Preliminary Water Quality Management Plan

For:

Pepper Industrial Building

APN: 0264-201-05

Prepared for:

Howard Industrial Partners

1944 North Tustin Street, Suite 122

Orange, CA 92865

(714) 769-9155

Prepared by:

FMCivil Engineers, Inc

29995 Technology Drive, Suite 306

Murrieta, CA 92563

(951) 973-0201

Submittal Date: December 15, 2021

Approval Date:_____

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for **Howard Industrial Partners, LLC** by **FMCivil Engineers Inc**. The WQMP is intended to comply with the requirements of the County of San Bernardino and the NPDES Areawide Stormwater Program requiring the preparation of a WQMP. 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 San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county 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."

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Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	TBD	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0264-201-05

Owner's Signature			
Owner Name: Tim Howard			
Title	Partner		
Company	Howard Industrial Partners		
Address	1944 North Tustin Street, Suite 122		
Email	thoward@hipre.net		
Telephone #	(714) 769-9155		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	TBD	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0264-201-05

"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 Regional Water Quality Control Board Order No. R8-2010-0036."

Engineer: Francisco Martinez		PE Stamp Below
Title	Principal	
Company	FMCivil Engineers, Inc	
Address	29995 Technology Drive, Suite 306 Murrieta, CA 92563	
Email	Francisco.martinez@fmcivil.com	
Telephone #	(951) 973-0201	
Signature		
Date		

Table of Contents

Forms

Section 1 Discretionary Permit(s)

Form 1-1 Project Information					
Project Name	Pepper Industrial Building				
Project Owner Contact Name:	Tim Howard				
Mailing Address:	1944 North Tustin Street, Suite 122 Orange, CA 92865	E-mail Address:	thoward@hipre.net	Telephone:	(714) 769-9155
Permit/Application Number(s):	TBD	Tract/Parcel Map Number(s):	TBD		
Additional Information/ Comments:					
Description of Project:	The overall site, which totals ±23.7 acres, is currently a vacant parcel. The proposed site consists of an industrial building, truck yard, landscaping improvements, and underground infiltration chambers. The site is comprised of a single drainage area. Flows up to a mitigated 2-year 24-hour storm event from this area will be directed to hydrodynamic separators, and then to the underground infiltration BMP, to address water quality and HCOC. Flows greater than the mitigated 2-year 24-hour storm will bubble out of the underground infiltration BMP into an outlet structure and then to an existing natural flow path toward Lytle Creek. Lytle Creek runs until its confluence with Warm Creek, which itself confluences with the Santa Ana River approximately half a mile east of the I-10 and I-215 Junction in the City of Colton.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.					

Section 2 Project Description

2.1 Project Information

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

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

Form 2.1-1 Description of Proposed Project

1 Development Category (Select all that apply):

☐ Significant re-development involving the addition or replacement of 5,000 ft² or more of impervious surface on an already developed site	☒ New development involving the creation of 10,000 ft² or more of impervious surface collectively over entire site	☐ Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539	☐ Restaurants (with SIC code 5812) where the land area of development is 5,000 ft² or more
☐ Hillside developments of 5,000 ft² or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	☐ Developments of 2,500 ft² of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters.	☒ Parking lots of 5,000 ft² or more exposed to storm water	☐ Retail gasoline outlets that are either 5,000 ft² or more, or have a projected average daily traffic of 100 or more vehicles per day

☐ Non-Priority / Non-Category Project *May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements*.

2 Project Area (ft2):	1,032,445	**3** Number of Dwelling Units:	N/A	**4** SIC Code:	4225 – General Warehousing and Storage

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.*

6 Does Project include roads? Yes ☐ No ☒ *If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)*

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:

Contact Info:

-Tim Howard
-Partner
-Howard Industrial Partners
-1944 North Tustin Street, Suite 122
-Orange, CA 92865
-thoward@hipre.net

The maintenance of the proposed development is the responsibility of the owner until the property is sold to a new owner and then they assume responsibility of the BMP maintenance and management. There is no homeowner's or property owner's association set up for this proposed development. All of the BMP's are the responsibility of the owner to maintain. BMPs include, but are not limited to, BMP maintenance; e.g. inspection, storm drain stenciling, efficient irrigation and landscape maintenance, BMP maintenance of sub-surface infiltration system, hydrodynamic separators and pervious pavement.

No infrastructure will be transferred to a public agency after project completion.

2.3 Potential Stormwater Pollutants

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-3 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 ☐	Wild Birds/Animal Waste/Garbage
Nutrients - Phosphorous	E ☒	N ☐	Fertilizer/Food Waste/Garbage
Nutrients - Nitrogen	E ☒	N ☐	Fertilizer/Food Waste/Garbage
Noxious Aquatic Plants	E ☒	N ☐	Landscape areas
Sediment	E ☒	N ☐	Driveways/Sidewalks
Metals	E ☒	N ☐	Cars/Trucks
Oil and Grease	E ☒	N ☐	Cars/Trucks
Trash/Debris	E ☒	N ☐	Parking Lot/Poorly managed trash containers
Pesticides / Herbicides	E ☒	N ☐	Landscape Use
Organic Compounds	E ☒	N ☐	Landscape Use
Other: Oxygen Demanding Compounds	E ☒	N ☐	Cars/Trucks
Other: Petroleum Hydrocarbons	E ☒	N ☐	Cars/Trucks
Other: Solvents	E ☒	N ☐	Cars/Trucks
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

2.4 Water Quality Credits

A water quality credit program is applicable for certain types of development projects if it is not feasible to meet the requirements for on-site LID. Proponents for eligible projects, as described below, can apply for water quality credits that would reduce project obligations for selecting and sizing other treatment BMP or participating in other alternative compliance programs. Refer to Section 6.2 in the TGD for WQMP to determine if water quality credits are applicable for the project.

Form 2.4-1 Water Quality Credits

1 Project Types that Qualify for Water Quality Credits: *Select all that apply*			
☐ Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced]	Higher density development projects ☐ Vertical density [20%] ☐ 7 units/ acre [5%]	☐ Mixed use development, (combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that demonstrate environmental benefits not realized through single use projects) [20%]	☐ Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%]
☐ Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	☐ Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	☐ In-fill projects (conversion of empty lots & other underused spaces < 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%]	☐ Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]
2 Total Credit % 0 *(Total all credit percentages up to a maximum allowable credit of 50 percent)*			
Description of Water Quality Credit Eligibility (if applicable)	This project is not eligible for any Water Quality Credits.		

Section 3 Site and Watershed Description

Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed 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.***

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34°07'52.15"N	Longitude 117°21'03.22"W	Thomas Bros Map: Page 576

1 San Bernardino County climatic region: ☒ Valley ☐ Mountain

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 (23.70ac) to Subsurface Basin 1	All drainage will surface flow via gutter and be conveyed to two hydrodynamic separators, and then to a system of underground infiltration chambers at equal depths connected via storm drain where the DCV will be treated, along with storing flows due to address HCOC requirements.

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A			
1 DMA drainage area (ft^2)	1,032,445			
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*	II			
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	A			
5 Longest flowpath length (ft)	1,762			
6 Longest flowpath slope (ft/ft)	0.012			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Grass			
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	Fair			

Form 3-3 Watershed Description for Drainage Area

Receiving waters *Refer to Watershed Mapping Tool - http://permitrack.sbcounty.gov/wap/ See 'Drainage Facilities" link at this website*	Lytle Creek Warm Creek Santa Ana River, Reach 4 Santa Ana River, Reach 3 Prado Flood Control Basin
Applicable TMDLs *Refer to Local Implementation Plan*	None
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/ and State Water Resources Control Board website – http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml*	Santa Ana River, Reach 4 – Pathogens Santa Ana River, Reach 3 – Pathogens, Lead Prado Flood Control Basin - pH
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	San Bernardino Kangaroo Rat Riversidian Alluvial Sage Scrub
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	Santa Ana River, Reach 4 Santa Ana River, Reach 3
Hydrologic Conditions of Concern	☒ Yes *Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal* ☐ No
Watershed–based BMP included in a RWQCB approved WAP	☐ Yes *Attach verification of regional BMP evaluation criteria in WAP* • *More Effective than On-site LID* • *Remaining Capacity for Project DCV* • *Upstream of any Water of the US* • *Operational at Project Completion* • *Long-Term Maintenance Plan* ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMP

4.1.1 Pollution Prevention

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.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	The owner shall familiarize himself with the contents of the WQMP and County Ordinances and brochures and furnish copies of the County BMP factsheets to all future tenants through lease agreements.
N2	Activity Restrictions	☒	☐	Tenants shall not be allowed to discharge chemicals, chemical residues, wastewater or other prohibited discharges listed in the County Ordinances, to the outside, paved areas of the site; or store chemicals or other pollutant sources in non-spill contained or covered facilities.
N3	Landscape Management BMPs	☒	☐	Landscape crews contracted by the owner shall inspect the irrigation system and the health of the landscaping plant cover after each landscape procedure and shall report all repairs and problems to the owner. All routine landscaping maintenance shall be done in conformance with BMP fact sheet SD-10 in Section 6.4.5.
N4	BMP Maintenance	☒	☐	BMP maintenance will be provided by the property owner and will take place at a minimum of twice a year and after any major rainfall event. Manufacturer of underground infiltration system recommends yearly inspection at a minimum, with maintenance occurring should the inspection reveal sediment or trash clogging the system. Maintaining the BMP at more frequent intervals will help it retain its effectiveness and longevity.
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	The owner/tenant will file appropriate hazardous material disclosures, if any storage is conducted, and must comply with all the Title 22 CCR, Chapter 29 regulations.
N6	Local Water Quality Ordinances	☒	☐	The owner shall ensure that all business activities at the site comply with the County of San Bernardino's Stormwater Ordinance through the implementation of BMP's.
N7	Spill Contingency Plan	☒	☐	Absorbent materials will be kept on site at all times, along with equipment necessary to address small and large non-hazardous spills/leaks, with private cleanup company being contacted to handle hazardous spills/leaks from trucks on site per CASQA SC-11.
N8	Underground Storage Tank Compliance	☐	☒	The project site does not incorporate underground storage tanks.
N9	Hazardous Materials Disclosure Compliance	☒	☐	The current owner and future owners shall prohibit the storage of hazardous materials.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☒	☐	All fire code requirements shall be implemented at this site per Uniform Fire Code Article 80 as applicable.
N11	Litter/Debris Control Program	☒	☐	The project will implement the maintenance and removal of litter from common areas by private contractor.
N12	Employee Training	☒	☐	Training will be required within 6 months of hire dates for new employees, and then annually thereafter. Training will cover the impact of dumping oil, paint, solvents, or other potentially harmful chemical into the storm drain system; the use of fertilizers and pesticides in landscaping maintenance practices; and the impacts of litter and improper waste disposal.
N13	Housekeeping of Loading Docks	☒	☐	General good housekeeping procedures will include maintenance of loading docks.
N14	Catch Basin Inspection Program	☒	☐	The on-site catch basins shall be inspected monthly during the rainy season (October-May) and before and after each storm to ensure proper operation. The owner shall contract with a qualified landscape contractor to inspect and clean out accumulation of trash, litter and sediment and check for evidence of illegal dumping of waste materials into on-site drains.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Parking lots shall be vacuum swept weekly to prevent sediment, garden waste, and trash, or other pollutants from entering on-site drains and public storm channels. Vacuum sweeping will be done by a landscape contractor or other contractor provided by the owner.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	This is a private project.
N17	Comply with all other applicable NPDES permits	☒	☐	The developer of this site shall comply with the state's General Construction Stormwater Permit by filing a NOI, SWPPP, and obtain a WDID #, prior to start of grading/construction. All future occupants requiring coverage under the NPDES General Industrial Activities Permit shall comply with the permit requirements by filing a notice of intent and SWPPP with the state and obtaining a WDID Discharge Permit Number, prior to commencement of industrial activities, covered under the permit.

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)	☒	☐	A painted message "No Dumping- Drains to River" shall be placed on each catch basin. The message shall be inspected annually & repainted as necessary.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage shall be allowed at this facility.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	All dumpsters shall have working lids which shall be kept closed, at all times. Trash enclosure shall comply with CASQA SD-32 and shall have doors.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	The irrigation system will include devices to prevent low head drainage, overspray and run off through the use of pressure regulating devices, check valves, rain shutoff valves, flow sensors, pressure drop sensors, proper spacing, low precipitation emission devises and ET or weather based controllers. Landscape and irrigation shall be consistent with the State Model Water Efficient landscape Ordinance and the County of San Bernardino landscape Development Standards. Plants installed will be arranged according to similar hydrozones and meet the required water budget for the site. Landscape areas used for water quality swales or infiltration areas shall have proper plants for saturated soils, drought tolerance and erosion control qualities. Shade trees shall be used to intercept rainwater and reduce heat gain on paving.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Proposed landscape will comply with depressed area requirements by finishing landscaped areas 1-2 inches below the top of curb, sidewalks, or pavement.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	Proposed slopes will be vegetated to prevent erosion.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☒	☐	Proposed docks are equipped with dock high doors so that truck trailers back up flush with building and loading/unloading activities are contained inside building.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	The project site does not incorporate maintenance bays, covered or otherwise
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No car wash area proposed on project site
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No outdoor processing areas proposed on project site
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No proposed wash areas proposed on project site
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling areas proposed on project site
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No hillside conditions present on project site.
S14	Wash water control for food preparation areas	☐	☒	N/A
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	N/A

4.1.2 Preventative LID Site Design Practices

Site design practices associated with new LID requirements in the MS4 Permit should be considered in the earliest phases of a project. Preventative site design practices can result in smaller DCV for LID BMP and hydromodification control BMP by reducing runoff generation. 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 Preventative LID Site Design Practices Checklist

Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Minimize impervious areas: Yes ☒ No ☐ Explanation: The project site will minimize the impervious areas by incorporating porous concrete at auto parking stalls and drive aisles to the north-west and west of the building, and by providing landscaping in all feasible areas to the maximum extent practicable.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: The project site will utilize underground infiltration chambers as well as porous concrete, which will maximize the natural infiltration capacity.
Preserve existing drainage patterns and time of concentration: Yes ☐ No ☒ Explanation: Existing drainage patterns will be preserved. Time of concentration will differ but will be mitigated through the use of the infiltration chambers.
Disconnect impervious areas: Yes ☒ No ☐ Explanation: Proposed development runoff water is disconnected from the MS4 by directing 2-year, 1-hour storm event into the underground infiltration basin, which retain the entire DCV for this project.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: Onsite vegetation will not be preserved; however, non-paved areas will be landscaped to the maximum extent practicable.
Re-vegetate disturbed areas: Yes ☒ No ☐ Explanation: All areas not paved will be landscaped.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: The project will minimize unnecessary compaction in the infiltration BMP areas. Contractor will be informed to minimize compaction per manufacturer's and Geotechnical Engineer's recommendations at the underground infiltration area during grading and installation.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Vegetated swales were not practical or feasible given the proposed use for the project site. Surface drainage paths would be damaged by regular truck traffic.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐ Explanation: The project will stake off areas that will be used for landscaping to minimize compaction during construction.

4.2 Project Performance Criteria

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in the 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 of any downstream waterbody segments with a HCOC. ***If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.***

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the P_6 method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program 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 mi²), 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 HCOC 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): 1,032,445	**2** Imperviousness after applying preventative site design practices (Imp%): 88.2	**3** Runoff Coefficient (Rc): 0.7014 *$R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.637 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.9432 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; 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): 112,165 *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 HCOC Assessment (DA 1)

Does project have the potential to cause or contribute to an HCOC in a downstream channel: Yes ☒ No ☐

Go to: *http://permitrack.sbcounty.gov/wap/*

If "Yes", then complete HCOC assessment of site hydrology for 2yr 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)*

If "No," then proceed to Section 4.3 Project Conformance Analysis

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	**1** 21,453 *Form 4.2-3 Item 12*	**2** 66.30 *Form 4.2-4 Item 13*	**3** 4.61 *Form 4.2-5 Item 10*
Post-developed	**4** 212,982 *Form 4.2-3 Item 13*	**5** 18.72 *Form 4.2-4 Item 14*	**6** 27.35 *Form 4.2-5 Item 14*
Difference	**7** *191,529* *Item 4 – Item 1*	**8** *47.58* *Item 2 – Item 5*	**9** *22.74* *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** *892.8%* *Item 7 / Item 1*	**11** *71.8%* *Item 8 / Item 2*	**12** *493.3%* *Item 9 / Item 3*

Values 12 & 13 calculated using CivilDesign Hydrology Software run attached in Appendix 6.4.7

Form 4.2-3 HCOC 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 2 yr, 24 hr storm (in): 2.94
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3): **21,453**
*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): **212,982**
*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 HCOC Requirement, (ft^3): **180,880**
*V_{HCOC} = (Item 13 * 0.95) – Item 12*

Values 13 & 14 calculated using CivilDesign Hydrology Software run attached in Appendix 6.4.7

Form 4.2-4 HCOC 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): **66.30** *Minimum of Item 12 pre-developed DMA*

14 Post-developed time of concentration (min): **18.72** *Minimum of Item 12 post-developed DMA*

15 Additional time of concentration needed to meet HCOC requirement (min): $T_{C\text{-}HCOC}$ = *(Item 13 * 0.95) – Item 14 =* ***44.27***

Values 10 & 14 calculated using CivilDesign Hydrology Software run attached in Appendix 6.4.7

Form 4.2-5 HCOC 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 - 0.6 LOG Form 4.2-4 Item 5 /60)*							
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*							
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*							
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	*n/a*			*n/a*		
	DMA B		*n/a*			*n/a*	
	DMA C			*n/a*			*n/a*

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

10 Peak runoff from pre-developed condition confluence analysis (cfs): **4.61** *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): **27.35** *Maximum of Item 11, 12, and 13 (including additional forms as needed)*

15 Peak runoff reduction needed to meet HCOC Requirement (cfs): *$Q_{p\text{-}HCOC}$ = (Item 14 * 0.95) – Item 10 =* **21.37**

4.3 Project Conformance Analysis

Complete the following forms for each project site DA to document that the proposed LID BMPs conform to the project DCV developed to meet performance criteria specified in the 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 MS4 Permit (see Section 5.3.1 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design and Hydrologic Source Controls (Form 4.3-2)
- Retention and Infiltration (Form 4.3-3)
- Harvested and Use (Form 4.3-4) or
- Biotreatment (Form 4.3-5).

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 5.3.2.1 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 Forms 4.3-2 and 4.3-4 to determine the feasibility of applicable HSC and harvest and use 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 HSC 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 LID HSC, retention and infiltration, and harvest and use BMPs are unable to mitigate the entire DCV, then biotreatment BMPs may be implemented by the project proponent. If biotreatment BMPs are used, then they must be sized to provide sufficient capacity for effective treatment of the remainder of the volume-based performance criteria that cannot be achieved with LID BMPs (TGD for WQMP Section 5.4.4.2). **Under no circumstances shall any portion of the DCV be released from the site without effective mitigation and/or treatment**.

Form 4.3-1 Infiltration BMP Feasibility (DA 1)

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

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

If Yes, Provide basis: (attach)

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

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

If Yes, Provide basis: (attach)

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

If Yes, Provide basis: (attach)

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

If Yes, Provide basis: (attach)

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

If Yes, Provide basis: (attach)

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

If Yes, Provide basis: (attach)

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

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

[9] All answers to Item 1 through Item 6 are "No": Yes ☒ 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, Hydrologic Source Control BMP.

4.3.1 Site Design Hydrologic Source Control BMP

Section XI.E. of the Permit emphasizes the use of LID preventative measures; and the use of LID HSC BMPs reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable HSC 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 HSC, if a project cannot feasibly meet BMP sizing requirements or cannot fully address HCOCs, feasibility of all applicable HSC 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 HSC BMP. Refer to Section 5.4.1 in the TGD for more detailed guidance.

Form 4.3-2 Site Design Hydrologic Source Control 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)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (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 Hydrologic Source Control BMPs (DA 1)

14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☒ *If yes, complete Items 15-20. If no, proceed to Item 21*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Rooftop area planned for ET BMP (ft^2)			
16 Average wet season ET demand (in/day) *Use local values, typical ~ 0.1*			
17 Daily ET demand (ft^3/day) *Item 15 * (Item 16 / 12)*			
18 Drawdown time (hrs) *Copy Item 6 in Form 4.2-1*			
19 Retention Volume (ft^3) *$V_{retention}$ = Item 17 * (Item 18 / 24)*			
20 Runoff volume retention from evapotranspiration BMPs (ft^3): *$V_{retention}$ =Sum of Item 19 for all BMPs*			
21 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 22-25. If no, proceed to Item 26*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
22 Number of Street Trees			
23 Average canopy cover over impervious area (ft^2)			
24 Runoff volume retention from street trees (ft^3) *$V_{retention}$ = Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches*			
25 Runoff volume retention from street tree BMPs (ft^3): *$V_{retention}$ = Sum of Item 24 for all BMPs*			
26 Implementation of residential rain barrel/cisterns: Yes ☐ No ☒ *If yes, complete Items 27-29; If no, proceed to Item 30*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
27 Number of rain barrels/cisterns			
28 Runoff volume retention from rain barrels/cisterns (ft^3) *$V_{retention}$ = Item 27 * 3*			
29 Runoff volume retention from residential rain barrels/Cisterns (ft3): *$V_{retention}$ =Sum of Item 28 for all BMPs*			
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs: 0 *Sum of Items 5, 13, 20, 25 and 29*			

4.3.2 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 D 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 5.5.1 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).

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

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 112,165 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*

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 D of the TGD for WQMP for minimum requirements for assessment methods*	2.50		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	3.13		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.80		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	4		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	3.2		
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*	66,000		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	n/a		
10 Amended soil porosity	n/a		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	2', 1' above and 1' below 4' CMP		
12 Gravel porosity	40%		
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))]*	0		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	254,779		

16 Total Retention Volume from LID Infiltration BMPs: 254,779 CF *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 227.1% *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.

4.3.3 Harvest and Use BMP

Harvest and use BMP may be considered if the full LID DCV cannot be met by maximizing infiltration BMPs. Use Form 4.3-4 to compute on-site retention of runoff from proposed harvest and use BMPs.

Volume retention estimates for harvest and use BMPs are sensitive to the on-site demand for captured stormwater. Since irrigation water demand is low in the wet season, when most rainfall events occur in San Bernardino County, the volume of water that can be used within a specified drawdown period is relatively low. The bottom portion of Form 4.3-4 facilitates the necessary computations to show infeasibility if a minimum incremental benefit of 40 percent of the LID DCV would not be achievable with MEP implementation of on-site harvest and use of stormwater (Section 5.5.4 of the TGD for WQMP).

Form 4.3-4 Harvest and Use BMPs (DA 1)

1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3): 0 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16*			
BMP Type(s) *Compute runoff volume retention from proposed harvest and use BMP (Select BMPs from Table 5-4 of the 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 Describe cistern or runoff detention facility			
3 Storage volume for proposed detention type (ft^3) *Volume of cistern*			
4 Landscaped area planned for use of harvested stormwater (ft^2)			
5 Average wet season daily irrigation demand (in/day) Use local values, typical ~ 0.1 in/day			
6 Daily water demand (ft^3/day) *Item 4 * (Item 5 / 12)*			
7 Drawdown time (hrs) *Copy Item 6 from Form 4.2-1*			
8 Retention Volume (ft^3) *$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))*			
9 Total Retention Volume (ft^3) from Harvest and Use BMP *Sum of Item 8 for all harvest and use BMP included in plan*			
10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest & use BMPs? Yes ☐ No ☐ *If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.*			

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration, and harvest and use BMPs. 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 4.3-5 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV w. Biotreatment computations are included as follows:

- Use Form 4.3-6 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-7 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-8 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)

1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft^3): 0 *Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9*	List pollutants of concern *Copy from Form 2.3-1.*	
2 Biotreatment BMP Selected *(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)*	Volume-based biotreatment *Use Forms 4.3-6 and 4.3-7 to compute treated volume*	Flow-based biotreatment *Use Form 4.3-8 to compute treated volume*
	☐ 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 4.3-6 Item 15 + Form 4.3-7 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 4.3-6 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 4.3-7 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 4.3-8 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 4.3-9 to demonstrate how on-site LID DCV is met with proposed site design hydrologic source control, infiltration, harvest and use, 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 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)

1 Total LID DCV for the Project DA-1 (ft^3): 112,165 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft^3): 0 *Copy Item 30 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 254,779 *Copy Item 16 in Form 4.3-3*

4 On-site retention with LID harvest and use BMP (ft^3): 0 *Copy Item 9 in Form 4.3-4*

5 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-5*

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

7 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design HSC, infiltration, or harvest and use 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 and biotreatment BMP provide 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

8 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 HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: : Yes ☐ No ☒
  Checked yes for Form 4.3-5 Item 7, 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)%*
- An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: Yes ☐ No ☒
  Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed

4.3.6 Hydromodification Control BMP

N/A – Project site is entirely within HCOC Exemption Area

Use Form 4.3-10 to compute the remaining runoff volume retention, after LID BMP are implemented, needed to address HCOC, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential HCOC. Describe hydromodification control BMP that address HCOC, which may include off-site BMP and/or in-stream controls. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-10 Hydromodification Control BMPs (DA 1)

1 Volume reduction needed for HCOC performance criteria (ft^3): **180,880** *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	**2** On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft^3): **254,779** *Sum of Form 4.3-9 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 HCOC volume reduction*
3 Remaining volume for HCOC volume capture (ft^3): 0 *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): **0** *Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)*

5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification ☐ *Attach in-stream control BMP selection and evaluation to this WQMP*

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

If yes, HCOC 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 or off-site retention BMP ☒ **See Appendix 6.4.7 for Hydrograph Analysis. The Infiltration BMPs will contain the entire 2-year storm.**
- 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 ☐
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

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

If yes, HCOC 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 or off-site retention BMPs ☒ **See Appendix 6.4.7 for Hydrograph Analysis. The Infiltration BMPs will contain the entire 2-year storm.**
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, harvest and use, 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 compliance plans may include one or more of the following elements:

- On-site structural treatment control BMP - All treatment control BMP should be located as close to possible to the pollutant sources and should not be located within receiving waters;
- Off-site structural treatment control BMP - Pollutant removal should occur prior to discharge of runoff to receiving waters;
- Urban runoff fund or In-lieu program, if available

Depending upon the proposed alternative compliance plan, approval by the executive officer may or may not be required (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMP 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 may require a Maintenance Agreement (consult the jurisdiction's LIP). If a Maintenance Agreement is required, it must also be attached to the WQMP.

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

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Education on Storm Water BMP's	Project Owner	Building owners shall furnish copies of City and County BMP factsheets to all future tenants through lease agreements.	Beginning of new tenancy
Activity Restrictions	Project Owner	Tenants shall not be allowed to discharge chemicals, chemical residues, wastewater or other prohibited discharges listed in the City and County Ordinances, to the outside, paved areas of the site; or store chemicals or other pollutant sources in non-spill contained or covered facilities. Pesticide application shall be done by a licensed applicator and car washing is prohibited on site.	On-going
Landscape Management	Project Owner	Landscape crews contracted by the owner shall inspect the irrigation system and the health of the landscaping plant cover after each landscape procedure and shall report all repairs and problems to the owner.	Weekly
BMP Maintenance	Project Owner	BMP maintenance will be provided by the property owner and will take place at a minimum of twice a year and after any major rainfall event.	Semi-Annual/ Oct. 1st & Feb. 1st (each year)
Title 22 CCR Compliance	Project Owner	The owner/tenant will file appropriate hazardous material disclosures, if any storage is conducted, and must comply with all the Title 22 CCR, Chapter 29 regulations.	As needed
Local Water Quality Ordinances	Project Owner	The property owner shall ensure that all business activities at the site comply with the County of San Bernardino Stormwater Ordinance through the implementation of BMP's.	On-going

Spill Contingency Plan	Project Owner	Any hazardous material storage, if any, will require a business/ emergency response plan as required by the San Bernardino County Fire Hazmat.	As needed
Hazardous Materials Disclosure Compliance	Project Owner	The current owner and future owners shall prohibit the storage of hazardous materials.	Beginning of new tenancy
Uniform Fire Code Implementation	Project Owner	All fire code requirements shall be implemented at this site.	On-going
Litter/Debris Control Program	Project Owner	A program shall be implemented to pick up litter and sweep and clean the existing trash enclosures daily. Trash enclosures are designed to divert all flows away from the enclosure. All dumpsters will have lids installed and will be inspected to ensure that the dumpsters remain covered and leak-proof. The owner shall ensure tenants contract with a refuse company to have the dumpsters emptied on a weekly basis, at a minimum.	Weekly
Employee Training	Project Owner	Property owner shall establish an educational program for site employees and contractors to inform and train personnel engaged in maintenance activities regarding the impact of dumping oil, paint, solvents, or other potentially harmful chemicals into the storm drain system; the use of fertilizers and pesticides in landscaping maintenance practices; and the impacts of litter and improper waste disposal.	Beginning of new tenancy
Housekeeping of Loading Docks	Project Owner	The loading/unloading of materials will take place at the docks; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or n other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. A program shall be implemented to train employees on applicable BMPs and general pollution prevention strategies and objectives. The dock area shall be swept daily and the maintenance policy for the site will address daily maintenance of the area.	Daily
Catch Basin Inspection Program	Project Owner	The on-site catch basins shall be inspected monthly during the rainy season (October- May) and before and after each storm to ensure proper operation. The owner shall contract with a qualified landscape contractor to inspect and clean out accumulation of trash, litter and sediment and check for evidence of illegal dumping of waste materials into on-site drains.	Monthly/ Seasonal

Vacuum Sweeping of Private Streets and Parking Lots	Project Owner	Parking lots shall be swept weekly to prevent sediment, garden waste, and trash, or other pollutants from entering on-site drains and public storm channels. Sweeping will be done by a landscape contractor or other contractor provided by the owner.	Weekly
Comply with all other applicable NPDES permits	Project Owner	The developer of this site shall comply with the state's General Construction Stormwater Permit by filing a NOI, SWPPP, and obtain a WDID #, prior to start of grading/construction. All future occupants requiring coverage under the NPDES General Industrial Activities Permit shall comply with the permit requirements by filing a notice of intent and SWPPP with the state and obtaining a WDID Discharge Permit Number, prior to commencement of industrial activities, covered under the permit.	Prior to construction /beginning of new tenancy
Provide storm drain system stenciling and signage	Project Owner	A painted message "No Dumping- Drains to River" shall be placed on each catch basin. The message shall be inspected annually & repainted as necessary.	On-going
Design and construct trash and waste storage areas to reduce pollution introduction	Project Owner	All dumpsters shall have working lids which shall be kept closed, at all times. Trash enclosure shall comply with CASQA SD-32 and shall have doors and permanent roofing.	During construction
Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	Project Owner	The irrigation system will include devices to prevent low head drainage, overspray and run off through the use of pressure regulating devices, check valves, rain shutoff valves, flow sensors, pressure drop sensors, proper spacing, low precipitation emission devises and ET or weather based controllers. Landscape and irrigation shall be consistent with the State Model Water Efficient landscape Ordinance and the San Bernardino County Landscape Development Standards. Plants installed will be arranged according to similar hydrozones and meet the required water budget for the site. Landscape areas used for water quality swales or infiltration areas shall have proper plants for saturated soils, drought tolerance and erosion control qualities. Shade trees shall be used to intercept rainwater and reduce heat gain on paving.	During construction
Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb,	Project Owner	Landscape complies with depressed area requirements.	During construction

sidewalk, or pavement			
Protect slopes and channels and provide energy dissipation	Project Owner	Proposed slopes will be protected to prevent erosion.	As Needed
Covered Dock Areas	Project Owner	Proposed docks are equipped with dock high doors so that truck trailers back up flush with building and loading/unloading activities are contained inside building.	On-going

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

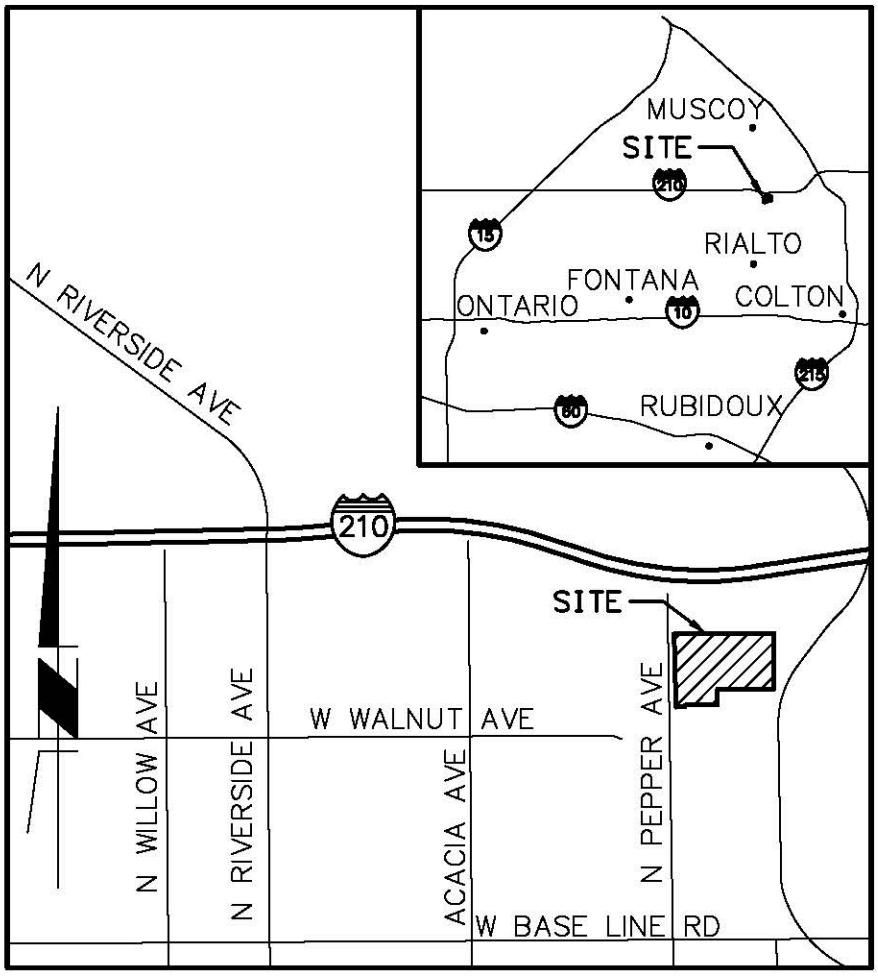
Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their local Local Implementation Plan), this section will describe the contents (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

6.4.1 - BMP Design Details
6.4.2 – Conceptual Grading Plans and Outlet Control Detail
6.4.3 - DCV and Factor of Safety Calculations
6.4.4 – USDA Soil Report
6.4.5 - BMP Educational Materials/Fact Sheets
6.4.6 - NOAA Precipitation Estimates
6.4.7 – CivilDesign 2-Year Rational Method and Unit Hydrograph Calculations



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951.331.9873 - FMCIVIL.COM

PEPPER AVENUE

FIGURE 1
VICINITY MAP

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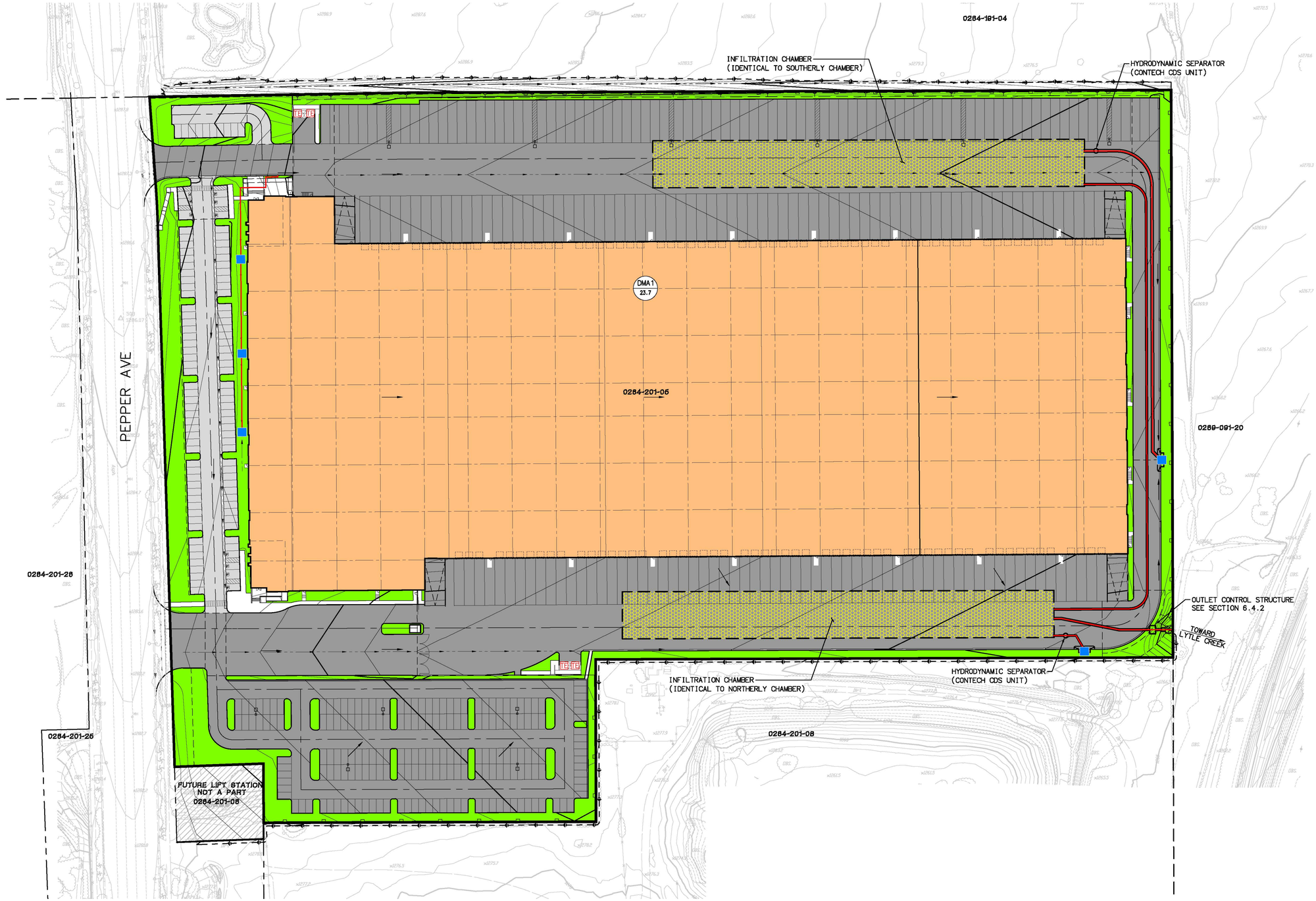

LEGEND

- DMA 1 / 3.38 — DA AREA NUMBER / AREA IN ACRES
- LANDSCAPE AREA
- PROPOSED P.C.C. DRIVE AISLE & PARKING AREAS
- PROPOSED POROUS CONCRETE DRIVE AISLE & PARKING AREAS
- PROPOSED ROOFTOP
- PROPOSED HARDSCAPE AREA
- UNDERGROUND INFILTRATION (SEE PLANS ATTACHED IN APPENDIX 6.4.1)
- DRAIN INLET STENCIL
- DMA BOUNDARY
- PROPOSED STORM DRAIN
- EXIST. PROPERTY LINE
- DIRECTION OF FLOW
- TE — TRASH ENCLOSURE

DMA	TOTAL	PERVIOUS	IMPERVIOUS	% PERVIOUS	% IMPERVIOUS	C_{AMP}	P_6	DCV	DRAWDOWN	STORAGE VOLUME REQUIRED	STORAGE VOLUME PROVIDED
DA 1	1,032,445 SF	122,176 SF	910,269 SF	11.8%	88.2%	0.7014	0.9432	112,165 SF	48 HR	112,165 SF	254,779 SF

SCALE 1"=60'

60 30 0 60 120 180

SCALE: 1"=60'

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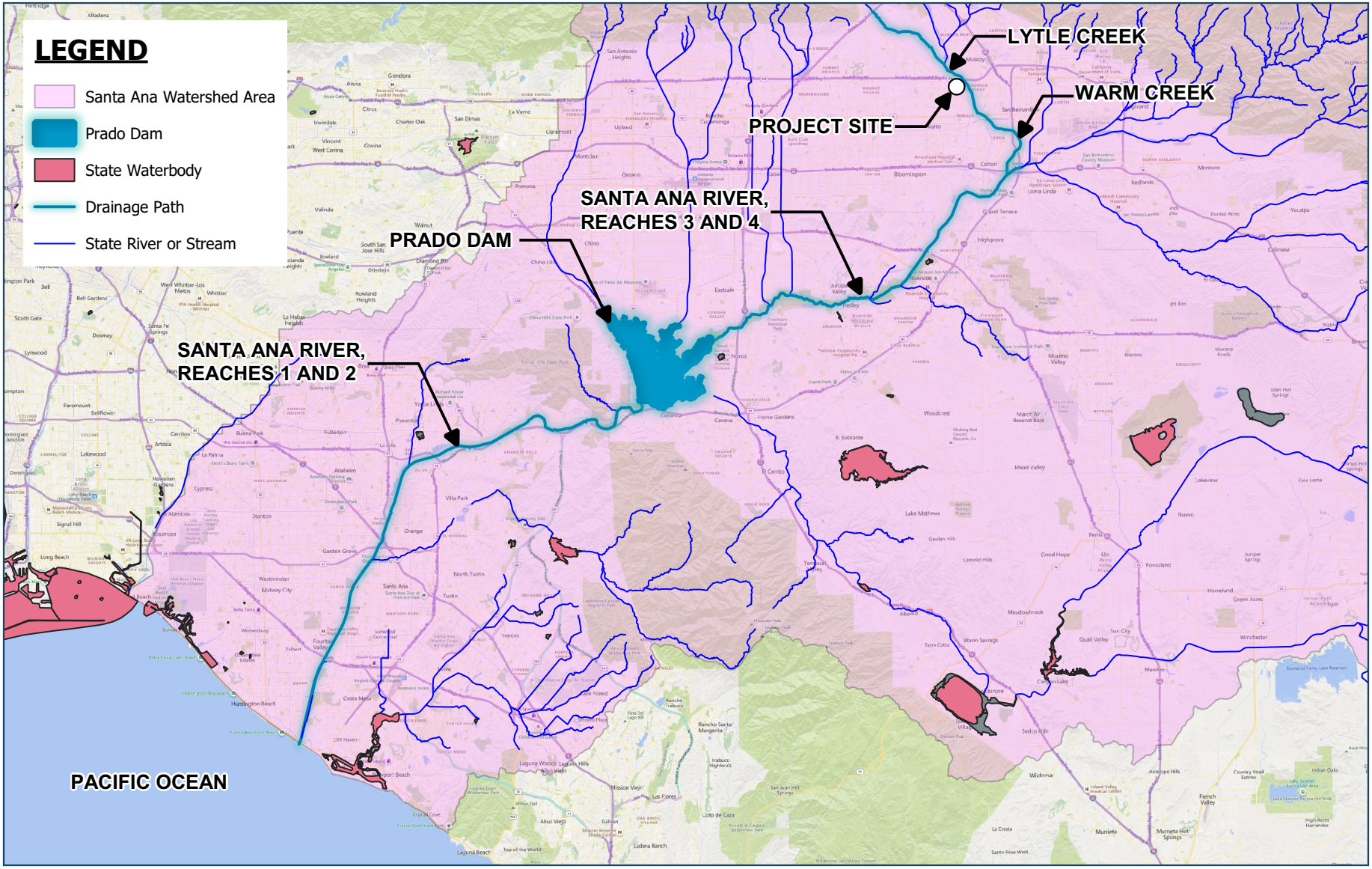
PEPPER INDUSTRIAL BUILDING

WQMP SITE PLAN

1 OF 1 SHEETS



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5 0 5 10 mi

Pepper Industrial Building

In Rialto, County of San Bernardino
Receiving Waters Exhibit

SECTION 6.4.1
BMP DESIGN DETAILS

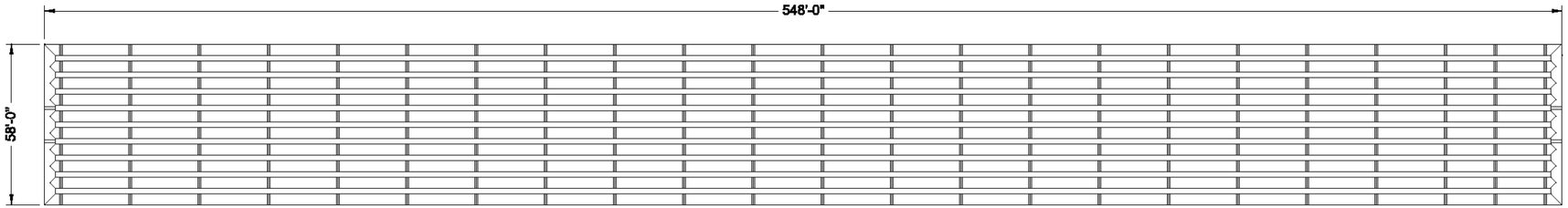
PROJECT SUMMARY

CALCULATION DETAILS
- LOADING = HS20 & HS25
- APPROX. LINEAR FOOTAGE = 5,516 lf.

STORAGE SUMMARY
- STORAGE VOLUME REQUIRED = N/A
- PIPE STORAGE VOLUME = 69,316 cf.
- BACKFILL STORAGE VOLUME = 58,073 cf.
- TOTAL STORAGE PROVIDED = 127,390 cf.

PIPE DETAILS
- DIAMETER = 48 IN.
- CORRUGATION = 2 2/3x1/2
- GAGE = 12
- COATING = ALT2
- WALL TYPE = Perforated
- BARRELL SPACING = 24 IN.

BACKFILL DETAILS
- WIDTH AT ENDS = 12 IN.
- ABOVE PIPE = 18 IN.
- WIDTH AT SIDES = 12 IN.
- BELOW PIPE = 12 IN.



NOTES

- ALL RISER AND STUB DIMENSIONS ARE TO CENTERLINE. ALL ELEVATIONS, DIMENSIONS, AND LOCATIONS OF RISERS AND INLETS, SHALL BE VERIFIED BY THE ENGINEER OF RECORD PRIOR TO RELEASING FOR FABRICATION.
- ALL FITTINGS AND REINFORCEMENT COMPLY WITH ASTM A998.
- ALL RISERS AND STUBS ARE $2\frac{2}{3}$" x $\frac{1}{2}$" CORRUGATION AND 16 GAGE UNLESS OTHERWISE NOTED.
- RISERS TO BE FIELD TRIMMED TO GRADE.
- QUANTITY OF PIPE SHOWN DOES NOT PROVIDE EXTRA PIPE FOR CONNECTING THE SYSTEM TO EXISTING PIPE OR DRAINAGE STRUCTURES. OUR SYSTEM AS DETAILED PROVIDES NOMINAL INLET AND/OR OUTLET PIPE STUB FOR CONNECTION TO EXISTING DRAINAGE FACILITIES. IF ADDITIONAL PIPE IS NEEDED IT IS THE RESPONSIBILITY OF THE CONTRACTOR.
- BAND TYPE TO BE DETERMINED UPON FINAL DESIGN.
- THE PROJECT SUMMARY IS REFLECTIVE OF THE DYODS DESIGN, QUANTITIES ARE APPROX. AND SHOULD BE VERIFIED UPON FINAL DESIGN AND APPROVAL. FOR EXAMPLE, TOTAL EXCAVATION DOES NOT CONSIDER ALL VARIABLES SUCH AS SHORING AND ONLY ACCOUNTS FOR MATERIAL WITHIN THE ESTIMATED EXCAVATION FOOTPRINT.
- THESE DRAWINGS ARE FOR CONCEPTUAL PURPOSES AND DO NOT REFLECT ANY LOCAL PREFERENCES OR REGULATIONS. PLEASE CONTACT YOUR LOCAL CONTECH REP FOR MODIFICATIONS.

ASSEMBLY

SCALE: 1" = 50'

DATE	REVISION DESCRIPTION	BY

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

DYO12190 Pepper Avenue - Rialto
Chamber 1 - Revised
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
5126	12190	12/15/2021
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: D1		

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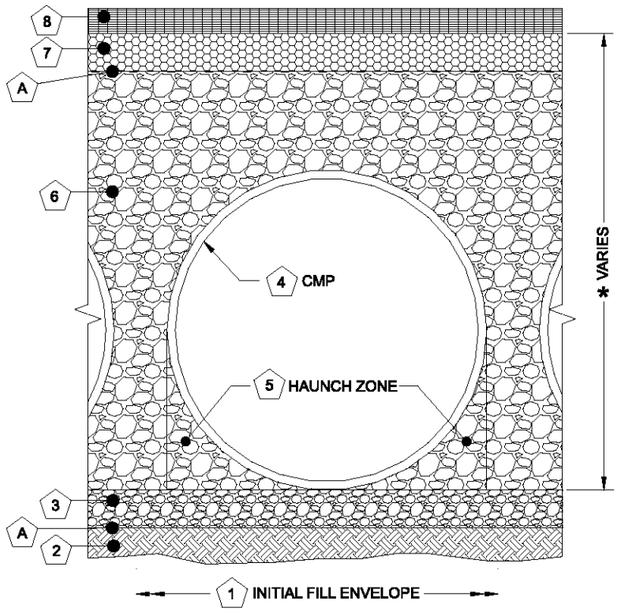


Infiltration Systems - CMP Infiltration & CMP Perforated Drainage Pipe			
Material Location	Description	Material Designation	Designation
8 Rigid or Flexible Pavement (If applicable)			
7 Road Base (If applicable			
A Geotextile Layer	Non-Woven Geotextile	CONTECH C-40 or C-45	Engineer Decision for consideration to prevent soil migration into varying soil types. Wrap the trench only.
6 Backfill	Infiltration pipe systems have a pipe perforation sized of 3/8" diameter. An open graded, free draining stone, with a particle size of ¼" – 2 ½" diameter is recommended.	AASHTO M 145-A-1 or AASHTO M 43 - 3, 4	Material shall be worked into the pipe haunches by means of shovel-slicing, rodding, air-tamper, vibratory rod, or other effective methods. Compaction of all placed fill material is necessary and shall be considered adequate when no further yielding of the material is observed under the compactor, or under foot, and the Project Engineer or his representative is satisfied with the level of compaction"
3 Bedding Stone	Well graded granular bedding material w/maximum particle size of 3"	AASHTO M43 - 3,357,4,467, 5, 56, 57	For soil aggregates larger than 3/8" a dedicated bedding layer is not required for CMP. Pipe may be placed on the trench bottom comprised of native suitable well graded & granular material. For Arch pipes it is recommended to be shaped to a relatively flat bottom or fine-grade the foundation to a slight v-shape. Soil aggregates less than 3/8" and unsuitable material should be over-excavated and re-placed with a 4"-6" layer of well graded & granular stone per the material designation.
A Geotextile Layer	None	None	Contech does not recommend geotextiles be placed under the invert of infiltration systems due to the propensity for geotextiles to clog over time.
* Note: The listed AASHTO designations are for gradation only. The stone must also be angular and clean.			

1 MINIMUM WIDTH DEPENDS ON SITE CONDITIONS AND ENGINEERING JUDGEMENT.

FOUNDATION/BEDDING PREPARATION

2 PRIOR TO PLACING THE BEDDING, THE FOUNDATION MUST BE CONSTRUCTED TO A UNIFORM AND STABLE GRADE. IN THE EVENT THAT UNSUITABLE FOUNDATION MATERIALS ARE ENCOUNTERED DURING EXCAVATION, THEY SHALL BE REMOVED AND BROUGHT BACK TO THE GRADE WITH A FILL MATERIAL AS APPROVED BY THE ENGINEER.

5 HAUNCH ZONE MATERIAL SHALL BE PLACED AND UNIFORMLY COMPACTED WITHOUT SOFT SPOTS.

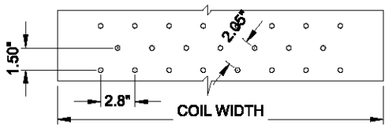
BACKFILL

MATERIAL SHALL BE PLACED IN 8"-10" MAXIMUM LIFTS. INADEQUATE COMPACTION CAN LEAD TO EXCESSIVE DEFLECTIONS WITHIN THE SYSTEM AND SETTLEMENT OF THE SOILS OVER THE SYSTEM. BACKFILL SHALL BE PLACED SUCH THAT THERE IS NO MORE THAN A TWO-LIFT DIFFERENTIAL BETWEEN THE SIDES OF ANY PIPE IN THE SYSTEM AT ALL TIMES DURING THE BACKFILL PROCESS. BACKFILL SHALL BE ADVANCED ALONG THE LENGTH OF THE SYSTEM AT THE SAME RATE TO AVOID DIFFERENTIAL LOADING ON ANY PIPES IN THE SYSTEM.

EQUIPMENT USED TO PLACE AND COMPACT THE BACKFILL SHALL BE OF A SIZE AND TYPE SO AS NOT TO DISTORT, DAMAGE, OR DISPLACE THE PIPE. ATTENTION MUST BE GIVEN TO PROVIDING ADEQUATE MINIMUM COVER FOR SUCH EQUIPMENT. MAINTAIN BALANCED LOADING ON ALL PIPES IN THE SYSTEM DURING ALL SUCH OPERATIONS.

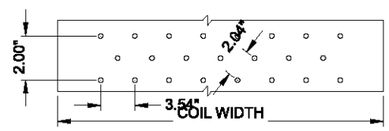
OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS. REFER TO TYPICAL BACKFILL DETAIL FOR MATERIAL REQUIRED.

2 2/3" x 1/2" CORRUGATION - STEEL AND ALUMINUM CMP EDGE SPACING EQUAL ON BOTH SIDES



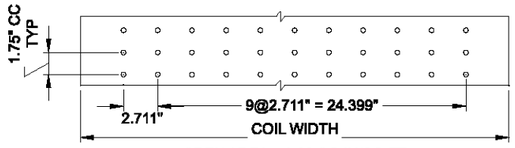
OPEN AREA = 3.76 SQ IN/SQ FT

3" x 1" CORRUGATION - STEEL AND ALUMINUM CMP (COIL PROVIDED FROM CONTECH LANTANA, FL PLANT)



OPEN AREA = 4.16 SQ IN/SQ FT

5" x 1" CORRUGATION - STEEL ONLY
EDGE SPACING EQUAL ON BOTH SIDES



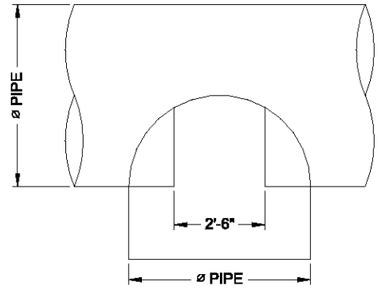
OPEN AREA = 3.33 SQ IN/SQ FT

NOTES:

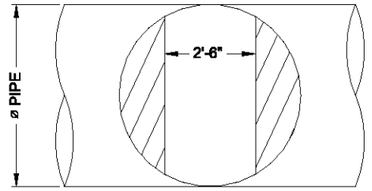
1. PERFORATIONS MEET AASHTO AND ASTM SPECIFICATIONS.
2. PERFORATION OPEN AREA PER SQUARE FOOT OF PIPE IS BASED ON THE NOMINAL DIAMETER AND LENGTH OF PIPE.
3. ALL DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.
4. ALL HOLES ⌀3/8".

TYPICAL PERFORATION DETAIL

SCALE: N.T.S.



PLAN

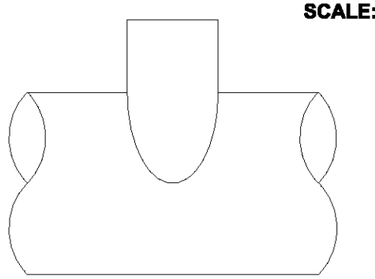


FRONT

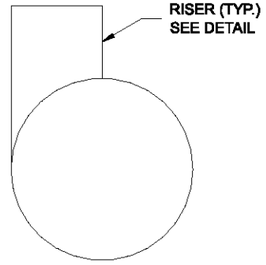
NOTE:
MANWAY DETAIL APPLICABLE FOR CMP SYSTEMS WITH DIAMETERS 48" AND LARGER. MANWAYS MAY BE REQUIRED ON SMALLER SYSTEMS DEPENDING ON ACTUAL SITE SPECIFIC CONDITIONS.

TYPICAL MANWAY DETAIL

SCALE: N.T.S.



ELEVATION

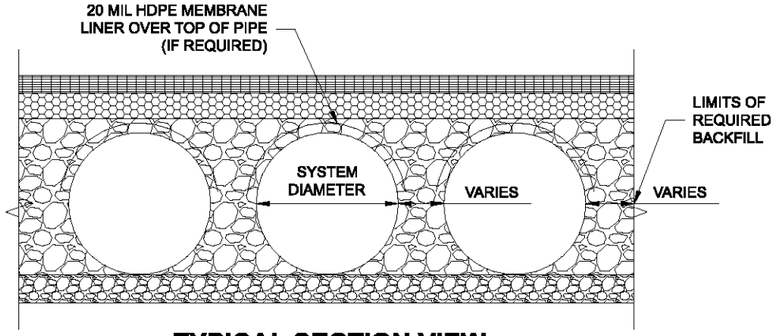


END

NOTE:
LADDERS ARE OPTIONAL AND ARE NOT REQUIRED FOR ALL SYSTEMS.

TYPICAL RISER DETAIL

SCALE: N.T.S.



TYPICAL SECTION VIEW

LINER OVER ROWS
SCALE: N.T.S.

NOTE: IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, AN HDPE MEMBRANE LINER IS RECOMMENDED WITH THE SYSTEM. THE IMPERMEABLE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.

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CONTECH CMP DETENTION SYSTEMS

CONTECH DYODS DRAWING

DYO12190 Pepper Avenue - Rialto
Chamber 1 - Revised
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
5126	12190	12/15/2021
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: D2		

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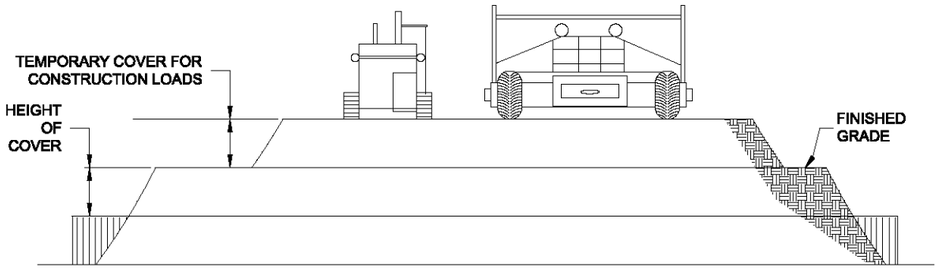


CONSTRUCTION LOADS

FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM

SCALE: N.T.S.

SPECIFICATION FOR DESIGNED DETENTION SYSTEM:

SCOPE
THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE DESIGNED DETENTION SYSTEM DETAILED IN THE PROJECT PLANS.

MATERIAL
THE MATERIAL SHALL CONFORM TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE APPLICABLE REQUIREMENTS OF AASHTO M-274 OR ASTM A-92.

THE GALVANIZED STEEL COILS SHALL CONFORM TO THE APPLICABLE REQUIREMENTS OF AASHTO M-218 OR ASTM A-929.

THE POLYMER COATED STEEL COILS SHALL CONFORM TO THE APPLICABLE REQUIREMENTS OF AASHTO M-246 OR ASTM A-742.

THE ALUMINUM COILS SHALL CONFORM TO THE APPLICABLE REQUIREMENTS OF AASHTO M-197 OR ASTM B-744.

CONSTRUCTION LOADS
CONSTRUCTION LOADS MAY BE HIGHER THAN FINAL LOADS. FOLLOW THE MANUFACTURER'S OR NCSPA GUIDELINES.

PIPE
THE PIPE SHALL BE MANUFACTURED IN ACCORDANCE TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2: AASHTO M-36 OR ASTM A-760

GALVANIZED: AASHTO M-36 OR ASTM A-760

POLYMER COATED: AASHTO M-245 OR ASTM A-762

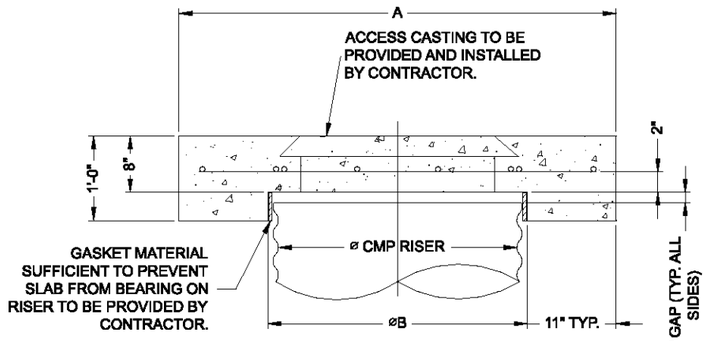
ALUMINUM: AASHTO M-196 OR ASTM B-745

HANDLING AND ASSEMBLY
SHALL BE IN ACCORDANCE WITH NCSP'S (NATIONAL CORRUGATED STEEL PIPE ASSOCIATION) FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL. SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS FOR ALUMINUM PIPE.

INSTALLATION
SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II DIVISION II OR ASTM A-798 (FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL) OR ASTM B-788 (FOR ALUMINUM PIPE) AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

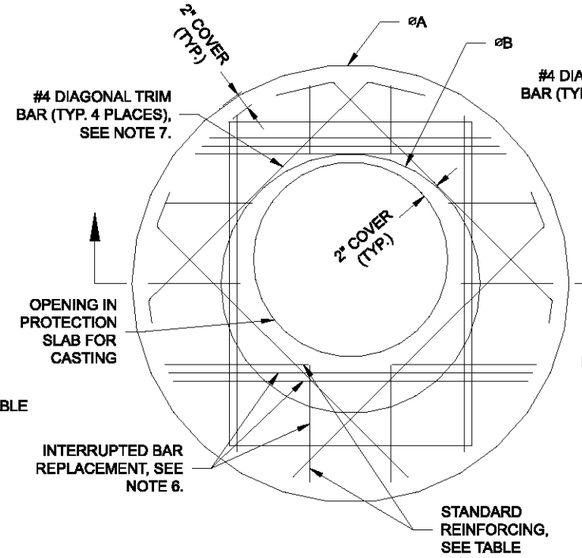
NOTE:
THESE DRAWINGS ARE FOR CONCEPTUAL PURPOSES AND DO NOT REFLECT ANY LOCAL PREFERENCES OR REGULATIONS. PLEASE CONTACT YOUR LOCAL CONTECH REP FOR MODIFICATIONS.



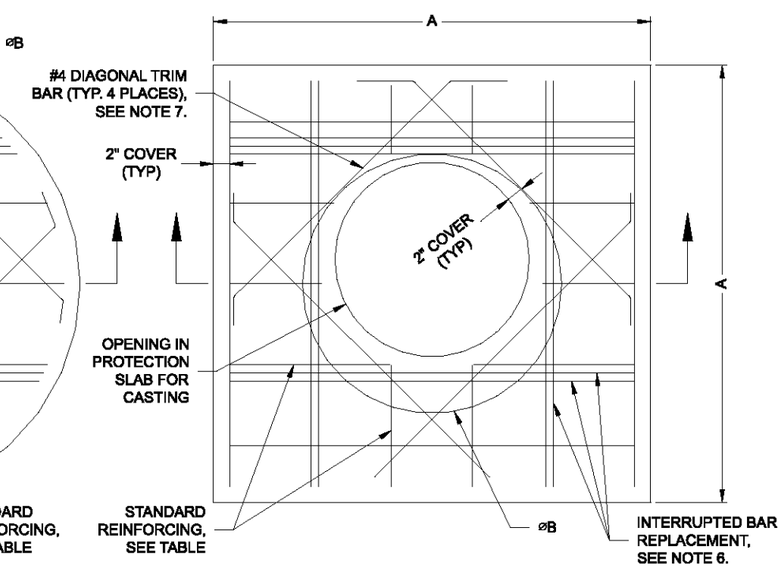
SECTION VIEW

REINFORCING TABLE				
ø CMP RISER	A	ø B	REINFORCING	**BEARING PRESSURE (PSF)
24"	ø 4' 4'X4'	26"	#5 @ 12" OCEW #5 @ 12" OCEW	2,410 1,780
30"	ø 4'-6" 4'-6" X 4'-6"	32"	#5 @ 12" OCEW #5 @ 12" OCEW	2,120 1,530
36"	ø 5' 5' X 5'	38"	#5 @ 10" OCEW #5 @ 10" OCEW	1,890 1,350
42"	ø 5'-6" 5'-6" X 5'-6"	44"	#5 @ 10" OCEW #5 @ 9" OCEW	1,720 1,210
48"	ø 6' 6' X 6'	50"	#5 @ 9" OCEW #5 @ 8" OCEW	1,600 1,100

** ASSUMED SOIL BEARING CAPACITY



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 3,500 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERING, BINGHAMTON, NY.

MANHOLE CAP DETAIL

SCALE: N.T.S.

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CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

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DETENTION SYSTEM

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CHECKED: DYO	APPROVED: DYO	
SHEET NO.: D3		

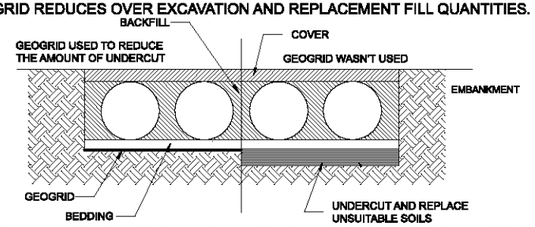
CMP DETENTION INSTALLATION GUIDE

PROPER INSTALLATION OF A FLEXIBLE UNDERGROUND DETENTION SYSTEM WILL ENSURE LONG-TERM PERFORMANCE. THE CONFIGURATION OF THESE SYSTEMS OFTEN REQUIRES SPECIAL CONSTRUCTION PRACTICES THAT DIFFER FROM CONVENTIONAL FLEXIBLE PIPE CONSTRUCTION. CONTECH ENGINEERED SOLUTIONS STRONGLY SUGGESTS SCHEDULING A PRE-CONSTRUCTION MEETING WITH YOUR LOCAL SALES ENGINEER TO DETERMINE IF ADDITIONAL MEASURES, NOT COVERED IN THIS GUIDE, ARE APPROPRIATE FOR YOUR SITE.

FOUNDATION

CONSTRUCT A FOUNDATION THAT CAN SUPPORT THE DESIGN LOADING APPLIED BY THE PIPE AND ADJACENT BACKFILL WEIGHT AS WELL AS MAINTAIN ITS INTEGRITY DURING CONSTRUCTION.

IF SOFT OR UNSUITABLE SOILS ARE ENCOUNTERED, REMOVE THE POOR SOILS DOWN TO A SUITABLE DEPTH AND THEN BUILD UP TO THE APPROPRIATE ELEVATION WITH A COMPETENT BACKFILL MATERIAL. THE STRUCTURAL FILL MATERIAL GRADATION SHOULD NOT ALLOW THE MIGRATION OF FINES, WHICH CAN CAUSE SETTLEMENT OF THE DETENTION SYSTEM OR PAVEMENT ABOVE. IF THE STRUCTURAL FILL MATERIAL IS NOT COMPATIBLE WITH THE UNDERLYING SOILS AN ENGINEERING FABRIC SHOULD BE USED AS A SEPARATOR. IN SOME CASES, USING A STIFF REINFORCING GEOGRID REDUCES OVER EXCAVATION AND REPLACEMENT FILL QUANTITIES.

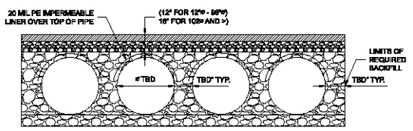


GRADE THE FOUNDATION SUBGRADE TO A UNIFORM OR SLIGHTLY SLOPING GRADE. IF THE SUBGRADE IS CLAY OR RELATIVELY NON-POROUS AND THE CONSTRUCTION SEQUENCE WILL LAST FOR AN EXTENDED PERIOD OF TIME, IT IS BEST TO SLOPE THE GRADE TO ONE END OF THE SYSTEM. THIS WILL ALLOW EXCESS WATER TO DRAIN QUICKLY, PREVENTING SATURATION OF THE SUBGRADE.

GEOMEMBRANE BARRIER

A SITE'S RESISTIVITY MAY CHANGE OVER TIME WHEN VARIOUS TYPES OF SALTING AGENTS ARE USED, SUCH AS ROAD SALTS FOR DEICING AGENTS. IF SALTING AGENTS ARE USED ON OR NEAR THE PROJECT SITE, A GEOMEMBRANE BARRIER IS RECOMMENDED WITH THE SYSTEM. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM THE USE OF SUCH AGENTS INCLUDING PREMATURE CORROSION AND REDUCED ACTUAL SERVICE LIFE.

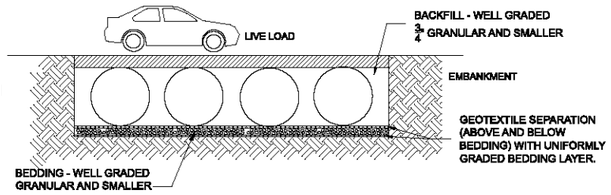
THE PROJECT'S ENGINEER OF RECORD IS TO EVALUATE WHETHER SALTING AGENTS WILL BE USED ON OR NEAR THE PROJECT SITE, AND USE HIS/HER BEST JUDGEMENT TO DETERMINE IF ANY ADDITIONAL PROTECTIVE MEASURES ARE REQUIRED. BELOW IS A TYPICAL DETAIL SHOWING THE PLACEMENT OF A GEOMEMBRANE BARRIER FOR PROJECTS WHERE SALTING AGENTS ARE USED ON OR NEAR THE PROJECT SITE.



IN-SITU TRENCH WALL

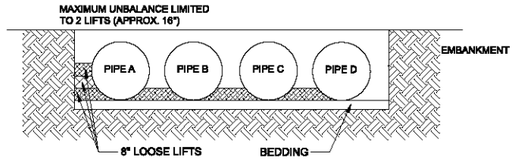
IF EXCAVATION IS REQUIRED, THE TRENCH WALL NEEDS TO BE CAPABLE OF SUPPORTING THE LOAD THAT THE PIPE SHEDS AS THE SYSTEM IS LOADED. IF SOILS ARE NOT CAPABLE OF SUPPORTING THESE LOADS, THE PIPE CAN DEFLECT. PERFORM A SIMPLE SOIL PRESSURE CHECK USING THE APPLIED LOADS TO DETERMINE THE LIMITS OF EXCAVATION BEYOND THE SPRING LINE OF THE OUTER MOST PIPES.

IN MOST CASES THE REQUIREMENTS FOR A SAFE WORK ENVIRONMENT AND PROPER BACKFILL PLACEMENT AND COMPACTION TAKE CARE OF THIS CONCERN.



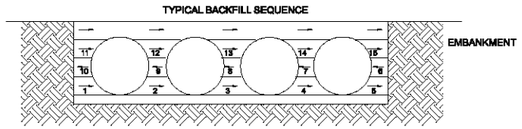
BACKFILL PLACEMENT

MATERIAL SHALL BE WORKED INTO THE PIPE HAUNCHES BY MEANS OF SHOVEL-SLICING, RODDING, AIR TAMPER, VIBRATORY ROD, OR OTHER EFFECTIVE METHODS.

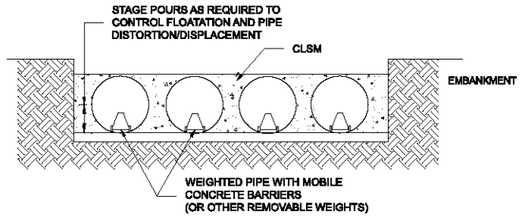


IF AASHTO T99 PROCEDURES ARE DETERMINED INFEASIBLE BY THE GEOTECHNICAL ENGINEER OF RECORD, COMPACTION IS CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE GEOTECHNICAL ENGINEER OF RECORD (OR REPRESENTATIVE THEREOF) IS SATISFIED WITH THE LEVEL OF COMPACTION.

FOR LARGE SYSTEMS, CONVEYOR SYSTEMS, BACKHOES WITH LONG REACHES OR DRAGLINES WITH STONE BUCKETS MAY BE USED TO PLACE BACKFILL. ONCE MINIMUM COVER FOR CONSTRUCTION LOADING ACROSS THE ENTIRE WIDTH OF THE SYSTEM IS REACHED, ADVANCE THE EQUIPMENT TO THE END OF THE RECENTLY PLACED FILL, AND BEGIN THE SEQUENCE AGAIN UNTIL THE SYSTEM IS COMPLETELY BACKFILLED. THIS TYPE OF CONSTRUCTION SEQUENCE PROVIDES ROOM FOR STOCKPILED BACKFILL DIRECTLY BEHIND THE BACKHOE, AS WELL AS THE MOVEMENT OF CONSTRUCTION TRAFFIC. MATERIAL STOCKPILES ON TOP OF THE BACKFILLED DETENTION SYSTEM SHOULD BE LIMITED TO 8- TO 10-FEET HIGH AND MUST PROVIDE BALANCED LOADING ACROSS ALL BARRELS. TO DETERMINE THE PROPER COVER OVER THE PIPES TO ALLOW THE MOVEMENT OF CONSTRUCTION EQUIPMENT SEE TABLE 1, OR CONTACT YOUR LOCAL CONTECH SALES ENGINEER.



WHEN FLOWABLE FILL IS USED, YOU MUST PREVENT PIPE FLOATATION. TYPICALLY, SMALL LIFTS ARE PLACED BETWEEN THE PIPES AND THEN ALLOWED TO SET-UP PRIOR TO THE PLACEMENT OF THE NEXT LIFT. THE ALLOWABLE THICKNESS OF THE CLSM LIFT IS A FUNCTION OF A PROPER BALANCE BETWEEN THE UPLIFT FORCE OF THE CLSM, THE OPPOSING WEIGHT OF THE PIPE, AND THE EFFECT OF OTHER RESTRAINING MEASURES. THE PIPE CAN CARRY LIMITED FLUID PRESSURE WITHOUT PIPE DISTORTION OR DISPLACEMENT, WHICH ALSO AFFECTS THE CLSM LIFT THICKNESS. YOUR LOCAL CONTECH SALES ENGINEER CAN HELP DETERMINE THE PROPER LIFT THICKNESS.

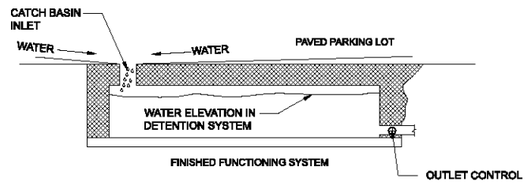


CONSTRUCTION LOADING

TYPICALLY, THE MINIMUM COVER SPECIFIED FOR A PROJECT ASSUMES H-20 LIVE LOAD. BECAUSE CONSTRUCTION LOADS OFTEN EXCEED DESIGN LIVE LOADS, INCREASED TEMPORARY MINIMUM COVER REQUIREMENTS ARE NECESSARY. SINCE CONSTRUCTION EQUIPMENT VARIES FROM JOB TO JOB, IT IS BEST TO ADDRESS EQUIPMENT SPECIFIC MINIMUM COVER REQUIREMENTS WITH YOUR LOCAL CONTECH SALES ENGINEER DURING YOUR PRE-CONSTRUCTION MEETING.

ADDITIONAL CONSIDERATIONS

BECAUSE MOST SYSTEMS ARE CONSTRUCTED BELOW-GRADE, RAINFALL CAN RAPIDLY FILL THE EXCAVATION; POTENTIALLY CAUSING FLOATATION AND MOVEMENT OF THE PREVIOUSLY PLACED PIPES. TO HELP MITIGATE POTENTIAL PROBLEMS, IT IS BEST TO START THE INSTALLATION AT THE DOWNSTREAM END WITH THE OUTLET ALREADY CONSTRUCTED TO ALLOW A ROUTE FOR THE WATER TO ESCAPE. TEMPORARY DIVERSION MEASURES MAY BE REQUIRED FOR HIGH FLOWS DUE TO THE RESTRICTED NATURE OF THE OUTLET PIPE.



CMP DETENTION SYSTEM INSPECTION AND MAINTENANCE

UNDERGROUND STORMWATER DETENTION AND INFILTRATION SYSTEMS MUST BE INSPECTED AND MAINTAINED AT REGULAR INTERVALS FOR PURPOSES OF PERFORMANCE AND LONGEVITY.

INSPECTION

INSPECTION IS THE KEY TO EFFECTIVE MAINTENANCE OF CMP DETENTION SYSTEMS AND IS EASILY PERFORMED. CONTECH RECOMMENDS ONGOING, ANNUAL INSPECTIONS. SITES WITH HIGH TRASH LOAD OR SMALL OUTLET CONTROL ORIFICES MAY NEED MORE FREQUENT INSPECTIONS. THE RATE AT WHICH THE SYSTEM COLLECTS POLLUTANTS WILL DEPEND MORE ON SITE SPECIFIC ACTIVITIES RATHER THAN THE SIZE OR CONFIGURATION OF THE SYSTEM.

INSPECTIONS SHOULD BE PERFORMED MORE OFTEN IN EQUIPMENT WASHDOWN AREAS, IN CLIMATES WHERE SANDING AND/OR SALTING OPERATIONS TAKE PLACE, AND IN OTHER VARIOUS INSTANCES IN WHICH ONE WOULD EXPECT HIGHER ACCUMULATIONS OF SEDIMENT OR ABRASIVE/ CORROSIVE CONDITIONS. A RECORD OF EACH INSPECTION IS TO BE MAINTAINED FOR THE LIFE OF THE SYSTEM

MAINTENANCE

CMP DETENTION SYSTEMS SHOULD BE CLEANED WHEN AN INSPECTION REVEALS ACCUMULATED SEDIMENT OR TRASH IS CLOGGING THE DISCHARGE ORIFICE.

ACCUMULATED SEDIMENT AND TRASH CAN TYPICALLY BE EVACUATED THROUGH THE MANHOLE OVER THE OUTLET ORIFICE. IF MAINTENANCE IS NOT PERFORMED AS RECOMMENDED, SEDIMENT AND TRASH MAY ACCUMULATE IN FRONT OF THE OUTLET ORIFICE. MANHOLE COVERS SHOULD BE SECURELY SEATED FOLLOWING CLEANING ACTIVITIES. CONTECH SUGGESTS THAT ALL SYSTEMS BE DESIGNED WITH AN ACCESS/INSPECTION MANHOLE SITUATED AT OR NEAR THE INLET AND THE OUTLET ORIFICE. SHOULD IT BE NECESSARY TO GET INSIDE THE SYSTEM TO PERFORM MAINTENANCE ACTIVITIES, ALL APPROPRIATE PRECAUTIONS REGARDING CONFINED SPACE ENTRY AND OSHA REGULATIONS SHOULD BE FOLLOWED.

ANNUAL INSPECTIONS ARE BEST PRACTICE FOR ALL UNDERGROUND SYSTEMS. DURING THIS INSPECTION, IF EVIDENCE OF SALTING/DE-ICING AGENTS IS OBSERVED WITHIN THE SYSTEM, IT IS BEST PRACTICE FOR THE SYSTEM TO BE RINSED, INCLUDING ABOVE THE SPRING LINE SOON AFTER THE SPRING THAW AS PART OF THE MAINTENANCE PROGRAM FOR THE SYSTEM.

MAINTAINING AN UNDERGROUND DETENTION OR INFILTRATION SYSTEM IS EASIEST WHEN THERE IS NO FLOW ENTERING THE SYSTEM. FOR THIS REASON, IT IS A GOOD IDEA TO SCHEDULE THE CLEANOUT DURING DRY WEATHER.

THE FOREGOING INSPECTION AND MAINTENANCE EFFORTS HELP ENSURE UNDERGROUND PIPE SYSTEMS USED FOR STORMWATER STORAGE CONTINUE TO FUNCTION AS INTENDED BY IDENTIFYING RECOMMENDED REGULAR INSPECTION AND MAINTENANCE PRACTICES. INSPECTION AND MAINTENANCE RELATED TO THE STRUCTURAL INTEGRITY OF THE PIPE OR THE SOUNDNESS OF PIPE JOINT CONNECTIONS IS BEYOND THE SCOPE OF THIS GUIDE.

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CONTECH CMP DETENTION SYSTEMS
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DYO12190 Pepper Avenue - Rialto
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5126	12190	12/15/2021
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: D4		

CMP: Underground Detention System Storage Volume Estimation

Date: 12/14/2021
Project Name: Chamber 1 - Revised - 12190 (12-14-2021 22-56-39)

City / County: Rialto
State: CA

Designed By: FMC
Company:
Telephone:

=Adjustable Input Cells

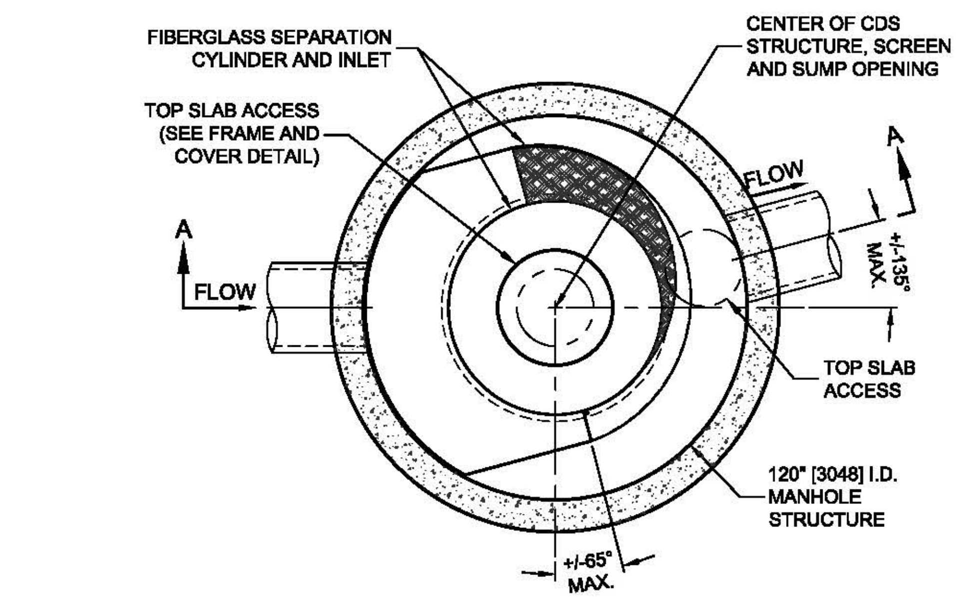
Contech Engineered Solutions, LLC is pleased to offer the following estimate of storage volume for the above named project. The results are submitted as an estimate only, without liability on the part of Contech Engineered Solutions, LLC for accuracy or suitability to any particular applicaton and are subject to verification of the Engineer of Record. **This tool is only applicable for rectangular shaped systems.**

Summary of Inputs (Project contains two identical chambers as shown below)

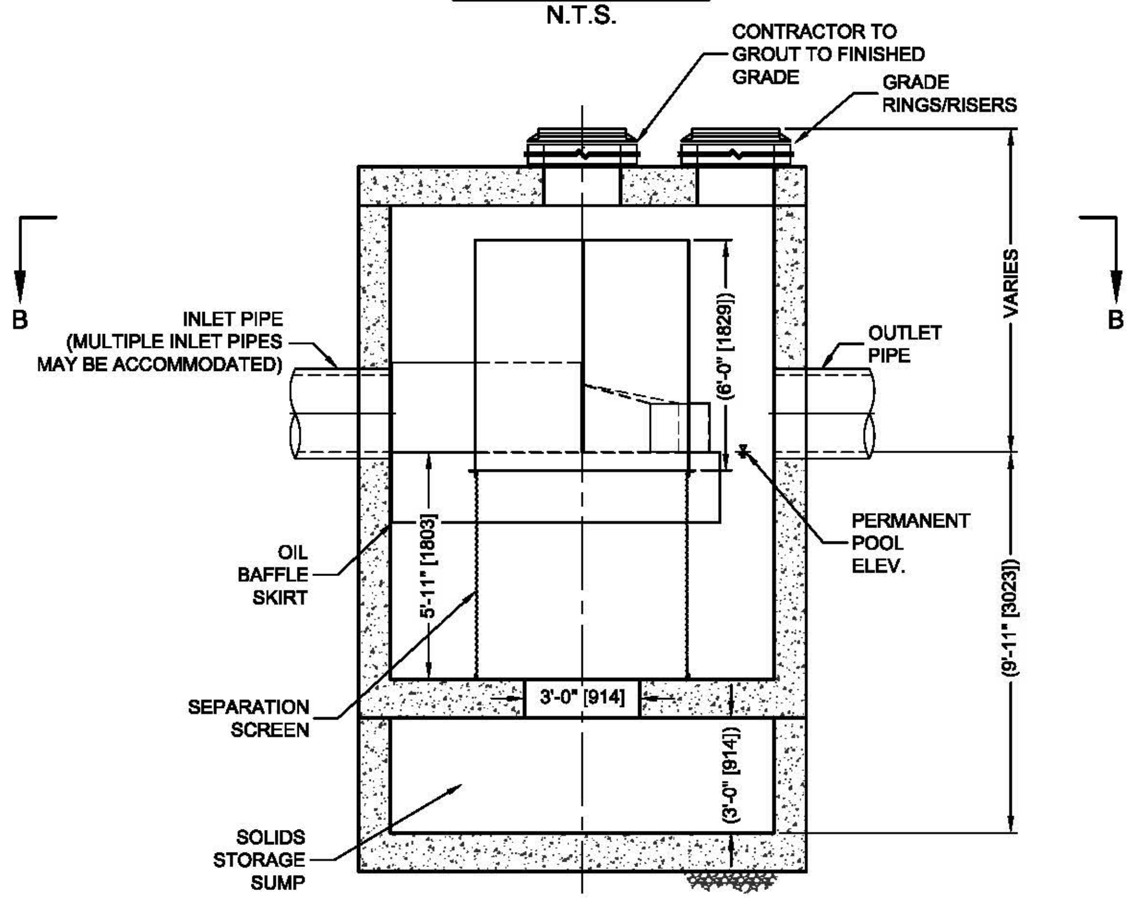
System Information		Backfill Information		Pipe & Analysis Information	
Out-to-out length (ft):	548.0	Backfill Porosity (%):	40%	System Diameter (in):	48
Out-to-out width (ft):	58.0	Depth Above Pipe (in):	18.0	Pipe Spacing (in):	24
Number of Manifolds (ea):	2.0	Depth Below Pipe (in):	12.0	Incremental Analysis (in):	2
Number of Barrels (ea):	10.0	Width At Ends (ft):	1.0	System Invert (Elevation):	1263.8
		Width At Sides (ft):	1.0		

Storage Volume Estimation

System		Pipe		Stone		Single Chamber		Miscellaneous		Dual Chamber
Depth (ft)	Elevation (ft)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Percent Open Storage (%)	Ave. Surface Area (sf)	Total Cumulative Site Storage (cf)
0.00	1263.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0%	13,200.0	0
0.17	1263.96	0.0	0.0	2,200.0	2,200.0	2,200.0	2,200.0	0.0%	13,200.0	4400.0
0.33	1264.13	0.0	0.0	2,200.0	4,400.0	2,200.0	4,400.0	0.0%	13,200.0	8800.0
0.50	1264.30	0.0	0.0	2,200.0	6,600.0	2,200.0	6,600.0	0.0%	13,200.0	13200.0
0.67	1264.46	0.0	0.0	2,200.0	8,800.0	2,200.0	8,800.0	0.0%	13,200.0	17600.0
0.83	1264.63	0.0	0.0	2,200.0	11,000.0	2,200.0	11,000.0	0.0%	13,200.0	22000.0
1.00	1264.80	0.0	0.0	2,200.0	13,200.0	2,200.0	13,200.0	0.0%	13,200.0	26400.0
1.17	1264.96	988.2	988.2	1,804.7	15,004.7	2,792.9	15,992.9	6.2%	18,490.8	31985.9
1.33	1265.13	1,770.7	2,759.0	1,491.7	16,496.4	3,262.4	19,255.4	14.3%	20,517.8	38510.7
1.50	1265.30	2,242.0	5,000.9	1,303.2	17,799.6	3,545.2	22,800.6	21.9%	21,956.4	45601.1
1.67	1265.46	2,592.7	7,593.6	1,162.9	18,962.5	3,755.6	26,556.2	28.6%	23,067.3	53112.4
1.83	1265.63	2,868.4	10,462.0	1,052.6	20,015.2	3,921.0	30,477.2	34.3%	23,952.7	60954.4
2.00	1265.80	3,089.3	13,551.4	964.3	20,979.5	4,053.6	34,530.8	39.2%	24,664.8	69061.6
2.17	1265.96	3,266.8	16,818.2	893.3	21,872.7	4,160.1	38,690.9	43.5%	25,234.5	77381.8
2.33	1266.13	3,407.6	20,225.8	836.9	22,709.7	4,244.6	42,935.5	47.1%	25,681.3	85871.0
2.50	1266.30	3,516.2	23,742.1	793.5	23,503.2	4,309.7	47,245.2	50.3%	26,018.0	94490.5
2.67	1266.46	3,595.5	27,337.6	761.8	24,265.0	4,357.3	51,602.5	53.0%	26,253.2	103205.1
2.83	1266.63	3,647.4	30,985.0	741.0	25,006.0	4,388.4	55,991.0	55.3%	26,392.4	111982.0
3.00	1266.80	3,673.1	34,658.1	730.8	25,736.8	4,403.8	60,394.8	57.4%	26,438.4	120789.7
3.17	1266.96	3,673.1	38,331.1	730.8	26,467.6	4,403.8	64,798.7	59.2%	26,392.4	129597.3
3.33	1267.13	3,647.4	41,978.5	741.0	27,208.6	4,388.4	69,187.1	60.7%	26,253.2	138374.2
3.50	1267.30	3,595.5	45,574.0	761.8	27,970.4	4,357.3	73,544.4	62.0%	26,018.0	147088.8
3.67	1267.46	3,516.2	49,090.3	793.5	28,763.9	4,309.7	77,854.2	63.1%	25,681.3	155708.3
3.83	1267.63	3,407.6	52,497.9	836.9	29,600.8	4,244.6	82,098.7	63.9%	25,234.5	164197.5
4.00	1267.80	3,266.8	55,764.7	893.3	30,494.1	4,160.1	86,258.8	64.6%	24,664.8	172517.7
4.17	1267.96	3,089.3	58,854.1	964.3	31,458.4	4,053.6	90,312.4	65.2%	23,952.7	180624.9
4.33	1268.13	2,868.4	61,722.5	1,052.6	32,511.0	3,921.0	94,233.5	65.5%	23,067.3	188466.9
4.50	1268.30	2,592.7	64,315.2	1,162.9	33,673.9	3,755.6	97,989.1	65.6%	21,956.4	195978.2
4.67	1268.46	2,242.0	66,557.1	1,303.2	34,977.1	3,545.2	101,534.3	65.6%	20,517.8	203068.6
4.83	1268.63	1,770.7	68,327.9	1,491.7	36,468.9	3,262.4	104,796.7	65.2%	18,490.8	209593.4
5.00	1268.80	988.2	69,316.1	1,804.7	38,273.6	2,792.9	107,589.7	64.4%	13,200.0	215179.3
5.17	1268.96	0.0	69,316.1	2,200.0	40,473.6	2,200.0	109,789.7	63.1%	13,200.0	219579.3
5.33	1269.13	0.0	69,316.1	2,200.0	42,673.6	2,200.0	111,989.7	61.9%	13,200.0	223979.3
5.50	1269.30	0.0	69,316.1	2,200.0	44,873.6	2,200.0	114,189.7	60.7%	13,200.0	228379.3
5.67	1269.46	0.0	69,316.1	2,200.0	47,073.6	2,200.0	116,389.7	59.6%	13,200.0	232779.3
5.83	1269.63	0.0	69,316.1	2,200.0	49,273.6	2,200.0	118,589.7	58.5%	13,200.0	237179.3
6.00	1269.80	0.0	69,316.1	2,200.0	51,473.6	2,200.0	120,789.7	57.4%	13,200.0	241579.3
6.17	1269.96	0.0	69,316.1	2,200.0	53,673.6	2,200.0	122,989.7	56.4%	13,200.0	245979.3
6.33	1270.13	0.0	69,316.1	2,200.0	55,873.6	2,200.0	125,189.7	55.4%	13,200.0	250379.3
6.50	1270.30	0.0	69,316.1	2,200.0	58,073.6	2,200.0	127,389.7	54.4%	13,200.0	254779.3



PLAN VIEW B-B
N.T.S.

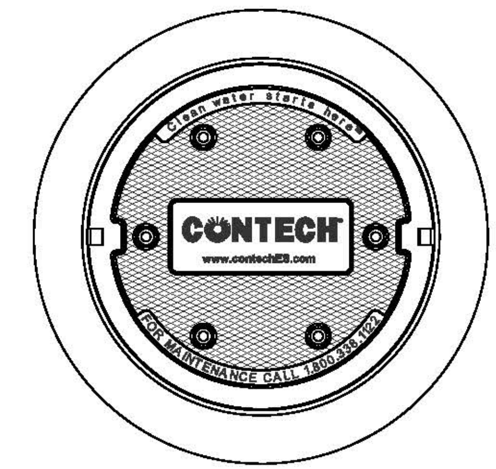


ELEVATION A-A
N.T.S.

CDS5653-10-C DESIGN NOTES

THE STANDARD CDS5653-10-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION)
SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechEScom
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET HS20 (AASHTO M 306) AND BE CAST WITH THE CONTECH LOGO.
6. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH®
ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

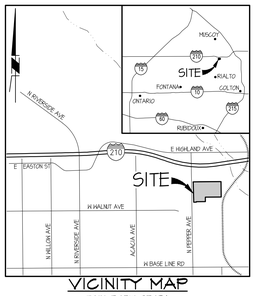
CDS5653-10-C
INLINE CDS
STANDARD DETAIL

C:\USERS\SCHLACHTERH\DESKTOP\CDS DETAILS 180 MICRON SIZING\ACAD\CDS5653-10-C-DTL.DWG 5/19/2014 5:38 PM

SECTION 6.4.2
CONCEPTUAL GRADING PLANS AND OUTLET CONTROL DETAIL

CITY OF RIALTO
COUNTY OF SAN BERNARDINO, CALIFORNIA

PEPPER AVENUE INDUSTRIAL BUILDING
CONCEPTUAL GRADING



VICINITY MAP
T01N, R05W, SEC36
NOT TO SCALE

APPLICANT/OWNER
HOWARD INDUSTRIAL PARTNERS
1144 NORTH TUSTIN STREET, SUITE 122
ORANGE, CA 92865
CONTACT: TIM HOWARD
(TEL)714-769-9155

ARCHITECT
AO ARCHITECTURE
1144 NORTH STREET
ORANGE, CA 92866
CONTACT: STEPHEN PRZYBYLOWSKI
(TEL)714-694-4860

ENGINEER
FMCIVIL ENGINEERS INC.
29985 TECHNOLOGY DRIVE, SUITE 306
MURRIETA, CA 92563
CONTACT: FRANCISCO MARTINEZ
(TEL)951-331-4873

PROJECT DESCRIPTION
AN INDUSTRIAL WAREHOUSE FACILITY CONSISTING OF A WAREHOUSE TOTALING 432,000 SQUARE FEET ON 23.82 ACRES.

SITE PLAN KEYNOTES

1. PAINTED CONCRETE TILT-UP WAREHOUSE / OFFICE / MANUFACTURING FACILITY. BUILDING TO BE DESIGNED PER ARCHITECT'S PLANS
2. ON SITE ACCESSIBLE SIDEWALK AND CURB RAMPS.
3. CONCRETE CURB
4. CONCRETE CURB & GUTTER
5. STANDARD PARKING STALL MIN. 9' X 18' - STRIPE PER STANDARDS SHOWN ON ARCHITECT'S PLANS
6. HANDICAP PARKING STALL MIN. 9' X 18' - STRIPE PER STANDARDS SHOWN ON ARCHITECT'S PLANS
7. TRAILER PARKING STALL MIN. 12' X 50' - STRIPE PER STANDARDS SHOWN ON ARCHITECT'S PLANS
8. ACCESSIBLE BUILDING ENTRY WITH ADJACENT BICYCLE RACKS PER ARCHITECT'S PLANS
9. PORTLAND CONC. CEMENT (PCC) PAVED TRUCK YARD ARCHITECT'S PLANS
10. POROUS ASPHALT PAVED PARKING PER ARCHITECT'S PLANS
11. DOCK HIGH TRUCK DOOR PER ARCHITECT'S PLANS
12. GRADE LEVEL RAMP DOOR PER ARCHITECT'S PLANS
13. EXTERIOR MAN DOOR AND STAIRS W/GUARD POST PER ARCHITECT'S PLANS
14. COMMERCIAL DRIVEWAY APPROACH PER SAN BERNARDINO COUNTY STD. 129B, LOCATED PER STD. 130, WITH DECORATIVE CONCRETE PAVING PER ARCHITECT'S PLANS
15. DETENTION BASIN
16. UNDERGROUND STORM WATER CHAMBER SYSTEM
17. LANDSCAPE AREA PER LANDSCAPE ARCHITECT'S PLANS
18. APPROXIMATE LOCATION OF TRASH ENCLOSURE PER ARCHITECT'S PLANS
19. METAL, MANUAL OPERATED SECURITY GATE WITH KNOX-PAD LOCK FOR FIRE DEPARTMENT ACCESS PER ARCHITECT'S PLANS
20. CONCRETE SCREEN WALL PER ARCHITECT'S PLANS
21. COMBINATION SCREEN & RETAINING WALL PER ARCHITECT'S PLANS
22. COMBINATION RETAINING WALL & TUBE STEEL FENCE PER ARCHITECT'S PLANS
23. TUBE STEEL FENCE PER ARCHITECT'S PLANS
24. RETAINING WALL
25. PROPOSED LOCATION OF FUTURE SEWER LIFT STATION (BY OTHERS)

LEGEND

- 1025 — INDEX CONTOUR
- RETAINING WALL
- FENCE
- EDGE OF PAVEMENT
- SIGN
- MH — MANHOLE
- RIGHT OF WAY
- EASEMENT
- PARCEL LINE
- PARCEL MAP BOUNDARY
- STREET CENTER LINE
- SCREEN WALL
- COMBINATION SCREEN/RETAINING WALL
- EXISTING LOT LINE
- RIDGE LINE
- RIBBON GUTTER
- FLOW ARROW
- PROPOSED EDGE OF PAVEMENT
- EX W — EXISTING WATER LINE
- EX SS — EXISTING SWR LINE
- SD — EXISTING STORM DRAIN PIPE
- SD — PROPOSED STORM DRAIN PIPE
- CUT/FILL LINE
- SLOPE SYMBOL
- PROPOSED STREET AC PAVEMENT
- GRIND AND OVERLAY
- POROUS PAVEMENT

SEWER

EXISTING SEWER:
PUBLIC SEWER

PROPOSED SEWER:
PRIVATE & PUBLIC SEWER

UTILITY COMPANIES:

WATER:	WEST VALLEY WATER DISTRICT PHONE: (909) 875-1322 RIALTO WATER SERVICES PHONE: (909) 820-2546
ELECTRIC:	SOUTHERN CALIFORNIA EDISON PHONE: (800) 655-4555
TELEPHONE:	AT&T PHONE: (800) 288-2020
CABLE:	SPECTRUM PHONE: (855) 243-8892
GAS:	SOUTHERN CALIFORNIA GAS COMPANY PHONE: (800) 427-2200
SCHOOL:	RIALTO UNIFIED SCHOOL DISTRICT PHONE: (909) 820-7700
SEWER:	RIALTO WATER SERVICES PHONE: (909) 820-2546

EARTHWORK ESTIMATE:

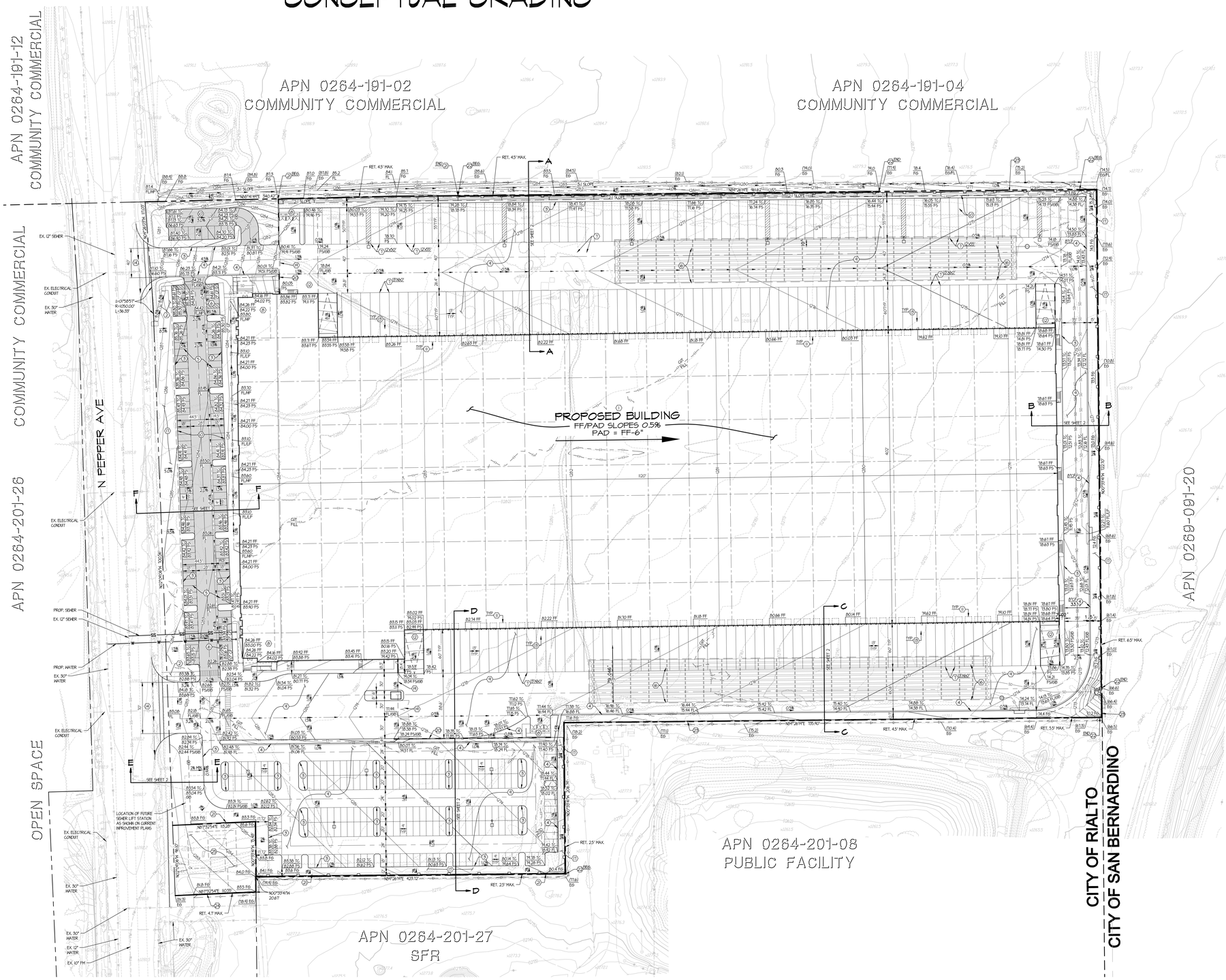
RAW CUT:	62,230 CY
RAW FILL:	49,740 CY
NET:	12,490 CY EXPORT

HAUL TRIPS:
ASSUMED (13 CY PER TRIP) = 961

ZONING ORDINANCE

EXISTING ZONING:
PEPPER AVENUE SPECIFIC PLAN COMMUNITY COMMERCIAL

PROPOSED ZONING:
PEPPER AVENUE SPECIFIC PLAN COMMUNITY COMMERCIAL (ALLOWING WAREHOUSE & LOGISTICS USES)

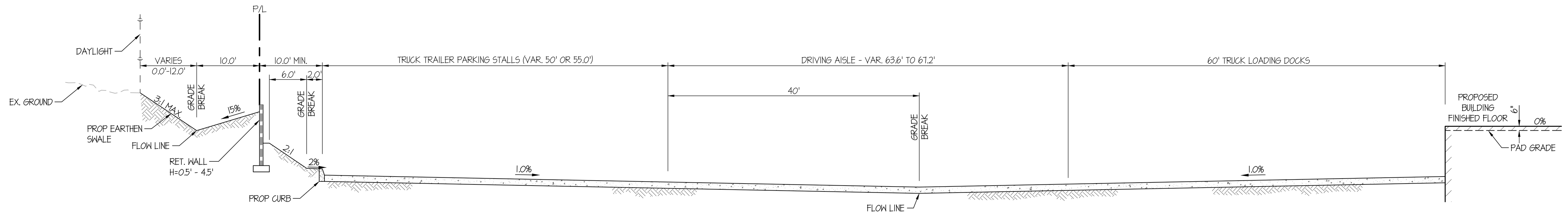


SAN BERNARDINO COUNTY		
PEPPER AVENUE INDUSTRIAL BUILDING CONCEPTUAL GRADING		
SCALE: AS SHOWN DATE: DEC. 2021 DESIGNED: AJ CHECKED: FM PLN CK REF:	FMCIVIL ENGINEERS INC. 29985 TECHNOLOGY DRIVE, SUITE 306 MURRIETA	CA 92563 951.973.0201 - FMCIVIL.COM	SHEET 1 OF 2 SHEETS

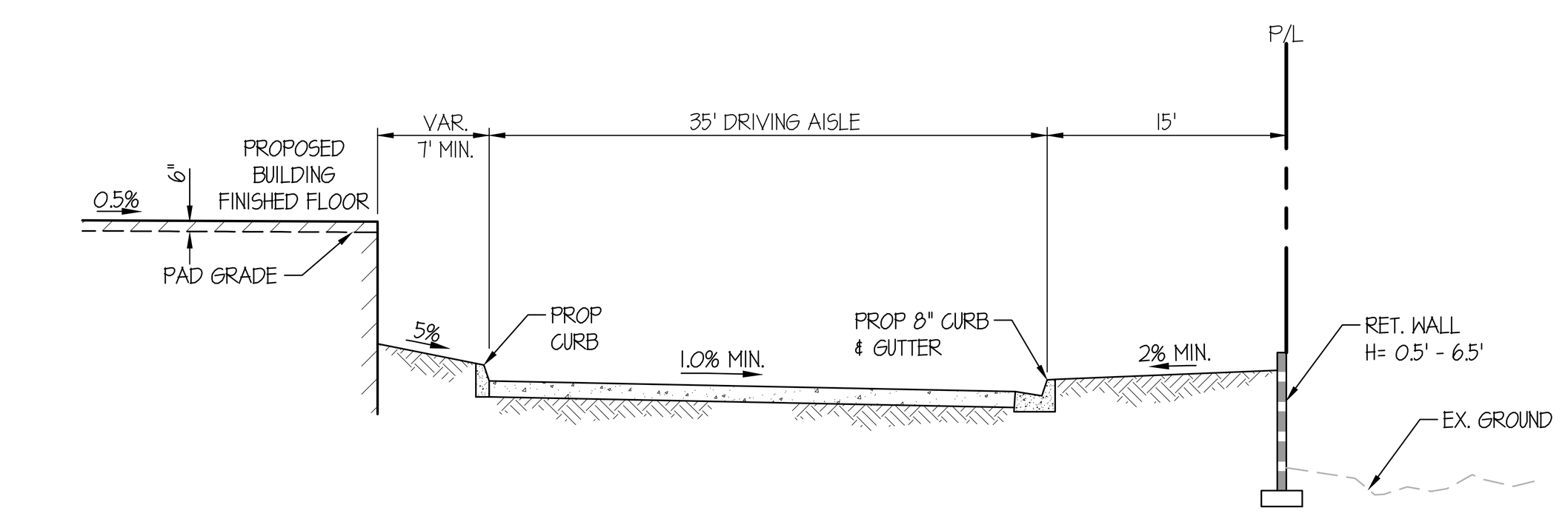
N:\PROJECTS\19-006 HIP RIALTO PEPPER AVE\DWGS\PLAN\ENTITLEMENT\CONCEPTUS\19-006-GD-001.DWG DANIEL 12/14/2021 6:19 PM

CITY OF RIALTO
COUNTY OF SAN BERNARDINO, CALIFORNIA

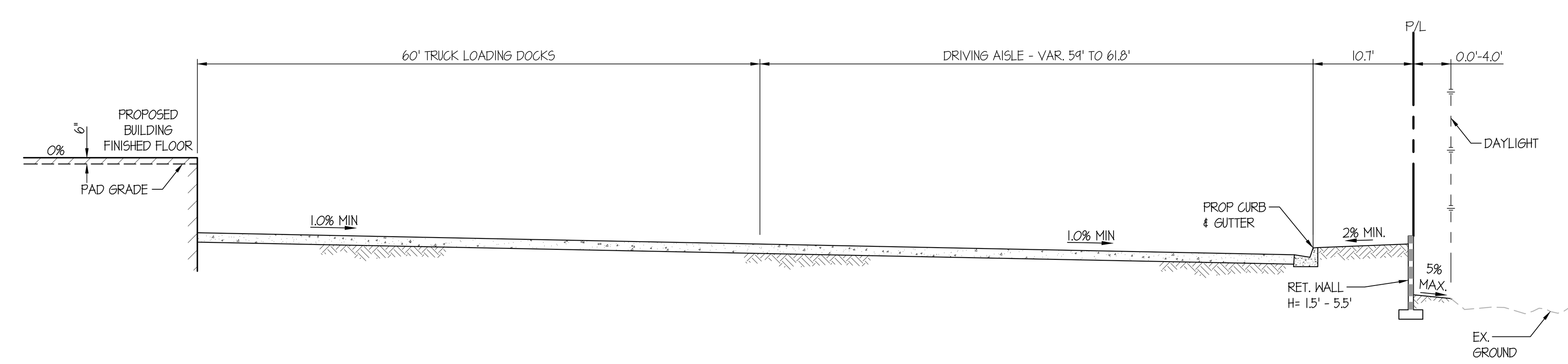
PEPPER AVENUE INDUSTRIAL BUILDING
CONCEPTUAL GRADING



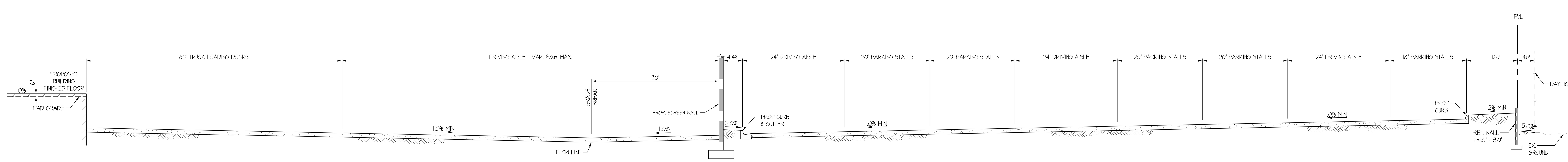
SECTION A-A
HOR. SCALE: 1"=10'



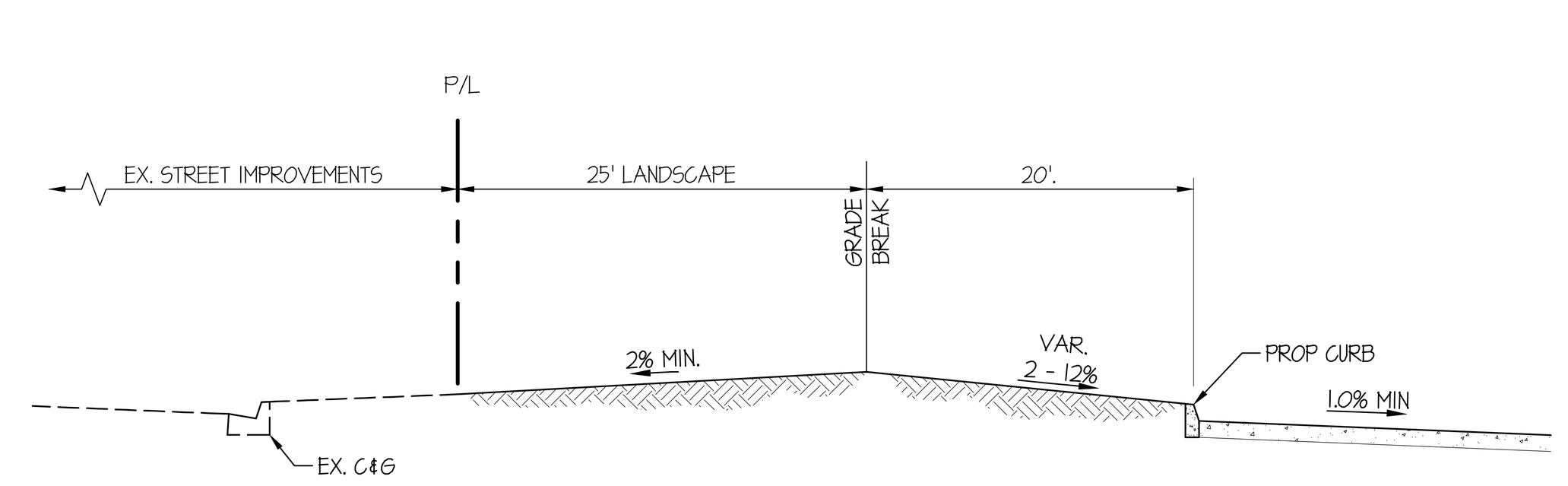
SECTION B-B
HOR. SCALE: 1"=10'



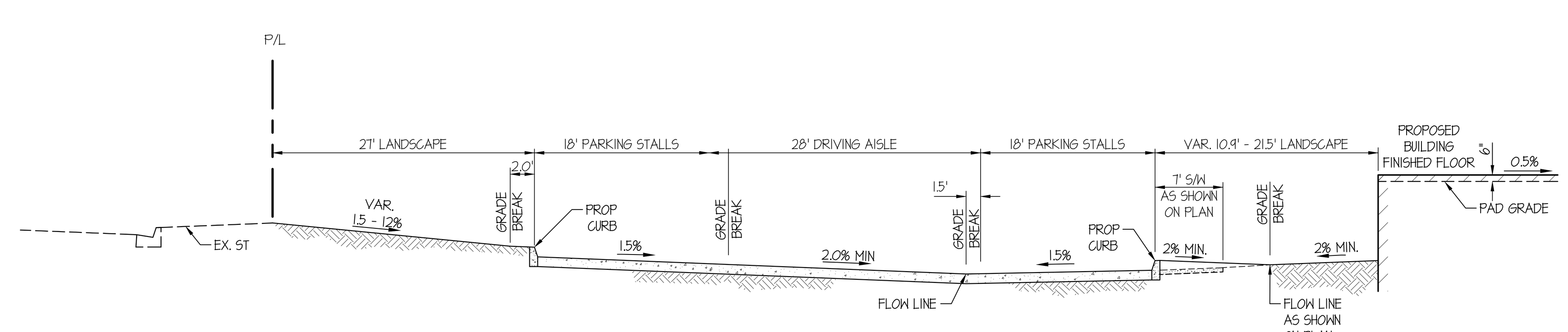
SECTION C-C
HOR. SCALE: 1"=10'



SECTION D-D
HOR. SCALE: 1"=10'

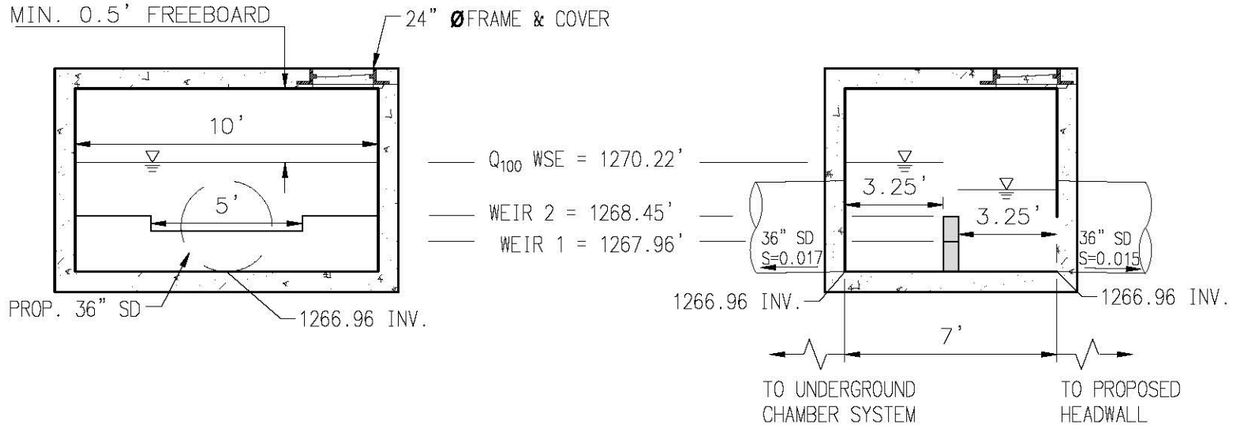


SECTION E-E
HOR. SCALE: 1"=10'



SECTION F-F
HOR. SCALE: 1"=10'

SAN BERNARDINO COUNTY	
PEPPER AVENUE INDUSTRIAL BUILDING TYPICAL SECTIONS	
SCALE: AS SHOWN DATE: DEC. 2021 DESIGNED: AJ CHECKED: FM PLN CK REF:	FMCIVIL ENGINEERS INC. 29995 TECHNOLOGY DRIVE, SUITE 306 MURRIETA	CA 92563 951.479.0201 - FMCIVIL.COM — SHEET 2 OF 2 SHEETS



OUTLET CONTROL STRUCTURE

UNDERGROUND CHAMBER SYSTEM BOTTOM = 1264.77

FMCIVIL ENGINEERS INC.
29995 TECHNOLOGY DRIVE, SUITE 306 | MURRIETA | CA 92563
951.331.9873 - FMCIVIL.COM

PEPPER AVE

OUTLET CONTROL STRUCTURE DETAIL

1

OF 1 SHEETS

SECTION 6.4.3
DCV AND FACTOR OF SAFETY CALCULATIONS

Santa Ana Watershed

BMP Design Volume, V_{BMP}

Company Name	FMCIVIL Engineers Inc.
Designed by	Francisco Martinez, PE
Project	Pepper Industrial Building (DA 1)
Date	12/15/2021

DA 1	**Surface Type**	**Area (SF)**
	Roof	465,518.26
	Concrete or Asphalt	444,750.92
	Future Impervious Area	-
	Restore to Natural	
	Ornamental Landscaping, Basin, and Pervious Concrete	122,175.82
	Total Area (SF)	1,032,445.00
	Total Area (Acres)	23.7

Impervious Ratio =	**(i)**	88.2%
C_{BMP} = Runoff Coefficient	**$0.858i^3-0.78i^2+0.774i+0.04$**	0.7041
$P_{2yr,1hr}$	**NOAA - 2-yr 1-hr rainfall depth**	0.637
a_1 = San Bernardino Climate Region	**Valley = 1.4807 Mountain = 1.909 Desert = 1.2371**	1.4807
P_6 - Mean Storm Rainfall Depth	**$P_6 = a_1 * P_{2yr,1hr}$**	0.9432
a_2 = Drawdown rate of Basin	**1.582 for 24-hr 1.963 for 48-hr**	1.9630
Project Area (SF)	**(DA)**	1,032,445.00
Design Capture Volume (cu.ft.)	**DCV = DA * C_{BMP} * a_2 * P_6/12**	112,164.67
Volume Provided, cu. Ft.	**ConTech Chamber Capacity**	254,779.30

Pepper Industrial Building **DMA 1**

Infiltration Test No.	Infiltration Rate (in/hr)	
I-3	0.8	
I-4	4.2	
Infiltration Rate (lowest) =	**2.5**	Used
Geotechnical Report recommendation =	3.9 (N/A)	

Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	2	0.5
		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	1	0.25
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \sum p$			1.25
B	Design	Tributary area size	0.25	2	0.5
		Level of pretreatment/ expected sediment loads	0.25	3	0.75
		Redundancy	0.25	3	0.75
		Compaction during construction	0.25	2	0.5
		Design Safety Factor, $S_B = \sum p$			2.5
Combined Safety Factor, $S_{total} = S_A x S_B$					3.13
Observed Infiltration Rate, inch/hr, $K_{observed}$ (corrected for test-specific bias)					2.50
Design Infiltration Rate, in/hr, Kdesign = $K_{0bserved} / S_{total}$					**0.80**

Infiltration values I-3 and I-4 obtained from Southern California Geotechnical's Report #20G234-3 dated August 31, 2021. Other infiltration values were omitted as those infiltration tests do not fall within the proposed chamber footprint.

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

SECTION 6.4.4
INFILTRATION AND USDA SOIL REPORTS

August 31, 2021

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Howard Industrial Partners
1944 North Tustin Street, Suite 122
Orange, California 92865

Attention: Mr. Mike Tunney

Project No.: **20G234-3**

Subject: **Results of Infiltration Testing**
Proposed Commercial/Industrial Building
Pepper Avenue, South of Foothill Freeway
Rialto, California

Mr. Tunney:

In accordance with your request, we have conducted infiltration testing at the subject site. We are pleased to present this report summarizing the results of the infiltration testing and our design recommendations.

Scope of Services

The scope of services performed for this project was in general accordance with our Proposal No. 20P409-2 dated August 6, 2021. The scope of services included a visual site reconnaissance and the review of the previously prepared infiltration report to determine the infiltration rates of the on-site soils. The infiltration testing was performed in general accordance with the guidelines published in the Riverside County – Low Impact Development BMP Design Handbook – Section 2.3 of Appendix A, prepared for the Riverside County Department of Environmental Health (RCDEH), dated December, 2013. The San Bernardino County standards defer to the guidelines published by the RCDEH.

Site and Project Description

The subject site is located on the east side of Pepper Avenue, approximately 500 feet south of the intersection of Pepper Avenue and the Foothill Freeway (CA-210) in Rialto, California. The site is bounded to the north and east by vacant lots, to the west by Pepper Avenue, and to the south by a vacant lot and a detention basin with an above-ground storage tank (AST). The general location of the site is illustrated on the Site Location Map, included as Plate 1 of this report.

The site consists of an L-shaped parcel, 24.23± acres in size. Based on aerial photographs obtained from Google Earth, the site is vacant and undeveloped. The ground surface cover consists of exposed soil with sparse to moderate native grass and weed growth.

Topographic information by Inland Aerial Surveys, Inc. was provided by the client. The site topography ranges from 1267± feet mean sea level (msl) located in the southeast corner of the site to 1290± msl in the northwest corner of the site. The site generally slopes downward to the southeast at a gradient of 1½± percent.

Proposed Development

SCG was provided with a conceptual site plan provided to our office, the subject site will be developed with one commercial/industrial building, 436,000± ft² in size, located in the north-central area of the site. Dock-high doors will be constructed along portions of the north and south building walls. The building will be surrounded by asphaltic concrete pavements in the parking and drive lanes, Portland cement concrete pavements in the loading dock areas, concrete flatwork, and limited areas of landscape planters throughout.

Based on an infiltration exhibit provided by FMCIVIL Engineers Inc. (FMC), the proposed development will include on-site stormwater infiltration. The infiltration systems will consist of one (1) detention basin and one (1) below-grade chamber system located in the southeastern area of the site. The bottom of the basin will range from approximately 1 to 3½ feet below the existing site grades and the bottom of the chamber system will range from approximately 8 to 12½ feet below the existing site grades.

Previous Study

SCG previously performed a geotechnical feasibility study at the subject site, which is referenced below.

> Geotechnical Feasibility Study, Proposed Commercial/Industrial Building, Pepper Avenue, South of Foothill Freeway, Rialto, California, prepared by Southern California Geotechnical, Inc. (SCG) for Howard Industrial Partners, SCG Project No. 20G234-1, dated December 15, 2020.

As part of this investigation, four (4) borings were advanced to a depth of 50± feet below the existing site grades. Native alluvium was encountered at the ground surface at all of the boring locations, extending to at least the maximum depth explored of 50± feet below the existing site grades. The near-surface alluvium generally consisted of very loose to medium dense silty sands, sandy silts, gravelly sands, and well-graded sands, with varying silt and gravel content, extending to depths of 7 to 10± feet. The underlying alluvium generally consisted of medium dense to dense silty sands, sandy silts, and well-graded sands with varying fine gravel and silt content, extending to depths of 15 to 20± feet. At greater depths the alluvial soils generally consisted of dense to very dense silty sands, gravely sands, sandy gravels, and well-graded sands, with varying silt, gravel and cobble content. Free water was not encountered during the drilling of any of the borings.

Groundwater

Free water was not encountered during the drilling of any of the borings. Based on the lack of any water within the borings, and the moisture contents of the recovered soil samples, the static groundwater is considered to have existed at a depth in excess of 50± feet at the time of the subsurface exploration. As part of our research, we reviewed readily available groundwater data in order to determine regional groundwater depths. The primary reference used to determine the groundwater depths in the subject site area is the California Department of Water Resources website, http://www.water.ca.gov/waterdatalibrary/. The nearest monitoring well is located

approximately 800 feet southeast from the site. Water level readings within this monitoring well indicates a high groundwater level of 418± feet below the ground surface in September 2020.

Subsurface Exploration

Scope of Exploration

The subsurface exploration conducted for the infiltration testing consisted of seven (7) infiltration test borings (identified as I-1 through I-7), advanced to a depth of 2 to 12½± feet below the existing site grades.

The infiltration borings were advanced using a truck-mounted drilling rig, equipped with 8-inch diameter hollow stem augers and were logged during drilling by a member of our staff. Upon the completion of the infiltration borings, the bottom of each test boring was covered with 2± inches of clean ¾-inch gravel. A sufficient length of 3-inch-diameter perforated PVC casing was then placed into each test hole so that the PVC casing extended from the bottom of the test hole to the ground surface. Clean ¾-inch gravel was then installed in the annulus surrounding the PVC casing.

The approximate locations of the infiltration borings are indicated on the Infiltration Test Location Plan, enclosed as Plate 2 of this report.

Geotechnical Conditions

Native alluvial soils were encountered at the ground surface at all of the infiltration boring locations, extending to at least the maximum depth explored of 12½± feet below the existing site grades. The near-surface alluvium within the upper 5± feet generally consists of loose silty sands and fine sands with varying gravel content. At greater depths, the alluvium generally consists of medium dense silty sands and occasional sandy silts. Groundwater was not encountered during the drilling of these borings. The Boring Logs, which illustrate the conditions encountered at the boring locations, are included with this report.

Infiltration Testing

As previously mentioned, the infiltration testing was performed in general accordance with the guidelines published in Riverside County – Low Impact Development BMP Design Handbook – Section 2.3 of Appendix A, which apply to San Bernardino County.

Pre-soaking

In accordance with the county infiltration standards for sandy soils, all infiltration test borings were pre-soaked 2 hours prior to the infiltration testing or until all of the water had percolated through the test holes. The pre-soaking process consisted of filling test borings by inverting a full 5-gallon bottle of clear water supported over each hole so that the water flow into the hole holds constant at a level at least 5 times the hole's radius above the gravel at the bottom of each hole. Pre-soaking was completed after all of the water had percolated through the test holes.

Infiltration Testing

Following the pre-soaking process of the infiltration test borings, SCG performed the infiltration testing. Each test hole was filled with water to a depth of at least 5 times the hole's radius above the gravel at the bottom of the test holes. In accordance with the San Bernardino County guidelines, since "sandy soils" were encountered at the bottom of both of the infiltration test borings (where 6 inches of water infiltrated into the surrounding soils for two consecutive 25-minute readings), readings were taken at 10-minute intervals for a total of 1 hour at each test location. After each reading, water was added to the borings so that the depth of the water was at least 5 times the radius of the hole. The water level readings are presented on the spreadsheets enclosed with this report. The infiltration rates for each of the timed intervals are also tabulated on the spreadsheets.

The infiltration rates from the test are tabulated in inches per hour. In accordance with the typically accepted practice, it is recommended that the most conservative reading from the latter part of the infiltration tests be used as the design infiltration rate. The rates are summarized below:

Infiltration Test No.	Depth (feet)	Test Elevation (feet) MSL	Soil Description	Infiltration Rate (inches/hour)
I-1	9½	1261.5	Light Gray Silty fine to medium Sand	7.2
I-2	8	1262	Light Gray fine Sandy Silt, little medium Sand	5.7
I-3	12½	1261.5	Gray Brown Silty fine to coarse Sand, little fine to coarse Gravel	0.8
I-4	11	1262	Gray Brown Silty fine to medium Sand	4.2
I-5	8½	1262	Gray Brown Silty fine to medium Sand, little coarse Gravel	1.7
I-6	3½	1266.5	Gray Brown Silty fine to medium Sand	9.0
I-7	2	1265.5	Gray Brown Silty fine to medium Sand	1.7

Laboratory Testing

Moisture Content

The moisture contents for the recovered soil samples within the borings were determined in accordance with ASTM D-2216 and are expressed as a percentage of the dry weight. These test results are presented on the Boring Logs.

Grain Size Analysis

The grain size distribution of selected soils collected from the base of each infiltration test boring have been determined using a range of wire mesh screens. These tests were performed in general accordance with ASTM D-422 and/or ASTM D-1140. The weight of the portion of the sample

retained on each screen is recorded and the percentage finer or coarser of the total weight is calculated. The results of these tests are presented on Plates C-1 through C-7 of this report.

Design Recommendations

Seven (7) infiltration tests were performed at the subject site. As noted above, the infiltration rates at these locations vary from 0.8 to 9.0 inches per hour.

Based on the results of the infiltration testing, we recommend the following infiltration rates for the proposed infiltration systems:

Infiltration System	Infiltration Rate (Inches per Hour)
Chamber System	3.9
Detention Basin	5.3

The design of the storm water infiltration system should be performed by the project civil engineer, in accordance with the City of Rialto and/or County of San Bernardino guidelines. It is recommended that the system be constructed so as to facilitate removal of silt and clay, or other deleterious materials from any water that may enter the system. The presence of such materials would decrease the effective infiltration rate. **It is recommended that the project civil engineer apply an appropriate factor of safety. The infiltration rate recommended above is based on the assumption that only clean water will be introduced to the subsurface profile. Any fines, debris, or organic materials could significantly impact the infiltration rate.** It should be noted that the recommended infiltration rates are based on infiltration testing at seven (7) discrete locations and that the overall infiltration rate of the proposed infiltration system could vary considerably.

Infiltration Rate Considerations

The infiltration rates presented herein was determined in accordance with the San Bernardino County guidelines and are considered valid only for the time and place of the actual test. Varying subsurface conditions will exist in other areas of the site, which could alter the recommended infiltration rate presented above. The infiltration rate will decline over time between maintenance cycles as silt or clay particles accumulate on the BMP surface. The infiltration rate is highly dependent upon a number of factors, including density, silt and clay content, grainsize distribution throughout the range of particle sizes, and particle shape. Small changes in these factors can cause large changes in the infiltration rate.

Infiltration rates are based on unsaturated flow. As water is introduced into soils by infiltration, the soils become saturated and the wetting front advances from the unsaturated zone to the saturated zone. Once the soils become saturated, infiltration rates become zero, and water can only move through soils by hydraulic conductivity at a rate determined by pressure head and soil permeability. Changes in soil moisture content will affect the infiltration rate. Infiltration rates should be expected to decrease until the soils become saturated. Soil permeability values will then govern groundwater movement. Permeability values may be on the order of 10 to 20 times less than infiltration rates. The system designer should incorporate adequate factors of safety

and allow for overflow design into appropriate traditional storm drain systems, which would transport storm water off-site.

Construction Considerations

The infiltration rate presented in this report is specific to the tested location and tested depth. Infiltration rates can be significantly reduced if the soils are exposed to excessive disturbance or compaction during construction. Therefore, the subgrade soils within the proposed infiltration system area should not be overexcavated, undercut or compacted in any significant manner. **It is recommended that a note to this effect be added to the project plans and/or specifications.**

We recommend that a representative from the geotechnical engineer be on-site during the construction of the proposed infiltration system to identify the soil classification at the base of the system. It should be confirmed that the soils at the base of the proposed infiltration system correspond with those presented in this report to ensure that the performance of the system will be consistent with the rate reported herein.

We recommend that scrapers and other rubber-tired heavy equipment not be operated on the system bottom, or at levels lower than 2 feet above the bottom of the system, particularly within basins. As such, the bottom 24 inches of the infiltration system should be excavated with non-rubber-tired equipment, such as excavators.

Basin Maintenance

The proposed project may include infiltration basins. Water flowing into these basins will carry some level of sediment. Wind-blown sediments and erosion of the basin side walls will also contribute to sediment deposition at the bottom of the basin. This layer has the potential to significantly reduce the infiltration rate of the basin subgrade soils. Therefore, a formal basin maintenance program should be established to ensure that these silt and clay deposits are removed from the basin on a regular basis. Appropriate vegetation on the basin sidewalls and bottom may reduce erosion and sediment deposition.

Basin maintenance should also include measures to prevent animal burrows, and to repair any burrows or damage caused by such. Animal burrows in the basin sidewalls can significantly increase the risk of erosion and piping failures.

Location of Infiltration Systems

The use of on-site storm water infiltration systems carries a risk of creating adverse geotechnical conditions. Increasing the moisture content of the soil can cause the soil to lose internal shear strength and increase its compressibility, resulting in a change in the designed engineering properties. Overlying structures and pavements in the infiltration area could potentially be damaged due to saturation of the subgrade soils. **The proposed infiltration systems for this site should be located at least 25 feet away from any structures, including retaining walls.** Even with this provision of locating the infiltration system at least 25 feet from the building(s), it is possible that infiltrating water into the subsurface soils could have an adverse effect on the proposed or existing structures. It should also be noted that utility trenches which

happen to collect storm water can also serve as conduits to transmit storm water toward the structure, depending on the slope of the utility trench. Therefore, consideration should also be given to the proposed locations of underground utilities which may pass near the proposed infiltration system.

The infiltration system designer should also give special consideration to the effect that the proposed infiltration systems may have on nearby subterranean structures, open excavations, or descending slopes. In particular, infiltration systems should not be located near the crest of descending slopes, particularly where the slopes are comprised of granular soils. Such systems will require specialized design and analysis to evaluate the potential for slope instability, piping failures and other phenomena that typically apply to earthen dam design. This type of analysis is beyond the scope of this infiltration test report, but these factors should be considered by the infiltration system designer when locating the infiltration systems.

General Comments

This report has been prepared as an instrument of service for use by the client in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. This report may be provided to the contractor(s) and other design consultants to disclose information relative to the project. However, this report is not intended to be utilized as a specification in and of itself, without appropriate interpretation by the project architect, structural engineer, and/or civil engineer. The design of the proposed storm water infiltration system is the responsibility of the civil engineer. The role of the geotechnical engineer is limited to determination of infiltration rate only. By using the design infiltration rate contained herein, the civil engineer agrees to indemnify, defend, and hold harmless the geotechnical engineer for all aspects of the design and performance of the proposed storm water infiltration system. The reproduction and distribution of this report must be authorized by the client and Southern California Geotechnical, Inc. Furthermore, any reliance on this report by an unauthorized third party is at such party's sole risk, and we accept no responsibility for damage or loss which may occur.

The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between boring locations and testing depths. If the conditions encountered during construction vary significantly from those detailed herein, we should be contacted immediately to determine if the conditions alter the recommendations contained herein.

This report has been based on assumed or provided characteristics of the proposed development. It is recommended that the owner, client, architect, structural engineer, and civil engineer carefully review these assumptions to ensure that they are consistent with the characteristics of the proposed development. If discrepancies exist, they should be brought to our attention to verify that they do not affect the conclusions and recommendations contained herein. We also recommend that the project plans and specifications be submitted to our office for review to verify that our recommendations have been correctly interpreted. The analysis, conclusions, and recommendations contained within this report have been promulgated in accordance with

generally accepted professional geotechnical engineering practice. No other warranty is implied or expressed.

Closure

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

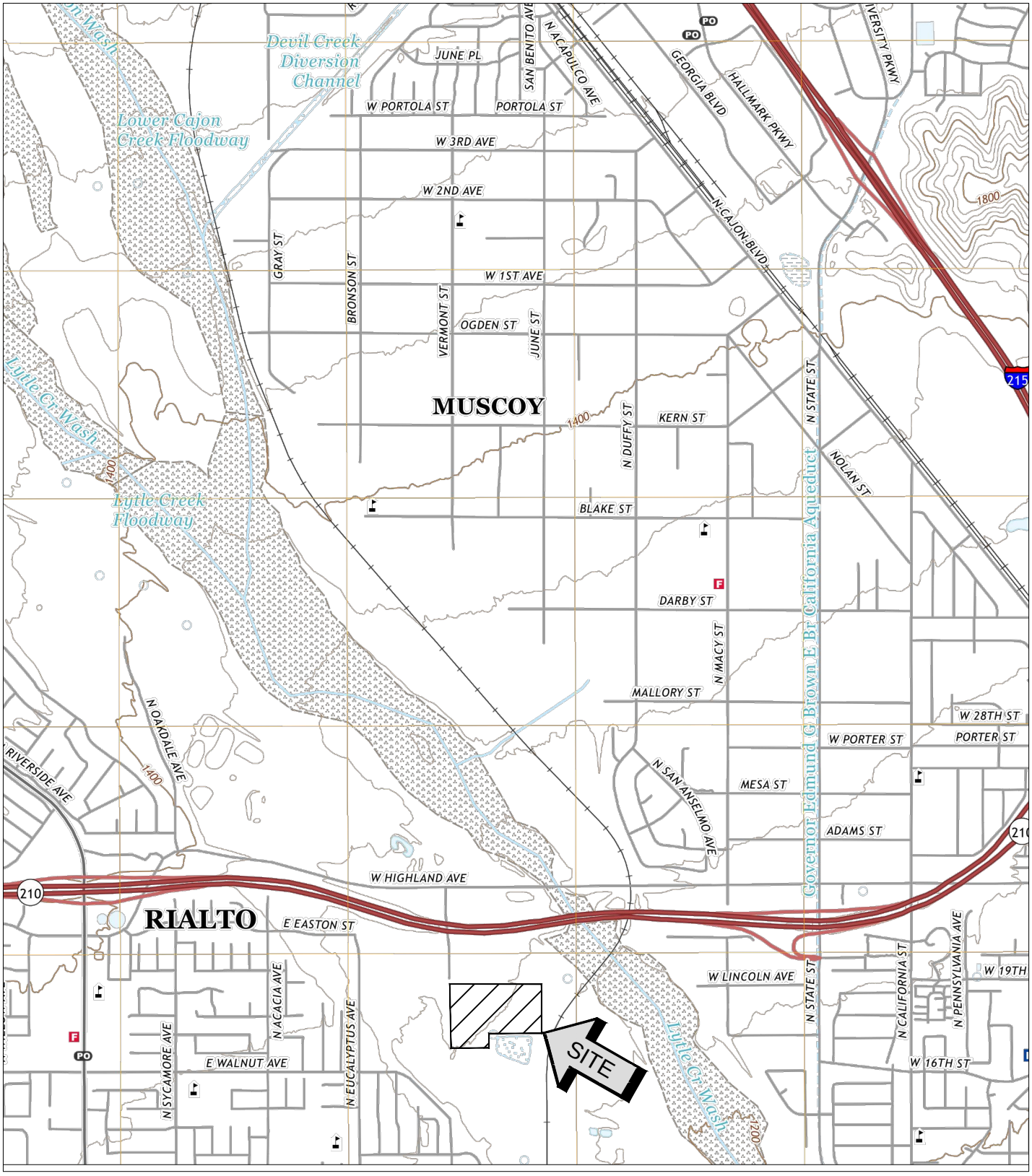
SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

Jose Zuniga
Staff Engineer

Robert G. Trazo, GE 2655
Principal Engineer

Distribution: (1) Addressee

Enclosures: Plate 1 - Site Location Map
Plate 2 - Infiltration Test Location Plan
Boring Log Legend and Logs (9 pages)
Infiltration Test Results Spreadsheets (7 pages)
Grain Size Distribution Graphs (7 pages)



SOURCE: USGS TOPOGRAPHIC MAPS OF THE SAN BERNARDINO NORTH QUADRANGLES, SAN BERNARDINO COUNTY, CALIFORNIA, 2018.

SITE LOCATION MAP

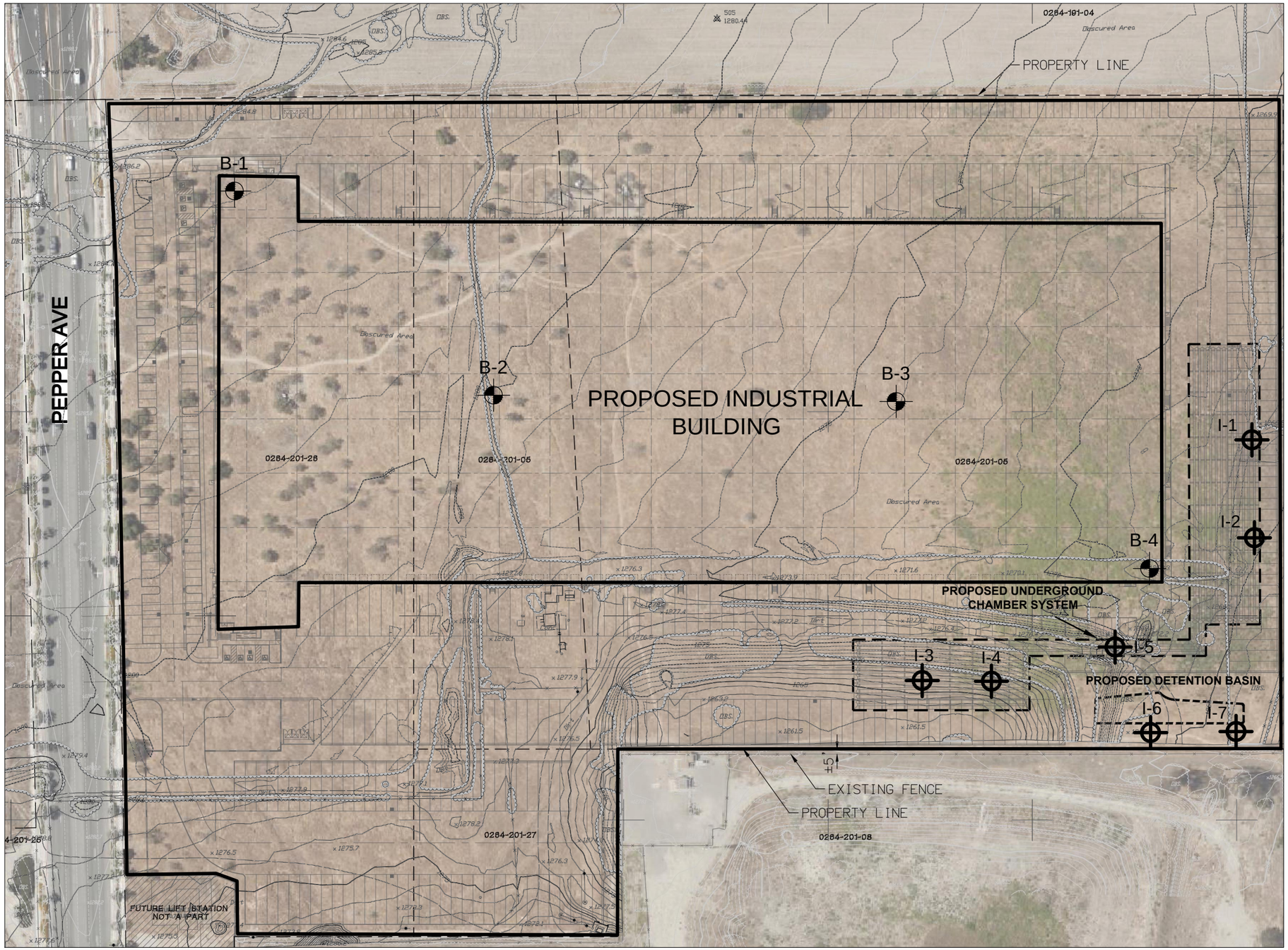
PROPOSED COMMERCIAL/INDUSTRIAL BUILDING

RIALTO, CALIFORNIA

SCALE: 1" = 2000'	
DRAWN: JAH CHKD: RGT	
SCG PROJECT 20G234-3	
PLATE 1	

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



NORTH

SoCalGeo

GEOTECHNICAL LEGEND

APPROXIMATE INFILTRATION BORING LOCATION

PREVIOUS BORING LOCATION (SCG PROJECT NO. 20G234-1)

NOTE: AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH. CONCEPTUAL SITE PLAN PROVIDED BY THE CLIENT.

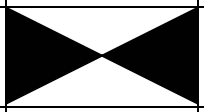
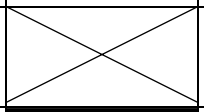
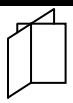
INFILTRATION TEST LOCATION PLAN

PROPOSED COMMERCIAL/INDUSTRIAL BUILDING

RIALTO, CALIFORNIA

SCALE: 1" = 120'	SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: JAH CHKD: RGT	
SCG PROJECT 20G234-3	
PLATE 2	

BORING LOG LEGEND

SAMPLE TYPE	GRAPHICAL SYMBOL	SAMPLE DESCRIPTION
AUGER		SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED)
CORE		ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK.
GRAB		SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED)
CS		CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED)
NSR		NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL.
SPT		STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED)
SH		SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED)
VANE		VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED.

COLUMN DESCRIPTIONS

DEPTH: Distance in feet below the ground surface.

SAMPLE: Sample Type as depicted above.

BLOW COUNT: Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3" indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.

POCKET PEN.: Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.

GRAPHIC LOG: Graphic Soil Symbol as depicted on the following page.

DRY DENSITY: Dry density of an undisturbed or relatively undisturbed sample in lbs/ft^3.

MOISTURE CONTENT: Moisture content of a soil sample, expressed as a percentage of the dry weight.

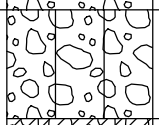
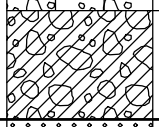
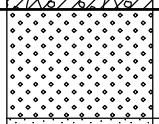
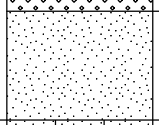
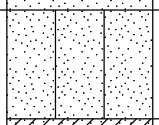
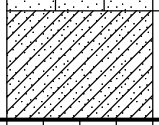
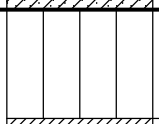
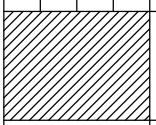
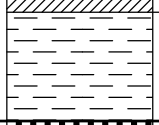
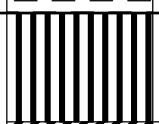
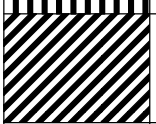
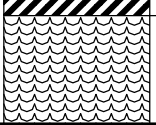
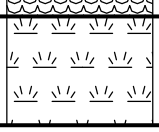
LIQUID LIMIT: The moisture content above which a soil behaves as a liquid.

PLASTIC LIMIT: The moisture content above which a soil behaves as a plastic.

PASSING #200 SIEVE: The percentage of the sample finer than the #200 standard sieve.

UNCONFINED SHEAR: The shear strength of a cohesive soil sample, as measured in the unconfined state.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO 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 (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% 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 OR 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 GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. I-1

JOB NO.: 20G234-3
PROJECT: Proposed C/I Building
LOCATION: Rialto, California

DRILLING DATE: 8/10/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: Dry
CAVE DEPTH: ---
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 1271 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
		4			ALLUVIUM: Light Gray Brown fine Sand, trace Silt, very loose to loose-damp		4					
		8			Light Gray Silty fine Sand, loose to medium dense-damp		5					
5		12			@ 6 to 7½ feet, little Iron oxide staining		7					
		18			Light Gray Silty fine to medium Sand, medium dense-damp		4			31		
					Boring Terminated at 9½ feet							

TBL 20G234-3.GPJ SOCALGEO.GDT 8/31/21

TEST BORING LOG

PLATE B-1

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. I-2

JOB NO.: 20G234-3
PROJECT: Proposed C/I Building
LOCATION: Rialto, California

DRILLING DATE: 8/10/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: Dry
CAVE DEPTH: ---
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 1270 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
		3			ALLUVIUM: Light Gray to Light Gray Brown fine Sand, trace to little Silt, very loose to loose-dry to damp		2					
		6					4					
5					Light Gray fine Sandy Silt, little medium Sand, medium dense-damp							
		10					6			63		
					Boring Terminated at 8 feet							

TBL 20G234-3.GPJ SOCALGEO.GDT 8/31/21

TEST BORING LOG

PLATE B-2

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. I-3

JOB NO.: 20G234-3
PROJECT: Proposed C/I Building
LOCATION: Rialto, California

DRILLING DATE: 8/10/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: Dry
CAVE DEPTH: ---
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 1274 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
5		10			ALLUVIUM: Gray Brown fine Sand, trace medium to coarse Sand, trace Silt, trace Iron oxide staining, medium dense-dry to damp		3					
10		18			Dark Gray Brown Silty fine Sand, little medium Sand, trace coarse Gravel, medium dense-moist		11					
		25			Gray Brown Silty fine to coarse Sand, little fine to coarse Gravel, medium dense-damp		6			23		
					Boring Terminated at 12½ feet							

TBL 20G234-3.GPJ SOCALGEO.GDT 8/31/21

TEST BORING LOG **PLATE B-3**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. I-4

JOB NO.: 20G234-3
PROJECT: Proposed C/I Building
LOCATION: Rialto, California

DRILLING DATE: 8/10/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: Dry
CAVE DEPTH: ---
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 1273 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
		7			ALLUVIUM: Gray Brown Silty fine Sand, little medium to coarse Sand, trace fine Gravel, loose-damp		6					
		10			Light Gray fine Sand, little Iron oxide staining, medium dense-damp		5					
5		12			Gray Brown Silty fine Sand, trace fine Gravel, trace fine to medium Sand, medium dense-damp		7					
					Gray Brown Silty fine to medium Sand, medium dense-moist							
10		15					10			44		
					Boring Terminated at 11 feet							

TBL 20G234-3.GPJ SOCALGEO.GDT 8/31/21

TEST BORING LOG **PLATE B-4**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. I-5

JOB NO.: 20G234-3
PROJECT: Proposed C/I Building
LOCATION: Rialto, California

DRILLING DATE: 8/10/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: Dry
CAVE DEPTH: ---
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 1270.5 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
		6			ALLUVIUM: Light Gray fine Sand, little Silt, little medium to coarse Sand, loose-dry		2					
		6			@ 3½ to 5 feet, 2-inch Dark Gray Silty fine Sand lense, moist		10					
5												
		24			Gray Brown Silty fine to medium Sand, little coarse Gravel, medium dense-moist		9			37		
					Boring Terminated at 8½ feet							

TBL 20G234-3.GPJ SOCALGEO.GDT 8/31/21

TEST BORING LOG

PLATE B-5

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. I-6

JOB NO.: 20G234-3
PROJECT: Proposed C/I Building
LOCATION: Rialto, California

DRILLING DATE: 8/10/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: Dry
CAVE DEPTH: ---
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 1270 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
	X	5			ALLUVIUM: Gray Brown Silty fine to medium Sand, trace fine root fibers, loose-damp		4			42		
					Boring Terminated at 3½ feet							

TBL 20G234-3.GPJ SOCALGEO.GDT 8/31/21

TEST BORING LOG

PLATE B-6

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. I-7

JOB NO.: 20G234-3
PROJECT: Proposed C/I Building
LOCATION: Rialto, California

DRILLING DATE: 8/10/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: Dry
CAVE DEPTH: ---
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 1267.5 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
	X	4			ALLUVIUM: Gray Brown Silty fine to medium Sand, little fine root fibers, very loose to loose-dry to damp		3			46		
					Boring Terminated at 2 feet							

TBL 20G234-3.GPJ SOCALGEO.GDT 8/31/21

TEST BORING LOG

PLATE B-7

INFILTRATION CALCULATIONS

Project Name	Proposed Commercial/Industrial Building
Project Location	Rialto. CA
Project Number	20G234-3
Engineer	Caleb Brackett

Test Hole Radius	4	(in)
Test Depth	9.50	(ft)

Infiltration Test Hole: I-1

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	8:10 AM	25.00	7.10	36.00	YES	SANDY SOILS
	Final	8:35 AM		10.10			
2	Initial	8:37 AM	25.00	7.10	36.00	YES	SANDY SOILS
	Final	9:02 AM		10.10			

Test Data

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	9:10 AM	10.00	7.10	1.93	1.44	14.46
	Final	9:20 AM		9.03			
2	Initial	9:22 AM	10.00	7.10	1.32	1.74	8.31
	Final	9:32 AM		8.42			
3	Initial	9:34 AM	10.00	7.10	1.20	1.80	7.32
	Final	9:44 AM		8.30			
4	Initial	9:46 AM	10.00	7.10	1.19	1.81	7.24
	Final	9:56 AM		8.29			
5	Initial	9:58 AM	10.00	7.10	1.18	1.81	7.16
	Final	10:08 AM		8.28			
6	Initial	10:10 AM	10.00	7.10	1.18	1.81	7.16
	Final	10:20 AM		8.28			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where:
- Q = Infiltration Rate (in inches per hour)
- ΔH = Change in Height (Water Level) over the time interval
- r = Test Hole (Borehole) Radius
- Δt = Time Interval
- H_{avg} = Average Head Height over the time interval

INFILTRATION CALCULATIONS

Project Name	Proposed Commercial/Industrial Building
Project Location	Rialto. CA
Project Number	20G234-3
Engineer	Caleb Brackett

Test Hole Radius	4	(in)
Test Depth	8.00	(ft)

Infiltration Test Hole	I-2

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	10:50 AM	25.00	4.70	36.00	YES	SANDY SOILS
	Final	11:15 AM		7.70			
2	Initial	11:17 AM	25.00	4.70	36.00	YES	SANDY SOILS
	Final	11:42 AM		7.70			

Test Data

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	11:45 AM	10.00	4.70	1.80	2.40	8.42
	Final	11:55 AM		6.50			
2	Initial	11:57 AM	10.00	4.70	1.48	2.56	6.51
	Final	12:07 PM		6.18			
3	Initial	12:09 PM	10.00	4.70	1.45	2.58	6.35
	Final	12:19 PM		6.15			
4	Initial	12:21 PM	10.00	4.70	1.40	2.60	6.07
	Final	12:31 PM		6.10			
5	Initial	12:33 PM	10.00	4.70	1.34	2.63	5.75
	Final	12:43 PM		6.04			
6	Initial	12:45 PM	10.00	4.70	1.34	2.63	5.75
	Final	12:55 PM		6.04			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)

ΔH = Change in Height (Water Level) over the time interval

r = Test Hole (Borehole) Radius

Δt = Time Interval

H_{avg} = Average Head Height over the time interval

INFILTRATION CALCULATIONS

Project Name	Proposed Commercial/Industrial Building
Project Location	Rialto. CA
Project Number	20G234-3
Engineer	Caleb Brackett

Test Hole Radius	4	(in)
Test Depth	12.50	(ft)

Infiltration Test Hole: I-3

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	1:15 PM	25.00	9.30	15.60	YES	SANDY SOILS
	Final	1:40 PM		10.60			
2	Initial	1:42 PM	25.00	9.30	13.32	YES	SANDY SOILS
	Final	2:07 PM		10.41			

Test Data

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	2:09 PM	10.00	9.30	0.25	3.08	0.93
	Final	2:19 PM		9.55			
2	Initial	2:21 PM	10.00	9.30	0.23	3.09	0.85
	Final	2:31 PM		9.53			
3	Initial	2:33 PM	10.00	9.30	0.23	3.09	0.85
	Final	2:43 PM		9.53			
4	Initial	2:45 PM	10.00	9.30	0.22	3.09	0.81
	Final	2:55 PM		9.52			
5	Initial	2:57 PM	10.00	9.30	0.22	3.09	0.81
	Final	3:07 PM		9.52			
6	Initial	3:09 PM	10.00	9.30	0.22	3.09	0.81
	Final	3:19 PM		9.52			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where:
- Q = Infiltration Rate (in inches per hour)
- ΔH = Change in Height (Water Level) over the time interval
- r = Test Hole (Borehole) Radius
- Δt = Time Interval
- H_{avg} = Average Head Height over the time interval

INFILTRATION CALCULATIONS

Project Name	Proposed Commercial/Industrial Building
Project Location	Rialto. CA
Project Number	20G234-3
Engineer	Caleb Brackett

Test Hole Radius	4	(in)
Test Depth	11.00	(ft)

Infiltration Test Hole	I-4

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	3:30 PM	25.00	8.00	31.92	YES	SANDY SOILS
	Final	3:55 PM		10.66			
2	Initial	3:57 PM	25.00	8.00	28.08	YES	SANDY SOILS
	Final	4:22 PM		10.34			

Test Data

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	4:25 PM	10.00	8.00	1.10	2.45	5.04
	Final	4:35 PM		9.10			
2	Initial	4:37 PM	10.00	8.00	1.05	2.48	4.77
	Final	4:47 PM		9.05			
3	Initial	4:49 PM	10.00	8.00	0.97	2.52	4.34
	Final	4:59 PM		8.97			
4	Initial	5:01 PM	10.00	8.00	0.96	2.52	4.29
	Final	5:11 PM		8.96			
5	Initial	5:13 PM	10.00	8.00	0.95	2.53	4.24
	Final	5:23 PM		8.95			
6	Initial	5:25 PM	10.00	8.00	0.95	2.53	4.24
	Final	5:35 PM		8.95			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)

ΔH = Change in Height (Water Level) over the time interval

r = Test Hole (Borehole) Radius

Δt = Time Interval

H_{avg} = Average Head Height over the time interval

INFILTRATION CALCULATIONS

Project Name	Proposed Commercial/Industrial Building
Project Location	Rialto. CA
Project Number	20G234-3
Engineer	Caleb Brackett

Test Hole Radius	4	(in)
Test Depth	8.50	(ft)

Infiltration Test Hole: I-5

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	8:00 AM	25.00	5.20	17.40	YES	SANDY SOILS
	Final	8:25 AM		6.65			
2	Initial	8:28 AM	25.00	5.30	15.60	YES	SANDY SOILS
	Final	8:53 AM		6.60			

Test Data

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	8:55 AM	10.00	5.20	0.95	2.83	3.81
	Final	9:05 AM		6.15			
2	Initial	9:07 AM	10.00	5.20	0.95	2.83	3.81
	Final	9:17 AM		6.15			
3	Initial	9:19 AM	10.00	5.20	0.50	3.05	1.87
	Final	9:29 AM		5.70			
4	Initial	9:31 AM	10.00	5.20	0.49	3.06	1.83
	Final	9:41 AM		5.69			
5	Initial	9:43 AM	10.00	5.20	0.48	3.06	1.79
	Final	9:53 AM		5.68			
6	Initial	9:55 AM	10.00	5.20	0.47	3.07	1.75
	Final	10:05 AM		5.67			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where:
- Q = Infiltration Rate (in inches per hour)
- ΔH = Change in Height (Water Level) over the time interval
- r = Test Hole (Borehole) Radius
- Δt = Time Interval
- H_{avg} = Average Head Height over the time interval

INFILTRATION CALCULATIONS

Project Name	Proposed Commercial/Industrial Building
Project Location	Rialto. CA
Project Number	20G234-3
Engineer	Caleb Brackett

Test Hole Radius	4	(in)
Test Depth	3.50	(ft)

Infiltration Test Hole	I-6

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	10:30 AM	25.00	0.50	34.80	YES	SANDY SOILS
	Final	10:55 AM		3.40			
2	Initial	10:57 AM	25.00	0.50	34.80	YES	SANDY SOILS
	Final	11:22 AM		3.40			

Test Data

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	11:24 AM	10.00	0.50	2.11	1.95	11.99
	Final	11:34 AM		2.61			
2	Initial	11:36 AM	10.00	0.50	1.94	2.03	10.60
	Final	11:46 AM		2.44			
3	Initial	11:48 AM	10.00	0.50	1.80	2.10	9.53
	Final	11:58 AM		2.30			
4	Initial	12:00 PM	10.00	0.50	1.75	2.13	9.16
	Final	12:10 PM		2.25			
5	Initial	12:12 PM	10.00	0.50	1.73	2.14	9.02
	Final	12:22 PM		2.23			
6	Initial	12:24 PM	10.00	0.50	1.73	2.14	9.02
	Final	12:34 PM		2.23			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)

ΔH = Change in Height (Water Level) over the time interval

r = Test Hole (Borehole) Radius

Δt = Time Interval

H_{avg} = Average Head Height over the time interval

INFILTRATION CALCULATIONS

Project Name	Proposed Commercial/Industrial Building
Project Location	Rialto. CA
Project Number	20G234-3
Engineer	Caleb Brackett

Test Hole Radius	4	(in)
Test Depth	2.00	(ft)

Infiltration Test Hole: I-7

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	1:00 PM	25.00	0.25	9.00	YES	SANDY SOILS
	Final	1:25 PM		1.00			
2	Initial	1:27 PM	25.00	0.25	6.60	YES	SANDY SOILS
	Final	1:52 PM		0.80			

Test Data

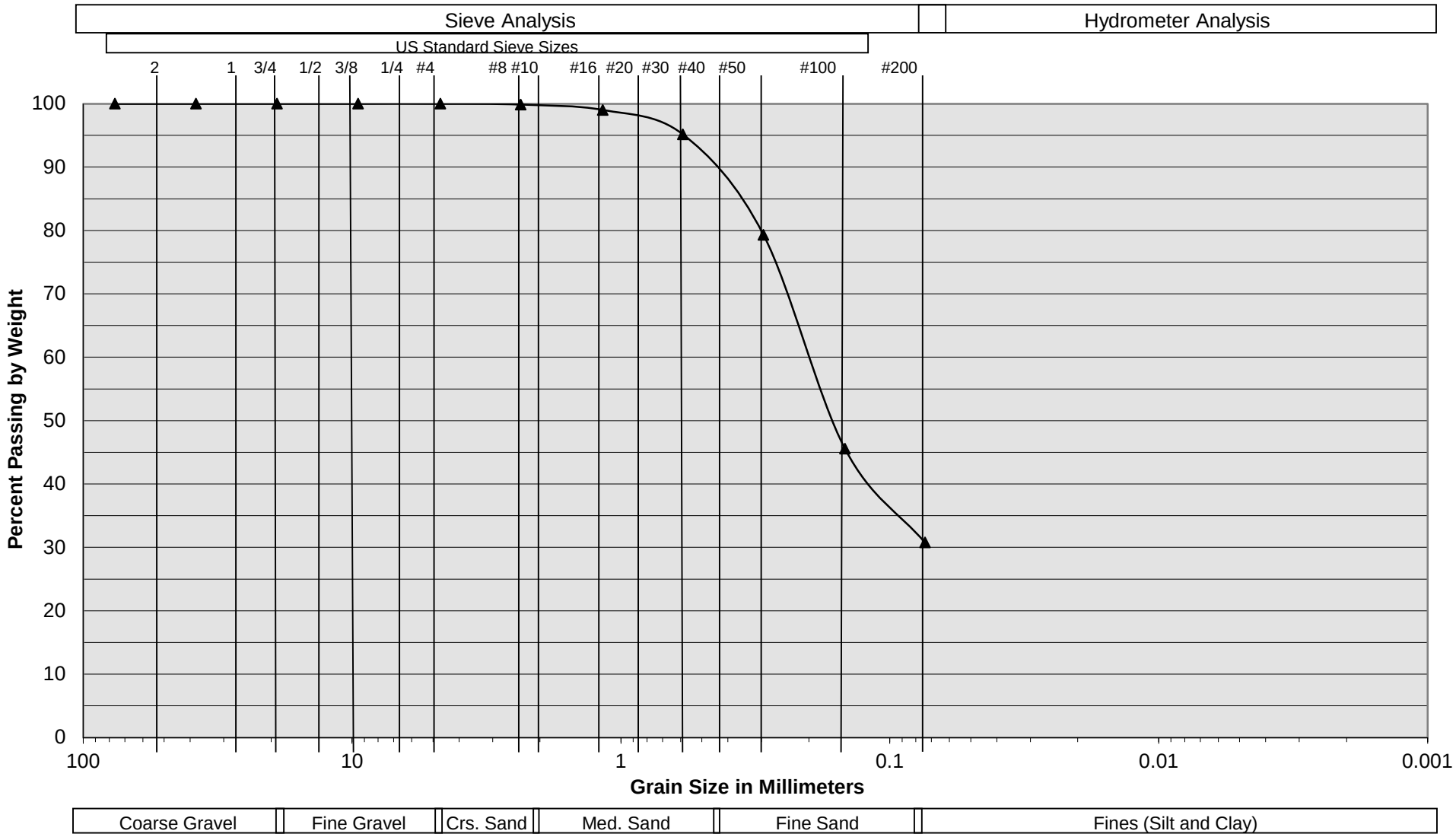
Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	1:54 PM	10.00	0.25	0.32	1.59	2.19
	Final	2:04 PM		0.57			
2	Initial	2:06 PM	10.00	0.25	0.31	1.60	2.11
	Final	2:16 PM		0.56			
3	Initial	2:18 PM	10.00	0.25	0.30	1.60	2.04
	Final	2:28 PM		0.55			
4	Initial	2:30 PM	10.00	0.25	0.28	1.61	1.89
	Final	2:40 PM		0.53			
5	Initial	2:42 PM	10.00	0.25	0.25	1.63	1.67
	Final	2:52 PM		0.50			
6	Initial	2:55 PM	10.00	0.25	0.25	1.63	1.67
	Final	3:05 PM		0.50			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where:
- Q = Infiltration Rate (in inches per hour)
- ΔH = Change in Height (Water Level) over the time interval
- r = Test Hole (Borehole) Radius
- Δt = Time Interval
- H_{avg} = Average Head Height over the time interval

Grain Size Distribution

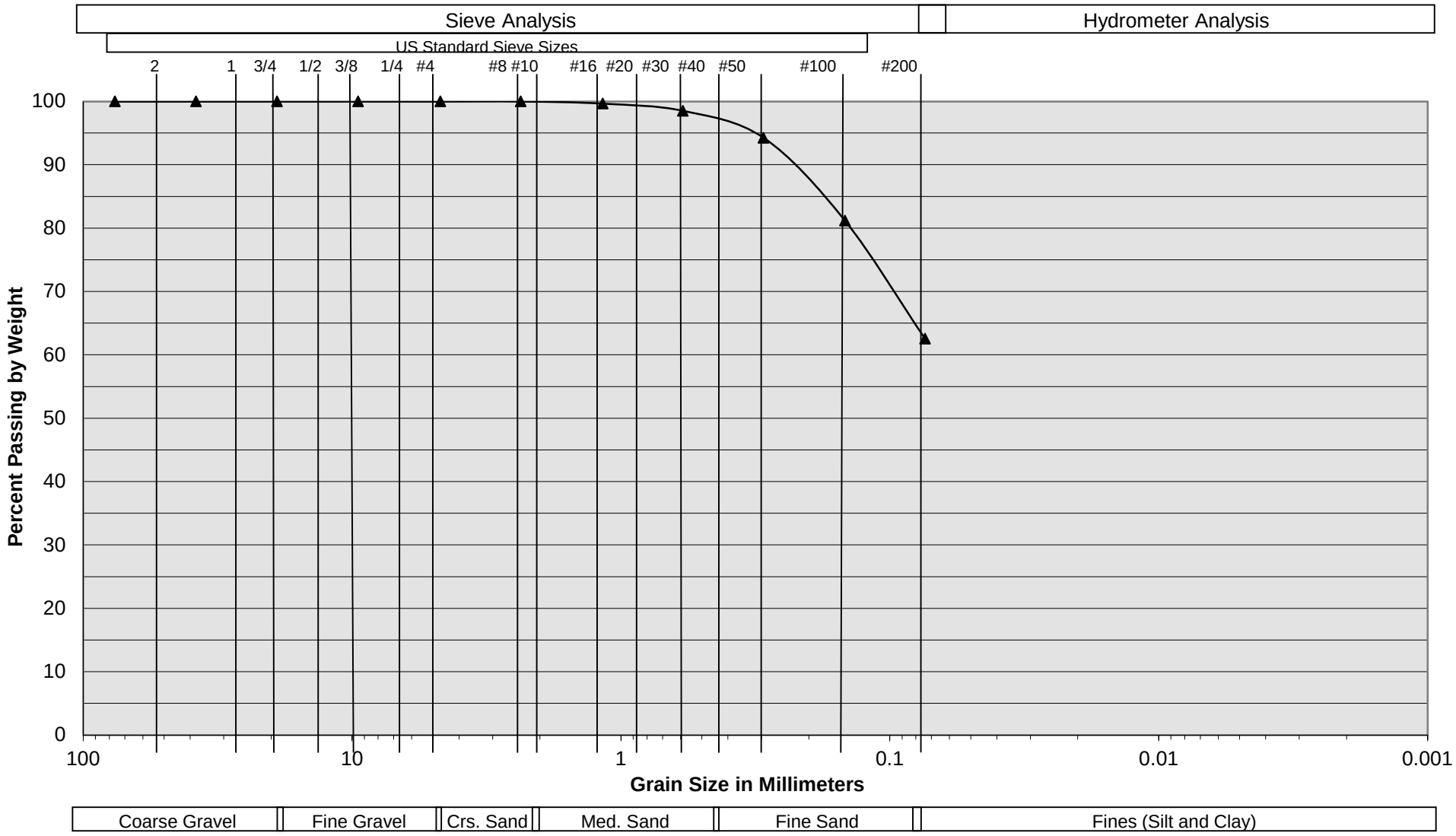


Sample Description	I-1 @ 8 feet
Soil Classification	Light Gray Silty fine to medium Sand

Proposed Commercial/Industrial Building
Rialto, CA
Project No. 20G234-3
PLATE C- 1

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Grain Size Distribution



Sample Description	I-2 @ 6½ feet
Soil Classification	Light Gray fine Sandy Silt, little medium Sand

Proposed Commercial/Industrial Building
Rialto, CA
Project No. 20G234-3
PLATE C- 2

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

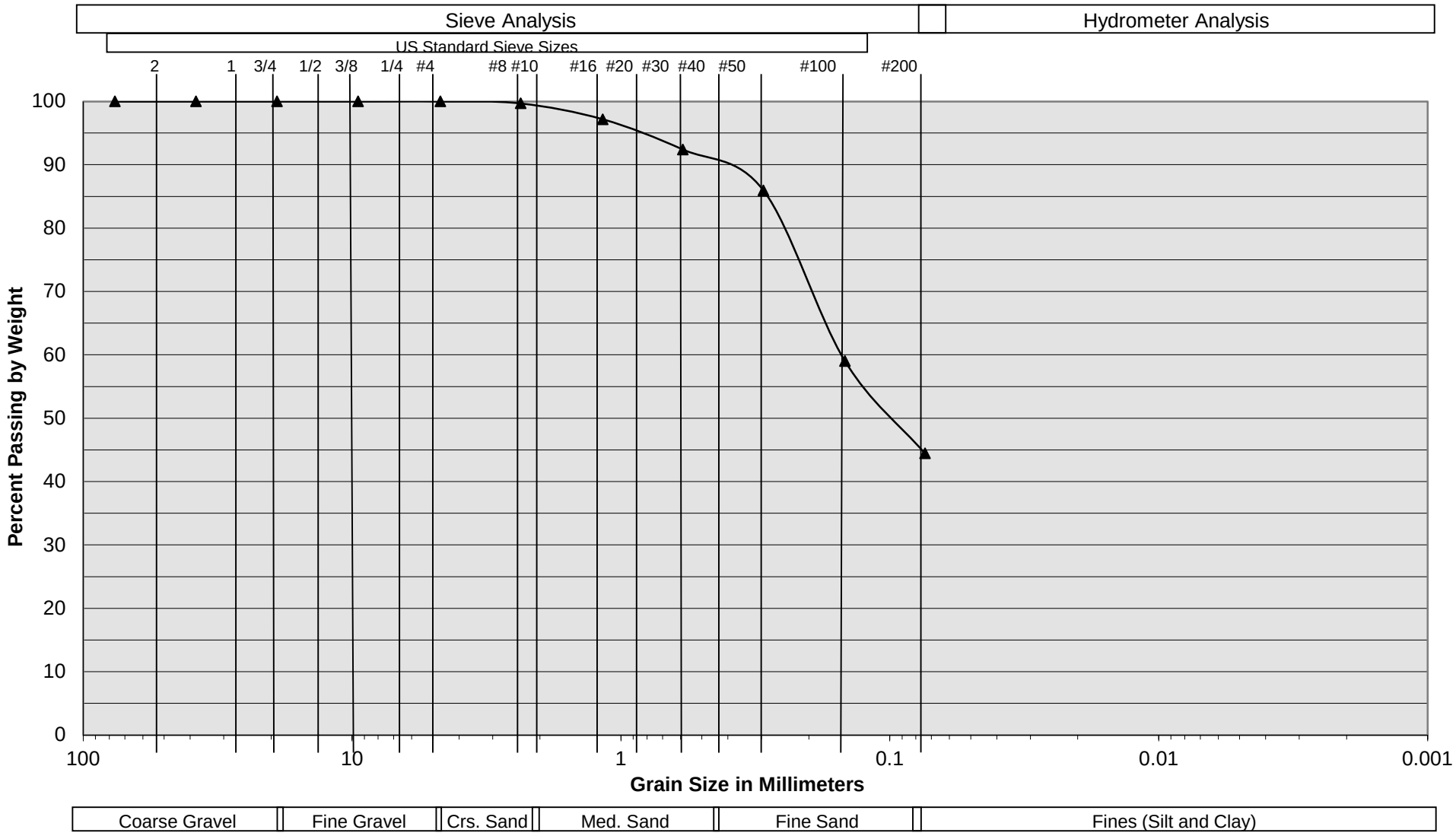
Grain Size Distribution

Sample Description	I-3 @ 11 feet
Soil Classification	Gray Brown Silty fine to coarse Sand, little fine to coarse Gravel

Proposed Commercial/Industrial Building
Rialto, CA
Project No. 20G234-3
PLATE C- 3

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Grain Size Distribution



Sample Description	I-4 @ 9½ feet
Soil Classification	Gray Brown Silty fine to medium Sand

Proposed Commercial/Industrial Building
Rialto, CA
Project No. 20G234-3
PLATE C- 4

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

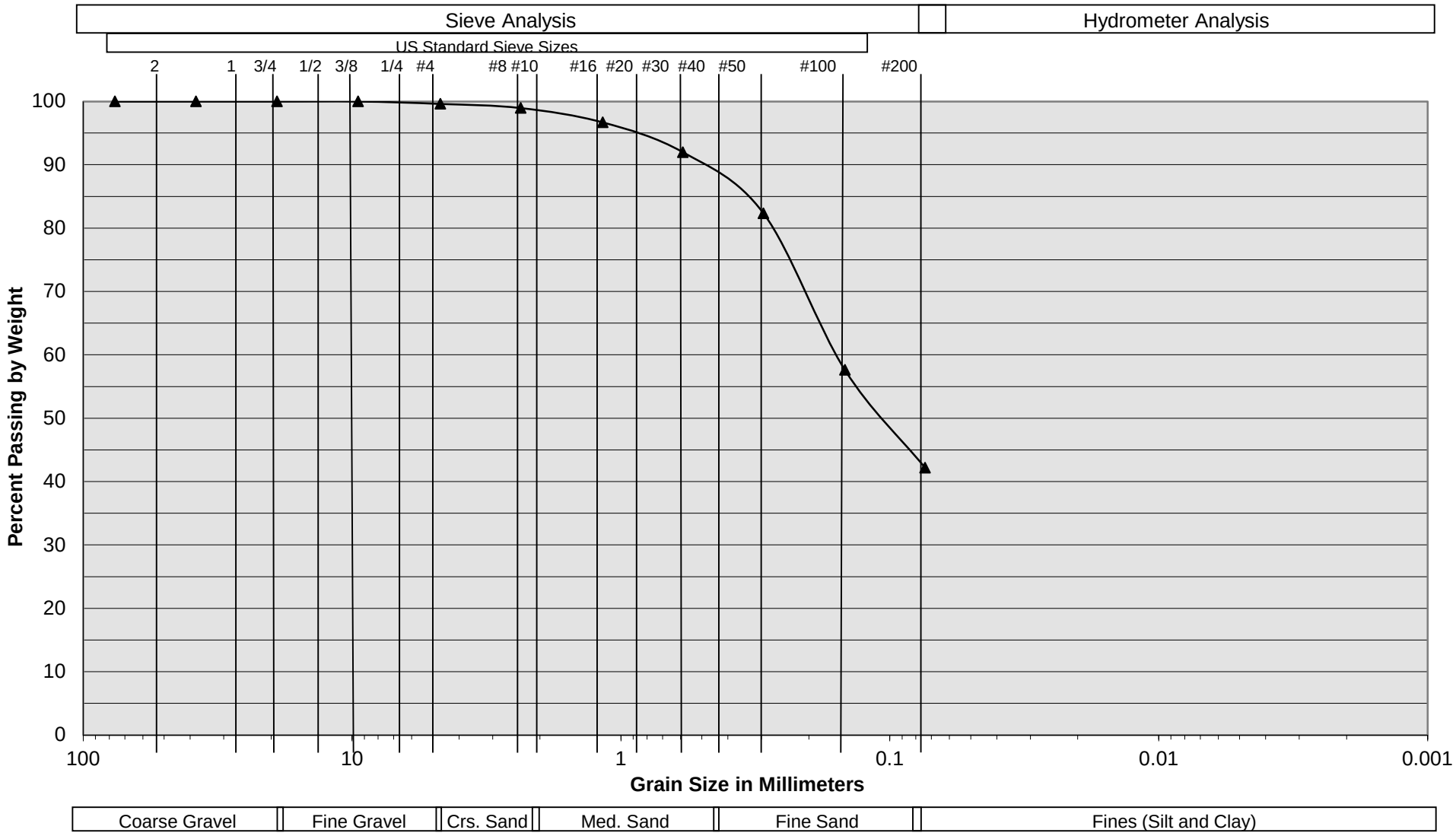
Grain Size Distribution

Sample Description	I-5 @ 7 feet
Soil Classification	Gray Brown Silty fine to medium Sand, little coarse Gravel

Proposed Commercial/Industrial Building
Rialto, CA
Project No. 20G234-3
PLATE C- 5

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Grain Size Distribution

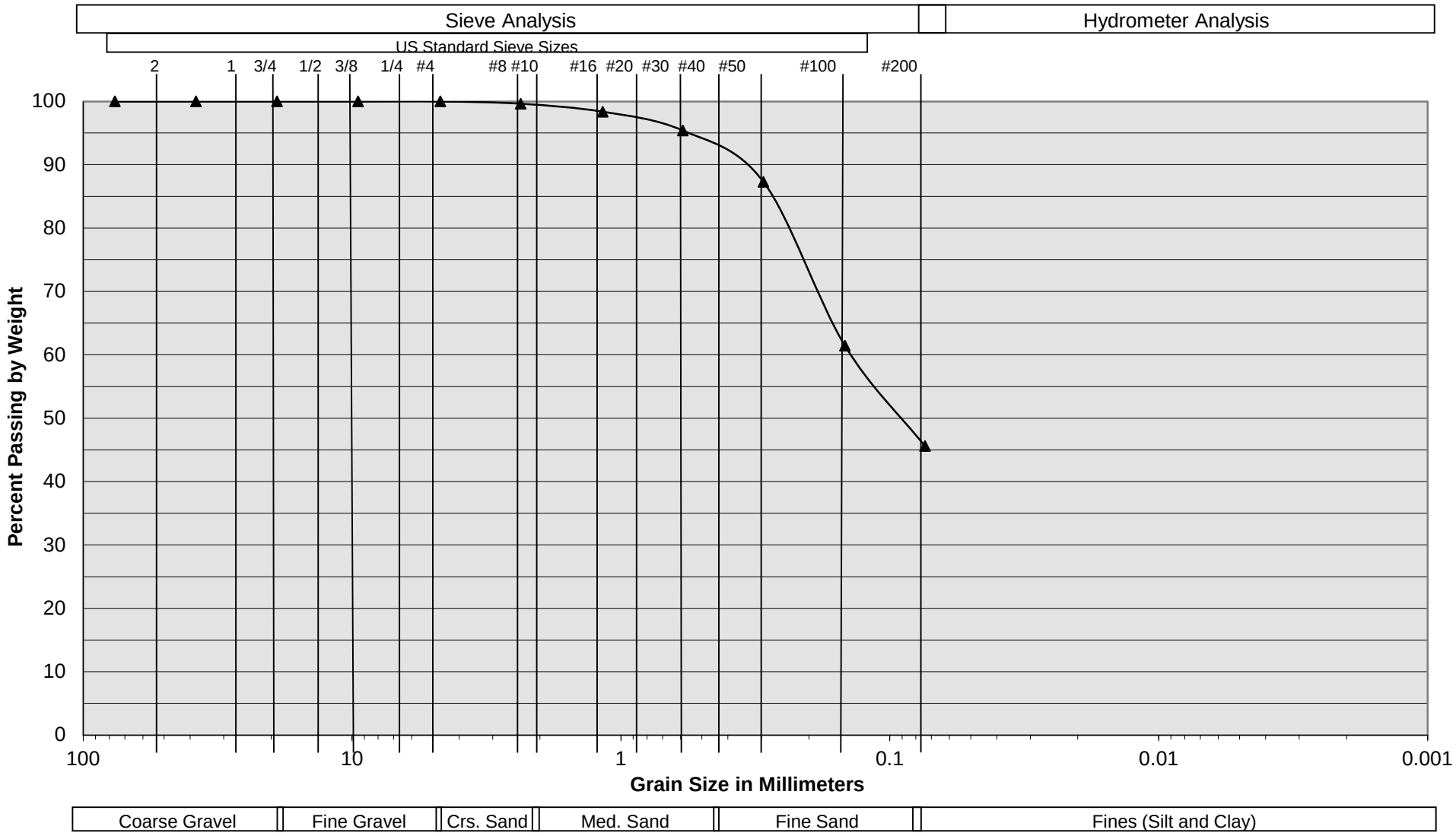


Sample Description	I-6 @ 2 feet
Soil Classification	Gray Brown Silty fine to medium Sand

Proposed Commercial/Industrial Building
Rialto, CA
Project No. 20G234-3
PLATE C- 6

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Grain Size Distribution



Sample Description	I-7 @ ½ feet
Soil Classification	Gray Brown Silty fine to medium Sand

Proposed Commercial/Industrial Building
Rialto, CA
Project No. 20G234-3
PLATE C- 7

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for San Bernardino County Southwestern Part, California

Pepper Avenue Industrial Building

May 31, 2021

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,460 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 12, May 27, 2020

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

Date(s) aerial images were photographed: Apr 1, 2018—Jun 30, 2018

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

MAP LEGEND

MAP INFORMATION

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Gr	Grangeville fine sandy loam, warm MAAT, MLRA 19	15.8	65.7%
TuB	Tujunga loamy sand, 0 to 5 percent slopes	8.3	34.3%
Totals for Area of Interest		**24.1**	**100.0%**

Map Unit Descriptions

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

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

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

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

onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

San Bernardino County Southwestern Part, California

Gr—Grangeville fine sandy loam, warm MAAT, MLRA 19

Map Unit Setting

National map unit symbol: 2vncy
Elevation: 490 to 1,430 feet
Mean annual precipitation: 11 to 17 inches
Mean annual air temperature: 64 to 66 degrees F
Frost-free period: 271 to 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Grangeville

Setting

Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 12 inches: fine sandy loam
C - 12 to 79 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 3.0
Available water capacity: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

San emigdio, fine sandy loam

Percent of map unit: 5 percent
Landform: Alluvial fans, flood plains

Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Unnamed, hydric

Percent of map unit: 5 percent
Landform: Alluvial fans, depressions, flood plains
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Chino

Percent of map unit: 5 percent
Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

TuB—Tujunga loamy sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2sx6y
Elevation: 650 to 3,110 feet
Mean annual precipitation: 10 to 25 inches
Mean annual air temperature: 62 to 65 degrees F
Frost-free period: 325 to 365 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Tujunga, Loamy Sand

Setting

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

Typical profile

A - 0 to 6 inches: loamy sand
C1 - 6 to 18 inches: loamy sand
C2 - 18 to 60 inches: loamy sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Tujunga, gravelly loamy sand

Percent of map unit: 10 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hanford, sandy loam

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

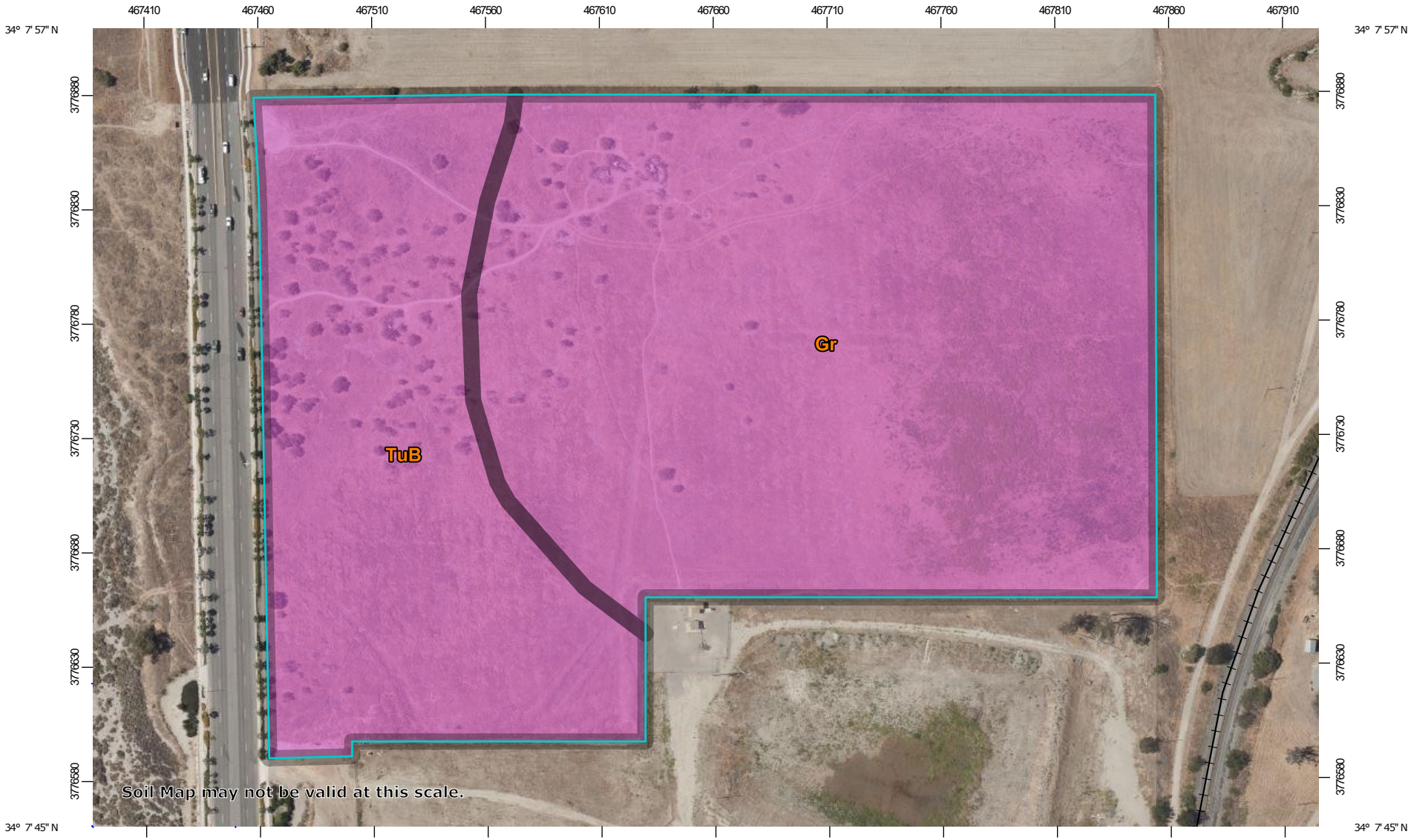
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:2,460 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 12, May 27, 2020

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

Date(s) aerial images were photographed: Apr 1, 2018—Jun 30, 2018

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

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Gr	Grangeville fine sandy loam, warm MAAT, MLRA 19	A	15.8	65.7%
TuB	Tujunga loamy sand, 0 to 5 percent slopes	A	8.3	34.3%
Totals for Area of Interest			**24.1**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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SECTION 6.4.5
BMP EDUCATIONAL MATERIALS/FACT SHEETS

Spill Prevention, Control & Cleanup SC-11

Objectives

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

Description

Spills and leaks, if not properly controlled, can adversely impact the storm drain system and receiving waters. Due to the type of work or the materials involved, many activities that occur either at a municipal facility or as a part of municipal field programs have the potential for accidental spills and leaks. Proper spill response planning and preparation can enable municipal employees to effectively respond to problems when they occur and minimize the discharge of pollutants to the environment.

Targeted Constituents

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

Approach

- An effective spill response and control plan should include:
  - Spill/leak prevention measures;
  - Spill response procedures;
  - Spill cleanup procedures;
  - Reporting; and
  - Training
- A well thought out and implemented plan can prevent pollutants from entering the storm drainage system and can be used as a tool for training personnel to prevent and control future spills as well.

Pollution Prevention

- Develop and implement a Spill Prevention Control and Response Plan. The plan should include:

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- A description of the facility, the address, activities and materials involved
- Identification of key spill response personnel
- Identification of the potential spill areas or operations prone to spills/leaks
- Identification of which areas should be or are bermed to contain spills/leaks
- Facility map identifying the key locations of areas, activities, materials, structural BMPs, etc.
- Material handling procedures
- Spill response procedures including:
    - Assessment of the site and potential impacts
    - Containment of the material
    - Notification of the proper personnel and evacuation procedures
    - Clean up of the site
    - Disposal of the waste material and
    - Proper record keeping

- Product substitution – use less toxic materials (i.e. use water based paints instead of oil based paints)
- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of materials that are brought into the facility or into the field.

Suggested Protocols

Spill/Leak Prevention Measures

- If possible, move material handling indoors, under cover, or away from storm drains or sensitive water bodies.
- Properly label all containers so that the contents are easily identifiable.
- Berm storage areas so that if a spill or leak occurs, the material is contained.
- Cover outside storage areas either with a permanent structure or with a seasonal one such as a tarp so that rain can not come into contact with the materials.
- Check containers (and any containment sumps) often for leaks and spills. Replace containers that are leaking, corroded, or otherwise deteriorating with containers in good condition. Collect all spilled liquids and properly dispose of them.

- Store, contain and transfer liquid materials in such a manner that if the container is ruptured or the contents spilled, they will not discharge, flow or be washed into the storm drainage system, surface waters, or groundwater.

- Place drip pans or absorbent materials beneath all mounted taps and at all potential drip and spill locations during the filling and unloading of containers. Any collected liquids or soiled absorbent materials should be reused/recycled or properly disposed of.

- For field programs, only transport the minimum amount of material needed for the daily activities and transfer materials between containers at a municipal yard where leaks and spill are easier to control.

- If paved, sweep and clean storage areas monthly, do not use water to hose down the area unless all of the water will be collected and disposed of properly.

- Install a spill control device (such as a tee section) in any catch basins that collect runoff from any storage areas if the materials stored are oil, gas, or other materials that separate from and float on water. This will allow for easier cleanup if a spill occurs.

- If necessary, protect catch basins while conducting field activities so that if a spill occurs, the material will be contained.

Training

- Educate employees about spill prevention, spill response and cleanup on a routine basis.

- Well-trained employees can reduce human errors that lead to accidental releases or spills:

  - The employees should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan if one is available.

- Training of staff from all municipal departments should focus on recognizing and reporting potential or current spills/leaks and who they should contact.

- Employees responsible for aboveground storage tanks and liquid transfers for large bulk containers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.

Spill Response and Prevention

- Identify key spill response personnel and train employees on who they are.

- Store and maintain appropriate spill cleanup materials in a clearly marked location near storage areas; and train employees to ensure familiarity with the site's spill control plan and/or proper spill cleanup procedures.

- Locate spill cleanup materials, such as absorbents, where they will be readily accessible (e.g. near storage and maintenance areas, on field trucks).

SC-11 Spill Prevention, Control & Cleanup

- Follow the Spill Prevention Control and Countermeasure Plan if one is available.
- If a spill occurs, notify the key spill response personnel immediately. If the material is unknown or hazardous, the local fire department may also need to be contacted.
- If safe to do so, attempt to contain the material and block the nearby storm drains so that the area impacted is minimized. If the material is unknown or hazardous wait for properly trained personnel to contain the materials.
- Perform an assessment of the area where the spill occurred and the downstream area that it could impact. Relay this information to the key spill response and clean up personnel.

Spill Cleanup Procedures

- Small non-hazardous spills
  - Use a rag, damp cloth or absorbent materials for general clean up of liquids
  - Use brooms or shovels for the general clean up of dry materials
  - If water is used, it must be collected and properly disposed of. The wash water can not be allowed to enter the storm drain.
  - Dispose of any waste materials properly
  - Clean or dispose of any equipment used to clean up the spill properly
- Large non-hazardous spills
  - Use absorbent materials for general clean up of liquids
  - Use brooms, shovels or street sweepers for the general clean up of dry materials
  - If water is used, it must be collected and properly disposed of. The wash water can not be allowed to enter the storm drain.
  - Dispose of any waste materials properly
  - Clean or dispose of any equipment used to clean up the spill properly
- For hazardous or very large spills, a private cleanup company or Hazmat team may need to be contacted to assess the situation and conduct the cleanup and disposal of the materials.
- Chemical cleanups of material can be achieved with the use of absorbents, gels, and foams. Remove the adsorbent materials promptly and dispose of according to regulations.
- If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

Reporting

- Report any spills immediately to the identified key municipal spill response personnel.

- Report spills in accordance with applicable reporting laws. Spills that pose an immediate threat to human health or the environment must be reported immediately to the Office of Emergency Service (OES)

- Spills that pose an immediate threat to human health or the environment may also need to be reported within 24 hours to the Regional Water Quality Control Board.

- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour)

- After the spill has been contained and cleaned up, a detailed report about the incident should be generated and kept on file (see the section on Reporting below). The incident may also be used in briefing staff about proper procedures

Other Considerations

- State regulations exist for facilities with a storage capacity of 10,000 gallons or more of petroleum to prepare a Spill Prevention Control and Countermeasure Plan (SPCC) Plan (Health & Safety Code Chapter 6.67).

- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.

- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, if permitted to do so, prohibiting any hard connections to the storm drain.

Requirements

Costs

- Will vary depending on the size of the facility and the necessary controls.

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of wastes, contaminated soil and water is very expensive

Maintenance

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the response and containment of a spill. A good record keeping system helps the municipality minimize incident recurrence, correctly respond with appropriate containment and cleanup activities, and comply with legal requirements.

A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm drain.

These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Examples

The City of Palo Alto includes spill prevention and control as a major element of its highly effective program for municipal vehicle maintenance shops.

References and Resources

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

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

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

Parking/Storage Area Maintenance SC-43

Objectives

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

Targeted Constituents

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

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The following protocols are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook).
- Keep accurate maintenance logs to evaluate BMP implementation.

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.

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- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel and dispose of litter in the trash.

Surface cleaning

- Use dry cleaning methods (e.g. sweeping or vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- If water is used follow the procedures below:
  - Block the storm drain or contain runoff.
  - Wash water should be collected and pumped to the sanitary sewer or discharged to a pervious surface, do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- When cleaning heavy oily deposits:
  - Use absorbent materials on oily spots prior to sweeping or washing.
  - Dispose of used absorbents appropriately.

Surface Repair

- Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff.
- Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc., where applicable. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.

- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of the parking facilities and stormwater conveyance systems associated with them on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, nad implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

Requirements

Costs

Cleaning/sweeping costs can be quite large, construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities on a regular basis to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Use only as much water as necessary for dust control, to avoid runoff.

References and Resources

http://www.stormwatercenter.net/

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality control Board. July 1998 (Revised February 2002 by the California Coastal Commission).

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

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) http://www.basma.org

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

Housekeeping Practices SC-60

Description

Promote efficient and safe housekeeping practices (storage, use, and cleanup) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals. Related information is provided in BMP fact sheets SC-11 Spill Prevention, Control & Cleanup and SC-34 Waste Handling & Disposal.

Approach

Pollution Prevention

- Purchase only the amount of material that will be needed for foreseeable use. In most cases this will result in cost savings in both purchasing and disposal. See SC-61 Safer Alternative Products for additional information.
- Be aware of new products that may do the same job with less environmental risk and for less or the equivalent cost. Total cost must be used here; this includes purchase price, transportation costs, storage costs, use related costs, clean up costs and disposal costs.

Suggested Protocols

General

- Keep work sites clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Dispose of wash water, sweepings, and sediments, properly.
- Recycle or dispose of fluids properly.
- Establish a daily checklist of office, yard and plant areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy any problems found.
- Post waste disposal charts in appropriate locations detailing for each waste its hazardous nature (poison, corrosive, flammable), prohibitions on its disposal (dumpster, drain, sewer) and the recommended disposal method (recycle, sewer, burn, storage, landfill).
- Summarize the chosen BMPs applicable to your operation and post them in appropriate conspicuous places.

Objectives

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

Targeted Constituents

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

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- Require a signed checklist from every user of any hazardous material detailing amount taken, amount used, amount returned and disposal of spent material.
- Do a before audit of your site to establish baseline conditions and regular subsequent audits to note any changes and whether conditions are improving or deteriorating.
- Keep records of water, air and solid waste quantities and quality tests and their disposition.
- Maintain a mass balance of incoming, outgoing and on hand materials so you know when there are unknown losses that need to be tracked down and accounted for.
- Use and reward employee suggestions related to BMPs, hazards, pollution reduction, work place safety, cost reduction, alternative materials and procedures, recycling and disposal.
- Have, and review regularly, a contingency plan for spills, leaks, weather extremes etc. Make sure all employees know about it and what their role is so that it comes into force automatically.

Training

- Train all employees, management, office, yard, manufacturing, field and clerical in BMPs and pollution prevention and make them accountable.
- Train municipal employees who handle potentially harmful materials in good housekeeping practices.
- Train personnel who use pesticides in the proper use of the pesticides. The California Department of Pesticide Regulation license pesticide dealers, certify pesticide applicators and conduct onsite inspections.
- Train employees and contractors in proper techniques for spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and Countermeasure (SPCC) plant up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- There are no major limitations to this best management practice.
- There are no regulatory requirements to this BMP. Existing regulations already require municipalities to properly store, use, and dispose of hazardous materials

Requirements

Costs

- Minimal cost associated with this BMP. Implementation of good housekeeping practices may result in cost savings as these procedures may reduce the need for more costly BMPs.

Maintenance

- Ongoing maintenance required to keep a clean site. Level of effort is a function of site size and type of activities.

Supplemental Information

Further Detail of the BMP

- The California Integrated Waste Management Board's Recycling Hotline, 1-800-553-2962, provides information on household hazardous waste collection programs and facilities.

Examples

There are a number of communities with effective programs. The most pro-active include Santa Clara County and the City of Palo Alto, the City and County of San Francisco, and the Municipality of Metropolitan Seattle (Metro).

References and Resources

British Columbia Lake Stewardship Society. Best Management Practices to Protect Water Quality from Non-Point Source Pollution. March 2000.
http://www.nalms.org/bclss/bmphome.html#bmp

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

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities, Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July, 1998, Revised by California Coastal Commission, February 2002.

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

San Mateo STOPPP - (http://stoppp.tripod.com/bmp.html)

Landscape Maintenance SC-73

Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

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

Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

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- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.
- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).
- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.
- Use a training log or similar method to document training.

Spill Response and Prevention

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

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

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Drainage System Maintenance SC-74

Photo Credit: Geoff Brosseau

Objectives

- Contain
- Educate
- Reduce/Minimize

Description

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

Targeted Constituents

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

Approach

Suggested Protocols

Catch Basins/Inlet Structures

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

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

Storm Drain Conveyance System

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

Pump Stations

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

Open Channel

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

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

Illicit Connections and Discharges

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

Illegal Dumping

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

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).
- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Only properly trained individuals are allowed to handle hazardous materials/wastes.
- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.
- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.
- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

Spill Response and Prevention

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

Other Considerations

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.
- Private property access rights may be needed to track illegal discharges up gradient.

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

Requirements

Costs

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

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

Maintenance

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

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

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

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

Supplemental Information

Further Detail of the BMP

Storm Drain flushing

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

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to

cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed up water and resulting in the cleaning of the storm drain segment.

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

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

Flow Management

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

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

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

Stream Corridor Planning

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

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

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

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

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

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

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

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

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

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

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

Examples

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

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

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

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Site Design & Landscape Planning SD-10

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

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Designing New Installations

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

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

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

Conserve Natural Areas during Landscape Planning

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

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

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

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

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

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

Protection of Slopes and Channels during Landscape Design

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

Redeveloping Existing Installations

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

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

Other Resources

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

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

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

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

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

Efficient Irrigation SD-12

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Other Resources

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

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

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

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

Storm Drain Signage SD-13

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Placement

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

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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

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).

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- 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.

Trash Storage Areas SD-32

Description

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

Approach

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

Design Objectives

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

Suitable Applications

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

Design Considerations

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

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

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Other Resources

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

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

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

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

Infiltration Basin TC-11

Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

Targeted Constituents

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

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

Description

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

California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated.

Advantages

- Provides 100% reduction in the load discharged to surface waters.
- The principal benefit of infiltration basins is the approximation of pre-development hydrology during which a

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significant portion of the average annual rainfall runoff is infiltrated and evaporated rather than flushed directly to creeks.

- If the water quality volume is adequately sized, infiltration basins can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

Limitations

- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.
- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- Upstream drainage area must be completely stabilized before construction.
- Difficult to restore functioning of infiltration basins once clogged.

Design and Sizing Guidelines

- Water quality volume determined by local requirements or sized so that 85% of the annual runoff volume is captured.
- Basin sized so that the entire water quality volume is infiltrated within 48 hours.
- Vegetation establishment on the basin floor may help reduce the clogging rate.

Construction/Inspection Considerations

- Before construction begins, stabilize the entire area draining to the facility. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction or remove the top 2 inches of soil after the site is stabililized. Stabilize the entire contributing drainage area, including the side slopes, before allowing any runoff to enter once construction is complete.
- Place excavated material such that it can not be washed back into the basin if a storm occurs during construction of the facility.
- Build the basin without driving heavy equipment over the infiltration surface. Any equipment driven on the surface should have extra-wide ("low pressure") tires. Prior to any construction, rope off the infiltration area to stop entrance by unwanted equipment.
- After final grading, till the infiltration surface deeply.
- Use appropriate erosion control seed mix for the specific project and location.

Performance

As water migrates through porous soil and rock, pollutant attenuation mechanisms include precipitation, sorption, physical filtration, and bacterial degradation. If functioning properly, this approach is presumed to have high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Actual pollutant removal in the subsurface would be expected to vary depending upon site-specific soil types. This technology eliminates discharge to surface waters except for the very largest storms; consequently, complete removal of all stormwater constituents can be assumed.

There remain some concerns about the potential for groundwater contamination despite the findings of the NURP and Nightingale (1975; 1987a,b,c; 1989). For instance, a report by Pitt et al. (1994) highlighted the potential for groundwater contamination from intentional and unintentional stormwater infiltration. That report recommends that infiltration facilities not be sited in areas where high concentrations are present or where there is a potential for spills of toxic material. Conversely, Schroeder (1995) reported that there was no evidence of groundwater impacts from an infiltration basin serving a large industrial catchment in Fresno, CA.

Siting Criteria

The key element in siting infiltration basins is identifying sites with appropriate soil and hydrogeologic properties, which is critical for long term performance. In one study conducted in Prince George's County, Maryland (Galli, 1992), all of the infiltration basins investigated clogged within 2 years. It is believed that these failures were for the most part due to allowing infiltration at sites with rates of less than 0.5 in/hr, basing siting on soil type rather than field infiltration tests, and poor construction practices that resulted in soil compaction of the basin invert.

A study of 23 infiltration basins in the Pacific Northwest showed better long-term performance in an area with highly permeable soils (Hilding, 1996). In this study, few of the infiltration basins had failed after 10 years. Consequently, the following guidelines for identifying appropriate soil and subsurface conditions should be rigorously adhered to.

- Determine soil type (consider RCS soil type 'A, B or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30% clay or more than 40% of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.

- Groundwater separation should be at least 3 m from the basin invert to the measured ground water elevation. There is concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.

- Location away from buildings, slopes and highway pavement (greater than 6 m) and wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15% should not be considered.

- Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.

- Base flow should not be present in the tributary watershed.

Secondary Screening Based on Site Geotechnical Investigation

- At least three in-hole conductivity tests shall be performed using USBR 7300-89 or Bouwer-Rice procedures (the latter if groundwater is encountered within the boring), two tests at different locations within the proposed basin and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.

- The minimum acceptable hydraulic conductivity as measured in any of the three required test holes is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.

- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.

- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Additional Design Guidelines

(1) Basin Sizing - The required water quality volume is determined by local regulations or sufficient to capture 85% of the annual runoff.

(2) Provide pretreatment if sediment loading is a maintenance concern for the basin.

(3) Include energy dissipation in the inlet design for the basins. Avoid designs that include a permanent pool to reduce opportunity for standing water and associated vector problems.

(4) Basin invert area should be determined by the equation:

$$A = \frac{WQV}{kt}$$

where A = Basin invert area (m^2)

WQV = water quality volume (m^3)

k = 0.5 times the lowest field-measured hydraulic conductivity (m/hr)

t = drawdown time (48 hr)

(5) The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).

Maintenance

Regular maintenance is critical to the successful operation of infiltration basins. Recommended operation and maintenance guidelines include:

- Inspections and maintenance to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.
- Observe drain time for the design storm after completion or modification of the facility to confirm that the desired drain time has been obtained.
- Schedule semiannual inspections for beginning and end of the wet season to identify potential problems such as erosion of the basin side slopes and invert, standing water, trash and debris, and sediment accumulation.
- Remove accumulated trash and debris in the basin at the start and end of the wet season.
- Inspect for standing water at the end of the wet season.
- Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of the basin.
- If erosion is occurring within the basin, revegetate immediately and stabilize with an erosion control mulch or mat until vegetation cover is established.
- To avoid reversing soil development, scarification or other disturbance should only be performed when there are actual signs of clogging, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a very light tractor.

Cost

Infiltration basins are relatively cost-effective practices because little infrastructure is needed when constructing them. One study estimated the total construction cost at about $2 per ft (adjusted for inflation) of storage for a 0.25-acre basin (SWRPC, 1991). As with other BMPs, these published cost estimates may deviate greatly from what might be incurred at a specific site. For instance, Caltrans spent about $18/ft^3 for the two infiltration basins constructed in southern California, each of which had a water quality volume of about 0.34 ac.-ft. Much of the higher cost can be attributed to changes in the storm drain system necessary to route the runoff to the basin locations.

Infiltration basins typically consume about 2 to 3% of the site draining to them, which is relatively small. Additional space may be required for buffer, landscaping, access road, and fencing. Maintenance costs are estimated at 5 to 10% of construction costs.

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time.

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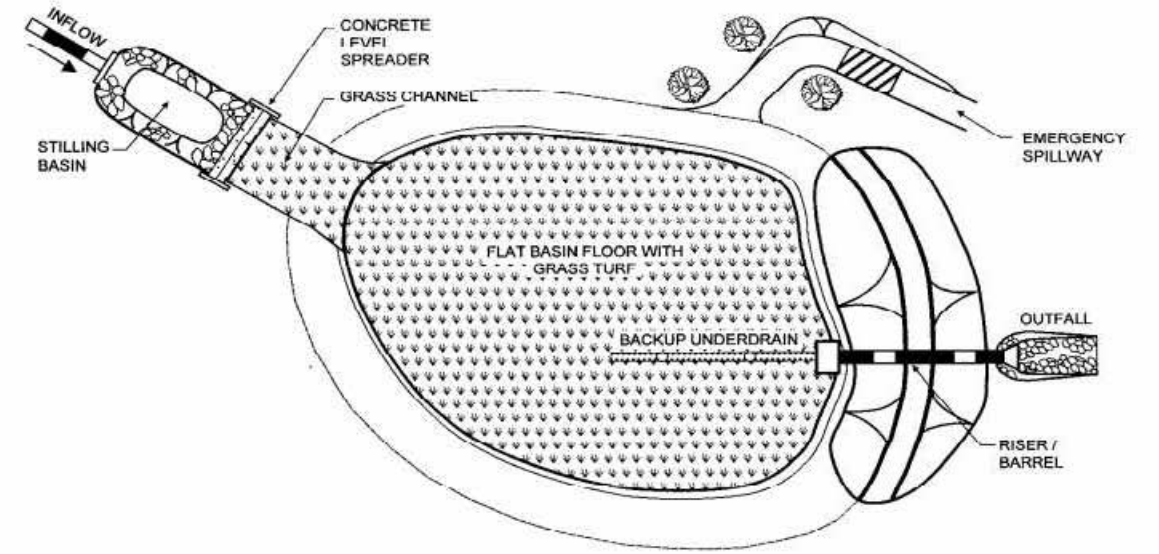
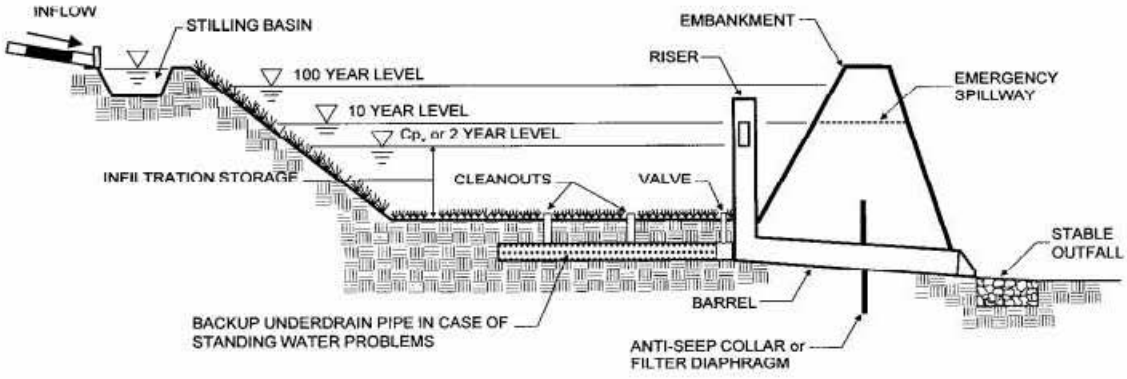


PLAN VIEW



PROFILE

Drain Inserts MP-52

Description

Drain inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris. There are a multitude of inserts of various shapes and configurations, typically falling into one of three different groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are one box; that is, the setting area and filtration through media occur in the same box. Some products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon.

California Experience

The number of installations is unknown but likely exceeds a thousand. Some users have reported that these systems require considerable maintenance to prevent plugging and bypass.

Advantages

- Does not require additional space as inserts as the drain inlets are already a component of the standard drainage systems.
- Easy access for inspection and maintenance.
- As there is no standing water, there is little concern for mosquito breeding.
- A relatively inexpensive retrofit option.

Limitations

Performance is likely significantly less than treatment systems that are located at the end of the drainage system such as ponds and vaults. Usually not suitable for large areas or areas with trash or leaves than can plug the insert.

Design and Sizing Guidelines

Refer to manufacturer's guidelines. Drain inserts come any many configurations but can be placed into three general groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are

Design Considerations

- Use with other BMPs
- Fit and Seal Capacity within Inlet

Targeted Constituents

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

Removal Effectiveness

See New Development and Redevelopment Handbook-Section 5.

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one box; that is, the setting area and filtration through media occurs in the same box. One manufacturer has a double-box. Stormwater enters the first box where setting occurs. The stormwater flows into the second box where the filter media is located. Some products consist of one or more trays or mesh grates. The trays can hold different types of media. Filtration media vary with the manufacturer: types include polypropylene, porous polymer, treated cellulose, and activated carbon.

Construction/Inspection Considerations

Be certain that installation is done in a manner that makes certain that the stormwater enters the unit and does not leak around the perimeter. Leakage between the frame of the insert and the frame of the drain inlet can easily occur with vertical (drop) inlets.

Performance

Few products have performance data collected under field conditions.

Siting Criteria

It is recommended that inserts be used only for retrofit situations or as pretreatment where other treatment BMPs presented in this section area used.

Additional Design Guidelines

Follow guidelines provided by individual manufacturers.

Maintenance

Likely require frequent maintenance, on the order of several times per year.

Cost

- The initial cost of individual inserts ranges from less than $100 to about $2,000. The cost of using multiple units in curb inlet drains varies with the size of the inlet.
- The low cost of inserts may tend to favor the use of these systems over other, more effective treatment BMPs. However, the low cost of each unit may be offset by the number of units that are required, more frequent maintenance, and the shorter structural life (and therefore replacement).

References and Sources of Additional Information

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Manufacturers literature

Santa Monica (City), Santa Monica Bay Municipal Stormwater/Urban Runoff Project - Evaluation of Potential Catch basin Retrofits, Woodward Clyde, September 24, 1998

Woodward Clyde, June 11, 1996, Parking Lot Monitoring Report, Santa Clara Valley Nonpoint Source Pollution Control Program.

Round Curb Inlet Filter (R-GISB)

PROVEN STORMWATER TREATMENT TECHNOLOGY

Bio Clean
A Forterra Company

Overview

The Bio Clean Round Curb Inlet Filter (R-GISB) is a favorite amongst cities and municipalities nationwide. Many agencies have chosen this system as their standard due to its quick cleaning time and large storage capacity.

Its patented 'Shelf System' allows cleaning to be done in less than 15 minutes, and its larger storage capacity of 3.85 cubic feet allows for maximized cleaning intervals and minimized attention required by maintenance crews.

The modularized design of the 'Shelf System' for curb inlets makes it adaptable to any size or type catch basin.

Its multi-stage filtration screens allow this device to meet "full trash capture" requirements by removing 100% of trash & debris 5 mm and greater. Made of marine grade fiberglass and high grade stainless steel these filters come in standard and custom designs.

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

Includes the Patented 'Shelf System'

Higher Storage Capacity & 15 Minute Service Time

Advantages

- 8 Year Warranty
- Works in Any Size Catch Basin
- No Nets or Geofabrics
- 15+ Year User Life
- Meets **LEED** Requirements
- Patented Shelf System
- Fiberglass Construction

Performance

- 74%-86% Removal of TSS
- 54% Removal of Oils & Grease
- 57%-71% Removal of Phosphorus
- 56%-60% Removal of Nitrogen

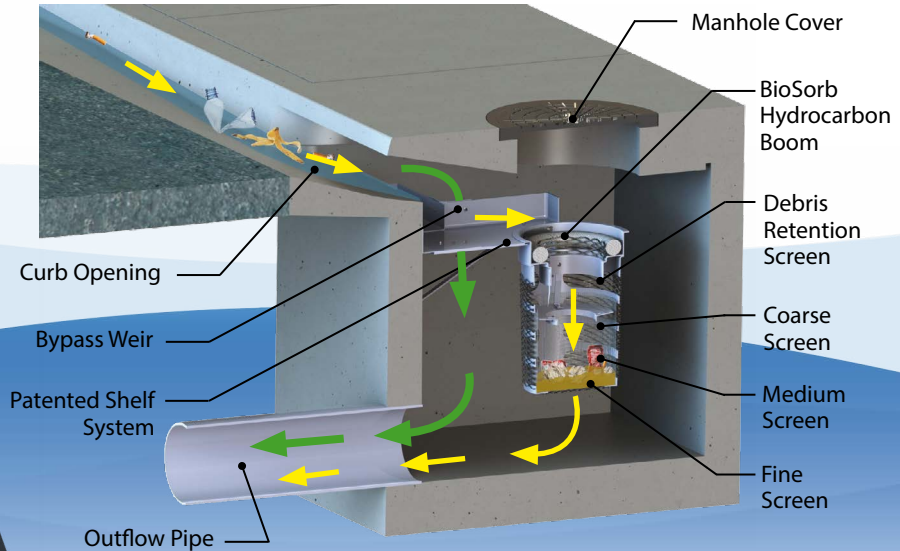
Specifications

Model #	Treatment Flow (CFS)	Bypass Flow (CFS)
BC-RGISB-22-24	2.4	Unlimited

Operation

Bypass Flow Path

Treatment Flow Path



www.BioCleanEnvironmental.com

Round Curb Inlet Filter (R-GISB)

PROVEN STORMWATER TREATMENT TECHNOLOGY

Media Filter

The Bio Clean Round Curb Inlet Media Filter (RGISB-MF) is an advanced level filtration device designed with a multi-layered media filter for increased removal efficiencies.

Performance

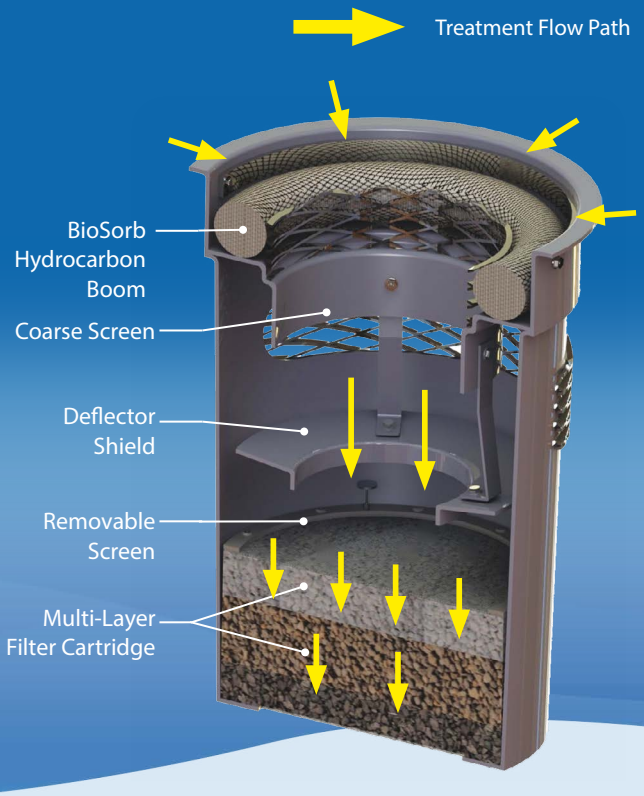
- 85% Removal of Fine TSS
- 69% Removal of Dissolved Phosphorus
- 95% Removal of Copper
- 87% Removal of Lead
- 95% Removal of Zinc
- 90% to 95% Removal of Oils & Grease
- 68% Removal of Fecal Coliform (bacteria)

Specifications

Model #	Media Treatment Flow (CFS)	Screen Treatment Flow (CFS)	Bypass Flow (CFS)
BC-RGISB-MF-22-24	0.12	2	Unlimited

Higher Flow Rate Models Available

Operation



Installation & Maintenance

- Cleaned Without Catch Basin Entry ✓
- Cleaned Easily With Vac Truck ✓
- 15 Minute Service Time ✓

Application

- Parking Lots
- Roadways

Easily Removed without Entry into Basin

Always Positioned Under Manhole Opening

Approvals

City and County of Honolulu

County of San Diego

County of Orange

Meets Full Capture Requirements

398 Via El Centro
Oceanside, CA 92058
p 760.433.7640 f 760.433.3176
www.BioCleanEnvironmental.com

Bio Clean
A Forterra Company

SECTION 6.4.6
NOAA PRECIPITATION ESTIMATES AND STORMWATER REPORT

NOAA Atlas 14, Volume 6, Version 2
Location name: Rialto, California, USA*
Latitude: 34.1311°, Longitude: -117.3509°
Elevation: 1275.95 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.129** (0.107-0.156)	**0.169** (0.141-0.206)	**0.224** (0.186-0.273)	**0.269** (0.221-0.331)	**0.332** (0.264-0.423)	**0.382** (0.297-0.497)	**0.435** (0.329-0.579)	**0.490** (0.361-0.672)	**0.567** (0.400-0.812)	**0.630** (0.429-0.934)
10-min	**0.184** (0.153-0.224)	**0.243** (0.202-0.295)	**0.321** (0.266-0.391)	**0.386** (0.317-0.474)	**0.477** (0.378-0.606)	**0.548** (0.426-0.713)	**0.623** (0.472-0.830)	**0.702** (0.517-0.963)	**0.813** (0.574-1.16)	**0.903** (0.615-1.34)
15-min	**0.223** (0.186-0.271)	**0.294** (0.244-0.357)	**0.388** (0.322-0.473)	**0.467** (0.384-0.574)	**0.576** (0.458-0.733)	**0.663** (0.515-0.862)	**0.753** (0.571-1.00)	**0.849** (0.625-1.17)	**0.984** (0.694-1.41)	**1.09** (0.744-1.62)
30-min	**0.330** (0.275-0.401)	**0.435** (0.361-0.529)	**0.575** (0.476-0.701)	**0.691** (0.568-0.850)	**0.854** (0.678-1.09)	**0.982** (0.763-1.28)	**1.12** (0.846-1.49)	**1.26** (0.926-1.73)	**1.46** (1.03-2.09)	**1.62** (1.10-2.40)
60-min	**0.484** (0.403-0.588)	**0.637** (0.530-0.775)	**0.842** (0.698-1.03)	**1.01** (0.832-1.25)	**1.25** (0.993-1.59)	**1.44** (1.12-1.87)	**1.64** (1.24-2.18)	**1.84** (1.36-2.53)	**2.13** (1.51-3.06)	**2.37** (1.61-3.51)
2-hr	**0.710** (0.590-0.862)	**0.917** (0.762-1.11)	**1.19** (0.987-1.45)	**1.42** (1.17-1.74)	**1.73** (1.37-2.20)	**1.97** (1.53-2.57)	**2.23** (1.69-2.97)	**2.49** (1.83-3.41)	**2.85** (2.01-4.08)	**3.14** (2.14-4.66)
3-hr	**0.884** (0.735-1.07)	**1.13** (0.942-1.38)	**1.46** (1.21-1.78)	**1.73** (1.42-2.13)	**2.11** (1.67-2.68)	**2.39** (1.86-3.11)	**2.69** (2.04-3.59)	**3.00** (2.21-4.11)	**3.42** (2.42-4.90)	**3.76** (2.56-5.57)
6-hr	**1.26** (1.05-1.54)	**1.61** (1.34-1.96)	**2.07** (1.72-2.52)	**2.44** (2.01-3.00)	**2.95** (2.34-3.75)	**3.34** (2.60-4.34)	**3.74** (2.83-4.98)	**4.15** (3.06-5.69)	**4.71** (3.32-6.74)	**5.14** (3.50-7.63)
12-hr	**1.69** (1.41-2.05)	**2.17** (1.80-2.63)	**2.79** (2.31-3.40)	**3.29** (2.70-4.04)	**3.96** (3.14-5.04)	**4.47** (3.48-5.81)	**4.99** (3.78-6.65)	**5.52** (4.07-7.57)	**6.23** (4.40-8.92)	**6.79** (4.62-10.1)
24-hr	**2.26** (2.01-2.61)	**2.94** (2.60-3.39)	**3.81** (3.36-4.40)	**4.50** (3.94-5.25)	**5.44** (4.61-6.55)	**6.15** (5.10-7.56)	**6.86** (5.56-8.64)	**7.58** (5.98-9.82)	**8.55** (6.47-11.5)	**9.30** (6.80-13.0)
2-day	**2.77** (2.45-3.19)	**3.65** (3.23-4.22)	**4.81** (4.24-5.56)	**5.75** (5.03-6.70)	**7.02** (5.94-8.46)	**7.99** (6.63-9.83)	**8.97** (7.27-11.3)	**9.99** (7.87-12.9)	**11.4** (8.59-15.3)	**12.4** (9.08-17.3)
3-day	**2.94** (2.61-3.39)	**3.95** (3.50-4.56)	**5.29** (4.66-6.12)	**6.39** (5.59-7.45)	**7.89** (6.68-9.51)	**9.06** (7.52-11.1)	**10.3** (8.31-12.9)	**11.5** (9.07-14.9)	**13.2** (10.0-17.8)	**14.6** (10.7-20.3)
4-day	**3.14** (2.78-3.61)	**4.26** (3.76-4.91)	**5.75** (5.07-6.65)	**6.98** (6.11-8.14)	**8.69** (7.36-10.5)	**10.0** (8.32-12.3)	**11.4** (9.25-14.4)	**12.9** (10.1-16.7)	**14.9** (11.3-20.1)	**16.5** (12.0-23.0)
7-day	**3.55** (3.14-4.09)	**4.87** (4.30-5.61)	**6.63** (5.85-7.67)	**8.10** (7.09-9.44)	**10.1** (8.59-12.2)	**11.8** (9.76-14.5)	**13.4** (10.9-16.9)	**15.2** (12.0-19.7)	**17.7** (13.4-23.8)	**19.6** (14.3-27.4)
10-day	**3.86** (3.42-4.45)	**5.33** (4.71-6.14)	**7.30** (6.44-8.44)	**8.95** (7.83-10.4)	**11.2** (9.53-13.6)	**13.1** (10.8-16.1)	**15.0** (12.1-18.9)	**17.0** (13.4-22.0)	**19.8** (15.0-26.7)	**22.0** (16.1-30.8)
20-day	**4.71** (4.18-5.43)	**6.58** (5.82-7.59)	**9.10** (8.03-10.5)	**11.2** (9.82-13.1)	**14.2** (12.0-17.1)	**16.6** (13.8-20.4)	**19.1** (15.5-24.0)	**21.7** (17.1-28.2)	**25.5** (19.3-34.4)	**28.5** (20.8-39.8)
30-day	**5.56** (4.92-6.41)	**7.77** (6.87-8.97)	**10.8** (9.51-12.5)	**13.3** (11.7-15.5)	**16.9** (14.3-20.4)	**19.8** (16.4-24.3)	**22.8** (18.5-28.7)	**26.0** (20.5-33.7)	**30.6** (23.1-41.3)	**34.3** (25.1-47.8)
45-day	**6.66** (5.90-7.67)	**9.27** (8.20-10.7)	**12.8** (11.3-14.8)	**15.9** (13.9-18.5)	**20.1** (17.0-24.2)	**23.6** (19.5-29.0)	**27.2** (22.0-34.2)	**31.1** (24.5-40.2)	**36.5** (27.7-49.3)	**41.0** (30.0-57.2)
60-day	**7.78** (6.89-8.96)	**10.7** (9.51-12.4)	**14.8** (13.1-17.1)	**18.2** (16.0-21.3)	**23.1** (19.6-27.8)	**27.0** (22.4-33.2)	**31.2** (25.2-39.3)	**35.6** (28.1-46.1)	**41.9** (31.7-56.5)	**47.1** (34.4-65.7)

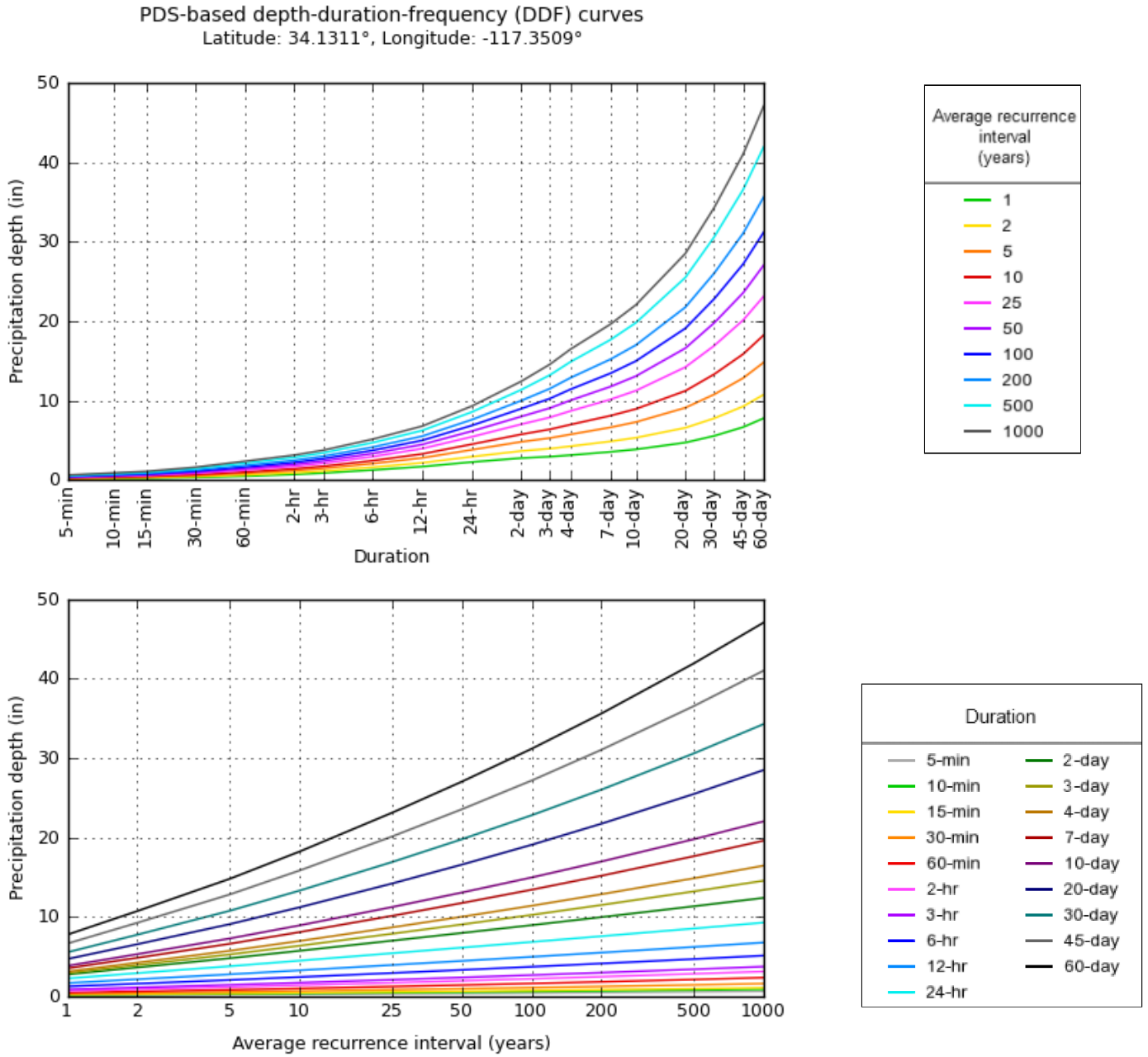
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



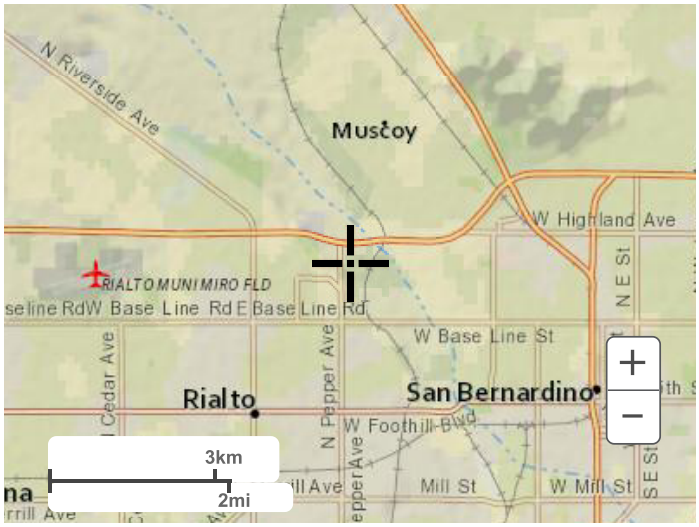
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Mon May 31 18:18:56 2021

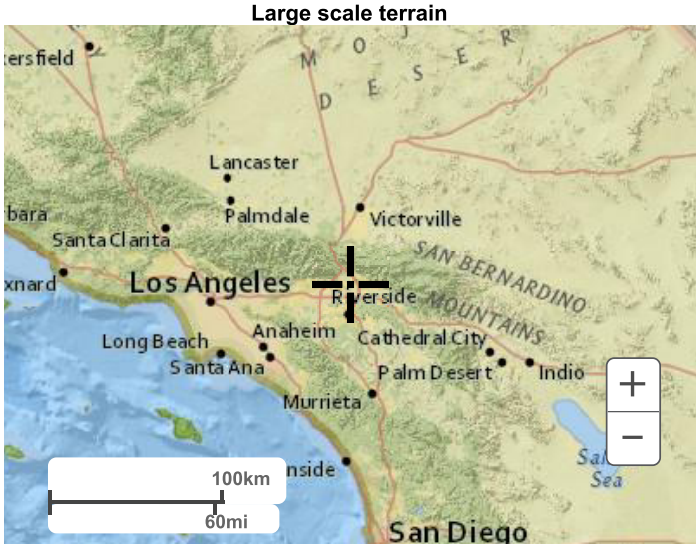
Back to Top

Maps & aerials

Small scale terrain

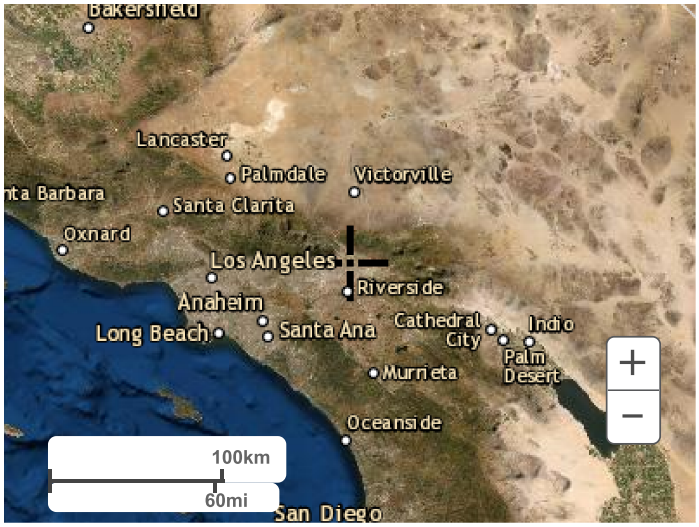


Large scale terrain



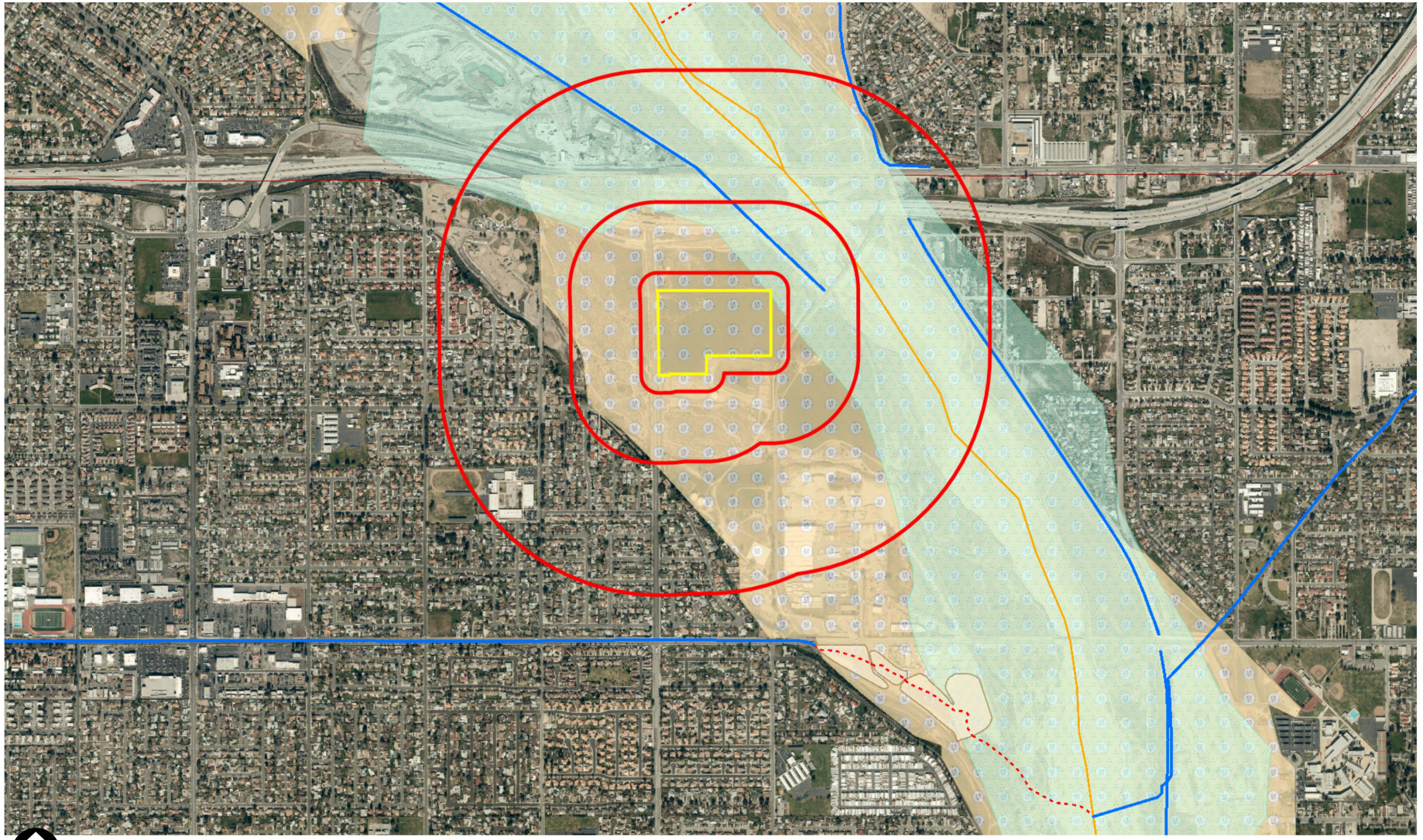
Large scale map

Large scale aerial



Back to Top

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



Site Address: permitrack.sbcounty.gov/wap

County of San Bernardino
Stormwater Facility Mapping

Stormwater Map

WQMP Project Report

County of San Bernardino Stormwater Program

Santa Ana River Watershed Geodatabase

Monday, May 31, 2021

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

Project Site Parcel Number(s):	026420106, 026420126, 026420105
Project Site Acreage:	24.485
HCOC Exempt Area:	No
Closest Receiving Waters: (Applicant to verify based on local drainage facilities and topography.)	**System Number** - 207 **Facility Name** - Island Levee, COE **Owner** - SBCFCD
Closest channel segment's susceptibility to Hydromodification:	EHM
Highest downstream hydromodification susceptibility:	High
Is this drainage segment subject to TMDLs?	No
Are there downstream drainage segments subject to TMDLs?	No
Is this drainage segment a 303d listed stream?	Yes
Are there 303d listed streams downstream?	Yes
Are there unlined downstream waterbodies?	No
Project Site Onsite Soil Group(s):	A, B
Environmentally Sensitive Areas within 200':	SAN BERNARDINO KANGAROO RAT,Riversidian Alluvial Sage Scru
Groundwater Depth (FT):	-410
Parcels with potential septic tanks within 1000':	Yes
Known Groundwater Contamination Plumes within 1000':	No
Studies and Reports Related to Project Site:	Cactus Basin Preliminary Report on Proposed North SBFCP Rialto MPD Vol1 Rialto MPD Vol II RS-Rialto Map Book-FINAL Layout2 School Site Map Comprehensive Storm Drain Plan SBVMWD High Groundwater / Pressure Zone Area

SECTION 6.4.7

CIVILDESIGN 2-YEAR RATIONAL METHOD AND UNIT HYDROGRAPH CALCULATIONS

-EXISITING CONDITION 2-YEAR RATIONAL METHOD

-PROPOSED CONDITION 2-YEAR RATIONAL METHOD

- EXISITING CONDITION 2-YEAR UNIT HYDROGRAPH

-PROPOSED CONDITION 2-YEAR UNIT HYDROGRAPH

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2014 Version 9.0
Rational Hydrology Study Date: 12/14/21

PEPPER INDUSTRIAL BUILDING
EXISTING CONDITION
2-YEAR STORM EVENT ANALYSIS - WATERSHED A

Program License Serial Number 6405

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

Rational hydrology study storm event year is 2.0
Computed rainfall intensity:
Storm year = 2.00 1 hour rainfall = 0.637 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 13.000 to Point/Station 14.000
**** INITIAL AREA EVALUATION ****

Soil classification AP and SCS values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2) = 50.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.810(In/Hr)
Initial subarea data:
Initial area flow distance = 668.000(Ft.)
Top (of initial area) elevation = 1288.700(Ft.)
Bottom (of initial area) elevation = 1282.000(Ft.)
Difference in elevation = 6.700(Ft.)
Slope = 0.01003 s(%)= 1.00
TC = k(0.950)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 32.164 min.
Rainfall intensity = 0.926(In/Hr) for a 2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.113
Subarea runoff = 0.117(CFS)
Total initial stream area = 1.120(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.810(In/Hr)

++
Process from Point/Station 14.000 to Point/Station 15.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

```
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.054(Ft.), Average velocity =   0.530(Ft/s)
      ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2            100.00              0.00
      3            200.00              1.00
Manning's 'N' friction factor =   0.030
------------------------------------------------------------------
Sub-Channel flow  =      0.154(CFS)
  '     '    flow top width =     10.799(Ft.)
  '     '    velocity=    0.530(Ft/s)
  '     '    area =      0.292(Sq.Ft)
  '     '    Froude number =     0.568

Upstream point elevation =  1282.000(Ft.)
Downstream point elevation =  1266.700(Ft.)
Flow length =  1084.000(Ft.)
Travel time  =   34.12 min.
Time of concentration =   66.28 min.
Depth of flow =   0.054(Ft.)
Average velocity =   0.530(Ft/s)
Total irregular channel flow =     0.154(CFS)
Irregular channel normal depth above invert elev. =   0.054(Ft.)
Average velocity of channel(s) =   0.530(Ft/s)
 Adding area flow to channel
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 50.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.810(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =      0.000(CFS)
therefore the upstream flow rate of Q =      0.117(CFS) is being used
Rainfall intensity =      0.600(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.000
Subarea runoff =      0.000(CFS) for   22.580(Ac.)
Total runoff =      0.117(CFS)
Effective area this stream =       23.70(Ac.)
Total Study Area (Main Stream No. 1) =       23.70(Ac.)
Area averaged Fm value =    0.810(In/Hr)
Depth of flow =   0.049(Ft.), Average velocity =   0.495(Ft/s)
End of computations, Total Study Area =           23.70 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

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

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2014 Version 9.0
Rational Hydrology Study Date: 12/14/21

PEPPER INDUSTRIAL BUILDING
PROPOSED CONDITION
2-YEAR STORM EVENT ANALYSIS - WATERSHED A

Program License Serial Number 6405

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

Rational hydrology study storm event year is 2.0
Computed rainfall intensity:
Storm year = 2.00 1 hour rainfall = 0.637 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 10.000 to Point/Station 11.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
Initial subarea data:
Initial area flow distance = 500.000(Ft.)
Top (of initial area) elevation = 1288.200(Ft.)
Bottom (of initial area) elevation = 1277.700(Ft.)
Difference in elevation = 10.500(Ft.)
Slope = 0.02100 s(%)= 2.10
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 7.907 min.
Rainfall intensity = 2.149(In/Hr) for a 2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.859
Subarea runoff = 8.399(CFS)
Total initial stream area = 4.550(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.098(In/Hr)

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Upstream point elevation =  1277.700(Ft.)
Downstream point elevation =  1273.400(Ft.)
Channel length thru subarea  =   818.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank =  23.330
Slope or 'Z' of right channel bank =  23.330
Estimated mean flow rate at midpoint of channel =      9.626(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    4.500(Ft.)
Flow(q) thru subarea =      9.626(CFS)
Depth of flow =   0.407(Ft.), Average velocity =   2.485(Ft/s)
Channel flow top width =   19.011(Ft.)
Flow Velocity =    2.49(Ft/s)
Travel time  =    5.49 min.
Time of concentration =   13.39 min.
Critical depth =      0.402(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Rainfall intensity =      1.566(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.844
Subarea runoff =      2.373(CFS) for    3.600(Ac.)
Total runoff =     10.772(CFS)
Effective area this stream =        8.15(Ac.)
Total Study Area (Main Stream No. 1) =        8.15(Ac.)
Area averaged Fm value =    0.098(In/Hr)
Depth of flow =   0.425(Ft.), Average velocity =   2.556(Ft/s)
Critical depth =      0.422(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       13.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Upstream point elevation =  1273.400(Ft.)
Downstream point elevation =  1271.600(Ft.)
Channel length thru subarea  =   366.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank = 100.000
Slope or 'Z' of right channel bank = 100.000
Estimated mean flow rate at midpoint of channel =     12.085(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.300(Ft.)
Flow(q) thru subarea =     12.085(CFS)
Depth of flow =   0.260(Ft.), Average velocity =   1.784(Ft/s)
Channel flow top width =   52.054(Ft.)
```

```
Flow Velocity =    1.78(Ft/s)
Travel time  =    3.42 min.
Time of concentration =   16.81 min.
Critical depth =      0.246(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Rainfall intensity =      1.367(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.836
Subarea runoff =      2.555(CFS) for    3.520(Ac.)
Total runoff =     13.327(CFS)
Effective area this stream =       11.67(Ac.)
Total Study Area (Main Stream No. 1) =       11.67(Ac.)
Area averaged Fm value =    0.098(In/Hr)
Depth of flow =   0.270(Ft.), Average velocity =   1.828(Ft/s)
Critical depth =      0.256(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       13.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     11.670(Ac.)
Runoff from this stream =     13.327(CFS)
Time of concentration =   16.81 min.
Rainfall intensity =     1.367(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       13.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   306.000(Ft.)
Top (of initial area) elevation =  1273.700(Ft.)
Bottom (of initial area) elevation =  1271.600(Ft.)
Difference in elevation =     2.100(Ft.)
Slope =    0.00686  s(%)=       0.69
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.126 min.
Rainfall intensity =      2.114(In/Hr) for a     2.0 year storm
```

```
Effective runoff coefficient used for area (Q=KCIA) is C = 0.858
Subarea runoff =      5.498(CFS)
Total initial stream area =        3.030(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       13.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      3.030(Ac.)
Runoff from this stream =      5.498(CFS)
Time of concentration =    8.13 min.
Rainfall intensity =     2.114(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1     13.33    11.670     16.81    0.098      1.367
2      5.50     3.030      8.13    0.098      2.114
Qmax(1) =
         1.000 *    1.000 *    13.327) +
         0.629 *    1.000 *     5.498) + =      16.787
Qmax(2) =
         1.589 *    0.483 *    13.327) +
         1.000 *    1.000 *     5.498) + =      15.734

Total of 2 streams to confluence:
Flow rates before confluence point:
      13.327       5.498
Maximum flow rates at confluence using above data:
       16.787       15.734
Area of streams before confluence:
       11.670        3.030
Effective area values after confluence:
       14.700        8.670
Results of confluence:
Total flow rate =     16.787(CFS)
Time of concentration =    16.812 min.
Effective stream area after confluence =     14.700(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total (this main stream) =      14.70(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       19.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =  1265.600(Ft.)
Downstream point/station elevation =  1264.770(Ft.)
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```
Pipe length  =   465.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    16.787(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    16.787(CFS)
Normal flow depth in pipe =   23.77(In.)
Flow top width inside pipe =   24.34(In.)
Critical Depth =   16.62(In.)
Pipe flow velocity =      4.02(Ft/s)
Travel time through pipe =    1.93 min.
Time of concentration (TC) =    18.74 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       19.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     14.700(Ac.)
Runoff from this stream =     16.787(CFS)
Time of concentration =   18.74 min.
Rainfall intensity =     1.281(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       15.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   431.000(Ft.)
Top (of initial area) elevation =  1284.800(Ft.)
Bottom (of initial area) elevation =  1282.500(Ft.)
Difference in elevation =     2.300(Ft.)
Slope =    0.00534  s(%)=       0.53
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.800 min.
Rainfall intensity =      1.889(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.853
Subarea runoff =      1.645(CFS)
Total initial stream area =        1.020(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       17.000
**** IMPROVED CHANNEL TRAVEL TIME ****
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```
Upstream point elevation =  1282.500(Ft.)
Downstream point elevation =  1276.900(Ft.)
Channel length thru subarea  =   565.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank =  48.300
Slope or 'Z' of right channel bank =  48.300
Estimated mean flow rate at midpoint of channel =      4.062(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.240(Ft.)
Flow(q) thru subarea =      4.062(CFS)
Depth of flow =   0.199(Ft.), Average velocity =   2.119(Ft/s)
Channel flow top width =   19.244(Ft.)
Flow Velocity =    2.12(Ft/s)
Travel time  =    4.44 min.
Time of concentration =   14.24 min.
Critical depth =      0.213(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Rainfall intensity =      1.510(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.842
Subarea runoff =      4.772(CFS) for    4.030(Ac.)
Total runoff =      6.417(CFS)
Effective area this stream =        5.05(Ac.)
Total Study Area (Main Stream No. 2) =       19.75(Ac.)
Area averaged Fm value =    0.098(In/Hr)
Depth of flow =   0.236(Ft.), Average velocity =   2.376(Ft/s)
Critical depth =      0.256(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       17.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      5.050(Ac.)
Runoff from this stream =      6.417(CFS)
Time of concentration =   14.24 min.
Rainfall intensity =     1.510(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       17.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
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Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   538.000(Ft.)
Top (of initial area) elevation =  1284.100(Ft.)
Bottom (of initial area) elevation =  1276.900(Ft.)
Difference in elevation =     7.200(Ft.)
Slope =    0.01338  s(%)=       1.34
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.910 min.
Rainfall intensity =      2.000(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.856
Subarea runoff =      3.544(CFS)
Total initial stream area =        2.070(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       17.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      2.070(Ac.)
Runoff from this stream =      3.544(CFS)
Time of concentration =    8.91 min.
Rainfall intensity =     2.000(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      6.42     5.050     14.24    0.098      1.510
2      3.54     2.070      8.91    0.098      2.000
Qmax(1) =
         1.000 *    1.000 *     6.417) +
         0.742 *    1.000 *     3.544) + =       9.047
Qmax(2) =
         1.348 *    0.626 *     6.417) +
         1.000 *    1.000 *     3.544) + =       8.954

Total of 2 streams to confluence:
Flow rates before confluence point:
       6.417       3.544
Maximum flow rates at confluence using above data:
        9.047        8.954
Area of streams before confluence:
        5.050        2.070
Effective area values after confluence:
        7.120        5.229
Results of confluence:
Total flow rate =      9.047(CFS)
```

```
Time of concentration =    14.244 min.
Effective stream area after confluence =      7.120(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total (this main stream) =       7.12(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       17.000 to Point/Station       18.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =  1276.900(Ft.)
Downstream point elevation =  1273.700(Ft.)
Channel length thru subarea  =   628.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank = 100.000
Slope or 'Z' of right channel bank =  12.500
Estimated mean flow rate at midpoint of channel =      9.216(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.240(Ft.)
Flow(q) thru subarea =      9.216(CFS)
Depth of flow =   0.290(Ft.), Average velocity =   1.950(Ft/s)
Channel flow top width =   32.605(Ft.)
Flow Velocity =    1.95(Ft/s)
Travel time  =    5.37 min.
Time of concentration =   19.61 min.
Critical depth =      0.277(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Rainfall intensity =      1.246(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.829
Subarea runoff =      0.265(CFS) for    1.890(Ac.)
Total runoff =      9.312(CFS)
Effective area this stream =        9.01(Ac.)
Total Study Area (Main Stream No. 2) =       23.71(Ac.)
Area averaged Fm value =    0.098(In/Hr)
Depth of flow =   0.291(Ft.), Average velocity =   1.956(Ft/s)
Critical depth =      0.279(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       19.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =  1268.200(Ft.)
Downstream point/station elevation =  1264.770(Ft.)
Pipe length  =    50.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.312(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     9.312(CFS)
```

```
Normal flow depth in pipe =    9.82(In.)
Flow top width inside pipe =    9.25(In.)
Critical depth could not be calculated.
Pipe flow velocity =     13.54(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =    19.67 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       19.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      9.010(Ac.)
Runoff from this stream =      9.312(CFS)
Time of concentration =   19.67 min.
Rainfall intensity =     1.244(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1     16.79    14.700     18.74    0.098      1.281
2      9.31     9.010     19.67    0.098      1.244
Qmax(1) =
         1.000 *    1.000 *    16.787) +
         1.032 *    0.953 *     9.312) + =      25.942
Qmax(2) =
         0.969 *    1.000 *    16.787) +
         1.000 *    1.000 *     9.312) + =      25.577

Total of 2 main streams to confluence:
Flow rates before confluence point:
      17.787      10.312
Maximum flow rates at confluence using above data:
       25.942       25.577
Area of streams before confluence:
       14.700        9.010
Effective area values after confluence:
       23.283       23.710


Results of confluence:
Total flow rate =     25.942(CFS)
Time of concentration =    18.739 min.
Effective stream area after confluence  =     23.283(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total =      23.71(Ac.)
End of computations, Total Study Area =           23.71 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
```

effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number = 32.0

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

Study date 12/14/21

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

Program License Serial Number 6405

PEPPER INDUSTRIAL BUILDING
ONSITE EXISTING CONDITION
2-YEAR, 24-HOUR STORM EVENT ANALYSIS

Storm Event Year = 2

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 2		
23.70	1	0.64
Rainfall data for year 2		
23.70	6	1.61
Rainfall data for year 2		
23.70	24	2.94

++

******** 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)
50.0	50.0	23.70	1.000	0.810	1.000	0.810

Area-averaged adjusted loss rate Fm (In/Hr) = 0.810

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

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
23.70	1.000	50.0	50.0	10.00	0.027

Area-averaged catchment yield fraction, Y = 0.027
Area-averaged low loss fraction, Yb = 0.973
User entry of time of concentration = 1.105 (hours)
++
Watershed area = 23.70(Ac.)
Catchment Lag time = 0.884 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 9.4294
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.810(In/Hr)
Average low loss rate fraction (Yb) = 0.973 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.237(In)
Computed peak 30-minute rainfall = 0.485(In)
Specified peak 1-hour rainfall = 0.640(In)
Computed peak 3-hour rainfall = 1.127(In)
Specified peak 6-hour rainfall = 1.610(In)
Specified peak 24-hour rainfall = 2.940(In)

Rainfall depth area reduction factors:
Using a total area of 23.70(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999 Adjusted rainfall = 0.237(In)
30-minute factor = 0.999 Adjusted rainfall = 0.484(In)
1-hour factor = 0.999 Adjusted rainfall = 0.639(In)
3-hour factor = 1.000 Adjusted rainfall = 1.127(In)
6-hour factor = 1.000 Adjusted rainfall = 1.610(In)
24-hour factor = 1.000 Adjusted rainfall = 2.940(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 = 286.62 (CFS))		
1	0.523	1.499
2	1.693	3.353
3	3.183	4.270
4	5.639	7.041
5	9.431	10.866
6	14.420	14.302
7	19.986	15.953

8	26.068	17.431
9	32.724	19.077
10	40.175	21.357
11	48.728	24.515
12	56.898	23.417
13	65.685	25.186
14	72.345	19.087
15	76.562	12.088
16	80.671	11.778
17	85.064	12.592
18	88.357	9.438
19	90.095	4.982
20	92.065	5.645
21	93.765	4.873
22	95.112	3.861
23	96.154	2.986
24	96.954	2.295
25	97.603	1.860
26	98.104	1.437
27	98.298	0.555
28	98.468	0.487
29	98.637	0.487
30	98.807	0.487
31	98.977	0.487
32	99.147	0.486
33	99.316	0.486
34	99.486	0.486
35	99.656	0.487
36	99.825	0.486
37	99.948	0.351
38	100.000	0.150

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.2366	0.2366
2	0.3122	0.0756
3	0.3672	0.0550
4	0.4120	0.0448
5	0.4504	0.0385
6	0.4845	0.0341
7	0.5153	0.0308
8	0.5436	0.0283
9	0.5698	0.0262
10	0.5943	0.0245
11	0.6174	0.0231
12	0.6393	0.0219
13	0.6662	0.0269
14	0.6922	0.0260
15	0.7173	0.0251
16	0.7415	0.0243
17	0.7651	0.0236
18	0.7880	0.0229
19	0.8103	0.0223
20	0.8320	0.0217
21	0.8532	0.0212
22	0.8739	0.0207
23	0.8942	0.0203

24	0.9140	0.0198
25	0.9335	0.0194
26	0.9525	0.0191
27	0.9713	0.0187
28	0.9897	0.0184
29	1.0077	0.0181
30	1.0255	0.0178
31	1.0430	0.0175
32	1.0602	0.0172
33	1.0772	0.0170
34	1.0939	0.0167
35	1.1104	0.0165
36	1.1266	0.0163
37	1.1426	0.0160
38	1.1584	0.0158
39	1.1740	0.0156
40	1.1894	0.0154
41	1.2046	0.0152
42	1.2197	0.0150
43	1.2346	0.0149
44	1.2493	0.0147
45	1.2638	0.0145
46	1.2782	0.0144
47	1.2924	0.0142
48	1.3065	0.0141
49	1.3205	0.0139
50	1.3343	0.0138
51	1.3479	0.0137
52	1.3615	0.0135
53	1.3749	0.0134
54	1.3882	0.0133
55	1.4014	0.0132
56	1.4145	0.0131
57	1.4274	0.0130
58	1.4402	0.0128
59	1.4530	0.0127
60	1.4656	0.0126
61	1.4781	0.0125
62	1.4906	0.0124
63	1.5029	0.0123
64	1.5151	0.0122
65	1.5273	0.0121
66	1.5393	0.0121
67	1.5513	0.0120
68	1.5632	0.0119
69	1.5750	0.0118
70	1.5867	0.0117
71	1.5983	0.0116
72	1.6099	0.0116
73	1.6196	0.0097
74	1.6292	0.0096
75	1.6387	0.0095
76	1.6481	0.0095
77	1.6575	0.0094
78	1.6668	0.0093
79	1.6761	0.0092
80	1.6853	0.0092

81	1.6944	0.0091
82	1.7035	0.0091
83	1.7124	0.0090
84	1.7214	0.0089
85	1.7302	0.0089
86	1.7391	0.0088
87	1.7478	0.0088
88	1.7565	0.0087
89	1.7652	0.0086
90	1.7737	0.0086
91	1.7823	0.0085
92	1.7908	0.0085
93	1.7992	0.0084
94	1.8076	0.0084
95	1.8159	0.0083
96	1.8242	0.0083
97	1.8324	0.0082
98	1.8406	0.0082
99	1.8487	0.0081
100	1.8568	0.0081
101	1.8649	0.0080
102	1.8729	0.0080
103	1.8808	0.0080
104	1.8887	0.0079
105	1.8966	0.0079
106	1.9044	0.0078
107	1.9122	0.0078
108	1.9199	0.0077
109	1.9277	0.0077
110	1.9353	0.0077
111	1.9429	0.0076
112	1.9505	0.0076
113	1.9581	0.0075
114	1.9656	0.0075
115	1.9730	0.0075
116	1.9805	0.0074
117	1.9879	0.0074
118	1.9952	0.0074
119	2.0026	0.0073
120	2.0099	0.0073
121	2.0171	0.0073
122	2.0243	0.0072
123	2.0315	0.0072
124	2.0387	0.0072
125	2.0458	0.0071
126	2.0529	0.0071
127	2.0600	0.0071
128	2.0670	0.0070
129	2.0740	0.0070
130	2.0810	0.0070
131	2.0879	0.0069
132	2.0948	0.0069
133	2.1017	0.0069
134	2.1086	0.0069
135	2.1154	0.0068
136	2.1222	0.0068
137	2.1289	0.0068

138	2.1357	0.0067
139	2.1424	0.0067
140	2.1491	0.0067
141	2.1557	0.0067
142	2.1623	0.0066
143	2.1689	0.0066
144	2.1755	0.0066
145	2.1821	0.0066
146	2.1886	0.0065
147	2.1951	0.0065
148	2.2016	0.0065
149	2.2080	0.0064
150	2.2144	0.0064
151	2.2208	0.0064
152	2.2272	0.0064
153	2.2336	0.0064
154	2.2399	0.0063
155	2.2462	0.0063
156	2.2525	0.0063
157	2.2588	0.0063
158	2.2650	0.0062
159	2.2712	0.0062
160	2.2774	0.0062
161	2.2836	0.0062
162	2.2897	0.0062
163	2.2959	0.0061
164	2.3020	0.0061
165	2.3081	0.0061
166	2.3141	0.0061
167	2.3202	0.0060
168	2.3262	0.0060
169	2.3322	0.0060
170	2.3382	0.0060
171	2.3442	0.0060
172	2.3501	0.0059
173	2.3560	0.0059
174	2.3619	0.0059
175	2.3678	0.0059
176	2.3737	0.0059
177	2.3795	0.0058
178	2.3854	0.0058
179	2.3912	0.0058
180	2.3970	0.0058
181	2.4027	0.0058
182	2.4085	0.0058
183	2.4142	0.0057
184	2.4200	0.0057
185	2.4257	0.0057
186	2.4314	0.0057
187	2.4370	0.0057
188	2.4427	0.0057
189	2.4483	0.0056
190	2.4539	0.0056
191	2.4595	0.0056
192	2.4651	0.0056
193	2.4707	0.0056
194	2.4762	0.0056

195	2.4818	0.0055
196	2.4873	0.0055
197	2.4928	0.0055
198	2.4983	0.0055
199	2.5038	0.0055
200	2.5092	0.0055
201	2.5147	0.0054
202	2.5201	0.0054
203	2.5255	0.0054
204	2.5309	0.0054
205	2.5363	0.0054
206	2.5417	0.0054
207	2.5470	0.0054
208	2.5523	0.0053
209	2.5577	0.0053
210	2.5630	0.0053
211	2.5683	0.0053
212	2.5736	0.0053
213	2.5788	0.0053
214	2.5841	0.0053
215	2.5893	0.0052
216	2.5945	0.0052
217	2.5997	0.0052
218	2.6049	0.0052
219	2.6101	0.0052
220	2.6153	0.0052
221	2.6205	0.0052
222	2.6256	0.0051
223	2.6307	0.0051
224	2.6359	0.0051
225	2.6410	0.0051
226	2.6460	0.0051
227	2.6511	0.0051
228	2.6562	0.0051
229	2.6613	0.0051
230	2.6663	0.0050
231	2.6713	0.0050
232	2.6763	0.0050
233	2.6813	0.0050
234	2.6863	0.0050
235	2.6913	0.0050
236	2.6963	0.0050
237	2.7012	0.0050
238	2.7062	0.0049
239	2.7111	0.0049
240	2.7160	0.0049
241	2.7210	0.0049
242	2.7259	0.0049
243	2.7307	0.0049
244	2.7356	0.0049
245	2.7405	0.0049
246	2.7453	0.0049
247	2.7502	0.0048
248	2.7550	0.0048
249	2.7598	0.0048
250	2.7646	0.0048
251	2.7694	0.0048

252	2.7742	0.0048
253	2.7790	0.0048
254	2.7838	0.0048
255	2.7885	0.0048
256	2.7933	0.0047
257	2.7980	0.0047
258	2.8027	0.0047
259	2.8074	0.0047
260	2.8121	0.0047
261	2.8168	0.0047
262	2.8215	0.0047
263	2.8262	0.0047
264	2.8309	0.0047
265	2.8355	0.0047
266	2.8402	0.0046
267	2.8448	0.0046
268	2.8494	0.0046
269	2.8540	0.0046
270	2.8586	0.0046
271	2.8632	0.0046
272	2.8678	0.0046
273	2.8724	0.0046
274	2.8770	0.0046
275	2.8815	0.0046
276	2.8861	0.0045
277	2.8906	0.0045
278	2.8951	0.0045
279	2.8996	0.0045
280	2.9042	0.0045
281	2.9087	0.0045
282	2.9131	0.0045
283	2.9176	0.0045
284	2.9221	0.0045
285	2.9266	0.0045
286	2.9310	0.0045
287	2.9355	0.0044
288	2.9399	0.0044

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0044	0.0043	0.0001
2	0.0044	0.0043	0.0001
3	0.0045	0.0043	0.0001
4	0.0045	0.0044	0.0001
5	0.0045	0.0044	0.0001
6	0.0045	0.0044	0.0001
7	0.0045	0.0044	0.0001
8	0.0045	0.0044	0.0001
9	0.0045	0.0044	0.0001
10	0.0046	0.0044	0.0001
11	0.0046	0.0044	0.0001
12	0.0046	0.0045	0.0001
13	0.0046	0.0045	0.0001
14	0.0046	0.0045	0.0001
15	0.0046	0.0045	0.0001

16	0.0046	0.0045	0.0001
17	0.0047	0.0045	0.0001
18	0.0047	0.0045	0.0001
19	0.0047	0.0046	0.0001
20	0.0047	0.0046	0.0001
21	0.0047	0.0046	0.0001
22	0.0047	0.0046	0.0001
23	0.0048	0.0046	0.0001
24	0.0048	0.0046	0.0001
25	0.0048	0.0047	0.0001
26	0.0048	0.0047	0.0001
27	0.0048	0.0047	0.0001
28	0.0048	0.0047	0.0001
29	0.0049	0.0047	0.0001
30	0.0049	0.0047	0.0001
31	0.0049	0.0048	0.0001
32	0.0049	0.0048	0.0001
33	0.0049	0.0048	0.0001
34	0.0049	0.0048	0.0001
35	0.0050	0.0048	0.0001
36	0.0050	0.0048	0.0001
37	0.0050	0.0049	0.0001
38	0.0050	0.0049	0.0001
39	0.0050	0.0049	0.0001
40	0.0050	0.0049	0.0001
41	0.0051	0.0049	0.0001
42	0.0051	0.0049	0.0001
43	0.0051	0.0050	0.0001
44	0.0051	0.0050	0.0001
45	0.0051	0.0050	0.0001
46	0.0052	0.0050	0.0001
47	0.0052	0.0050	0.0001
48	0.0052	0.0051	0.0001
49	0.0052	0.0051	0.0001
50	0.0052	0.0051	0.0001
51	0.0053	0.0051	0.0001
52	0.0053	0.0051	0.0001
53	0.0053	0.0052	0.0001
54	0.0053	0.0052	0.0001
55	0.0054	0.0052	0.0001
56	0.0054	0.0052	0.0001
57	0.0054	0.0052	0.0001
58	0.0054	0.0053	0.0001
59	0.0054	0.0053	0.0001
60	0.0055	0.0053	0.0001
61	0.0055	0.0053	0.0002
62	0.0055	0.0054	0.0002
63	0.0055	0.0054	0.0002
64	0.0056	0.0054	0.0002
65	0.0056	0.0054	0.0002
66	0.0056	0.0054	0.0002
67	0.0056	0.0055	0.0002
68	0.0057	0.0055	0.0002
69	0.0057	0.0055	0.0002
70	0.0057	0.0055	0.0002
71	0.0057	0.0056	0.0002
72	0.0058	0.0056	0.0002

73	0.0058	0.0056	0.0002
74	0.0058	0.0057	0.0002
75	0.0058	0.0057	0.0002
76	0.0059	0.0057	0.0002
77	0.0059	0.0057	0.0002
78	0.0059	0.0058	0.0002
79	0.0060	0.0058	0.0002
80	0.0060	0.0058	0.0002
81	0.0060	0.0059	0.0002
82	0.0060	0.0059	0.0002
83	0.0061	0.0059	0.0002
84	0.0061	0.0059	0.0002
85	0.0062	0.0060	0.0002
86	0.0062	0.0060	0.0002
87	0.0062	0.0060	0.0002
88	0.0062	0.0061	0.0002
89	0.0063	0.0061	0.0002
90	0.0063	0.0061	0.0002
91	0.0064	0.0062	0.0002
92	0.0064	0.0062	0.0002
93	0.0064	0.0062	0.0002
94	0.0064	0.0063	0.0002
95	0.0065	0.0063	0.0002
96	0.0065	0.0063	0.0002
97	0.0066	0.0064	0.0002
98	0.0066	0.0064	0.0002
99	0.0067	0.0065	0.0002
100	0.0067	0.0065	0.0002
101	0.0067	0.0066	0.0002
102	0.0068	0.0066	0.0002
103	0.0068	0.0066	0.0002
104	0.0069	0.0067	0.0002
105	0.0069	0.0067	0.0002
106	0.0069	0.0067	0.0002
107	0.0070	0.0068	0.0002
108	0.0070	0.0068	0.0002
109	0.0071	0.0069	0.0002
110	0.0071	0.0069	0.0002
111	0.0072	0.0070	0.0002
112	0.0072	0.0070	0.0002
113	0.0073	0.0071	0.0002
114	0.0073	0.0071	0.0002
115	0.0074	0.0072	0.0002
116	0.0074	0.0072	0.0002
117	0.0075	0.0073	0.0002
118	0.0075	0.0073	0.0002
119	0.0076	0.0074	0.0002
120	0.0077	0.0075	0.0002
121	0.0077	0.0075	0.0002
122	0.0078	0.0076	0.0002
123	0.0079	0.0077	0.0002
124	0.0079	0.0077	0.0002
125	0.0080	0.0078	0.0002
126	0.0080	0.0078	0.0002
127	0.0081	0.0079	0.0002
128	0.0082	0.0080	0.0002

129	0.0083	0.0081	0.0002
130	0.0083	0.0081	0.0002
131	0.0084	0.0082	0.0002
132	0.0085	0.0082	0.0002
133	0.0086	0.0084	0.0002
134	0.0086	0.0084	0.0002
135	0.0088	0.0085	0.0002
136	0.0088	0.0086	0.0002
137	0.0089	0.0087	0.0002
138	0.0090	0.0087	0.0002
139	0.0091	0.0089	0.0003
140	0.0092	0.0089	0.0003
141	0.0093	0.0091	0.0003
142	0.0094	0.0091	0.0003
143	0.0095	0.0093	0.0003
144	0.0096	0.0093	0.0003
145	0.0116	0.0112	0.0003
146	0.0116	0.0113	0.0003
147	0.0118	0.0115	0.0003
148	0.0119	0.0116	0.0003
149	0.0121	0.0117	0.0003
150	0.0121	0.0118	0.0003
151	0.0123	0.0120	0.0003
152	0.0124	0.0121	0.0003
153	0.0126	0.0123	0.0003
154	0.0127	0.0124	0.0003
155	0.0130	0.0126	0.0004
156	0.0131	0.0127	0.0004
157	0.0133	0.0129	0.0004
158	0.0134	0.0131	0.0004
159	0.0137	0.0133	0.0004
160	0.0138	0.0134	0.0004
161	0.0141	0.0137	0.0004
162	0.0142	0.0138	0.0004
163	0.0145	0.0141	0.0004
164	0.0147	0.0143	0.0004
165	0.0150	0.0146	0.0004
166	0.0152	0.0148	0.0004
167	0.0156	0.0152	0.0004
168	0.0158	0.0154	0.0004
169	0.0163	0.0158	0.0004
170	0.0165	0.0160	0.0005
171	0.0170	0.0165	0.0005
172	0.0172	0.0167	0.0005
173	0.0178	0.0173	0.0005
174	0.0181	0.0176	0.0005
175	0.0187	0.0182	0.0005
176	0.0191	0.0186	0.0005
177	0.0198	0.0193	0.0005
178	0.0203	0.0197	0.0006
179	0.0212	0.0206	0.0006
180	0.0217	0.0211	0.0006
181	0.0229	0.0223	0.0006
182	0.0236	0.0229	0.0006
183	0.0251	0.0244	0.0007
184	0.0260	0.0252	0.0007
185	0.0219	0.0213	0.0006

186	0.0231	0.0225	0.0006
187	0.0262	0.0255	0.0007
188	0.0283	0.0275	0.0008
189	0.0341	0.0331	0.0009
190	0.0385	0.0374	0.0011
191	0.0550	0.0535	0.0015
192	0.0756	0.0675	0.0081
193	0.2366	0.0675	0.1691
194	0.0448	0.0435	0.0012
195	0.0308	0.0300	0.0008
196	0.0245	0.0239	0.0007
197	0.0269	0.0262	0.0007
198	0.0243	0.0236	0.0007
199	0.0223	0.0217	0.0006
200	0.0207	0.0201	0.0006
201	0.0194	0.0189	0.0005
202	0.0184	0.0179	0.0005
203	0.0175	0.0170	0.0005
204	0.0167	0.0163	0.0005
205	0.0160	0.0156	0.0004
206	0.0154	0.0150	0.0004
207	0.0149	0.0145	0.0004
208	0.0144	0.0140	0.0004
209	0.0139	0.0136	0.0004
210	0.0135	0.0132	0.0004
211	0.0132	0.0128	0.0004
212	0.0128	0.0125	0.0004
213	0.0125	0.0122	0.0003
214	0.0122	0.0119	0.0003
215	0.0120	0.0116	0.0003
216	0.0117	0.0114	0.0003
217	0.0097	0.0094	0.0003
218	0.0095	0.0092	0.0003
219	0.0092	0.0090	0.0003
220	0.0091	0.0088	0.0002
221	0.0089	0.0086	0.0002
222	0.0087	0.0085	0.0002
223	0.0085	0.0083	0.0002
224	0.0084	0.0081	0.0002
225	0.0082	0.0080	0.0002
226	0.0081	0.0079	0.0002
227	0.0080	0.0077	0.0002
228	0.0078	0.0076	0.0002
229	0.0077	0.0075	0.0002
230	0.0076	0.0074	0.0002
231	0.0075	0.0073	0.0002
232	0.0074	0.0072	0.0002
233	0.0073	0.0071	0.0002
234	0.0072	0.0070	0.0002
235	0.0071	0.0069	0.0002
236	0.0070	0.0068	0.0002
237	0.0069	0.0067	0.0002
238	0.0068	0.0066	0.0002
239	0.0067	0.0065	0.0002
240	0.0066	0.0064	0.0002
241	0.0066	0.0064	0.0002
242	0.0065	0.0063	0.0002

243	0.0064	0.0062	0.0002
244	0.0063	0.0062	0.0002
245	0.0063	0.0061	0.0002
246	0.0062	0.0060	0.0002
247	0.0061	0.0060	0.0002
248	0.0061	0.0059	0.0002
249	0.0060	0.0058	0.0002
250	0.0059	0.0058	0.0002
251	0.0059	0.0057	0.0002
252	0.0058	0.0057	0.0002
253	0.0058	0.0056	0.0002
254	0.0057	0.0056	0.0002
255	0.0057	0.0055	0.0002
256	0.0056	0.0055	0.0002
257	0.0056	0.0054	0.0002
258	0.0055	0.0054	0.0002
259	0.0055	0.0053	0.0002
260	0.0054	0.0053	0.0001
261	0.0054	0.0052	0.0001
262	0.0053	0.0052	0.0001
263	0.0053	0.0051	0.0001
264	0.0053	0.0051	0.0001
265	0.0052	0.0051	0.0001
266	0.0052	0.0050	0.0001
267	0.0051	0.0050	0.0001
268	0.0051	0.0050	0.0001
269	0.0051	0.0049	0.0001
270	0.0050	0.0049	0.0001
271	0.0050	0.0048	0.0001
272	0.0049	0.0048	0.0001
273	0.0049	0.0048	0.0001
274	0.0049	0.0047	0.0001
275	0.0048	0.0047	0.0001
276	0.0048	0.0047	0.0001
277	0.0048	0.0046	0.0001
278	0.0047	0.0046	0.0001
279	0.0047	0.0046	0.0001
280	0.0047	0.0046	0.0001
281	0.0047	0.0045	0.0001
282	0.0046	0.0045	0.0001
283	0.0046	0.0045	0.0001
284	0.0046	0.0044	0.0001
285	0.0045	0.0044	0.0001
286	0.0045	0.0044	0.0001
287	0.0045	0.0044	0.0001
288	0.0045	0.0043	0.0001

Total soil rain loss = 2.69(In)
Total effective rainfall = 0.25(In)
Peak flow rate in flood hydrograph = 4.61(CFS)

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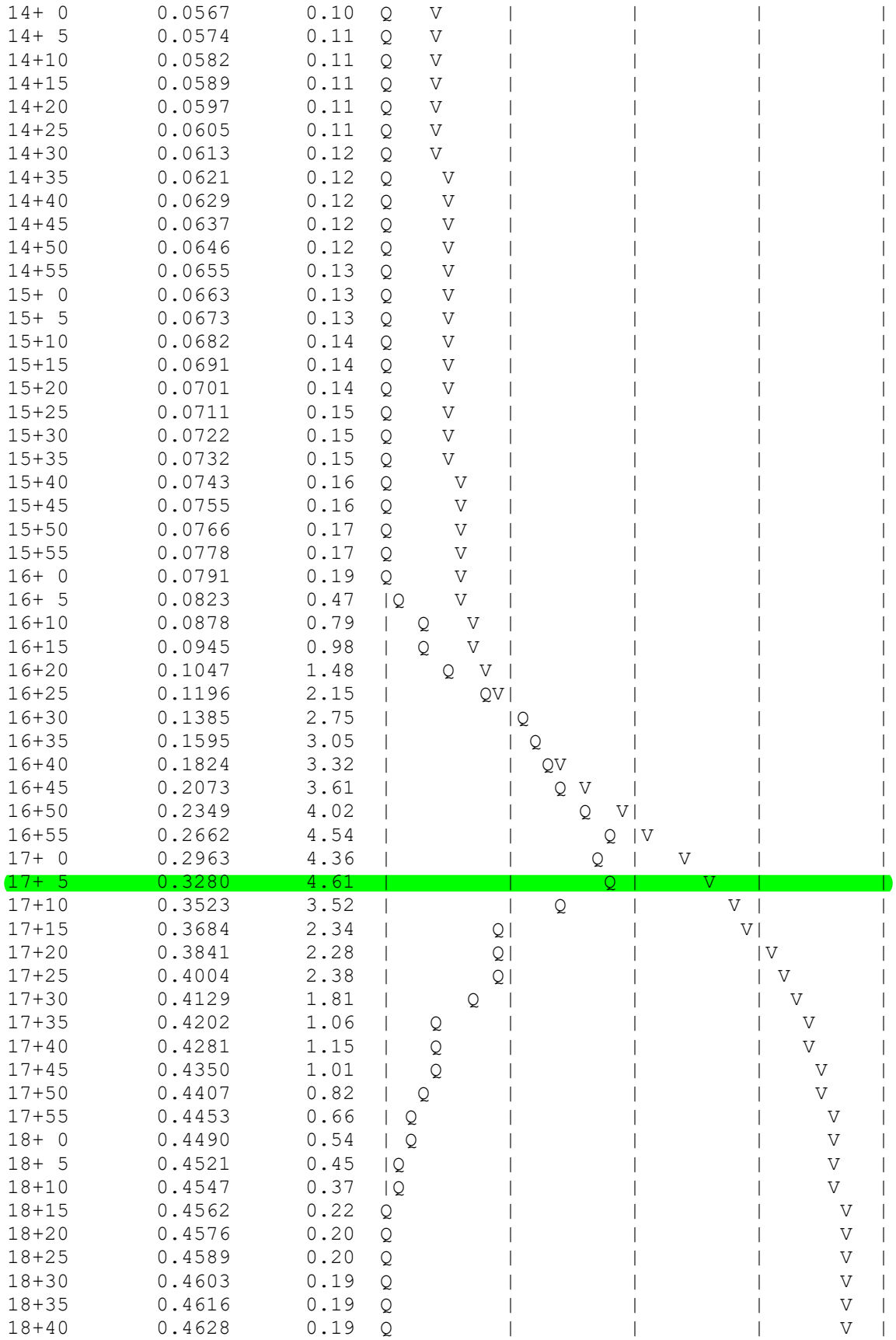
24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

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	0.0000	0.00	Q	|	|	|	|
0+10	0.0000	0.00	Q	|	|	|	|
0+15	0.0000	0.00	Q	|	|	|	|
0+20	0.0000	0.00	Q	|	|	|	|
0+25	0.0000	0.00	Q	|	|	|	|
0+30	0.0001	0.01	Q	|	|	|	|
0+35	0.0001	0.01	Q	|	|	|	|
0+40	0.0002	0.01	Q	|	|	|	|
0+45	0.0003	0.01	Q	|	|	|	|
0+50	0.0004	0.01	Q	|	|	|	|
0+55	0.0005	0.02	Q	|	|	|	|
1+ 0	0.0006	0.02	Q	|	|	|	|
1+ 5	0.0008	0.02	Q	|	|	|	|
1+10	0.0010	0.03	Q	|	|	|	|
1+15	0.0012	0.03	Q	|	|	|	|
1+20	0.0014	0.03	Q	|	|	|	|
1+25	0.0016	0.03	Q	|	|	|	|
1+30	0.0018	0.03	Q	|	|	|	|
1+35	0.0020	0.03	Q	|	|	|	|
1+40	0.0022	0.03	Q	|	|	|	|
1+45	0.0025	0.03	Q	|	|	|	|
1+50	0.0027	0.03	Q	|	|	|	|
1+55	0.0029	0.03	Q	|	|	|	|
2+ 0	0.0032	0.04	Q	|	|	|	|
2+ 5	0.0034	0.04	Q	|	|	|	|
2+10	0.0037	0.04	Q	|	|	|	|
2+15	0.0039	0.04	Q	|	|	|	|
2+20	0.0042	0.04	Q	|	|	|	|
2+25	0.0044	0.04	Q	|	|	|	|
2+30	0.0047	0.04	Q	|	|	|	|
2+35	0.0049	0.04	Q	|	|	|	|
2+40	0.0052	0.04	Q	|	|	|	|
2+45	0.0054	0.04	Q	|	|	|	|
2+50	0.0057	0.04	Q	|	|	|	|
2+55	0.0059	0.04	Q	|	|	|	|
3+ 0	0.0062	0.04	Q	|	|	|	|
3+ 5	0.0065	0.04	Q	|	|	|	|
3+10	0.0067	0.04	Q	|	|	|	|
3+15	0.0070	0.04	Q	|	|	|	|
3+20	0.0072	0.04	Q	|	|	|	|
3+25	0.0075	0.04	Q	|	|	|	|
3+30	0.0078	0.04	Q	|	|	|	|
3+35	0.0080	0.04	Q	|	|	|	|
3+40	0.0083	0.04	Q	|	|	|	|
3+45	0.0086	0.04	Q	|	|	|	|
3+50	0.0088	0.04	Q	|	|	|	|
3+55	0.0091	0.04	Q	|	|	|	|
4+ 0	0.0094	0.04	Q	|	|	|	|
4+ 5	0.0097	0.04	Q	|	|	|	|
4+10	0.0099	0.04	Q	|	|	|	|
4+15	0.0102	0.04	Q	|	|	|	|
4+20	0.0105	0.04	Q	|	|	|	|
4+25	0.0108	0.04	Q	|	|	|	|

4+30	0.0110	0.04	Q				
4+35	0.0113	0.04	Q				
4+40	0.0116	0.04	Q				
4+45	0.0119	0.04	Q				
4+50	0.0121	0.04	Q				
4+55	0.0124	0.04	QV				
5+ 0	0.0127	0.04	QV				
5+ 5	0.0130	0.04	QV				
5+10	0.0133	0.04	QV				
5+15	0.0136	0.04	QV				
5+20	0.0139	0.04	QV				
5+25	0.0141	0.04	QV				
5+30	0.0144	0.04	QV				
5+35	0.0147	0.04	QV				
5+40	0.0150	0.04	QV				
5+45	0.0153	0.04	QV				
5+50	0.0156	0.04	QV				
5+55	0.0159	0.04	QV				
6+ 0	0.0162	0.04	QV				
6+ 5	0.0165	0.04	QV				
6+10	0.0168	0.04	QV				
6+15	0.0171	0.04	QV				
6+20	0.0174	0.04	QV				
6+25	0.0177	0.04	QV				
6+30	0.0180	0.04	QV				
6+35	0.0183	0.04	QV				
6+40	0.0186	0.04	QV				
6+45	0.0189	0.04	QV				
6+50	0.0192	0.05	QV				
6+55	0.0196	0.05	QV				
7+ 0	0.0199	0.05	QV				
7+ 5	0.0202	0.05	QV				
7+10	0.0205	0.05	QV				
7+15	0.0208	0.05	QV				
7+20	0.0211	0.05	QV				
7+25	0.0215	0.05	QV				
7+30	0.0218	0.05	QV				
7+35	0.0221	0.05	QV				
7+40	0.0224	0.05	QV				
7+45	0.0228	0.05	QV				
7+50	0.0231	0.05	QV				
7+55	0.0234	0.05	QV				
8+ 0	0.0238	0.05	QV				
8+ 5	0.0241	0.05	QV				
8+10	0.0244	0.05	QV				
8+15	0.0248	0.05	Q V				
8+20	0.0251	0.05	Q V				
8+25	0.0255	0.05	Q V				
8+30	0.0258	0.05	Q V				
8+35	0.0261	0.05	Q V				
8+40	0.0265	0.05	Q V				
8+45	0.0268	0.05	Q V				
8+50	0.0272	0.05	Q V				
8+55	0.0276	0.05	Q V				
9+ 0	0.0279	0.05	Q V				
9+ 5	0.0283	0.05	Q V				
9+10	0.0286	0.05	Q V				

9+15	0.0290	0.05	Q	V			
9+20	0.0294	0.05	Q	V			
9+25	0.0297	0.05	Q	V			
9+30	0.0301	0.05	Q	V			
9+35	0.0305	0.05	Q	V			
9+40	0.0308	0.05	Q	V			
9+45	0.0312	0.05	Q	V			
9+50	0.0316	0.06	Q	V			
9+55	0.0320	0.06	Q	V			
10+ 0	0.0324	0.06	Q	V			
10+ 5	0.0327	0.06	Q	V			
10+10	0.0331	0.06	Q	V			
10+15	0.0335	0.06	Q	V			
10+20	0.0339	0.06	Q	V			
10+25	0.0343	0.06	Q	V			
10+30	0.0347	0.06	Q	V			
10+35	0.0351	0.06	Q	V			
10+40	0.0355	0.06	Q	V			
10+45	0.0359	0.06	Q	V			
10+50	0.0364	0.06	Q	V			
10+55	0.0368	0.06	Q	V			
11+ 0	0.0372	0.06	Q	V			
11+ 5	0.0376	0.06	Q	V			
11+10	0.0380	0.06	Q	V			
11+15	0.0385	0.06	Q	V			
11+20	0.0389	0.06	Q	V			
11+25	0.0393	0.06	Q	V			
11+30	0.0398	0.06	Q	V			
11+35	0.0402	0.06	Q	V			
11+40	0.0407	0.07	Q	V			
11+45	0.0411	0.07	Q	V			
11+50	0.0416	0.07	Q	V			
11+55	0.0421	0.07	Q	V			
12+ 0	0.0425	0.07	Q	V			
12+ 5	0.0430	0.07	Q	V			
12+10	0.0435	0.07	Q	V			
12+15	0.0440	0.07	Q	V			
12+20	0.0444	0.07	Q	V			
12+25	0.0449	0.07	Q	V			
12+30	0.0454	0.07	Q	V			
12+35	0.0460	0.08	Q	V			
12+40	0.0465	0.08	Q	V			
12+45	0.0470	0.08	Q	V			
12+50	0.0476	0.08	Q	V			
12+55	0.0482	0.08	Q	V			
13+ 0	0.0488	0.08	Q	V			
13+ 5	0.0494	0.09	Q	V			
13+10	0.0500	0.09	Q	V			
13+15	0.0506	0.09	Q	V			
13+20	0.0512	0.09	Q	V			
13+25	0.0519	0.09	Q	V			
13+30	0.0525	0.10	Q	V			
13+35	0.0532	0.10	Q	V			
13+40	0.0539	0.10	Q	V			
13+45	0.0546	0.10	Q	V			
13+50	0.0553	0.10	Q	V			
13+55	0.0560	0.10	Q	V			



18+45	0.4641	0.18	Q	|	|	|	V |
18+50	0.4653	0.18	Q	|	|	|	V |
18+55	0.4665	0.17	Q	|	|	|	V |
19+ 0	0.4677	0.17	Q	|	|	|	V |
19+ 5	0.4687	0.14	Q	|	|	|	V |
19+10	0.4694	0.11	Q	|	|	|	V |
19+15	0.4699	0.08	Q	|	|	|	V |
19+20	0.4705	0.07	Q	|	|	|	V |
19+25	0.4710	0.07	Q	|	|	|	V |
19+30	0.4714	0.07	Q	|	|	|	V |
19+35	0.4719	0.07	Q	|	|	|	V |
19+40	0.4724	0.07	Q	|	|	|	V |
19+45	0.4728	0.07	Q	|	|	|	V |
19+50	0.4733	0.06	Q	|	|	|	V |
19+55	0.4737	0.06	Q	|	|	|	V |
20+ 0	0.4741	0.06	Q	|	|	|	V |
20+ 5	0.4746	0.06	Q	|	|	|	V |
20+10	0.4750	0.06	Q	|	|	|	V |
20+15	0.4754	0.06	Q	|	|	|	V |
20+20	0.4758	0.06	Q	|	|	|	V |
20+25	0.4762	0.06	Q	|	|	|	V |
20+30	0.4766	0.06	Q	|	|	|	V |
20+35	0.4770	0.06	Q	|	|	|	V |
20+40	0.4773	0.05	Q	|	|	|	V |
20+45	0.4777	0.05	Q	|	|	|	V |
20+50	0.4781	0.05	Q	|	|	|	V |
20+55	0.4784	0.05	Q	|	|	|	V |
21+ 0	0.4788	0.05	Q	|	|	|	V |
21+ 5	0.4792	0.05	Q	|	|	|	V |
21+10	0.4795	0.05	Q	|	|	|	V |
21+15	0.4799	0.05	Q	|	|	|	V |
21+20	0.4802	0.05	Q	|	|	|	V|
21+25	0.4805	0.05	Q	|	|	|	V|
21+30	0.4809	0.05	Q	|	|	|	V|
21+35	0.4812	0.05	Q	|	|	|	V|
21+40	0.4815	0.05	Q	|	|	|	V|
21+45	0.4819	0.05	Q	|	|	|	V|
21+50	0.4822	0.05	Q	|	|	|	V|
21+55	0.4825	0.05	Q	|	|	|	V|
22+ 0	0.4828	0.05	Q	|	|	|	V|
22+ 5	0.4831	0.05	Q	|	|	|	V|
22+10	0.4834	0.04	Q	|	|	|	V|
22+15	0.4837	0.04	Q	|	|	|	V|
22+20	0.4840	0.04	Q	|	|	|	V|
22+25	0.4843	0.04	Q	|	|	|	V|
22+30	0.4846	0.04	Q	|	|	|	V|
22+35	0.4849	0.04	Q	|	|	|	V|
22+40	0.4852	0.04	Q	|	|	|	V|
22+45	0.4855	0.04	Q	|	|	|	V|
22+50	0.4858	0.04	Q	|	|	|	V|
22+55	0.4861	0.04	Q	|	|	|	V|
23+ 0	0.4864	0.04	Q	|	|	|	V|
23+ 5	0.4867	0.04	Q	|	|	|	V|
23+10	0.4869	0.04	Q	|	|	|	V|
23+15	0.4872	0.04	Q	|	|	|	V|
23+20	0.4875	0.04	Q	|	|	|	V|
23+25	0.4878	0.04	Q	|	|	|	V|

23+30	0.4880	0.04	Q	|	|	|	V|
23+35	0.4883	0.04	Q	|	|	|	V|
23+40	0.4886	0.04	Q	|	|	|	V|
23+45	0.4888	0.04	Q	|	|	|	V|
23+50	0.4891	0.04	Q	|	|	|	V|
23+55	0.4894	0.04	Q	|	|	|	V|
24+ 0	0.4896	0.04	Q	|	|	|	V|
24+ 5	0.4899	0.04	Q	|	|	|	V|
24+10	0.4901	0.04	Q	|	|	|	V|
24+15	0.4904	0.04	Q	|	|	|	V|
24+20	0.4906	0.03	Q	|	|	|	V|
24+25	0.4908	0.03	Q	|	|	|	V|
24+30	0.4911	0.03	Q	|	|	|	V|
24+35	0.4913	0.03	Q	|	|	|	V|
24+40	0.4915	0.03	Q	|	|	|	V|
24+45	0.4916	0.02	Q	|	|	|	V|
24+50	0.4918	0.02	Q	|	|	|	V|
24+55	0.4919	0.02	Q	|	|	|	V|
25+ 0	0.4920	0.02	Q	|	|	|	V|
25+ 5	0.4921	0.01	Q	|	|	|	V|
25+10	0.4922	0.01	Q	|	|	|	V|
25+15	0.4922	0.01	Q	|	|	|	V|
25+20	0.4923	0.01	Q	|	|	|	V|
25+25	0.4923	0.01	Q	|	|	|	V|
25+30	0.4923	0.00	Q	|	|	|	V|
25+35	0.4924	0.00	Q	|	|	|	V|
25+40	0.4924	0.00	Q	|	|	|	V|
25+45	0.4924	0.00	Q	|	|	|	V|
25+50	0.4924	0.00	Q	|	|	|	V|
25+55	0.4924	0.00	Q	|	|	|	V|
26+ 0	0.4924	0.00	Q	|	|	|	V|
26+ 5	0.4924	0.00	Q	|	|	|	V|
26+10	0.4924	0.00	Q	|	|	|	V|
26+15	0.4924	0.00	Q	|	|	|	V|
26+20	0.4924	0.00	Q	|	|	|	V|
26+25	0.4924	0.00	Q	|	|	|	V|
26+30	0.4924	0.00	Q	|	|	|	V|
26+35	0.4924	0.00	Q	|	|	|	V|
26+40	0.4924	0.00	Q	|	|	|	V|
26+45	0.4924	0.00	Q	|	|	|	V|
26+50	0.4924	0.00	Q	|	|	|	V|
26+55	0.4924	0.00	Q	|	|	|	V|
27+ 0	0.4925	0.00	Q	|	|	|	V|
27+ 5	0.4925	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 12/14/21

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

Program License Serial Number 6405

PEPPER INDUSTRIAL BUILDING
ONSITE PROPOSED CONDITION
2-YEAR, 24-HOUR STORM EVENT ANALYSIS

Storm Event Year = 2

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 2		
23.71	1	0.64
Rainfall data for year 2		
23.71	6	1.61
Rainfall data for year 2		
23.71	24	2.94

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******** 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)
32.0	32.0	23.71	1.000	0.978	0.100	0.098

Area-averaged adjusted loss rate Fm (In/Hr) = 0.098

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

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
2.37	0.100	32.0	32.0	14.70	0.000
21.34	0.900	98.0	98.0	0.20	0.921

Area-averaged catchment yield fraction, Y = 0.829
Area-averaged low loss fraction, Yb = 0.171
User entry of time of concentration = 0.312 (hours)
++
Watershed area = 23.71(Ac.)
Catchment Lag time = 0.250 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 33.3547
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.098(In/Hr)
Average low loss rate fraction (Yb) = 0.171 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.237(In)
Computed peak 30-minute rainfall = 0.485(In)
Specified peak 1-hour rainfall = 0.640(In)
Computed peak 3-hour rainfall = 1.127(In)
Specified peak 6-hour rainfall = 1.610(In)
Specified peak 24-hour rainfall = 2.940(In)

Rainfall depth area reduction factors:
Using a total area of 23.71(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999 Adjusted rainfall = 0.237(In)
30-minute factor = 0.999 Adjusted rainfall = 0.484(In)
1-hour factor = 0.999 Adjusted rainfall = 0.639(In)
3-hour factor = 1.000 Adjusted rainfall = 1.127(In)
6-hour factor = 1.000 Adjusted rainfall = 1.610(In)
24-hour factor = 1.000 Adjusted rainfall = 2.940(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 = 286.74 (CFS))	
1	2.273	6.516
2	13.730	32.854
3	35.629	62.793
4	63.903	81.075
5	82.434	53.136
6	91.872	27.062

7	96.479	13.210
8	98.283	5.174
9	98.903	1.778
10	99.504	1.721
11	100.000	1.423

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.2366	0.2366
2	0.3122	0.0756
3	0.3672	0.0550
4	0.4120	0.0448
5	0.4504	0.0385
6	0.4845	0.0341
7	0.5153	0.0308
8	0.5436	0.0283
9	0.5698	0.0262
10	0.5943	0.0245
11	0.6174	0.0231
12	0.6393	0.0219
13	0.6662	0.0269
14	0.6922	0.0260
15	0.7173	0.0251
16	0.7415	0.0243
17	0.7651	0.0236
18	0.7880	0.0229
19	0.8103	0.0223
20	0.8320	0.0217
21	0.8532	0.0212
22	0.8739	0.0207
23	0.8942	0.0203
24	0.9140	0.0198
25	0.9335	0.0194
26	0.9525	0.0191
27	0.9713	0.0187
28	0.9897	0.0184
29	1.0077	0.0181
30	1.0255	0.0178
31	1.0430	0.0175
32	1.0602	0.0172
33	1.0772	0.0170
34	1.0939	0.0167
35	1.1104	0.0165
36	1.1266	0.0163
37	1.1426	0.0160
38	1.1584	0.0158
39	1.1740	0.0156
40	1.1894	0.0154
41	1.2046	0.0152
42	1.2197	0.0150
43	1.2346	0.0149
44	1.2493	0.0147
45	1.2638	0.0145
46	1.2782	0.0144
47	1.2924	0.0142
48	1.3065	0.0141
49	1.3205	0.0139

50	1.3343	0.0138
51	1.3479	0.0137
52	1.3615	0.0135
53	1.3749	0.0134
54	1.3882	0.0133
55	1.4014	0.0132
56	1.4145	0.0131
57	1.4274	0.0130
58	1.4402	0.0128
59	1.4530	0.0127
60	1.4656	0.0126
61	1.4781	0.0125
62	1.4906	0.0124
63	1.5029	0.0123
64	1.5151	0.0122
65	1.5273	0.0121
66	1.5393	0.0121
67	1.5513	0.0120
68	1.5632	0.0119
69	1.5750	0.0118
70	1.5867	0.0117
71	1.5983	0.0116
72	1.6099	0.0116
73	1.6196	0.0097
74	1.6292	0.0096
75	1.6387	0.0095
76	1.6481	0.0095
77	1.6575	0.0094
78	1.6668	0.0093
79	1.6761	0.0092
80	1.6853	0.0092
81	1.6944	0.0091
82	1.7035	0.0091
83	1.7124	0.0090
84	1.7214	0.0089
85	1.7302	0.0089
86	1.7391	0.0088
87	1.7478	0.0088
88	1.7565	0.0087
89	1.7652	0.0086
90	1.7737	0.0086
91	1.7823	0.0085
92	1.7908	0.0085
93	1.7992	0.0084
94	1.8076	0.0084
95	1.8159	0.0083
96	1.8242	0.0083
97	1.8324	0.0082
98	1.8406	0.0082
99	1.8487	0.0081
100	1.8568	0.0081
101	1.8649	0.0080
102	1.8729	0.0080
103	1.8808	0.0080
104	1.8887	0.0079
105	1.8966	0.0079
106	1.9044	0.0078

107	1.9122	0.0078
108	1.9199	0.0077
109	1.9277	0.0077
110	1.9353	0.0077
111	1.9429	0.0076
112	1.9505	0.0076
113	1.9581	0.0075
114	1.9656	0.0075
115	1.9730	0.0075
116	1.9805	0.0074
117	1.9879	0.0074
118	1.9952	0.0074
119	2.0026	0.0073
120	2.0099	0.0073
121	2.0171	0.0073
122	2.0243	0.0072
123	2.0315	0.0072
124	2.0387	0.0072
125	2.0458	0.0071
126	2.0529	0.0071
127	2.0600	0.0071
128	2.0670	0.0070
129	2.0740	0.0070
130	2.0810	0.0070
131	2.0879	0.0069
132	2.0948	0.0069
133	2.1017	0.0069
134	2.1086	0.0069
135	2.1154	0.0068
136	2.1222	0.0068
137	2.1289	0.0068
138	2.1357	0.0067
139	2.1424	0.0067
140	2.1491	0.0067
141	2.1557	0.0067
142	2.1623	0.0066
143	2.1689	0.0066
144	2.1755	0.0066
145	2.1821	0.0066
146	2.1886	0.0065
147	2.1951	0.0065
148	2.2016	0.0065
149	2.2080	0.0064
150	2.2144	0.0064
151	2.2208	0.0064
152	2.2272	0.0064
153	2.2336	0.0064
154	2.2399	0.0063
155	2.2462	0.0063
156	2.2525	0.0063
157	2.2588	0.0063
158	2.2650	0.0062
159	2.2712	0.0062
160	2.2774	0.0062
161	2.2836	0.0062
162	2.2897	0.0062
163	2.2959	0.0061

164	2.3020	0.0061
165	2.3081	0.0061
166	2.3141	0.0061
167	2.3202	0.0060
168	2.3262	0.0060
169	2.3322	0.0060
170	2.3382	0.0060
171	2.3442	0.0060
172	2.3501	0.0059
173	2.3560	0.0059
174	2.3619	0.0059
175	2.3678	0.0059
176	2.3737	0.0059
177	2.3795	0.0058
178	2.3854	0.0058
179	2.3912	0.0058
180	2.3970	0.0058
181	2.4027	0.0058
182	2.4085	0.0058
183	2.4142	0.0057
184	2.4200	0.0057
185	2.4257	0.0057
186	2.4314	0.0057
187	2.4370	0.0057
188	2.4427	0.0057
189	2.4483	0.0056
190	2.4539	0.0056
191	2.4595	0.0056
192	2.4651	0.0056
193	2.4707	0.0056
194	2.4762	0.0056
195	2.4818	0.0055
196	2.4873	0.0055
197	2.4928	0.0055
198	2.4983	0.0055
199	2.5038	0.0055
200	2.5092	0.0055
201	2.5147	0.0054
202	2.5201	0.0054
203	2.5255	0.0054
204	2.5309	0.0054
205	2.5363	0.0054
206	2.5417	0.0054
207	2.5470	0.0054
208	2.5523	0.0053
209	2.5577	0.0053
210	2.5630	0.0053
211	2.5683	0.0053
212	2.5736	0.0053
213	2.5788	0.0053
214	2.5841	0.0053
215	2.5893	0.0052
216	2.5945	0.0052
217	2.5997	0.0052
218	2.6049	0.0052
219	2.6101	0.0052
220	2.6153	0.0052

221	2.6205	0.0052
222	2.6256	0.0051
223	2.6307	0.0051
224	2.6359	0.0051
225	2.6410	0.0051
226	2.6460	0.0051
227	2.6511	0.0051
228	2.6562	0.0051
229	2.6613	0.0051
230	2.6663	0.0050
231	2.6713	0.0050
232	2.6763	0.0050
233	2.6813	0.0050
234	2.6863	0.0050
235	2.6913	0.0050
236	2.6963	0.0050
237	2.7012	0.0050
238	2.7062	0.0049
239	2.7111	0.0049
240	2.7160	0.0049
241	2.7210	0.0049
242	2.7259	0.0049
243	2.7307	0.0049
244	2.7356	0.0049
245	2.7405	0.0049
246	2.7453	0.0049
247	2.7502	0.0048
248	2.7550	0.0048
249	2.7598	0.0048
250	2.7646	0.0048
251	2.7694	0.0048
252	2.7742	0.0048
253	2.7790	0.0048
254	2.7838	0.0048
255	2.7885	0.0048
256	2.7933	0.0047
257	2.7980	0.0047
258	2.8027	0.0047
259	2.8074	0.0047
260	2.8121	0.0047
261	2.8168	0.0047
262	2.8215	0.0047
263	2.8262	0.0047
264	2.8309	0.0047
265	2.8355	0.0047
266	2.8402	0.0046
267	2.8448	0.0046
268	2.8494	0.0046
269	2.8540	0.0046
270	2.8586	0.0046
271	2.8632	0.0046
272	2.8678	0.0046
273	2.8724	0.0046
274	2.8770	0.0046
275	2.8815	0.0046
276	2.8861	0.0045
277	2.8906	0.0045

278	2.8951	0.0045
279	2.8996	0.0045
280	2.9042	0.0045
281	2.9087	0.0045
282	2.9131	0.0045
283	2.9176	0.0045
284	2.9221	0.0045
285	2.9266	0.0045
286	2.9310	0.0045
287	2.9355	0.0044
288	2.9399	0.0044

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0044	0.0008	0.0037
2	0.0044	0.0008	0.0037
3	0.0045	0.0008	0.0037
4	0.0045	0.0008	0.0037
5	0.0045	0.0008	0.0037
6	0.0045	0.0008	0.0037
7	0.0045	0.0008	0.0037
8	0.0045	0.0008	0.0038
9	0.0045	0.0008	0.0038
10	0.0046	0.0008	0.0038
11	0.0046	0.0008	0.0038
12	0.0046	0.0008	0.0038
13	0.0046	0.0008	0.0038
14	0.0046	0.0008	0.0038
15	0.0046	0.0008	0.0038
16	0.0046	0.0008	0.0038
17	0.0047	0.0008	0.0039
18	0.0047	0.0008	0.0039
19	0.0047	0.0008	0.0039
20	0.0047	0.0008	0.0039
21	0.0047	0.0008	0.0039
22	0.0047	0.0008	0.0039
23	0.0048	0.0008	0.0039
24	0.0048	0.0008	0.0040
25	0.0048	0.0008	0.0040
26	0.0048	0.0008	0.0040
27	0.0048	0.0008	0.0040
28	0.0048	0.0008	0.0040
29	0.0049	0.0008	0.0040
30	0.0049	0.0008	0.0040
31	0.0049	0.0008	0.0041
32	0.0049	0.0008	0.0041
33	0.0049	0.0008	0.0041
34	0.0049	0.0008	0.0041
35	0.0050	0.0008	0.0041
36	0.0050	0.0008	0.0041
37	0.0050	0.0009	0.0041
38	0.0050	0.0009	0.0042
39	0.0050	0.0009	0.0042
40	0.0050	0.0009	0.0042
41	0.0051	0.0009	0.0042

42	0.0051	0.0009	0.0042
43	0.0051	0.0009	0.0042
44	0.0051	0.0009	0.0042
45	0.0051	0.0009	0.0043
46	0.0052	0.0009	0.0043
47	0.0052	0.0009	0.0043
48	0.0052	0.0009	0.0043
49	0.0052	0.0009	0.0043
50	0.0052	0.0009	0.0043
51	0.0053	0.0009	0.0044
52	0.0053	0.0009	0.0044
53	0.0053	0.0009	0.0044
54	0.0053	0.0009	0.0044
55	0.0054	0.0009	0.0044
56	0.0054	0.0009	0.0045
57	0.0054	0.0009	0.0045
58	0.0054	0.0009	0.0045
59	0.0054	0.0009	0.0045
60	0.0055	0.0009	0.0045
61	0.0055	0.0009	0.0046
62	0.0055	0.0009	0.0046
63	0.0055	0.0009	0.0046
64	0.0056	0.0009	0.0046
65	0.0056	0.0010	0.0046
66	0.0056	0.0010	0.0046
67	0.0056	0.0010	0.0047
68	0.0057	0.0010	0.0047
69	0.0057	0.0010	0.0047
70	0.0057	0.0010	0.0047
71	0.0057	0.0010	0.0048
72	0.0058	0.0010	0.0048
73	0.0058	0.0010	0.0048
74	0.0058	0.0010	0.0048
75	0.0058	0.0010	0.0048
76	0.0059	0.0010	0.0049
77	0.0059	0.0010	0.0049
78	0.0059	0.0010	0.0049
79	0.0060	0.0010	0.0049
80	0.0060	0.0010	0.0050
81	0.0060	0.0010	0.0050
82	0.0060	0.0010	0.0050
83	0.0061	0.0010	0.0050
84	0.0061	0.0010	0.0051
85	0.0062	0.0011	0.0051
86	0.0062	0.0011	0.0051
87	0.0062	0.0011	0.0052
88	0.0062	0.0011	0.0052
89	0.0063	0.0011	0.0052
90	0.0063	0.0011	0.0052
91	0.0064	0.0011	0.0053
92	0.0064	0.0011	0.0053
93	0.0064	0.0011	0.0053
94	0.0064	0.0011	0.0053
95	0.0065	0.0011	0.0054
96	0.0065	0.0011	0.0054
97	0.0066	0.0011	0.0055
98	0.0066	0.0011	0.0055

99	0.0067	0.0011	0.0055
100	0.0067	0.0011	0.0055
101	0.0067	0.0012	0.0056
102	0.0068	0.0012	0.0056
103	0.0068	0.0012	0.0057
104	0.0069	0.0012	0.0057
105	0.0069	0.0012	0.0057
106	0.0069	0.0012	0.0058
107	0.0070	0.0012	0.0058
108	0.0070	0.0012	0.0058
109	0.0071	0.0012	0.0059
110	0.0071	0.0012	0.0059
111	0.0072	0.0012	0.0060
112	0.0072	0.0012	0.0060
113	0.0073	0.0012	0.0060
114	0.0073	0.0013	0.0061
115	0.0074	0.0013	0.0061
116	0.0074	0.0013	0.0062
117	0.0075	0.0013	0.0062
118	0.0075	0.0013	0.0063
119	0.0076	0.0013	0.0063
120	0.0077	0.0013	0.0064
121	0.0077	0.0013	0.0064
122	0.0078	0.0013	0.0065
123	0.0079	0.0013	0.0065
124	0.0079	0.0014	0.0066
125	0.0080	0.0014	0.0066
126	0.0080	0.0014	0.0067
127	0.0081	0.0014	0.0067
128	0.0082	0.0014	0.0068
129	0.0083	0.0014	0.0069
130	0.0083	0.0014	0.0069
131	0.0084	0.0014	0.0070
132	0.0085	0.0014	0.0070
133	0.0086	0.0015	0.0071
134	0.0086	0.0015	0.0072
135	0.0088	0.0015	0.0073
136	0.0088	0.0015	0.0073
137	0.0089	0.0015	0.0074
138	0.0090	0.0015	0.0075
139	0.0091	0.0016	0.0076
140	0.0092	0.0016	0.0076
141	0.0093	0.0016	0.0077
142	0.0094	0.0016	0.0078
143	0.0095	0.0016	0.0079
144	0.0096	0.0016	0.0080
145	0.0116	0.0020	0.0096
146	0.0116	0.0020	0.0096
147	0.0118	0.0020	0.0098
148	0.0119	0.0020	0.0099
149	0.0121	0.0021	0.0100
150	0.0121	0.0021	0.0101
151	0.0123	0.0021	0.0102
152	0.0124	0.0021	0.0103
153	0.0126	0.0022	0.0105
154	0.0127	0.0022	0.0106
155	0.0130	0.0022	0.0107

156	0.0131	0.0022	0.0108
157	0.0133	0.0023	0.0110
158	0.0134	0.0023	0.0111
159	0.0137	0.0023	0.0113
160	0.0138	0.0024	0.0114
161	0.0141	0.0024	0.0117
162	0.0142	0.0024	0.0118
163	0.0145	0.0025	0.0121
164	0.0147	0.0025	0.0122
165	0.0150	0.0026	0.0125
166	0.0152	0.0026	0.0126
167	0.0156	0.0027	0.0129
168	0.0158	0.0027	0.0131
169	0.0163	0.0028	0.0135
170	0.0165	0.0028	0.0137
171	0.0170	0.0029	0.0141
172	0.0172	0.0029	0.0143
173	0.0178	0.0030	0.0147
174	0.0181	0.0031	0.0150
175	0.0187	0.0032	0.0155
176	0.0191	0.0033	0.0158
177	0.0198	0.0034	0.0165
178	0.0203	0.0035	0.0168
179	0.0212	0.0036	0.0176
180	0.0217	0.0037	0.0180
181	0.0229	0.0039	0.0190
182	0.0236	0.0040	0.0195
183	0.0251	0.0043	0.0208
184	0.0260	0.0044	0.0215
185	0.0219	0.0037	0.0181
186	0.0231	0.0039	0.0191
187	0.0262	0.0045	0.0217
188	0.0283	0.0048	0.0234
189	0.0341	0.0058	0.0283
190	0.0385	0.0066	0.0319
191	0.0550	0.0081	0.0468
192	0.0756	0.0081	0.0674
193	0.2366	0.0081	0.2285
194	0.0448	0.0077	0.0371
195	0.0308	0.0053	0.0255
196	0.0245	0.0042	0.0203
197	0.0269	0.0046	0.0223
198	0.0243	0.0041	0.0201
199	0.0223	0.0038	0.0185
200	0.0207	0.0035	0.0172
201	0.0194	0.0033	0.0161
202	0.0184	0.0031	0.0152
203	0.0175	0.0030	0.0145
204	0.0167	0.0029	0.0139
205	0.0160	0.0027	0.0133
206	0.0154	0.0026	0.0128
207	0.0149	0.0025	0.0123
208	0.0144	0.0025	0.0119
209	0.0139	0.0024	0.0116
210	0.0135	0.0023	0.0112
211	0.0132	0.0023	0.0109
212	0.0128	0.0022	0.0106

213	0.0125	0.0021	0.0104
214	0.0122	0.0021	0.0101
215	0.0120	0.0020	0.0099
216	0.0117	0.0020	0.0097
217	0.0097	0.0017	0.0080
218	0.0095	0.0016	0.0078
219	0.0092	0.0016	0.0077
220	0.0091	0.0015	0.0075
221	0.0089	0.0015	0.0074
222	0.0087	0.0015	0.0072
223	0.0085	0.0015	0.0071
224	0.0084	0.0014	0.0069
225	0.0082	0.0014	0.0068
226	0.0081	0.0014	0.0067
227	0.0080	0.0014	0.0066
228	0.0078	0.0013	0.0065
229	0.0077	0.0013	0.0064
230	0.0076	0.0013	0.0063
231	0.0075	0.0013	0.0062
232	0.0074	0.0013	0.0061
233	0.0073	0.0012	0.0060
234	0.0072	0.0012	0.0059
235	0.0071	0.0012	0.0059
236	0.0070	0.0012	0.0058
237	0.0069	0.0012	0.0057
238	0.0068	0.0012	0.0056
239	0.0067	0.0011	0.0056
240	0.0066	0.0011	0.0055
241	0.0066	0.0011	0.0054
242	0.0065	0.0011	0.0054
243	0.0064	0.0011	0.0053
244	0.0063	0.0011	0.0052
245	0.0063	0.0011	0.0052
246	0.0062	0.0011	0.0051
247	0.0061	0.0010	0.0051
248	0.0061	0.0010	0.0050
249	0.0060	0.0010	0.0050
250	0.0059	0.0010	0.0049
251	0.0059	0.0010	0.0049
252	0.0058	0.0010	0.0048
253	0.0058	0.0010	0.0048
254	0.0057	0.0010	0.0047
255	0.0057	0.0010	0.0047
256	0.0056	0.0010	0.0047
257	0.0056	0.0010	0.0046
258	0.0055	0.0009	0.0046
259	0.0055	0.0009	0.0045
260	0.0054	0.0009	0.0045
261	0.0054	0.0009	0.0045
262	0.0053	0.0009	0.0044
263	0.0053	0.0009	0.0044
264	0.0053	0.0009	0.0044
265	0.0052	0.0009	0.0043
266	0.0052	0.0009	0.0043
267	0.0051	0.0009	0.0043
268	0.0051	0.0009	0.0042
269	0.0051	0.0009	0.0042

270	0.0050	0.0009	0.0042
271	0.0050	0.0009	0.0041
272	0.0049	0.0008	0.0041
273	0.0049	0.0008	0.0041
274	0.0049	0.0008	0.0040
275	0.0048	0.0008	0.0040
276	0.0048	0.0008	0.0040
277	0.0048	0.0008	0.0040
278	0.0047	0.0008	0.0039
279	0.0047	0.0008	0.0039
280	0.0047	0.0008	0.0039
281	0.0047	0.0008	0.0039
282	0.0046	0.0008	0.0038
283	0.0046	0.0008	0.0038
284	0.0046	0.0008	0.0038
285	0.0045	0.0008	0.0038
286	0.0045	0.0008	0.0037
287	0.0045	0.0008	0.0037
288	0.0045	0.0008	0.0037

Total soil rain loss = 0.46(In)
Total effective rainfall = 2.48(In)
Peak flow rate in flood hydrograph = 27.35(CFS)

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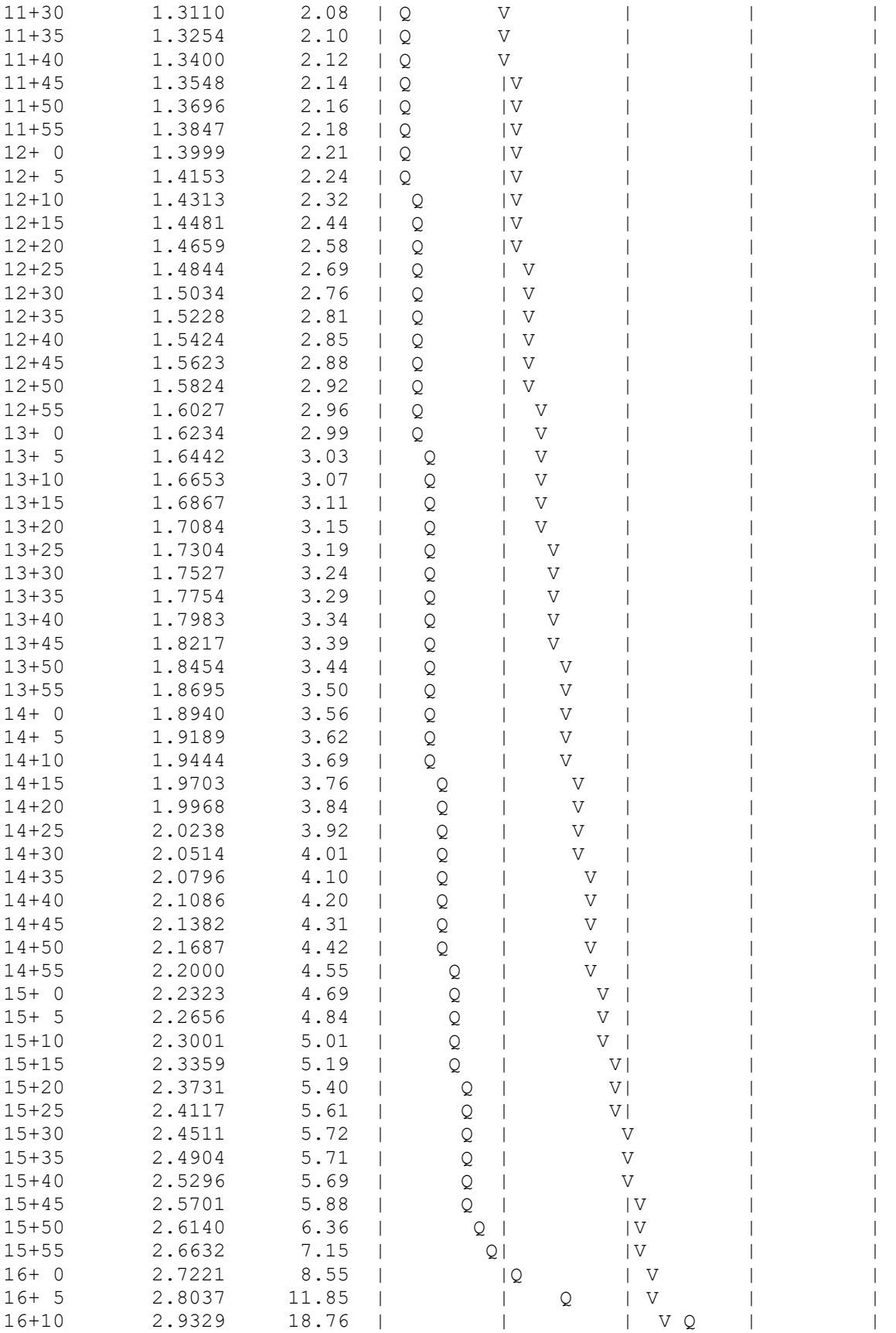
24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	7.5	15.0	22.5	30.0
0+ 5	0.0002	0.02	Q				
0+10	0.0012	0.14	Q				
0+15	0.0038	0.38	Q				
0+20	0.0084	0.68	Q				
0+25	0.0144	0.87	VQ				
0+30	0.0211	0.98	VQ				
0+35	0.0282	1.03	VQ				
0+40	0.0354	1.05	VQ				
0+45	0.0427	1.06	VQ				
0+50	0.0501	1.07	VQ				
0+55	0.0575	1.08	VQ				
1+ 0	0.0649	1.08	VQ				
1+ 5	0.0724	1.08	VQ				
1+10	0.0799	1.09	VQ				
1+15	0.0874	1.09	VQ				
1+20	0.0949	1.09	VQ				
1+25	0.1025	1.10	VQ				
1+30	0.1101	1.10	VQ				
1+35	0.1177	1.10	VQ				
1+40	0.1253	1.11	|Q				
1+45	0.1329	1.11	|Q				
1+50	0.1406	1.11	|Q				
1+55	0.1483	1.12	|Q				

2+ 0	0.1560	1.12	|Q	|	|	|	|
2+ 5	0.1638	1.13	|Q	|	|	|	|
2+10	0.1716	1.13	|Q	|	|	|	|
2+15	0.1794	1.13	|Q	|	|	|	|
2+20	0.1872	1.14	|Q	|	|	|	|
2+25	0.1951	1.14	|Q	|	|	|	|
2+30	0.2030	1.14	|Q	|	|	|	|
2+35	0.2109	1.15	|Q	|	|	|	|
2+40	0.2188	1.15	|Q	|	|	|	|
2+45	0.2268	1.16	|Q	|	|	|	|
2+50	0.2348	1.16	|Q	|	|	|	|
2+55	0.2428	1.16	|Q	|	|	|	|
3+ 0	0.2508	1.17	|QV	|	|	|	|
3+ 5	0.2589	1.17	|QV	|	|	|	|
3+10	0.2670	1.18	|QV	|	|	|	|
3+15	0.2752	1.18	|QV	|	|	|	|
3+20	0.2833	1.19	|QV	|	|	|	|
3+25	0.2915	1.19	|QV	|	|	|	|
3+30	0.2997	1.19	|QV	|	|	|	|
3+35	0.3080	1.20	|QV	|	|	|	|
3+40	0.3163	1.20	|QV	|	|	|	|
3+45	0.3246	1.21	|QV	|	|	|	|
3+50	0.3330	1.21	|QV	|	|	|	|
3+55	0.3413	1.22	|QV	|	|	|	|
4+ 0	0.3497	1.22	|QV	|	|	|	|
4+ 5	0.3582	1.23	|QV	|	|	|	|
4+10	0.3667	1.23	|QV	|	|	|	|
4+15	0.3752	1.24	|Q V	|	|	|	|
4+20	0.3837	1.24	|Q V	|	|	|	|
4+25	0.3923	1.25	|Q V	|	|	|	|
4+30	0.4009	1.25	|Q V	|	|	|	|
4+35	0.4096	1.26	|Q V	|	|	|	|
4+40	0.4182	1.26	|Q V	|	|	|	|
4+45	0.4270	1.27	|Q V	|	|	|	|
4+50	0.4357	1.27	|Q V	|	|	|	|
4+55	0.4445	1.28	|Q V	|	|	|	|
5+ 0	0.4533	1.28	|Q V	|	|	|	|
5+ 5	0.4622	1.29	|Q V	|	|	|	|
5+10	0.4711	1.29	|Q V	|	|	|	|
5+15	0.4800	1.30	|Q V	|	|	|	|
5+20	0.4890	1.30	|Q V	|	|	|	|
5+25	0.4980	1.31	|Q V	|	|	|	|
5+30	0.5071	1.31	|Q V	|	|	|	|
5+35	0.5162	1.32	|Q V	|	|	|	|
5+40	0.5253	1.33	|Q V	|	|	|	|
5+45	0.5345	1.33	|Q V	|	|	|	|
5+50	0.5437	1.34	|Q V	|	|	|	|
5+55	0.5529	1.34	|Q V	|	|	|	|
6+ 0	0.5622	1.35	|Q V	|	|	|	|
6+ 5	0.5716	1.36	|Q V	|	|	|	|
6+10	0.5810	1.36	|Q V	|	|	|	|
6+15	0.5904	1.37	|Q V	|	|	|	|
6+20	0.5999	1.38	|Q V	|	|	|	|
6+25	0.6094	1.38	|Q V	|	|	|	|
6+30	0.6189	1.39	|Q V	|	|	|	|
6+35	0.6286	1.40	|Q V	|	|	|	|
6+40	0.6382	1.40	|Q V	|	|	|	|

6+45	0.6479	1.41	|Q V |	|	|	|
6+50	0.6577	1.42	|Q V |	|	|	|
6+55	0.6675	1.42	|Q V |	|	|	|
7+ 0	0.6773	1.43	|Q V |	|	|	|
7+ 5	0.6872	1.44	|Q V |	|	|	|
7+10	0.6972	1.44	|Q V |	|	|	|
7+15	0.7072	1.45	|Q V |	|	|	|
7+20	0.7172	1.46	|Q V |	|	|	|
7+25	0.7273	1.47	|Q V |	|	|	|
7+30	0.7375	1.48	|Q V |	|	|	|
7+35	0.7477	1.48	|Q V |	|	|	|
7+40	0.7580	1.49	|Q V |	|	|	|
7+45	0.7683	1.50	|Q V |	|	|	|
7+50	0.7787	1.51	| Q V |	|	|	|
7+55	0.7891	1.52	| Q V |	|	|	|
8+ 0	0.7996	1.52	| Q V |	|	|	|
8+ 5	0.8102	1.53	| Q V |	|	|	|
8+10	0.8208	1.54	| Q V |	|	|	|
8+15	0.8315	1.55	| Q V |	|	|	|
8+20	0.8423	1.56	| Q V |	|	|	|
8+25	0.8531	1.57	| Q V |	|	|	|
8+30	0.8639	1.58	| Q V |	|	|	|
8+35	0.8749	1.59	| Q V |	|	|	|
8+40	0.8859	1.60	| Q V |	|	|	|
8+45	0.8970	1.61	| Q V |	|	|	|
8+50	0.9081	1.62	| Q V |	|	|	|
8+55	0.9193	1.63	| Q V |	|	|	|
9+ 0	0.9306	1.64	| Q V |	|	|	|
9+ 5	0.9420	1.65	| Q V |	|	|	|
9+10	0.9534	1.66	| Q V |	|	|	|
9+15	0.9649	1.67	| Q V |	|	|	|
9+20	0.9765	1.68	| Q V |	|	|	|
9+25	0.9882	1.69	| Q V |	|	|	|
9+30	1.0000	1.71	| Q V |	|	|	|
9+35	1.0118	1.72	| Q V |	|	|	|
9+40	1.0237	1.73	| Q V |	|	|	|
9+45	1.0357	1.74	| Q V |	|	|	|
9+50	1.0478	1.76	| Q V |	|	|	|
9+55	1.0600	1.77	| Q V |	|	|	|
10+ 0	1.0722	1.78	| Q V |	|	|	|
10+ 5	1.0846	1.79	| Q V |	|	|	|
10+10	1.0970	1.81	| Q V |	|	|	|
10+15	1.1096	1.82	| Q V|	|	|	|
10+20	1.1222	1.84	| Q V|	|	|	|
10+25	1.1350	1.85	| Q V|	|	|	|
10+30	1.1478	1.87	| Q V|	|	|	|
10+35	1.1608	1.88	| Q V|	|	|	|
10+40	1.1739	1.90	| Q V|	|	|	|
10+45	1.1870	1.91	| Q V|	|	|	|
10+50	1.2003	1.93	| Q V|	|	|	|
10+55	1.2137	1.95	| Q V|	|	|	|
11+ 0	1.2272	1.96	| Q V |	|	|	|
11+ 5	1.2409	1.98	| Q V |	|	|	|
11+10	1.2546	2.00	| Q V |	|	|	|
11+15	1.2685	2.02	| Q V |	|	|	|
11+20	1.2826	2.04	| Q V |	|	|	|
11+25	1.2967	2.06	| Q V |	|	|	|



16+15	3.1061	25.14	|	|	|	V	|	Q	|
16+20	3.2944	27.35	|	|	|	V	|	Q	|
16+25	3.4342	20.30	|	|	|	QV	|		|
16+30	3.5282	13.64	|	|	Q |	V	|		|
16+35	3.5953	9.74	|	Q |	|	V	|		|
16+40	3.6468	7.48	|	Q |	|	V	|		|
16+45	3.6903	6.32	|	Q |	|	V	|		|
16+50	3.7305	5.84	|	Q |	|	V	|		|
16+55	3.7674	5.36	|	Q |	|	V	|		|
17+ 0	3.8002	4.76	|	Q |	|	|	V		|
17+ 5	3.8310	4.47	|	Q |	|	|	V		|
17+10	3.8602	4.24	|	Q |	|	|	V		|
17+15	3.8880	4.04	|	Q |	|	|	V		|
17+20	3.9146	3.87	|	Q |	|	|	V		|
17+25	3.9402	3.71	|	Q |	|	|	V		|
17+30	3.9648	3.58	|	Q |	|	|	V		|
17+35	3.9886	3.46	|	Q |	|	|	V		|
17+40	4.0117	3.35	|	Q |	|	|	V		|
17+45	4.0341	3.25	|	Q |	|	|	V		|
17+50	4.0558	3.16	|	Q |	|	|	V		|
17+55	4.0770	3.08	|	Q |	|	|	V		|
18+ 0	4.0976	3.00	|	Q |	|	|	V		|
18+ 5	4.1177	2.92	|	Q |	|	|	V		|
18+10	4.1371	2.80	|	Q |	|	|	V		|
18+15	4.1553	2.65	|	Q |	|	|	V		|
18+20	4.1723	2.47	|	Q |	|	|	V		|
18+25	4.1884	2.34	|	Q |	|	|	V		|
18+30	4.2039	2.25	|	Q |	|	|	V		|
18+35	4.2189	2.18	|	Q |	|	|	V		|
18+40	4.2335	2.13	|	Q |	|	|	V		|
18+45	4.2479	2.08	|	Q |	|	|	V		|
18+50	4.2619	2.04	|	Q |	|	|	V		|
18+55	4.2757	2.00	|	Q |	|	|	V		|
19+ 0	4.2892	1.97	|	Q |	|	|	V		|
19+ 5	4.3025	1.93	|	Q |	|	|	V		|
19+10	4.3156	1.90	|	Q |	|	|	V		|
19+15	4.3285	1.87	|	Q |	|	|	V		|
19+20	4.3411	1.84	|	Q |	|	|	V		|
19+25	4.3536	1.81	|	Q |	|	|	V		|
19+30	4.3659	1.78	|	Q |	|	|	V		|
19+35	4.3780	1.76	|	Q |	|	|	V		|
19+40	4.3899	1.73	|	Q |	|	|	V		|
19+45	4.4017	1.71	|	Q |	|	|		V	|
19+50	4.4132	1.68	|	Q |	|	|		V	|
19+55	4.4247	1.66	|	Q |	|	|		V	|
20+ 0	4.4360	1.64	|	Q |	|	|		V	|
20+ 5	4.4471	1.62	|	Q |	|	|		V	|
20+10	4.4582	1.60	|	Q |	|	|		V	|
20+15	4.4690	1.58	|	Q |	|	|		V	|
20+20	4.4798	1.56	|	Q |	|	|		V	|
20+25	4.4904	1.54	|	Q |	|	|		V	|
20+30	4.5009	1.53	|	Q |	|	|		V	|
20+35	4.5113	1.51	|	Q |	|	|		V	|
20+40	4.5216	1.49	|	Q |	|	|		V	|
20+45	4.5318	1.48	|	Q |	|	|		V	|
20+50	4.5418	1.46	|	Q |	|	|		V	|
20+55	4.5518	1.45	|	Q |	|	|		V	|

21+ 0	4.5616	1.43	|Q	|	|	|	V |
21+ 5	4.5714	1.42	|Q	|	|	|	V |
21+10	4.5810	1.40	|Q	|	|	|	V |
21+15	4.5906	1.39	|Q	|	|	|	V |
21+20	4.6001	1.38	|Q	|	|	|	V |
21+25	4.6095	1.36	|Q	|	|	|	V |
21+30	4.6188	1.35	|Q	|	|	|	V |
21+35	4.6280	1.34	|Q	|	|	|	V |
21+40	4.6371	1.33	|Q	|	|	|	V |
21+45	4.6462	1.31	|Q	|	|	|	V |
21+50	4.6552	1.30	|Q	|	|	|	V |
21+55	4.6641	1.29	|Q	|	|	|	V |
22+ 0	4.6729	1.28	|Q	|	|	|	V |
22+ 5	4.6816	1.27	|Q	|	|	|	V |
22+10	4.6903	1.26	|Q	|	|	|	V |
22+15	4.6989	1.25	|Q	|	|	|	V |
22+20	4.7075	1.24	|Q	|	|	|	V |
22+25	4.7160	1.23	|Q	|	|	|	V |
22+30	4.7244	1.22	|Q	|	|	|	V |
22+35	4.7327	1.21	|Q	|	|	|	V |
22+40	4.7410	1.20	|Q	|	|	|	V |
22+45	4.7492	1.19	|Q	|	|	|	V |
22+50	4.7574	1.19	|Q	|	|	|	V |
22+55	4.7655	1.18	|Q	|	|	|	V |
23+ 0	4.7736	1.17	|Q	|	|	|	V|
23+ 5	4.7816	1.16	|Q	|	|	|	V|
23+10	4.7895	1.15	|Q	|	|	|	V|
23+15	4.7974	1.14	|Q	|	|	|	V|
23+20	4.8052	1.14	|Q	|	|	|	V|
23+25	4.8130	1.13	|Q	|	|	|	V|
23+30	4.8207	1.12	|Q	|	|	|	V|
23+35	4.8284	1.11	|Q	|	|	|	V|
23+40	4.8360	1.11	|Q	|	|	|	V|
23+45	4.8436	1.10	|Q	|	|	|	V|
23+50	4.8511	1.09	|Q	|	|	|	V|
23+55	4.8586	1.09	|Q	|	|	|	V|
24+ 0	4.8661	1.08	|Q	|	|	|	V|
24+ 5	4.8733	1.05	|Q	|	|	|	V|
24+10	4.8797	0.92	|Q	|	|	|	V|
24+15	4.8844	0.69	Q	|	|	|	V|
24+20	4.8870	0.38	Q	|	|	|	V|
24+25	4.8883	0.19	Q	|	|	|	V|
24+30	4.8889	0.09	Q	|	|	|	V|
24+35	4.8892	0.04	Q	|	|	|	V|
24+40	4.8893	0.02	Q	|	|	|	V|
24+45	4.8894	0.01	Q	|	|	|	V|
24+50	4.8894	0.01	Q	|	|	|	V
