6.417    0.67    0.00      0.290  O        |        |        |        |      0.68
6.500    0.68    0.00      0.295  O        |        |        |        |      0.69
6.583    0.68    0.00      0.299  O        |        |        |        |      0.70
6.667    0.68    0.00      0.304  O        |        |        |        |      0.71
6.750    0.69    0.00      0.309  O        |        |        |        |      0.72
6.833    0.69    0.00      0.313  O        |        |        |        |      0.74
6.917    0.69    0.00      0.318  O        |        |        |        |      0.75
7.000    0.70    0.00      0.323  O        |        |        |        |      0.76
7.083    0.70    0.00      0.328  O        |        |        |        |      0.77
7.167    0.71    0.00      0.333  O        |        |        |        |      0.78
7.250    0.71    0.00      0.337  O        |        |        |        |      0.79
7.333    0.71    0.00      0.342  O        |        |        |        |      0.80
7.417    0.72    0.00      0.347  O        |        |        |        |      0.81
7.500    0.72    0.00      0.352  O        |        |        |        |      0.82
7.583    0.73    0.00      0.357  O        |        |        |        |      0.83
7.667    0.73    0.00      0.362  O        |        |        |        |      0.85
7.750    0.73    0.00      0.367  O        |        |        |        |      0.86
7.833    0.74    0.00      0.372  O        |        |        |        |      0.87
7.917    0.74    0.00      0.377  O        |        |        |        |      0.88
8.000    0.75    0.00      0.383  O        |        |        |        |      0.89
8.083    0.75    0.00      0.388  OI       |        |        |        |      0.90
8.167    0.76    0.00      0.393  OI       |        |        |        |      0.92
8.250    0.76    0.00      0.398  OI       |        |        |        |      0.93
8.333    0.77    0.00      0.403  OI       |        |        |        |      0.94
8.417    0.77    0.00      0.409  OI       |        |        |        |      0.95
8.500    0.78    0.00      0.414  OI       |        |        |        |      0.96
8.583    0.78    0.00      0.419  OI       |        |        |        |      0.98
8.667    0.79    0.00      0.425  OI       |        |        |        |      0.99
8.750    0.79    0.00      0.430  OI       |        |        |        |      1.00
8.833    0.80    0.00      0.436  OI       |        |        |        |      1.01
8.917    0.80    0.00      0.441  OI       |        |        |        |      1.02
9.000    0.81    0.00      0.447  OI       |        |        |        |      1.04
9.083    0.81    0.00      0.452  OI       |        |        |        |      1.05
9.167    0.82    0.00      0.458  OI       |        |        |        |      1.06
9.250    0.82    0.00      0.463  OI       |        |        |        |      1.07
9.333    0.83    0.00      0.469  OI       |        |        |        |      1.08
9.417    0.84    0.00      0.475  OI       |        |        |        |      1.10
9.500    0.84    0.00      0.481  OI       |        |        |        |      1.11
9.583    0.85    0.00      0.486  OI       |        |        |        |      1.12
9.667    0.85    0.00      0.492  OI       |        |        |        |      1.14
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 9.750    0.86    0.00      0.498  OI       |        |        |        |      1.15
 9.833    0.87    0.00      0.504  OI       |        |        |        |      1.16
 9.917    0.87    0.00      0.510  OI       |        |        |        |      1.17
10.000    0.88    0.00      0.516  OI       |        |        |        |      1.19
10.083    0.89    0.00      0.522  OI       |        |        |        |      1.20
10.167    0.89    0.00      0.528  OI       |        |        |        |      1.21
10.250    0.90    0.00      0.534  OI       |        |        |        |      1.23
10.333    0.91    0.00      0.541  OI       |        |        |        |      1.24
10.417    0.92    0.00      0.547  OI       |        |        |        |      1.25
10.500    0.92    0.00      0.553  OI       |        |        |        |      1.27
10.583    0.93    0.00      0.560  OI       |        |        |        |      1.28
10.667    0.94    0.00      0.566  OI       |        |        |        |      1.30
10.750    0.95    0.00      0.573  OI       |        |        |        |      1.31
10.833    0.96    0.00      0.579  OI       |        |        |        |      1.32
10.917    0.97    0.00      0.586  OI       |        |        |        |      1.34
11.000    0.98    0.00      0.592  OI       |        |        |        |      1.35
11.083    0.98    0.00      0.599  OI       |        |        |        |      1.37
11.167    0.99    0.00      0.606  OI       |        |        |        |      1.38
11.250    1.00    0.00      0.613  OI       |        |        |        |      1.40
11.333    1.01    0.00      0.620  OI       |        |        |        |      1.41
11.417    1.02    0.00      0.627  OI       |        |        |        |      1.43
11.500    1.03    0.00      0.634  OI       |        |        |        |      1.44
11.583    1.05    0.00      0.641  OI       |        |        |        |      1.46
11.667    1.06    0.00      0.648  OI       |        |        |        |      1.47
11.750    1.07    0.00      0.656  OI       |        |        |        |      1.49
11.833    1.08    0.06      0.663  OI       |        |        |        |      1.51
11.917    1.09    0.19      0.669  OI       |        |        |        |      1.52
12.000    1.10    0.31      0.675  OI       |        |        |        |      1.53
12.083    1.11    0.42      0.680  OI       |        |        |        |      1.54
12.167    1.11    0.51      0.685  OI       |        |        |        |      1.55
12.250    1.09    0.59      0.689  OI       |        |        |        |      1.56
12.333    1.09    0.65      0.692  OI       |        |        |        |      1.56
12.417    1.09    0.71      0.695  OI       |        |        |        |      1.57
12.500    1.10    0.76      0.697   |O      |        |        |        |      1.57
12.583    1.11    0.81      0.699   |O      |        |        |        |      1.58
12.667    1.12    0.85      0.701   |O      |        |        |        |      1.58
12.750    1.14    0.88      0.703   |O      |        |        |        |      1.59
12.833    1.15    0.92      0.705   |O      |        |        |        |      1.59
12.917    1.17    0.95      0.706   |O      |        |        |        |      1.59
13.000    1.18    0.98      0.708   |O      |        |        |        |      1.60
13.083    1.20    1.01      0.709   |O      |        |        |        |      1.60
13.167    1.22    1.03      0.711   |O      |        |        |        |      1.60
13.250    1.24    1.06      0.712   |O      |        |        |        |      1.60
13.333    1.26    1.08      0.713   |O      |        |        |        |      1.61
13.417    1.28    1.11      0.714   |O      |        |        |        |      1.61
13.500    1.31    1.13      0.716   |O      |        |        |        |      1.61
13.583    1.33    1.16      0.717   |O      |        |        |        |      1.61
13.667    1.36    1.18      0.718   |O      |        |        |        |      1.62
13.750    1.39    1.21      0.719   |O      |        |        |        |      1.62
13.833    1.41    1.23      0.720   |O      |        |        |        |      1.62
13.917    1.45    1.26      0.722   |O      |        |        |        |      1.62
14.000    1.48    1.29      0.723   |O      |        |        |        |      1.63
14.083    1.51    1.31      0.724   |OI     |        |        |        |      1.63
14.167    1.55    1.34      0.726   |OI     |        |        |        |      1.63
14.250    1.59    1.37      0.727   |OI     |        |        |        |      1.63
14.333    1.63    1.40      0.729   |OI     |        |        |        |      1.64
14.417    1.68    1.44      0.730   |OI     |        |        |        |      1.64
14.500    1.72    1.47      0.732   |OI     |        |        |        |      1.64
14.583    1.78    1.51      0.734   | O     |        |        |        |      1.65
14.667    1.83    1.55      0.736   | O     |        |        |        |      1.65
14.750    1.89    1.59      0.738   | O     |        |        |        |      1.66
14.833    1.96    1.63      0.740   | O     |        |        |        |      1.66
14.917    2.03    1.68      0.742   | O     |        |        |        |      1.66
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15.000    2.11    1.73      0.745  | O     |       |       |       |     1.67
15.083    2.20    1.79      0.748  | O     |       |       |       |     1.68
15.167    2.30    1.85      0.751  | OI    |       |       |       |     1.68
15.250    2.42    1.92      0.754  | OI    |       |       |       |     1.69
15.333    2.54    1.99      0.757  | OI    |       |       |       |     1.69
15.417    2.68    2.07      0.762  | OI    |       |       |       |     1.70
15.500    2.76    2.16      0.766  | OI    |       |       |       |     1.71
15.583    2.80    2.24      0.770  | OI    |       |       |       |     1.72
15.667    2.94    2.32      0.774  |  O    |       |       |       |     1.73
15.750    3.20    2.42      0.779  |  OI   |       |       |       |     1.74
15.833    3.57    2.55      0.785  |  OI   |       |       |       |     1.75
15.917    4.21    2.72      0.793  |  O I  |       |       |       |     1.77
16.000    5.34    2.99      0.807  |  O   I|       |       |       |     1.79
16.083    8.62    3.52      0.832  |   O   |  I    |       |       |     1.84
16.167   16.52    4.70      0.891  |     O |       |     I |       |     1.96
16.250   23.99    5.79      0.994  |      O|       |       |       I     2.16
16.333   15.91    6.56      1.089  |       O       |    I  |       |     2.34
16.417   10.65    6.93      1.134  |       |O    I |       |       |     2.43
16.500    8.13    7.07      1.150  |       |OI     |       |       |     2.46
16.583    6.64    7.08      1.152  |       IO      |       |       |     2.47
16.667    5.66    7.03      1.146  |      I|O      |       |       |     2.45
16.750    4.76    6.93      1.134  |     I |O      |       |       |     2.43
16.833    4.17    6.80      1.117  |    I  |O      |       |       |     2.40
16.917    3.69    6.64      1.098  |   I   O       |       |       |     2.36
17.000    3.28    6.47      1.077  |   I   O       |       |       |     2.32
17.083    2.93    6.28      1.054  |  I    O       |       |       |     2.28
17.167    2.61    6.09      1.031  |  I    O       |       |       |     2.23
17.250    2.34    5.89      1.007  |  I   O|       |       |       |     2.19
17.333    2.13    5.69      0.982  | I    O|       |       |       |     2.14
17.417    2.05    5.49      0.958  | I    O|       |       |       |     2.09
17.500    1.94    5.30      0.935  | I    O|       |       |       |     2.05
17.583    1.76    5.11      0.911  | I   O |       |       |       |     2.00
17.667    1.57    4.68      0.889  | I   O |       |       |       |     1.96
17.750    1.40    4.26      0.869  |I   O  |       |       |       |     1.92
17.833    1.34    3.88      0.850  |I   O  |       |       |       |     1.88
17.917    1.29    3.54      0.834  |I  O   |       |       |       |     1.85
18.000    1.24    3.24      0.819  |I  O   |       |       |       |     1.82
18.083    1.20    2.98      0.806  |I O    |       |       |       |     1.79
18.167    1.18    2.74      0.794  |I O    |       |       |       |     1.77
18.250    1.17    2.54      0.784  |I O    |       |       |       |     1.75
18.333    1.16    2.36      0.776  |I O    |       |       |       |     1.73
18.417    1.14    2.20      0.768  |IO     |       |       |       |     1.72
18.500    1.12    2.06      0.761  |IO     |       |       |       |     1.70
18.583    1.09    1.93      0.755  |IO     |       |       |       |     1.69
18.667    1.07    1.82      0.749  |IO     |       |       |       |     1.68
18.750    1.05    1.72      0.744  |IO     |       |       |       |     1.67
18.833    1.03    1.63      0.740  |IO     |       |       |       |     1.66
18.917    1.01    1.55      0.736  |IO     |       |       |       |     1.65
19.000    0.99    1.48      0.733  |O      |       |       |       |     1.65
19.083    0.97    1.41      0.729  |O      |       |       |       |     1.64
19.167    0.96    1.36      0.726  |O      |       |       |       |     1.63
19.250    0.94    1.30      0.724  |O      |       |       |       |     1.63
19.333    0.93    1.25      0.721  |O      |       |       |       |     1.62
19.417    0.91    1.21      0.719  |O      |       |       |       |     1.62
19.500    0.90    1.17      0.717  |O      |       |       |       |     1.61
19.583    0.88    1.13      0.715  |O      |       |       |       |     1.61
19.667    0.87    1.10      0.714  |O      |       |       |       |     1.61
19.750    0.85    1.07      0.712  |O      |       |       |       |     1.60
19.833    0.84    1.04      0.711  |O      |       |       |       |     1.60
19.917    0.83    1.01      0.710  |O      |       |       |       |     1.60
20.000    0.82    0.99      0.708  |O      |       |       |       |     1.60
20.083    0.81    0.96      0.707  |O      |       |       |       |     1.59
20.167    0.80    0.94      0.706  |O      |       |       |       |     1.59
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20.250    0.79    0.92    0.705  |O       |       |       |       |      1.59
20.333    0.78    0.90    0.704  |O       |       |       |       |      1.59
20.417    0.77    0.89    0.703  |O       |       |       |       |      1.59
20.500    0.76    0.87    0.703  |O       |       |       |       |      1.59
20.583    0.75    0.86    0.702  IO       |       |       |       |      1.58
20.667    0.74    0.84    0.701  IO       |       |       |       |      1.58
20.750    0.73    0.83    0.700  IO       |       |       |       |      1.58
20.833    0.72    0.81    0.700  IO       |       |       |       |      1.58
20.917    0.71    0.80    0.699  IO       |       |       |       |      1.58
21.000    0.71    0.79    0.699  IO       |       |       |       |      1.58
21.083    0.70    0.78    0.698  IO       |       |       |       |      1.58
21.167    0.69    0.77    0.698  IO       |       |       |       |      1.58
21.250    0.68    0.76    0.697  IO       |       |       |       |      1.57
21.333    0.68    0.75    0.697  O        |       |       |       |      1.57
21.417    0.67    0.74    0.696  O        |       |       |       |      1.57
21.500    0.66    0.73    0.696  O        |       |       |       |      1.57
21.583    0.66    0.72    0.695  O        |       |       |       |      1.57
21.667    0.65    0.71    0.695  O        |       |       |       |      1.57
21.750    0.64    0.70    0.694  O        |       |       |       |      1.57
21.833    0.64    0.69    0.694  O        |       |       |       |      1.57
21.917    0.63    0.69    0.694  O        |       |       |       |      1.57
22.000    0.63    0.68    0.693  O        |       |       |       |      1.57
22.083    0.62    0.67    0.693  O        |       |       |       |      1.57
22.167    0.62    0.67    0.693  O        |       |       |       |      1.57
22.250    0.61    0.66    0.692  O        |       |       |       |      1.56
22.333    0.61    0.65    0.692  O        |       |       |       |      1.56
22.417    0.60    0.65    0.692  O        |       |       |       |      1.56
22.500    0.60    0.64    0.691  O        |       |       |       |      1.56
22.583    0.59    0.63    0.691  O        |       |       |       |      1.56
22.667    0.59    0.63    0.691  O        |       |       |       |      1.56
22.750    0.58    0.62    0.690  O        |       |       |       |      1.56
22.833    0.58    0.62    0.690  O        |       |       |       |      1.56
22.917    0.57    0.61    0.690  O        |       |       |       |      1.56
23.000    0.57    0.61    0.690  O        |       |       |       |      1.56
23.083    0.56    0.60    0.689  O        |       |       |       |      1.56
23.167    0.56    0.60    0.689  O        |       |       |       |      1.56
23.250    0.56    0.59    0.689  O        |       |       |       |      1.56
23.333    0.55    0.59    0.689  O        |       |       |       |      1.56
23.417    0.55    0.58    0.688  O        |       |       |       |      1.56
23.500    0.54    0.58    0.688  O        |       |       |       |      1.56
23.583    0.54    0.57    0.688  O        |       |       |       |      1.56
23.667    0.54    0.57    0.688  O        |       |       |       |      1.56
23.750    0.53    0.56    0.688  O        |       |       |       |      1.56
23.833    0.53    0.56    0.687  O        |       |       |       |      1.55
23.917    0.53    0.55    0.687  O        |       |       |       |      1.55
24.000    0.52    0.55    0.687  O        |       |       |       |      1.55
24.083    0.51    0.55    0.687  O        |       |       |       |      1.55
24.167    0.43    0.54    0.686  O        |       |       |       |      1.55
24.250    0.27    0.51    0.685  O        |       |       |       |      1.55
24.333    0.18    0.47    0.683  O        |       |       |       |      1.55
24.417    0.13    0.43    0.681  O        |       |       |       |      1.54
24.500    0.10    0.39    0.679  O        |       |       |       |      1.54
24.583    0.08    0.35    0.677  O        |       |       |       |      1.53
24.667    0.06    0.31    0.675  O        |       |       |       |      1.53
24.750    0.05    0.28    0.674  O        |       |       |       |      1.53
24.833    0.04    0.25    0.672  O        |       |       |       |      1.52
24.917    0.03    0.22    0.671  O        |       |       |       |      1.52
25.000    0.02    0.20    0.670  O        |       |       |       |      1.52
25.083    0.02    0.17    0.668  O        |       |       |       |      1.52
25.167    0.01    0.15    0.667  O        |       |       |       |      1.51
25.250    0.01    0.13    0.666  O        |       |       |       |      1.51
25.333    0.01    0.12    0.666  O        |       |       |       |      1.51
25.417    0.01    0.10    0.665  O        |       |       |       |      1.51
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25.500    0.00    0.09      0.664  O        |        |        |        |      1.51
25.583    0.00    0.08      0.664  O        |        |        |        |      1.51
25.667    0.00    0.07      0.663  O        |        |        |        |      1.51
25.750    0.00    0.06      0.663  O        |        |        |        |      1.51
25.833    0.00    0.05      0.662  O        |        |        |        |      1.50
25.917    0.00    0.04      0.662  O        |        |        |        |      1.50
26.000    0.00    0.04      0.662  O        |        |        |        |      1.50
26.083    0.00    0.03      0.662  O        |        |        |        |      1.50
26.167    0.00    0.03      0.661  O        |        |        |        |      1.50
26.250    0.00    0.03      0.661  O        |        |        |        |      1.50
26.333    0.00    0.02      0.661  O        |        |        |        |      1.50
26.417    0.00    0.02      0.661  O        |        |        |        |      1.50
26.500    0.00    0.02      0.661  O        |        |        |        |      1.50
26.583    0.00    0.01      0.661  O        |        |        |        |      1.50
26.667    0.00    0.01      0.661  O        |        |        |        |      1.50
26.750    0.00    0.01      0.660  O        |        |        |        |      1.50
26.833    0.00    0.01      0.660  O        |        |        |        |      1.50
26.917    0.00    0.01      0.660  O        |        |        |        |      1.50
27.000    0.00    0.01      0.660  O        |        |        |        |      1.50
27.083    0.00    0.01      0.660  O        |        |        |        |      1.50
27.167    0.00    0.01      0.660  O        |        |        |        |      1.50
27.250    0.00    0.00      0.660  O        |        |        |        |      1.50
27.333    0.00    0.00      0.660  O        |        |        |        |      1.50
27.417    0.00    0.00      0.660  O        |        |        |        |      1.50
27.500    0.00    0.00      0.660  O        |        |        |        |      1.50
27.583    0.00    0.00      0.660  O        |        |        |        |      1.50
27.667    0.00    0.00      0.660  O        |        |        |        |      1.50
27.750    0.00    0.00      0.660  O        |        |        |        |      1.50
27.833    0.00    0.00      0.660  O        |        |        |        |      1.50
27.917    0.00    0.00      0.660  O        |        |        |        |      1.50
28.000    0.00    0.00      0.660  O        |        |        |        |      1.50
28.083    0.00    0.00      0.660  O        |        |        |        |      1.50
28.167    0.00    0.00      0.660  O        |        |        |        |      1.50


      Remaining water in basin =    0.66 (Ac.Ft)


      ****************************HYDROGRAPH DATA****************************
                   Number of intervals =   338
                   Time interval =    5.0 (Min.)
                   Maximum/Peak flow rate =        7.085 (CFS)
                   Total volume =       1.942 (Ac.Ft)
             Status of hydrographs being held in storage
                        Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
             Peak (CFS)      0.000     0.000     0.000     0.000     0.000
             Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
      ***********************************************************************

      --------------------------------------------------------------------
```

APPENDIX F

Space Center Expansion Flag Lot

APN 3090-571-17
City of Victorville

OPERATION
AND MAINTENANCE MANUAL

Table of Contents

1. Discussion

The long-term operation and maintenance of storm water management systems on the Space Center property is critical to BMP performance as its design and construction. Proper operation and maintenance practices are outlined in this plan and will ensure that the BMPs will continue to remove and reduce sources of pollutants effectively over the long-term, and therefore, improve water quality. Without proper maintenance, BMPs are likely to fail and no longer provide the necessary Storm water treatment. Common maintenance issues that are encountered include:

- Maintenance that occurs too infrequently
- Owners not understanding the long-term financial burden for the maintenance of a storm water system
- Lack of the knowledge on the maintenance needs of the system and
- Conflicts between municipalities and landowners on who is responsible for maintenance of a storm water system.

To address these issues the following sections have been developed for the project owner

Maintenance Frequency
Maintenance frequency is outlined in Form 5-1. This form clearly identifies required inspection activities, the maintenance schedule, and directs provider to use a log sheet to document inspections and maintenance activities. There is the potential that a City or Regional Board inspector could visit this site and request owner to provide Maintenance records.

BMP Fact Sheets
BMP Fact sheets are provided to supplement BMP maintenance background and provide general knowledge on BMPs.

Maintenance Agreement
The maintenance agreement clearly identifies the project owner as the entity responsible for BMP maintenance and associated costs.

Reference Material
Reference material covers proprietary information for BMPs and recommended maintenance activities.

Inspection and Maintenance Log
The inspection and maintenance log provide a form to document inspections and maintenance. This form is a sample form and other forms can be used as long as they provide the minimum information outlined in this sample log.

WQMP Exhibit
The WQMP exhibit illustrates the spatial distribution of BMPS throughout the site and can be cross-referenced with Form 5-1 to identify where maintenance activities are expected to occur onsite.

2.Inspection and Maintenance Responsibility Form 5-1

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**	Regular inspections of system to observe sediment build up and infiltration capacity. Cleaning of accumulated trash, debris and seediment as determined by inspections. Cleaning is recommended during dry weather. See manufacturer recommendations for additional maintenance activities	Monthly and within 48 hours follwing a significant storm event to verify there is no standing water
Catch Basin /w Filter Insert	**Owner**	Inspect for illegal dumping and /or debris accumulation. Clean filters whenever 25% of filter capacity is exceeded by debris accumulation	At least 2 times a year and after any Storm Event
Landscape Maintenance	**Owner**	Maintain landscape area vegetation, slope protection and grades, adjacent to hardscape and prevent discharges of landscape maintenance waste into storm drains	Weekly
Roadways & Parking Area	**Owner**	Clean and remove accumulated sand and debris in parking lots and along roadway. Sweep pavement in lieu of using house or water spray. Ensure stormwater runoff is not impeded by deposit of debris and accumulated sediment by ground maintenance staff.	Inspect after wind storm or minimum monthly
Litter Control	**Owner**	Site to be inspected and all litter be collected and disposed of in trash containers. Inspection and maintenance to be performed by HOA	Weekly
Signage and Stencil	**Owner**	Clean the stencil/signage surface to remove any excess dirt Re-paint if necessary.	Annually

3. Inspection and Maintenance Log

Detention/Infiltration Basin Inspections and Maintenance Checklist

Site Name: ______________________ Owner Change since last inspection? Y ☐ N ☐

Location: ______________________

Owner Name: ______________________

Address: ______________________ Phone Number ______________________

Site Status: ______________________

Date: __________ Time: __________ Site conditions: ______________________

Inspection Frequency Key: A=annual; M=monthly; S=after major storms. ***BOLD*** *= recommended frequency.*

Inspection Items	**Inspection Frequency**	**Inspected? (Yes/No)**	**Maintenance Needed? (Yes/No)**	**Comments/Description**
Embankment and Emergency Spillway				
Vegetation healthy?	**A /** M **/ S**			
Erosion on embankment?	**A /** M **/ S**			
Animal burrows in embankment?	**A /** M **/ S**			
Cracking, sliding, bulging of dam?	**A /** M **/ S**			
Drains blocked or not functioning?	**A /** M **/ S**			
Leaks or seeps on embankment?	**A /** M **/ S**			
Emergency spillway obstructed?	**A /** M **/ S**			
Slope protection failure functional?	**A /** M **/ S**			
Erosion in/around emergency spillway?	**A /** M **/ S**			
Other (describe)	**A /** M **/ S**			
Riser and Principal Spillway				
Low-flow orifice functional?	**A /** M **/ S**			
Trash rack (Debris removal needed? Corrosion noted?)	**A /** M **/ S**			
Sediment buildup in riser?	**A /** M **/** S			
Concrete/masonry condition (Cracks or displacement? Spalling?)	**A /** M **/** S			
Metal pipe in good condition?	**A /** M **/** S			
Control valve operation?	**A /** M **/** S			
Pond drain valve operation?	**A /** M **/** S			
Outfall channels function, not eroding?	**A /** M **/** S			
Other (describe)	**A /** M **/** S			
Sediment Forebays				
Sedimentation description				
Sediment cleanout needed (over 50% full)?	**A /** M **/ S**			

Inspection Items	**Inspection Frequency**	**Inspected? (Yes/No)**	**Maintenance Needed? (Yes/No)**	**Comments/Description**
Permanent Pool Areas (if applicable)				
Undesirable vegetation growth?	A / **M** / S			
Visible pollution?	A / **M** / S			
Shoreline erosion?	A / **M** / S			
Erosion at outfalls into pond?	A / **M** / S			
Headwalls and endwalls in good condition?	A / **M** / S			
Encroachment into pond or easement area by other activities?	A / **M** / S			
Evidence of sediment accumulation?	**A** / M / S			
Dry Pond Areas (if applicable)				
Vegetation adequate?	A / **M** / S			
Undesirable vegetation or woody plant growth?	A / **M** / S			
Excessive sedimentation?	**A** / M / S			
Hazards				
Have there been complaints from residents?	A / **M** / S			
Public hazards noted?	A / **M** / S			

Inspector Comments: ____

____

____

____

Overall Condition of Facility: ☐: Acceptable ☐ Unacceptable

If any of the above Inspection items are checked "Yes" for "Maintenance Needed", list Maintenance actions and their completion dates below:

Maintenance Action Needed	**Due Date**

The next routine inspection is scheduled for approximately: ____________________________

Inspected by: (signature) ____

Inspected by: (printed) ____

Proprietary BMP
Inspections and Maintenance Checklist

Site Name: ______________________ Owner Change since last inspection? Y ☐ N ☐

Location: ______________________

Owner Name: ______________________

Address: ______________________ Phone Number ______________________

Site Status: ______________________

Date: __________ Time: __________ Site conditions: ______________________

Inspection Frequency Key: A=annual; M=monthly; S=after major storms. ***BOLD*** *= recommended frequency*

Inspection Items	**Inspection Frequency**	**Inspected? (Yes/No)**	**Maintenance Needed? (Yes/No)**	**Comments/Description**
Debris Removal				
Adjacent area free of debris?	A / **M** / S			
Inlets and Outlets free of debris?	A / **M** / S			
Facility (internally) free of debris?	A / **M** / S			
Vegetation				
Surroundng area fully stabilized? (no evidence of material eroding into sand filter)	**A** / M / S			
Grass mowed?	A / **M** / S			
Water Retention (where required)				
Water holding chambers at normal pool?	A / **M** / S			
Evidence of erosion?	A / **M** / S			
Sediment Deposition				
Filtration chamber free of sediments?	**A** / M / S			
Sedimentation chamber not more than 50% full?	**A** / M / S			
Structural Components				
Any evidence of structural deterioration?	**A** / M / S			
Grates in good condition?	**A** / M / S			
Spalling or cracking of structural parts?	**A** / M / S			
Outlet/Overflow Spillway	**A** / M / S			
Other				
Noticeable odors?	**A** / M / S			
Any evidence of filter(s) clogging?	A / **M** / S			
Evidence of flow bypassing facility?	**A** / M / S			

Inspector Comments: ____

____

____

____

Overall Condition of Facility: ☐: Acceptable ☐ Unacceptable

If any of the above Inspection items are checked "Yes" for "Maintenance Needed", list Maintenance actions and their completion dates below:

Maintenance Action Needed	Due Date

The next routine inspection is scheduled for approximately: ___________________________

Inspected by: (signature) ____

Inspected by: (printed) ____

4. Maintenance Agreement

RECORDING REQUESTED BY:
County of San Bernardino
Department of Public Works

AND WHEN RECORDED MAIL TO:
County of San Bernardino
Department of Public Works
825 E. Third Street, Room 117
San Bernardino, CA 92415-0835

SPACE ABOVE THIS LINE FOR RECORDER'S USE

COVENANT AND AGREEMENT REGARDING WATER QUALITY MANAGEMENT PLAN AND STORMWATER BEST MANAGEMENT PRACTICES TRANSFER, ACCESS AND MAINTENANCE

THIS PAGE ADDED TO PROVIDE ADEQUATE SPACE FOR RECORDING INFORMATION

Covenant and Agreement Regarding Water Quality Management Plan and Stormwater Best Management Practices Transfer, Access and Maintenance

OWNER NAME: ____

PROPERTY ADDRESS: ____

____

APN: ____

THIS AGREEMENT is made and entered into in

_______________________________________ ,California, this _________ day of

_______________________________________ , by and between

____ , hereinafter

referred to as Owner, and the COUNTY OF SAN BERNARDINO, a political subdivision of the State of California, hereinafter referred to as “the County”;

WHEREAS, the Owner owns real property (“Property”) in the County of San Bernardino, State of California, more specifically described in Exhibit “A” and depicted in Exhibit “B”, each of which exhibits is attached hereto and incorporated herein by this reference; and

WHEREAS, at the time of initial approval of development project known as

____ within the Property described herein, the County required the project to employ Best Management Practices, hereinafter referred to as “BMPs,” to minimize pollutants in urban runoff; and

WHEREAS, the Owner has chosen to install and/or implement BMPs as described in the Water Quality Management Plan, dated ______________________, on file with the County and incorporated herein by this reference, hereinafter referred to as “WQMP”, to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff; and

WHEREAS, said WQMP has been certified by the Owner and reviewed and approved by the County; and

WHEREAS, the Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs.

NOW THEREFORE, it is mutually stipulated and agreed as follows:

1. Owner shall comply with the WQMP.

2. All maintenance or replacement of BMPs proposed as part of the WQMP are the sole responsibility of the Owner in accordance with the terms of this Agreement.

3. Owner hereby provides the County's designee complete access, of any duration, to the BMPs and their immediate vicinity at any time, upon reasonable notice, or in the event of emergency, as determined by the County Director of Public Works, no advance notice, for the purpose of inspection, sampling, testing of the BMPs, and in case of emergency, to undertake all necessary repairs or other preventative measures at owner's expense as provided in paragraph 5 below. The County shall make every effort at all times to minimize or avoid interference with Owner's use of the Property. Denial of access to any premises or facility that contains WQMP features is a breach of this Agreement and may also be a violation of the County's Pollutant Discharge Elimination System regulations, which on the effective date of this Agreement are found in County Code Sections 35.0101 et seq. If there is reasonable cause to believe that an illicit discharge or breach of this Agreement is occurring on the premises then the authorized enforcement agency may seek issuance of a search warrant from any court of competent jurisdiction in addition to other enforcement actions. Owner recognizes that the County may perform routine and regular inspections, as well as emergency inspections, of the BMPs. Owner or Owner's successors or assigns shall pay County for all costs incurred by County in the inspection, sampling, testing of the BMPs within thirty (30) calendar days of County invoice.

4. Owner shall use its best efforts diligently to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by Owner and Owner's representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the County, the Owner shall provide the County with documentation identifying the material(s) removed, the quantity, and disposal destination), testing construction or reconstruction.

5. In the event Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) business days of being given written notice by the County , the County is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense against the Property and/or to the Owner or Owner's successors or assigns, including administrative costs, attorneys fees and interest thereon at the maximum rate authorized by the County Code from the date of the notice of expense until paid in full. Owner or Owner's successors or assigns shall pay County within thirty (30) calendar days of County invoice.

6. The County may require the owner to post security in form and for a time period satisfactory to the County to guarantee the performance of the obligations stated herein. Should the Owner fail to perform the obligations under the Agreement, the County may, in the case of a cash bond, act for the Owner using the proceeds from it, or in the case of a surety bond, require the surety(ies) to perform the obligations of this Agreement.

7. The County agrees, from time to time, within ten (10) business days after request of Owner, to execute and deliver to Owner, or Owner's designee, an estoppel certificate requested by Owner, stating that this Agreement is in full force and effect, and that Owner is not in default hereunder with regard to any maintenance or payment obligations (or specifying in detail the nature of Owner's default). Owner shall pay all costs and expenses incurred by the County in its investigation of whether to issue an estoppel certificate within thirty (30) calendar days after receipt of a County invoice and prior to the County's issuance of such certificate. Where the County cannot issue an estoppel certificate, Owner shall pay the County within thirty (30) calendar days of receipt of a County invoice.

8. Owner shall not change any BMPs identified in the WQMP without an amendment to this Agreement approved by authorized representatives of both the County and the Owner.

9. County and Owner shall comply with all applicable laws, ordinances, rules, regulations, court orders and government agency orders now or hereinafter in effect in carrying out the terms of this Agreement. If a provision of this Agreement is terminated or held to be invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions shall remain in full effect.

10. In addition to any remedy available to County under this Agreement, if Owner violates any term of this Agreement and does not cure the violation within the time already provided in this Agreement, or, if not provided, within thirty (30) calendar days, or within such time authorized by the County if said cure reasonably requires more than the subject time, the County may bring an action at law or in equity in a court of competent jurisdiction to enforce compliance by the Owner with the terms of this Agreement. In such action, the County may recover any damages to which the County may be entitled for the violation, enjoin the violation by temporary or permanent injunction without the necessity of proving actual damages or the inadequacy of otherwise available legal remedies, or obtain other equitable relief, including, but not limited to, the restoration of the Property and/or the BMPs identified in the WQMP to the condition in which it/they existed prior to any such violation or injury.

11. This Agreement shall be recorded in the Office of the Recorder of San Bernardino County, California, at the expense of the Owner and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the County, including interest as herein above set forth, subject to foreclosure in event of default in payment.

12. In event of legal action occasioned by any default or action of the Owner, or its successors or assigns, then the Owner and its successors or assigns agree(s) to hold the County harmless and pay all costs incurred by the County in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.

13. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien there against.

14. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the parties hereto. The term "Owner" shall include not only the present Owner, but also its heirs, successors, executors, administrators, and assigns. Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. Owner shall provide such notice prior to such successor obtaining an

interest in all or part of the Property. Owner shall provide a copy of such notice to the County at the same time such notice is provided to the successor.

15. Time is of the essence in the performance of this Agreement.

16. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.

17. Owner agrees to indemnify, defend (with counsel reasonably approved by the County) and hold harmless the County and its authorized officers, employees, agents and volunteers from any and all claims, actions, losses, damages, and/or liability arising out of this Agreement from any cause whatsoever, including the acts, errors or omissions of any person and for any costs or expenses incurred by the County on account of any claim except where such indemnification is prohibited by law. This indemnification provision shall apply regardless of the existence or degree of fault of indemnitees. The Owner's indemnification obligation applies to the County's "active" as well as "passive" negligence but does not apply to the County's "sole negligence" or "willful misconduct" within the meaning of Civil Code Section 2782, or to any claims, actions, losses, damages, and/or liabilities, to the extent caused by the acts or omissions of any third party contractors undertaking any work (other than field inspections) or other maintenance on the Property on behalf of the County under this Agreement..

[REMAINDER OF THIS PAGE INTENTIONALLY LEFT BLANK]

IF TO COUNTY :

Director of Public Works

825 E. Third Street, Room 117

San Bernardino, CA 92415-0835

IF TO OWNER:

____

____

____

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

OWNER:

Company/Trust:____________________________

Signature: ______________________________

Name: ________________________________

Title: ________________________________

Date: ________________________________

OWNER:

Company/Trust:____________________________

Signature: ______________________________

Name: ________________________________

Title: ________________________________

Date: ________________________________

FOR: Maintenance Agreement, dated __________________________, for the project known as ____________________________________ ____________________________________ (APN)______________________________, As described in the WQMP dated __________________________________.

NOTARIES ON FOLLOWING PAGE

A notary acknowledgement is required for recordation.

ACCEPTED BY:

____

BRENDON BIGGS, M.S., P.E., Director of Public Works

Date: ____________________________________

Attachment: Notary Acknowledgement

ATTACHMENT 1
Notary Acknowledgement)

EXHIBIT A
(Legal Description)

EXHIBIT B
(Map/illustration)

5. Reference Material

6. BMP Fact Sheets

Curb Inlet Filter

Trash Capture

Comprehensive Stormwater Solutions

Bio Clean

A Forterra Company

OVERVIEW

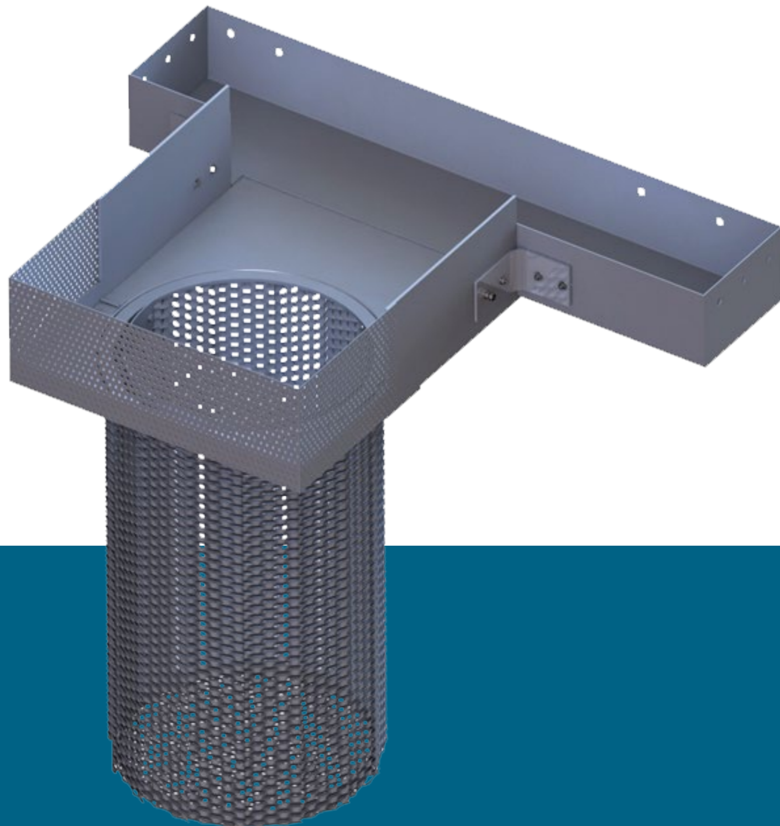
The Bio Clean Curb Inlet Filter is an insertable catch basin filter system designed to capture fine to coarse sediments, floatable trash, debris, and hydrocarbons conveyed in stormwater runoff. The filter system is available in three different model types: Full Trash Capture, Multi-Level Screening (MLS), and the revolutionary Kraken type media filter insert model.

The Curb Inlet Filter is an effective and economical solution to help property owners, developers, and municipalities meet local, state, and federal water quality requirements and regulations.

The expandable trough system is designed to convey water quality design flows through the filter basket while allowing peak flows to bypass over the trough without resuspending captured pollutants. The modular design of the trough system makes it adaptable to any size or type of curb inlet catch basin.

The Curb Inlet Filter provides easy access for maintenance from the surface without having to enter the catch basin. Maintenance service takes about 15 minutes and requires no confined space entry.

This filtration system addresses a wide array of pollutants including trash and debris, sediments, TSS, nutrients, metals, and hydrocarbons.



FULL TRASH CAPTURE TYPE

PERFORMANCE

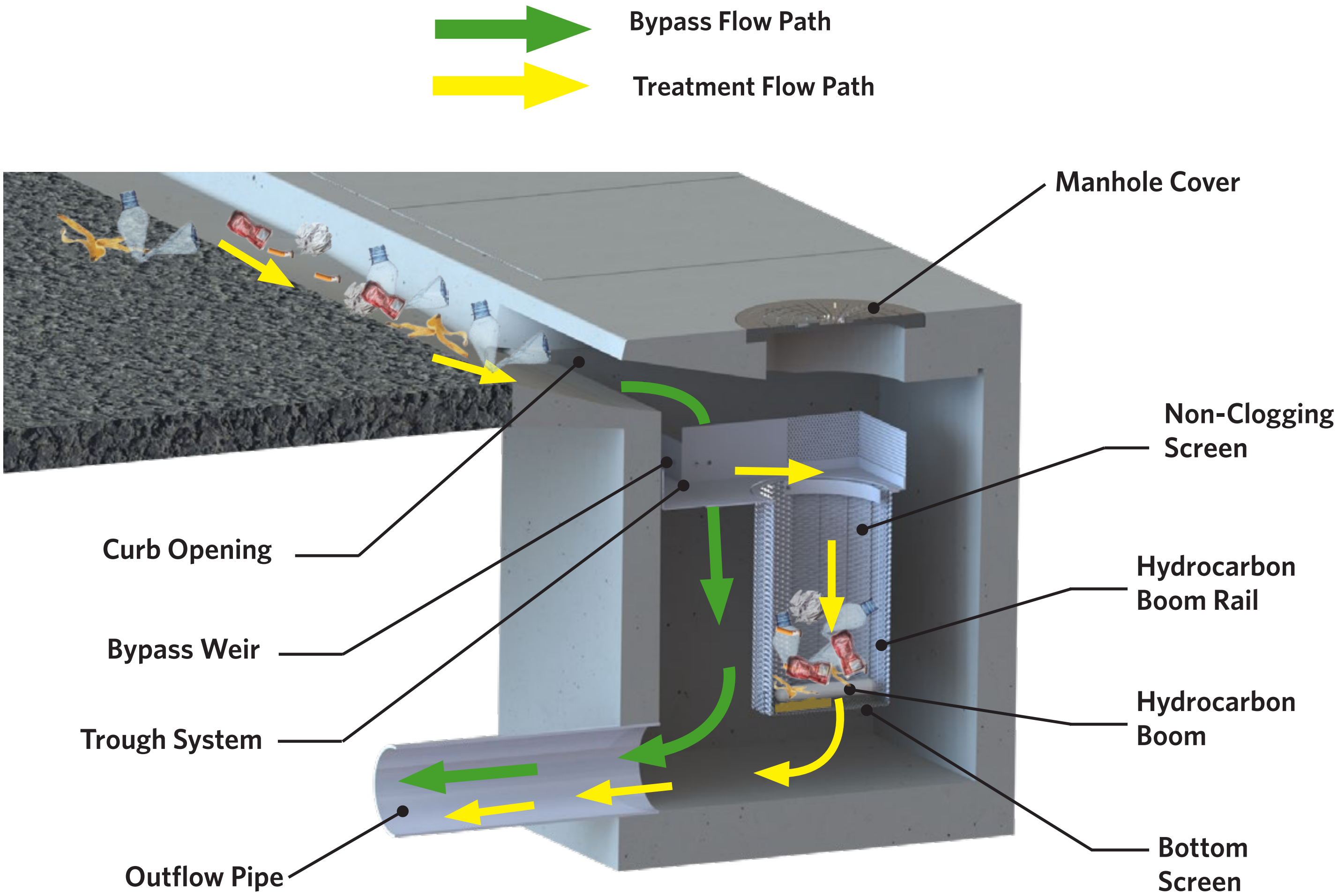
100% REMOVAL OF TRASH AND DEBRIS

- MEETS FULL CAPTURE REQUIREMENTS

ADVANTAGES

- 8-YEAR WARRANTY
- WORKS IN ANY SIZE CATCH BASIN
- NO NETS OR GEOFABRICS
- 15+ YEARS USER LIFE
- EASIEST TO MAINTAIN TROUGH SYSTEM ALLOWS FOR 15-MINUTE OR LESS SERVICE TIME
- STAINLESS STEEL AND FIBERGLASS CONSTRUCTION

OPERATION



APPLICATIONS

- Parking Lots
- Roadways

SPECIFICATIONS

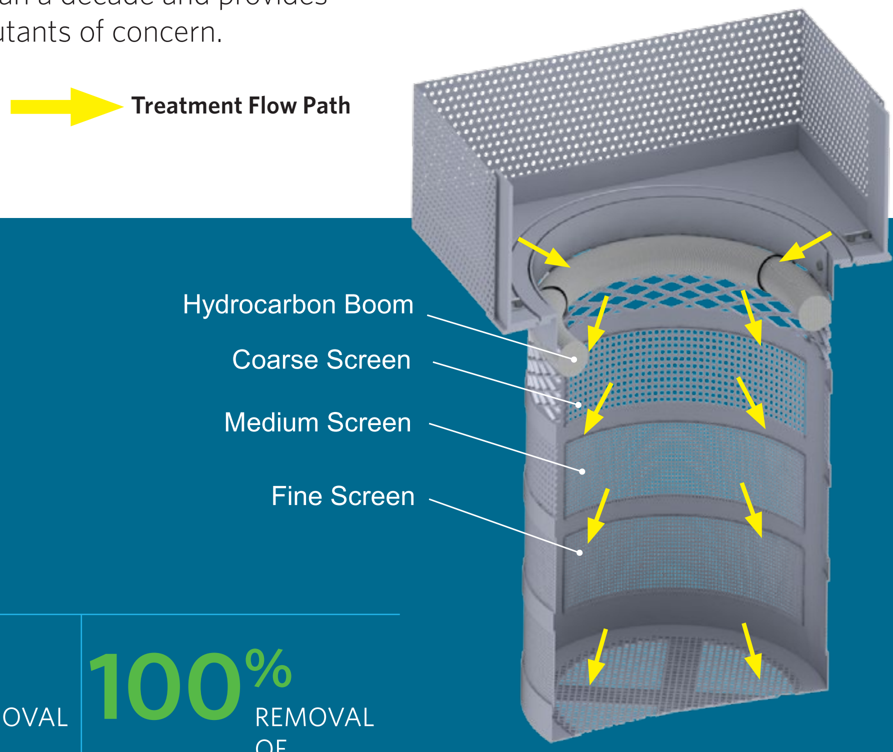
MODEL #	TREATMENT FLOW CAPACITY (cfs)	BYPASS FLOW (cfs)
BIO-CURB-FULL	2.85	UNLIMITED

Note: Treatment flow rate limited to the weir capacity - actual flow rates of the filter basket is greater than 2.85 cfs.
Various depth filter baskets available.

CURB INLET FILTER

The Bio Clean Multi-Level Screening Curb Inlet Filter is the standard configuration used for more than a decade and provides the best overall performance for all pollutants of concern.

OPERATION



MULTI-LEVEL SCREENING

PERFORMANCE

80% REMOVAL OF SEDIMENTS	100% REMOVAL OF TRASH	100% REMOVAL OF FOLIAGE

- MEDIUM LEVEL REMOVAL FOR PARTICULATE METALS AND NUTRIENTS
- INCLUDES HYDROCARBON BOOM FOR REMOVAL OF OILS AND GREASE

SPECIFICATIONS

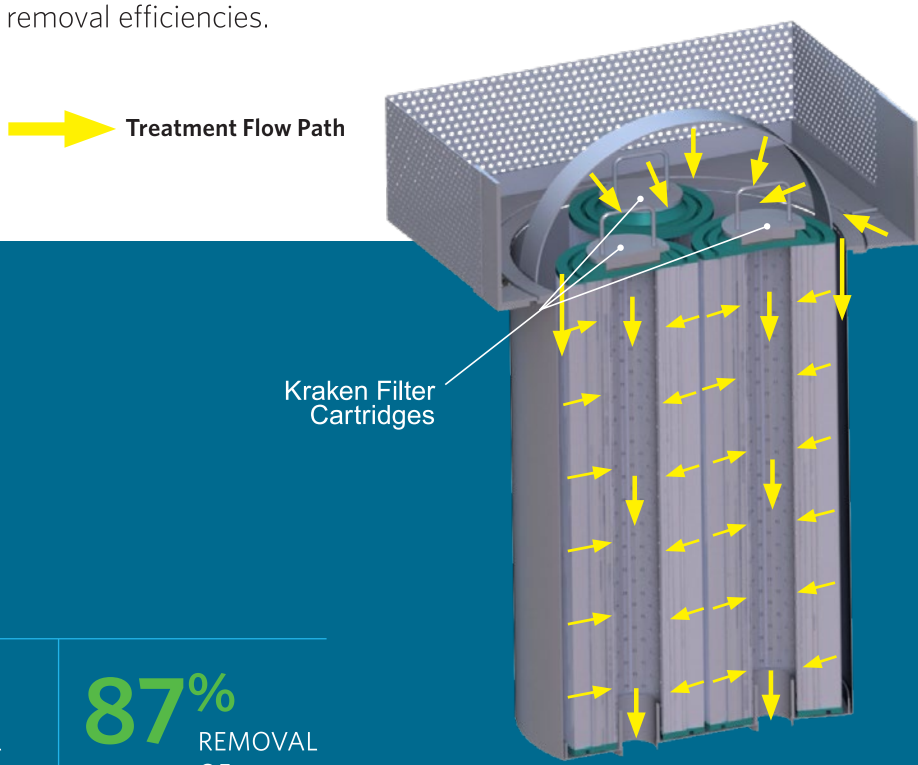
MODEL #	SCREEN TREATMENT FLOW (cfs)	BYPASS FLOW (cfs)
BIO-CURB-MLS	2.85	UNLIMITED

Note: Treatment flow rate limited to the weir capacity – actual flow rates of the filter basket is greater than 2.85 cfs.
Various depth filter baskets available.

CURB INLET MEDIA FILTER

The Bio Clean Kraken Curb Inlet Media Filter is an advanced membrane filter for increased removal efficiencies.

OPERATION



KRAKEN TYPE

PERFORMANCE

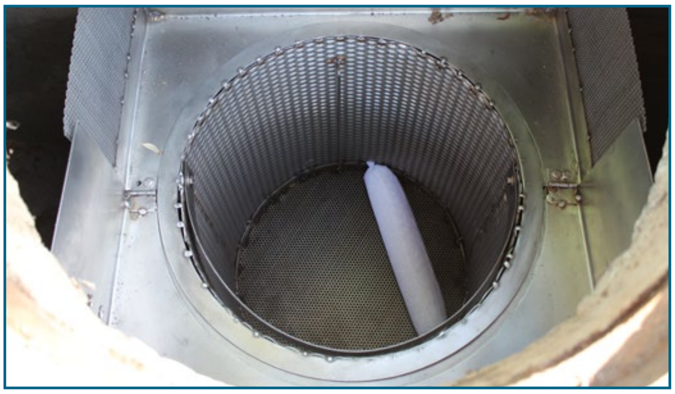
85% REMOVAL OF FINE TSS	52% REMOVAL OF COPPER	87% REMOVAL OF LEAD	
58% REMOVAL OF ZINC	60% REMOVAL OF FECAL COLIFORM (BACTERIA)	81% - 95% REMOVAL OF OILS AND GREASE (MOTOR OIL)	72% REMOVAL OF DISSOLVED PHOSPHORUS

SPECIFICATIONS

MODEL #	MEDIA TREATMENT FLOW (cfs)	BYPASS FLOW (cfs)
BIO-CURB-KMF-30	0.11	UNLIMITED

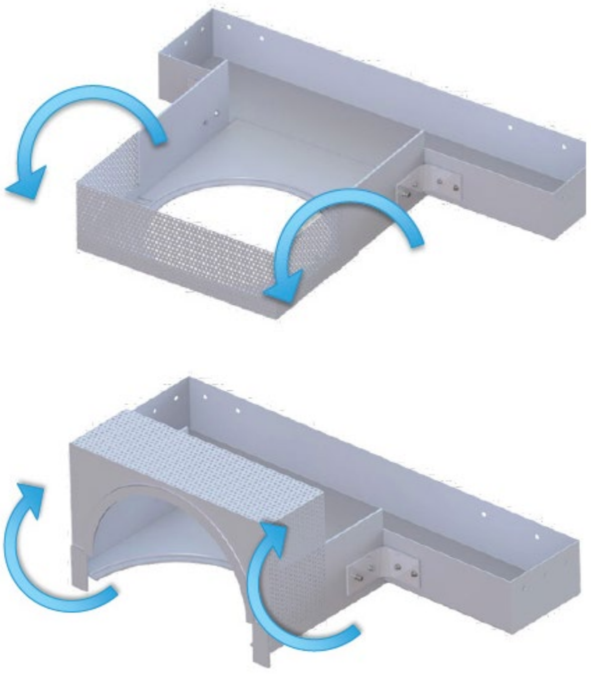
Note: Media treatment flow rate based on three 30" tall Kraken filter cartridges. Various filter basket and Kraken Filter Cartridge heights available.

INSTALLATION



Always positioned under manhole opening.

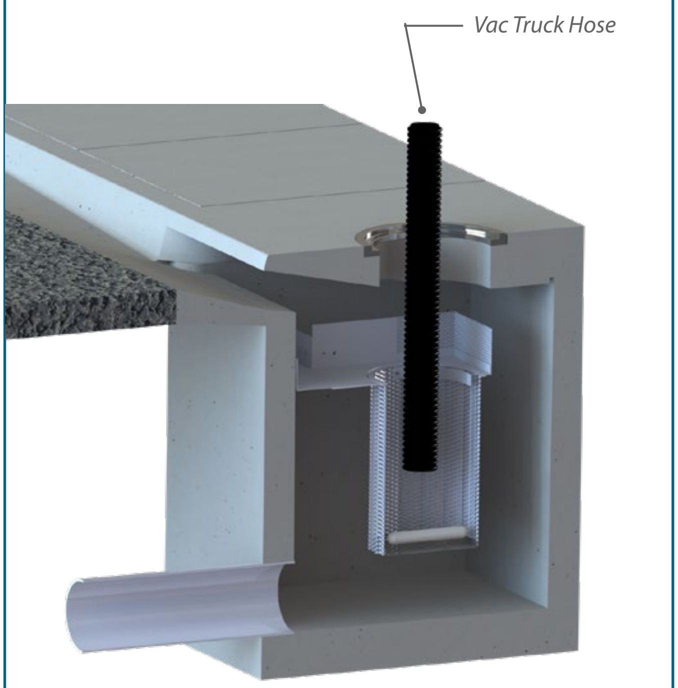
The Curb Inlet Filter features a folding weir that hinges up after the basket is removed to allow easy access to the catch basin if needed.



MAINTENANCE

Cleaned easily with vac truck, without catch basin entry, and about 15 minutes is required for service.

Easily removed without entry into basin.



Bio Clean
A Forterra Company

398 Via El Centro
Oceanside, CA 92058
855.566.3938
stormwater@forterrabp.com
biocleanenvironmental.com

072718R1

Maintenance Concerns, Objectives, and Goals

- Vector Control
- Clogged soil or outlet structures
- Vegetation/Landscape Maintenance
- Groundwater contamination
- Accumulation of metals
- Aesthetics

Targeted Constituents

✓	Sediment	■
✓	Nutrients	■
✓	Trash	■
✓	Metals	■
✓	Bacteria	■
✓	Oil and Grease	■
✓	Organics	■
✓	Oxygen Demanding	■

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

General Description

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

Inspection/Maintenance Considerations

Infiltration basins perform better in well-drained permeable soils. Infiltration basins in areas of low permeability can clog within a couple years, and require more frequent inspections and maintenance. The use and regular maintenance of pretreatment BMPs will significantly minimize maintenance requirements for the basin. Spill response procedures and controls should be implemented to prevent spills from reaching the infiltration system.

Scarification or other disturbance should only be performed when there are actual signs of clogging or significant loss of infiltrative capacity, 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 light tractor. This BMP may require groundwater monitoring. Basins cannot be put into operation until the upstream tributary area is stabilized.

Clogged infiltration basins with surface standing water can become a breeding area for mosquitoes and midges. Maintenance efforts associated with infiltration basins should include frequent inspections 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.

Inspection Activities	Suggested Frequency
■ Observe drain time for a storm after completion or modification of the facility to confirm that the desired drain time has been obtained. ■ Newly established vegetation should be inspected several times to determine if any landscape maintenance (reseeding, irrigation, etc.) is necessary.	Post construction
■ Inspect for the following issues: differential accumulation of sediment, signs of wetness or damage to structures, erosion of the basin floor, dead or dying grass on the bottom, condition of riprap, drain time, signs of petroleum hydrocarbon contamination, standing water, trash and debris, sediment accumulation, slope stability, pretreatment device condition	Semi-annual and after extreme events

Maintenance Activities	Suggested Frequency
■ Factors responsible for clogging should be repaired immediately. ■ Weed once monthly during the first two growing seasons.	Post construction
■ Stabilize eroded banks. ■ Repair undercut and eroded areas at inflow and outflow structures. ■ Maintain access to the basin for regular maintenance activities. ■ Mow as appropriate for vegetative cover species. ■ Monitor health of vegetation and replace as necessary. ■ Control mosquitoes as necessary. ■ Remove litter and debris from infiltration basin area as required.	Standard maintenance (as needed)
■ Mow and remove grass clippings, litter, and debris. ■ Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons. ■ Replant eroded or barren spots to prevent erosion and accumulation of sediment.	Semi-annual
■ Scrape bottom and remove sediment when accumulated sediment reduces original infiltration rate by 25-50%. Restore original cross-section and infiltration rate. Properly dispose of sediment. ■ Seed or sod to restore ground cover. ■ Disc or otherwise aerate bottom. ■ Dethatch basin bottom.	3-5 year maintenance

Additional Information

In most cases, sediment from an infiltration basin does not contain toxins at levels posing a hazardous concern. Studies to date indicate that pond sediments are generally below toxicity limits and can be safely landfilled or disposed onsite. Onsite sediment disposal is always preferable (if local authorities permit) as long as the sediments are deposited away from the shoreline to prevent their reentry into the pond and away from recreation areas, where they could possibly be ingested by young children. Sediments should be tested for toxicants in compliance with current disposal requirements if land uses in the catchment include commercial or industrial zones, or if visual or olfactory indications of pollution are noticed. Sediments containing high levels of pollutants should be disposed of properly.

Light equipment, which will not compact the underlying soil, should be used to remove the top layer of sediment. The remaining soil should be tilled and revegetated as soon as possible.

Sediment removal within the basin should be performed when the sediment is dry enough so that it is cracked and readily separates from the basin floor. This also prevents smearing of the basin floor.

References

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Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

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7. WQMP Exhibit

APPENDIX G

The Updated Model Water Efficient Landscape Ordinance

CALIFORNIA DEPARTMENT OF WATER RESOURCES

Landscapes are essential to the quality of life in California. They provide areas for recreation, enhance the environment, clean the air and water, prevent erosion, offer fire protection and replace ecosystems lost to development.

California's economic prosperity and environmental quality are dependant on an adequate supply of water for beneficial uses. In California, about half of the urban water used is for landscape irrigation. Ensuring **efficient landscapes** in new developments and reducing water waste in existing landscapes are the most cost-effective ways to stretch our limited water supplies and ensure that we continue to have sufficient water for California to prosper.

The Water Conservation in Landscaping Act of 2006 (Assembly Bill 1881, Laird) requires cities, counties, and charter cities and charter counties, to adopt landscape water conservation ordinances by January 1, 2010. Pursuant to this law, the Department of Water Resources (DWR) has prepared a Model Water Efficient Landscape Ordinance (Model Ordinance) for use by local agencies. The Model Ordinance was approved by the Office of Administrative Law on September 10, 2009. The Model Ordinance became effective on September 10.

All local agencies must adopt a water efficient landscape ordinance by **January 1, 2010**. The local agencies may adopt the state Model Ordinance, or craft an ordinance to fit local conditions. In addition, several local agencies may collaborate and craft a region-wide ordinance. In any case, the adopted ordinance must be as effective as the Model Ordinance in regard to water conservation.

For more information, please visit our web site at
http://www.water.ca.gov/wateruseefficiency/landscapeordinance/

DWR October 2009

Important points to consider...

Water purveyors have an important role.

The enabling statute was directed to local agencies that make land use decisions and approve land development. Active participation by water purveyors can make the implementation, enforcement and follow-up actions of an ordinance more effective.

Most new and rehabilitated landscapes are subject to a water efficient landscape ordinance. Public landscapes and private development projects including developer installed single family and multi-family residential landscapes with at least 2500 sq. ft. of landscape area are subject to the Model Ordinance .

Homeowner provided landscaping at single family and multi-family homes are subject to the Model Ordinance if the landscape area is at least 5000 sq. ft

Existing landscapes are also subject to the Model Ordinance.

Water waste is common in landscapes that are poorly designed or not well maintained. Water waste (from runoff, overspray, low head drainage, leaks and excessive amounts of applied irrigation water in landscapes is prohibited by Section 2, Article X of the California Constitution.

Any landscape installed prior to January 1, 2010, that is at least one acre in size may be subject to irrigation audits, irrigation surveys or water use analysis programs for evaluating irrigation system performance and adherence to the Maximum Applied Water Allowance as defined in the 1992 Model Ordinance with an Evapotranspiration Adjustment Factor (ETAF) of 0.8. Local agencies and water purveyors (designated by the local agency) may institute these or other programs to increase efficiency in existing landscapes.

All new landscapes will be assigned a water budget.

The water budget approach is a provision in the statute that ensures a landscape is allowed sufficient water. There are two water budgets in the Model Ordinance; the Maximum Applied Water Allowance (MAWA) and the Estimated Total Water Use (ETWU).

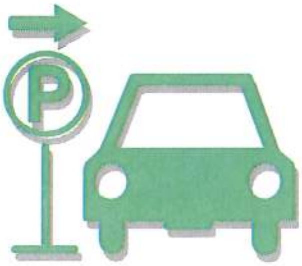
The MAWA, is the water budget used for compliance and is an annual water allowance based on landscape area, local evapotranspiration and ETAF of 0.7. The ETWU is an annual water use estimation for design purposes and is based on the water needs of the plants actually chosen for a given landscape. The ETWU may not exceed the MAWA.

Water efficient landscapes offer multiple benefits.

Water efficient landscapes will stretch our limited water supplies. Other benefits include reduced irrigation runoff, reduced pollution of waterways, less property damage, less green waste, increased drought resistance and a smaller carbon footprint.

The Department of Water Resources will offer technical assistance.

The Department plans to offer a series of workshops, publications and other assistance for successful adoption and implementation of the Model Ordinance or local water efficient landscape ordinances. Information regarding these resources may be found on the DWR website: **http://www.water.ca.gov/wateruseefficiency/landscapeordinance/** Questions on the Model Ordinance may be sent by e-mail to DWR staff at: **mweo@water.ca.gov.**



R-3
AUTOMOBILE PARKING

The activities outlined in this fact sheet target the following pollutants:	
Sediment	x
Nutrients	
Bacteria	
Foaming Agents	
Metals	X
Hydrocarbons	X
Hazardous Materials	x
Pesticides and Herbicides	
Other	

Parked automobiles may contribute pollutants to the storm drain because poorly maintained vehicles may leak fluids containing hydrocarbons, metals, and other pollutants. In addition, heavily soiled automobiles may drop clods of dirt onto the parking surface, contributing to the sediment load when runoff is present. During rain events, or wash-down activities, the pollutants may be carried into the storm drain system. The pollution prevention activities outlined in this fact sheets are used to prevent the discharge of pollutants to the storm drain system.

Think before parking your car. Remember - The ocean starts at your front door.

Required Activities

- If required, vehicles have to be removed from the street during designated street sweeping/cleaning times.
- If the automobile is leaking, place a pan or similar collection device under the automobile, until such time as the leak may be repaired.
- Use dry cleaning methods to remove any materials deposited by vehicles (e.g. adsorbents for fluid leaks, sweeping for soil clod deposits).

Recommended Activities

- Park automobiles over permeable surfaces (e.g. gravel, or porous cement).
- Limit vehicle parking to covered areas.
- Perform routine maintenance to minimize fluid leaks, and maximize fuel efficiency.

For additional information contact:
County of Orange, **OC Watershed**
Main: (714) 955-0600/ 24hr Water Pollution Discharge Hotline 1-877-89-SPILL
or visit our website at: www.ocwatersheds.com

R-8
WATER CONSERVATION

Excessive irrigation and/or the overuse of water is often the most significant factor in transporting pollutants to the storm drain system. Pollutants from a wide variety of sources including automobile repair and maintenance, automobile washing, automobile parking, home and garden care activities and pet care may dissolve in the water and be transported to the storm drain. In addition, particles and materials coated with fertilizers and pesticides may be suspended in the flow and be transported to the storm drain.

The activities outlined in this fact sheet target the following pollutants:	
Sediment	x
Nutrients	x
Bacteria	x
Foaming Agents	x
Metals	x
Hydrocarbons	x
Hazardous Materials	x
Pesticides and Herbicides	x
Other	x

Hosing off outside areas to wash them down not only consumes large quantities of water, but also transports any pollutants, sediments, and waste to the storm drain system. The pollution prevention activities outlined in this fact sheets are used to prevent the discharge of pollutants to the storm drain system.

Think before using water. Remember - The ocean starts at your front door.

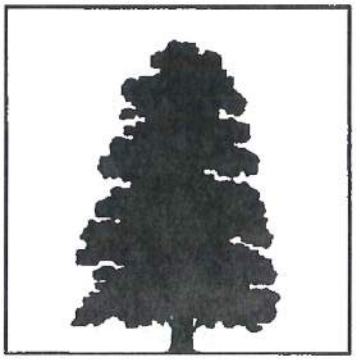
Required Activities

- Irrigation systems must be properly adjusted to reflect seasonal water needs.
- Do not hose off outside surfaces to clean, sweep with a broom instead.

Recommended Activities

- Fix any leaking faucets and eliminate unnecessary water sources.
- Use xeroscaping and drought tolerant landscaping to reduce the watering needs.
- Do not over watering lawns or gardens. Over watering wastes water and promotes diseases.
- Use a bucket to re-soak sponges/rags while washing automobiles and other items outdoors. Use hose only for rinsing.
- Wash automobiles at a commercial car wash employing water recycling.

For additional information contact:
County of Orange, **OC Watershed**
Main: (714) 955-0600/ 24hr Water Pollution Discharge Hotline 1-877-89-SPILL
or visit our website at: www.ocwatersheds.com



FP-2

LANDSCAPE MAINTENANCE

The model procedures described below focus on minimizing the discharge of pesticides and fertilizers, landscape waste, trash, debris, and other pollutants to the storm drain system and receiving waters. Landscape maintenance practices may involve one or more of the following activities:

1. **Mowing, Trimming/Weeding, and Planting**
2. **Irrigation**
3. **Fertilizer and Pesticide Management**
4. **Managing Landscape Waste**
5. **Erosion Control**

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 landscape maintenance include:

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools. Refer to Appendix D, Fertilizer and Pesticide Management Guidance for further details.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) will preserve the landscapes water efficiency.
- Once per year, educate municipal staff on pollution prevention measures.

MODEL PROCEDURES:

1. Mowing, Trimming/Weeding, and Planting

Mowing, Trimming/Weeding

✓ Whenever possible, use mechanical methods of vegetation removal rather than applying herbicides. Use hand weeding where practical.

✓ When conducting mechanical or manual weed control, avoid loosening the soil, which could erode into streams or storm drains.

✓ Use coarse textured mulches or geotextiles to suppress weed growth and reduce the use of herbicides.

✓ Do not blow or rake leaves, etc. into the street or place yard waste in gutters or on dirt shoulders. Sweep up any leaves, litter or residue in gutters or on street.

✓ 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 procedure sheet).

✓ Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

✓ Where feasible, retain and/or plant selected native vegetation whose features are determined to be beneficial. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting ornamental vegetation.

✓ When planting or replanting consider using low water use groundcovers.

OPTIONAL:

- Careful soil mixing and layering techniques using a topsoil mix or composted organic material can be used as an effective measure to reduce herbicide use and watering.

2. Irrigation

✓ Utilize water delivery rates that do not exceed the infiltration rate of the soil.

✓ Use timers appropriately or a drip system to prevent runoff and then only irrigate as much as is needed.

✓ 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.

✓ 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.

✓ If re-claimed water is used for irrigation, ensure that there is no runoff from the landscaped area(s).

✓ 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.

3. Fertilizer and Pesticide Management

Usage

- ✓ Utilize a comprehensive management system that incorporates integrated pest management techniques.
- ✓ 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.
- ✓ 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.
- ✓ When applicable use the least toxic pesticides that will do the job. Avoid use of copper-based pesticides if possible.
- ✓ Do not mix or prepare pesticides or fertilizers 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.
- ✓ 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.
- ✓ Inspect pesticide/fertilizer equipment and transportation vehicles daily.
- ✓ Refer to Appendix D for further guidance on Fertilizer and Pesticide management

OPTIONAL:

- Work fertilizers into the soil rather than dumping or broadcasting them onto the surface.
- Use beneficial insects where possible to control pests (green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seedhead weevils, and spiders prey on detrimental pest species).
- Use slow release fertilizers whenever possible to minimize leaching.

Scheduling

- ✓ Do not use pesticides if rain is expected within 24 hours.
- ✓ Apply pesticides only when wind speeds are low (less than 5 mph).

Disposal

- ✓ 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.

4. Managing Landscape Waste

Also see Waste Handling and Disposal procedure sheet

- ✓ 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.
- ✓ Inspection of drainage facilities should be conducted to detect illegal dumping of clippings/cuttings in or near these facilities. Materials found should be picked up and properly disposed of.
- ✓ Landscape wastes in and around storm drain inlets should be avoided by either using bagging equipment or by manually picking up the material.

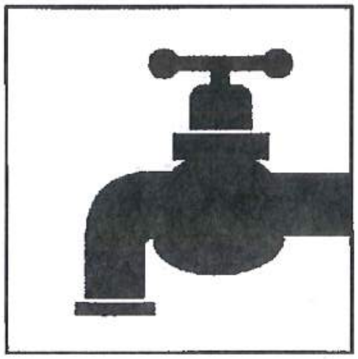
5. Erosion Control

Also see Waste Handling and Disposal procedure sheet

- ✓ Maintain vegetative cover on medians and embankments to prevent soil erosion. Apply mulch or leave clippings to serve as additional cover for soil stabilization and to reduce the velocity of storm water runoff.
- ✓ Minimize the use of disking as a means of vegetation management because the practice may result in erodable barren soil.
- ✓ Confine excavated materials to pervious surfaces away from storm drain inlets, sidewalks, pavement, and ditches. Material must be covered if rain is expected.

LIMITATIONS:

Alternative pest/weed controls may not be available, suitable, or effective in every case.



FP-6

WATER AND SEWER UTILITY OPERATION AND MAINTENANCE

Although the operation and maintenance of public utilities are not considered themselves a chronic source of stormwater pollution, some activities and accidents can result in the discharge of pollutants that can pose a threat to both human health and the quality of receiving waters if they enter the storm drain system. Activities associated with the operation and maintenance of water and sewer utilities to prevent and handle such incidents include the following:

1. **Water Line Maintenance**
2. **Sanitary Sewer Maintenance**
3. **Spill/Leak/Overflow Control, Response, and Containment**

Cities that do not provide maintenance of water and sewer utilities should coordinate with the contracting agency responsible for these activities and ensure that these model procedures are followed.

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 water and sewer utility operation and maintenance include:

- Inspect potential non-storm water discharge flow paths and clear/cleanup any debris or pollutants found (i.e. remove trash, leaves, sediment, and wipe up liquids, including oil spills).
- Once per year, educate municipal staff on pollution prevention measures.

MODEL PROCEDURES:

1. Water Line Maintenance

Procedures can be employed to reduce pollutants from discharges associated with water utility operation and maintenance activities. Planned discharges may include fire hydrant testing, flushing water supply mains after new construction, flushing lines due to complaints of taste and odor, dewatering mains for maintenance work. Unplanned discharges from treated, recycled water, raw water, and groundwater systems operation and maintenance activities can occur from water main breaks, sheared fire hydrants, equipment malfunction, and operator error.

Planned Discharges

✓ For planned discharges use one of the following options:

- Reuse water for dust suppression, irrigation, or construction compaction
- Discharge to the sanitary sewer system with approval
- Discharge to the storm drain system or to a creek using applicable pollution control measures listed below (this option is ONLY applicable to uncontaminated pumped ground water, water line flushing, fire hydrant testing and flushing, discharges from potable water sources other than water main breaks) and may require a permit from the Regional Water Quality Control Board.

✓ If water is discharged to a storm drain inlet (catch basin), control measures must be put in place to control potential pollutants (i.e. sediment, chlorine, etc.). Examples of some storm drain inlet protection options include:

- Silt fence – appropriate where the inlet drains a relatively flat area.
- Gravel and wire mesh sediment filter – Appropriate where concentrated flows are expected.
- Wooden weir and fabric – use at curb inlets where a compact installation is desired.

✓ Prior to discharge, inspect discharge flow path and clear/cleanup any debris or pollutants found (i.e. remove trash, leaves, sediment, and wipe up liquids, including oil spills).

✓ Select appropriate pollution control measure(s) considering the receiving system (i.e. curb inlet, drop inlet, culvert, creek, etc.) and ensure that the control device(s) fit properly.

✓ General design considerations for inlet protection devices include the following:

- The device should be constructed such that cleaning and disposal of trapped sediment is made easy, while minimizing interference with discharge activities.
- Devices should be constructed so that any standing water resulting from the discharge will not cause excessive inconvenience or flooding/damage to adjacent land or structures.

✓ The effectiveness of control devices must be monitored during the discharge period and any necessary repairs or modifications made as needed.

OPTIONAL:

- Sediment removal may be enhanced by placing filter fabric, gravel bags, etc. at storm drain inlets.

Unplanned Discharges

✓ Stop the discharge as quickly as possible by turning off water source.

✓ Inspect flow path of the discharged water:

- Control erosion along the flow path.
- Identify areas that may produce significant sediment or gullies, use sandbags to redirect the flow.
- Identify erodible areas which may need to be repaired or protected during subsequent repairs or corrective actions

✓ If repairs or corrective action will cause additional discharges of water, select the appropriate procedures for erosion control, chlorine residual, turbidity, and chemical additives. Prevent potential pollutants from entering the flow path and ensure that no additional discharged water enters storm drain inlets.

2. Sanitary Sewer Maintenance

Applicable to municipalities who own and operated a sewage collection system. Facilities that are covered under this program include sanitary sewer pipes and pump stations owned and operated by the Permittee. The owner of the sanitary sewer facilities is the entity responsible for carrying out this prevention and response program.

Sewer System Cleaning

✓ Sewer lines should be cleaned on a regular basis to remove grease, grit, and other debris that may lead to sewer backups.

✓ Establish routine maintenance program. Cleaning should be conducted at an established minimum frequency and more frequently for problem areas such as restaurants that are identified

✓ Cleaning activities may require removal of tree roots and other identified obstructions.

Preventative and Corrective Maintenance

✓ During routine maintenance and inspection note the condition of sanitary sewer structures and identify areas that need repair or maintenance. Items to note may include the following:

- cracked/deteriorating pipes
- leaking joints/seals at manhole
- frequent line plugs
- line generally flows at or near capacity
- suspected infiltration or exfiltration

✓ Document suggestions and requests for repair and report the information to the appropriate manager or supervisor.

✓ Prioritize repairs based on the nature and severity of the problem. Immediate clearing of blockage or repair is required where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g. pump station failures, sewer line ruptures, sewer line blockages). These repairs may be temporary until scheduled or capital improvements can be completed.

✓ Review previous sewer maintenance records to help identify "hot spots" or areas with frequent maintenance problems and locations of potential system failure.

3. Spill/Leak/Overflow Control, Response, and Containment

Control

Also see Drainage System procedures sheet

✓ Refer to countywide *Illicit Discharge Detection and Elimination Program.* Components of this program include:

- Investigation/inspection and follow-up
- Elimination of illicit discharges and connections
- Enforcement of ordinances
- Respond to sewage spills

- Facilitate public reporting of illicit discharges and connections. A citizen's hotline for reporting observed overflow conditions should be established to supplement the field screening efforts being conducted by the Principal Permittee.

Response and Containment

- ✓ Establish lead department/agency responsible for spill response and containment. Provide coordination within departments.
- ✓ When a spill, leak, and/or overflow occurs, keep sewage from entering the storm drain system to the maximum extent practicable by covering or blocking storm drain inlets or by containing and diverting the sewage away from open channels and other storm drain facilities (using sandbags, inflatable dams, etc.).
- ✓ If a spill reaches the storm drain notify County of Orange Health Care Agency through Control One at (714) 628-7208.
- ✓ Remove the sewage using vacuum equipment or use other measures to divert it back to the sanitary sewer system.
- ✓ Record required information at the spill site.
- ✓ Perform field tests as necessary to determine the source of the spill.
- ✓ Develop additional notification procedures regarding spill reporting as needed.

LIMITATIONS:

Private property access rights needed to perform testing along storm drain right-of-ways. Requirements of municipal ordinance authority for suspected source verification testing necessary for guaranteed rights of entry.

REFERENCES:

California Storm Water Best Management Practice Handbooks. Municipal Best Management Practice Handbook. Prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates for Stormwater Quality Task Force. March 1993.

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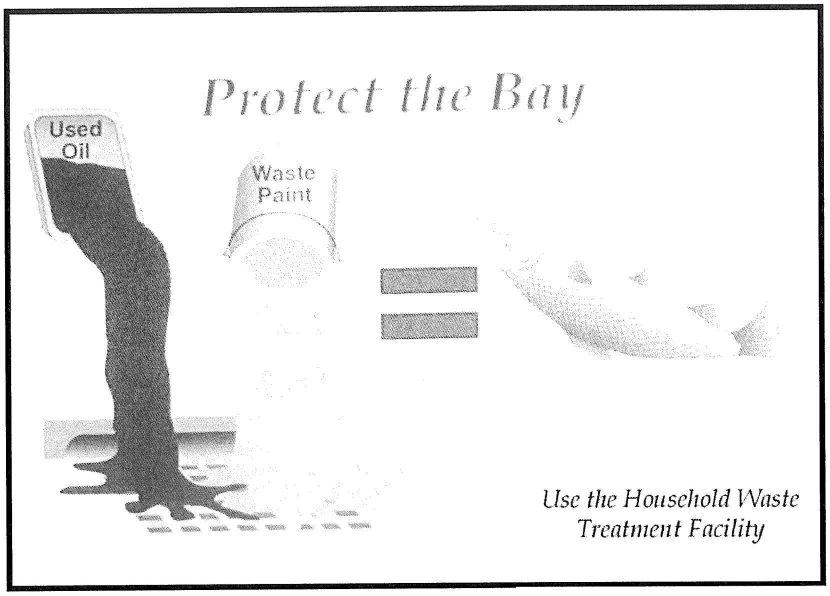

Graphic by: Margie Winter

Objectives

- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

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

Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. For municipalities non-stormwater discharges present themselves in two situations. One is from fixed facilities owned and/or operated by the municipality. The other situation is non-stormwater discharges that are discovered during the normal operation of a field program. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, and surface cleaning. However, there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances (such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants) into storm drains. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges.

Approach

The municipality must address non-stormwater discharges from its fixed facilities by assessing the types of non-stormwater discharges and implementing BMPs for the discharges determined to pose environmental concern. For field programs the field staff must be

CASQA California Stormwater Quality Association trained to now what to look for regarding non-stormwater discharges and the procedures to follow in investigating the detected discharges.

Suggested Protocols

Fixed Facility

General

- Post "No Dumping" signs with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- 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.
- Landscaping and beautification efforts of hot spots might also discourage future dumping, as well as provide open space and increase property values.
- Lighting or barriers may also be needed to discourage future dumping.

Illicit Connections

- Locate discharges from the fixed facility drainage system to the municipal storm drain system through review of "as-built" piping schematics.
- Use techniques such as smoke testing, dye testing and television camera inspection (as noted below) to verify physical connections.
- Isolate problem areas and plug illicit discharge points.

Visual Inspection and Inventory

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

Review Infield Piping

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

Smoke Testing

- Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two systems.

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

  Dye Testing

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

TV Inspection of Storm Sewer

- TV Cameras can be employed to visually identify illicit connections to the fixed facility storm drain system.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Clean up spills on paved surfaces with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.
- See fact sheet SC-11 Spill Prevention, Control, and Clean Up.

Field Program

General

- Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially ones that involve more than one jurisdiction and those that are not classified as hazardous, which are often not responded to as effectively as they need to be.
- 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.
- See SC-74 Stormwater Drainage System Maintenance for additional information.

Field Inspection

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- During routine field program maintenance field staff should look for evidence of illegal discharges or illicit connection:
  - 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 and notify appropriate investigating agency.
- If trained, conduct field investigation of non-stormwater discharges to determine whether they pose a threat to water quality.

Recommended Complaint Investigation Equipment

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

- Educational materials

Reporting

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

Enforcement

- Educate the responsible party if identified on the impacts of their actions, explain the stormwater requirements, and provide information regarding Best Management Practices (BMP), as appropriate. Initiate follow-up and/or enforcement procedures.
- If an illegal discharge is traced to a commercial, residential or industrial source, conduct the following activities or coordinate the following activities with the appropriate agency:
  - Contact the responsible party to discuss methods of eliminating the non-stormwater discharge, including disposal options, recycling, and possible discharge to the sanitary sewer (if within POTW limits).
  - Provide information regarding BMPs to the responsible party, where appropriate.
  - Begin enforcement procedures, if appropriate.
  - Continue inspection and follow-up activities until the illicit discharge activity has ceased.
- If an illegal discharge is traced to a commercial or industrial activity, coordinate information on the discharge with the jurisdiction's commercial and industrial facility inspection program.

Training

- Train technical staff to identify and document illegal dumping incidents.
- Well-trained employees can reduce human errors that lead to accidental releases or spills. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur. Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Train employees to identify non-stormwater discharges and report them to the appropriate departments.
- Train staff who have the authority to conduct surveillance and inspections, and write citations for those caught illegally dumping.

- Train municipal staff responsible for surveillance and inspection in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).
  - OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and federal OSHA 29 CFR 1910.146).
  - Procedural training (field screening, sampling, smoke/dye testing, TV inspection).
- Educate the identified responsible party on the impacts of his or her actions.

Spill Response and Prevention

- See SC-11 Spill Prevention Control and Clean Up

Other Considerations

- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The cost of fees for dumping at a proper waste disposal facility are often more than the fine for an illegal dumping offense, thereby discouraging people from complying with the law. The absence of routine or affordable pickup service for trash and recyclables in some communities also encourages illegal dumping. A lack of understanding regarding applicable laws or the inadequacy of existing laws may also contribute to the problem.
- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.
- Many facilities do not have accurate, up-to-date schematic drawings.
- Can be difficult to locate illicit connections especially if there is groundwater infiltration.

Requirements

Costs

- Eliminating illicit connections can be expensive especially if structural modifications are required such re-plumbing cross connections under an existing slab.
- Minor cost to train field crews regarding the identification of non-stormwater discharges. The primary cost is for a fully integrated program to identify and eliminate illicit connections and illegal dumping. However, by combining with other municipal programs (i.e. pretreatment program) cost may be lowered.
- Municipal cost for containment and disposal may be borne by the discharger.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

What constitutes a "non-stormwater" discharge?

- Non-stormwater discharges are discharges not made up entirely of stormwater and include water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, landscape irrigation, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

Permit Requirements

- Current municipal NPDES permits require municipalities to effectively prohibit non-stormwater discharges unless authorized by a separate NPDES permit or allowed in accordance with the current NPDES permit conditions. Typically the current permits allow certain non-stormwater discharges in the storm drain system as long as the discharges are not significant sources of pollutants. In this context the following non-stormwater discharges are typically allowed:

  - Diverted stream flows;
  - Rising found waters;
  - Uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20));
  - Uncontaminated pumped ground water;
  - Foundation drains;
  - Springs;
  - Water from crawl space pumps;
  - Footing drains;
  - Air conditioning condensation;
  - Flows from riparian habitats and wetlands;
  - Water line and hydrant flushing ;
  - Landscape irrigation;
  - Planned and unplanned discharges from potable water sources;
  - Irrigation water;
  - Individual residential car washing; and
  - Lawn watering.

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

Illegal Dumping

- 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

Outreach

One of the keys to success of reducing or eliminating illegal dumping is increasing the number of people on the street who are aware of the problem and who have the tools to at least identify the incident, if not correct it. There we a number of ways of accomplishing this:

- Train municipal staff from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report the incidents.
- Deputize municipal staff who may come into contact with illegal dumping with the authority to write illegal dumping tickets for offenders caught in the act (see below).
- Educate the public. As many as 3 out of 4 people do not understand that in most communities the storm drain does not go to the wastewater treatment plant. Unfortunately, with the heavy emphasis in recent years on public education about solid waste management, including recycling and household hazardous waste, the sewer system (both storm and sanitary) has been the likely recipient of cross-media transfers of waste.
- Provide the public with a mechanism for reporting incidents such as a hot line and/or door hanger (see below).
- Help areas where incidents occur more frequently set up environmental watch programs (like crime watch programs).
- Train volunteers to notice and report the presence and suspected source of an observed pollutant to the appropriate public agency.

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- Non-stormwater discharges are discharges not made up entirely of stormwater and include water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, landscape irrigation, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

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    - Diverted stream flows;
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    - Foundation drains;
    - Springs;
    - Water from crawl space pumps;
    - Footing drains;
    - Air conditioning condensation;
    - Flows from riparian habitats and wetlands;
    - Water line and hydrant flushing ;
    - Landscape irrigation;
    - Planned and unplanned discharges from potable water sources;
    - Irrigation water;
    - Individual residential car washing; and
    - Lawn watering.

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

Storm Drain Stenciling

- Stencil storm drain inlets with a message to prohibit illegal dumpings, especially in areas with waste handling facilities.
- Encourage public reporting of improper waste disposal by a HOTLINE number stenciled onto the storm drain inlet.
- See Supplemental Information section of this fact sheet for further detail on stenciling program approach.

Oil Recycling

- Contract collection and hauling of used oil to a private licensed used oil hauler/recycler.
- Comply with all applicable state and federal regulations regarding storage, handling, and transport of petroleum products.
- Create procedures for collection such as; collection locations and schedule, acceptable containers, and maximum amounts accepted.
- The California Integrated Waste Management Board has a Recycling Hotline, (800) 553-2962, that provides information and recycling locations for used oil.

Household Hazardous Waste

- Provide household hazardous waste (HHW) collection facilities. Several types of collection approaches are available including permanent, periodic, or mobile centers, curbside collection, or a combination of these systems.

Training

- Train municipal employees and contractors in proper and consistent methods for waste disposal.
- Train municipal employees to recognize and report illegal dumping.
- Train employees and subcontractors in proper hazardous waste management.

Spill Response and Prevention

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

Other Considerations

- Federal Regulations (RCRA, SARA, CERCLA) and state regulations exist regarding the disposal of hazardous waste.

- Municipalities are required to have a used oil recycling and a HHW element within their integrate waste management plan.

- Significant liability issues are involved with the collection, handling, and disposal of HHW.

Examples

The City of Palo Alto has developed a public participation program for reporting dumping violations. When a concerned citizen or public employee encounters evidence of illegal dumping, a door hanger (similar in format to hotel "Do Not Disturb" signs) is placed on the front doors in the neighborhood. The door hanger notes that a violation has occurred in the neighborhood, informs the reader why illegal dumping is a problem, and notes that illegal dumping carries a significant financial penalty. Information is also provided on what citizens can do as well as contact numbers for more information or to report a violation.

The Port of Long Beach has a state of the art database incorporating storm drain infrastructure, potential pollutant sources, facility management practices, and a pollutant tracking system.

The State Department of Fish and Game has a hotline for reporting violations called CalTIP (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.

References and Resources

http://www.stormwatercenter.net/

California's Nonpoint Source Program Plan http://www.co.clark.wa.us/pubworks/bmpman.pdf

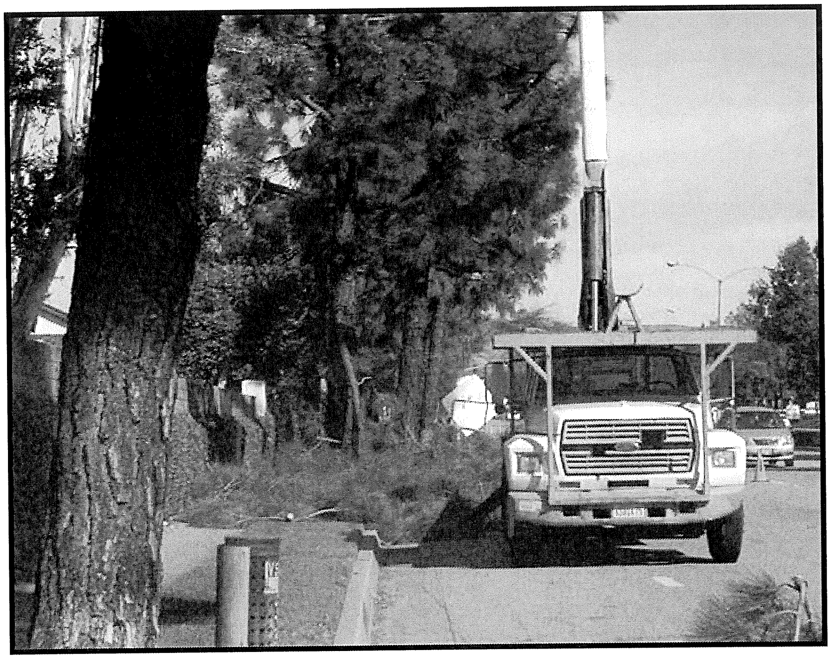
King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

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

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (http://www.projectcleanwater.org)

Santa Clara Valley Urban Runoff Pollution Prevention Program
http://www.scvurppp-w2k.com/pdf%20documents/PS_ICID.PDF

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.

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- 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.

References and Resources

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995. King County Surface Water Management. July. On-line: http://dnr.metrokc.gov/wlr/dss/spcm.htm

Los Angeles County Stormwater Quality Model Programs. Public Agency Activities http://ladpw.org/wmd/npdes/model_links.cfm

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

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

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

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Landscaping and Lawn Care. Office of Water. Office of Wastewater Management. On-line: http://www.epa.gov/npdes/menuofbmps/poll_8.htm

Photo Credit: Geoff Brosseau

Objectives

- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

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

Description

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

Approach

Suggested Protocols

Catch Basins/Inlet Structures

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

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

Storm Drain Conveyance System

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

Pump Stations

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

Open Channel

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

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

Illicit Connections and Discharges

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

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
    - Illegal dumping hot spots
    - Types and quantities (in some cases) of wastes
    - Patterns in time of occurrence (time of day/night, month, or year)
    - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
    - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).

- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.

- Only properly trained individuals are allowed to handle hazardous materials/wastes.

- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.

- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.

- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

Spill Response and Prevention

- Refer to SC-11, Prevention, Control & Cleanup

- Have spill cleanup materials readily available and in a known location.

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.

- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.

- Regulations may include adoption of substantial penalties for illegal dumping and disposal.

- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

- Private property access rights may be needed to track illegal discharges up gradient.

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

Requirements

Costs

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

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

Maintenance

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

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

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

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

Supplemental Information

Further Detail of the BMP

Storm Drain flushing

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

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

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

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

Flow Management

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

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

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

Stream Corridor Planning

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

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

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

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

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

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

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

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

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

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

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

Examples

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

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

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

References and Resources

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

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

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

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

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

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

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.

Rain Garden

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

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

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

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

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

Dry wells and Infiltration Trenches

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

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

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

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

Pop-up Drainage Emitter

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

Foundation Planting

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

Redeveloping Existing Installations

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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.

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APPENDIX H