MOJAVE RIVER WATERSHED

Water Quality Management Plan

For:

San Bernardino County High Desert Service Center

APN 3093-251-01

Prepared for:

County of San Bernardino
Project Management Division

385 N. Arrowhead Avenue, 3rd Floor

San Bernardino, CA 92415

Prepared by:

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Submittal Date: December 1, 2016

Revision No. and Date: February 23, 2017

Revision No. and Date: _____

Revision No. and Date: _____

Revision No. and Date: _____

Revision No. and Date: _____

Final Approval Date:_____

Project Owner's Certification

This Mojave River Watershed Water Quality Management Plan (WQMP) has been prepared for County of San Bernardino Project Management Division by W.J. McKeever Inc.. The WQMP is intended to comply with the requirements of the Insert Jurisdiction 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):	B201700541
Tract/Parcel Map Number(s):		Building Permit Number(s):	B201609113
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 3093-251-01

Owner's Signature			
Owner Name: County of San Bernardino			
Title	Scott Hughes		
Company			
Address	385 N. Arrowhead Avenue, 3rd Floor, San Bernardino, CA 92415		
Email	scott.hughes@pmd.sbcounty.gov		
Telephone #	909 771-1182		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):		Grading Permit Number(s):	B201700541
Tract/Parcel Map Number(s):		Building Permit Number(s):	B201609113
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 3093-251-01

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

Engineer: William J. McKeever		PE Stamp Below
Title	RCE 22502	
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Address	900 E.Washington St., Ste. 208, Colton, CA 92324	
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Telephone #	(909) 825-8048	
Signature		
Date	2/24/17	

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 (LRWQCB). This document should not be confused with the WQMP template for the Santa Ana Phase I area of San Bernardino County.

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

Section 1 Discretionary Permit(s)

Form 1-1 Project Information

Project Name	San Bernardino County High Desert Service Center				
Project Owner Contact Name:	County of San Bernardino				
Mailing Address:	385 N. Arrowhead Ave., 3rd Floor, San Bernardino, CA 92415	E-mail Address:	scott.hughes@pmd.sbcounty.gov	Telephone:	909 771-1182
Permit/Application Number(s):		Tract/Parcel Map Number(s):	APN 3093-251-01		
Additional Information/ Comments:					
Description of Project:	Construct a 24,389 SF vehicle and equipment maintenance building and associated 111,292 +/- SF parking and access area on a 3.6 Acre Lot. The project will construct an infiltration basin with a pre-filter capable of treating the entire DCV of 9,064 CF. The proposed capture volume is 11,960 CF.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.					

Section 2 Project Description

2.1 Project Information

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

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

2.1.1 Project Sizing Categorization

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

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

Form 2.1-1 Description of Proposed Project

1 Regulated Development Project Category (Select all that apply):			
☒ #1 New development involving the creation of 5,000 ft^2 or more of impervious surface collectively over entire site	☐ #2 Significant re-development involving the addition or replacement of 5,000 ft^2 or more of impervious surface on an already developed site	☐ #3 Road Project – any road, sidewalk, or bicycle lane project that creates greater than 5,000 square feet of contiguous impervious surface	☐ #4 LUPs – linear underground/overhead projects that has a discrete location with 5,000 sq. ft. or more new constructed impervious surface

☐ Site Design Only (Project Total Square Feet > 2,500 but < 5,000 sq.ft.) *Will require source control Site Design Measures. Use the "PCMP" Template. Do not use this WQMP Template.*

2 Project Area (ft2):	215,622 SF	3 Number of Dwelling Units:	0	4 SIC Code:	7539

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 stormwater facilities:
The County of San Bernardino will be the Owner and Operator of the property. They will provide the long term maintenance of the infiltration water quality basin.

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 ☐	Solvent 140 (Petoleum Distillate Mineral Oil)
Nutrients - Phosphorous	E ☒	N ☐	Landscape Fertilizer
Nutrients - Nitrogen	E ☒	N ☐	Landscape Fertilizer
Noxious Aquatic Plants	E ☒	N ☐	Landscaping
Sediment	E ☐	N ☒	from Landscaping
Metals	E ☒	N ☐	Waste Materials from Welding
Oil and Grease	E ☒	N ☐	Motor Oil, Ethylene Glycol. Antifreeze
Trash/Debris	E ☒	N ☐	General Office, Rubber
Pesticides / Herbicides	E ☒	N ☐	Pest Control
Organic Compounds	E ☒	N ☐	Landscape, Solvents 140, 1, 1, 1, 2-Tetraflouroethane Refrigerant
Other:	E ☒	N ☐	Lead Acid Batteries
Other:	E ☒	N ☐	Argon Gas - Welding
Other:	E ☒	N ☐	Propane

Section 3 Site and Watershed Description

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

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34.4732	Longitude -117.3359	Thomas Bros Map page 4386 A6

1 San Bernardino County climatic region: ☒ Desert

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

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 DMA C flows to DA1 DMA A	*Ex. Bioretention overflow to vegetated bioswale with 4' bottom width, 5:1 side slopes and bed slope of 0.01. Conveys runoff for 1000' through DMA 1 to existing catch basin on SE corner of property*
DA1 DMA A to Outlet 1	Project surface drains to an infiltration basin that captures the entire DCV.
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	DMA B	DMA C	DMA D
1 DMA drainage area (ft^2)	157,239			
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*	1			
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)	580			
6 Longest flowpath slope (ft/ft)	S=0.0228			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Barren			
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***	Good			

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 SWRCB site: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	Mojave River
Applicable TMDLs *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	Fluoride
303(d) listed impairments *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	Fluoride
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	Desert Tortoise Habitat Cat 3
Hydromodification Assessment	☐ Yes *Complete Hydromodification Assessment. Include Forms 4.2-2 thraugh Form 4.2-5 and Hydromodification BMP Form 4.3-9 in submittal* ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMPs and Site Design BMP Measures

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

4.1.1 Source Control BMPs

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

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

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

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	County to distribute to onsite Superintendent practical educational materials on general housekeeping practices tht contribute to the protection of stormwater quality.
N2	Activity Restrictions	☒	☐	County will direct staff to restrict the use and handling of potential pollutants that could discharge in the storm drain system. Some of the material that should be mentioned is as follows: (1) prohibition of blowing, sweeping or hosing debris into streets, (2) prohibit dumping of any waste into the MS4 or receiving waters. Educational materials on this BMP can be found in Section 4 of this report.
N3	Landscape Management BMPs	☒	☐	Site Superintendent to check landscape and irrigation on a weekly basis.
N4	BMP Maintenance	☒	☐	Site Superintendent to inspect and repair as necessary prior to and after any rain event.
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	Site Superintendent to follow all State and County requirements.
N6	Local Water Quality Ordinances	☒	☐	County to comply with any City of Victorville Water Quality Ordinances.
N7	Spill Contingency Plan	☒	☐	County will provide a "Spill Contingency Plan" that will be in accordance with Section 6.95 of the California Health and Safety Code. County will follow the San Bernardino's Spill Contingency Plan found at www.sbcfire.org/hazmat/forms.guidelines.asp. Educational materials on this BMP can be found in Section 4 of this report.
N8	Underground Storage Tank Compliance	☐	☒	There are no underground storage tanks on this site.
N9	Hazardous Materials Disclosure Compliance	☒	☐	Superintendent to follow all State and County requirements.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☒	☐	Superintendent to follow Code requirements.
N11	Litter/Debris Control Program	☒	☐	Superintendet to inspect property on a weekly basis and collect and properly dispose of any litter/debris found.
N12	Employee Training	☒	☐	Superintendent to inform all employees of WQMP and provisions they are to fulfill.
N13	Housekeeping of Loading Docks	☐	☒	No loading docks onsite.
N14	Catch Basin Inspection Program	☐	☒	No catch basins.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Private parking lots will be swept at least quarterly of each year including prior to the storm season (Oct 1-April 30 each year) in the later summer or early fall, to reduce the amount of sediment, garden waste and trash entering infiltration/water quality basin. Further educational materials on this BMP can be found in Section 4 of this report.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	No non-structural measures.
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)	☐	☒	No storm drains.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	None onsite.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	All dumpsters will be in a trash enclosure that is designed to prevent run on of offsite flows. All dumpsters will have lids and be inspected weekly for leaks and replaced as necessary.
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)	☒	☐	Landscaping throughout the project will include drought tolerant plantings resulting in water conservation. Owner will implement practices to maintain landscaping, some of which include: (1) Inspect irrigation system if any signs of malfunction have occurrd, (2) If malfunction found, repair the irrigation equipment immediately, (3) if mulch is used, replenish mulch, (4) Weeding and removal of litter if weeding and/or litter is visible. Further educational materials on this BMP can be found in Section 4 of this report.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Will provide onsite.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	All slopes to be re-vegetated with deep rooted drought tolerant plants to prevent material runoff.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	No dock onsite.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☒	☐	All maintenance takes place inside of building.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☒	☐	Wash area contained within a berm and has a control valve.

S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No outdoor processing.

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)	☒	☐	Wash area contained within a berm and has a conrol valve.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling areas
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No hillsides
S14	Wash water control for food preparation areas	☐	☒	No food preparation
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	No community car wash racks

4.1.2 Site Design BMPs

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

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

Describe site design and drainage plan including:

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

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

Form 4.1-3 Site Design Practices Checklist

Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Minimize impervious areas: Yes ☒ No ☐ Explanation: Only necessary portion of site is being used for development. A portion of the site on the North and South side will be left natural.
Maximize natural infiltration capacity; Including improvement and maintenance of soil: Yes ☒ No ☐ Explanation: A portion of the site on the North and South will be left natural.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: Site will discharge at original northeast corner location.
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: Entire developed site will discharge to an Infiltration Basin.
Use of Porous Pavement.: Yes ☐ No ☒ Explanation: This site has a heavy traffic load, but the entire developed site will discharge to an Infiltration Basin.
Protect existing vegetation and sensitive areas: Yes ☒ No ☐ Explanation: A portion of the site on the North and South side will be left natural.
Re-vegetate disturbed areas. Including planting and preservation of drought tolerant vegetation. : Yes ☒ No ☐ Explanation: All landscape area to be re-vegetated with drought tolerant vegetation.

Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: No compaction methods will be used in basin.
Utilize naturalized/rock-lined drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: No underground piping onsite.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐ Explanation: Landscape areas will be staked.
Use of Rain Barrels and Cisterns, Including the use of on-site water collection systems.: Yes ☐ No ☒ Explanation: No onsite collection system proposed.
Stream Setbacks. Includes a specified distance from an adjacent steam: : Yes ☐ No ☒ Explanation: No adjacent 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 BMPs and Site Design BMP measures, any remaining runoff from impervious DMAs must be directed to one or more on-site, treatment BMPs (LID or biotreatment) designed to infiltrate, evaportranspire, and/or bioretain the amount of runoff specified in Permit Section E.12.e (ii)(c) Numeric Sizing Criteria for Storm Water Retention and Treatment.

4.2.1 Project Specific Hydrology Characterization

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

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

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

Methods applied in the following forms include:

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

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

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

1 Project area DA 1 (ft^2): 157,239	2 Imperviousness after applying preventative site design practices (Imp%): 90 %	3 Runoff Coefficient (Rc): _0.7303 $R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.39 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.4825 *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): 9,064 *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** *Form 4.2-3 Item 12*	**2** *Form 4.2-4 Item 13*	**3** *Form 4.2-5 Item 10*
Post-developed	**4** *Form 4.2-3 Item 13*	**5** *Form 4.2-4 Item 14*	**6** *Form 4.2-5 Item 14*
Difference	**7** *Item 4 – Item 1*	**8** *Item 2 – Item 5*	**9** *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** % *Item 7 / Item 1*	**11** % *Item 8 / Item 2*	**12** % *Item 9 / Item 3*

10-Year 24-Hour Volume Undeveloped	26,428 CF
10-Year 24-Hour Volume Developed	32,186 CF
Difference	5,758 CF

See Synthetic Unit Calculations

The difference in the 10-year 24-hour undeveloped and developed volume will be contained in the infiltration area of the basin.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Compute peak runoff for pre- and post-developed conditions

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

8 Pre-developed Q_p at T_c for DMA A: *Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	**9** Pre-developed Q_p at T_c for DMA B: *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	**10** Pre-developed Q_p at T_c for DMA C: *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*
10 Peak runoff from pre-developed condition confluence analysis (cfs):		*Maximum of Item 8, 9, and 10 (including additional forms as needed)*
11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*	**12** Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*	**13** Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*
14 Peak runoff from post-developed condition confluence analysis (cfs):		*Maximum of Item 11, 12, and 13 (including additional forms as needed)*
15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs):		*$Q_{p\text{-}hydro}$ = (Item 14 * 0.95) – Item 10*

4.3 BMP Selection and Sizing

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

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

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

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

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

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

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

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

4.3.1 Exceptions to Requirements for Bioretention Facilities

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

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

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

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

Form 4.3-1 Infiltration BMP Feasibility (DA 1)	
Feasibility Criterion – Complete evaluation for each DA on the Project Site	
[1] Would infiltration BMP pose significant risk for groundwater related concerns? *Refer to Section 5.3.2.1 of the TGD for WQMP*	Yes ☐ No ☒
If Yes, Provide basis: (attach)	
[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? (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.	Yes ☐ No ☒
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? *See Section 3.5 of the TGD for WQMP and WAP*	Yes ☐ No ☒
If Yes, Provide basis: (attach)	
[7] Any answer from Item 1 through Item 3 is "Yes": *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.*	Yes ☐ No ☐
[8] Any answer from Item 4 through Item 6 is "Yes": *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.*	Yes ☐ No ☐
[9] All answers to Item 1 through Item 6 are "No": *Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP.* *Proceed to Form 4.3-2, Site Design BMPs.*	

4.3.2 Site Design BMP

Section E.12.e. of the Small Phase II MS4 Permit emphasizes the use of LID preventative measures; and the use of Site Design Measures reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable Site Design Measures shall be provided except where they are mutually exclusive

with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of Site Design BMPs. If a project cannot feasibly meet BMP sizing requirements or cannot fully address hydromodification, feasibility of all applicable Site Design BMPs must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design BMP. Refer to Section 5.4 in the TGD for more detailed guidance.

Form 4.3-2 Site Design BMPs (DA 1)

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 adequate pretreatment to address pollutants of concern unless these high-risk areas are isolated from storm water runoff or bioretention areas with no chance of spill migration.

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

1 Remaining LID DCV not met by site design BMP (ft^3): *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 DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods*	7.0		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	3.5		
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*	2		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2		
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*	4,160		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0		
12 Gravel porosity	0		
13 Duration of storm as basin is filling (hrs) *Typical ~3hrs*	3		
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	11,960		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	0		
16 Total Retention Volume from LID Infiltration BMPs: 11,960 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 100% *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 (ft^3): 0 *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 ond 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*	Flow-based biotreatment *Use Form 4.3-7 to compute treated flow*
	☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft^3): *Form 4.3-5 Item 15 + Form 4.3-6 Item 13*	**4** Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): *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): 9,064 *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): 11,960 *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): 0 *(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): 11,960 *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): 0 *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site BMPs (ft^3): 0

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

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

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

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

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

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

4.4 Alternative Compliance Plan (if applicable)

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

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

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

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

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

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

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

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

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

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

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

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Infiltration Basin	County of San Bernardino	Clean out debris and overgrown brush	Pre storm and on a monthly basis
Swale Guard	County of San Bernardino	Clean out sediment and debris see maintenance guide attached	Prior to, during and following rainy season Oct-March

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.

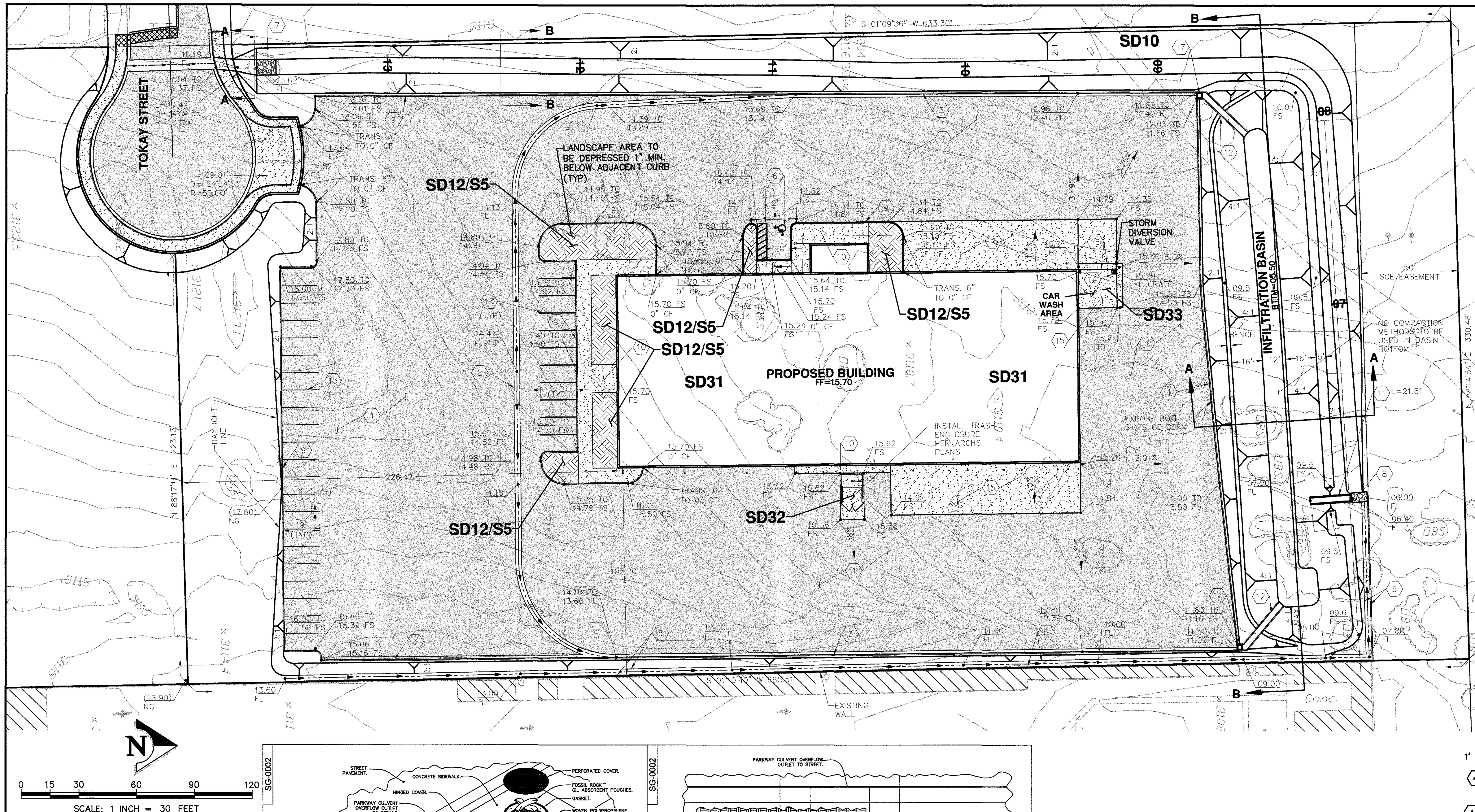
6.3 Post Construction

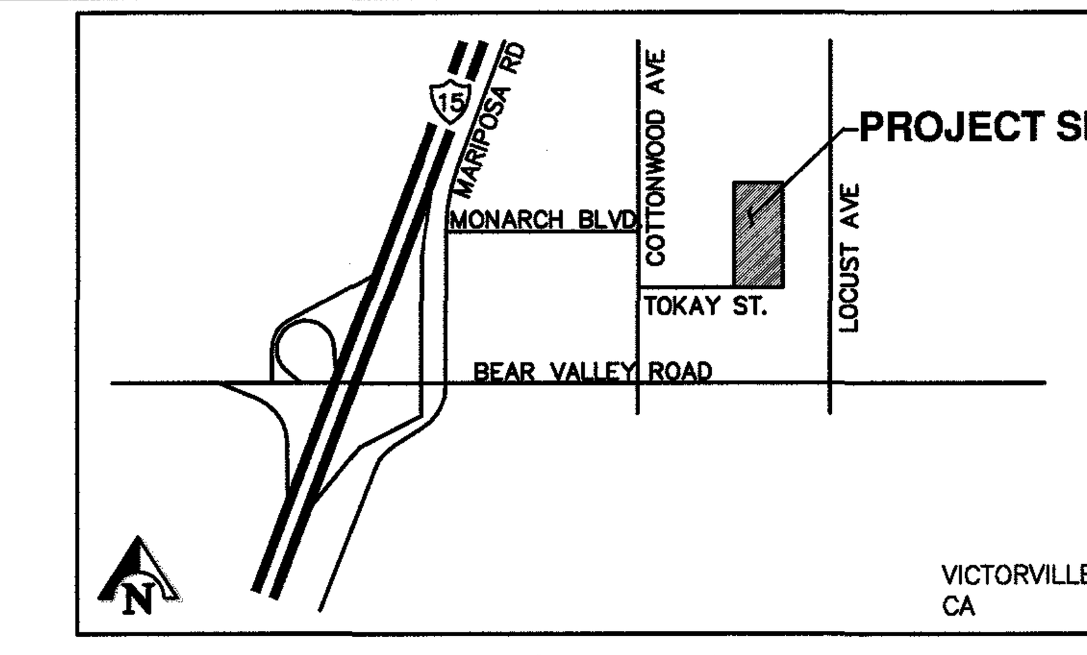
Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

6.4 Other Supporting Documentation

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

EXHIBIT "A"
WATER QUALITY MANAGEMENT PLAN





VICINITY MAP
NTS

NOTE LEGEND:

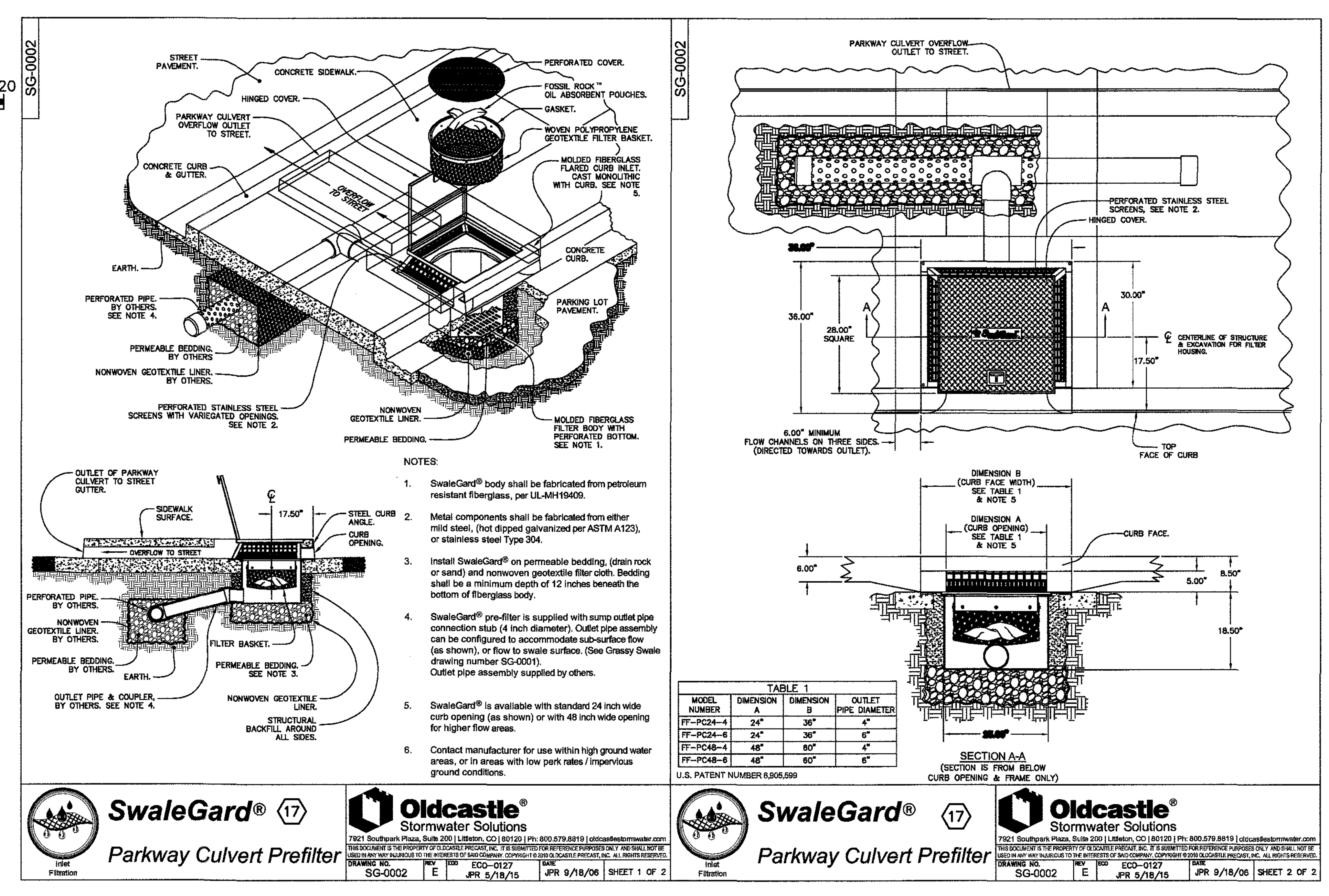
S5 – DEPRESS LANDSCAPE AREAS
SD10 – SITE DESIGN & LANDSCAPE PLANNING
SD12 – EFFICIENT IRRIGATION
SD31 – MAINTENANCE BAYS AND DOCKS
SD32 – TRASH STORAGE AREA
SD33 – VEHICLE WASHING AREAS

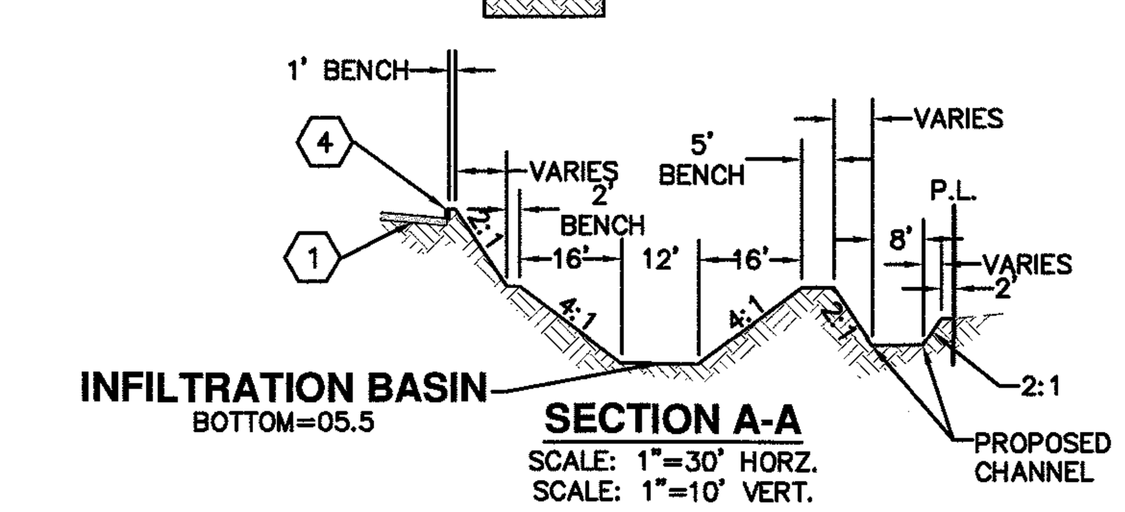
CONSTRUCTION NOTES:

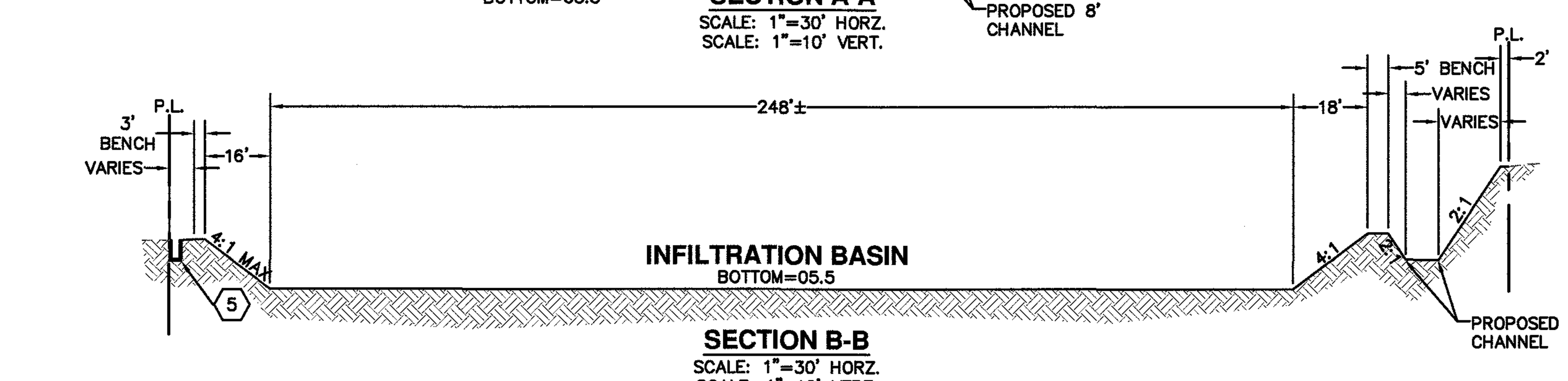
1. CONSTRUCT 3.5" OF AC PAVEMENT OVER 6.5" CLASS 2 AB
2. CONSTRUCT 3' WIDE RIBBON GUTTER.
3. CONSTRUCT 6" CURB & GUTTER PER CITY OF VICTORVILLE STD. DWG. S-01.
4. CONSTRUCT 6" AC BERM PER S.B. COUNTY STD. DWG. NO.117
5. CONSTRUCT 2' WIDE CHANNEL.
6. PLACE HANDICAP SPACES.
7. INSTALL 4" THICK 10'x10' CONCRETE RIP. RAD PAD W/ 6" MIN. DIA. ROCK SET 2" INTO CONCRETE.
8. CONSTRUCT 4" THICK CONCRETE RIP RAP PAD W/ 6" MIN. DIA. ROCK SET 2" INTO CONCRETE.
9. CONSTRUCT 6" CURB PER CITY OF VICTORVILLE STD. DWG. S-09.
10. CONSTRUCT 4" THICK SIDEWALK
11. INSTALL DISCHARGE OUTLET BASIN NO. 3.
12. CONSTRUCT DOWNDRAIN
13. PAINT 4" PARKING STRIPING.
14. INSTALL FOX DEMAND DRIVEN DIVERSION SYSTEM DD 600 W/A CLASS D GRATE OR APPROVED EQUAL SEE PLUMBING PLAN FOR CONNECTION TO WATER SYSTEM.
15. CONSTRUCT 7" OF CONCRETE OVER 4" CLASS 2 BASE. #4 BARS 12" O.C. BOTH WAYS.
16. CONSTRUCT CONCRETE BERM
17. INSTALL KRISTAR SWALEGARD PREFILTER PER DETAIL THIS SHEET.

HATCH LEGEND:

– INDICATES AC PAVENING
– INDICATES CONCRETE
– INDICATES LANDSCAPING







BENCHMARK

ELEVATIONS FOR THIS PROJECT WERE ESTABLISHED BY GPS METHODS, TRANSFERRED FROM CORS STATION P470, ELLIPSOID HEIGHT 3254.90, AS PUBLISHED BY THE NATIONAL GEODETIC SURVEY. ELLIPSOID HEIGHT WAS MODELED TO AN ELEVATION OF 3359.33 (NAVD88) USING USGEOID12B.

REGISTERED PROFESSIONAL ENGINEER – WILLIAM J. McKEEVER – No. 22502 – Exp. 12-31-17 – CIVIL – STATE OF CALIFORNIA

W.J. McKEEVER, INC.
CIVIL ENGINEERING
900 E. WASHINGTON STREET, SUITE 208 COLTON, CA 92324
PH:(909) 825-8048 FAX:(909) 825-8639

PREPARED BY: WILLIAM J. McKEEVER
R.C.E. NO. 22502
DATE: 2/21/17

CITY OF VICTORVILLE
ENGINEERING DEPARTMENT
14343 Civic Drive, Victorville, Co. 92392 (760) 955-5158

NO.	REVISION	BY	DATE
1	PLAN CHECK SUBMITTAL		12/9/16

WATER QUALITY CONTROL PLAN
–
PLAN VIEW

FIELD BOOK NO. (S)
BENCH MARK: – SEE ABOVE
ELEVATION = –
COV CONTROL –
DESIGN BY: G.M.
DRAWN BY: J.V.
CHECKED BY: W.J.M.
DATE: XXX
SHEET NO. 1 OF 1
DRAWING No. XX-00
PROJECT NO. TBD
APPROVED BY: CITY ENGINEER –
DATE:
R.C.E. –
EXP. –

User: Admin
File Name: G:\ACADDWGS\H-216 Holt W\H216_Final Engineering\H216_WQMP_01 PV.dwg
Last Update:
Plot Date: 2/21/2017 3:05 PM
2/21/2017 2:56 PM

2/21/2017 3:05:27 PM

EXHIBIT "B"

BMPs

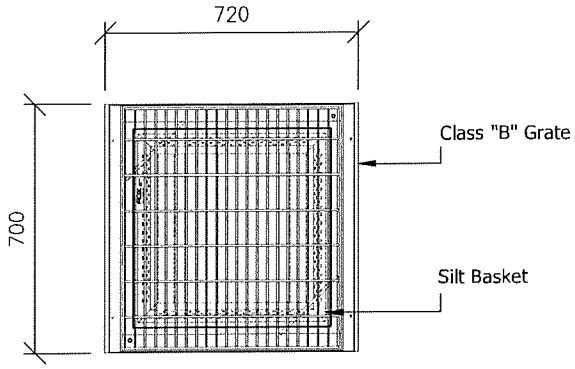
Schematic Detail of DD600 System

SPECIFICATIONS

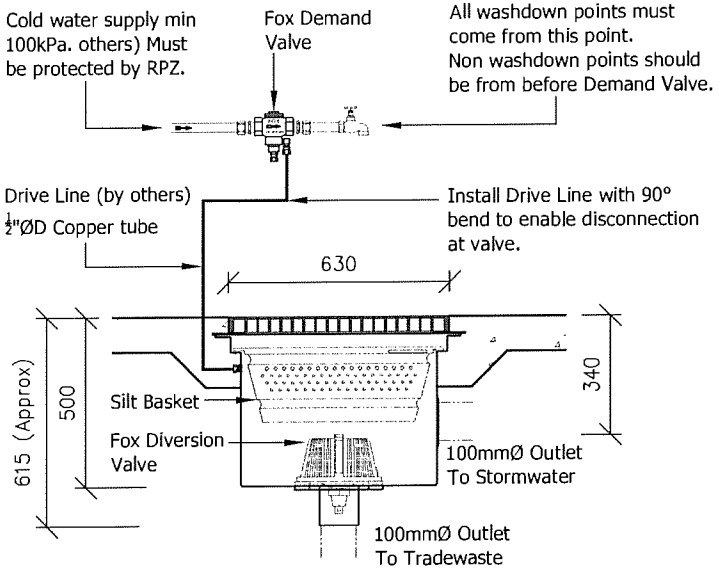
Chamber Capacity	130 Litres
Material	6mm MDPE
Silt Basket Capacity	50 Litres 9mm holes
Diversion Valve	
Flow Rate	1200l/min @.5m head
Grate	Class 'B' Galvanised

Available Option
150mm Stormwater Outlet
Class 'D' Grate
Note: Inverts will change.
Request details if required.

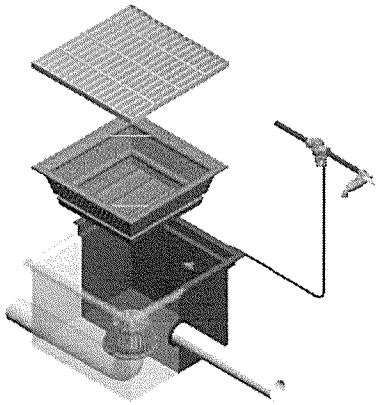
PROCESS DESCRIPTION
The Fox DD600 is a demand driven diversion unit that is designed for use in an area where, at the end of a wash activity the area will be hosed clean of pollutants such as grease and oils. **It is most important that the area be left clean as there is no protection for the environment when a wash operation is not taking place.**
All runoff is presented through the grated inlet and a polyethylene basket captures silt, solids and free floating debris. This is removable for disposal of captured pollutants.
A Fox Diversion Valve is fitted in the bottom of the pit and is connected via a ½" drive line to the Demand Valve by the installing plumber. This is the signal line that will activate the diversion valve when the demand for wash water is detected.
During a wash operation all runoff is diverted to a holding tank for treatment before exiting to the sewer. Once the wash activity has ended the valve will close allowing any rain to fill the chamber and leave through the stormwater outlet.



PLAN



Elevation



FOX ENVIRONMENTAL SYSTEMS

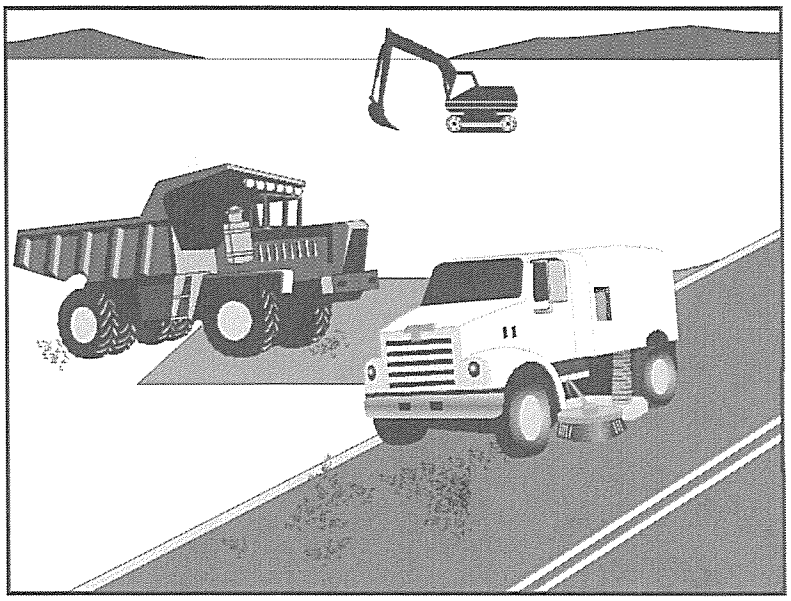
This is a schematic representation only. Slab size and gradient to engineers details as arranged by customer. All plumbing and electrical connections to be installed by certified tradesmen in accordance with relative authorities requirements. Tradesmen to be engaged by the purchaser. System to be approved by relative Local Authorities before installation.

Project
System Specifications

Drawing Title
DD600 System

Drawn by:	J.F.S
Date:	20/10/2009
Scale:	As Specified
Drawing No:	A4-SPEC-1003/2

Street Sweeping and Vacuuming SE-7



Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Targeted Constituents

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

Potential Alternatives

None

Description and Purpose

Street sweeping and vacuuming includes use of self-propelled and walk-behind equipment to remove sediment from streets and roadways, and to clean paved surfaces in preparation for final paving. Sweeping and vacuuming prevents sediment from the project site from entering storm drains or receiving waters.

Suitable Applications

Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

Limitations

Sweeping and vacuuming may not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

Implementation

- Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be focused, and perhaps save money.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed on a daily basis.
- Do not use kick brooms or sweeper attachments. These tend to spread the dirt rather than remove it.

- If not mixed with debris or trash, consider incorporating the removed sediment back into the project

Costs

Rental rates for self-propelled sweepers vary depending on hopper size and duration of rental. Expect rental rates from $58/hour (3 yd^3 hopper) to $88/hour (9 yd^3 hopper), plus operator costs. Hourly production rates vary with the amount of area to be swept and amount of sediment. Match the hopper size to the area and expect sediment load to minimize time spent dumping.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- When actively in use, points of ingress and egress must be inspected daily.
- When tracked or spilled sediment is observed outside the construction limits, it must be removed at least daily. More frequent removal, even continuous removal, may be required in some jurisdictions.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently; maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Labor Surcharge and Equipment Rental Rates, State of California Department of Transportation (Caltrans), April 1, 2002 – March 31, 2003.

Trash Storage Areas SD-32

Description

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

Approach

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

Design Objectives

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

Suitable Applications

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

Design Considerations

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

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

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Other Resources

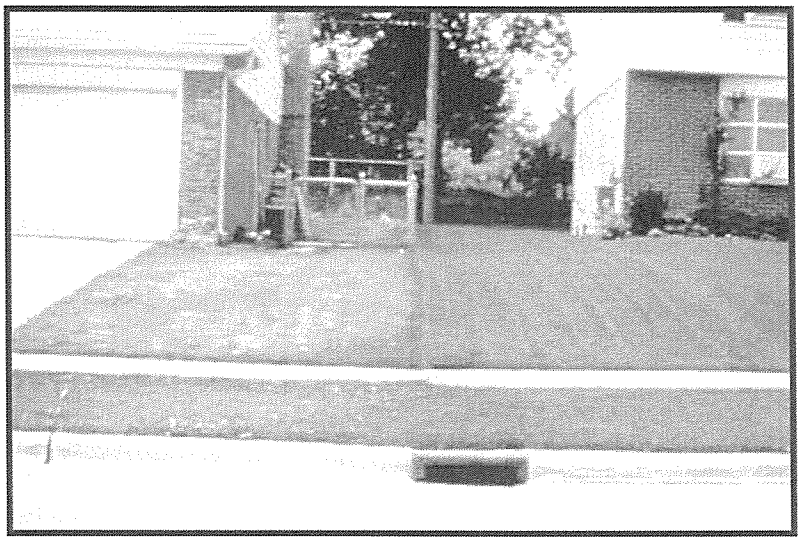
A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

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

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

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

Efficient Irrigation SD-12



Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Other Resources

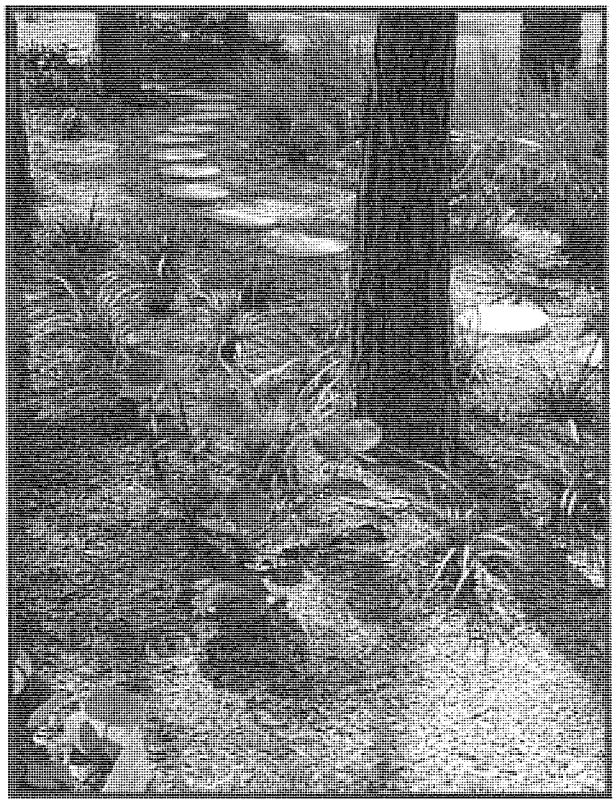
A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

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

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

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

Site Design & Landscape Planning SD-10



Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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

Conserve Natural Areas during Landscape Planning

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

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

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

Protection of Slopes and Channels during Landscape Design

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

Redeveloping Existing Installations

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

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

Other Resources

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

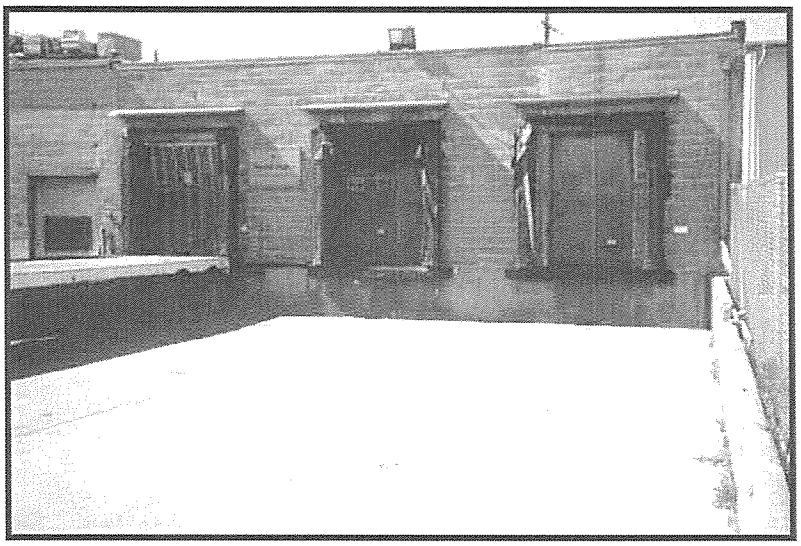
Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

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

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

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

Maintenance Bays & Docks SD-31



Design Objectives

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

Description

Several measures can be taken to prevent operations at maintenance bays and loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the stormwater conveyance system.

Approach

In designs for maintenance bays and loading docks, containment is encouraged. Preventative measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

Suitable Applications

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

Design Considerations

Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Designing New Installations

Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.
- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).

- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters form entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.

- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.

- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.

- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.

- Other features may be 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.

Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

Other Resources

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

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

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

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

Vehicle Washing Areas SD-33

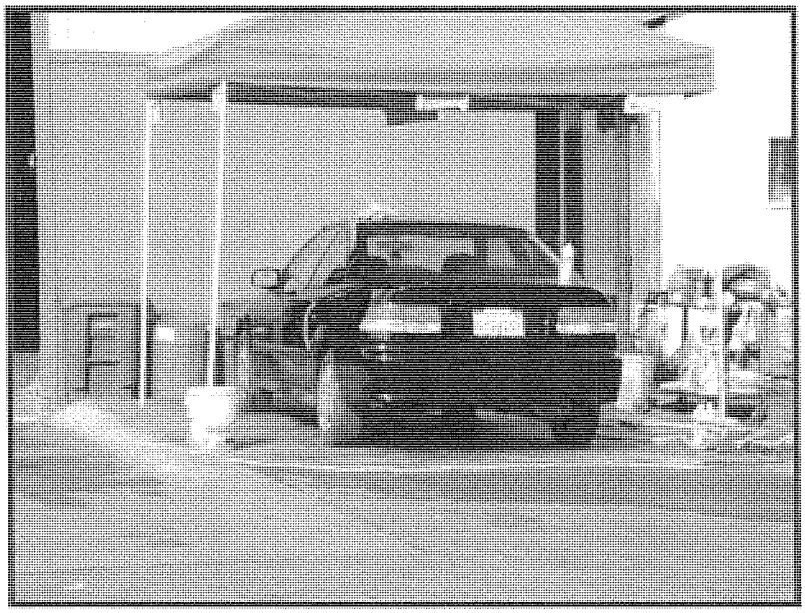


Photo Credit: Geoff Brosseau

Design Objectives

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

Description

Vehicle washing, equipment washing, and steam cleaning may contribute high concentrations of metals, oil and grease, solvents, phosphates, and suspended solids to wash waters that drain to stormwater conveyance systems.

Approach

Project plans should include appropriately designed area(s) for washing-steam cleaning of vehicles and equipment. Depending on the size and other parameters of the wastewater facility, wash water may be conveyed to a sewer, an infiltration system, recycling system or other alternative. Pretreatment may be required for conveyance to a sanitary sewer.

Suitable Applications

Appropriate applications include commercial developments, restaurants, retail gasoline outlets, automotive repair shops and others.

Design Considerations

Design requirements for vehicle maintenance are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. Design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Designing New Installations

Areas for washing/steam cleaning should incorporate one of the following features:

- Be self-contained and/or covered with a roof or overhang
- Be equipped with a clarifier or other pretreatment facility
- Have a proper connection to a sanitary sewer

- Include other features which are comparable and equally effective

CAR WASH AREAS - Some jurisdictions' stormwater management plans include vehicle-cleaning area source control design requirements for community car wash racks in complexes with a large number of dwelling units. In these cases, wash water from the areas may be directed to the sanitary sewer, to an engineered infiltration system, or to an equally effective alternative. Pre-treatment may also be required.

Depending on the jurisdiction, developers may be directed to divert surface water runoff away from the exposed area around the wash pad (parking lot, storage areas), and wash pad itself to alternatives other than the sanitary sewer. Roofing may be required for exposed wash pads.

It is generally advisable to cover areas used for regular washing of vehicles, trucks, or equipment, surround them with a perimeter berm, and clearly mark them as a designated washing area. Sumps or drain lines can be installed to collect wash water, which may be treated for reuse or recycling, or for discharge to the sanitary sewer. Jurisdictions may require some form of pretreatment, such as a trap, for these areas.

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.

Additional Information

Maintenance Considerations

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

Other Resources

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

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

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

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

EXHIBIT "C"
UNIT HYDROGRAPH CALCULATIONS

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

Study date 11/17/16

++

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

Program License Serial Number 6222

S.B. Co. High Desert Service Center
Victorville
Onsite Undeveloped
10 Yr 24 Hr

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		
3.60	1	0.67
Rainfall data for year 2		
3.60	6	0.87
Rainfall data for year 2		
3.60	24	1.56
Rainfall data for year 100		
3.60	1	1.14
Rainfall data for year 100		
3.60	6	2.37
Rainfall data for year 100		
3.60	24	4.68

++

******** 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)
91.0	91.0	3.60	1.000	0.174	1.000	0.174

Area-averaged adjusted loss rate Fm (In/Hr) = 0.174

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

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
3.60	1.000	91.0	91.0	0.99	0.677

Area-averaged catchment yield fraction, Y = 0.677
Area-averaged low loss fraction, Yb = 0.323
++
Watercourse length = 580.00(Ft.)
Length from concentration point to centroid = 290.00(Ft.)
Elevation difference along watercourse = 13.20(Ft.)
Mannings friction factor along watercourse = 0.030
Watershed area = 3.60(Ac.)
Catchment Lag time = 0.042 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 200.4621
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.174(In/Hr)
Average low loss rate fraction (Yb) = 0.323 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall = 0.319(In)
Computed peak 30-minute rainfall = 0.547(In)
Specified peak 1-hour rainfall = 0.673(In)
Computed peak 3-hour rainfall = 1.093(In)
Specified peak 6-hour rainfall = 1.485(In)
Specified peak 24-hour rainfall = 2.844(In)

Rainfall depth area reduction factors:
Using a total area of 3.60(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000	Adjusted rainfall = 0.319(In)
30-minute factor = 1.000	Adjusted rainfall = 0.547(In)
1-hour factor = 1.000	Adjusted rainfall = 0.673(In)
3-hour factor = 1.000	Adjusted rainfall = 1.093(In)
6-hour factor = 1.000	Adjusted rainfall = 1.485(In)
24-hour factor = 1.000	Adjusted rainfall = 2.844(In)

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

++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
(K = 43.54 (CFS))		
1	42.286	18.410
2	87.800	19.816
3	96.624	3.842
4	100.000	1.470

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.3193	0.3193
2	0.3931	0.0738
3	0.4439	0.0508
4	0.4840	0.0400
5	0.5175	0.0335
6	0.5466	0.0291
7	0.5724	0.0259
8	0.5958	0.0234
9	0.6172	0.0214
10	0.6371	0.0198
11	0.6555	0.0185
12	0.6729	0.0173
13	0.6971	0.0242
14	0.7203	0.0232
15	0.7426	0.0223
16	0.7641	0.0215
17	0.7848	0.0207
18	0.8049	0.0201
19	0.8243	0.0195
20	0.8432	0.0189
21	0.8616	0.0184
22	0.8795	0.0179
23	0.8969	0.0174
24	0.9139	0.0170
25	0.9306	0.0166
26	0.9468	0.0163
27	0.9628	0.0159
28	0.9783	0.0156
29	0.9936	0.0153
30	1.0086	0.0150
31	1.0233	0.0147
32	1.0378	0.0145
33	1.0520	0.0142
34	1.0660	0.0140
35	1.0797	0.0137
36	1.0932	0.0135
37	1.1065	0.0133
38	1.1196	0.0131
39	1.1326	0.0129
40	1.1453	0.0127
41	1.1578	0.0126
42	1.1702	0.0124
43	1.1825	0.0122
44	1.1945	0.0121
45	1.2064	0.0119
46	1.2182	0.0118
47	1.2298	0.0116
48	1.2413	0.0115
49	1.2527	0.0114
50	1.2639	0.0112
51	1.2750	0.0111
52	1.2860	0.0110
53	1.2968	0.0109
54	1.3076	0.0107
55	1.3182	0.0106
56	1.3288	0.0105
57	1.3392	0.0104

58	1.3495	0.0103
59	1.3597	0.0102
60	1.3699	0.0101
61	1.3799	0.0100
62	1.3899	0.0099
63	1.3997	0.0099
64	1.4095	0.0098
65	1.4192	0.0097
66	1.4288	0.0096
67	1.4383	0.0095
68	1.4477	0.0094
69	1.4571	0.0094
70	1.4664	0.0093
71	1.4756	0.0092
72	1.4847	0.0091
73	1.4944	0.0096
74	1.5039	0.0096
75	1.5134	0.0095
76	1.5229	0.0094
77	1.5322	0.0094
78	1.5415	0.0093
79	1.5507	0.0092
80	1.5599	0.0092
81	1.5690	0.0091
82	1.5781	0.0091
83	1.5871	0.0090
84	1.5960	0.0089
85	1.6049	0.0089
86	1.6137	0.0088
87	1.6225	0.0088
88	1.6312	0.0087
89	1.6398	0.0087
90	1.6485	0.0086
91	1.6570	0.0086
92	1.6655	0.0085
93	1.6740	0.0085
94	1.6824	0.0084
95	1.6908	0.0084
96	1.6991	0.0083
97	1.7074	0.0083
98	1.7156	0.0082
99	1.7238	0.0082
100	1.7319	0.0081
101	1.7400	0.0081
102	1.7481	0.0081
103	1.7561	0.0080
104	1.7640	0.0080
105	1.7720	0.0079
106	1.7799	0.0079
107	1.7877	0.0079
108	1.7955	0.0078
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114	1.8416	0.0076
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116	1.8567	0.0075
117	1.8642	0.0075

118	1.8716	0.0075
119	1.8791	0.0074
120	1.8864	0.0074
121	1.8938	0.0074
122	1.9011	0.0073
123	1.9084	0.0073
124	1.9157	0.0073
125	1.9229	0.0072
126	1.9301	0.0072
127	1.9372	0.0072
128	1.9444	0.0071
129	1.9515	0.0071
130	1.9586	0.0071
131	1.9656	0.0070
132	1.9726	0.0070
133	1.9796	0.0070
134	1.9866	0.0070
135	1.9935	0.0069
136	2.0004	0.0069
137	2.0073	0.0069
138	2.0142	0.0069
139	2.0210	0.0068
140	2.0278	0.0068
141	2.0346	0.0068
142	2.0413	0.0068
143	2.0480	0.0067
144	2.0547	0.0067
145	2.0614	0.0067
146	2.0681	0.0067
147	2.0747	0.0066
148	2.0813	0.0066
149	2.0879	0.0066
150	2.0944	0.0066
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152	2.1075	0.0065
153	2.1140	0.0065
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189	2.3341	0.0058
190	2.3399	0.0058
191	2.3456	0.0058
192	2.3514	0.0057
193	2.3571	0.0057
194	2.3628	0.0057
195	2.3685	0.0057
196	2.3742	0.0057
197	2.3799	0.0057
198	2.3855	0.0057
199	2.3912	0.0056
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201	2.4024	0.0056
202	2.4080	0.0056
203	2.4136	0.0056
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208	2.4413	0.0055
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221	2.5117	0.0053
222	2.5170	0.0053
223	2.5223	0.0053
224	2.5276	0.0053
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243	2.6259	0.0051
244	2.6310	0.0051
245	2.6360	0.0050
246	2.6410	0.0050
247	2.6461	0.0050
248	2.6511	0.0050
249	2.6561	0.0050
250	2.6611	0.0050
251	2.6661	0.0050
252	2.6710	0.0050
253	2.6760	0.0050
254	2.6810	0.0050
255	2.6859	0.0049
256	2.6908	0.0049
257	2.6958	0.0049
258	2.7007	0.0049
259	2.7056	0.0049
260	2.7105	0.0049
261	2.7153	0.0049
262	2.7202	0.0049
263	2.7251	0.0049
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265	2.7348	0.0048
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267	2.7444	0.0048
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272	2.7684	0.0048
273	2.7732	0.0048
274	2.7779	0.0048
275	2.7827	0.0047
276	2.7874	0.0047
277	2.7921	0.0047
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279	2.8016	0.0047
280	2.8063	0.0047
281	2.8110	0.0047
282	2.8157	0.0047
283	2.8203	0.0047
284	2.8250	0.0047
285	2.8297	0.0047
286	2.8343	0.0046
287	2.8389	0.0046
288	2.8436	0.0046

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0046	0.0015	0.0031
2	0.0046	0.0015	0.0031
3	0.0047	0.0015	0.0032
4	0.0047	0.0015	0.0032

5	0.0047	0.0015	0.0032
6	0.0047	0.0015	0.0032
7	0.0047	0.0015	0.0032
8	0.0047	0.0015	0.0032
9	0.0047	0.0015	0.0032
10	0.0047	0.0015	0.0032
11	0.0048	0.0015	0.0032
12	0.0048	0.0015	0.0032
13	0.0048	0.0015	0.0032
14	0.0048	0.0016	0.0033
15	0.0048	0.0016	0.0033
16	0.0048	0.0016	0.0033
17	0.0049	0.0016	0.0033
18	0.0049	0.0016	0.0033
19	0.0049	0.0016	0.0033
20	0.0049	0.0016	0.0033
21	0.0049	0.0016	0.0033
22	0.0049	0.0016	0.0033
23	0.0049	0.0016	0.0033
24	0.0050	0.0016	0.0034
25	0.0050	0.0016	0.0034
26	0.0050	0.0016	0.0034
27	0.0050	0.0016	0.0034
28	0.0050	0.0016	0.0034
29	0.0050	0.0016	0.0034
30	0.0050	0.0016	0.0034
31	0.0051	0.0016	0.0034
32	0.0051	0.0016	0.0034
33	0.0051	0.0016	0.0035
34	0.0051	0.0017	0.0035
35	0.0051	0.0017	0.0035
36	0.0052	0.0017	0.0035
37	0.0052	0.0017	0.0035
38	0.0052	0.0017	0.0035
39	0.0052	0.0017	0.0035
40	0.0052	0.0017	0.0035
41	0.0052	0.0017	0.0036
42	0.0053	0.0017	0.0036
43	0.0053	0.0017	0.0036
44	0.0053	0.0017	0.0036
45	0.0053	0.0017	0.0036
46	0.0053	0.0017	0.0036
47	0.0054	0.0017	0.0036
48	0.0054	0.0017	0.0036
49	0.0054	0.0017	0.0037
50	0.0054	0.0017	0.0037
51	0.0054	0.0018	0.0037
52	0.0055	0.0018	0.0037
53	0.0055	0.0018	0.0037
54	0.0055	0.0018	0.0037
55	0.0055	0.0018	0.0037
56	0.0055	0.0018	0.0038
57	0.0056	0.0018	0.0038
58	0.0056	0.0018	0.0038
59	0.0056	0.0018	0.0038
60	0.0056	0.0018	0.0038
61	0.0057	0.0018	0.0038
62	0.0057	0.0018	0.0038
63	0.0057	0.0018	0.0039
64	0.0057	0.0018	0.0039

65	0.0057	0.0019	0.0039
66	0.0058	0.0019	0.0039
67	0.0058	0.0019	0.0039
68	0.0058	0.0019	0.0039
69	0.0058	0.0019	0.0040
70	0.0059	0.0019	0.0040
71	0.0059	0.0019	0.0040
72	0.0059	0.0019	0.0040
73	0.0059	0.0019	0.0040
74	0.0060	0.0019	0.0040
75	0.0060	0.0019	0.0041
76	0.0060	0.0019	0.0041
77	0.0061	0.0020	0.0041
78	0.0061	0.0020	0.0041
79	0.0061	0.0020	0.0041
80	0.0061	0.0020	0.0042
81	0.0062	0.0020	0.0042
82	0.0062	0.0020	0.0042
83	0.0062	0.0020	0.0042
84	0.0063	0.0020	0.0042
85	0.0063	0.0020	0.0043
86	0.0063	0.0020	0.0043
87	0.0064	0.0021	0.0043
88	0.0064	0.0021	0.0043
89	0.0064	0.0021	0.0043
90	0.0064	0.0021	0.0044
91	0.0065	0.0021	0.0044
92	0.0065	0.0021	0.0044
93	0.0066	0.0021	0.0044
94	0.0066	0.0021	0.0045
95	0.0066	0.0021	0.0045
96	0.0067	0.0021	0.0045
97	0.0067	0.0022	0.0045
98	0.0067	0.0022	0.0046
99	0.0068	0.0022	0.0046
100	0.0068	0.0022	0.0046
101	0.0069	0.0022	0.0046
102	0.0069	0.0022	0.0047
103	0.0069	0.0022	0.0047
104	0.0070	0.0022	0.0047
105	0.0070	0.0023	0.0048
106	0.0070	0.0023	0.0048
107	0.0071	0.0023	0.0048
108	0.0071	0.0023	0.0048
109	0.0072	0.0023	0.0049
110	0.0072	0.0023	0.0049
111	0.0073	0.0024	0.0049
112	0.0073	0.0024	0.0050
113	0.0074	0.0024	0.0050
114	0.0074	0.0024	0.0050
115	0.0075	0.0024	0.0051
116	0.0075	0.0024	0.0051
117	0.0076	0.0024	0.0051
118	0.0076	0.0025	0.0052
119	0.0077	0.0025	0.0052
120	0.0077	0.0025	0.0052
121	0.0078	0.0025	0.0053
122	0.0079	0.0025	0.0053
123	0.0079	0.0026	0.0054
124	0.0080	0.0026	0.0054

125	0.0081	0.0026	0.0055
126	0.0081	0.0026	0.0055
127	0.0082	0.0026	0.0055
128	0.0082	0.0027	0.0056
129	0.0083	0.0027	0.0056
130	0.0084	0.0027	0.0057
131	0.0085	0.0027	0.0057
132	0.0085	0.0027	0.0058
133	0.0086	0.0028	0.0058
134	0.0087	0.0028	0.0059
135	0.0088	0.0028	0.0059
136	0.0088	0.0028	0.0060
137	0.0089	0.0029	0.0061
138	0.0090	0.0029	0.0061
139	0.0091	0.0029	0.0062
140	0.0092	0.0030	0.0062
141	0.0093	0.0030	0.0063
142	0.0094	0.0030	0.0063
143	0.0095	0.0031	0.0064
144	0.0096	0.0031	0.0065
145	0.0091	0.0030	0.0062
146	0.0092	0.0030	0.0062
147	0.0094	0.0030	0.0063
148	0.0094	0.0030	0.0064
149	0.0096	0.0031	0.0065
150	0.0097	0.0031	0.0066
151	0.0099	0.0032	0.0067
152	0.0099	0.0032	0.0067
153	0.0101	0.0033	0.0069
154	0.0102	0.0033	0.0069
155	0.0104	0.0034	0.0071
156	0.0105	0.0034	0.0071
157	0.0107	0.0035	0.0073
158	0.0109	0.0035	0.0074
159	0.0111	0.0036	0.0075
160	0.0112	0.0036	0.0076
161	0.0115	0.0037	0.0078
162	0.0116	0.0038	0.0079
163	0.0119	0.0038	0.0081
164	0.0121	0.0039	0.0082
165	0.0124	0.0040	0.0084
166	0.0126	0.0041	0.0085
167	0.0129	0.0042	0.0087
168	0.0131	0.0042	0.0089
169	0.0135	0.0044	0.0092
170	0.0137	0.0044	0.0093
171	0.0142	0.0046	0.0096
172	0.0145	0.0047	0.0098
173	0.0150	0.0048	0.0102
174	0.0153	0.0049	0.0104
175	0.0159	0.0051	0.0108
176	0.0163	0.0052	0.0110
177	0.0170	0.0055	0.0115
178	0.0174	0.0056	0.0118
179	0.0184	0.0059	0.0124
180	0.0189	0.0061	0.0128
181	0.0201	0.0065	0.0136
182	0.0207	0.0067	0.0140
183	0.0223	0.0072	0.0151
184	0.0232	0.0075	0.0157

185	0.0173	0.0056	0.0117
186	0.0185	0.0060	0.0125
187	0.0214	0.0069	0.0145
188	0.0234	0.0076	0.0158
189	0.0291	0.0094	0.0197
190	0.0335	0.0108	0.0227
191	0.0508	0.0145	0.0364
192	0.0738	0.0145	0.0593
193	0.3193	0.0145	0.3048
194	0.0400	0.0129	0.0271
195	0.0259	0.0083	0.0175
196	0.0198	0.0064	0.0134
197	0.0242	0.0078	0.0164
198	0.0215	0.0069	0.0145
199	0.0195	0.0063	0.0132
200	0.0179	0.0058	0.0121
201	0.0166	0.0054	0.0113
202	0.0156	0.0050	0.0106
203	0.0147	0.0047	0.0100
204	0.0140	0.0045	0.0095
205	0.0133	0.0043	0.0090
206	0.0127	0.0041	0.0086
207	0.0122	0.0039	0.0083
208	0.0118	0.0038	0.0080
209	0.0114	0.0037	0.0077
210	0.0110	0.0035	0.0074
211	0.0106	0.0034	0.0072
212	0.0103	0.0033	0.0070
213	0.0100	0.0032	0.0068
214	0.0098	0.0032	0.0066
215	0.0095	0.0031	0.0064
216	0.0093	0.0030	0.0063
217	0.0096	0.0031	0.0065
218	0.0094	0.0030	0.0064
219	0.0092	0.0030	0.0063
220	0.0091	0.0029	0.0061
221	0.0089	0.0029	0.0060
222	0.0087	0.0028	0.0059
223	0.0086	0.0028	0.0058
224	0.0084	0.0027	0.0057
225	0.0083	0.0027	0.0056
226	0.0081	0.0026	0.0055
227	0.0080	0.0026	0.0054
228	0.0079	0.0025	0.0053
229	0.0078	0.0025	0.0053
230	0.0077	0.0025	0.0052
231	0.0076	0.0024	0.0051
232	0.0075	0.0024	0.0050
233	0.0074	0.0024	0.0050
234	0.0073	0.0023	0.0049
235	0.0072	0.0023	0.0049
236	0.0071	0.0023	0.0048
237	0.0070	0.0023	0.0047
238	0.0069	0.0022	0.0047
239	0.0068	0.0022	0.0046
240	0.0068	0.0022	0.0046
241	0.0067	0.0022	0.0045
242	0.0066	0.0021	0.0045
243	0.0065	0.0021	0.0044
244	0.0065	0.0021	0.0044

245	0.0064	0.0021	0.0043
246	0.0063	0.0020	0.0043
247	0.0063	0.0020	0.0042
248	0.0062	0.0020	0.0042
249	0.0062	0.0020	0.0042
250	0.0061	0.0020	0.0041
251	0.0060	0.0019	0.0041
252	0.0060	0.0019	0.0041
253	0.0059	0.0019	0.0040
254	0.0059	0.0019	0.0040
255	0.0058	0.0019	0.0039
256	0.0058	0.0019	0.0039
257	0.0057	0.0019	0.0039
258	0.0057	0.0018	0.0039
259	0.0056	0.0018	0.0038
260	0.0056	0.0018	0.0038
261	0.0056	0.0018	0.0038
262	0.0055	0.0018	0.0037
263	0.0055	0.0018	0.0037
264	0.0054	0.0018	0.0037
265	0.0054	0.0017	0.0036
266	0.0053	0.0017	0.0036
267	0.0053	0.0017	0.0036
268	0.0053	0.0017	0.0036
269	0.0052	0.0017	0.0035
270	0.0052	0.0017	0.0035
271	0.0052	0.0017	0.0035
272	0.0051	0.0017	0.0035
273	0.0051	0.0016	0.0034
274	0.0051	0.0016	0.0034
275	0.0050	0.0016	0.0034
276	0.0050	0.0016	0.0034
277	0.0050	0.0016	0.0034
278	0.0049	0.0016	0.0033
279	0.0049	0.0016	0.0033
280	0.0049	0.0016	0.0033
281	0.0048	0.0016	0.0033
282	0.0048	0.0016	0.0033
283	0.0048	0.0015	0.0032
284	0.0048	0.0015	0.0032
285	0.0047	0.0015	0.0032
286	0.0047	0.0015	0.0032
287	0.0047	0.0015	0.0032
288	0.0046	0.0015	0.0031

Total soil rain loss = 0.82(In)
Total effective rainfall = 2.03(In)
Peak flow rate in flood hydrograph = 6.96(CFS)

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

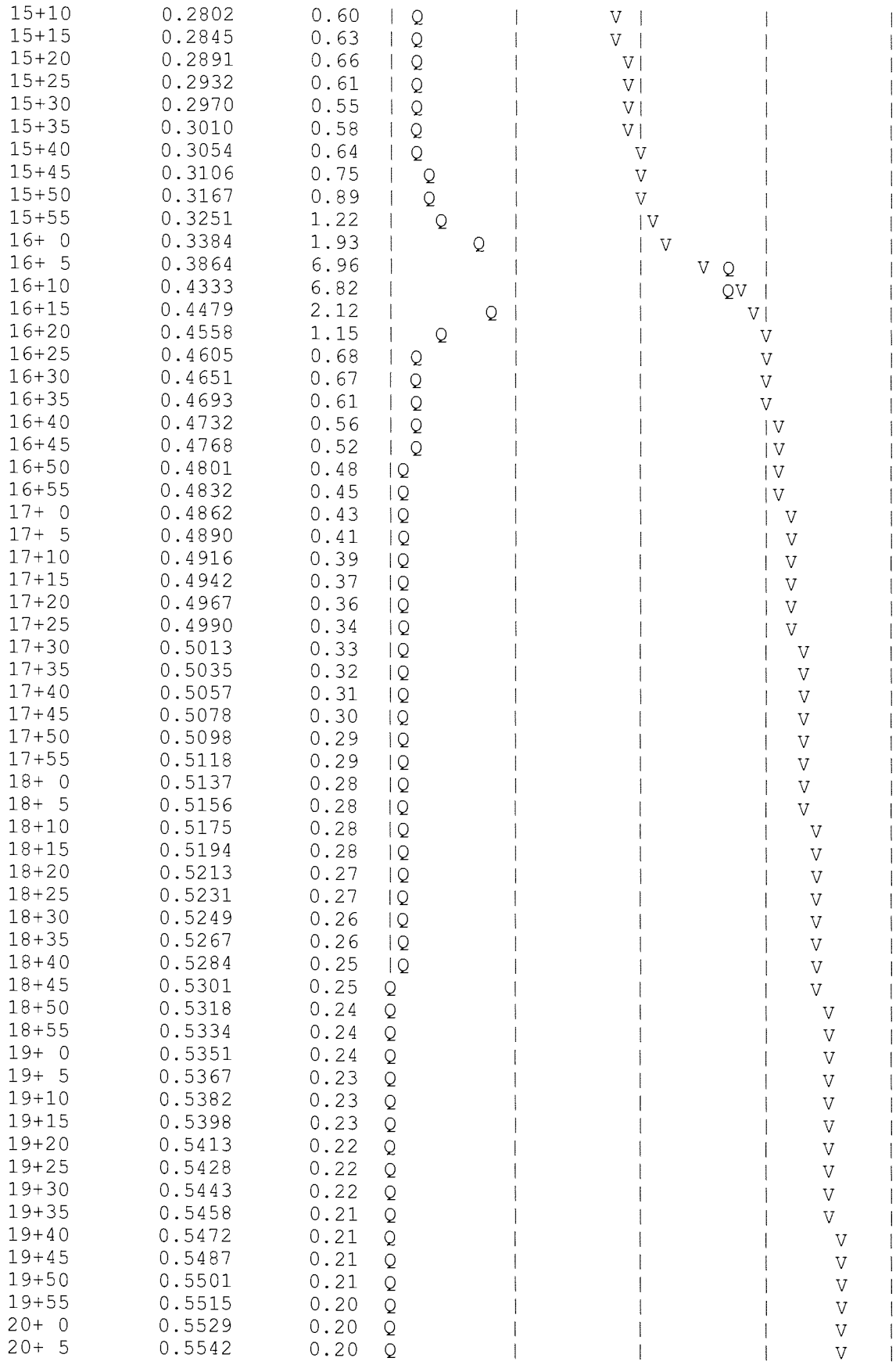
Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0004	0.06	Q	|	|	|	|

0+10	0.0012	0.12	Q				
0+15	0.0021	0.13	Q				
0+20	0.0031	0.14	Q				
0+25	0.0040	0.14	Q				
0+30	0.0050	0.14	Q				
0+35	0.0059	0.14	Q				
0+40	0.0069	0.14	Q				
0+45	0.0079	0.14	Q				
0+50	0.0088	0.14	Q				
0+55	0.0098	0.14	Q				
1+ 0	0.0108	0.14	Q				
1+ 5	0.0117	0.14	Q				
1+10	0.0127	0.14	Q				
1+15	0.0137	0.14	Q				
1+20	0.0147	0.14	Q				
1+25	0.0156	0.14	QV				
1+30	0.0166	0.14	QV				
1+35	0.0176	0.14	QV				
1+40	0.0186	0.14	QV				
1+45	0.0196	0.14	QV				
1+50	0.0206	0.14	QV				
1+55	0.0216	0.15	QV				
2+ 0	0.0226	0.15	QV				
2+ 5	0.0236	0.15	QV				
2+10	0.0246	0.15	QV				
2+15	0.0256	0.15	QV				
2+20	0.0266	0.15	QV				
2+25	0.0277	0.15	QV				
2+30	0.0287	0.15	QV				
2+35	0.0297	0.15	QV				
2+40	0.0307	0.15	Q V				
2+45	0.0318	0.15	Q V				
2+50	0.0328	0.15	Q V				
2+55	0.0339	0.15	Q V				
3+ 0	0.0349	0.15	Q V				
3+ 5	0.0359	0.15	Q V				
3+10	0.0370	0.15	Q V				
3+15	0.0381	0.15	Q V				
3+20	0.0391	0.15	Q V				
3+25	0.0402	0.15	Q V				
3+30	0.0412	0.15	Q V				
3+35	0.0423	0.16	Q V				
3+40	0.0434	0.16	Q V				
3+45	0.0445	0.16	Q V				
3+50	0.0455	0.16	Q V				
3+55	0.0466	0.16	Q V				
4+ 0	0.0477	0.16	Q V				
4+ 5	0.0488	0.16	Q V				
4+10	0.0499	0.16	Q V				
4+15	0.0510	0.16	Q V				
4+20	0.0521	0.16	Q V				
4+25	0.0532	0.16	Q V				
4+30	0.0543	0.16	Q V				
4+35	0.0555	0.16	Q V				
4+40	0.0566	0.16	Q V				
4+45	0.0577	0.16	Q V				
4+50	0.0588	0.16	Q V				
4+55	0.0600	0.16	Q V				
5+ 0	0.0611	0.17	Q V				
5+ 5	0.0622	0.17	Q V				

5+10	0.0634	0.17	Q	V	|	|	|	|
5+15	0.0646	0.17	Q	V	|	|	|	|
5+20	0.0657	0.17	Q	V	|	|	|	|
5+25	0.0669	0.17	Q	V	|	|	|	|
5+30	0.0680	0.17	Q	V	|	|	|	|
5+35	0.0692	0.17	Q	V	|	|	|	|
5+40	0.0704	0.17	Q	V	|	|	|	|
5+45	0.0716	0.17	Q	V	|	|	|	|
5+50	0.0728	0.17	Q	V	|	|	|	|
5+55	0.0740	0.17	Q	V	|	|	|	|
6+ 0	0.0752	0.17	Q	V	|	|	|	|
6+ 5	0.0764	0.17	Q	V	|	|	|	|
6+10	0.0776	0.18	Q	V	|	|	|	|
6+15	0.0788	0.18	Q	V	|	|	|	|
6+20	0.0800	0.18	Q	V	|	|	|	|
6+25	0.0812	0.18	Q	V	|	|	|	|
6+30	0.0825	0.18	Q	V	|	|	|	|
6+35	0.0837	0.18	Q	V	|	|	|	|
6+40	0.0849	0.18	Q	V	|	|	|	|
6+45	0.0862	0.18	Q	V	|	|	|	|
6+50	0.0874	0.18	Q	V	|	|	|	|
6+55	0.0887	0.18	Q	V	|	|	|	|
7+ 0	0.0900	0.18	Q	V	|	|	|	|
7+ 5	0.0912	0.18	Q	V	|	|	|	|
7+10	0.0925	0.19	Q	V	|	|	|	|
7+15	0.0938	0.19	Q	V	|	|	|	|
7+20	0.0951	0.19	Q	V	|	|	|	|
7+25	0.0964	0.19	Q	V	|	|	|	|
7+30	0.0977	0.19	Q	V	|	|	|	|
7+35	0.0990	0.19	Q	V	|	|	|	|
7+40	0.1003	0.19	Q	V	|	|	|	|
7+45	0.1016	0.19	Q	V	|	|	|	|
7+50	0.1030	0.19	Q	V	|	|	|	|
7+55	0.1043	0.19	Q	V	|	|	|	|
8+ 0	0.1057	0.20	Q	V	|	|	|	|
8+ 5	0.1070	0.20	Q	V	|	|	|	|
8+10	0.1084	0.20	Q	V	|	|	|	|
8+15	0.1098	0.20	Q	V	|	|	|	|
8+20	0.1111	0.20	Q	V	|	|	|	|
8+25	0.1125	0.20	Q	V	|	|	|	|
8+30	0.1139	0.20	Q	V	|	|	|	|
8+35	0.1153	0.20	Q	V	|	|	|	|
8+40	0.1167	0.20	Q	V	|	|	|	|
8+45	0.1181	0.21	Q	V	|	|	|	|
8+50	0.1196	0.21	Q	V	|	|	|	|
8+55	0.1210	0.21	Q	V	|	|	|	|
9+ 0	0.1224	0.21	Q	V	|	|	|	|
9+ 5	0.1239	0.21	Q	V	|	|	|	|
9+10	0.1254	0.21	Q	V	|	|	|	|
9+15	0.1268	0.21	Q	V	|	|	|	|
9+20	0.1283	0.22	Q	V	|	|	|	|
9+25	0.1298	0.22	Q	V	|	|	|	|
9+30	0.1313	0.22	Q	V	|	|	|	|
9+35	0.1328	0.22	Q	V	|	|	|	|
9+40	0.1343	0.22	Q	V	|	|	|	|
9+45	0.1359	0.22	Q	V	|	|	|	|
9+50	0.1374	0.22	Q	V	|	|	|	|
9+55	0.1390	0.23	Q	V	|	|	|	|
10+ 0	0.1405	0.23	Q	V	|	|	|	|
10+ 5	0.1421	0.23	Q	V	|	|	|	|

10+10	0.1437	0.23	Q	V|	|	|	|
10+15	0.1453	0.23	Q	V|	|	|	|
10+20	0.1469	0.23	Q	V|	|	|	|
10+25	0.1485	0.24	Q	V|	|	|	|
10+30	0.1502	0.24	Q	V|	|	|	|
10+35	0.1518	0.24	Q	V|	|	|	|
10+40	0.1535	0.24	Q	V	|	|	|
10+45	0.1552	0.24	Q	V	|	|	|
10+50	0.1568	0.25	Q	V	|	|	|
10+55	0.1585	0.25	Q	V	|	|	|
11+ 0	0.1603	0.25	Q	V	|	|	|
11+ 5	0.1620	0.25	|Q	V	|	|	|
11+10	0.1638	0.25	|Q	V	|	|	|
11+15	0.1655	0.26	|Q	V	|	|	|
11+20	0.1673	0.26	|Q	|V	|	|	|
11+25	0.1691	0.26	|Q	|V	|	|	|
11+30	0.1709	0.26	|Q	|V	|	|	|
11+35	0.1728	0.27	|Q	|V	|	|	|
11+40	0.1746	0.27	|Q	|V	|	|	|
11+45	0.1765	0.27	|Q	|V	|	|	|
11+50	0.1784	0.27	|Q	|V	|	|	|
11+55	0.1803	0.28	|Q	|V	|	|	|
12+ 0	0.1822	0.28	|Q	|V	|	|	|
12+ 5	0.1841	0.28	|Q	| V	|	|	|
12+10	0.1860	0.27	|Q	| V	|	|	|
12+15	0.1879	0.27	|Q	| V	|	|	|
12+20	0.1898	0.28	|Q	| V	|	|	|
12+25	0.1917	0.28	|Q	| V	|	|	|
12+30	0.1936	0.28	|Q	| V	|	|	|
12+35	0.1956	0.29	|Q	| V	|	|	|
12+40	0.1976	0.29	|Q	| V	|	|	|
12+45	0.1997	0.30	|Q	| V	|	|	|
12+50	0.2017	0.30	|Q	| V	|	|	|
12+55	0.2038	0.30	|Q	| V	|	|	|
13+ 0	0.2059	0.31	|Q	| V	|	|	|
13+ 5	0.2081	0.31	|Q	| V	|	|	|
13+10	0.2103	0.32	|Q	| V	|	|	|
13+15	0.2125	0.32	|Q	| V	|	|	|
13+20	0.2148	0.33	|Q	| V	|	|	|
13+25	0.2171	0.33	|Q	| V	|	|	|
13+30	0.2194	0.34	|Q	| V	|	|	|
13+35	0.2218	0.35	|Q	| V	|	|	|
13+40	0.2242	0.35	|Q	| V	|	|	|
13+45	0.2267	0.36	|Q	| V	|	|	|
13+50	0.2292	0.37	|Q	| V	|	|	|
13+55	0.2318	0.37	|Q	| V	|	|	|
14+ 0	0.2344	0.38	|Q	| V	|	|	|
14+ 5	0.2371	0.39	|Q	| V	|	|	|
14+10	0.2398	0.40	|Q	| V	|	|	|
14+15	0.2427	0.41	|Q	| V	|	|	|
14+20	0.2456	0.42	|Q	| V	|	|	|
14+25	0.2485	0.43	|Q	| V	|	|	|
14+30	0.2516	0.44	|Q	| V	|	|	|
14+35	0.2547	0.46	|Q	| V	|	|	|
14+40	0.2580	0.47	|Q	| V	|	|	|
14+45	0.2613	0.49	|Q	| V	|	|	|
14+50	0.2648	0.50	| Q	| V	|	|	|
14+55	0.2684	0.52	| Q	| V	|	|	|
15+ 0	0.2722	0.54	| Q	| V	|	|	|
15+ 5	0.2761	0.57	| Q	| V	|	|	|



20+10	0.5556	0.20	Q	|	|	|	V |
20+15	0.5569	0.19	Q	|	|	|	V |
20+20	0.5582	0.19	Q	|	|	|	V |
20+25	0.5595	0.19	Q	|	|	|	V |
20+30	0.5608	0.19	Q	|	|	|	V |
20+35	0.5621	0.19	Q	|	|	|	V |
20+40	0.5634	0.18	Q	|	|	|	V |
20+45	0.5646	0.18	Q	|	|	|	V |
20+50	0.5659	0.18	Q	|	|	|	V |
20+55	0.5671	0.18	Q	|	|	|	V |
21+ 0	0.5684	0.18	Q	|	|	|	V |
21+ 5	0.5696	0.18	Q	|	|	|	V |
21+10	0.5708	0.17	Q	|	|	|	V |
21+15	0.5720	0.17	Q	|	|	|	V |
21+20	0.5731	0.17	Q	|	|	|	V |
21+25	0.5743	0.17	Q	|	|	|	V |
21+30	0.5755	0.17	Q	|	|	|	V |
21+35	0.5766	0.17	Q	|	|	|	V |
21+40	0.5778	0.17	Q	|	|	|	V |
21+45	0.5789	0.16	Q	|	|	|	V |
21+50	0.5800	0.16	Q	|	|	|	V |
21+55	0.5811	0.16	Q	|	|	|	V |
22+ 0	0.5823	0.16	Q	|	|	|	V |
22+ 5	0.5834	0.16	Q	|	|	|	V |
22+10	0.5844	0.16	Q	|	|	|	V |
22+15	0.5855	0.16	Q	|	|	|	V |
22+20	0.5866	0.16	Q	|	|	|	V |
22+25	0.5877	0.16	Q	|	|	|	V |
22+30	0.5887	0.15	Q	|	|	|	V |
22+35	0.5898	0.15	Q	|	|	|	V |
22+40	0.5908	0.15	Q	|	|	|	V |
22+45	0.5919	0.15	Q	|	|	|	V |
22+50	0.5929	0.15	Q	|	|	|	V|
22+55	0.5939	0.15	Q	|	|	|	V|
23+ 0	0.5949	0.15	Q	|	|	|	V|
23+ 5	0.5960	0.15	Q	|	|	|	V|
23+10	0.5970	0.15	Q	|	|	|	V|
23+15	0.5980	0.15	Q	|	|	|	V|
23+20	0.5990	0.14	Q	|	|	|	V|
23+25	0.5999	0.14	Q	|	|	|	V|
23+30	0.6009	0.14	Q	|	|	|	V|
23+35	0.6019	0.14	Q	|	|	|	V|
23+40	0.6029	0.14	Q	|	|	|	V|
23+45	0.6038	0.14	Q	|	|	|	V|
23+50	0.6048	0.14	Q	|	|	|	V|
23+55	0.6058	0.14	Q	|	|	|	V|
24+ 0	0.6067	0.14	Q	|	|	|	V|
24+ 5	0.6072	0.08	Q	|	|	|	V|
24+10	0.6074	0.02	Q	|	|	|	V|
24+15	0.6074	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 11/17/16

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

Program License Serial Number 6222

S.B. Co. High Desert Service Center
Victoville
Onsite Developed
10 Yr 24 Hr

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		
3.60	1	0.67
Rainfall data for year 2		
3.60	6	0.87
Rainfall data for year 2		
3.60	24	1.56
Rainfall data for year 100		
3.60	1	1.14
Rainfall data for year 100		
3.60	6	2.37
Rainfall data for year 100		
3.60	24	4.68

++

******** 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)
69.0	69.0	3.60	1.000	0.548	0.100	0.055

Area-averaged adjusted loss rate Fm (In/Hr) = 0.055

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

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
0.36	0.100	69.0	69.0	4.49	0.207
3.24	0.900	98.0	98.0	0.20	0.919

Area-averaged catchment yield fraction, Y = 0.848
Area-averaged low loss fraction, Yb = 0.152
++
Watercourse length = 755.00(Ft.)
Length from concentration point to centroid = 298.00(Ft.)
Elevation difference along watercourse = 11.90(Ft.)
Mannings friction factor along watercourse = 0.015
Watershed area = 3.60(Ac.)
Catchment Lag time = 0.025 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 334.7653
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.055(In/Hr)
Average low loss rate fraction (Yb) = 0.152 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall = 0.319(In)
Computed peak 30-minute rainfall = 0.547(In)
Specified peak 1-hour rainfall = 0.673(In)
Computed peak 3-hour rainfall = 1.093(In)
Specified peak 6-hour rainfall = 1.485(In)
Specified peak 24-hour rainfall = 2.844(In)

Rainfall depth area reduction factors:
Using a total area of 3.60(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.319(In)
30-minute factor = 1.000 Adjusted rainfall = 0.547(In)
1-hour factor = 1.000 Adjusted rainfall = 0.673(In)
3-hour factor = 1.000 Adjusted rainfall = 1.093(In)
6-hour factor = 1.000 Adjusted rainfall = 1.485(In)
24-hour factor = 1.000 Adjusted rainfall = 2.844(In)

U n i t H y d r o g r a p h
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Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
(K = 43.54 (CFS))		
1	59.632	25.962
2	96.221	15.930
3	100.000	1.645

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.3193	0.3193
2	0.3931	0.0738
3	0.4439	0.0508
4	0.4840	0.0400
5	0.5175	0.0335
6	0.5466	0.0291
7	0.5724	0.0259
8	0.5958	0.0234
9	0.6172	0.0214
10	0.6371	0.0198
11	0.6555	0.0185
12	0.6729	0.0173
13	0.6971	0.0242
14	0.7203	0.0232
15	0.7426	0.0223
16	0.7641	0.0215
17	0.7848	0.0207
18	0.8049	0.0201
19	0.8243	0.0195
20	0.8432	0.0189
21	0.8616	0.0184
22	0.8795	0.0179
23	0.8969	0.0174
24	0.9139	0.0170
25	0.9306	0.0166
26	0.9468	0.0163
27	0.9628	0.0159
28	0.9783	0.0156
29	0.9936	0.0153
30	1.0086	0.0150
31	1.0233	0.0147
32	1.0378	0.0145
33	1.0520	0.0142
34	1.0660	0.0140
35	1.0797	0.0137
36	1.0932	0.0135
37	1.1065	0.0133
38	1.1196	0.0131
39	1.1326	0.0129
40	1.1453	0.0127
41	1.1578	0.0126
42	1.1702	0.0124
43	1.1825	0.0122
44	1.1945	0.0121
45	1.2064	0.0119
46	1.2182	0.0118
47	1.2298	0.0116
48	1.2413	0.0115
49	1.2527	0.0114
50	1.2639	0.0112
51	1.2750	0.0111
52	1.2860	0.0110
53	1.2968	0.0109
54	1.3076	0.0107
55	1.3182	0.0106
56	1.3288	0.0105
57	1.3392	0.0104

58	1.3495	0.0103
59	1.3597	0.0102
60	1.3699	0.0101
61	1.3799	0.0100
62	1.3899	0.0099
63	1.3997	0.0099
64	1.4095	0.0098
65	1.4192	0.0097
66	1.4288	0.0096
67	1.4383	0.0095
68	1.4477	0.0094
69	1.4571	0.0094
70	1.4664	0.0093
71	1.4756	0.0092
72	1.4847	0.0091
73	1.4944	0.0096
74	1.5039	0.0096
75	1.5134	0.0095
76	1.5229	0.0094
77	1.5322	0.0094
78	1.5415	0.0093
79	1.5507	0.0092
80	1.5599	0.0092
81	1.5690	0.0091
82	1.5781	0.0091
83	1.5871	0.0090
84	1.5960	0.0089
85	1.6049	0.0089
86	1.6137	0.0088
87	1.6225	0.0088
88	1.6312	0.0087
89	1.6398	0.0087
90	1.6485	0.0086
91	1.6570	0.0086
92	1.6655	0.0085
93	1.6740	0.0085
94	1.6824	0.0084
95	1.6908	0.0084
96	1.6991	0.0083
97	1.7074	0.0083
98	1.7156	0.0082
99	1.7238	0.0082
100	1.7319	0.0081
101	1.7400	0.0081
102	1.7481	0.0081
103	1.7561	0.0080
104	1.7640	0.0080
105	1.7720	0.0079
106	1.7799	0.0079
107	1.7877	0.0079
108	1.7955	0.0078
109	1.8033	0.0078
110	1.8110	0.0077
111	1.8187	0.0077
112	1.8264	0.0077
113	1.8340	0.0076
114	1.8416	0.0076
115	1.8492	0.0076
116	1.8567	0.0075
117	1.8642	0.0075

118	1.8716	0.0075
119	1.8791	0.0074
120	1.8864	0.0074
121	1.8938	0.0074
122	1.9011	0.0073
123	1.9084	0.0073
124	1.9157	0.0073
125	1.9229	0.0072
126	1.9301	0.0072
127	1.9372	0.0072
128	1.9444	0.0071
129	1.9515	0.0071
130	1.9586	0.0071
131	1.9656	0.0070
132	1.9726	0.0070
133	1.9796	0.0070
134	1.9866	0.0070
135	1.9935	0.0069
136	2.0004	0.0069
137	2.0073	0.0069
138	2.0142	0.0069
139	2.0210	0.0068
140	2.0278	0.0068
141	2.0346	0.0068
142	2.0413	0.0068
143	2.0480	0.0067
144	2.0547	0.0067
145	2.0614	0.0067
146	2.0681	0.0067
147	2.0747	0.0066
148	2.0813	0.0066
149	2.0879	0.0066
150	2.0944	0.0066
151	2.1010	0.0065
152	2.1075	0.0065
153	2.1140	0.0065
154	2.1204	0.0065
155	2.1269	0.0064
156	2.1333	0.0064
157	2.1397	0.0064
158	2.1461	0.0064
159	2.1524	0.0064
160	2.1588	0.0063
161	2.1651	0.0063
162	2.1714	0.0063
163	2.1777	0.0063
164	2.1839	0.0063
165	2.1901	0.0062
166	2.1963	0.0062
167	2.2025	0.0062
168	2.2087	0.0062
169	2.2149	0.0062
170	2.2210	0.0061
171	2.2271	0.0061
172	2.2332	0.0061
173	2.2393	0.0061
174	2.2453	0.0061
175	2.2514	0.0060
176	2.2574	0.0060
177	2.2634	0.0060

178	2.2694	0.0060
179	2.2754	0.0060
180	2.2813	0.0059
181	2.2872	0.0059
182	2.2932	0.0059
183	2.2991	0.0059
184	2.3049	0.0059
185	2.3108	0.0059
186	2.3166	0.0058
187	2.3225	0.0058
188	2.3283	0.0058
189	2.3341	0.0058
190	2.3399	0.0058
191	2.3456	0.0058
192	2.3514	0.0057
193	2.3571	0.0057
194	2.3628	0.0057
195	2.3685	0.0057
196	2.3742	0.0057
197	2.3799	0.0057
198	2.3855	0.0057
199	2.3912	0.0056
200	2.3968	0.0056
201	2.4024	0.0056
202	2.4080	0.0056
203	2.4136	0.0056
204	2.4192	0.0056
205	2.4247	0.0056
206	2.4302	0.0055
207	2.4358	0.0055
208	2.4413	0.0055
209	2.4468	0.0055
210	2.4523	0.0055
211	2.4577	0.0055
212	2.4632	0.0055
213	2.4686	0.0054
214	2.4740	0.0054
215	2.4795	0.0054
216	2.4849	0.0054
217	2.4902	0.0054
218	2.4956	0.0054
219	2.5010	0.0054
220	2.5063	0.0053
221	2.5117	0.0053
222	2.5170	0.0053
223	2.5223	0.0053
224	2.5276	0.0053
225	2.5329	0.0053
226	2.5381	0.0053
227	2.5434	0.0053
228	2.5486	0.0052
229	2.5539	0.0052
230	2.5591	0.0052
231	2.5643	0.0052
232	2.5695	0.0052
233	2.5747	0.0052
234	2.5799	0.0052
235	2.5850	0.0052
236	2.5902	0.0052
237	2.5953	0.0051

238	2.6004	0.0051
239	2.6056	0.0051
240	2.6107	0.0051
241	2.6157	0.0051
242	2.6208	0.0051
243	2.6259	0.0051
244	2.6310	0.0051
245	2.6360	0.0050
246	2.6410	0.0050
247	2.6461	0.0050
248	2.6511	0.0050
249	2.6561	0.0050
250	2.6611	0.0050
251	2.6661	0.0050
252	2.6710	0.0050
253	2.6760	0.0050
254	2.6810	0.0050
255	2.6859	0.0049
256	2.6908	0.0049
257	2.6958	0.0049
258	2.7007	0.0049
259	2.7056	0.0049
260	2.7105	0.0049
261	2.7153	0.0049
262	2.7202	0.0049
263	2.7251	0.0049
264	2.7299	0.0049
265	2.7348	0.0048
266	2.7396	0.0048
267	2.7444	0.0048
268	2.7492	0.0048
269	2.7540	0.0048
270	2.7588	0.0048
271	2.7636	0.0048
272	2.7684	0.0048
273	2.7732	0.0048
274	2.7779	0.0048
275	2.7827	0.0047
276	2.7874	0.0047
277	2.7921	0.0047
278	2.7969	0.0047
279	2.8016	0.0047
280	2.8063	0.0047
281	2.8110	0.0047
282	2.8157	0.0047
283	2.8203	0.0047
284	2.8250	0.0047
285	2.8297	0.0047
286	2.8343	0.0046
287	2.8389	0.0046
288	2.8436	0.0046

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0046	0.0007	0.0039
2	0.0046	0.0007	0.0039
3	0.0047	0.0007	0.0039
4	0.0047	0.0007	0.0040

5	0.0047	0.0007	0.0040
6	0.0047	0.0007	0.0040
7	0.0047	0.0007	0.0040
8	0.0047	0.0007	0.0040
9	0.0047	0.0007	0.0040
10	0.0047	0.0007	0.0040
11	0.0048	0.0007	0.0040
12	0.0048	0.0007	0.0040
13	0.0048	0.0007	0.0041
14	0.0048	0.0007	0.0041
15	0.0048	0.0007	0.0041
16	0.0048	0.0007	0.0041
17	0.0049	0.0007	0.0041
18	0.0049	0.0007	0.0041
19	0.0049	0.0007	0.0041
20	0.0049	0.0007	0.0041
21	0.0049	0.0007	0.0042
22	0.0049	0.0008	0.0042
23	0.0049	0.0008	0.0042
24	0.0050	0.0008	0.0042
25	0.0050	0.0008	0.0042
26	0.0050	0.0008	0.0042
27	0.0050	0.0008	0.0042
28	0.0050	0.0008	0.0043
29	0.0050	0.0008	0.0043
30	0.0050	0.0008	0.0043
31	0.0051	0.0008	0.0043
32	0.0051	0.0008	0.0043
33	0.0051	0.0008	0.0043
34	0.0051	0.0008	0.0043
35	0.0051	0.0008	0.0044
36	0.0052	0.0008	0.0044
37	0.0052	0.0008	0.0044
38	0.0052	0.0008	0.0044
39	0.0052	0.0008	0.0044
40	0.0052	0.0008	0.0044
41	0.0052	0.0008	0.0044
42	0.0053	0.0008	0.0045
43	0.0053	0.0008	0.0045
44	0.0053	0.0008	0.0045
45	0.0053	0.0008	0.0045
46	0.0053	0.0008	0.0045
47	0.0054	0.0008	0.0045
48	0.0054	0.0008	0.0046
49	0.0054	0.0008	0.0046
50	0.0054	0.0008	0.0046
51	0.0054	0.0008	0.0046
52	0.0055	0.0008	0.0046
53	0.0055	0.0008	0.0046
54	0.0055	0.0008	0.0047
55	0.0055	0.0008	0.0047
56	0.0055	0.0008	0.0047
57	0.0056	0.0008	0.0047
58	0.0056	0.0009	0.0047
59	0.0056	0.0009	0.0048
60	0.0056	0.0009	0.0048
61	0.0057	0.0009	0.0048
62	0.0057	0.0009	0.0048
63	0.0057	0.0009	0.0048
64	0.0057	0.0009	0.0048

65	0.0057	0.0009	0.0049
66	0.0058	0.0009	0.0049
67	0.0058	0.0009	0.0049
68	0.0058	0.0009	0.0049
69	0.0058	0.0009	0.0050
70	0.0059	0.0009	0.0050
71	0.0059	0.0009	0.0050
72	0.0059	0.0009	0.0050
73	0.0059	0.0009	0.0050
74	0.0060	0.0009	0.0051
75	0.0060	0.0009	0.0051
76	0.0060	0.0009	0.0051
77	0.0061	0.0009	0.0051
78	0.0061	0.0009	0.0052
79	0.0061	0.0009	0.0052
80	0.0061	0.0009	0.0052
81	0.0062	0.0009	0.0052
82	0.0062	0.0009	0.0052
83	0.0062	0.0010	0.0053
84	0.0063	0.0010	0.0053
85	0.0063	0.0010	0.0053
86	0.0063	0.0010	0.0054
87	0.0064	0.0010	0.0054
88	0.0064	0.0010	0.0054
89	0.0064	0.0010	0.0054
90	0.0064	0.0010	0.0055
91	0.0065	0.0010	0.0055
92	0.0065	0.0010	0.0055
93	0.0066	0.0010	0.0056
94	0.0066	0.0010	0.0056
95	0.0066	0.0010	0.0056
96	0.0067	0.0010	0.0056
97	0.0067	0.0010	0.0057
98	0.0067	0.0010	0.0057
99	0.0068	0.0010	0.0057
100	0.0068	0.0010	0.0058
101	0.0069	0.0010	0.0058
102	0.0069	0.0010	0.0058
103	0.0069	0.0011	0.0059
104	0.0070	0.0011	0.0059
105	0.0070	0.0011	0.0059
106	0.0070	0.0011	0.0060
107	0.0071	0.0011	0.0060
108	0.0071	0.0011	0.0060
109	0.0072	0.0011	0.0061
110	0.0072	0.0011	0.0061
111	0.0073	0.0011	0.0062
112	0.0073	0.0011	0.0062
113	0.0074	0.0011	0.0063
114	0.0074	0.0011	0.0063
115	0.0075	0.0011	0.0063
116	0.0075	0.0011	0.0064
117	0.0076	0.0012	0.0064
118	0.0076	0.0012	0.0065
119	0.0077	0.0012	0.0065
120	0.0077	0.0012	0.0066
121	0.0078	0.0012	0.0066
122	0.0079	0.0012	0.0067
123	0.0079	0.0012	0.0067
124	0.0080	0.0012	0.0068

125	0.0081	0.0012	0.0068
126	0.0081	0.0012	0.0069
127	0.0082	0.0012	0.0069
128	0.0082	0.0013	0.0070
129	0.0083	0.0013	0.0071
130	0.0084	0.0013	0.0071
131	0.0085	0.0013	0.0072
132	0.0085	0.0013	0.0072
133	0.0086	0.0013	0.0073
134	0.0087	0.0013	0.0073
135	0.0088	0.0013	0.0074
136	0.0088	0.0013	0.0075
137	0.0089	0.0014	0.0076
138	0.0090	0.0014	0.0076
139	0.0091	0.0014	0.0077
140	0.0092	0.0014	0.0078
141	0.0093	0.0014	0.0079
142	0.0094	0.0014	0.0079
143	0.0095	0.0014	0.0080
144	0.0096	0.0015	0.0081
145	0.0091	0.0014	0.0077
146	0.0092	0.0014	0.0078
147	0.0094	0.0014	0.0079
148	0.0094	0.0014	0.0080
149	0.0096	0.0015	0.0081
150	0.0097	0.0015	0.0082
151	0.0099	0.0015	0.0084
152	0.0099	0.0015	0.0084
153	0.0101	0.0015	0.0086
154	0.0102	0.0016	0.0087
155	0.0104	0.0016	0.0088
156	0.0105	0.0016	0.0089
157	0.0107	0.0016	0.0091
158	0.0109	0.0017	0.0092
159	0.0111	0.0017	0.0094
160	0.0112	0.0017	0.0095
161	0.0115	0.0018	0.0097
162	0.0116	0.0018	0.0099
163	0.0119	0.0018	0.0101
164	0.0121	0.0018	0.0102
165	0.0124	0.0019	0.0105
166	0.0126	0.0019	0.0106
167	0.0129	0.0020	0.0109
168	0.0131	0.0020	0.0111
169	0.0135	0.0021	0.0115
170	0.0137	0.0021	0.0116
171	0.0142	0.0022	0.0120
172	0.0145	0.0022	0.0122
173	0.0150	0.0023	0.0127
174	0.0153	0.0023	0.0130
175	0.0159	0.0024	0.0135
176	0.0163	0.0025	0.0138
177	0.0170	0.0026	0.0144
178	0.0174	0.0027	0.0148
179	0.0184	0.0028	0.0156
180	0.0189	0.0029	0.0160
181	0.0201	0.0031	0.0170
182	0.0207	0.0032	0.0176
183	0.0223	0.0034	0.0189
184	0.0232	0.0035	0.0197

185	0.0173	0.0026	0.0147
186	0.0185	0.0028	0.0157
187	0.0214	0.0033	0.0182
188	0.0234	0.0036	0.0198
189	0.0291	0.0044	0.0247
190	0.0335	0.0046	0.0289
191	0.0508	0.0046	0.0463
192	0.0738	0.0046	0.0692
193	0.3193	0.0046	0.3147
194	0.0400	0.0046	0.0355
195	0.0259	0.0039	0.0219
196	0.0198	0.0030	0.0168
197	0.0242	0.0037	0.0205
198	0.0215	0.0033	0.0182
199	0.0195	0.0030	0.0165
200	0.0179	0.0027	0.0152
201	0.0166	0.0025	0.0141
202	0.0156	0.0024	0.0132
203	0.0147	0.0022	0.0125
204	0.0140	0.0021	0.0118
205	0.0133	0.0020	0.0113
206	0.0127	0.0019	0.0108
207	0.0122	0.0019	0.0104
208	0.0118	0.0018	0.0100
209	0.0114	0.0017	0.0096
210	0.0110	0.0017	0.0093
211	0.0106	0.0016	0.0090
212	0.0103	0.0016	0.0088
213	0.0100	0.0015	0.0085
214	0.0098	0.0015	0.0083
215	0.0095	0.0015	0.0081
216	0.0093	0.0014	0.0079
217	0.0096	0.0015	0.0082
218	0.0094	0.0014	0.0080
219	0.0092	0.0014	0.0078
220	0.0091	0.0014	0.0077
221	0.0089	0.0014	0.0075
222	0.0087	0.0013	0.0074
223	0.0086	0.0013	0.0073
224	0.0084	0.0013	0.0071
225	0.0083	0.0013	0.0070
226	0.0081	0.0012	0.0069
227	0.0080	0.0012	0.0068
228	0.0079	0.0012	0.0067
229	0.0078	0.0012	0.0066
230	0.0077	0.0012	0.0065
231	0.0076	0.0012	0.0064
232	0.0075	0.0011	0.0063
233	0.0074	0.0011	0.0062
234	0.0073	0.0011	0.0062
235	0.0072	0.0011	0.0061
236	0.0071	0.0011	0.0060
237	0.0070	0.0011	0.0059
238	0.0069	0.0011	0.0059
239	0.0068	0.0010	0.0058
240	0.0068	0.0010	0.0057
241	0.0067	0.0010	0.0057
242	0.0066	0.0010	0.0056
243	0.0065	0.0010	0.0055
244	0.0065	0.0010	0.0055

245	0.0064	0.0010	0.0054
246	0.0063	0.0010	0.0054
247	0.0063	0.0010	0.0053
248	0.0062	0.0009	0.0053
249	0.0062	0.0009	0.0052
250	0.0061	0.0009	0.0052
251	0.0060	0.0009	0.0051
252	0.0060	0.0009	0.0051
253	0.0059	0.0009	0.0050
254	0.0059	0.0009	0.0050
255	0.0058	0.0009	0.0049
256	0.0058	0.0009	0.0049
257	0.0057	0.0009	0.0049
258	0.0057	0.0009	0.0048
259	0.0056	0.0009	0.0048
260	0.0056	0.0009	0.0047
261	0.0056	0.0008	0.0047
262	0.0055	0.0008	0.0047
263	0.0055	0.0008	0.0046
264	0.0054	0.0008	0.0046
265	0.0054	0.0008	0.0046
266	0.0053	0.0008	0.0045
267	0.0053	0.0008	0.0045
268	0.0053	0.0008	0.0045
269	0.0052	0.0008	0.0044
270	0.0052	0.0008	0.0044
271	0.0052	0.0008	0.0044
272	0.0051	0.0008	0.0043
273	0.0051	0.0008	0.0043
274	0.0051	0.0008	0.0043
275	0.0050	0.0008	0.0043
276	0.0050	0.0008	0.0042
277	0.0050	0.0008	0.0042
278	0.0049	0.0008	0.0042
279	0.0049	0.0007	0.0042
280	0.0049	0.0007	0.0041
281	0.0048	0.0007	0.0041
282	0.0048	0.0007	0.0041
283	0.0048	0.0007	0.0041
284	0.0048	0.0007	0.0040
285	0.0047	0.0007	0.0040
286	0.0047	0.0007	0.0040
287	0.0047	0.0007	0.0040
288	0.0046	0.0007	0.0039

Total soil rain loss = 0.38(In)
Total effective rainfall = 2.47(In)
Peak flow rate in flood hydrograph = 9.35(CFS)

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

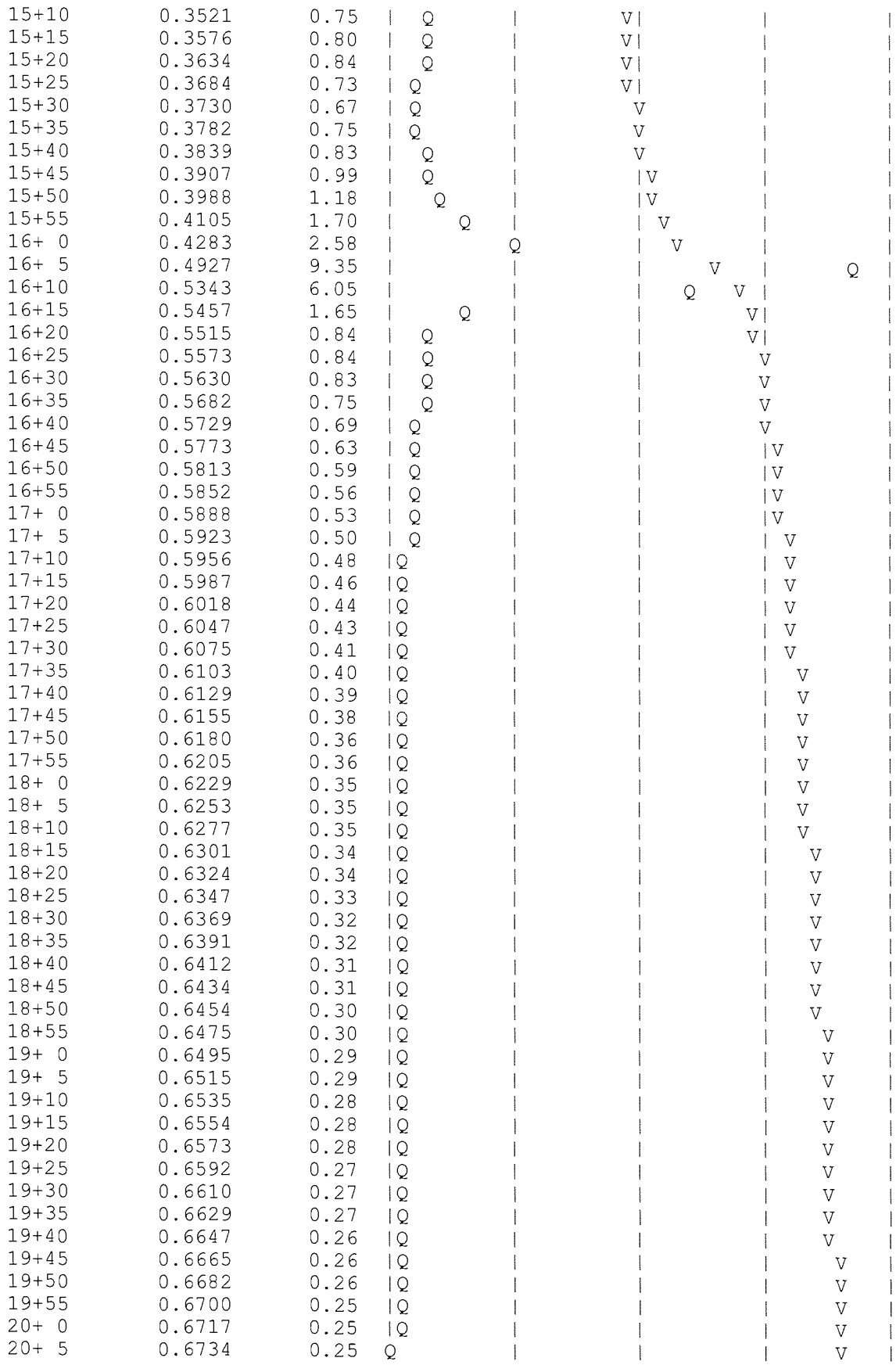
Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0007	0.10	Q	|	|	|	|

0+10	0.0018	0.16	Q				
0+15	0.0030	0.17	Q				
0+20	0.0042	0.17	Q				
0+25	0.0054	0.17	Q				
0+30	0.0066	0.17	Q				
0+35	0.0078	0.17	Q				
0+40	0.0090	0.17	Q				
0+45	0.0102	0.17	Q				
0+50	0.0114	0.18	Q				
0+55	0.0126	0.18	Q				
1+ 0	0.0138	0.18	Q				
1+ 5	0.0150	0.18	Q				
1+10	0.0162	0.18	Q				
1+15	0.0175	0.18	Q				
1+20	0.0187	0.18	QV				
1+25	0.0199	0.18	QV				
1+30	0.0212	0.18	QV				
1+35	0.0224	0.18	QV				
1+40	0.0236	0.18	QV				
1+45	0.0249	0.18	QV				
1+50	0.0261	0.18	QV				
1+55	0.0274	0.18	QV				
2+ 0	0.0286	0.18	QV				
2+ 5	0.0299	0.18	QV				
2+10	0.0312	0.18	QV				
2+15	0.0324	0.18	QV				
2+20	0.0337	0.18	QV				
2+25	0.0350	0.19	QV				
2+30	0.0363	0.19	QV				
2+35	0.0376	0.19	Q V				
2+40	0.0389	0.19	Q V				
2+45	0.0401	0.19	Q V				
2+50	0.0414	0.19	Q V				
2+55	0.0427	0.19	Q V				
3+ 0	0.0441	0.19	Q V				
3+ 5	0.0454	0.19	Q V				
3+10	0.0467	0.19	Q V				
3+15	0.0480	0.19	Q V				
3+20	0.0493	0.19	Q V				
3+25	0.0507	0.19	Q V				
3+30	0.0520	0.19	Q V				
3+35	0.0533	0.19	Q V				
3+40	0.0547	0.20	Q V				
3+45	0.0560	0.20	Q V				
3+50	0.0574	0.20	Q V				
3+55	0.0587	0.20	Q V				
4+ 0	0.0601	0.20	Q V				
4+ 5	0.0615	0.20	Q V				
4+10	0.0629	0.20	Q V				
4+15	0.0642	0.20	Q V				
4+20	0.0656	0.20	Q V				
4+25	0.0670	0.20	Q V				
4+30	0.0684	0.20	Q V				
4+35	0.0698	0.20	Q V				
4+40	0.0712	0.20	Q V				
4+45	0.0726	0.20	Q V				
4+50	0.0740	0.21	Q V				
4+55	0.0755	0.21	Q V				
5+ 0	0.0769	0.21	Q V				
5+ 5	0.0783	0.21	Q V				

5+10	0.0798	0.21	Q	V	|	|	|	|
5+15	0.0812	0.21	Q	V	|	|	|	|
5+20	0.0827	0.21	Q	V	|	|	|	|
5+25	0.0841	0.21	Q	V	|	|	|	|
5+30	0.0856	0.21	Q	V	|	|	|	|
5+35	0.0870	0.21	Q	V	|	|	|	|
5+40	0.0885	0.21	Q	V	|	|	|	|
5+45	0.0900	0.22	Q	V	|	|	|	|
5+50	0.0915	0.22	Q	V	|	|	|	|
5+55	0.0930	0.22	Q	V	|	|	|	|
6+ 0	0.0945	0.22	Q	V	|	|	|	|
6+ 5	0.0960	0.22	Q	V	|	|	|	|
6+10	0.0975	0.22	Q	V	|	|	|	|
6+15	0.0990	0.22	Q	V	|	|	|	|
6+20	0.1006	0.22	Q	V	|	|	|	|
6+25	0.1021	0.22	Q	V	|	|	|	|
6+30	0.1036	0.22	Q	V	|	|	|	|
6+35	0.1052	0.23	Q	V	|	|	|	|
6+40	0.1067	0.23	Q	V	|	|	|	|
6+45	0.1083	0.23	Q	V	|	|	|	|
6+50	0.1099	0.23	Q	V	|	|	|	|
6+55	0.1115	0.23	Q	V	|	|	|	|
7+ 0	0.1130	0.23	Q	V	|	|	|	|
7+ 5	0.1146	0.23	Q	V	|	|	|	|
7+10	0.1162	0.23	Q	V	|	|	|	|
7+15	0.1179	0.23	Q	V	|	|	|	|
7+20	0.1195	0.23	Q	V	|	|	|	|
7+25	0.1211	0.24	Q	V	|	|	|	|
7+30	0.1227	0.24	Q	V	|	|	|	|
7+35	0.1244	0.24	Q	V	|	|	|	|
7+40	0.1260	0.24	Q	V	|	|	|	|
7+45	0.1277	0.24	Q	V	|	|	|	|
7+50	0.1294	0.24	Q	V	|	|	|	|
7+55	0.1310	0.24	Q	V	|	|	|	|
8+ 0	0.1327	0.25	Q	V	|	|	|	|
8+ 5	0.1344	0.25	Q	V	|	|	|	|
8+10	0.1361	0.25	Q	V	|	|	|	|
8+15	0.1378	0.25	Q	V	|	|	|	|
8+20	0.1396	0.25	|Q	V	|	|	|	|
8+25	0.1413	0.25	|Q	V	|	|	|	|
8+30	0.1431	0.25	|Q	V	|	|	|	|
8+35	0.1448	0.26	|Q	V	|	|	|	|
8+40	0.1466	0.26	|Q	V	|	|	|	|
8+45	0.1484	0.26	|Q	V	|	|	|	|
8+50	0.1501	0.26	|Q	V	|	|	|	|
8+55	0.1519	0.26	|Q	V	|	|	|	|
9+ 0	0.1537	0.26	|Q	V	|	|	|	|
9+ 5	0.1556	0.26	|Q	V	|	|	|	|
9+10	0.1574	0.27	|Q	V	|	|	|	|
9+15	0.1592	0.27	|Q	V	|	|	|	|
9+20	0.1611	0.27	|Q	V	|	|	|	|
9+25	0.1630	0.27	|Q	V	|	|	|	|
9+30	0.1649	0.27	|Q	V	|	|	|	|
9+35	0.1668	0.28	|Q	V	|	|	|	|
9+40	0.1687	0.28	|Q	V	|	|	|	|
9+45	0.1706	0.28	|Q	V	|	|	|	|
9+50	0.1725	0.28	|Q	V	|	|	|	|
9+55	0.1745	0.28	|Q	V	|	|	|	|
10+ 0	0.1764	0.28	|Q	V	|	|	|	|
10+ 5	0.1784	0.29	|Q	V	|	|	|	|

10+10	0.1804	0.29	Q	V			
10+15	0.1824	0.29	Q	V			
10+20	0.1844	0.29	Q	V			
10+25	0.1865	0.30	Q	V			
10+30	0.1885	0.30	Q	V			
10+35	0.1906	0.30	Q	V			
10+40	0.1927	0.30	Q	V			
10+45	0.1948	0.31	Q	V			
10+50	0.1969	0.31	Q	V			
10+55	0.1990	0.31	Q	V			
11+ 0	0.2012	0.31	Q	V			
11+ 5	0.2034	0.32	Q	V			
11+10	0.2056	0.32	Q	V			
11+15	0.2078	0.32	Q	V			
11+20	0.2100	0.32	Q	V			
11+25	0.2123	0.33	Q	V			
11+30	0.2146	0.33	Q	V			
11+35	0.2169	0.33	Q	V			
11+40	0.2192	0.34	Q	V			
11+45	0.2215	0.34	Q	V			
11+50	0.2239	0.34	Q	V			
11+55	0.2263	0.35	Q	V			
12+ 0	0.2287	0.35	Q	V			
12+ 5	0.2311	0.34	Q	V			
12+10	0.2334	0.34	Q	V			
12+15	0.2358	0.34	Q	V			
12+20	0.2382	0.35	Q	V			
12+25	0.2406	0.35	Q	V			
12+30	0.2430	0.36	Q	V			
12+35	0.2455	0.36	Q	V			
12+40	0.2480	0.37	Q	V			
12+45	0.2506	0.37	Q	V			
12+50	0.2532	0.38	Q	V			
12+55	0.2558	0.38	Q	V			
13+ 0	0.2585	0.39	Q	V			
13+ 5	0.2612	0.39	Q	V			
13+10	0.2639	0.40	Q	V			
13+15	0.2667	0.41	Q	V			
13+20	0.2696	0.41	Q	V			
13+25	0.2725	0.42	Q	V			
13+30	0.2754	0.43	Q	V			
13+35	0.2784	0.44	Q	V			
13+40	0.2814	0.44	Q	V			
13+45	0.2846	0.45	Q	V			
13+50	0.2877	0.46	Q	V			
13+55	0.2910	0.47	Q	V			
14+ 0	0.2943	0.48	Q	V			
14+ 5	0.2977	0.49	Q	V			
14+10	0.3011	0.50	Q	V			
14+15	0.3047	0.52	Q	V			
14+20	0.3083	0.53	Q	V			
14+25	0.3121	0.54	Q	V			
14+30	0.3159	0.56	Q	V			
14+35	0.3199	0.58	Q	V			
14+40	0.3240	0.59	Q	V			
14+45	0.3283	0.62	Q	V			
14+50	0.3326	0.64	Q	V			
14+55	0.3372	0.66	Q	V			
15+ 0	0.3419	0.69	Q	V			
15+ 5	0.3469	0.72	Q	V			



20+10	0.6751	0.24	Q	|	|	|	V |
20+15	0.6768	0.24	Q	|	|	|	V |
20+20	0.6784	0.24	Q	|	|	|	V |
20+25	0.6800	0.24	Q	|	|	|	V |
20+30	0.6817	0.23	Q	|	|	|	V |
20+35	0.6833	0.23	Q	|	|	|	V |
20+40	0.6848	0.23	Q	|	|	|	V |
20+45	0.6864	0.23	Q	|	|	|	V |
20+50	0.6880	0.23	Q	|	|	|	V |
20+55	0.6895	0.22	Q	|	|	|	V |
21+ 0	0.6910	0.22	Q	|	|	|	V |
21+ 5	0.6926	0.22	Q	|	|	|	V |
21+10	0.6941	0.22	Q	|	|	|	V |
21+15	0.6955	0.22	Q	|	|	|	V |
21+20	0.6970	0.21	Q	|	|	|	V |
21+25	0.6985	0.21	Q	|	|	|	V |
21+30	0.6999	0.21	Q	|	|	|	V |
21+35	0.7014	0.21	Q	|	|	|	V |
21+40	0.7028	0.21	Q	|	|	|	V |
21+45	0.7042	0.21	Q	|	|	|	V |
21+50	0.7056	0.20	Q	|	|	|	V |
21+55	0.7070	0.20	Q	|	|	|	V |
22+ 0	0.7084	0.20	Q	|	|	|	V |
22+ 5	0.7098	0.20	Q	|	|	|	V |
22+10	0.7111	0.20	Q	|	|	|	V |
22+15	0.7125	0.20	Q	|	|	|	V |
22+20	0.7138	0.20	Q	|	|	|	V |
22+25	0.7152	0.19	Q	|	|	|	V |
22+30	0.7165	0.19	Q	|	|	|	V |
22+35	0.7178	0.19	Q	|	|	|	V |
22+40	0.7191	0.19	Q	|	|	|	V |
22+45	0.7204	0.19	Q	|	|	|	V |
22+50	0.7217	0.19	Q	|	|	|	V|
22+55	0.7230	0.19	Q	|	|	|	V|
23+ 0	0.7242	0.18	Q	|	|	|	V|
23+ 5	0.7255	0.18	Q	|	|	|	V|
23+10	0.7268	0.18	Q	|	|	|	V|
23+15	0.7280	0.18	Q	|	|	|	V|
23+20	0.7293	0.18	Q	|	|	|	V|
23+25	0.7305	0.18	Q	|	|	|	V|
23+30	0.7317	0.18	Q	|	|	|	V|
23+35	0.7329	0.18	Q	|	|	|	V|
23+40	0.7341	0.18	Q	|	|	|	V|
23+45	0.7354	0.17	Q	|	|	|	V|
23+50	0.7366	0.17	Q	|	|	|	V|
23+55	0.7377	0.17	Q	|	|	|	V|
24+ 0	0.7389	0.17	Q	|	|	|	V|
24+ 5	0.7394	0.07	Q	|	|	|	V|
24+10	0.7395	0.01	Q	|	|	|	V

EXHIBIT "D"

PERCOLATION INVESTIGATION

C.H.J. Incorporated
1355 E. Cooley Drive, Colton, CA 92324 • Phone (909) 824-7210 • Fax (909) 824-7209
15345 Anacapa Road, Suite D, Victorville, CA 92392 • Phone (760) 243-0506 • Fax (760) 243-1225
77-564A Country Club Drive, Suite 122, Palm Desert, CA 92211 • Phone (760) 772-8234 • Fax (909) 824-7209

August 11, 2016

County of San Bernardino
Project Management Division
385 North Arrowhead Drive, Third Floor
San Bernardino, California 92415
Attention: Mr. Scott Hughes

Job No. G16-028-2

Subject: Percolation Investigation
Proposed High Desert Service Center
Tokay Street and Cottonwood Avenue
Victorville, California

Dear Mr. Hughes:

As requested, percolation testing was performed for the subject project. We anticipate that the percolation rates obtained from the testing and subsequent infiltration rates derived from the percolation testing may be used for the project's water quality management plan. This report presents the test data and summarizes the scope of testing. The site location is shown on Enclosure "A-1", and the locations of the percolation tests are shown on Enclosure "A-2". Concurrently with this report, we performed percolation tests for a proposed septic system for the site. The locations of those percolation tests are also included on Enclosure "A-2". The results of those percolation tests will be included in a separate report, as required by the San Bernardino County Department of Environmental Health Services.

The soil conditions underlying the subject site were explored by means of four exploratory borings drilled to a maximum depth of 41-1/2 feet below the existing ground surface (bgs) with a truck-mounted CME 75 drill rig equipped for soil sampling.

Continuous logs of the subsurface conditions, as encountered within the exploratory borings, were recorded at the time of drilling by a geologist from this firm. A California-modified ring sampler (3-inch outer diameter and 2-3/8-inch inner diameter) was utilized in our investigation. The penetration resistance was recorded on the boring logs as the number of hammer blows used to advance the sampler in 6-inch increments (or less if noted). The sampler was driven with an automatic hammer that drops a 140-pound weight 30 inches for each blow. After the required seating, samplers are advanced up to 18 inches, providing up to three sets of blowcounts at each sampling interval. The recorded blows are raw numbers without any corrections for hammer type (automatic vs. manual cathead) or sampler size (ring sampler vs. SPT sampler). Both relatively undisturbed and bulk samples of typical soil types obtained were returned to the laboratory in sealed containers for testing and evaluation.

Our exploratory boring logs, together with our uncorrected blowcount data and in-place density data, are presented in Enclosures "B-1" through "B-4". The stratification lines presented on the boring logs represent approximate boundaries between soil types, which may include gradual transitions.

At the completion of the field investigation, all borings were backfilled to the initial grade of the boring with spoils and tamped using hand tools. This backfilling operation is expected to compact the boring to a density approximating that of the existing soils. If backfill material in addition to the excavated material was necessary to complete the backfill, then such material was secured and utilized in the backfilling operation. It is possible that some settlement of the backfilled material may occur. Our firm will not monitor excavation locations for any settlement. This is deemed to be, and is accepted to be, the responsibility of our client. If the client observes settlement, then this firm should be notified.

The percolation tests intended to evaluate the conditions at the proposed storm water basin were performed in general accordance with the San Bernardino County Stormwater Program Technical Guidance Document for Water Quality Management Plans, which indicates that the percolation testing should follow the shallow percolation test method described in Appendix "A" of the Riverside County Low Impact Development BMP Design Handbook (2011). Two of our exploratory borings were utilized for percolation testing using this method. After each boring was drilled, a perforated PVC pipe was placed in the center of the boring. Gravel was placed in the annular space to prevent caving of the hole. The test holes were pre-soaked 24 hours prior to testing. Representative soil samples from each test location were taken, and sieve analyses were performed to provide classification of the soil. Based on this testing the soil was determined to be silty sand (SM).

One exploratory boring was drilled to a depth of 10 feet below the proposed basin bottom to evaluate the soil conditions underlying the bottom. Sieve analysis testing was performed on samples taken from below the bottom basin. Based upon this investigation we have determined that no impermeable layer is present below the proposed basin bottom.

Per the test method, if two consecutive measurements show that 6 inches of water seep away in less than 25 minutes, the location is considered "sandy" and the test should be run for an additional hour with measurements taken every 10 minutes. If less than 6 inches of water seep away in 25 minutes, the location is considered "non-sandy" and measurements are taken every 30 minutes for a total testing time of six hours. The test locations are considered sandy for the purposes of the percolation testing. The final measurements taken were used to calculate the percolation rates.

It should be noted that the percolation rate is related to but not equal to the infiltration rate. The infiltration rate is a measure of the speed at which water progresses downward into the soil, while the percolation rate includes both downward and horizontal speeds. Infiltration rates should be considered for use in detention basin or permeable pavement design, and percolation rates should be considered for dry well design.

Both the percolation rates and infiltration rates are provided in this report. The percolation test data obtained was used to calculate the average infiltration rate of the soil at each test location. The Porchet method was used to convert the percolation data to the infiltration rate. Our calculations correct for the use of 3/4" gravel in the annular space.

The percolation and infiltration rates obtained are presented in the following table. The rates provided do not include safety factors.

Infiltration and Percolation Rates				
Test No.	Depth (ft.)	Percolation Rate (gal./sq. ft./day)	Infiltration Rate (in./hr.)	Soil Type
P-3	5	20.9	7.0	SM
P-4	5	131	43.6	SM

It should be noted that infiltration and percolation rates are based on field test results utilizing clear water. Infiltration rates can be affected by silt buildup, debris, degree of soil saturation, site variability and other factors. The rates were obtained at specific locations, are representative of the locations tested and may not be representative of the entire site. The rates presented above are measured field rates and should NOT be considered design infiltration rates. The designer of individual basins should consider possible site variability in their design. Application of an appropriate safety factor may be prudent to account for subsoil inconsistencies, possible compaction related to site grading and potential silting of the percolating soils, depending on the application.

LIMITATIONS

C.H.J., Incorporated has striven to perform our services within the limits prescribed by our client, and in a manner consistent with the usual thoroughness and competence of reputable geotechnical engineers and engineering geologists practicing under similar circumstances. No other representation, express or implied, and no warranty or guarantee is included or intended by virtue of the services performed or reports, opinion, documents, or otherwise supplied.

This report reflects the testing conducted on the site as the site existed during the investigation, which is the subject of this report. However, changes in the conditions of a property can occur with the passage of time, due to natural processes or the works of man on this or adjacent properties. Changes in applicable or appropriate standards may also occur whether as a result of legislation, application or the broadening of knowledge. Therefore, this report is indicative of only those conditions tested at the time of the subject investigation, and the findings of this report may be invalidated fully or partially by changes outside of the control of C.H.J., Incorporated. This report is therefore subject to review and should not be relied upon after a period of one year.

The conclusions and recommendations in this report are based upon observations performed and data collected at separate locations, and interpolation between these locations, carried out for the project and the scope of services described. It is assumed and expected that the conditions between locations observed and/or sampled are similar to those encountered at the individual locations where observation and sampling was performed. However, conditions between these locations may vary significantly. Should conditions that appear different from those described herein be encountered in the field by the client or any firm performing services for the client or the client's assign, this firm should be contacted immediately in order that we might evaluate their effect.

The information presented in this report is not intended or represented to be suitable for reuse on extensions or modifications of this project, or for use on any other project.

CLOSURE

We appreciate this opportunity to be of service and trust this report provides the information desired at this time. Should questions arise, please do not hesitate to contact this office.

Respectfully submitted,

C.H.J., INCORPORATED

PROFESSIONAL GEOLOGIST
VINCENT J. ROMANO
No. 9360
Exp. 05-31-17
STATE OF CALIFORNIA

V. John Romano, P.G. 9360
Consulting Geologist

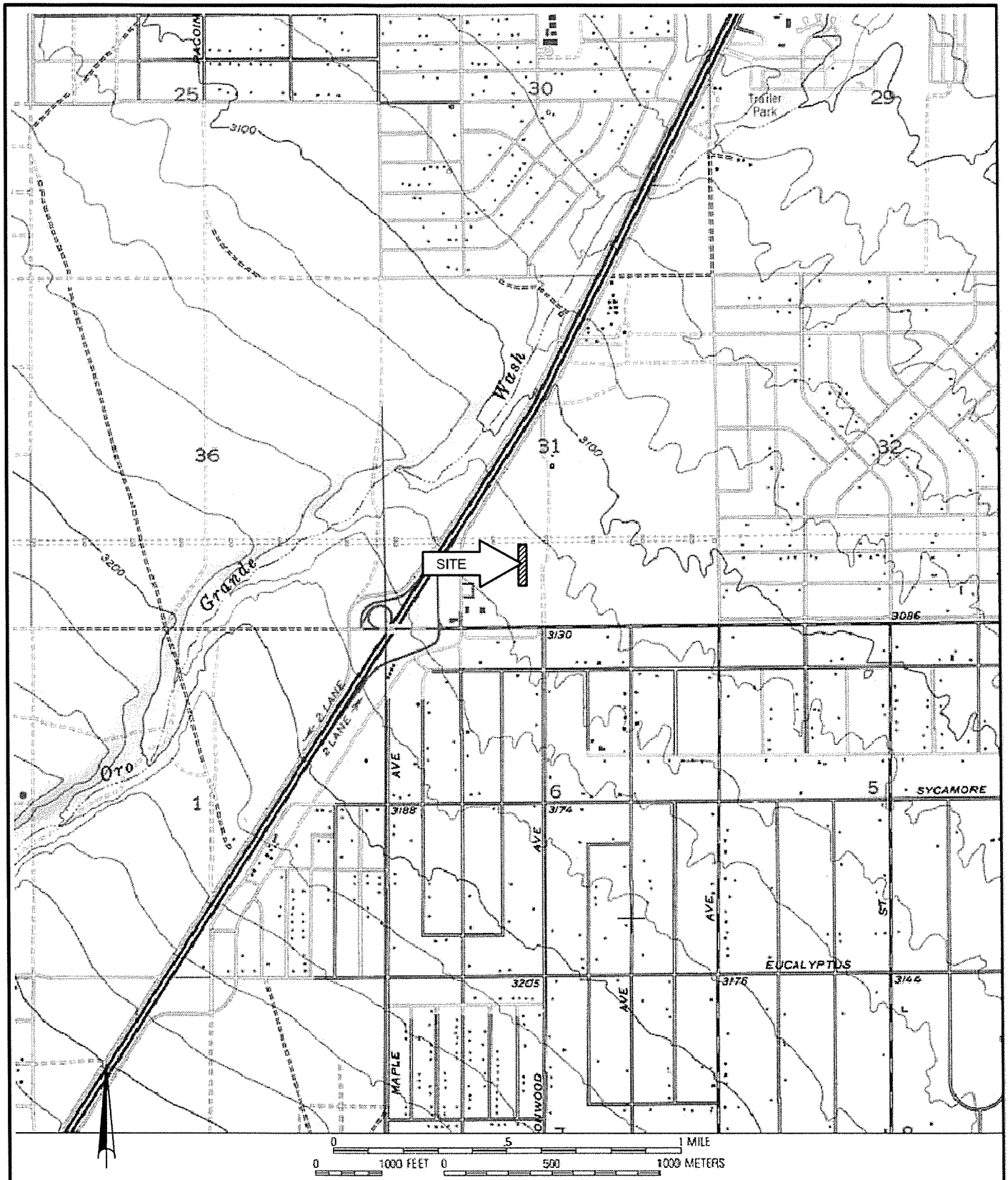
PROFESSIONAL GEOLOGIST
JAY J. MARTIN
No. 1529
CERTIFIED ENGINEERING GEOLOGIST
Exp. 8-31-16
STATE OF CALIFORNIA

Jay J. Martin, E.G. 1529
Consulting Geologist

George Battey II, P.E.
President

VJR/JJM/GB:vjr/lb

Enclosures:
"A-1" - Index Map
"A-2" - Site Plan
"B-1" - "B-4" - Exploratory Boring Logs
"C-1" - "C-2" - Particle Size Distribution

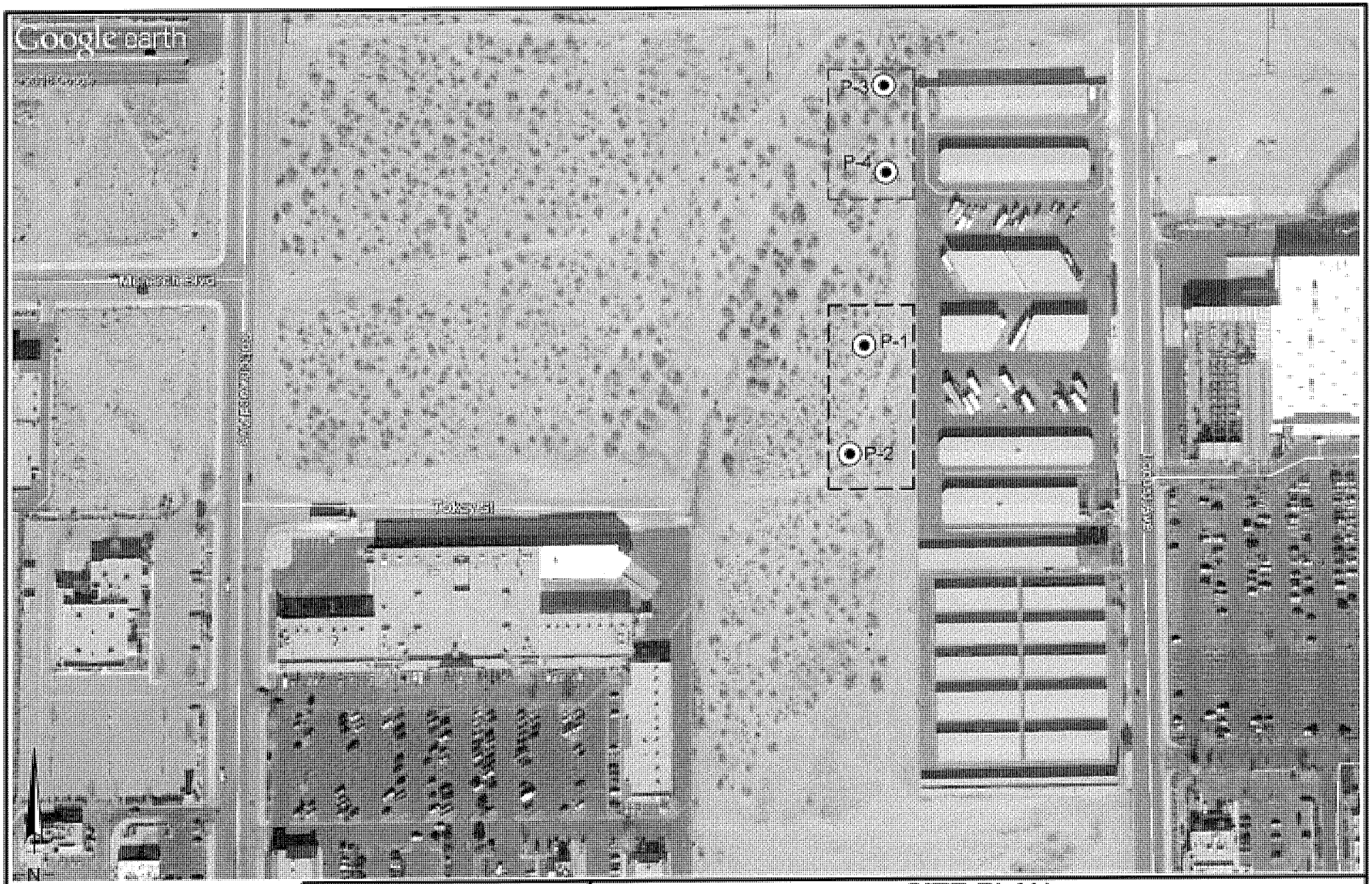


SCALE: 1" = 2000'

INDEX MAP

FOR: COUNTY OF SAN BERNARDINO PROJECT MANAGEMENT DIVISION	PERCOLATION INVESTIGATION PROPOSED HIGH DESERT SERVICE CENTER TOKAY STREET AND COTTONWOOD AVENUE VICTORVILLE, CALIFORNIA	ENCLOSURE "A-1"
DATE: AUGUST 2016		JOB NUMBER G16-028-2

C.H.J. Incorporated



SCALE: 1" = Approx. 200'

0 200 400

LEGEND:

- P-4 — Percolation Tests
- Proposed Storm Drain Basin
- Proposed Seepage Pits

SITE PLAN

FOR: COUNTY OF SAN BERNARDINO
PROJECT MANAGEMENT DIVISION

DATE: AUGUST 2016

PERCOLATION INVESTIGATION
PROPOSED HIGH DESERT SERVICE CENTER
TOKAY STREET AND COTTONWOOD AVENUE
VICTORVILLE, CALIFORNIA

ENCLOSURE "A-2"

JOB NUMBER G16-028-2

C.H.J. Incorporated

EXPLORATORY BORING NO. P-1

Date Excavated: 8/1/16

Client: County of San Bernardino

Equipment: CME75 Truck Rig

Bucket Size: 140lbs./30in./3.0" O.D.

Surface Elevation(ft): N/A

Logged by: VJR

Station No.: N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
0		(SM) Silty Sand, fine to medium, brown	Native		▨		4.5		SA
10		(SM) Silty Sand, fine to medium, with gravel to 1", light brown		☒		8 24 30	1.4	126	Ring
20				☒		21 34 50/5"	3.9	125	Ring
30				☒		18 46 50/4"	5.6	Dist.	Ring
					▨		4.0		SA

PERCOLATION BORING 2016 16361-2.GPJ CHJ.GDT 8/9/16

CHJ

PROPOSED HIGH DESERT SERVICE CENTER
TOKAY ST AND COTTONWOOD AVE, VICTORVILLE, CA

Job No. G16-028-2

Enclosure B-1a

EXPLORATORY BORING NO. P-1

Date Excavated: 8/1/16 | Client: County of San Bernardino

Equipment: CME75 Truck Rig | Bucket Size: 140lbs./30in./3.0" O.D.

Surface Elevation(ft): N/A | Logged by: VJR | Station No.: N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(SM) Silty Sand, fine to coarse, with gravel to 1", light brown							
40		(SP-SM) Sand, fine to coarse, with silt and gravel to 1", brown		X		13 20 28	0.8	Dist.	Ring
		END OF BORING							
		NO REFUSAL, NO BEDROCK NO GROUNDWATER NO FILL, SLIGHT CAVING							
45									
50									
55									
60									
65									

PERCOLATION BORING 2016 16361-2.GPJ CHJ.GDT 8/9/16

CHJ

PROPOSED HIGH DESERT SERVICE CENTER
TOKAY ST AND COTTONWOOD AVE, VICTORVILLE, CA

Job No. G16-028-2

Enclosure B-1b

EXPLORATORY BORING NO. P-2

Date Excavated: 8/1/16 | Client: County of San Bernardino

Equipment: CME75 Truck Rig | Bucket Size: 140lbs./30in./3.0" O.D.

Surface Elevation(ft): N/A | Logged by: VJR | Station No.: N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
0		(SM) Silty Sand, fine to coarse, with gravel to 1", brown	Native		▨		2.9		
10				☒		10 27 40	1.3	124	Ring
20		(ML) Sandy Silt, fine to medium, light brown		☒		15 23 49	6.6	109	Ring
25					▨		5.5		SA
30				☒		21 50/5"	5.1	114	Ring
		END OF BORING NO REFUSAL, NO BEDROCK NO GROUNDWATER NO FILL, SLIGHT CAVING							

PERCOLATION BORING 2016 16361-2.GPJ CHJ.GDT 8/9/16

CHJ

PROPOSED HIGH DESERT SERVICE CENTER
TOKAY ST AND COTTONWOOD AVE, VICTORVILLE, CA

Job No. G16-028-2

Enclosure B-2

EXPLORATORY BORING NO. P-3

Date Excavated: 8/1/16 | Client: County of San Bernardino

Equipment: CME75 Truck Rig | Bucket Size: 140lbs./30in./3.0" O.D.

Surface Elevation(ft): N/A | Logged by: VJR | Station No.: N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
0		(SM) Silty Sand, fine to medium, brown	Native						
					▨		1.5		SA
5		END OF BORING							
		NO REFUSAL, NO BEDROCK NO GROUNDWATER NO FILL, SLIGHT CAVING							
10									
15									
20									
25									
30									

PERCOLATION BORING 2016 16361-2.GPJ CHJ.GDT 8/9/16

CHJ

PROPOSED HIGH DESERT SERVICE CENTER
TOKAY ST AND COTTONWOOD AVE, VICTORVILLE, CA

Job No. G16-028-2

Enclosure B-3

EXPLORATORY BORING NO. P-4

Date Excavated: 8/1/16 | Client: County of San Bernardino

Equipment: CME75 Truck Rig | Bucket Size: 140lbs./30in./3.0" O.D.

Surface Elevation(ft): N/A | Logged by: VJR | Station No.: N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
0		(SM) Silty Sand, fine to medium, brown	Native						
					▨		2.6		SA
5		END OF BORING							
		NO REFUSAL, NO BEDROCK NO GROUNDWATER NO FILL, SLIGHT CAVING							
10									
15									
20									
25									
30									

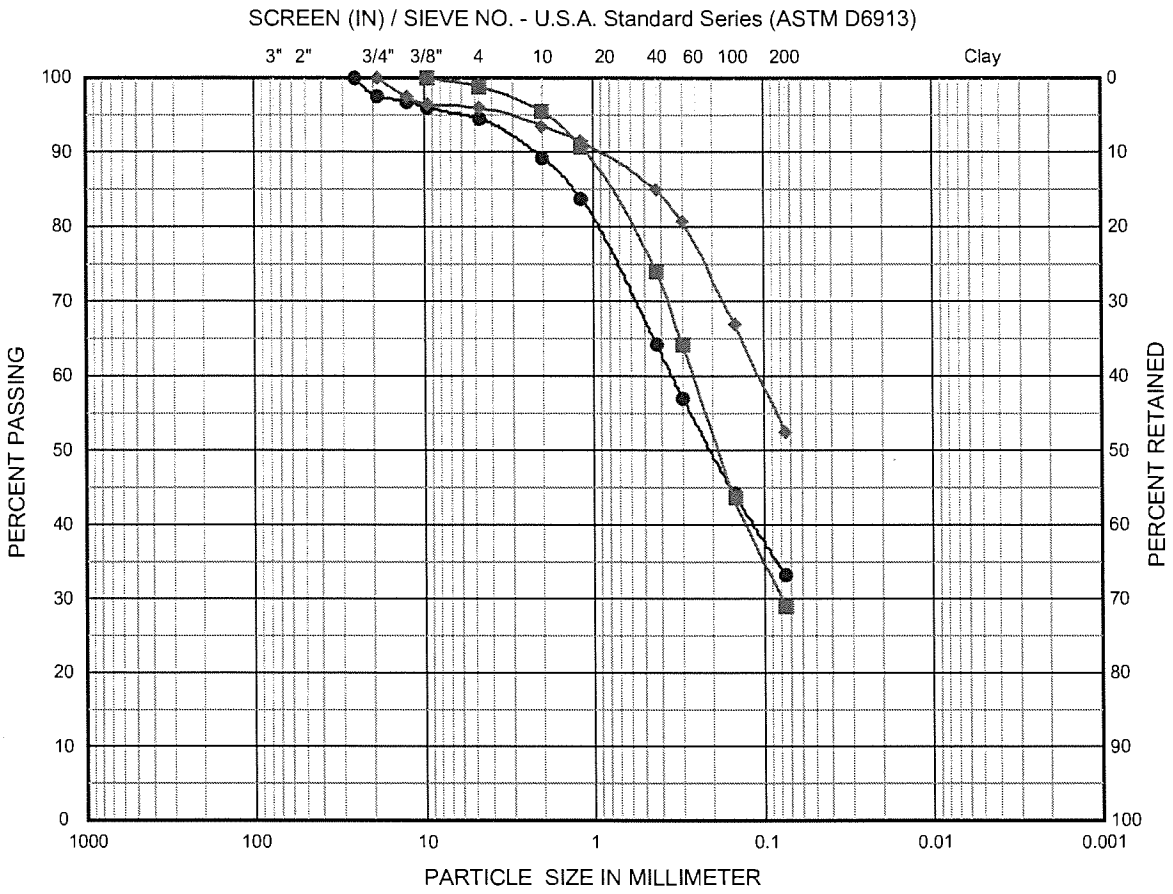
PERCOLATION BORING 2016 16361-2.GPJ CHJ.GDT 8/9/16

CHJ

PROPOSED HIGH DESERT SERVICE CENTER
TOKAY ST AND COTTONWOOD AVE, VICTORVILLE, CA

Job No. G16-028-2

Enclosure B-4



Cobbles & Boulders	Gravel		Sand			Silt	Clay
	Coarse	Fine	Coarse	Medium	Fine		

	Sample No.	Gravel	Sand	Fines	Clay	D_{10}	D_{30}	D_{50}	D_{60}	C_u	C_c
●	1A (5 ft)	5.5	61.4	33.2			0.061	0.208	0.347		
	(SM) Silty sand, fine to medium										
■	1B (32 ft)	1.1	69.9	29.0			0.079	0.189	0.261		
	(SM) Silty sand, fine to medium										
◆	2A (28 ft)	4.0	43.3	52.6				0.066	0.107		
	(ML) Sandy Silt, fine to medium										

PARTICLE SIZE DISTRIBUTION (ASTM D6913)

Project:	High Desert Service Center				
Location:	Victorville, California				
Job Number:	G16-028-2	Engineer:	MN/VJR	Enclosure:	C-1

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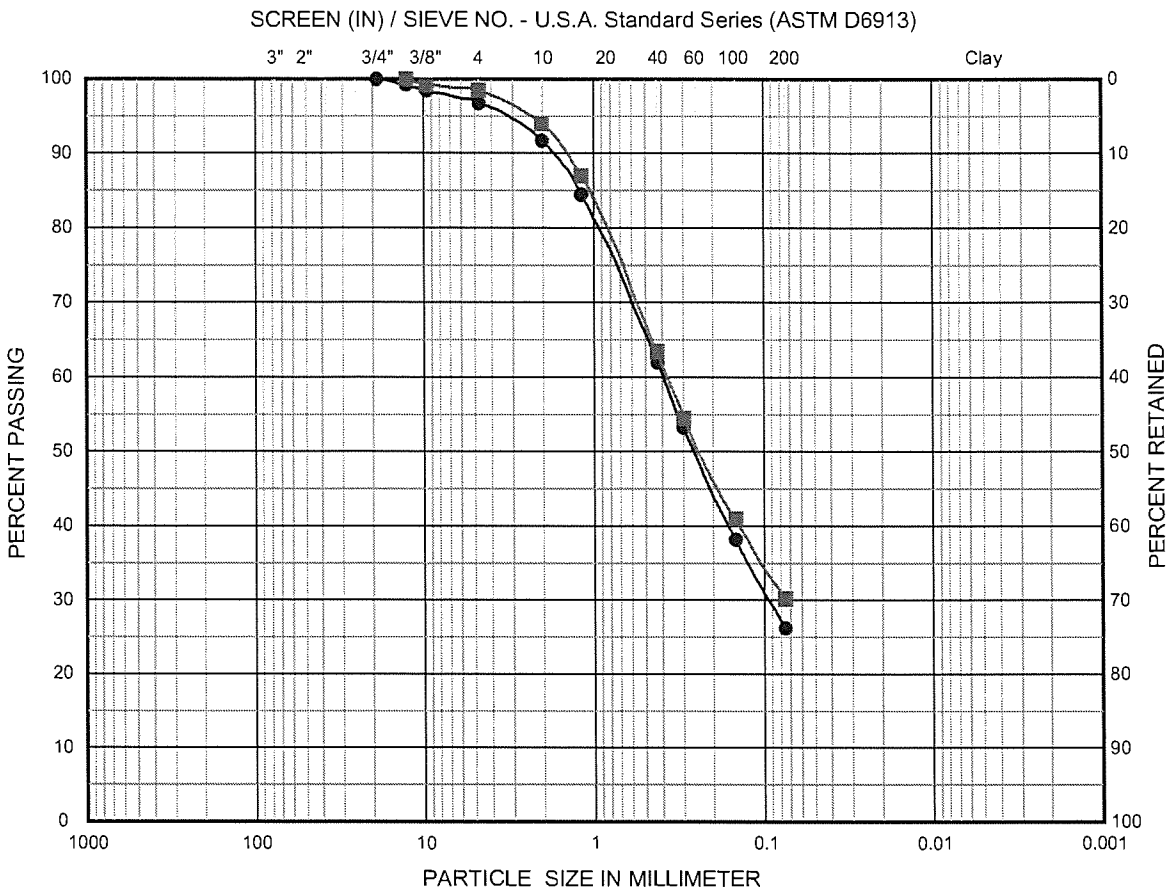

Cobbles & Boulders	Gravel		Sand			Silt	Clay
	Coarse	Fine	Coarse	Medium	Fine		

	Sample No.	Gravel	Sand	Fines	Clay	D_{10}	D_{30}	D_{50}	D_{60}	C_u	C_c
●	3A (4 ft)	3.2	70.5	26.3			0.094	0.261	0.393		
	(SM) Silty sand, fine to medium										
■	4A (4 ft)	1.6	68.3	30.1			0.074	0.242	0.372		
	(SM) Silty sand, fine to medium										

PARTICLE SIZE DISTRIBUTION (ASTM D6913)

Project:	High Desert Service Center				
Location:	Victorville, California				
Job Number:	G16-028-2	Engineer:	MN/VJR	Enclosure:	C-2

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EXHIBIT "E"
EDUCATIONAL
MATERIALS

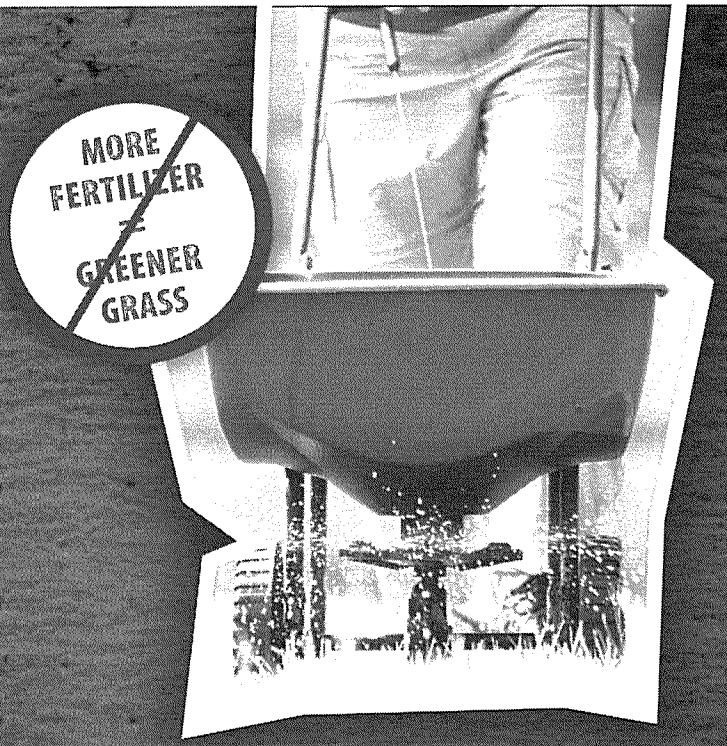
IT'S A STORMWATER POLLUTION REVOLUTION!

Keeping your grass green and the Mojave River Watershed clean!

Excess fertilizer use is a major contributor to toxins entering the Mojave River - harming our natural wildlife and eventually making its way back to our faucets, hoses, drinking water and other waterways in the High Desert.

We need your help! Follow these simple steps when applying fertilizer to prevent stormwater pollution and protect our community from toxins:

- **Read the label and use only as directed**
- **Avoid applying near driveways and gutters**
- **Never apply 24 hours before rain**
- **Store in a covered area in sealed, waterproof containers**
- **Buy non-toxic! They're just as effective and better for our watershed.**



Fertilizer Chemistry 101

Fertilizers serve different purposes depending on what your lawn needs. Each bag has three percentages (N-P-K) of ingredients to meet your needs. Buy smart and apply safely to save money!

- **N** Nitrogen makes for greener grass
- **P** Phosphorus helps establish a new lawn or tree
- **K** Potassium protects plants from temperature extremes, insects, and disease

To report illegal dumping or for more information on stormwater pollution prevention call 1 (800) 78 CRIME or visit our website at www.mojaveriver.org, Facebook at MojaveWatershed, Twitter @MojaveRiver, or Pinterest at Mojave Watershed.

Disposal Centers

Apple Valley
13450 Nomwaket Road

Hesperia Fire Station
17443 Lemon Street

Victorville Fire Department
East of Desert Knoll Drive
on Loves Lane

Barstow Corporation Yard
900 South Avenue H

San Bernardino County
2824 East W Street
San Bernardino, CA

Don't Get Turned Away!

For hours of operation, quantity limitations and other rules and regulations, call (800) 645-9228 or visit the MRWG website at www.mojaveriver.org before dropping off materials.

IT'S A STORMWATER POLLUTION REVOLUTION!

Keeping construction sites and the Mojave River Watershed clean!

Stormwater runoff from construction sites are major contributors to toxins entering the Mojave River - harming our natural wildlife and eventually making its way back to our faucets, hoses, drinking water and other waterways in the High Desert.

We need your help! Follow these simple steps when doing small or large-scale construction to prevent stormwater pollution and protect our community from toxins:

- Identify path for stormwater discharge
- Secure storm drain inlets with sandbags
- Protect slopes and channels
- Store materials off the ground on wooden pallets
- Never sweep or wash anything into a storm drain

Installing Storm Drain Inlet Protection 101

Prevent sediment from entering a storm drain by following the simple installation and maintenance steps outlined below. Use silt fence, rock-filled bags, or block and gravel.

Installation:
Install protection prior to starting activity; Protect all inlets that may receive discharge; Design protection to handle maximum volume of water expected.

Maintenance:
Inspect frequently; Remove trapped sediment; Replace or repair protection as needed; Sweep streets, sidewalks and other paved areas regularly.

To report illegal dumping or for more information on stormwater pollution prevention call 1 (800) 78 CRIME or visit our website at www.mojaveriver.org, Facebook at MojaveWatershed, Twitter @MojaveRiver, or Pinterest at Mojave Watershed.

Disposal Centers

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Barstow Corporation Yard
900 South Avenue H

Hesperia Fire Station
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San Bernardino County
2824 East W Street
San Bernardino, CA

Victorville Fire Department
East of Desert Knoll Drive
on Loves Lane

Don't Get Turned Away!

For hours of operation, quantity limitations and other rules and regulations, call (800) 645-9228 or visit the MRWG website at www.mojaveriver.org before dropping off materials.

IT'S A STORMWATER POLLUTION REVOLUTION!

Flat or sheen? Let's keep the Mojave River Watershed clean!

Washing a paint brush and dumping rinse water in the gutter are major contributors to toxins entering the Mojave River - harming our natural wildlife and eventually making its way back to our faucets, hoses, drinking water and other waterways in the High Desert.

We need your help! Follow these simple steps when using paint to prevent stormwater pollution and protect our community from toxins:

- **Store in sealed containers**
- **Use water-based paint whenever possible, not oil-based**
- **Clean water-based paint materials in the sink and oil-based paint materials with thinner**
- **Never clean or rinse brushes and containers in the street, gutter or near a storm drain**

Paint Chemistry 101

Want your paint to last longer? Use the tips below repeatedly to maximize the effectiveness of your paint – and save money!

FLAT: Almost no shine; Good for low foot traffic areas (dining rooms & bedrooms); Hides surface irregularities

LOW-LUSTER, SATIN, OR EGGSHELL: Subtle sheen; Good for bedrooms, hallways & family rooms

SEMI-GLOSS: More gloss; More durable; Good for kids' rooms, bathrooms, & trim; More water-resistant

HIGH-GLOSS: Shiny; Good for trim, molding, doors, & cabinets; Takes abuse; Easy to clean

To report illegal dumping or for more information on stormwater pollution prevention call 1 (800) 78 CRIME or visit our website at www.mojaveriver.org, Facebook at MojaveWatershed, Twitter @MojaveRiver, or Pinterest at Mojave Watershed.

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San Bernardino County
2824 East W Street
San Bernardino, CA

Don't Get Turned Away!

For hours of operation, quantity limitations and other rules and regulations, call (800) 645-9228 or visit the MRWG website at www.mojaveriver.org before dropping off materials.

IT'S A STORMWATER POLLUTION REVOLUTION!

Keeping your yard bug free and the Mojave River Watershed clean!

Excess pesticide use is a major contributor to toxins entering the Mojave River - harming our natural wildlife and eventually making its way back to our faucets, hoses, drinking water and other waterways in the High Desert.

We need your help! Follow these simple steps when applying pesticides to prevent stormwater pollution and protect our community from toxins:

- **Read the label and use only as directed**
- **Never apply 24 hours before rain**
- **Spot apply rather than blanketing an entire area**
- **Buy non-toxic! They're just as effective and better for our watershed.**

Pesticide Chemistry 101

Cost-saving alternatives are available to keep pests at bay rather than using pesticides. Try these pesticide-free tips to keep your lawn bug free, prevent stormwater pollution, and save money!

BARRIERS AND TRAPS: Collars, netting and coffee can traps capture or impede pests

TRAP PLANTS: Strategically plant plants that lure harmful insects away from plants you wish to protect. Once infested, the plant can be disposed.

BENEFICIAL INSECTS: Introduce safe insects (ladybugs, praying mantises, spiders and more!) for your garden that feed on harmful ones.

COMPANION PLANTING: Plant insect-repelling plants near ones you want to protect.

To report illegal dumping or for more information on stormwater pollution prevention call 1 (800) 78 CRIME or visit our website at www.mojaveriver.org, Facebook at MojaveWatershed, Twitter @MojaveRiver, or Pinterest at Mojave Watershed.

MOJAVE RIVER WATERSHED GROUP

Disposal Centers

Apple Valley
13450 Nomwaket Road

Barstow Corporation Yard
900 South Avenue H

Hesperia Fire Station
17443 Lemon Street

San Bernardino County
2824 East W Street
San Bernardino, CA

Victorville Fire Department
East of Desert Knoll Drive
on Loves Lane

Don't Get Turned Away!

For hours of operation, quantity limitations and other rules and regulations, call (800) 645-9228 or visit the MRWG website at www.mojaveriver.org before dropping off materials.

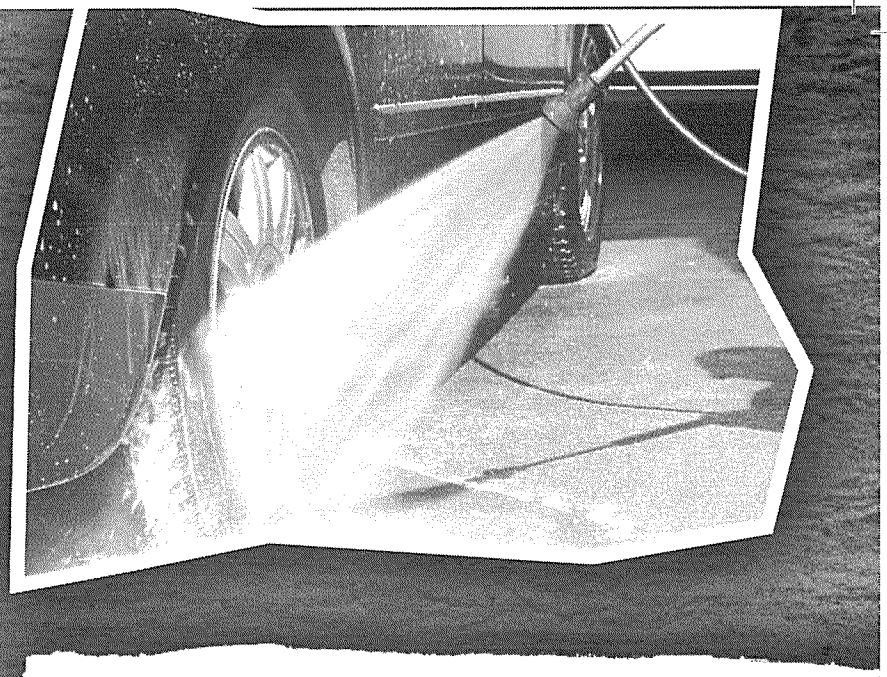
IT'S A STORMWATER POLLUTION REVOLUTION!

Smart Tips for Mobile Wash and Car Detailing Businesses

Water runoff from mobile car washing and detailing can collect harmful and toxic chemicals on the roadway. This polluted water flows into the Mojave River and our watershed, the underground drainage basins and aquifers of the High Desert. Ultimately, stormwater pollution impacts our waterways and the water we use in faucets, hoses and for drinking.

We need your help! Businesses can play an important role in pollution prevention by following these simple steps:

- Call MRWG today to schedule a FREE stormwater pollution prevention training for your employees (951) 462-1106.
- Safely prep the area by sweeping up debris and throwing it away in a trashcan.
- Avoid harsh chemicals and use biodegradable products.
- Always keep water on the washing site – do not allow water to flow into the street.
- Use a portable vacuum recovery system to contain water runoff and dispose of properly, and if possible, recycle the water.
- Do not wash undercarriage of vehicle – only cosmetic washing is permitted to reduce amount of metal, oil and antifreeze runoff.
- Use a high pressure/low volume hose with a shut-off nozzle.
- Invest in containment tools such as booms and drain covers.



Always refer to local city or county permitting requirements before getting started.

- County of San Bernardino Public Works – (909) 387-8063
- City of Hesperia – (760) 947-1000
- City of Victorville – (760) 955-5000
- Town of Apple Valley – (760) 240-7000

Be a good neighbor by adopting these stormwater savvy business practices. Failure to do so could result in violations and fines.

Have more questions about stormwater safe mobile washing? Contact us at www.mojaveriver.org, on Facebook at MojaveWatershed, Twitter @MojaveRiver, or Pinterest at Mojave Watershed. To report illegal dumping, call 1 (800) 78 CRIME or visit the website to use our digital pollution reporting form.

MOJAVE RIVER WATERSHED GROUP

IT'S A STORMWATER POLLUTION REVOLUTION!

Water-Safe Tips for Pressure Washing and Carpet Cleaning

Water runoff from pressure washing buildings and carpet cleaning services can collect harmful and toxic chemicals on the roadway. This polluted water flows into the Mojave River and our watershed, the underground drainage basins and aquifers of the High Desert. Ultimately, stormwater pollution impacts our waterways and the water we use in faucets, hoses and for drinking.

We need your help! Businesses can play an important role in pollution prevention by following these simple steps:

- **Call MRWG today to schedule a FREE stormwater pollution prevention training for your employees (951) 462-1106.**
- **Safely prep the area by sweeping up debris and throwing it away in a trashcan.**
- **Avoid harsh chemicals and use biodegradable products.**
- **Store cleaners in secured, airtight containers and keep a spill response kit on the truck.**
- **Always keep water on the washing site – do not allow water to flow into the street.**
- **Use a portable vacuum recovery system to contain water runoff, and if possible, recycle the water.**
- **Use a high pressure/low volume hose with a shut-off nozzle.**
- **Invest in containment tools such as booms and drain covers.**

Always refer to local city or county permitting requirements before getting started.

- County of San Bernardino Public Works – (909) 387-8063
- City of Hesperia – (760) 947-1000
- City of Victorville – (760) 955-5000
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Be a good neighbor by adopting these stormwater savvy business practices. Failure to do so could result in violations and fines.

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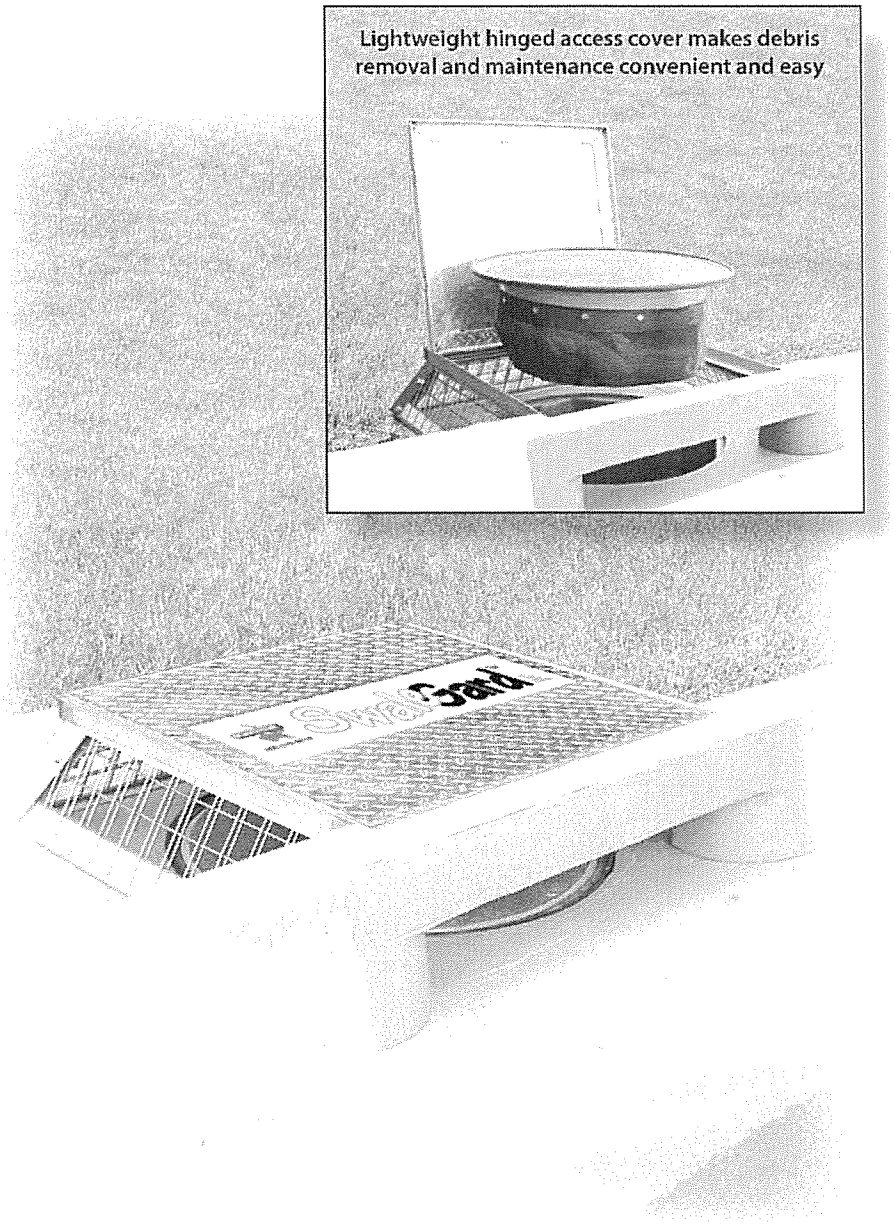
MOJAVE RIVER WATERSHED GROUP

SwaleGard® Pre-Filter

Bioretention / Biofiltration

Improves treatment performance & extends service life of bioretention systems

The SwaleGard Pre-Filter captures sediment, gross solids, trash, debris, and petroleum hydrocarbons in a single location before they get to a swale or bioretention cell system. By preventing these pollutants from reaching the bioretention surface, the SwaleGard Pre-Filter enhances treatment performance, extends the service life of the treatment area, and simplifies maintenance.



Pretreatment
Traps sediment, debris, and petroleum hydrocarbons to prevent them from entering the bioretention system.

Enhances Bioretention System Performance
Reduces pollutant load on bioretention facilities – enhancing performance, extending service life, and improving appearance.

Simple Design
Simple design is effective and economical.

Easy to Maintain
Collects and retains gross pollutants at one location for easy removal.

Cost-Effective
Economical BMP for new or retrofit applications.

Multiple Applications
Can be used for bioretention cell systems, grassy swales and parkway culverts.

US Patent No. 6,905,599

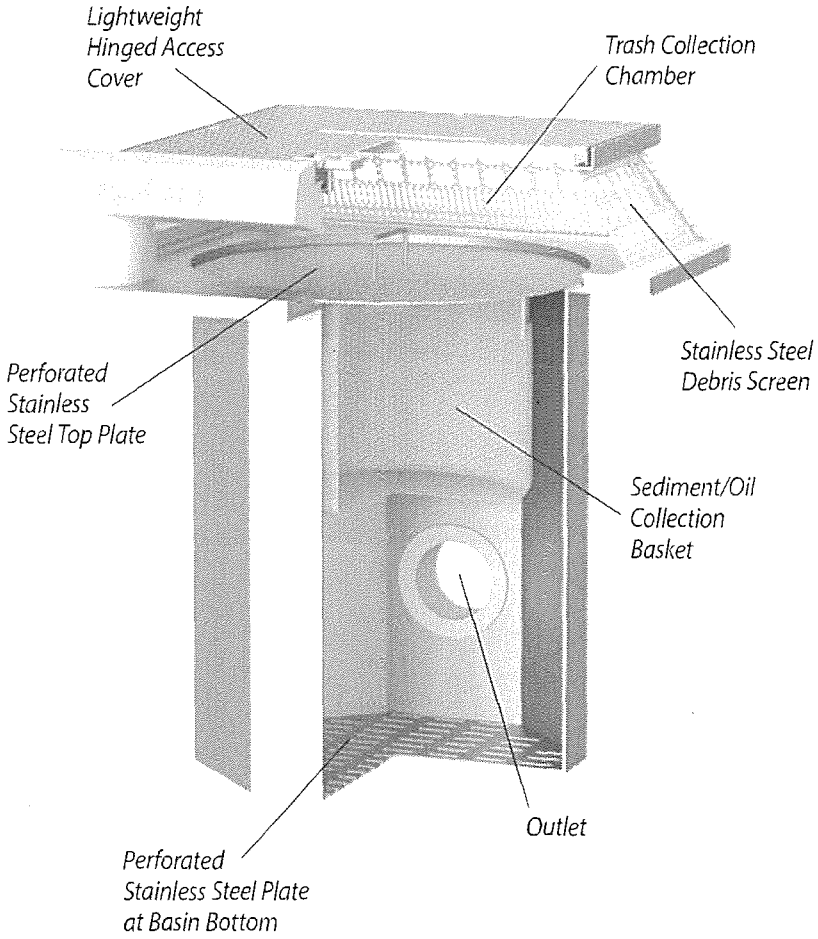
Oldcastle® Stormwater Solutions

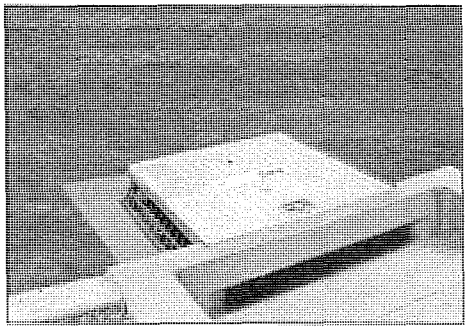
SwaleGard Pre-Filter

Collects sediments and associated pollutants that blind off bioretention systems, reducing infiltration capabilities.

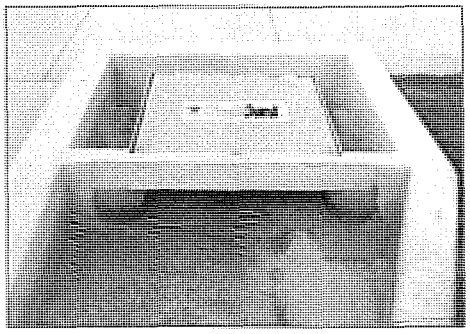
The **SwaleGard Pre-Filter** enhances treatment performance and extends service life of bioretention systems by collecting and retaining sediment, gross solids, trash, debris, and petroleum hydrocarbons at the entrance of the system. Sediments and associated pollutants can inhibit the infiltration rate of bioretention cells, and the **SwaleGard Pre-Filter** captures such pollutants in one location before they get to the bioretention facility. Collected trash and debris can be easily removed by hand or by using industrial vacuum equipment.

Fabricated from durable and corrosion-resistant stainless steel and lightweight petroleum-resistant fiberglass, the **SwaleGard Pre-Filter** is ideal for new construction or for retrofitting existing bioretention cell systems.





Installation in Grassy Swale



Installation in Parkway Culvert

SwaleGard Pre-Filter has been accepted for use in grassy swale and parkway culvert applications in the ***City of Los Angeles.***

GENERAL SPECIFICATIONS FOR MAINTENANCE OF *SWALEGARD™ PRE-FILTERS*

SCOPE:

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

RECOMMENDED FREQUENCY OF SERVICE:

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

RECOMMENDED TIMING OF SERVICE:

DPS guidelines for the timing of service are as follows:

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

SERVICE PROCEDURES:

1. Federal, State and Local regulators require that stormwater filtration systems be maintained and serviced on a recurring basis. The frequency of service depends on the amount of runoff, pollutant loading and interference from debris (leaves, vegetation, cans, paper, etc.); however, it is recommended that each installation be serviced a minimum of three times per year, with a change of filter medium once per year.
2. The timing of service for areas with a definite rainy season should be prior to, during and following the rainy season; for areas with year-round rainfall, the devices should be serviced (at least) every four months; for areas with winter snow and summer rain, service should occur prior to and just after the snow season and during the summer rain; for installed devices not subject to the elements (washracks, parking garages, etc.), the devices should be serviced on a regular basis at least three times per year.
3. The service should commence with collection and removal of sediment and debris (litter, leaves, papers, cans, etc.) and broom sweeping around the drainage inlet. Accumulated materials should be placed in a DOT approved container for later disposal.
4. Unlock and lift the aluminum access lid.
5. Remove the perforated separator plate.
6. Using an industrial vacuum, the collected materials remove the collected materials from the filter liner.
7. When the materials have been removed, the filter medium pouches should be removed by unsnapping the tether from the D-ring and set to one side. The filter liner, gaskets, stainless steel frame and mounting brackets, etc. should be inspected for continued serviceability. Minor damage or defects found should be corrected on the spot.

8. Inspect the filter medium pouches for defects and continued serviceability and replace as necessary and the pouch tethers re-attached to the liner's D-ring.
9. Replace the perforated separator plate and close and lock the access lid.

EXCHANGE AND DISPOSAL OF EXPOSED FILTER MEDIUM AND COLLECTED DEBRIS

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

Note: As the generator, the landowner is ultimately responsible for the proper disposal of the exposed filter medium and debris. Because the materials likely contain petroleum hydrocarbons, heavy metals and other harmful pollutants, the materials must be treated as an EPA Class 2 Hazardous Waste and properly disposed of. DPS relieves the landowner of the actual disposal task, and provides certification of its completion in accordance with appropriate regulations.

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

C.H.J. Incorporated
1355 E. Cooley Drive, Colton, CA 92324 ◆ Phone (909) 824-7210 ◆ Fax (909) 824-7209

August 11, 2016

County of San Bernardino
Project Management Division
385 North Arrowhead Drive, Third Floor
San Bernardino, California 92415
Attention: Mr. Scott Hughes

Job No. G16-028-2

Dear Mr. Hughes:

This letter transmits six copies of the Percolation Investigation report prepared for the septic system for the proposed High Desert Service Center, located at the northeast of Tokay Street and Cottonwood Avenue in Victorville, California.

We appreciate this opportunity to provide geologic services for this project. If you have questions or comments concerning this report, please contact us at your convenience.

Respectfully submitted,
C.H.J., INCORPORATED

George Battey III

George Battey III, P.E.
President

GB:lb

PERCOLATION INVESTIGATION
PROPOSED HIGH DESERT SERVICE CENTER
TOKAY STREET AND COTTONWOOD AVENUE
VICTORVILLE, CALIFORNIA
PREPARED FOR THE COUNTY OF SAN BERNARDINO
JOB NO. G16-028-2

1. DESCRIPTION OF SITE AND OF PROPOSAL:

1.0 Date County Specialist (Ms. Kimberly Tra) Notified: July 27, 2016, by Mr. V. John Romano, CHJ Consultants (email).

1.1 Prepared for: Mr. Scott Hughes
County of San Bernardino
Project Management Division
385 North Arrowhead Drive, Third Floor
San Bernardino, California 92415
Phone: (909) 387-5000

1.2 Location of Land: See Index Map (Enclosure "A-1").
Northeast of Cottonwood Avenue and Tokay Street in Victorville, California

.

1.3 Proposed Development/Project/Land Use:

a) Type of project: The type of structure was not provided during the course of our investigation. We anticipate that the project will consist of a one- or two-story wood framed with stucco or masonry type construction. Installation of a septic system with seepage pit for effluent treatment/disposal is planned.

b) 1. Acreage: Approximately 1 acre is available for the proposed system. Percolation testing was performed in areas designated for the seepage pit as provided by the client.

2. Number of lots: One.

3. Lot density: One lot per 52 acres.

c) Type of sewage disposal: Septic system consisting of seepage pits is considered for the disposal of sewage.

d) Grading: Minimal grading is required for the project.

1.4 Description of Site and Surroundings:

a) Topography: See Index Map (Enclosure "A-1"). The area of the proposed system is near planar and relatively level.

b) Water courses: No known water courses are located within 500 feet of the proposed system.

c) Vegetation type and density: Light growth of annual grasses and weeds.

d) Existing structures: None in the system area.

e) Existing wells or abandoned wells on or within 300 feet of project: None known.

f) Rock outcrops: No rock outcrops were observed.

g) Probable depth to water table: Groundwater was not encountered in our exploratory borings to the maximum depth drilled (41-1/2 feet below the existing ground surface, bgs). Groundwater is expected to be greater than 300 feet bgs. Groundwater is not expected to encroach within 10 feet of the bottom of the proposed seepage pits.

h) Any other features that may affect sewage disposal: None. The proposed system will be entirely within native alluvial materials.

2. EQUIPMENT:

Exploration: The soil conditions underlying the subject site were explored by means of four exploratory borings (two of which were used for percolation testing) excavated to a maximum depth of 41-1/2 feet bgs with a CME 75 truck-mounted drill rig with 8-inch hollow-stem augers. All exploratory logs are provided in Appendix "B".

Percolation Tests: Two percolation tests were performed for the septic system. The percolation tests were performed to a depth of approximately 30 feet below the ground surface. A 3-inch perforated PVC pipe was placed in the center of the holes, and gravel was placed in the annular space between the PVC pipe and the sidewalls to prevent caving. Measurements were taken with an electronic water-level reader with measurements to 0.1 feet.

3. METHODOLOGY AND PROCEDURES:

3.1 Locations of Exploratory Borings: See attached Plat (Enclosure "A-2"). Due to the relatively limited area of the proposed septic systems, the tests were taken at two evenly spaced locations. Final grading currently is not known. We anticipate that the seepage pit will be located within 5 feet of the tested depth.

3.2 Soil Characteristics to Determine Number of Borings: The investigation was based on a favorable soil classification. A total of two percolation tests were performed for the septic system.

3.3 Minimum Number of Exploratory Borings: As required by San Bernardino County Department of Environmental Health Service (DEHS) Soil Percolation Test Report Standards, a minimum of one exploratory boring is required in the area of the proposed system. For the purposes of this percolation report, two exploratory borings were drilled in the area of the proposed system. Additional borings were drilled for the storm water abatement system, and the results are provided in Appendix "B".

3.3.1 Exploratory boring results: See exploratory boring logs (Appendix "B"). The subsurface native soils generally consist of fine to medium silty sand with gravel (SM) and fine to medium sandy silt (ML). Results from sieve analyses performed for representative soils are provided in Appendix "C".

3.4 Minimum Number of Tests for Leachline: Not applicable

3.5 Minimum Number of Tests for Seepage Pits: Based on favorable soil conditions, two tests are required per 4,000-gallon septic tank capacity in the sewage disposal area.

Tests for Seepage Pits: In accordance with Section 3.5, two percolation tests were performed in the area of the proposed seepage pit.

3.5.1 - Not applicable

3.5.2 Sewage Pit, Falling Head Percolation Test Procedure:
Test Holes: In accordance with the Simplified Standard Percolation Test Procedures, Environmental Health Services, San Bernardino County, California, dated August 1992, the percolation tests were performed within 5 feet of the anticipated depth of the seepage pit (approximately 30 feet bgs). Percolation test holes were gravel packed to prevent caving.

Measurement of the Percolation Rate: The percolation tests were considered "sandy" for the purposes of testing. The tests holes were left to soak overnight. During testing, each hole was filled with water, and readings were generally

taken every 10 or 25 minutes. For the last two measurements, the water level was re-filled.

3.5.3 Seepage Pit Test Results:

3.5.3.1 Results: See Appendix "D".

3.5.3.2 Provide copies of field data: See attached logs (Appendix "B") and seepage pit percolation data sheets (Enclosures "D-1" to "D-2").

4. DISCUSSION OF RESULTS:

4.1 Soils: The soil conditions as encountered within the exploratory borings and test holes were generally uniform. The subsurface native soils generally consist of fine to medium silty sand with gravel (SM) and fine to medium sandy silt (ML). The soil conditions should be considered favorable.

4.2 Possible Sources of Error: Tests were performed in native soils. The material was generally uniform in nature. No other possible sources of error were noted.

4.3 Interpretation of Results: Results were generally as anticipated, based on the classification of the soils encountered.

5. DESIGN:

5.1 General Criteria

5.1.1 Percolation rates: The measured percolation rates for the proposed seepage pit are indicated in Appendix "D". Using the gravel packing correction factor and for the purposes of the design of the seepage pits, it is our recommendation that a percolation rate of 30 mpi should be used for seepage pit design.

5.1.2 The separation between the bottom of the proposed system and groundwater will exceed 10 feet based on data described above. The materials expected to be encountered below the seepage pit contain at least 15 percent passing the No. 200 sieve.

5.1.3 The recommended application rates are based on DEHS criteria. The design Q (gal/sf/day) is 4 gal/sf/day, which is the maximum design rate for septic systems.

5.2 Convert Percolation Rates to Leachline Design Rates: Not applicable.

5.3 Seepage Pit Design Rate - Falling Head Method: The design rate is 25 sf/100 gallons of septic tank capacity (gstc).

5.4 Special Criteria: No special criteria appear applicable to the site.

6. PLOT PER CURRENTLY ADOPTED UNIFORM PLUMBING CODE:

Details such as design of the septic system, including location of the system, should be designed by an engineer competent in disposal system design.

7. GENERAL DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS:

7.1 Seepage pit disposal systems for the site should be constructed in accordance with current DEHS criteria and applicable portions of the Uniform Plumbing Code. All pertinent requirements of the Regional Water Quality Control Board should be met.

7.2 According to information available to this firm, the proposed system area contains sufficient area to handle the liquid wastes, provided proper design is achieved. It is our opinion that there is sufficient area at the site for system installation, in addition to a 100 percent expansion area.

7.3 If more than one seepage pit is needed for a disposal system at the site, the system should be designed by an engineer competent in disposal system design, or a properly installed distribution box should be utilized to balance flow and equalize the distribution of effluent to each seepage pit in lieu of such a design. Based upon the rates obtained and the anticipated usage of the site, sewage mounding should not be a concern.

7.4 A copy of this report should be submitted to DEHS for their review and assignment of the final application rate.

7.5 A copy of the San Bernardino County's DEHS handout "Taking Care of Your Septic System" should be obtained and utilized.

We appreciate this opportunity to be of service and trust this report provides the necessary information. If at any time during the construction phase of this project questions arise concerning the content of this report or our recommendations, do not hesitate to contact this firm at your convenience.

Respectfully submitted,
C.H.J., INCORPORATED

LICENSED PROFESSIONAL ENGINEER
MAIHAN NOORZAY
No. 77901
Exp. 06-30-2017
CIVIL
STATE OF CALIFORNIA

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JAMES F. COOKE
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Maihan Noorzay, R.C.E. 77901
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JAY J. MARTIN
No. 1529
Exp. 08-31-18
STATE OF CALIFORNIA

Jay J. Martin, E.G. 1529
Consulting Geologist

George Battey III, P.E.
President

Enclosures:

"A-1"	- Index Map
"A-2"	- Site Plan
"B"	- Unified Soil Classification System Chart
"B-1" - "B-4"	- Exploratory Boring Logs
"C-1" – "C-2"	- Particle Size Distribution
"D-1" - "D-2"	- Falling Head Percolation Test Data Sheets
"D-3"	- Gravel Packing Correction

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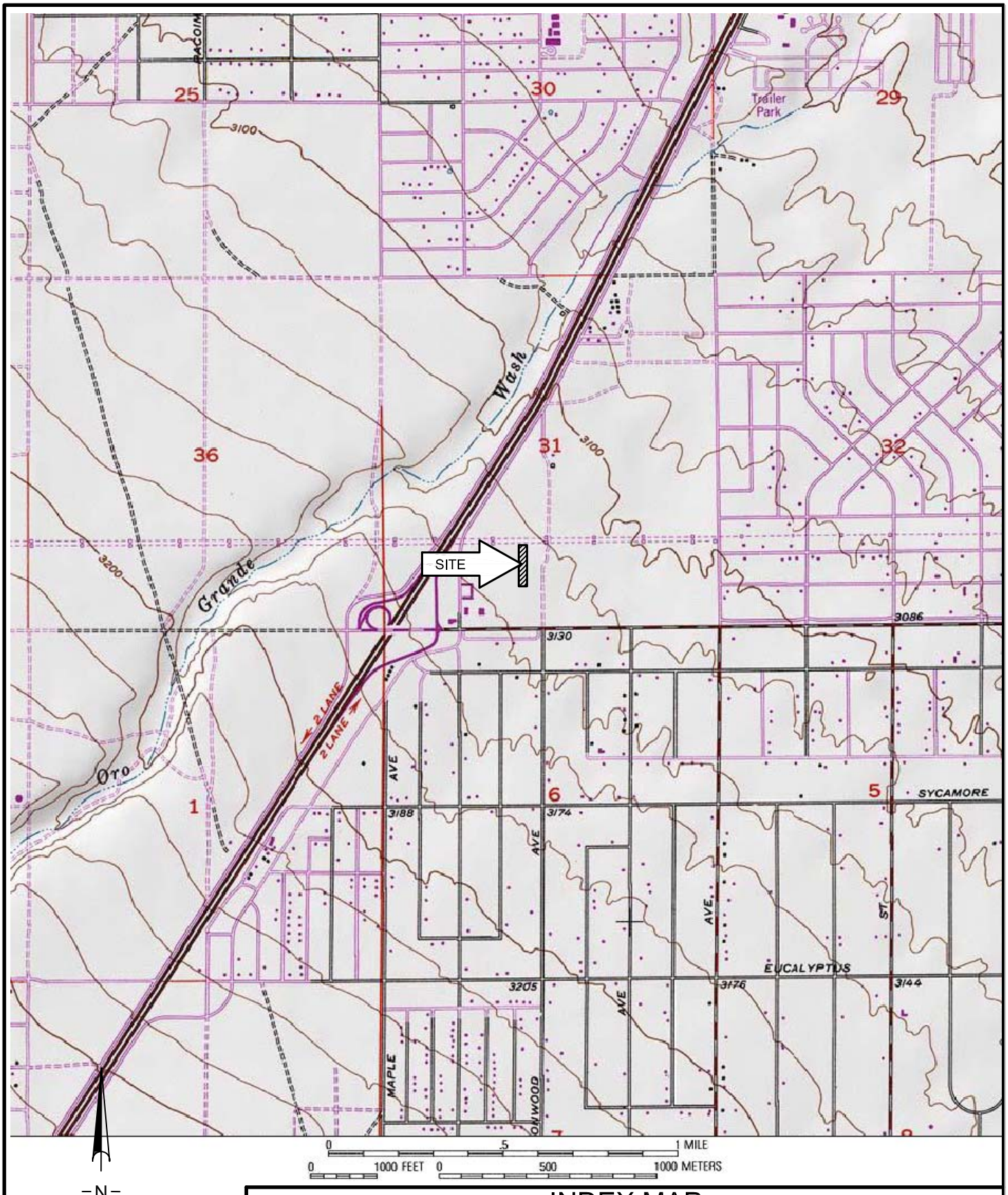


INDEX MAP

FOR: COUNTY OF SAN BERNARDINO PROJECT MANAGEMENT DIVISION	PERCOLATION INVESTIGATION PROPOSED HIGH DESERT SERVICE CENTER TOKAY STREET AND COTTONWOOD AVENUE VICTORVILLE, CALIFORNIA	ENCLOSURE "A-1"
DATE: AUGUST 2016		JOB NUMBER G16-028-2

C.H.J. Incorporated

SITE PLAN

FOR: COUNTY OF SAN BERNARDINO
PROJECT MANAGEMENT DIVISION

DATE: AUGUST 2016

PERCOLATION INVESTIGATION
PROPOSED HIGH DESERT SERVICE CENTER
TOKAY STREET AND COTTONWOOD AVENUE
VICTORVILLE, CALIFORNIA

ENCLOSURE "A-2"

JOB NUMBER G16-028-2

C.H.J. Incorporated

Enclosure "B" (1 of 1)
Job No. G16-028-2

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size)			
GRAVELS More than 50% of coarse fraction larger than No.4 sieve size	Clean Gravels (Less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No.4 sieve size	Clean Sands (Less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

LABORATORY CLASSIFICATION CRITERIA

GW $C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3

GP Not meeting all gradation requirements for GW

GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
GC	Atterberg limits above "A" line with P.I. greater than 7	

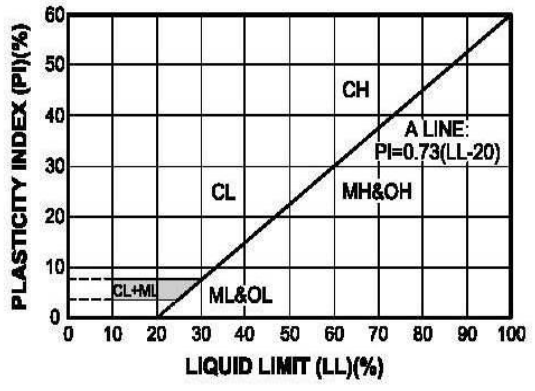
SW $C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3

SP Not meeting all gradation requirements for SW

SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size).
Coarse-grained soils are classified as follows:
Less than 5 percent.....GW, GP, SW, SP
More than 12 percent.....GM, GC, SM, SC
5 to 12 percent.....Borderline cases requiring dual symbols

PLASTICITY CHART



EXPLORATORY BORING NO. P-1

Date Excavated: 8/1/16 | Client: County of San Bernardino

Equipment: CME75 Truck Rig | Bucket Size: 140lbs./30in./3.0" O.D.

Surface Elevation(ft): N/A | Logged by: VJR | Station No.: N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(SM) Silty Sand, fine to medium, brown	Native				4.5		SA
10		(SM) Silty Sand, fine to medium, with gravel to 1", light brown		X		8 24 30	1.4	126	Ring
20				X		21 34 50/5"	3.9	125	Ring
30				X		18 46 50/4"	5.6	Dist.	Ring
							4.0		SA

PERCOLATION BORING 2016 16361-2.GPJ CHJ.GDT 8/9/16

CHJ

PROPOSED HIGH DESERT SERVICE CENTER
TOKAY ST AND COTTONWOOD AVE, VICTORVILLE, CA

Job No. G16-028-2

Enclosure B-1a

EXPLORATORY BORING NO. P-1

Date Excavated: 8/1/16 | Client: County of San Bernardino

Equipment: CME75 Truck Rig | Bucket Size: 140lbs./30in./3.0" O.D.

Surface Elevation(ft): N/A | Logged by: VJR | Station No.: N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(SM) Silty Sand, fine to coarse, with gravel to 1", light brown							
40		(SP-SM) Sand, fine to coarse, with silt and gravel to 1", brown		X		13 20 28	0.8	Dist.	Ring
		END OF BORING							
		NO REFUSAL, NO BEDROCK NO GROUNDWATER NO FILL, SLIGHT CAVING							
45									
50									
55									
60									
65									

PERCOLATION BORING 2016 16361-2.GPJ CHJ.GDT 8/9/16

CHJ

PROPOSED HIGH DESERT SERVICE CENTER
TOKAY ST AND COTTONWOOD AVE, VICTORVILLE, CA

Job No. G16-028-2

Enclosure B-1b

EXPLORATORY BORING NO. P-2

Date Excavated: 8/1/16 | Client: County of San Bernardino

Equipment: CME75 Truck Rig | Bucket Size: 140lbs./30in./3.0" O.D.

Surface Elevation(ft): N/A | Logged by: VJR | Station No.: N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(SM) Silty Sand, fine to coarse, with gravel to 1", brown	Native		▨		2.9		
10				☒		10 27 40	1.3	124	Ring
20		(ML) Sandy Silt, fine to medium, light brown		☒		15 23 49	6.6	109	Ring
					▨		5.5		SA
30				☒		21 50/5"	5.1	114	Ring
		END OF BORING NO REFUSAL, NO BEDROCK NO GROUNDWATER NO FILL, SLIGHT CAVING							

PERCOLATION BORING 2016 16361-2.GPJ CHJ.GDT 8/9/16

CHJ

PROPOSED HIGH DESERT SERVICE CENTER
TOKAY ST AND COTTONWOOD AVE, VICTORVILLE, CA

Job No. G16-028-2

Enclosure B-2

EXPLORATORY BORING NO. P-3

Date Excavated: 8/1/16 | Client: County of San Bernardino

Equipment: CME75 Truck Rig | Bucket Size: 140lbs./30in./3.0" O.D.

Surface Elevation(ft): N/A | Logged by: VJR | Station No.: N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
0		(SM) Silty Sand, fine to medium, brown	Native						
5					▨		1.5		SA
		END OF BORING NO REFUSAL, NO BEDROCK NO GROUNDWATER NO FILL, SLIGHT CAVING							
10									
15									
20									
25									
30									

PERCOLATION BORING 2016 16361-2.GPJ CHJ.GDT 8/9/16

CHJ

PROPOSED HIGH DESERT SERVICE CENTER
TOKAY ST AND COTTONWOOD AVE, VICTORVILLE, CA

Job No. G16-028-2

Enclosure B-3

EXPLORATORY BORING NO. P-4

Date Excavated: 8/1/16 | Client: County of San Bernardino

Equipment: CME75 Truck Rig | Bucket Size: 140lbs./30in./3.0" O.D.

Surface Elevation(ft): N/A | Logged by: VJR | Station No.: N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
0		(SM) Silty Sand, fine to medium, brown	Native						
5					▨		2.6		SA
		END OF BORING NO REFUSAL, NO BEDROCK NO GROUNDWATER NO FILL, SLIGHT CAVING							
10									
15									
20									
25									
30									

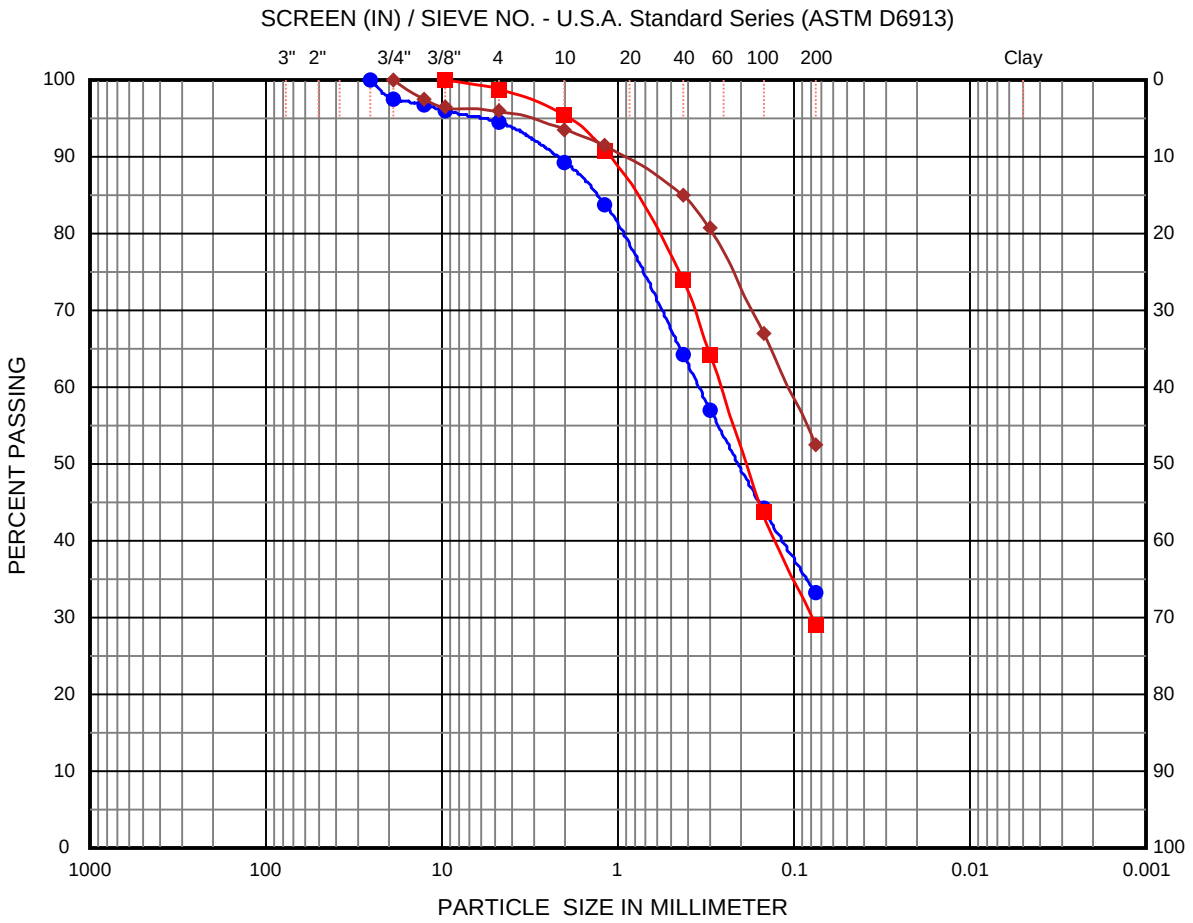
PERCOLATION BORING 2016 16361-2.GPJ CHJ.GDT 8/9/16

CHJ

PROPOSED HIGH DESERT SERVICE CENTER
TOKAY ST AND COTTONWOOD AVE, VICTORVILLE, CA

Job No. G16-028-2

Enclosure B-4



Cobbles & Boulders	Gravel		Sand			Silt	Clay
	Coarse	Fine	Coarse	Medium	Fine		

	Sample No.	Gravel	Sand	Fines	Clay	D_{10}	D_{30}	D_{50}	D_{60}	C_u	C_c
●	1A (5 ft)	5.5	61.4	33.2			0.061	0.208	0.347		
	(SM) Silty sand, fine to medium										
■	1B (32 ft)	1.1	69.9	29.0			0.079	0.189	0.261		
	(SM) Silty sand, fine to medium										
◆	2A (28 ft)	4.0	43.3	52.6				0.066	0.107		
	(ML) Sandy Silt, fine to medium										

PARTICLE SIZE DISTRIBUTION (ASTM D6913)

Project:	High Desert Service Center				
Location:	Victorville, California				
Job Number:	G16-028-2	Engineer:	MN/VJR	Enclosure:	C-1

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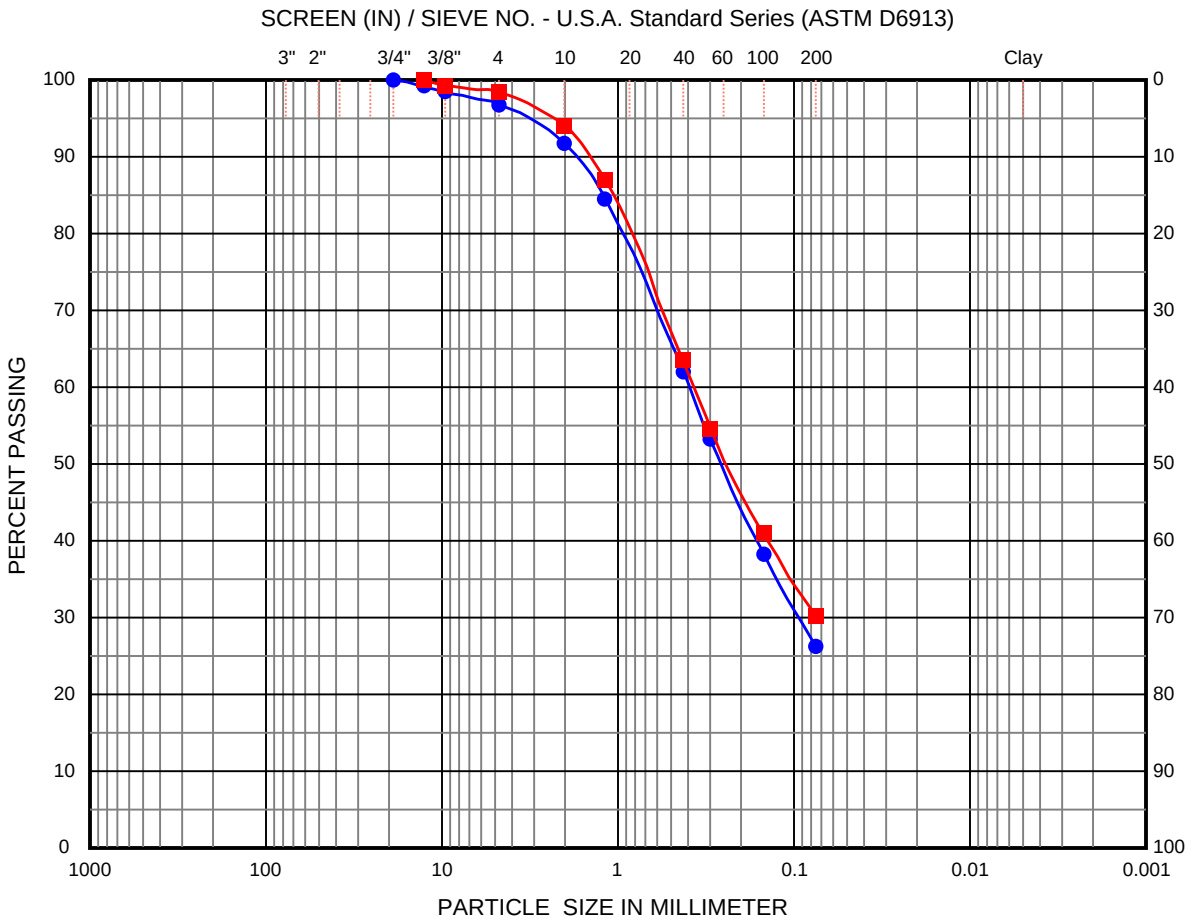
Prepared at 8/9/2016 2:00:27 PM



Cobbles & Boulders	Gravel		Sand			Silt	Clay
	Coarse	Fine	Coarse	Medium	Fine		

	Sample No.	Gravel	Sand	Fines	Clay	D_{10}	D_{30}	D_{50}	D_{60}	C_u	C_c
●	3A (4 ft)	3.2	70.5	26.3			0.094	0.261	0.393		
	(SM) Silty sand, fine to medium										
■	4A (4 ft)	1.6	68.3	30.1			0.074	0.242	0.372		
	(SM) Silty sand, fine to medium										

PARTICLE SIZE DISTRIBUTION (ASTM D6913)

Project:	High Desert Service Center				
Location:	Victorville, California				
Job Number:	G16-028-2	Engineer:	MN/VJR	Enclosure:	C-2

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Prepared at 8/9/2016 2:00:27 PM

Falling Head Percolation Test

Location:	NE of Tokay St. and Cottonwood Ave, North of P-2	Test Hole Number:	P-1			
Client:	San Bernardino County PMD	Job Number:	G16-028-2			
Depth (ft):	29.8	Tested By:	GA			
Date Excavated/Presoaked:	8/2/2016	Date Tested:	8/3/2016			
Radius of Hole (in)	4	Presoak Method:	Overnight	Radius of PVC (in.)	1.5	Gravel Packing Correction Factor
Soil Classification:	(SM) Silty sand, fine to medium			Void Ratio of Rock	0.46	0.54

Interval No.	Start or End	Time	Elapsed Time (min)	Total Time (min)	Depth to Water Surface (d_i/d_f)	Depth to Water Bottom (d_h)	Time (hr) ($\wedge t$)	Lave	Diamater (ft)(D)	F	Gallons of Sewage (Q)	Pit mpi
1	Start	8:53 AM	25	25	0.00	29.8	0.42	20.99	0.67	17.63	12.09	14.88
	End	9:18 AM			17.63							
2	Start	9:22 AM	25	50	0.00	29.8	0.42	21.84	0.67	15.93	10.50	17.14
	End	9:47 AM			15.93							
3	Start	10:50 AM	10	60	0.00	29.8	0.17	24.28	0.67	11.05	16.39	10.98
	End	11:00 AM			11.05							
4	Start	11:00 AM	10	70	0.00	29.8	0.17	24.74	0.67	10.13	14.73	12.22
	End	11:10 AM			10.13							
5	Start	11:10 AM	10	80	0.00	29.8	0.17	24.83	0.67	9.95	14.43	12.47
	End	11:20 AM			9.95							
6	Start	11:20 AM	10	90	0.00	29.8	0.17	24.44	0.67	10.73	15.80	11.39
	End	11:30 AM			10.73							
7	Start	11:30 AM	10	100	0.00	29.8	0.17	24.44	0.67	10.73	15.80	11.39
	End	11:40 AM			10.73							
8	Start	11:40 AM	10	110	0.00	29.8	0.17	24.55	0.67	10.50	15.40	11.69
	End	11:50 AM			10.50							
Corrected Rates (Corrected for Gravel Packing)											8.31	21.65

Falling Head Percolation Test

Location:	NE of Tokay St. and Cottonwood Ave, South of P-1		Test Hole Number:	P-2		
Client:	San Bernardino County PMD		Job Number:	G16-028-2		
Depth (ft):	29.3		Tested By:	GA		
Date Excavated/Presoaked:		8/2/2016	Date Tested:	8/3/2016		
Radius of Hole (in)	4	Presoak Method:	Overnight		Radius of PVC (in.)	1.5	Gravel Packing Correction Factor
Soil Classification:	(ML) Sandy silt, fine to medium				Void Ratio of Rock	0.46	0.54

Interval No.	Start or End	Time	Elapsed Time (min)	Total Time (min)	Depth to Water Surface (d_i/d_f)	Depth to Water Bottom (d_h)	Time (hr) ($\wedge t$)	Lave	Diamater (ft)(D)	F	Gallons of Sewage (Q)	Pit mpi
1	Start	9:04 AM	25	25	0.00	29.3	0.42	17.76	0.67	23.08	18.71	9.62
	End	9:29 AM			23.08							
2	Start	9:33 AM	25	50	0.00	29.3	0.42	18.40	0.67	21.80	17.06	10.55
	End	9:58 AM			21.80							
3	Start	10:55 AM	10	60	0.00	29.3	0.17	25.01	0.67	8.58	12.34	14.58
	End	11:05 AM			8.58							
4	Start	11:05 AM	10	70	0.00	29.3	0.17	24.99	0.67	8.63	12.43	14.49
	End	11:15 AM			8.63							
5	Start	11:15 AM	10	80	0.00	29.3	0.17	25.19	0.67	8.23	11.76	15.31
	End	11:25 AM			8.23							
6	Start	11:25 AM	10	90	0.00	29.3	0.17	25.28	0.67	8.05	11.47	15.70
	End	11:35 AM			8.05							
7	Start	11:35 AM	10	100	0.00	29.3	0.17	24.98	0.67	8.65	12.47	14.44
	End	11:45 AM			8.65							
8	Start	11:45 AM	10	110	0.00	29.3	0.17	25.06	0.67	8.48	12.17	14.79
	End	11:55 AM			8.48							
Corrected Rates (Corrected for Gravel Packing)											6.57	27.38

Enclosure "D-3"
Job No. G16-028-2

Gravel Packing Correction	
Radius of Hole	4 inches
Radius of PVC Pipe	1.5 inches
Void Ratio of Gravel	0.46

Correction Factor = $[1+P(c^2-1)]/c^2$

$c = r_2/r_1$

r_2 = radius of hole

r_1 = radius of pipe

P = % voids

correction factor = $[1+.046((4/1.5)^2 -1)]/(4/1.5)^2$

correction factor = 0.54