Preliminary

Water Quality Management Plan

For:

APN: 0243-142-01

Foothill Blvd and Maple Avenue Apartment

WQMP No. WQMPPC24-00031

Prepared for:

Diversified Pacific Communities

10621 Civic Center Drive

Rancho Cucamonga, CA 91730

Phone: (909) 481-1150

Prepared by:

Allard Engineering

16866 Seville Avenue

Fontana, CA 92335

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Initial Submittal Date: 4-3-2024
Revision Date: 6-25-2024
Preliminary for Entitlements Complete Date:
Construction WQMP Complete Date:
Final WQMP Approved Date:

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Diversified Pacific Communities by **Allard Engineering**. The WQMP is intended to comply with the requirements of the City of Fontana and the NPDES Area wide 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."

Project Data			
Permit/Application Number(s):	WQMPPC24-00031	Grading Permit Number(s):	
Tract/Parcel Map Number(s):	20704	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0243-142-01

Owner's Signature			
Owner Name:	**Nolan C. Leggio**		
Title	Director		
Company	Diversified Pacific Communities		
Address	10621 Civic Center Drive Rancho Cucamonga, CA 91730		
Email	NLeggio@DiversifiedPacific.com		
Telephone #	(909) 481-1150		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	WQMPPC24-00031	Grading Permit Number(s):	
Tract/Parcel Map Number(s):	20704	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0243-142-01

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0036."

Engineer: RAYMOND ALLARD		PE Stamp Below
Title	PRESIDENT	
Company	Allard Engineering	
Address	16866 Seville Avenue	
Email	rallard@allardeng.com	
Telephone #	(909) 356-1815	
Signature		
Date		

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Section 1 Discretionary Permit(s)

Form 1-1 Project Information

Project Name	Foothill Blvd. & Maple Avenue Apartments				
Project Owner Contact Name:	Nolan C. Leggio				
Mailing Address:	10621 Civic Center Drive Rancho Cucamonga, CA 91730	E-mail Address:	NLeggio@DiversifiedPacific.com	Telephone:	(909) 481-1150
Permit/Application Number(s):	WQMPPC24-00031		Tract/Parcel Map Number(s):	20704	
Additional Information/ Comments:	Lot currently vacant (Barren condition)				
Description of Project:	The proposed project site is 8.2 acres of development for a 270-units multi-apartments including street improvement. The proposed project consists of 270-units apartments clubhouse with pool/spa/fitness center, leasing office, courtyard, garden area, planters, sidewalks, car ports, driveways, parking lots and landscaping areas. The entire project site consists of a single drainage area (DA-1) with two (2) drainage management areas (DMA-1, DMA-2). DA-1 (DMA-1, DMA-2): Proposed Onsite drainage system consists of swales, ribbon gutter, storm drains, grate inlets with filter insert spreading all over the drainage management areas (DMA-1, DMA-2). Onsite runoff will drain to the proposed onsite drainage system in DMA-1 & DMA-2 and the runoff will convey to the proposed Contech infiltration/detention chamber system (CMP-1) for low flow infiltration (WQ runoff volume) as well as detention in order to mitigate high runoff flow rates to its existing flow rates for storm event up to 100-year storm. Pre-treatment of storm water will be achieved by the proposed trash rack/filter insert in the proposed grated inlets onsite prior to drain to the underground Inf/Det Chamber System. The site in existing condition is 100% pervious and the site in proposed condition is approximately 10% pervious. For pervious/impervious area in proposed condition, please refer t0 the WQMP Exhibit. DMA-1, DMA-2: Drain to CMP-1 When the onsite infiltration/detention chamber system (CMP-1) reaches its capacity (Bottom 2.7' of CMP-1), the runoff will be detained in the CMP-1 and will drain out in a mitigated flow rates via the storm drain outlet pipes to the existing grated inlet at the northeast corner of the site ROW and will finally discharge into the existing catch basin in Foothill Blvd. Runoff will then follow the existing City Storm drain System in Foothill Blvd. The flow will				

	continue in City Strom Drain System and finally discharge to the West Fontana Channel The proposed street frontage improvements are approximately 2,050-ft (On Foothill Blvd, Maple Avenue and Barbee Street) which is less than the minimum required length of ½ mile (2,640-ft) and is exempt from water quality treatment per the San Bernardino County Transportation Project Total Guidance Document (TGD).
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	Not Applicable

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):	357,212 sf	**3** Number of Dwelling Units:	270	**4** SIC Code:	8730

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 of WQMP stormwater facilities:

Diversified Pacific Communities will be responsible to build the site and the maintenance during the construction. An property owner association (POA) will be formed and will be responsible for the maintenance of the post-developed BMPs.

Address:

Nolan C. Leggio

10621 Civic Center Drive

Rancho Cucamonga, CA 91730

Phone Number: (909) 481-1150

Email: NLeggio@DiversifiedPacific.com

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 ☐	Bacteria and viruses are a potential pollutant for Residential Apartment developments if the land use involves animal waste. Due to the nature of the development there will be animal waste associated with this land use, and the site will be treated using site and source and treatment control BMPs. Bacteria and virus can also be detected in pavement runoff, therefore, the site has incorporated treatment control throughout. All paved and hardened surfaces will flow through the below ground infiltration chambers as part of Low Impact Design (LID).
Sediment	E ☒	N ☐	These are the solid materials eroded from land surface (park, landscape area). The eroded materials from onsite land surfaces will be first mitigated by the proposed pre-treatment units (Filter Inserts in Grate Inlets) and ultimate by the proposed below ground infiltration chambers. Impacted Water Body: None
Metals	E ☒	N ☐	Source of metal will be the falling/scrap pieces/parts of Motor vehicles. Any metal pieces in the parking lot/driveways will be picked up by street sweeper and also intercepted in the proposed grate inlets w/filter insert and in the below ground infiltration chambers as part of Low Impact Design (LID). Impacted Water Body: None
Oil and Grease	E ☒	N ☐	Source of Oil & Grease at this site will be the motor product from leaking vehicles. Oil and grease from parking lot/driveways will be drained to the proposed grate inlets w/filter insert and the below ground infiltration chambers to treat the pollutants as part of Low Impact Design (LID). Impacted Water Body: None
Trash/Debris	E ☒	N ☐	Trash and debris will be contained by the proposed filter insert in the proposed grate inlets proposed at the site. Also ultimately contained by the proposed below ground infiltration chambers. Impacted Water Body: None.
Pesticides / Herbicides	E ☒	N ☐	The potential pesticides and herbicides from landscape area will be contained in the proposed infiltration chambers for treatment and removal. Impacted Water Body: None

Organic Compounds	E ☒	N ☐	It's includes hydrocarbons from driveways/paved parking lot. Hydrocarbon will be conveyed to the infiltration chambers via onsite drainage system for containment and removal. Impacted Water Body: None
Other: Nutrients	E ☒	N ☐	Include nitrogen and phosphorus from expected usages of fertilizers in the proposed landscape area. Impacted Water Body: None
Other: Oxygen Demanding Compounds	E ☒	N ☐	This site includes landscaping area which will be the potential generation of this type of pollutants. Impacted Water Body: None

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)	N/A

Section 3 Site and Watershed Description

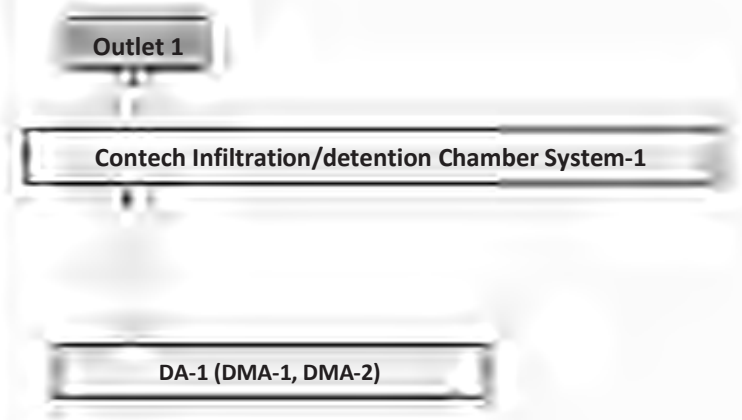
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and 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 34.10773 N	Longitude -117.406475 W	

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	
DA1 (DMA-1 & DMA-2) to Outlet 1	The entire project site consists of a single drainage area (DA-1) with two (2) drainage management areas (DMA-1, DMA-2). DA-1 (DMA-1, DMA-2): Proposed Onsite drainage system consists of swales, ribbon gutter, storm drains, grate inlets with filter insert spreading all over the drainage management areas (DMA-1, DMA-2). Onsite runoff will drain to the proposed onsite drainage system in DMA-1 & DMA-2 and the runoff will convey to the proposed Contech infiltration/detention chamber system (CMP-1) for low flow infiltration (WQ runoff volume) as well as detention in order to mitigate high runoff flow rates to its existing flow rates for storm event up to 100-year storm. Pre-treatment of storm water will be achieved by the proposed trash rack/filter insert in the proposed

	grated inlets onsite prior to drain to the underground Inf/Det Chamber System. The site in existing condition is 100% pervious and the site in proposed condition is approximately 10% pervious. For pervious/impervious area in proposed condition, please refer t0 the WQMP Exhibit. DMA-1, DMA-2: Drain to CMP-1 When the onsite infiltration/detention chamber system (CMP-1) reaches its capacity (Bottom 2.7' of CMP-1), the runoff will be detained in the CMP-1 and will drain out in a mitigated flow rates via the storm drain outlet pipes to the existing grated inlet at the northeast corner of the site ROW and will finally discharge into the existing catch basin in Foothill Blvd. Runoff will then follow the existing City Storm drain System in Foothill Blvd. The flow will continue in City Strom Drain System and finally discharge to the West Fontana Channel

Form 3-2 Existing Hydrologic Characteristics for Drainage Areas (DA-1)

For Drainage Areas 1-3 sub-watershed DMA, provide the following characteristics	DA1 (DMA-1, DMA-2)			
1 DMA drainage area (ft^2)	357,212			
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://sbcounty.permitrack.com/WAP*	A			
5 Longest flowpath length (ft)	810			
6 Longest flowpath slope (ft/ft)	1.6%			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Open Brush			
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			

SITE
EXISTING CONDITION
Google Earth
© 2023 Google
© 2024 Google
N
6.43 ft

SITE
EXISTING CONDITION
Google Earth
© 2023 Google
© 2024 Google
5.15 ft

Form 3-3 Watershed Description for Drainage Area (DA1)

Receiving waters *Refer to Watershed Mapping Tool -* *http://sbcounty.permitrack.com/WAP* *See 'Drainage Facilities" link at this website*	Existing storm drain system in Foothill Blvd Rialto Channel (EHM) Santa Ana River Reach 4 Predo Dam Santa Ana River Reach 3 Santa Ana River Reach 2 Santa Ana River Reach 1 Pacific Ocean
Applicable TMDLs *Refer to Local Implementation Plan*	Santa Ana River Reach 3: Pathogens "Bacterial Indicator TMLDs for Middle Santa Ana River Watershed Waterbodies (Bill Rice) Nitrate : Santa Ana River Reach 3 Nitrate TMDL (Hope Smythe) Prado Flood Control basin Pathogens "Bacterial Indicator TMLDs for Middle Santa Ana River Watershed Waterbodies (Bill Rice) Santa Ana River Reach 2 NONE Santa Ana River Reach 1 NONE Tidal Prism, Santa Ana River NONE
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP and State Water Resources Control Board website – http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml*	Expected pollutants of concern include heavy metals, organic compounds, trash/debris and oil/grease. Potential pollutants of concern include bacteria vitus, nutrients, pesticides, sediments, and oxygen demanding substances. There is no evidence to suggest that any other pollutants will be produced from the project site other than these 303(d) listed impairment Santa Ana River Reach 3: Pathogens, Metals (copper & lead) Prado Flood Control Basin: Pathogens and Nutrients Santa Ana River Reach 2: Pathogens Santa Ana River Reach 1 and Tidal prism Santa Ana River : NONE
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	NONE
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	Santa Ana River

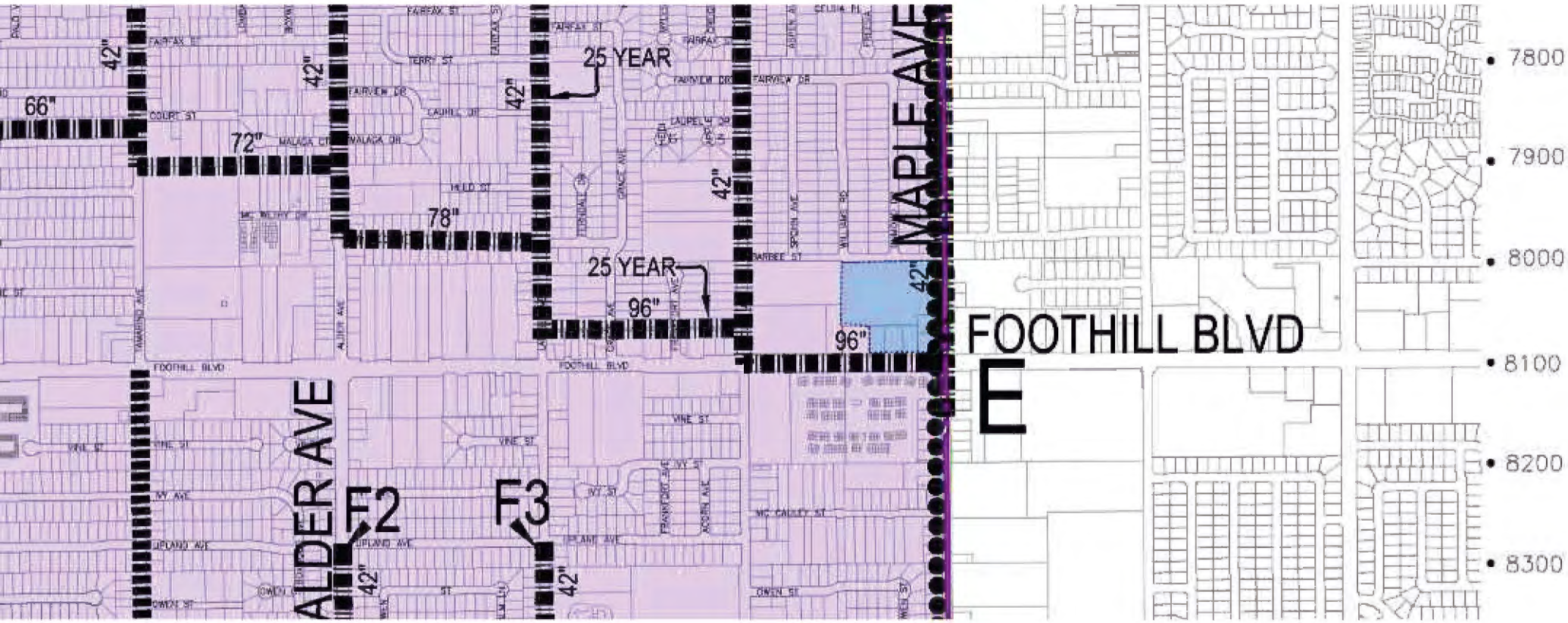
Hydrologic Conditions of Concern	☒ Yes *Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal* ☐ No
Watershed–based BMP included in a RWQCB approved WAP	☐ Yes *Attach verification of regional BMP evaluation 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

City of Fontana

Improvement Plans

Sewer Storm Drain Street Improvements

Esri, NASA, NGA, USGS, FEMA | Esri Community Maps Contributors, County of San Bernardino, California State Parks, © OpenStreetMap, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS... Powered by Esri


42"
66"
72"
78"
42"
42"
25 YEAR
42"
25 YEAR
96"
42"
96"
MARLE AVE
FOOTHILL BLVD
E
ALDER AVE
F2
F3
42"
42"
7800
7900
8000
8100
8200
8300

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	☒	☐	Practical education materials will be provided to property owner and assigned HOA and Maintenance staffs covering various water quality issues that will need to be addressed on their specific site. These materials will include general practices that contribute to the protection of storm water quality and BMP's that eliminate or reduce pollution during property improvements. The developer will request these materials in writing at least 30 days prior to intended distribution and will then be responsible for publication and distribution.
N2	Activity Restrictions	☒	☐	Restrictions may be developed by property owner/HOA or other mechanisms. Pesticide applications will be performed by an applicator certified by the California Department of Pesticide Regulation. Vehicle washing will be prohibited.
N3	Landscape Management BMPs	☒	☐	According to the California Stormwater Quality Associations Stormwater Best Management Practice Handbook, landscape planning is implemented to reduce groundwater and storm water contamination. This will be accomplished through an infiltration chambers, and landscape areas.
N4	BMP Maintenance	☒	☐	See section 5, Table 5.1 for details on BMP maintenance
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Not applicable. No hazardous waste onsite
N6	Local Water Quality Ordinances	☒	☐	Comply with applicable local water quality ordinances.
N7	Spill Contingency Plan	☒	☐	Not applicable. Residential Property
N8	Underground Storage Tank Compliance	☐	☒	No underground storage tank on the site.

Form 4.1-1 Non-Structural Source Control BMPs

N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials in the site.

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	☒	☐	Compliance with Article 80 of the Uniform Fire Code enforced by the fire protection agency.
N11	Litter/Debris Control Program	☒	☐	Will be responsible by landscaper contractor assigned by Owner/HOA. Litter/debris control once every two weeks.
N12	Employee Training	☒	☐	Gardeners and other maintenance staff will have training regarding the location and maintenance of the BMPs.
N13	Housekeeping of Loading Docks	☐	☒	Not applicable
N14	Catch Basin Inspection Program	☒	☐	Grate inlets will be inspected a minimum of once every three months during the dry season and a minimum of once every two months during the rainy season.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Streets and driveways will be vacuum sweep by the by landscaper contractor assigned by Owner/HOA. At a minimum all paved areas shall be swept, in late summer or early fall. Prior to the start of the rainy season.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not applicable

N17	Comply with all other applicable NPDES permits	☒	☐	NPDES permit for stormwater discharges (ORDER NO> CASE000002) will be rquired.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	Storm drain stencils or signage prohibiting dumping and discharge of materials ("No Dumping – Drains to Ocean") shall be provided adjacent to each of the project's proposed inlets. The stencils shall be inspected and re-stenciled as needed to maintain legibility.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No material storages areas in the project
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☐	☒	No trash and waste storage areas are proposed on the project.
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)	☒	☐	In conjunction with routine landscaping maintenance activities, inspect irrigation for signs of leaks, overspray and repair or adjust accordingly. Adjust system cycle to accommodate seasonal fluctuations in water demand and temperatures. Ensure use of native or drought tolerant/non-invasive plant species to minimize water consumption.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	New landscaped areas will be constructed at a minimum of 1 inch below existing paved areas. Notes and details will be provided in grading plans.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☐	☒	Not Applicable. No Slopes/channel onsite
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	Avoid disturbance of the infiltration/retention basins, and inlet/outlet pipes will have energy dissipation.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	No covered dock areas, Not applicable
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Not Applicable, Residential Property

S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No outdoor Processing, Not applicable

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No equipment wash areas, Not applicable
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No Fueling Areas, Not applicable
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No Hillside Landscaping, Not applicable
S14	Wash water control for food preparation areas	☐	☒	No food Preparation, Not applicable
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	No Community Car Wash, Not applicable

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: We will build multiple open space/landscape/planter areas in addition to Contech infiltration/detention chamber.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: Contech infiltration/detention chamber will be implemented on site. Surface/Roof drains will discharge runoff towards landscape areas, indirectly connecting impervious areas before runoff reaches the onsite storm drain. Detail will be provided in grading plans.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: The site currently drains southeast to the gutter in Foothill Blvd.. Post developed flow will also drain to the street and to Rialto Channel via the proposed drainage system onsite and existing City Storm Drain System in Foothill Blvd. This is consistent with existing flow pattern.
Disconnect impervious areas: Yes ☒ No ☐ Explanation: Impervious areas will drain into landscaped areas.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: There are no environmentally sensitive portions onsite and existing vegetation will be kept as much as possible.
Re-vegetate disturbed areas: Yes ☒ No ☐ Explanation: Part of the disturbed areas will be revegeated per landscape plan.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: No compaction will be performed within the area where the Contech infiltration/detention chamber is proposed.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Runoff will also be intercepted by the Contech infiltration/detention chamber and multiple landscaped areas. Notes will be provided in grading plan.
Stake off areas that will be used for landscaping to minimize compaction during construction: Yes ☒ No ☐ Explanation: No compaction will be performed within the area where landscape areas are proposed. Notes will be provided in grading plan.

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 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for 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: DMA 1)

1 Project area DMA 1 (ft^2): 204,732	**2** Imperviousness after applying preventative site design practices (Imp%): 90%	**3** Runoff Coefficient (Rc): 0.73 *$R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.626 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.9271 *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): 22,675 *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*		

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: DMA 2)

1 Project area DMA 1 (ft^2): 152,460	**2** Imperviousness after applying preventative site design practices (Imp%): 90%	**3** Runoff Coefficient (Rc): 0.73 *$R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.626 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.9271 *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): 16,886 *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*		

Total DCV generate from the entire site drainage area (DA-1): 39,561 cu-ft

Target Captured Volume
Watershed DMA 1

1) Calculate the "Watershed Imperviousness Ratio", I which is equal to the percent of impervious area in the BMP Drainage Area divided by 100

Imperviousness(i)= **0.9**

Total Acreage(A) = **4.70** 204,732

2) Calculate the composite Runoff Coefficient C_{bmp} for the drainage area

$C_{bmp} = 0.858i^3-0.78i^2+0.774i+0.04$

C_{bmp} = 0.73

3) Determine which Regression Coefficient to use by region the project is located in

Valley	1.481
Mountain	1.909
Desert	1.237

Regression coefficient for this project is: 1.481

4) Determine the area averaged "6 hour Mean Storm Rainfall" , P_6

2 yr 1 Hr Rainfall Depth per NOAA Atlas 14= **0.626** inches

P_6 = 2 yr 1 hr Rainfall x Regression coefficient

P_6 = 0.9271 inches

5) Determine Regression Constant (a) for 48 hour drawdown

a for 24 hour = 1.582
a for 48 hour = 1.963

a = 1.963

6) Calculate the Maximized Detention Volume, P_0

$P_0 = C \times a \times P6$

Po(inches) = 1.3290

7) Calculate the Target Capture Volume, V_0, in acre feet

$V_0 = (P_0 * A)/12$

V_0 = 0.52 acre-feet
V_0 = 22,675 CF

Target Captured Volume
Watershed DMA 2

1) Calculate the "Watershed Imperviousness Ratio", I which is equal to the percent of impervious area in the BMP Drainage Area divided by 100

Imperviousness(i)= **0.9**

Total Acreage(A) = **3.50** 152,460

2) Calculate the composite Runoff Coefficient C_{bmp} for the drainage area

$C_{bmp} = 0.858i^3-0.78i^2+0.774i+0.04$

C_{bmp} = 0.73

3) Determine which Regression Coefficient to use by region the project is located in

Valley	1.481
Mountain	1.909
Desert	1.237

Regression coefficient for this project is: 1.481

4) Determine the area averaged "6 hour Mean Storm Rainfall" , P_6

2 yr 1 Hr Rainfall Depth per NOAA Atlas 14= **0.626** inches

P_6 = 2 yr 1 hr Rainfall x Regression coefficient

P_6 = 0.9271 inches

5) Determine Regression Constant (a) for 48 hour drawdown

a for 24 hour = 1.582
a for 48 hour = 1.963

a = 1.963

6) Calculate the Maximized Detention Volume, P_0

P_0 = C x a x P6

Po(inches) = 1.3290

7) Calculate the Target Capture Volume, V_0, in acre feet

$V_0 = (P_0 * A)/12$

V_0 = 0.39 acre-feet
V_0 = 16,886 CF

Form 4.2-2 Summary of HCOC Assessment

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

Go to: http://sbcounty.permitrack.com/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** 16,657 *Form 4.2-3 Item 12*	**2** 17.48 *Form 4.2-4 Item 13*	**3** 4.77 *Form 4.2-5 Item 10*
Post-developed	**4** 78,909 *Form 4.2-3 Item 13*	**5** 10.12 *Form 4.2-4 Item 14*	**6** 13.19 *Form 4.2-5 Item 14*
Difference	**7** *63,252* *Item 4 – Item 1*	**8** *Item 5 – Item 2*	**9** *8.42* *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** *374%* *Item 7 / Item 1*	**11** *-42%* *Item 8 / Item 2*	**12** *176%* *Item 9 / Item 3*

The propose site is outside of the HCOC exempt area. HCOC assessment of the site hydrology for 2 year storm event provided using the computer software analysis based upon the San Bernardino County Hydrology Manual. The proposed onsite detention/infiltration chamber will mitigate runoff from 2-yr storm event and will drain to the frontal street Foothill Blvd. and then follow the existing drainage pattern and finally drains to the Rialto Channel via existing City storm drain system/on surface flow.

Form 4.2-3 HCOC Assessment for Runoff Volume

Weighted Curve Number Determination for: Pre-developed DA								
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 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):
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

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

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

14 Volume Reduction needed to meet HCOC Requirement, (ft^3):
*V_{HCOC} = (Item 13 * 0.95) – Item 12*

Form 4.2-4 HCOC Assessment for Time of Concentration

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*			
	DA 1	DMA B	DMA C	DMA D	DA 1	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):								
14 Post-developed time of concentration (min):								
15 Additional time of concentration needed to meet HCOC requirement (min):								

Form 4.2-5 HCOC Assessment for Peak Runoff

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

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

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 9 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":

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): 0 ft^3 *$V_{retention}$ =Sum of Item 19 for all BMPs*			
21 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 20-2. If no, proceed to Item 24*	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): 0 ft^3 *$V_{retention}$ = Sum of Item 24 for all BMPs*			
26 Implementation of residential rain barrels/cisterns: Yes ☐ No ☒ *If yes, complete Items 27-28; If no, proceed to Item 29*	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): 0 ft^3 *$V_{retention}$ =Sum of Item 28 for all BMPs*			
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs: 0 ft^3 *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).

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

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 39,561 ft^3 *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-1(DMA 1 , DMA2) 1-Contech CMP-1		
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*	9.10		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2.0		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	4.55		
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*	7.5 ft		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	7.5 ft		
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*	*26,322 sq-ft	*DMA1 & DMA2 drain to a single CMP Inf/Det Chamber (bottom 2.7' for WQ Retention)	
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0 ft		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0 ft		
12 Gravel porosity	0.40		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3 hrs		
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 ft^3		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	40,095 ft^3		
16 Total Retention Volume from LID Infiltration BMPs: 40,095 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 101% *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and 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.*			

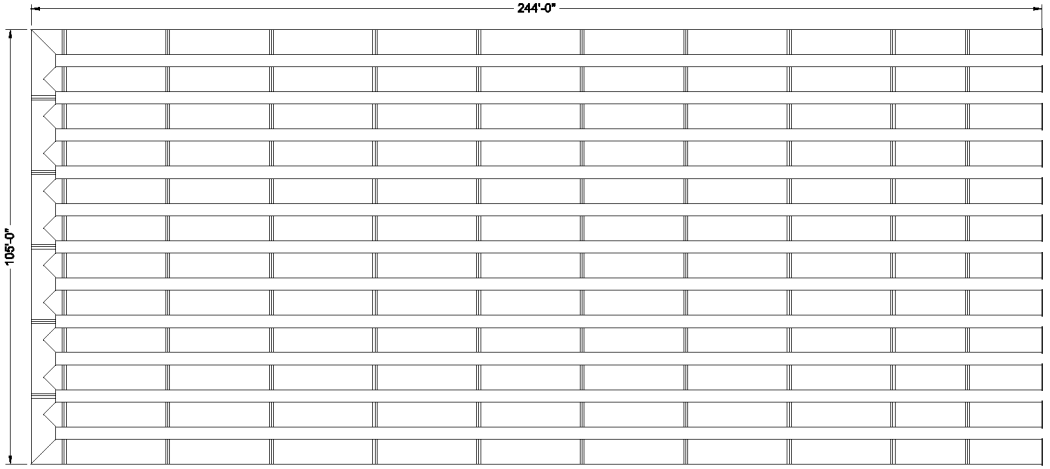
PROJECT SUMMARY

CALCULATION DETAILS
- LOADING = HS20/HS25
- APPROX. LINEAR FOOTAGE = 2,961 LF

STORAGE SUMMARY
- STORAGE VOLUME REQUIRED = 129,000 CF
- PIPE STORAGE VOLUME = 83,720 CF
- BACKFILL STORAGE VOLUME = 45,478 CF
- TOTAL STORAGE PROVIDED = 129,198 CF
- STONE VOID = 40%

PIPE DETAILS
- DIAMETER = 72"
- CORRUGATION = 5x1
- GAGE = 16
- COATING = ALT2
- WALL TYPE = PERFORATED
- BARREL SPACING = 36"

BACKFILL DETAILS
- WIDTH AT ENDS = 12"
- ABOVE PIPE = 6"
- WIDTH AT SIDES = 12"
- BELOW PIPE = 12"



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" = 30'

C:\USERS\JEREMY_JOHNSON\DOCUMENTS\DYO\CMP_V10.DWG 10/16/2018 10:02 AM

The design and information shown on this drawing is provided as a service to the project owner, engineer and contractor by Contech Engineered Solutions LLC ("Contech"). Neither this drawing, nor any part thereof, may be used, reproduced or modified in any manner without the prior written consent of Contech. Failure to comply is done at the user's own risk and Contech expressly disclaims any liability or responsibility for such use.

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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

DYO46936 Pacific Communities-Maple Ave, Fontana
CMP-1 INF/DET CHAMBER SYSTEM
Fontana, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
32414	46936	7/30/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

CONTECH ENGINEERED SOLUTIONS

Date: 7/30/2024
Project Name: CMP-1 INFDET CHAMBER SYSTEM - 46936 (7-30-2024 1

City / County:
State:

Designed By:
Company:
Telephone:

CMP: Underground Detention System
Storage Volume Estimation

=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

System Information		Backfill Information		Pipe & Analysis Information	
Out-to-out length (ft):	244.0	Backfill Porosity (%):	40%	System Diameter (in):	72
Out-to-out width (ft):	105.0	Depth Above Pipe (in):	6.0	Pipe Spacing (in):	36
Number of Manifolds (ea):	1.0	Depth Below Pipe (in):	12.0	Incremental Analysis (in):	2
Number of Barrels (ea):	12.0	Width At Ends (ft):	1.0	System Invert (Elevation):	0
		Width At Sides (ft):	1.0		

Storage Volume Estimation

System		Pipe		Stone		Total System		Miscellaneous	
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)
0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0%	10,528.8
0.17	0.16	0.0	0.0	1,754.8	1,754.8	1,754.8	1,754.8	0.0%	10,528.8
0.33	0.33	0.0	0.0	1,754.8	3,509.6	1,754.8	3,509.6	0.0%	10,528.8
0.50	0.50	0.0	0.0	1,754.8	5,264.4	1,754.8	5,264.4	0.0%	10,528.8
0.67	0.66	0.0	0.0	1,754.8	7,019.2	1,754.8	7,019.2	0.0%	10,528.8
0.83	0.83	0.0	0.0	1,754.8	8,774.0	1,754.8	8,774.0	0.0%	10,528.8
1.00	1.00	0.0	0.0	1,754.8	10,528.8	1,754.8	10,528.8	0.0%	10,528.8
1.17	1.16	652.5	652.5	1,493.8	12,022.6	2,146.3	12,675.1	5.1%	14,032.3
1.33	1.33	1,177.3	1,829.8	1,283.9	13,306.5	2,461.2	15,136.3	12.1%	15,412.2
1.50	1.50	1,502.5	3,332.3	1,153.8	14,460.3	2,656.3	17,792.6	18.7%	16,421.1
1.67	1.66	1,752.6	5,084.9	1,053.8	15,514.0	2,806.4	20,598.9	24.7%	17,228.8
1.83	1.83	1,957.2	7,042.1	971.9	16,486.0	2,929.1	23,528.1	29.9%	17,901.6
2.00	2.00	2,129.6	9,171.6	903.0	17,388.9	3,032.5	26,560.6	34.5%	18,474.0
2.17	2.16	2,277.1	11,448.7	844.0	18,232.9	3,121.0	29,681.6	38.6%	18,966.4
2.33	2.33	2,404.3	13,853.0	793.1	19,026.0	3,197.4	32,879.0	42.1%	19,392.0
2.50	2.50	2,514.4	16,367.4	749.0	19,775.0	3,263.4	36,142.4	45.3%	19,760.3
2.67	2.66	2,609.5	18,976.9	711.0	20,486.0	3,320.5	39,463.0	48.1%	20,077.7
2.83	2.83	2,691.2	21,668.1	678.3	21,164.3	3,369.5	42,832.5	50.6%	20,349.3
3.00	3.00	2,760.7	24,428.9	650.5	21,814.9	3,411.2	46,243.7	52.8%	20,578.8
3.17	3.16	2,818.9	27,247.8	627.2	22,442.1	3,446.2	49,689.9	54.8%	20,768.9
3.33	3.33	2,866.6	30,114.4	608.2	23,050.3	3,474.7	53,164.6	56.6%	20,921.9
3.50	3.50	2,904.1	33,018.4	593.2	23,643.4	3,497.2	56,661.9	58.3%	21,039.3
3.67	3.66	2,931.9	35,950.4	582.0	24,225.5	3,513.9	60,175.8	59.7%	21,122.4
3.83	3.83	2,950.3	38,900.7	574.7	24,800.1	3,525.0	63,700.8	61.1%	21,171.9
4.00	4.00	2,959.5	41,860.2	571.0	25,371.1	3,530.5	67,231.3	62.3%	21,188.4
4.17	4.16	2,959.5	44,819.6	571.0	25,942.1	3,530.5	70,761.8	63.3%	21,171.9
4.33	4.33	2,950.3	47,769.9	574.7	26,516.8	3,525.0	74,286.8	64.3%	21,122.4
4.50	4.50	2,931.9	50,701.9	582.0	27,098.9	3,513.9	77,800.7	65.2%	21,039.3
4.67	4.66	2,904.1	53,605.9	593.2	27,692.0	3,497.2	81,298.0	65.9%	20,921.9
4.83	4.83	2,866.6	56,472.5	608.2	28,300.2	3,474.7	84,772.7	66.6%	20,768.9
5.00	5.00	2,818.9	59,291.4	627.2	28,927.4	3,446.2	88,218.9	67.2%	20,578.8
5.17	5.16	2,760.7	62,052.2	650.5	29,577.9	3,411.2	91,630.1	67.7%	20,349.3
5.33	5.33	2,691.2	64,743.4	678.3	30,256.2	3,369.5	94,999.6	68.2%	20,077.7
5.50	5.50	2,609.5	67,352.9	711.0	30,967.2	3,320.5	98,320.1	68.5%	19,760.3
5.67	5.66	2,514.4	69,867.3	749.0	31,716.3	3,263.4	101,583.6	68.8%	19,392.0
5.83	5.83	2,404.3	72,271.6	793.1	32,509.4	3,197.4	104,781.0	69.0%	18,966.4
6.00	6.00	2,277.1	74,548.7	844.0	33,353.3	3,121.0	107,902.0	69.1%	18,474.0
6.17	6.16	2,129.6	76,678.2	903.0	34,256.3	3,032.5	110,934.5	69.1%	17,901.6
6.33	6.33	1,957.2	78,635.4	971.9	35,228.2	2,929.1	113,863.6	69.1%	17,228.8

These results are submitted to you as a guideline only, without liability on the part of CONTECH Engineered Solutions, LLC for accuracy or suitability to any particular application, and are subject to your verification.

6.50	6.50	1,752.6	80,388.0	1,053.8	36,282.0	2,806.4	116,670.0	68.9%	16,421.1
6.67	6.66	1,502.5	81,890.5	1,153.8	37,435.8	2,656.3	119,326.3	68.6%	15,412.2
6.83	6.83	1,177.3	83,067.8	1,283.9	38,719.7	2,461.2	121,787.5	68.2%	14,032.3
7.00	7.00	652.5	83,720.3	1,493.8	40,213.5	2,146.3	123,933.8	67.6%	10,528.8
7.17	7.16	0.0	83,720.3	1,754.8	41,968.3	1,754.8	125,688.6	66.6%	10,528.8
7.33	7.33	0.0	83,720.3	1,754.8	43,723.1	1,754.8	127,443.4	65.7%	10,528.8
7.50	7.50	0.0	83,720.3	1,754.8	45,477.9	1,754.8	129,198.2	64.8%	10,528.8

These results are submitted to you as a guideline only, without liability on the part of CONTECH Engineered Solutions, LLC for accuracy or suitability to any particular application, and are subject to your verification.

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		
		Predominant soil texture	0.25		
		Site soil variability	0.25		
		Depth to groundwater / impervious layer	0.25		
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			
B	Design	Tributary area size	0.25		
		Level of pretreatment/ expected sediment loads	0.25		
		Redundancy	0.25		
		Compaction during construction	0.25		
		Design Safety Factor, $S_B = \Sigma p$			
Combined Safety Factor, $S_{TOT} = S_A \times S_B$					
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)					
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT} \times K_M$					
Supporting Data					
Briefly describe infiltration test and provide reference to test forms:					

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

INFILTRATION TEST RESULTS

Plans for development of the subject property were not available at the time of our initial field work; however, conceptual plans were subsequently provided with tentative location for buried water quality chambers by the design civil engineer. A total of four percolation tests were conducted to assess infiltration rates of the near-surface onsite soils for preliminary design of detention basins to manage storm water runoff. The test locations are presented in Figure 2.

The initial infiltration test hole (P-1A) was excavated on July 25, 2023 using a conventional backhoe. A one-foot square hole was hand excavated from 4 to 5 feet bgs and 1 foot of perforated pipe embedded in 1 foot pea gravel was placed in the hand excavation. Solid pipe was added to the surface and the test pit was backfilled with native soils. Pre-soaking and testing was conducted at a depth of 4 to 5 feet using the Falling Head Test Method (RCFCD, 2011). The infiltration test was conducted in the lower one foot of the test pit. The hole was pre-soaked immediately after drilling. The infiltration rate was then calculated using the Porchet Method (RCFCD, 2011), commonly called the "inversed auger-hole method."

Three additional percolation test borings (P-1A through P-3) were drilled on August 24 , 2023 to depths of 10 to 12 feet, using a hollow-stem-auger drill rig. Following the installation of 3-inch PVC perforated casing and gravel pack, the test holes presoaked. These tests used the Falling Head Test Method (RCFCD, 2011). Infiltration rates were then calculated using the Porchet Method (RCFCD, 2011), commonly called the "inversed auger-hole method." The infiltration tests were conducted in the lower 5 feet of the borings.

Soils encountered in test locations consisted of medium- to course-grained gravelly sand. The test locations are shown in Figure 2. Test pit and boring logs are provided in Appendix A. The un-factored infiltration rate results are summarized below in Table 4, and test data are provided in Appendix D.

TABLE 4

Summary of Infiltration Rates

Percolation Test	Depth of Test (feet below surface)	Percolation Rate (gallons/day/ft^2)	Infiltration Rate (inches/hour)
P-1A	4 to 5	308	47
P-1	5 to 10	103	9.1
P-2	7 to 12	45	3.9
P-3	5 to 10	153	13.4

Inf Rate at the location of the Inf. Chamber System

Infiltration Drawdown Time Calculation CMP-1:

Infiltration Surface Area Provided:	26,322	SF	(Chamber Footprint: 246'x107')
Infiltration Rate per Soil Report	9.1	in/hr	(Inf Rate at P-1 at the System Location
	0.76	ft/hr	
Facor of Safety	2		
Design Infiltration Rate	0.379	ft/hr	
Volume needed to be Infiltrated	40,095	cu.ft	
Infiltration Volume per hour	9980.43	cu.ft/hr	(26,322 sft * 0.379 ft/hr)
Infiltration Draw Down Time	4.02	Hours	(40,095 cu.ft / 9980.43 cu.ft/hr)
	4 hr		< 48 hr draw down time. OK

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

1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3): *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 and 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

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.* None	
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 4.3-5 Not Applicable. The Site is using Infiltration BMPs for the full DCV mitigation.

Form 4.3-6 Volume Based Biotreatment– 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– 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

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): 39,561 ft^3 *Copy Item 7 in Form 4.2-1*

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

3 On-site retention with LID infiltration BMP (ft^3): 40,095 ft^3 *Copy Item 16 in Form 4.3-3*

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

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

6 Flow capacity provided by flow based biotreatment BMP (cfs): 0 ft^3 *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: ☐
  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: ☐
  Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed

4.3.6 Hydromodification Control BMP

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

1 Volume reduction needed for HCOC performance criteria (ft^3): 63,252 *(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): 99,253 *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 ☒ Site is proposing Inf/Det chamber system (LID BMP) to slow down the flow & increase Tc. *BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)* • 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 ☒ Site is proposing Inf/Det chamber system (LID BMP) to meter flow rate to existing flow. *BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)* • 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
Contech Infiltration / Retention Chamber System (6' dia Barrels)	Diversified Pacific Communities	Inspect Contech Chambers through the manhole to determine the depth of sediment. Follow local and OSHA rules for a confined space entry. JetVac maintenenace is recommended if sediment accumulation depth exceed 3"	*Immidiately after construction* *Thereafter Bi-annual inspection*
Education of Property Owners, Tenants and Occupants on Stormwater BMPs (N1)	Diversified Pacific Communities	Practical education materials will be provided to property owners covering various water quality issues that will need to be addressed on their specific site. These materials will include general good house keeping practices that contribute to the protection of storm water quality and BMP's that eliminate or reduce pollution during property improvements.	*Ongoing*
Landscape maintenance (N3)	Diversified Pacific Communities	Landscape planning is implemented to reduce groundwater and storm water contamination. This will be accomplished through an infiltration basin, and landscape areas.	*Monthly*

BMP maintenance (N4)	Diversified Pacific Communities	See BMP fact sheets and Table 5-1 details hereon	*Ongoing with every visit*
Litter debris control program (N11)	Diversified Pacific Communities	Litter debris control program may be developed by City of Upland	*Ongoing with every visit*
Employee training (N12)	Diversified Pacific Communities	Employee training may be developed by the owner/HOA	*As stated*
Catch basin inspection program (N14)	Diversified Pacific Communities	Catch basins will be inspected a minimum of once every three months during the dry season and a minimum of once every week or at each rain event during the rainy season.	*Place at grate installation and inspect once a year*
Provide storm drain system stencilling and signage (S1)	Diversified Pacific Communities	Signs will be placed above storm drain inlets to warn the public of prohibitions against waste disposal	*Inspect once a year*
Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (S4)	Diversified Pacific Communities	Rain sensors will be incorporated into the onsite sprinkler system so that no unnecessary watering of landscaped areas occurs after storm events.	*Once a year or according to Manufacturer Manuals*
Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement (S5)	Diversified Pacific Communities	New landscaped areas will be constructed at a minimum of 1 inch below existing paved areas	*Once a year*
Street Sweeping /Vacuuming (N15)	Diversified Pacific Communities	Street Sweeping and Vacuuming	*Bi-Monthly*

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

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

Section 6

WQMP Certification

6.1 Certification

"This Water Quality Management Plan has been prepared for Spiegel Development, Inc. by Allard Engineering. It is intended to comply with the requirements of the City of Fontana requiring the preparation of a Water Quality Management Plan (WQMP). The undersigned is aware that Best Management Practices (BMPs) are enforceable pursuant to the City's Water Quality Ordinance No. 3587. 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 Stormwater 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."

Spiegel Development, Inc.

By: _____ Date: _____

Name:

Its: Diversified Pacific Communities

Applicant's Telephone Number: (909) 481-1150

Certifications

I certify under penalty of law that this document and all the attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations

Developer's Project Engineer Signature

_____ _____
Signature Date

I/we certify that I/we am/are the legal owner of the project and hereby accept the responsibility for the implementation of the provisions of the SWQMP as long as I/we retain ownership of this property and that upon the sale of this land, I/we will deliver this plan to the future owner and inform him of the requirement to implement the plan.

Owner(s) Signature

Spiegel Development, Inc.

By: _____ Date: _____

Name:

Its: Diversified Pacific Communities

Applicant's Telephone Number: (909) 481-1150

For the use by City of Fontana

Environmental Section Approval of SWQMP

I, and /or personnel acting under my direction and supervision, have reviewed this SWQMP and find that it meets the requirements set forth in the City of Fontana's Storm Water Ordinance.

Acceptance or approval of this Storm Water Quality Management Plan in no way precludes the authority of this agency to require modification to the plan as conditions warrant nor does this agency take responsibility for performance of BMP's provided for in the plan.

_____ _____
Signature Date of SWQMP approval

EXHIBIT A

(Legal Description)

LEGAL DESCRIPTION:

A PORTION OF FARM LOT 425, ACCORDING TO THE MAP OF THE LANDS BELONGING TO SEMI-TROPIC LAND AND WATER COMPANY, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA AS PER PLAT THEREOF RECORDED IN BOOK 11 OF MAPS, PAGE 12, RECORDS OF SAID COUNTY

ASSESSOR'S PARCEL NO:

0243-142-01, 02, 03, 04, 05 & 06

EXHIBIT B

(Vicinity Map)

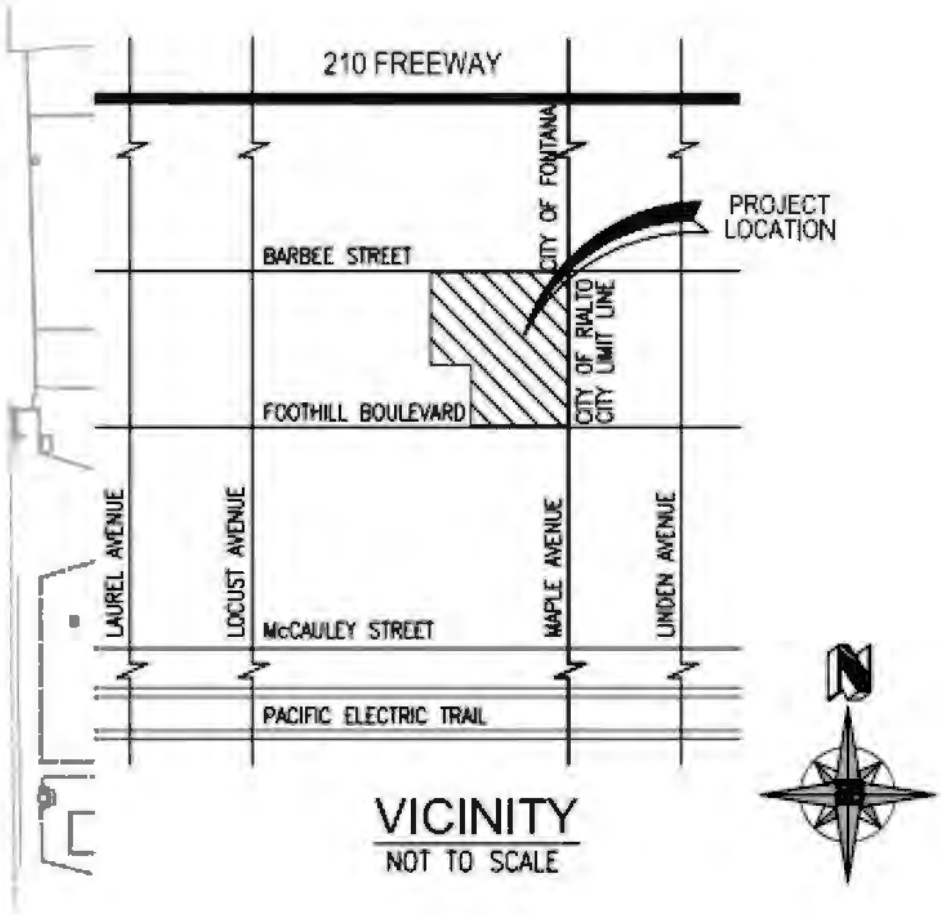

EXHIBIT C

(WQMP EXHIBIT)

PETRA GEOSCIENCES INC.

SOLID AS A ROCK

ENGINEERS + GEOLOGISTS + ENVIRONMENTAL SCIENTISTS

PRELIMINARY GEOTECHNICAL EVALUATION
DISTRICT PROPERTY 2, 8.4-ACRE SITE
NORTHWEST CORNER OF MAPLE AVENUE AND WEST FOOTHILL BOULEVARD
CITY OF FONTANA, SAN BERNARDINO COUNTY, CALIFORNIA

FONTANA INVESTMENT 2023, LLC

September 6, 2023
J.N. 23-203

September 6, 2023
J.N. 23-203

FONTANA INVESTMENT 2023, LLC
10621 Civic Center Drive
Rancho Cucamonga, California 91730

Attention: Mr. Nolan Leggio

Subject: **Preliminary Geotechnical Evaluation: *District Property 2,* 8.4-Acre Site, Northwest Corner of Maple Avenue and West Foothill Boulevard, City of Fontana, San Bernardino County, California**

Dear Mr. Leggio:

Petra Geosciences, Inc. (Petra) is submitting herewith our preliminary geotechnical evaluation report for the proposed development of undeveloped land at the northwest corner of Maple Avenue and West Foothill Boulevard, in the city of Fontana, San Bernardino County, California. This work was performed in general accordance with the scope of work outlined in our Proposal No. 23-203P, dated May 11, 2023, and subsequent amendment, dated August 23, 2023. This report presents the results of our field explorations, infiltration evaluation, the requirements of the 2022 California Building Code (CBC) and our engineering judgment, opinions, conclusions, and recommendations pertaining to geotechnical design aspects for the proposed development.

It has been a pleasure to be of service to you on this project. Should you have questions regarding the contents of this report or should you require additional information, please contact this office.

Respectfully submitted,

PETRA GEOSCIENCES, INC.

Edward Lump, CEG
Associate Geologist

Grayson R. Walker, GE
Principal Engineer

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FIGURE 1 – SITE LOCATION MAP

FIGURE 2 – EXPLORATION LOCATION MAP

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APPENDIX A – FIELD EXPLORATION LOGS (TEST PITS)

APPENDIX B – LABORATORY TEST PROCEDURES / LABORATORY DATA SUMMARY

APPENDIX C – SEISMIC DESIGN PARAMETERS

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PRELIMINARY GEOTECHNICAL EVALUATION
DISTRICT PROPERTY 2, 8.4-ACRE SITE
NORTHWEST CORNER OF MAPLE AVENUE AND WEST FOOTHILL BOULEVARD,
CITY OF FONTANA, SAN BERNARDINO COUNTY, CALIFORNIA

INTRODUCTION

Petra Geosciences, Inc. (Petra) is presenting herein the results of our updated geotechnical evaluation for the subject 8.4-acre undeveloped property. Our geotechnical evaluation included a review of regional geological maps published by the California Geological Survey (CGS) and other sources that encompass the site, including review of limited historic aerial photos and online imagery (Google Earth Imagery, 1994-2022) in the vicinity of the project site. The scope of work included the excavation of eight exploratory test pits and four infiltration test pits within the subject property.

PURPOSE AND SCOPE OF SERVICES

The purposes of this phase of evaluation were to obtain information on the subsurface geologic and soil conditions within the project area, assess infiltration rates in anticipated basin locations, evaluate the field and laboratory data, and provide conclusions and recommendations for design and construction of the proposed building and other site improvements as influenced by the subsurface conditions.

The scope of our evaluation consisted of the following:

- Reconnaissance of the site to evaluate existing conditions.
- Review of available published and unpublished data and maps concerning geologic and soil conditions within and adjacent to the site which could have an impact on the proposed improvements.
- Excavation of eight exploratory test pits, utilizing a rubber tire backhoe, to evaluate the stratigraphy of the subsurface soils and collect representative bulk samples for laboratory testing.
- Excavate 1 percolation test pit (P-1A) utilizing a rubber tire backhoe, and three percolation test borings (P-1, P-2, and P-3) using a hollow-stem auger drill rig to measure infiltration rates.
- Log and visually classify soil materials encountered in the borings in accordance with the Unified Soil Classification System.
- Conduct laboratory testing of representative samples (bulk) obtained from the test pits to determine their engineering properties.
- Perform engineering and geologic analysis of the data with respect to the proposed improvements.
- Preparation of this report, including pertinent figures and appendices, presenting the results of our evaluation and recommendations for the proposed improvements in general conformance with the requirements of the 2022 California Building Code (CBC), as well as in accordance with applicable local jurisdictional requirements.

SITE LOCATION AND DESCRIPTION

The subject property is a mostly vacant site, located on the west side of Maple Avenue between W. Foothill Boulevard on the south and Barbee Street on the north, in the city of Fontana, San Bernardino County, California. The site is bounded by Barbee Street on the north with residential development beyond; Maple Avenue to the east with multi-family residential development beyond to the northeast and vacant land to the southeast; W. Foothill Boulevard to the south with residential development beyond; and commercial (auto body repair) development to the west.

At the time of our field reconnaissance, the site was vacant land. A mobile classroom trailer and two metal storage bins are located near the north central portion of the subject site. Uniform grasses mantle the subject property, which appeared to have recently been disced. A few scattered trees are located in the southern portion of the subject site. A weathered asphalt drive extends north from a concrete driveway entrance on W. Foothill Boulevard to a widened asphalt paved area in the south-central portion of the subject property, that may have been part of a former parking area. A second concrete driveway entrance was observed off W. Foothill Boulevard near the southwest corner of the site. A billboard is located in the southeastern corner of the subject property. The site slopes gently to the south with existing elevations on the order of 1,315 feet above mean sea level (msl) to 1,305 feet above msl (Google Earth, 2023).

Overhead lines with one pole-mounted transformer were noted along the north side of W. Foothill Boulevard. The transformer was being serviced at the time of our reconnaissance. No damage was noted to the transformer. No pad mounted transformers were observed onsite. Wooden poles and overhead lines were also observed along the east side of N. Maple Avenue and the north side of Barbee Street.

An electric billboard supported on three steel posts was noted in the southeast corner of the subject site. A meter was attached to the southerly post and the conduit entered the ground. East of the billboard was a metal cabinet labeled “Crown Castle, PS-FNTA-G41-001, 18215 Foothill Blvd. PED, Fontana, CA 92335.” Discussion with Crown Castle indicated this box is a power supply for a small cell tower, and not associated with the billboard. No staining or discoloration was observed on the concrete base.

Historic Land Use

Information obtained during the concurrent Phase I Environmental Site Assessment (ESA) indicated that the subject property and vicinity appeared to have been utilized for agricultural use in the form of groves from at least 1938 to sometime after/during 1953 and before/during 1959. One residence and a single barn-type building were noted in the southeastern portion of the subject site, fronting Maple Avenue. In the 1949

aerial photograph, a cluster of three buildings was observed on the south side of the subject site, fronting Foothill Boulevard (Route 66). In the southwest corner of the property was one small building, also fronting Foothill Boulevard. Also in the 1949 aerial photo, property adjacent to the southwest edge of the subject site appeared to be a motel. The 1959 aerial photo depicts the orchard within the site removed and most of the orchards in the vicinity were also removed; however, the onsite buildings remain visible. Sometime during/after 1990 and during/before 1994, buildings within the southeast portion of subject property were removed; however, one small building remained in the southwest corner. Between 2002 and 2023, the subject property was undeveloped land, except for placement of the mobile classroom trailer in the north central portion of the subject site sometime during/after 2012 and during/before 2016. Historical information reviewed during this assessment includes aerial photographs (dating back to 1938), USGS topographical maps (dating back to 1896), and interviews.

PROPOSED DEVELOPMENT

The Option Two Conceptual Site Plan, prepared by AO and dated August 7, 2023, identifies: three 4-story HyTUCK apartment buildings, totaling 170 units with garages; four 3-story garden buildings, totaling 96 units; a leasing/club building and recreation center. It is expected that the apartment buildings will be of wood-frame construction supported on conventional slab-on-ground foundations. Appurtenant structures will include a paved entrance off Maple Avenue, interior access streets and parking stalls, concrete patio-type slabs and walkways, masonry block walls, surface and subsurface drainage control devices, landscaped areas, and above- and below-ground utilities. The Conceptual Site Plan is utilized as the base map for the field exploration and percolation testing program depicted in Figure 2.

Overall, the subject property is level, gently sloping to the south. Existing elevations range from approximately 1,320 feet above mean sea level (msl) near the northwest corner of the subject site to 1,305 feet above msl near the south boundary of the subject property (USGS, 2012). While proposed elevations are not known at this time, the relatively level topography suggests earthwork within the site is generally expected to entail minor cuts and fills up to approximately 5 feet with the possible exception of water quality basins. It is anticipated, however, that the ultimate amount of new fill required throughout the project will be greater due to the required remedial grading (i.e., removal and re-compaction of existing unsuitable surficial soils).

Literature Review

It is our understanding that geotechnical reports pertaining to the subject property do not exist. Petra researched and reviewed available published and unpublished geologic data pertaining to regional geology,

faulting, and geologic hazards that may affect the site. The results of this review are discussed under the Findings and Conclusions sections presented in this report.

Subsurface Exploration

A subsurface exploration program was performed under the direction of an engineering geologist from Petra on July 26, 2023. The exploration involved the excavation of eight exploratory test pits (TP-1 through TP-8), utilizing a backhoe, to a maximum depth of approximately 10 feet below existing grade (bgs). An additional test pit (P-1A) was excavated for the purpose of conducting shallow percolation tests, one on July 26, 2023. Three percolation test borings (P-1, P-2, and P-3) were drilled, pre-soaked and tested on August 24, 2023. Earth materials encountered within the exploratory test pits were classified and logged by a geologist in accordance with the visual-manual procedures of the Unified Soil Classification System. Disturbed bulk samples of soil materials were collected for classification, laboratory testing and engineering analyses. The approximate locations of the exploratory borings are shown on Figure 2 (Field Exploration Map). The test pit and boring logs are presented in Appendix A.

Laboratory Testing

Maximum dry density and optimum moisture content, expansion index, and corrosion suite (sulfate content, chloride content, pH/resistivity) for selected samples of onsite soils materials was conducted. A description of laboratory test methods and summaries of the laboratory test data are presented in Appendix B.

FINDINGS

Regional Geologic Setting

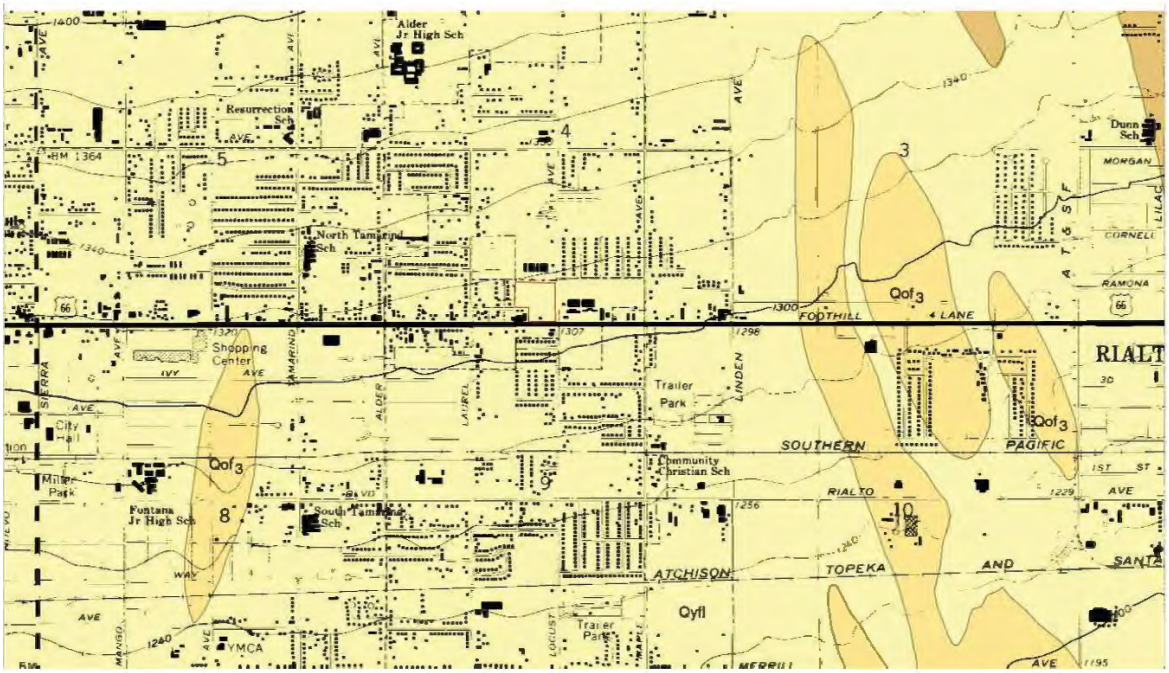
Geologically, the site lies within the northern portion of the Peninsular Ranges Geomorphic Province (CGS, 2002). The Peninsular Range Province extends from the tip of Baja California north to the Transverse Ranges Geomorphic Province and is characterized by northwest trending mountain ranges, separated by subparallel fault zones. The San Bernardino Mountains, located on the north side of the valley, provides the boundary between the Peninsula Range Province and the Transverse Ranges Province. In general, the province is underlain primarily of plutonic rock of the Southern California Batholith. These rocks formed from the cooling of molten magma deep within the earth's crust. Intense heat associated with the plutonic magma metamorphosed the ancient sedimentary rocks into which the plutons intruded. The Peninsular Range Geomorphic Province is generally characterized by alluviated basins and elevated erosion surfaces.

More specifically, the subject site is mapped as Holocene and late Pleistocene Young alluvial fan deposits of Lytle Creek consisting of unconsolidated, cobbly and bouldery alluvium of the Lytle Creek fan (Morton,

D.M., 2003). A portion of this regional geologic map exhibiting the subject property location is provided below as Figure A. The site does not lie within an Alquist-Priolo Earthquake Fault Zone (Bryant and Hart, 2007; CGS, 2023).

Local Geology and Subsurface Soil Conditions

Earth units encountered onsite consisted of topsoil and alluvial deposits. The site is covered by a three- to five-foot of mantle of topsoil and young alluvium, generally consisting of loose, dry, silty sands with minor gravel in the upper 1 to 2.5 feet. Below this depth native alluvial soils were found to consist predominately of brown, yellow-brown and gray-brown, dry to moist, loose to medium dense, fine-to coarse-grained gravelly sands with 10 to 40 percent gravel and cobbles 8 to 10 inches in longest dimension. While the deeper alluvium was generally observed to be medium to very dense, zones of low density and/or porous soils were observed within the upper 4 to 5 feet in test pits. Logs of exploratory test pits are presented in Appendix A. Test pit locations are presented on the Test Pit Location Map (Figure 2).



Qyfl — **Young alluvial-fan deposits of Lytle Creek (Holocene and late Pleistocene)**—Unconsolidated, gray, cobbly and bouldery alluvium of Lytle Creek fan. Relatively fine-grained (pebbly and cobbly) in southern extent; becomes coarser grained (cobbly and bouldery) northward. Forms broad channels west and north of Crestmore.

Figure A – Regional Geologic Map (Morton, D.M., 2003).

Surface Water

No indication of surface water was observed on the property or in close proximity at the time of our site field exploration.

The west portion of the subject property is situated within Flood Insurance Rate Map (FIRMette) 06071C8656H, and the east portion is located in FIRMette 06071C8657H. The subject property is mapped within Zone X, defined as an area defined as areas of 0.2 percent annual chance flood; areas of 1 percent annual chance flood with average depths of less than 1 foot or within drainage areas less than 1 square mile; and areas protected by levees from 1 percent annual chance flood. Figure B below depicts the Flood Insurance Rate Map (FIRM) for the subject site and vicinity. The FIRMette map (Map Revised August 28, 2008) is provided in Appendix B.

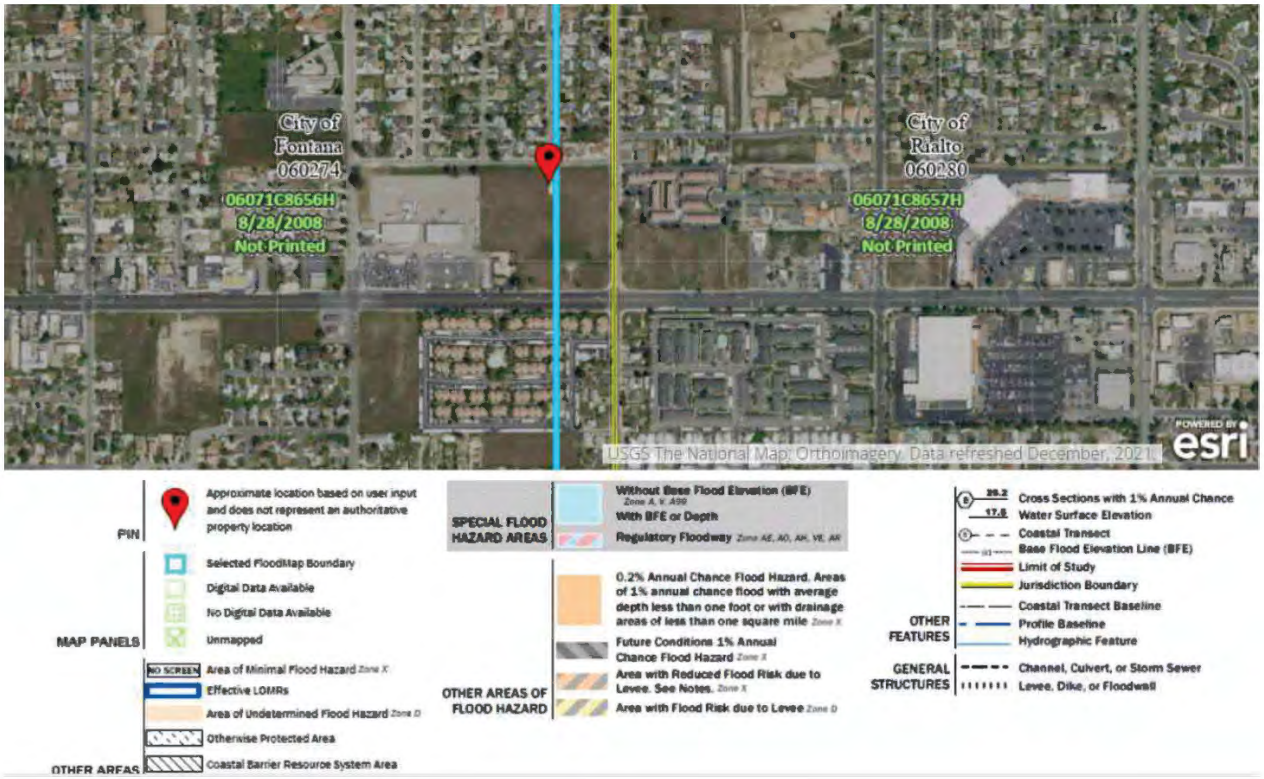


Figure B – General Flood Insurance Map (FEMA, 2023)

Groundwater

No groundwater was encountered in any of our test pits or borings, excavated to the maximum depth of 12 feet below the ground surface. The site is located within the Upper Santa Ana Valley – Rialto-Colton Basin, 8-002.04 (California Department of Water Resources [CDWR, 2023], Water Data Library). No groundwater wells were observed or mapped on the property (CDWR, 2023).

Based on our review, the closest mapped well to the subject property (Well ID: 01S05W16C002S) is reported approximately 1 mile to the southwest. In April 1929, this well reported a depth to groundwater of approximately 370 feet below the ground surface (bgs). The next available record from this well, between October 1978 and April 2000, reported depth to groundwater ranging from approximately 430 feet bgs to approximately 398 feet bgs, respectively. A second well, mapped approximately 1.1 miles to the northwest (Well ID: 01S05W04D002S), reported groundwater depths ranging from 258 feet bgs in March 1986 to approximately 335 feet bgs in October 2008. In general, groundwater depth varies within the area and though flow direction specifically beneath the subject property is unknown, it is reasonable to estimate flow to follow regional topography to the south/southeast.

Faulting

Based on our review of the referenced geologic maps and literature, no active faults are known to project through the property. Furthermore, the site does not lie within the boundaries of an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act (CGS, 2018). The Alquist-Priolo Earthquake Fault Zoning Act (AP Act) defines an *active fault* as one that "has had surface displacement within Holocene time (about the last 11,000 years)." The main objective of the AP Act is to prevent the construction of dwellings on top of active faults that could displace the ground surface resulting in loss of life and property.

However, it should be noted that according to the USGS Unified Hazard Tool website, the 2010 CGS Fault Activity Map of California, and the CGS Earthquake Hazard Zones (EQZapp) interactive map (CGS, 2023), the Lytle Creek Connector of the San Jacinto Fault zone, located approximately 2.8 miles (4.51 kilometers) east of the site, would probably generate the most severe site ground motions and, therefore, is the majority contributor to the deterministic minimum component of the ground motion models. The subject site is located at less than 5 miles (8 km) from the surface projection of this fault system, which is capable of producing a magnitude 7 or larger events with a slip rate along the fault greater than 0.04 inch per year. As such, the site should be considered as a **Near-Fault Site** in accordance with ASCE 7-16, Section 11.4.1.

Seismic Design Parameters

Earthquake loads on earthen structures and buildings are a function of ground acceleration which may be determined from the site-specific ground motion analysis. Alternatively, a design response spectrum can be developed for certain sites based on the code guidelines. To provide the design team with the parameters necessary to construct the design acceleration response spectrum for this project, we used two computer applications. Specifically, the first computer application, which was jointly developed by the Structural

Engineering Association of California (SEAOC) and California's Office of Statewide Health Planning and Development (OSHPD), the SEAOC/OSHPD Seismic Design Maps Tool website, https://seismicmaps.org, is used to calculate the ground motion parameters. The second computer application, the United Stated Geological Survey (USGS) Unified Hazard Tool website, https://earthquake.usgs.gov/hazards/interactive/, is used to estimate the earthquake magnitude and the distance to surface projection of the fault.

To run the above computer applications, site latitude and longitude, seismic risk category and knowledge of site class are required. The site class definition depends on the direct measurement and the ASCE 7-16 recommended procedure for calculating average small-strain shear wave velocity, V_{s30}, within the upper 30 meters (approximately 100 feet) of site soils.

A seismic risk category of II was assigned to the proposed buildings in accordance with 2022 CBC, Table 1604.5. No shear wave velocity measurement was performed at the site, however, the subsurface materials at the site appear to exhibit the characteristics of stiff soils condition for Site Class D designation. Therefore, an average shear wave velocity of 850 feet per second (259 meters per second) for the upper 100 feet was assigned to the site based on engineering judgment and geophysical experience. As such, in accordance with ASCE 7-16, Table 20.3-1, Site Class D (D- Default as per SEAOC/OSHPD software) has been assigned to the subject site.

The following table, Table 1, provides parameters required to construct the Seismic Response Coefficient – Natural Period, C_s – T, curve based on ASCE 7-16, Article 12.8 guidelines. A printout of the computer output is attached in Appendix C.

TABLE 1

Seismic Design Parameters

Ground Motion Parameters		Specific Reference	Parameter Value	Unit
Site Latitude (North)		-	34.1077	°
Site Longitude (West)		-	-117. 4065	°
Site Class Definition		Section 1613.2.2 (1), Chapter 20 (2)	D-Default (4)	-
Assumed Seismic Risk Category		Table 1604.5 (1)	II	-
M_w - Earthquake Magnitude		USGS Unified Hazard Tool (3)	7.98 (3)	-
R – Distance to Surface Projection of Fault		USGS Unified Hazard Tool (3)	4.51 (3)	km
S_s - Mapped Spectral Response Acceleration Short Period (0.2 second)		Figure 1613.2.1(1) (1)	1.888 (4)	g
S_1 - Mapped Spectral Response Acceleration Long Period (1.0 second)		Figure 1613.2.1(3) (1)	0.692 (4)	g
F_a – Short Period (0.2 second) Site Coefficient		Table 1613.2.3(1) (1)	1.2 (4)	-
F_v – Long Period (1.0 second) Site Coefficient		Table 1613.2.3(2) (1)	Null (4)	-
S_{MS} – MCE_R Spectral Response Acceleration Parameter Adjusted for Site Class Effect (0.2 second)		Equation 16-20 (1)	2.265 (4)	g
S_{M1} - MCE_R Spectral Response Acceleration Parameter Adjusted for Site Class Effect (1.0 second)		Equation 16-21 (1)	Null (4)	g
S_{DS} - Design Spectral Response Acceleration at 0.2-s		Equation 16-22 (1)	1.51 (4)	g
S_{D1} - Design Spectral Response Acceleration at 1-s		Equation 16-23 (1)	Null (4)	g
Domain of Constant Acceleration	$T_s = S_{D1}/ S_{DS}$	Section 11.4.6 (2)	Null	s
	$T_o = 0.2\ S_{D1}/ S_{DS}$	Section 11.4.6 (2)	Null	s
T_L - Long Period Transition Period		Figure 22-14 (2)	12 (4)	s
PGA - Peak Ground Acceleration Maximum Considered Earthquake Geometric Mean, MCE_G (*)		Figure 22-9 (2)	0.78	g
F_{PGA} - Site Coefficient Adjusted for Site Class Effect (2)		Table 11.8-1 (2)	1.2 (4)	-
PGA_M –Peak Ground Acceleration (2) Adjusted for Site Class Effect		Equation 11.8-1 (2)	0.936 (4)	g
Design PGA ≈ (⅔ PGA_M) - Slope Stability (†)		Similar to Eqs. 16-22 & 16-23 (2)	0.624	g
Design PGA ≈ (0.4 S_{DS}) – Short Retaining Walls (‡)		Equation 11.4-5 (2)	0.604	g
C_{RS} - Short Period Risk Coefficient		Figure 22-18A (2)	0.914 (4)	-
C_{R1} - Long Period Risk Coefficient		Figure 22-19A (2)	0.89 (4)	-
SDC - Seismic Design Category (§)		Section 1613.2.5 (1)	Null (4)	-

References:

(1) California Building Code (CBC), 2022, California Code of Regulations, Title 24, Part 2, Volume I and II.

(2) American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI), 2016, Minimum Design Loads and Associated Criteria for Buildings and Other Structures, Standards 7-16.

(3) USGS Unified Hazard Tool - https://earthquake.usgs.gov/hazards/interactive/ [Dynamic: Conterminous U.S. 2014 (update) (v4.2.0)]

(4) SEAOC/OSHPD Seismic Design Map Application – https://seismicmaps.org [Reference: ASCE 7-16]

Related References:

Federal Emergency Management Agency (FEMA), 2015, NEHRP (National Earthquake Hazards Reduction Program) Recommended Seismic Provision for New Building and Other Structures (FEMA P-1050).

Notes:

* PGA Calculated at the MCE return period of 2475 years (2 percent chance of exceedance in 50 years).

† PGA Calculated at the Design Level of ⅔ of MCE; approximately equivalent to a return period of 475 years (10 percent chance of exceedance in 50 years).

‡ PGA Calculated for short, stubby retaining walls with an infinitesimal (zero) fundamental period.

§ The designation provided herein may be superseded by the structural engineer in accordance with Section 1613.2.5.1, if applicable.

Discussion

General

Owing to the characteristics of the subsurface soils, as defined by Site Class D-Default designation, and proximity of the site to the sources of major ground shaking, the site is expected to experience strong ground shaking during its anticipated life span. Under these circumstances, where the code-specified design response spectrum may not adequately characterize site response, the 2022 CBC typically requires a site-specific seismic response analysis to be performed. This requirement is signified/identified by the "null" values that are output using SEAOC/OSHPD software in determination of short period, but mostly, in determination of long period seismic parameters, see Table 1.

For conditions where a "null" value is reported for the site, a variety of analytical design approaches are permitted by 2022 CBC and ASCE 7-16 (see Table 12.6-1)in lieu of a site-specific seismic hazard analysis. For any specific site, these alternative design approaches, which include Equivalent Lateral Force (ELF) procedure, Modal Response Spectrum Analysis (MRSA) procedure, Linear Response History Analysis (LRHA) procedure and Simplified Design procedure, among other methods, are expected to provide results that may or may not be more economical than those that are obtained if a site-specific seismic hazards analysis is performed. These design approaches and their limitations should be evaluated by the project structural engineer.

Seismic Design Category

Please note that the Seismic Design Category, SDC, is also designated as "null" in Table 1. For condition where the mapped spectral response acceleration parameter at 1 – second period, S_1, is less than 0.75, the 2022 CBC, Section 1613.2.5.1 allows that seismic design category to be determined from Table 1613.2.5(1) alone provided that all 4 requirements concerning fundamental period of structure, story drift, seismic response coefficient, and relative rigidity of the diaphragms are met. For this condition, Site Coefficient F_v, should be taken from Table 1613.2.3(2) for Site Class D, only for calculation of T_s.

Our interpretation of ASCE 7-16 is that for conditions where one or more of these 4 conditions are not met, seismic design category should be assigned based on: 1) 2022 CBC, Table 1613.2.5(1), 2) structure's risk category and 3) the value of S_{DS}, at the discretion of the project structural engineer.

Equivalent Lateral Force Method

As stated herein, the subject site is considered to be within a Site Class D-Stiff Soil. Per ASCE 7-16 Supplement 3, a site-specific ground motion hazard analysis is not required for structures on Site Class D-Stiff Soil with $S_1 \geq 0.2$ provided that the value of the parameter S_{M1} determined by Eq. (11.4-2) is increased

by 50 percent for all applications of S_{M1} and structural design is performed in accordance with Equivalent Lateral Force (ELF) procedure.

CONCLUSIONS

Site Suitability

From a geotechnical engineering and engineering geologic point of view, the subject property is considered suitable for the proposed development provided the following conclusions and recommendations are incorporated into the design criteria and project specifications.

Primary Geologic/Geotechnical Considerations

Groundwater

Regional groundwater or perched groundwater was not encountered in any of our exploratory test pits or borings, excavated to a maximum depth of 12 feet below the ground surface. Data provided in nearby public wells indicates groundwater is at depths exceeding 200 feet bgs. As such, regional groundwater is not anticipated to affect the subject development.

Fault Rupture

The site is not located within a currently designated State of California Alquist-Priolo Earthquake Fault Zone (CGS, 2023), nor is it within a San Bernardino County Fault Zone (County of San Bernardino, 2010). In addition, no known active faults have been identified on the site. While fault rupture would most likely occur along previously established fault traces, fault rupture could occur at other locations. However, the potential for active fault rupture at the site is considered to be very low.

Strong Ground Motions

The site is located in a seismically active area of southern California and will likely be subjected to very strong seismically related ground shaking during the anticipated life span of the project. Structures within the site should therefore be designed and constructed to resist the effects of strong ground motion in accordance with the 2022 California Building Code (CBC) and the seismic parameters included in the recommendations section herein.

Liquefaction, Landslides and Secondary Seismic Effects

The proposed residential development is not mapped within a zone with an expected liquefaction susceptibility (County of San Bernardino, 2010).

The site and immediate area exhibit level topography that is not prone to landsliding. Secondary effects of seismic activity normally considered as possible hazards to a site include several types of ground failure. Such ground failures, which might occur as a consequence of severe ground shaking at the site, include ground subsidence, ground lurching and lateral spreading. The probability of occurrence of each type of ground failure depends on the severity of the earthquake, distance from faults, topography, subsoils, and groundwater conditions, in addition to other factors. Based on the site conditions, proposed grading, depth to groundwater exceeding 200 feet, and gentle topography across the site, landsliding, liquefaction, ground subsidence, ground lurching and lateral spreading are considered unlikely at the site. The potential for seismic flooding due to a tsunami or seiche is considered negligible.

Compressible Soils

The most significant geotechnical factor affecting the project site is the presence of near-surface compressible soil materials. Such native materials consist of surficial topsoil/colluvium/alluvium and are not considered suitable for support of fill or structural loads. Based on our subsurface assessment and laboratory test results, remedial removal depths on the order of 4 to 5 feet below existing grades are expected. Accordingly, these materials will require remedial over-excavation to expose competent alluvial soils. Removed soils may be subsequently placed as properly compacted fill.

Flooding

The subject property is situated within two Flood Insurance Rate Map (FIRMette) 06071C8656H on the west and 06071C8657H on the east. The subject property and vicinity are mapped within Zone X, defined as an area defined as areas of 0.2 percent annual chance flood; areas of 1 percent annual chance flood with average depths of less than 1 foot or within drainage areas less than 1 square mile; and areas protected by levees from 1 percent annual chance flood. Figure B above depicts Flood Insurance Rate Maps (FIRM) for the subject site and vicinity.

EARTHWORK RECOMMENDATIONS

General Earthwork Recommendations

Earthwork should be performed in accordance with the Grading Code of the City of Fontana and/or County of San Bernardino, in addition to the applicable provisions of the 2022 CBC. Grading should also be performed in accordance with the following site-specific recommendations prepared by Petra based on the proposed construction.

Geotechnical Observations and Testing

Prior to the start of earthwork, a meeting should be held at the site with the owner, contractor, and geotechnical consultant to discuss the work schedule and geotechnical aspects of the grading. Earthwork, which in this instance will generally entail removal and re-compaction of the near surface soils, should be accomplished under full-time observation and testing of the geotechnical consultant. A representative of the project geotechnical consultant should be present onsite during all earthwork operations to document proper placement and compaction of fills, as well as to document compliance with the other recommendations presented herein.

Clearing and Grubbing

All existing weeds, grasses, brush, shrubs, trees, tree stumps and root balls, and similar vegetation existing within areas to be graded should be stripped and removed from the site. Clearing operations should also include the demolition and removal of all existing improvements (concrete slabs, concrete and asphalt rubble piles, etc.), any remaining trash, debris, vegetation, and similar deleterious materials. Any cavities or excavations created upon removal of structures or existing trees (i.e., root ball) or any unknown subsurface structures (included septic tanks and systems, and foundations), should be cleared of loose soil, shaped to provide access for backfilling and compaction equipment and then backfilled with properly compacted fill. Note that deleterious materials may be encountered within the site and may need to be removed by hand, i.e., root pickers, during the grading operations.

The project geotechnical consultant should provide periodic observation and testing services during clearing and grubbing operations to document compliance with the above recommendations. In addition, should unusual or adverse soil conditions or buried structures be encountered during grading that are not described herein, these conditions should be brought to the immediate attention of the project geotechnical consultant for corrective recommendations.

Excavation Characteristics

The existing site soil is expected to be readily excavated with conventional earthmoving equipment. Although oversize rocks (i.e., 12-inches in longest dimension or greater) were not encountered in our test pit or boring excavations, they may be locally associated with the native alluvial fan materials underlying the subject property and should be disposed of either offsite or properly buried within the planned deeper fills in an approved engineered fashion, a minimum of 5 feet below finish pad grades.

Ground Preparation - General

Our field evaluation revealed that near-surface soils within the areas of proposed construction generally exhibit low to moderate in-place densities, may contain some rootlets and other isolated organic material, and have been locally disturbed from previous onsite activities. These soils are subject to compression and settlement under the proposed foundation and slab loadings and, if left unmitigated and may result in excessive differential settlement beneath the proposed structures, associated foundations, and/or associated appurtenant improvements.

To create a uniform compacted fill mat below the proposed improvements and reduce the potential for distress due to excessive differential settlement, it is recommended that all near surface low-density native materials be removed to underlying competent alluvial materials and replaced as properly compacted fill materials. Based on our subsurface exploration and visual observations, remedial removal depths on the order of 4 to 5 feet below existing grades are expected. Recommended removal depths are presented on the Exploration Location Map (Figure 2). The horizontal limits of removal and re-compaction should extend to a minimum distance of 5 feet beyond the proposed improvements.

It must be noted that the depths of remedial grading provided herein are estimates only and are based on conditions observed at the boring locations. Subsurface conditions can and usually do vary between points of exploration. For this reason, the actual removal depths will have to be determined on the basis of in-grading observations and testing performed by a representative of the project geotechnical consultant. The Client, civil engineer, and project grading contractor should allow contingencies for additional earthwork quantities should adverse conditions and deeper removals be required.

Unsuitable Soil Removals

Existing surficial soils including disturbed topsoil/alluvium and upper weather alluvium deposits that are considered unsuitable for support of proposed fills, structures, flatwork, pavement, or other improvements and should be removed to underlying competent native valley deposit materials. All existing low-density, compressible surficial soils in areas to receive compacted fill or to support the residential building pads should be removed to underlying competent soils as approved by the project geotechnical consultant.

Based on our subsurface assessment and laboratory test results, remedial removal depths on the order of 4 to 5 feet below existing grades are expected. Unsuitable soil removals may also need to be locally deeper, depending on the exposed conditions encountered during grading. The actual depths and horizontal limits

of removals and over-excavations should be evaluated during grading on the basis of observations and testing performed by the project geotechnical consultant.

Prior to placing engineered fill, all exposed bottom surfaces in the removal areas should be approved by a representative of project geotechnical consultant and then scarified to a minimum depth of 12 inches, flooded with water and compacted with heavy vibratory equipment to achieve near-optimum moisture conditions and then compacted in-place to no less than 90 percent relative compaction.

Ground Preparation - Roadways

For proposed roadways, the existing ground surfaces should be over-excavated to a minimum depth of 12 inches below the existing ground surface or 2 feet below the proposed subgrade elevations, whichever is deeper. After completion of over-excavation, the areas should be moisture-conditioned, and recompacted to a minimum 95 percent relative compaction. The excavated materials may be replaced as properly compacted fill. The horizontal limits of over-excavation should extend to a minimum horizontal distance of 1 foot beyond the perimeter of the proposed improvements.

All fills should be placed in 6- to 8-inch-thick maximum lifts, watered or air dried as necessary to achieve slightly above-optimum moisture conditions, and then compacted to a minimum relative compaction of 95 percent per ASTM D 1557. The laboratory maximum dry density and optimum moisture content for each change in soil type should be determined in accordance with Test Method ASTM D 1557.

Cut Lots

Lots located entirely in cut exceeding 1 foot should be over-excavated a minimum of 3 feet below the bottom of the proposed foundations and replaced as properly compacted fill. Cut lots with less than 1 foot of cut should be over-excavated to a depth of 4 feet below existing grade. Prior to placing engineered fill, all exposed over-excavation bottom surfaces in the building pad areas should be flooded with water and compacted with heavy vibratory equipment to achieve near-optimum moisture conditions and then compacted in-place to no less than 90 percent relative compaction.

Cut-Fill Transition Lots/Building Pads

Cut/fill transitions should be eliminated from building-pad areas to reduce the detrimental effects of differential settlement. This should be accomplished by over-excavating the "cut" or shallow-fill portions to a depth of 3 feet below the bottom of the proposed foundations and replacing the excavated materials as properly compacted fill.

Horizontal limits of over-excavation should extend across the entire level portion of the lot. Prior to placing engineered fill, all exposed over-excavation bottom surfaces in the removal areas should be flooded with water and compacted with heavy vibratory equipment to achieve near-optimum moisture conditions and then compacted in-place to no less than 90 percent relative compaction.

Suitability of Site Soils as Fill

Site soils are suitable for use in engineered fills provided they are clean from organics and/or debris. Wet alluvial soils may also be encountered during site grading (depending upon the time of year grading occurs) and may require drying back before being reused as fill. Oversize rock, exceeding 12 inches, should be excluded from placement in the upper 5 feet of the building pads.

Fill Placement

Fill materials should be placed in approximately 6- to 8-inch-thick loose lifts, watered or air-dried as necessary to achieve a moisture content approximately 2 percent above optimum moisture condition, and then compacted in-place to no less than 90 percent relative compaction. The laboratory maximum dry density and optimum moisture content for each major soil type should be determined in accordance with ASTM D 1557.

Import Soils for Grading

If imported soils are needed to achieve final design grades, import soils should be free of deleterious materials, oversize rock, and any hazardous materials. The soils should also be non-expansive and essentially non-corrosive and approved by the project geotechnical consultant *prior* to being brought onsite. The geotechnical consultant should inspect the potential borrow site and conduct testing of the soil at least three days before the commencement of import operations.

Shrinkage and Subsidence

Volumetric changes in earth quantities will occur when excavated onsite soils are replaced as properly compacted fill. Following is an estimate of shrinkage factors for the alluvial soil present onsite. These estimates are based on in-place densities of the various materials and on the estimated average degree of relative compaction achieved during grading.

- Disturbed Surface Soils (0-2± feet)..…… Shrinkage of 15 to 20%±
- Alluvium (Upper 2-7± ft.) ……..…..... Shrinkage of 10 to 15%±

Subsidence from scarification and re-compaction of exposed bottom surfaces in removal areas to receive fill is expected to vary from negligible to approximately 0.1 foot. The above estimates of shrinkage and subsidence are intended as an aid for project engineers in determining earthwork quantities. However, these estimates should not be considered as absolute values and should be used with some caution. Contingencies should be made for balancing earthwork quantities based on actual shrinkage and subsidence that occurs during the grading operations.

Temporary Excavations

Temporary excavations to a depth possibly as much as 5± feet below existing grades may be required to accommodate the recommended over-excavation of unsuitable materials. Based on the physical properties of the onsite cohesionless soils, temporary excavations which are constructed exceeding 4 feet in height should be cut back to a ratio of 1:1 (h:v) or flatter for the duration of the over-excavation of unsuitable soil material and replacement as compacted fill, as well as placement of underground utilities. However, the temporary excavations should be observed by a representative of the project geotechnical consultant for evidence of potential instability. Depending on the results of these observations, revised slope configurations may be necessary. Other factors which should be considered with respect to the stability of the temporary slopes include construction traffic and/or storage of materials on or near the tops of the slopes, construction scheduling, presence of nearby walls or structures on adjacent properties and weather conditions at the time of construction. Applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health act of 1970 and the Construction Safety Act should also be followed.

FOUNDATION DESIGN RECOMMENDATIONS

Allowable Soil Bearing Capacities

Pad Footings

An allowable soil bearing capacity of 1,500 pounds per square foot may be utilized for design of isolated 24-inch-square footings founded at a minimum depth of 12 inches below the lowest adjacent final grade for pad footings that are not a part of the slab system and are used for support of such features as roof overhang, second-story decks, patio covers, etc. This value may be increased by 20 percent for each additional foot of depth and by 10 percent for each additional foot of width, to a maximum value of 2,500 pounds per square foot. The recommended allowable bearing value includes both dead and live loads and may be increased by one-third for short duration wind and seismic forces.

Continuous Footings

An allowable soil bearing capacity of 1,500 pounds per square foot may be utilized for design of continuous footings founded at a minimum depth of 12 inches below the lowest adjacent final grade. This value may be increased by 20 percent for each additional foot of depth and by 10 percent for each additional foot of width, to a maximum value of 2,500 pounds per square foot. The recommended allowable bearing value includes both dead and live loads and may be increased by one-third for short duration wind and seismic forces.

Estimated Footing Settlement

Based on the allowable bearing values provided above, total static settlement of the footings under the anticipated loads is expected to be on the order of 3/4 inch. Differential settlement is expected to be less than 1/2 inch over a horizontal span of 20 feet. The majority of settlement is likely to take place as footing loads are applied or shortly thereafter.

Lateral Resistance

A passive earth pressure of 250 pounds per square foot per foot of depth, to a maximum value of 2,500 pounds per square foot, may be used to determine lateral bearing resistance for footings. The passive pressure values may be increased by one-third when designing for transient wind or seismic forces. In addition, a coefficient of friction of 0.35 times the dead load forces may be used between concrete and the supporting soils to determine lateral sliding resistance. It should be noted that the above values are based on the condition where footings are cast in direct contact with compacted fill or competent native soils. In cases where the footing sides are formed, all backfill placed against the footings upon removal of forms should be compacted to at least 90 percent of the applicable maximum dry density.

Guidelines for Footings and Slab-on-Ground Design and Construction

The results of our laboratory tests performed on representative samples of near-surface soils within the site during our evaluation indicate that these materials predominantly exhibit expansion indices that are less than 20. As indicated in Section 1803.5.3 of 2022 California Building Code (2022 CBC), these soils are considered non-expansive and, as such, the design of slabs on-grade is considered to be exempt from the procedures outlined in Sections 1808.6.2 of the 2022 CBC and may be performed using any method deemed rational and appropriate by the project structural engineer. However, the following minimum recommendations are presented herein for conditions where the project design team may require geotechnical engineering guidelines for design and construction of footings and slabs on-grade at the project site.

The design and construction guidelines that follow are based on the above soil conditions and may be considered for reducing the effects of variability in fabric, composition and, therefore, the detrimental behavior of the site soils such as excessive short- and long-term total and differential heave or settlement. These guidelines have been developed on the basis of the previous experience of this firm on projects with similar soil conditions. Although construction performed in accordance with these guidelines has been found to reduce post-construction movement and/or distress, they generally do not positively eliminate all potential effects of variability in soils characteristics and future heave or settlement.

It should also be noted that the suggestions for dimension and reinforcement provided herein are performance-based and intended only as preliminary guidelines to achieve adequate performance under the anticipated soil conditions. However, they should not be construed as replacement for structural engineering analyses, experience, and judgment. The project structural engineer, architect and/or civil engineer should make appropriate adjustments to slab and footing dimensions, and reinforcement type, size and spacing to account for internal concrete forces (e.g., thermal, shrinkage and expansion), as well as external forces (e.g., applied loads) as deemed necessary. Consideration should also be given to minimum design criteria as dictated by local building code requirements.

Conventional Slabs on-Grade System

Onsite soils exhibit an expansion index of less than 20 and are classified as non-expansive. Accordingly, we recommend that footings and floor slabs be designed and constructed in accordance with the following minimum criteria.

Footings

1. Exterior continuous footings supporting one- and two-story structures should be founded at a minimum depth of 12 inches below the lowest adjacent final grade. Interior continuous footings may be founded at a minimum depth of 10 inches below the top of the adjacent finish floor slabs. The width and spacing of interior continuous footings should be designed by the project structural engineer.

2. In accordance with Table 1809.7 of 2022 CBC for light-frame construction, all continuous footings should have minimum widths of 12 inches for one- and two-story construction. We recommend all continuous footings should be reinforced with a minimum of two No. 4 bars, one top and one bottom.

3. A minimum 12-inch-wide grade beam founded at the same depth as adjacent footings should be provided across the garage entrances or similar openings (such as large doors or bay windows). The grade beam should be reinforced with a similar manner as provided above.

4. Interior isolated pad footings, if required, should be a minimum of 24 inches square and founded at a minimum depth of 12 inches below the bottoms of the adjacent floor slabs. Pad footings should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings.

5. Exterior isolated pad footings intended for support of colonnades, roof overhangs, upper-story decks, patio covers, and similar construction should be a minimum of 24 inches square and founded at a minimum depth of 18 inches below the lowest adjacent final grade. The pad footings should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings.

6. Exterior isolated pad footings may need to be connected to adjacent pad and/or continuous footings via tie beams at the discretion of the project structural engineer. Further, where excessive soils settlement issues have been identified for this site elsewhere in the report, it is strongly recommended to tie all footings both interior and exterior with a network of grade beams to reduce the potential differential settlement or isolated bearing distress issues below any independent footings.

7. The spacing and layout of the interior concrete grade beam system, if required below floor slabs, should be determined by the project structural engineer in accordance with the WRI publication.

8. The minimum footing dimensions and reinforcement recommended herein may be modified (increased or decreased subject to the constraints of Chapter 18 of the 2022 CBC) by the structural engineer responsible for foundation design based on his/her calculations, engineering experience, and judgment.

Building Floor Slabs

1. Concrete floor slabs should be a minimum of 4 inches thick and reinforced with a minimum of No. 3 bars spaced a maximum of 24 inches on centers, both ways. Alternatively, the structural engineer may recommend the use of prefabricated welded wire mesh for slab reinforcement. For this condition, the welded wire mesh should be of sheet type (not rolled) and should consist of 6x6/W2.9xW2.9 (per the Wire Reinforcement Institute, WRI, designation) or stronger. All slab reinforcement should be properly supported to ensure the desired placement near mid-depth. Care should be exercised to prevent warping of the welded wire mesh between the chairs in order to ensure its placement at the desired mid-slab position. Slab dimension, reinforcement type, size and spacing need to account for internal concrete forces (e.g., thermal, shrinkage and expansion) as well as external forces (e.g., applied loads), as deemed necessary.

   It should be noted that some of the non-climatic site parameters, which may impact slabs on-grade performance, are not known at this time, as it is the case for many projects at the design stage. Some of these site parameters include unsaturated soils diffusion conditions pre- and post-construction (e.g., casting the slabs at the end of long, dry or wet periods, maintenance during long, dry and wet periods, etc.), landscaping, alterations in site surface gradient, irrigation, trees, etc. While the effects of any or a combination of these parameters on slab performance cannot be accurately predicted, maintaining moisture content equilibrium within the soils mass and planting trees at a distance greater than half of their mature height away from the edge of foundation may reduce the potential for the adverse impact of these site parameters on slabs on-grade performance.

2. Living area concrete floor slabs and areas to receive moisture sensitive floor covering should be underlain with a moisture vapor retarder consisting of a minimum 10-mil-thick polyethylene or polyolefin membrane that meets the minimum requirements of ASTM E96 and ASTM E1745 for vapor retarders (such as Husky Yellow Guard®, Stego® Wrap, or equivalent). All laps within the membrane should be sealed, and at least 2 inches of clean sand should be placed over the membrane to promote uniform curing of the concrete.

   In general, to reduce the potential for punctures, the membrane should be placed on a pad surface that has been graded smooth without any sharp protrusions. If a smooth surface cannot be achieved by grading, consideration should be given to lowering the pad finished grade an additional inch and then placing a 1-inch-thick leveling course of sand across the pad surface prior to the placement of the membrane. Foot traffic on the membrane should be reduced to a minimum. Additional steps would also need to be taken to prevent puncturing of the vapor retarder during concrete placement.

   At the present time, some slab designers, geotechnical professionals and concrete experts view the sand layer below the slab (blotting sand) as a place for entrapment of excess moisture that could adversely impact moisture-sensitive floor coverings. As a preventive measure, the potential for moisture intrusion into the concrete slab could be reduced if the concrete is placed directly on the vapor retarder. However, if this sand layer is omitted, appropriate curing methods must be implemented to ensure that the concrete slab cures uniformly. A qualified contractor with experience in slab construction and curing should provide recommendations for alternative methods of curing and supervise the construction process to ensure uniform slab curing.

3. Garage floor slabs should be a minimum 4 inches thick and reinforced in a similar manner as living area floor slabs. Garage slabs should also be poured separately from adjacent wall footings with a positive separation maintained using ¾-inch-minimum felt expansion joint material. To control the propagation of shrinkage cracks, garage floor slabs should be quartered with weakened plane joints. Consideration should be given to placement of a moisture vapor retarder below the garage slab, similar to that provided in Item 2 above, should the garage slab be overlain with moisture sensitive floor covering.

4. Presaturation of the subgrade below floor slabs will not be required; however, prior to placing concrete, the subgrade below all dwelling and garage floor slab areas should be thoroughly moistened to achieve a moisture content that is at least equal to or slightly greater than optimum moisture content. This moisture content should penetrate to a minimum depth of 12 inches below the bottoms of the slabs.

5. The minimum dimensions and reinforcement recommended herein for building floor slabs may be modified (increased or decreased subject to the constraints of Chapter 18 of the 2022 CBC) by the structural engineer responsible for foundation design based on his/her calculations, engineering experience, and judgment.

Footing Observations

Foundation footing trenches should be observed by the project geotechnical consultant to document the trenches expose competent bearing-soils. The foundation excavations should be observed prior to the placement of forms, reinforcement, or concrete. The excavations should be trimmed neat, level, and square. Prior to placing concrete, all loose, sloughed, or softened soils and/or construction debris should be

removed. Excavated soil derived from footing and utility trench excavations should not be placed in slab-on-grade areas unless the soils are compacted to a relative compaction of 90 percent or more.

PRELIMINARY PAVEMENT DESIGN RECOMMENDATIONS

Based on experience with nearby sites, an R-value of 70 was estimated for the subject site. A traffic index (TI) of 5.5 was assumed for interior (local) streets and 6.5 for collectors in accordance with City of Fontana Standard Plan No. 402, Roadway Design Requirements. The traffic indices, along with the estimated design R-value, were utilized for preliminary pavement section design. The following pavement sections have been computed in accordance with Caltrans design procedures and presented in the following table, Table 2.

TABLE 2

Preliminary Pavement Design

Location	Design R-value	Traffic Index	Pavement Section
Interior (Local) Streets	70	5.5	4 in. AC[1] / Compacted Subgrade
Collectors	70	6.5	4.5 in. AC[1] / Compacted Subgrade

Notes:
AC = Asphalt Concrete
AB = Aggregate Base
[1] = Min. AC section per City of Fontana Standard Plan 400

The upper 12 inches of subgrade soils immediately below the aggregate base (base) or full-depth asphalt concrete section should be compacted to 95 percent or more relative compaction based on ASTM D 1557 to a depth of 12 inches or more. Final subgrade compaction should be performed prior to placing base and after utility trench backfills have been compacted and tested. *Subgrade shall be firm and unyielding*, as exhibited by proof-rolling, prior to placement of asphalt concrete. Asphalt-concrete materials and construction should conform to Section 203 of the Greenbook.

General Corrosivity Screening

As a screening level study, limited chemical and electrical tests were performed on samples considered representative of the onsite soils to identify potential corrosive characteristics of these soils. The common indicators that are generally associated with soil corrosivity, among other indicators, include water-soluble sulfate (a measure of soil corrosivity on concrete), water-soluble chloride (a measure of soil corrosivity on metals embedded in concrete), pH (a measure of soil acidity), and minimum electrical resistivity (a measure of corrosivity on metals embedded in soils). Test methodology and results are presented in Appendix B.

It should be noted that Petra does not practice corrosion engineering; therefore, the test results, opinion and engineering judgment provided herein should be considered as general guidelines only. Additional analyses, and/or determination of other indicators, would be warranted, especially, for cases where buried metallic building materials (such as copper and cast or ductile iron pipes) in contact with site soils are planned for the project. In many cases, the project geotechnical engineer may not be informed of these choices. Therefore, for conditions where such elements are considered, we recommend that other, relevant project design professionals (e.g., the architect, landscape architect, civil and/or structural engineer, etc.) to be involved. We also recommend considering a qualified corrosion engineer to conduct additional sampling and testing of near-surface soils during the final stages of site grading to provide a complete assessment of soil corrosivity. Recommendations to mitigate the detrimental effects of corrosive soils on buried metallic and other building materials that may be exposed to corrosive soils should be provided by the corrosion engineer as deemed appropriate.

In general, a soil's water-soluble sulfate levels and pH relate to the potential for concrete degradation; water-soluble chlorides in soils impact ferrous metals embedded or encased in concrete, e.g., reinforcing steel; and electrical resistivity is a measure of a soil's corrosion potential to a variety of buried metals used in the building industry, such as copper tubing and cast or ductile iron pipes. Table 3, below, presents test results with an interpretation of current code approach and guidelines that are commonly used in building construction industry. The table includes the code-related classifications of the soils as they relate to the various tests, as well as a general recommendation for possible mitigation measures in view of the potential adverse impact of corrosive soils on various components of the proposed structures in direct contact with site soils. The guidelines provided herein should be evaluated and confirmed, or modified, in their entirety by the project structural engineer, corrosion engineer and/or the contractor responsible for concrete placement for structural concrete used in exterior and interior footings, interior slabs on-ground, garage slabs, wall foundations and concrete exposed to weather such as driveways, patios, porches, walkways, ramps, steps, curbs, etc.

TABLE 3

Soil Corrosivity Screening Results

Test (Test Method Designation)	Test Results	Classification	General Recommendations
Soluble Sulfate (Cal 417)	SO_4^{2-} < 0.10 % by weight	**S0(1) - Not Applicable**	Type II cement; minimum f_c' = 2,500 psi; no water/cement ratio restrictions.
pH (Cal 643)	6.6 – 7.3	**Neutral**	No Special Recommendations
Soluble Chloride (Cal 422)	Cl^{1-} < 500 ppm	**C1(2) - Moderate**	Residence: No special recommendations; f_c' should not be less than 2,500 psi.
Resistivity (Cal 643)	5,000 – 10,000	**Moderately Corrosive(5)**	Protective wrapping/coating of buried pipes; corrosion resistant materials

Notes:
1. ACI 318-14, Section 19.3
2. ACI 318-14, Section 19.3
3. Pierre R. Roberge, "Handbook of Corrosion Engineering"
4. Exposure classification C2 applies specifically to swimming pools and appurtenant concrete elements
5. f_c', 28-day unconfined compressive strength of concrete

Exterior Concrete Flatwork

General

Near-surface compacted fill soils within the site are variable in fines content and expansion behavior, however, they are expected to exhibit a range of expansion indices that classify them as non-expansive, i.e., Expansion Index, EI, $\leq$ 20. Therefore, we recommend that all exterior concrete flatwork such as sidewalks, patio slabs, large decorative slabs, concrete subslabs that will be covered with decorative pavers, private and/or public vehicular parking, driveways and/or access roads within and adjacent to the site be designed by the project architect, civil and/or structural engineer with consideration given to mitigating the potential for cracking, curling, etc. that can potentially develop as a result of being underlain with soils that essentially exhibiting expansion index values that fall in the non-expansive category.

The guidelines that follow should be considered as minimums and are subject to review and revision by the project architect, civil engineer, structural engineer and/or landscape consultant as deemed appropriate.

Subgrade Preparation

Compaction

To reduce the potential for distress to concrete flatwork, the subgrade soils below concrete flatwork areas to a minimum depth of 12 inches (or deeper, as either prescribed elsewhere in this report or determined in the field) should be moisture conditioned to at least equal to, or slightly greater than, the optimum moisture

content and then compacted to a minimum relative compaction of 90 percent. Where concrete public roads, concrete segments of roads and/or concrete access driveways and heavy recreational vehicles parking are proposed, the upper 6 inches of subgrade soil should be compacted to a minimum 95 percent relative compaction.

Pre-Moistening

As a further measure to reduce the potential for concrete flatwork distress, subgrade soils should be thoroughly moistened prior to placing concrete. The moisture content of the soils should be at least 1.1 times the optimum moisture content and penetrate to a minimum depth of 12 inches into the subgrade. Flooding or ponding of the subgrade is not considered feasible to achieve the above moisture conditions since this method would likely require construction of numerous earth berms to contain the water. Therefore, moisture conditioning may be achieved with sprinklers or a light spray applied to the subgrade over a period of several hours to few days just prior to pouring concrete. Pre-watering of the soils is intended to promote uniform curing of the concrete, reduce the development of shrinkage cracks, and reduce the potential for differential expansion pressure on freshly poured flatwork. A representative of the project geotechnical consultant should observe and verify the density and moisture content of the soils, and the depth of moisture penetration prior to pouring concrete.

Thickness and Joint Spacing

To reduce the potential of unsightly cracking, concrete walkways, patio-type slabs, large decorative slabs and concrete subslabs to be covered with decorative pavers should be at least 4 inches thick and provided with construction joints or expansion joints every 6 feet or less. Private driveways that will be designed for the use of passenger cars for access to private garages should also be at least 4 inches thick and provided with construction joints or expansion joints every 10 feet or less. Concrete pavement that will be designed based on an unlimited number of applications of an 18-kip single-axle load in public access areas, segments of road that will be paved with concrete (such as bus stops and cross-walks) or access roads and driveways, which serve multiple residential units or garages, that will be subject to heavy truck loadings and parking of recreational vehicles should have a minimum thickness of 5 inches and be provided with control joints spaced at maximum 10-foot intervals. A modulus of subgrade reaction of 125 pounds per cubic foot may be used for design of the public and access roads.

Reinforcement

All concrete flatwork having their largest plan-view panel dimensions exceeding 10 feet should be reinforced with a minimum of No. 3 bars spaced 18 inches for 4-inch-thick slabs and No. 4 bars spaced 24

inches for 5-inch-thick slabs on centers, both ways. Alternatively, the slab reinforcement may consist of welded wire mesh of the sheet type (not rolled) with 6x6/W1.4xW1.4 WWF designations for 4-inch-thick slabs and 6x6/W2.9xW2.9 designations for 5-inch-thick slabs in accordance with the Wire Reinforcement Institute (WRI). The reinforcement should be properly positioned near the middle of the slabs. All foot and equipment traffic on the reinforcement should be avoided or reduced to a minimum.

The reinforcement recommendations provided herein are intended as a guideline to achieve adequate performance for anticipated soil conditions. As such, this guideline may not satisfy certain acceptable approaches, e.g., the area of reinforcement to be equal to or greater that 0.2 percent of the area of concrete. The project architect, civil and/or structural engineer should make appropriate adjustments in reinforcement type, size and spacing to account for concrete internal (e.g., shrinkage and thermal) and external (e.g., applied loads) forces as deemed necessary.

Edge Beams (Optional)

Where the outer edges of concrete flatwork are to be bordered by landscaping, it is recommended that considerations be given to the use of edge beams (thickened edges) to prevent excessive infiltration and accumulation of water under the slabs. Edge beams, if used, should be 6 to 8 inches wide, extend 8 inches below the tops of the finish slab surfaces. Edge beams are not mandatory; however, their inclusion in flatwork construction adjacent to landscaped areas is intended to reduce the potential for vertical and horizontal movement and subsequent cracking of the flatwork related to uplift forces that can develop in expansive soils.

Drainage

Drainage from patios and other flatwork areas should be directed to local area drains and/or graded earth swales designed to carry runoff water to the adjacent streets or other approved drainage structures. The concrete flatwork should be sloped at a minimum gradient of one percent, or as prescribed by project civil engineer or local codes, away from building foundations, retaining walls, masonry garden walls and slope areas.

Tree Wells

Tree wells are not recommended in concrete flatwork areas because they typically introduce excessive water into the subgrade soils and allow root invasion, both of which can cause heaving and cracking of the flatwork.

INFILTRATION TEST RESULTS

Plans for development of the subject property were not available at the time of our initial field work; however, conceptual plans were subsequently provided with tentative location for buried water quality chambers by the design civil engineer. A total of four percolation tests were conducted to assess infiltration rates of the near-surface onsite soils for preliminary design of detention basins to manage storm water runoff. The test locations are presented in Figure 2.

The initial infiltration test hole (P-1A) was excavated on July 25, 2023 using a conventional backhoe. A one-foot square hole was hand excavated from 4 to 5 feet bgs and 1 foot of perforated pipe embedded in 1 foot pea gravel was placed in the hand excavation. Solid pipe was added to the surface and the test pit was backfilled with native soils. Pre-soaking and testing was conducted at a depth of 4 to 5 feet using the Falling Head Test Method (RCFCD, 2011). The infiltration test was conducted in the lower one foot of the test pit. The hole was pre-soaked immediately after drilling. The infiltration rate was then calculated using the Porchet Method (RCFCD, 2011), commonly called the "inversed auger-hole method."

Three additional percolation test borings (P-1A through P-3) were drilled on August 24 , 2023 to depths of 10 to 12 feet, using a hollow-stem-auger drill rig. Following the installation of 3-inch PVC perforated casing and gravel pack, the test holes presoaked. These tests used the Falling Head Test Method (RCFCD, 2011). Infiltration rates were then calculated using the Porchet Method (RCFCD, 2011), commonly called the "inversed auger-hole method." The infiltration tests were conducted in the lower 5 feet of the borings.

Soils encountered in test locations consisted of medium- to course-grained gravelly sand. The test locations are shown in Figure 2. Test pit and boring logs are provided in Appendix A. The un-factored infiltration rate results are summarized below in Table 4, and test data are provided in Appendix D.

TABLE 4

Summary of Infiltration Rates

Percolation Test	Depth of Test (feet below surface)	Percolation Rate (gallons/day/ft^2)	Infiltration Rate (inches/hour)
P-1A	4 to 5	308	47
P-1	5 to 10	103	9.1
P-2	7 to 12	45	3.9
P-3	5 to 10	153	13.4

POST-GRADING RECOMMENDATIONS

Site Drainage

Surface drainage systems consisting of sloping concrete flatwork, graded earth swales and/or an underground area drain system are anticipated to be constructed to collect and direct all surface waters to the adjacent streets and storm drain facilities. In addition, the ground surface around the proposed buildings should be sloped at a positive gradient away from the structures. The purpose of the precise grading is to prevent ponding of surface water within the level areas of the site and against building foundations and associated site improvements. The drainage systems should be properly maintained throughout the life of the proposed development.

It should be emphasized that the slopes away from the structures area drain inlets and storm drain structures to be properly maintained, not to be obstructed, and that future improvements not to alter established gradients unless replaced with suitable alternative drainage systems.

Slope Landscaping and Maintenance

Adequate slope and pad drainage facilities are essential in the design of grading for the subject site. An anticipated rainfall equivalency on the order of 60 to 100 inches per year at the site can result due to irrigation. The overall stability of the graded slopes should not be adversely affected provided drainage provisions are properly constructed and maintained thereafter and provided engineered slopes are landscaped immediately following grading with a deep-rooted, drought-tolerant, and maintenance-free plant species, as recommended by the project landscape architect. Additional comments and recommendations are presented below with respect to slope drainage, landscaping, and irrigation.

A common type of slope failure in hillside areas is the surficial instability and usually involves the upper 1 to 6 feet. For a given gradient, these surficial slope failures are generally caused by a wide variety of conditions, such as overwatering, cyclic changes in moisture content and density of slope soils from both seasonal and irrigation-induced wetting and drying, soil expansiveness, time lapse between slope construction and slope planting, type and spacing of plant materials used for slope protection, rainfall intensity and/or lack of a proper maintenance program. Based on this discussion, the following recommendations are presented to mitigate potential surficial slope failures.

- Proper drainage provisions for engineered slopes should consist of concrete terrace drains, down drains and energy dissipaters (where required) constructed in accordance with the Grading Code of the City of Fontana. Provisions should also be made for construction of compacted-earth berms along the tops of engineered slopes.

- Permanent engineered slopes should be landscaped as soon as practical at the completion of grading. As noted, the landscaping should consist of a deep-rooted, drought-tolerant, and maintenance-free plant species. If landscaping cannot be provided within a reasonable period of time, jute matting (or equivalent) or a spray-on product designed to seal slope surfaces should be considered as a temporary measure to inhibit surface erosion until such time permanent landscape plants have become well-established.

- Irrigation systems should be installed on the engineered slopes and a watering program then implemented which maintains a uniform, near-optimum moisture condition in the soils. Overwatering and subsequent saturation of the slope soils should be avoided. On the other hand, allowing the soils to dry-out is also detrimental to slope performance.

- Irrigation systems should be constructed at the surface only. Construction of sprinkler lines in trenches should not be allowed without prior approval from the geotechnical engineer and engineering geologist.

- A permanent slope-maintenance program should be initiated for major slopes not maintained by individual homeowners. Proper slope maintenance should include the care of drainage- and erosion-control provisions, rodent control, and repair of leaking or damaged irrigation systems.

- Homeowners should be advised of the potential problems that can develop when drainage on the pads and slopes is altered. Drainage can be altered due to the placement of fill and construction of garden walls, retaining walls, walkways, patios, swimming pools, spas, and planters.

Utility Trenches

Utility-trench backfill within street rights-of-way, utility easements, under sidewalks, driveways and building-floor slabs should be compacted to a minimum relative compaction of 90 percent (or more). Where onsite soils are utilized as backfill, mechanical compaction should be used. Density testing, along with probing, should be performed by the project geotechnical consultant or his representative to document adequate compaction. Utility-trench sidewalls deeper than about 4 feet should be laid back at a ratio of 1:1 (h:v) or flatter or shored. A trench box may be used in lieu of shoring. If shoring is anticipated, the project geotechnical consultant should be contacted to provide design parameters.

For trenches with vertical walls, backfill should be placed in approximately 1- to 2-foot-thick loose lifts and then mechanically compacted with a hydra-hammer, pneumatic tampers, or similar compaction equipment. For deep trenches with sloped walls, backfill materials should be placed in approximately 8- to 12-inch-thick loose lifts and then compacted by rolling with a sheepsfoot tamper or similar equipment.

Where utility trenches are proposed in a direction that parallels any building footing (interior and/or exterior trenches), the bottom of the trench should not be located within a 1:1 (h:v) plane projected downward from the outside bottom edge of the adjacent footing.

Retaining Walls

Footing Embedment

The base of retaining-wall footings constructed on level ground may be founded at a depth of 12 inches or more below the lowest adjacent final grade for low height walls. Where retaining walls are proposed on or within 15 feet from the top of adjacent descending fill slope, the footings should be deepened such that a horizontal clearance of 7 feet or more is maintained between the outside bottom edges of the footings and the face of the slope. The above-recommended footing setback is preliminary and may be revised based on site-specific soil conditions. Footing trenches should be observed by the project geotechnical representative to document that the footing trenches have been excavated into competent bearing soils and to the embedments recommended above. These observations should be performed prior to placing forms or reinforcing steel.

Allowable Bearing Values and Lateral Resistance

Retaining wall footings may be designed using the allowable bearing values and lateral resistance values provided previously for building foundations; however, when calculating passive resistance, the resistance of the upper 6 inches of the soil cover in front of the wall should be ignored in areas where the front of the wall will not be covered with concrete flatwork.

Active Earth Pressures

As of the date of this report, it is uncertain whether the proposed retaining walls will be backfilled with on-site soils or imported granular materials. For this reason, active and at-rest earth pressures are provided below for both conditions. However, considering that the onsite earth materials have an expansion index of 0 to 20, the use of imported granular materials for backfilling behind the retaining walls as described in the following sections is optional.

1. Onsite Soils Used for Backfill

   Onsite soils have an expansion index of 0 to 20. Therefore, active earth pressures equivalent to fluids having a density of 35 psf/ft and 51 psf/ft should be used for design of cantilevered walls retaining a level backfill and ascending 2:1 backfill, respectively. For walls that are restrained at the top, at-rest earth pressures of 53 pounds per cubic foot (equivalent fluid pressures) should be used. The above values are for retaining walls that have been supplied with a proper subdrain system (see Figure RW-1). All walls should be designed to support any adjacent structural surcharge loads imposed by other nearby walls or footings in addition to the above recommended active and at-rest earth pressures.

2. Imported Sand, Pea Gravel or Rock Used for Wall Backfill

Imported clean sand exhibiting a sand equivalent value (SE) of 30 or greater, pea gravel or crushed rock may be used for wall backfill to reduce the lateral earth pressures provided these granular backfill materials extend behind the walls to a minimum horizontal distance equal to one-half the wall height. In addition, the sand, pea gravel or rock backfill materials should extend behind the walls to a minimum horizontal distance of 2 feet at the base of the wall or to a horizontal distance equal to the heel width of the footing, whichever is greater (see Figures RW-2 and RW-3). For the above conditions, cantilevered walls retaining a level backfill and ascending 2:1 backfill may be designed to resist active earth pressures equivalent to fluids having densities of 30 and 41 pounds per cubic foot, respectively. For walls that are restrained at the top, at-rest earth pressures equivalent to fluids having densities of 45 and 62 pounds per cubic foot are recommended for design of restrained walls supporting a level backfill and ascending 2:1 backfill, respectively. These values are also for retaining walls supplied with a proper subdrain system. Furthermore, as with native soil backfill, the walls should be designed to support any adjacent structural surcharge loads imposed by other nearby walls or footings in addition to the recommended active and at-rest earth pressures.

All structural calculations and details should be provided to the project geotechnical consultant for verification purposes prior to grading and construction phases.

Earthquake Loads

It is our understanding that retaining wall plans are not available at the time of this report. Section 1803.5.12 of the 2022 CBC requires the determination of lateral loads on retaining walls from earthquake forces for structures in seismic design categories D through E that are supporting more than six feet of backfill height. Recommendations for design of walls exceeding six feet in height can be provided once retaining walls plans are available for review.

Geotechnical Observation and Testing

All grading associated with retaining wall construction, including backcut excavations, observation of the footing trenches, installation of the subdrainage systems, and placement of backfill should be provided by a representative of the project geotechnical consultant.

Backdrains

To reduce the likelihood of the entrapment of water in the backfill soils, weepholes or open vertical masonry joints may be considered for retaining walls not exceeding a height of 3 feet. Weepholes, if used, should be 3-inches minimum diameter and provided at intervals of 6 feet or less along the wall. Open vertical masonry joints, if used, should be provided at 32-inch intervals. A continuous gravel fill, 3 inches by 12 inches, should be placed behind the weepholes or open masonry joints. The gravel should be wrapped in filter fabric to prevent infiltration of fines and subsequent clogging of the gravel. Filter fabric may consist of Mirafi 140N or equivalent.

A perforated pipe-and-gravel backdrain should be constructed behind retaining walls exceeding a height of 3 feet (see Figure RW-1). Perforated pipe should consist of 4-inch-minimum diameter PVC Schedule 40, or ABS SDR-35, with the perforations laid down. The pipe should be encased in a 1-foot-wide column of ¾-inch to 1½-inch open-graded gravel. If on-site soils are used as backfill, the open-graded gravel should extend above the wall footings to a minimum height equal to one-third the wall height or to a minimum height of 1.5 feet above the footing, whichever is greater. The open-graded gravel should be completely wrapped in filter fabric consisting of Mirafi 140N or equivalent. Solid outlet pipes should be connected to the subdrains and then routed to a suitable area for discharge of accumulated water.

Waterproofing

The backfilled sides of retaining walls should be coated with an approved waterproofing compound or covered with a similar material to inhibit migration of moisture through the walls.

Temporary Excavations

Temporary slopes may be cut at a gradient no steeper than 1:1 (h:v). However, the project geotechnical engineer should observe temporary slopes for evidence of potential instability. Depending on the results of these observations, flatter slopes may be necessary. The potential effects of various parameters such as weather, heavy equipment travel, storage near the tops of the temporary excavations and construction scheduling should also be considered in the stability of temporary slopes.

Wall Backfill

Recommended active and at-rest earth pressures for design of retaining walls are based on the physical and mechanical properties of the onsite soil materials. The backfill behind the proposed retaining walls, they should be placed in approximately 6- to 8-inch-thick maximum lifts, watered as necessary to achieve near optimum moisture conditions, and then mechanically compacted in place to a minimum relative compaction of 90 percent. Flooding or jetting of the backfill materials should be avoided. A representative of the project geotechnical consultant should observe the backfill procedures and test the wall backfill to verify adequate compaction.

Masonry Block Screen Walls

Construction On or Near the Tops of Descending Slopes

Continuous footings for masonry walls proposed on or within 5 feet from the top of a descending cut or fill slope should be deepened such that a horizontal clearance of 5 feet is maintained between the outside bottom edge of the footing and the slope face. The footings should be reinforced with two No. 4 bars, one top and

one bottom. Plans for top-of-slope masonry walls proposing pier and grade beam footings should be reviewed by the project geotechnical consultant prior to construction.

Construction on Level Ground

Where masonry walls are proposed on level ground and 5 feet or more from the tops of descending slopes, the footings for these walls may be founded 18 inches or more below the lowest adjacent final grade. These footings should also be reinforced with two No. 4 bars, one top and one bottom.

Construction Joints

In order to reduce the potential for unsightly cracking related to the effects of differential settlement, positive separations (construction joints) should be provided in the walls at horizontal intervals of approximately 20 to 25 feet and at each corner. The separations should be provided in the blocks only and not extend through the footings. The footings should be placed monolithically with continuous rebars to serve as effective "grade beams" along the full lengths of the walls.

CONSTRUCTION SERVICES

This report has been prepared for the exclusive use of Fontana Investment 2023, LLC to assist the project engineers and architect in the design of the proposed development. It is recommended that Petra be engaged to review the final-design drawings and specifications prior to construction. This is to document that the recommendations contained in this report have been properly interpreted and are incorporated into the project specifications. If Petra is not accorded the opportunity to review these documents, we can take no responsibility for misinterpretation of our recommendations.

We recommend that Petra be retained to provide soil-engineering services during construction of the excavation and foundation phases of the work. This is to observe compliance with the design, specifications, or recommendations and to allow design changes if subsurface conditions differ from those anticipated prior to start of construction.

If the project plans change significantly (e.g., building loads or type of structures), we should be retained to review our original design recommendations and their applicability to the revised construction. If conditions are encountered during construction that appears to be different than those indicated in this report, this office should be notified immediately. Design and construction revisions may be required.

LIMITATIONS

This report is based on the project, as described, and the geotechnical data obtained from the field tests performed and our laboratory test data. The materials encountered on the project site and utilized in our laboratory evaluation are believed representative of the total area. However, soil materials can vary in characteristics between excavations, both laterally and vertically.

The conclusions and opinions contained in this report are based on the results of the described geotechnical evaluations and represent our professional judgment. The findings, conclusions and opinions contained in this report are to be considered tentative only and subject to confirmation by the undersigned during the construction process. Without this confirmation, this report is to be considered incomplete and Petra or the undersigned professionals assume no responsibility for its use. In addition, this report should be reviewed and updated after a period of 1 year or if the site ownership or project concept changes from that described herein.

The professional opinions contained herein have been derived in accordance with current standards of practice and no warranty is expressed or implied.

Respectfully submitted,

PETRA GEOSCIENCES, INC.

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Associate Geologist
CEG 1924

REGISTERED GEOLOGIST
EDWARD P. LUMP
No. 1924
Certified Engineering Geologist
STATE OF CALIFORNIA

9/6/23

Grayson R. Walker
Principal Engineer
GE 871

REGISTERED PROFESSIONAL ENGINEER
GRAYSON R. WALKER
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GEOTECHNICAL
STATE OF CALIFORNIA

EL/GRW/lv

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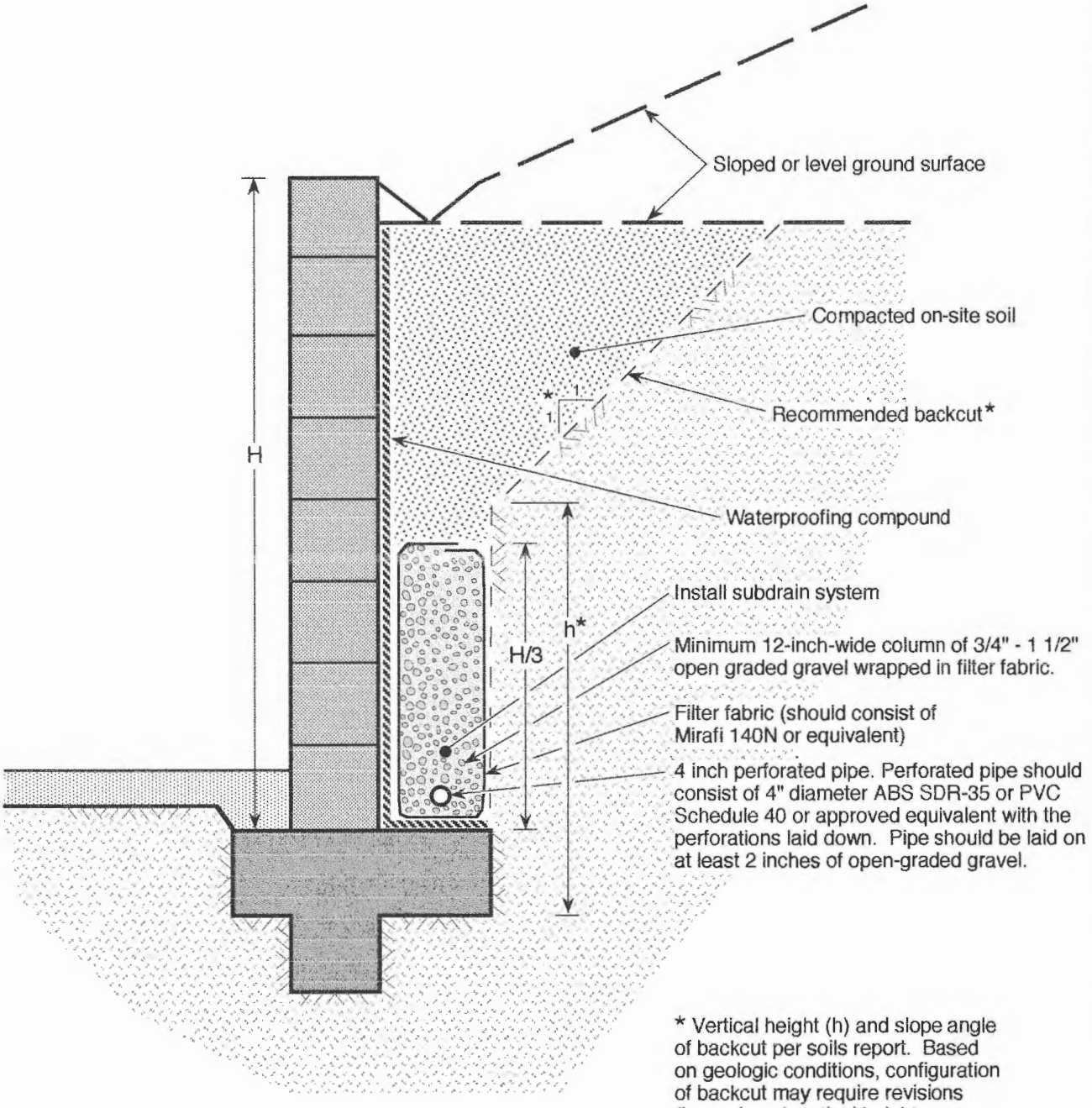
FIGURES

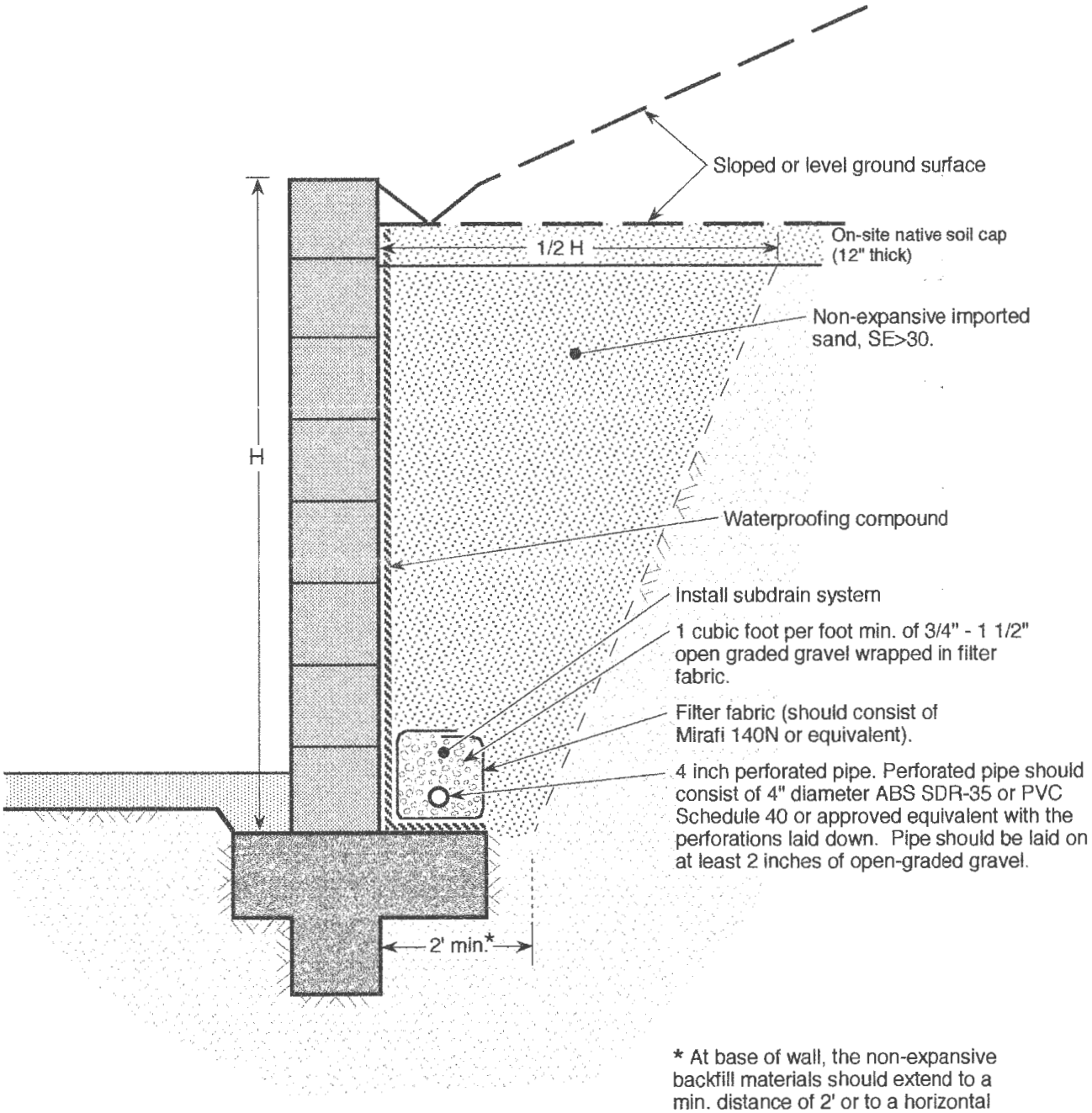
NATIVE SOIL BACKFILL



* Vertical height (h) and slope angle of backcut per soils report. Based on geologic conditions, configuration of backcut may require revisions (i.e. reduced vertical height, revised slope angle, etc.)

PETRA	RETAINING WALL BACKFILL AND SUBDRAIN DETAILS	FIGURE RW-1

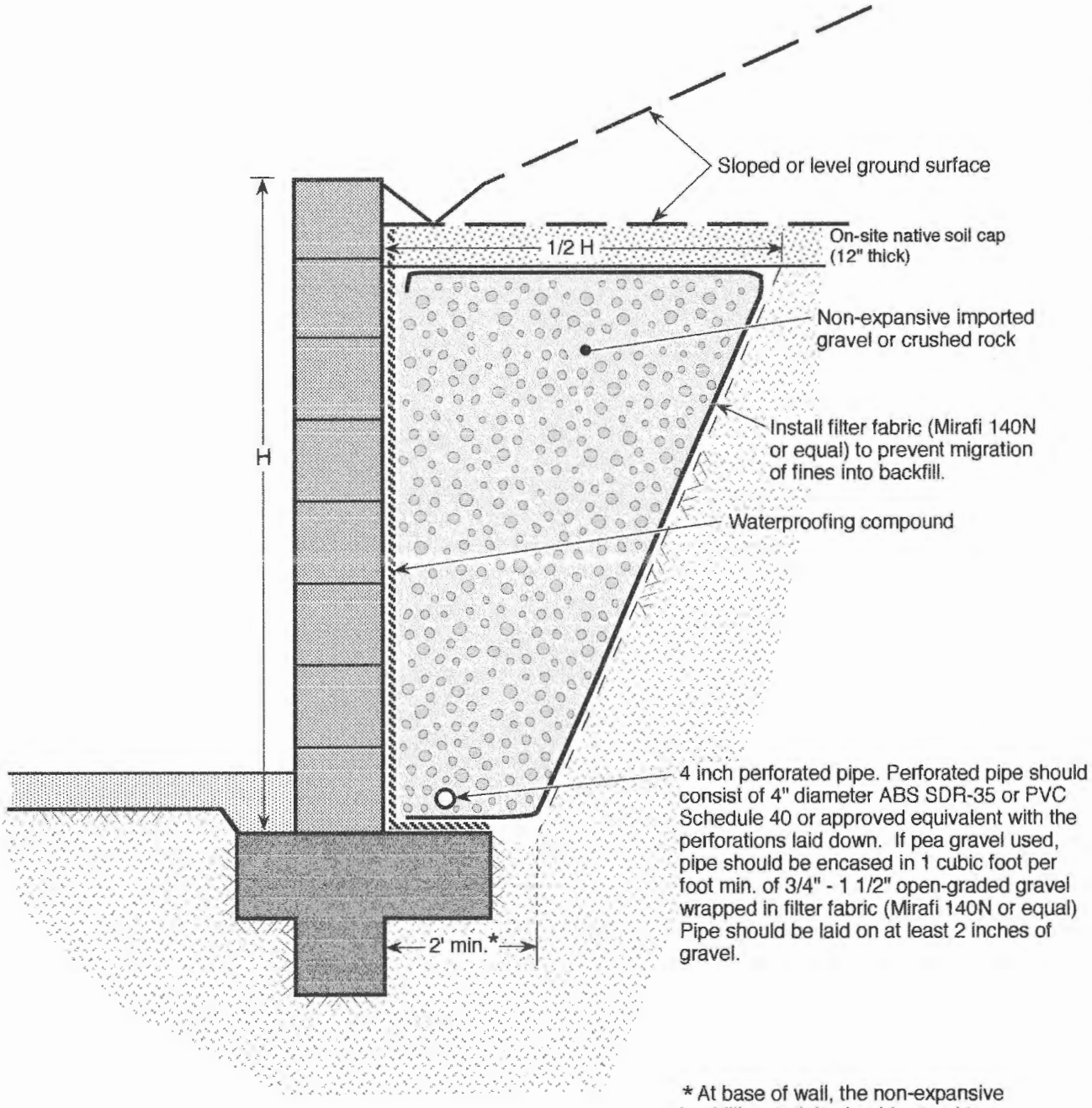
IMPORTED SAND BACKFILL



* At base of wall, the non-expansive backfill materials should extend to a min. distance of 2' or to a horizontal distance equal to the heel width of the footing, whichever is greater.

PETRA	RETAINING WALL BACKFILL AND SUBDRAIN DETAILS	FIGURE RW-2

IMPORTED GRAVEL OR CRUSHED ROCK BACKFILL



* At base of wall, the non-expansive backfill materials should extend to a min. distance of 2' or to a horizontal distance equal to the heel width of the footing, whichever is greater.

PETRA	RETAINING WALL BACKFILL AND SUBDRAIN DETAILS	FIGURE RW-3

LEGEND

7Ł

Site LoicanMipniaFLMpng

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tiuinr1 FLn 1MCcepM LLU-mU.

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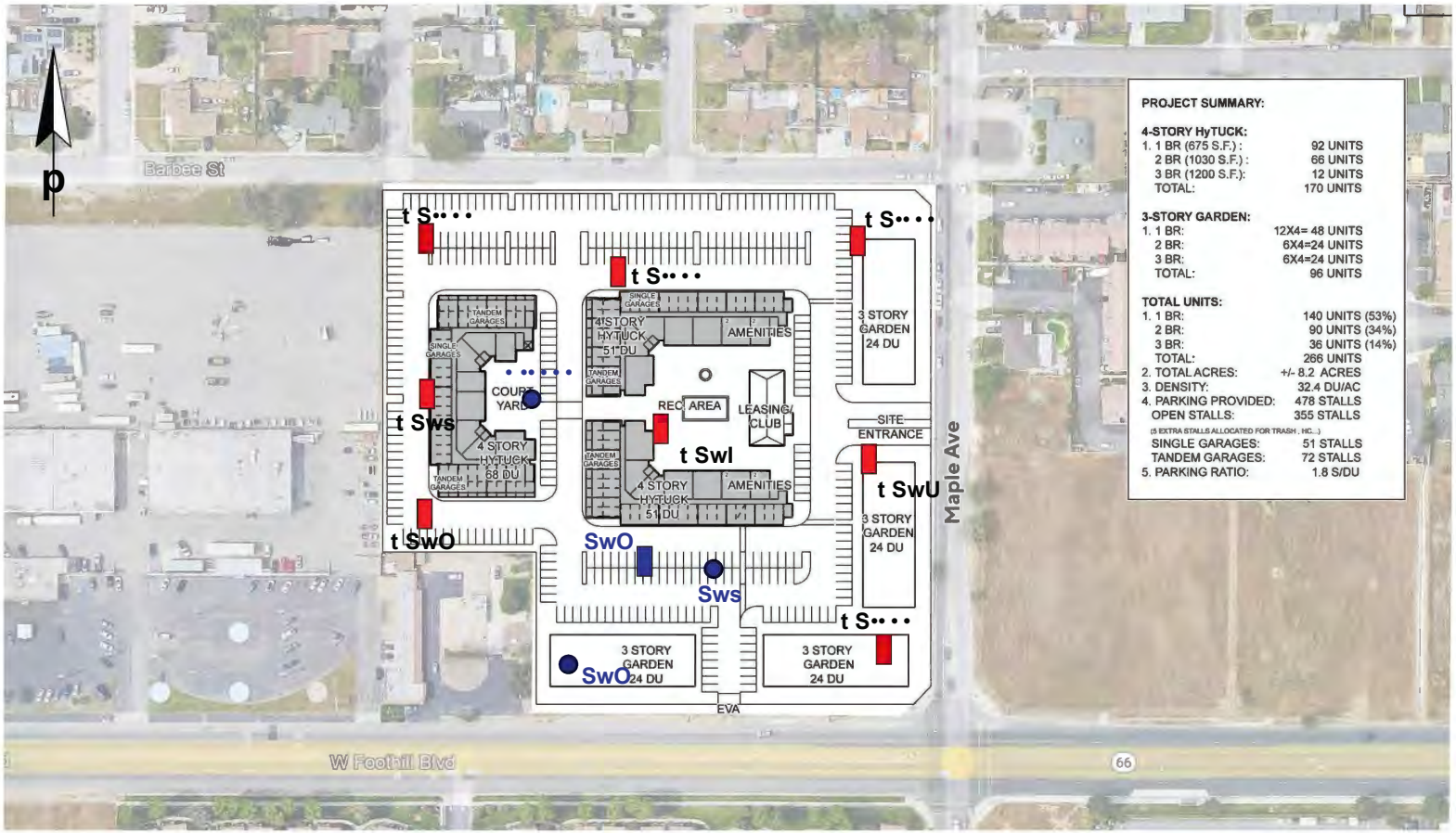
Site Location Map

E tiN Sept.L-5-B GgpgN-B7-5B

Figure 1



Foothill Blvd & Maple Ave Apartments
Fontana, CA
Diversified

OPTION TWO
Conceptual Site

0 50' 100' 200'

Architecture. Design. Relationships.

01

Bi o i pC

SwO

Site Lio ceaeneMpeF ceongurpeu ang1FEG EnpNDTepTrneP -5-BP 7ggTNDAA SAfuCEeLiEaeT1eMTtP 7gMTiMsFEP uiTeuErwrtT OQ

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APPENDIX A

EXPLORATION LOGS

Key to Soil and Bedrock Symbols and Terms

PETRA

Unified Soil Classification System

Coarse-grained Soils > 1/2 of materials is larger than #200 sieve	GRAVELS more than half of coarse fraction is larger than #4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		Gravels with fines	GM	Silty Gravels, poorly-graded gravel-sand-silt mixtures
			GC	Clayey Gravels, poorly-graded gravel-sand-clay mixtures
	SANDS more than half of coarse fraction is smaller than #4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly-graded sands, gravelly sands, little or no fines
		Sands with fines	SM	Silty Sands, poorly-graded sand-gravel-silt mixtures
			SC	Clayey Sands, poorly-graded sand-gravel-clay mixtures
Fine-grained Soils > 1/2 of materials is smaller than #200 sieve	SILTS & CLAYS Liquid Limit Less Than 50		ML	Inorganic silts & very fine sands, silty or clayey fine sands, clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts & clays of low plasticity
	SILTS & CLAYS Liquid Limit Greater Than 50		MH	Inorganic silts, micaceous or diatomaceous fine sand or silt
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic silts and clays of medium-to-high plasticity
Highly Organic Soils			PT	Peat, humus swamp soils with high organic content

The No. 200 U.S. Standard Sieve is about the smallest particle visible to the naked eye

Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		>12"	>12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19"	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized to
Fines		Passing #200	<0.0029"	Flour-sized and smaller

Modifiers

Trace	< 1 %
Few	1 - 5%
Some	5 - 12 %
Numerous	12 - 20 %

Laboratory Test Abbreviations

MAX	Maximum Dry Density	MA	Mechanical (Particle Size) Analysis
EXP	Expansion Potential	AT	Atterberg Limits
SO4	Soluble Sulfate Content	#200	#200 Screen Wash
RES	Resistivity	DSU	Direct Shear (Undisturbed Sample)
pH	Acidity	DSR	Direct Shear (Remolded Sample)
CON	Consolidation	HYD	Hydrometer Analysis
SW	Swell	SE	Sand Equivalent
CL	Chloride Content	OC	Organic Content
RV	R-Value	COMP	Mortar Cylinder Compression

Bedrock Hardness

Soft	Can be crushed and granulated by hand; "soil like" and structureless
Moderately Hard	Can be grooved with fingernails; gouged easily with butter knife; crumbles under light hammer blows
Hard	Cannot break by hand; can be grooved with a sharp knife; breaks with a moderate hammer blow
Very Hard	Sharp knife leaves scratch; chips with repeated hammer blows

Sampler and Symbol Descriptions

Approximate Depth of

Approximate Depth of Standing Groundwater

Modified California Split Spoon Sample

Standard Penetration Test

Bulk Sample

Notes:

Blows Per Foot: Number of blows required to advance sampler 1 foot (unless a lesser distance is specified). Samplers in general were driven into the soil or bedrock at the bottom of the bole with a standard (140 lb.) hammer dropping a standard 30 inches unless noted otherwise in Log Notes. Drive samples collected in bucket auger borings may be obtained by dropping non-standard weight from variable heights. When a SPT sampler is used the blow count conforms to ASTM D-1586

TEST PIT LOG

Project: **North Maple Avenue and Barbee Street**		Boring No.:	**P-1A**
Location: **Fontana**		Elevation:	
Job No.: **23-203**	Client: **Diversified Pacific Communites**	Date:	**7/26/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**YOUNGER ALLUVIUM (Qya)** Silty SAND (SM): Grayish brown, dry, loose, fine-grained. moist.				■			
5		Gravelly SAND (SP/GP): Grayish brown, moist, medium- to coarse-grained, gravel - 35%, subangular cobbles up to 8" - 15%.							
		Total Depth = 5' No groundwater encountered Percolation test installed at bottom of pit.							
10									
15									
20									
25									
30									
35									

PLATE A-1

Petra Geosciences, Inc.

TEST PIT LOG

Project: **North Maple Avenue and Barbee Street**			Boring No.: **T-1**
Location: **Fontana**			Elevation:
Job No.: **23-203**	Client: **Diversified Pacific Communites**		Date: **7/26/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**		Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ARTIFICIAL FILL (af)** Silty SAND (SM): Brown, moist, loose, fine-grained, trace gravel, glass debris.							
		YOUNGER ALLUVIUM (Qya) Gravelly SAND (SP/GP): Brown, moist, fine- to medium-grained, gravel - 40%, cobbles - 15%, sand - 45%. Yellowish brown.							
5									
10		Total Depth = 9' No groundwater encountered Test pit backfilled with cuttings.							
15									
20									
25									
30									
35									

PLATE A-2

Petra Geosciences, Inc.

TEST PIT LOG

Project: **North Maple Avenue and Barbee Street**			Boring No.: **T-2**
Location: **Fontana**			Elevation:
Job No.: **23-203**	Client: **Diversified Pacific Communites**		Date: **7/26/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**		Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**YOUNGER ALLUVIUM (Qya)** Silty SAND (SM): Yellowish brown, dry, medium dense, fine-grained, rootlets.							
		Gravelly SAND (SP/GP): Yellowish brown, dry, fine- to coarse-grained, gravel - 20%, cobbles up to 8" - 10%.							
5									
		Total Depth = 7.5' No groundwater encountered Test pit backfilled with cuttings.							
10									
15									
20									
25									
30									
35									

PLATE A-3

Petra Geosciences, Inc.

TEST PIT LOG

Project: **North Maple Avenue and Barbee Street**			Boring No.: **T-3**
Location: **Fontana**			Elevation:
Job No.: **23-203**	Client: **Diversified Pacific Communites**		Date: **7/26/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**		Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**YOUNGER ALLUVIUM (Qya)** Silty SAND (SM): Brown, moist, fine-grained, gravel - 5%, cobbles up to 6" - 2%.							
		Gravelly SAND (SP/GP): Yellowish brown, moist, fine- to medium-grained, gravel - 40%, cobbles of to 10" - 10%.							
5		gravel - 25%, cobbles - 10%, sand 65%.				■			
10		Total Depth = 10' No groundwater encountered Test pit backfilled with cuttings.							
15									
20									
25									
30									
35									

PLATE A-4

Petra Geosciences, Inc.

TEST PIT LOG

Project: **North Maple Avenue and Barbee Street**			Boring No.: **T-4**
Location: **Fontana**			Elevation:
Job No.: **23-203**	Client: **Diversified Pacific Communites**		Date: **7/26/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**		Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**YOUNGER ALLUVIUM (Qya)** Silty SAND (SM): Grayish brown, dry, fine-grained, trace rootlets, gravel - 2%, cobbles up to 10" - 2%.							
5		Gravelly SAND (SP/GP): Yellowish brown, dry, medium- to coarse-grained, gravel - 40%, cobbles up tp 10" - 10%.							
10		Total Depth = 9' No groundwater encountered Test pit backfilled with cuttings.							
15									
20									
25									
30									
35									

PLATE A-5

Petra Geosciences, Inc.

TEST PIT LOG

Project: **North Maple Avenue and Barbee Street**			Boring No.: **T-5**
Location: **Fontana**			Elevation:
Job No.: **23-203**	Client: **Diversified Pacific Communites**		Date: **7/26/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**		Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**YOUNGER ALLUVIUM (Qya)** Silty SAND (SM): Brown, dry, loose, fine-grained.							
		Gravelly SAND (SP/GP): Brown, dry, fine- to medium-grained, gravel - 35%, cobbles up to 6" - 15%.							
		Silty SAND (SM): Yellowish brown, dry, fine-grained.							
5		Gravelly SAND (SP/GP): Yellowish brown to gray, dry, medium- to coarse-grained, gravel - 45%, cobbles - 10%, sand - 45%.							
10		Total Depth = 9' No groundwater encountered Test pit backfilled with cuttings.							
15									
20									
25									
30									
35									

PLATE A-6

Petra Geosciences, Inc.

TEST PIT LOG

Project: **North Maple Avenue and Barbee Street**			Boring No.: **T-6**
Location: **Fontana**			Elevation:
Job No.: **23-203**	Client: **Diversified Pacific Communites**		Date: **7/26/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**		Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**YOUNGER ALLUVIUM (Qya)** Silty SAND (SM): Grayish brown, dry, loose, fine-grained, gravel up to 3" - 5%.							
		Gravelly SAND (SP/GP): Yellowish brown, dry, medium-grained, gravel - 35%, cobbles up to 5" - 10%.							
5		Silty SAND (SM): Yellowish brown, dry, fine-grained.							
		Gravelly SAND (SP/GP): Yellowish brown, dry, medium- to coarse-grained, gravel - 40%, cobbles up to 8" - 10 %.							
10		Total Depth = 9.5' No groundwater encountered Test pit backfilled with cuttings.							
15									
20									
25									
30									
35									

PLATE A-7

Petra Geosciences, Inc.

TEST PIT LOG

Project: **North Maple Avenue and Barbee Street**			Boring No.: **T-7**
Location: **Fontana**			Elevation:
Job No.: **23-203**	Client: **Diversified Pacific Communites**		Date: **7/26/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**		Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**YOUNGER ALLUVIUM (Qya)** Silty SAND (SM): Brown, dry, loose, fine-grained, trace rootlets.							
		Gravelly SAND (SP/GP): Pale yellowish brown, dry, medium- to coarse-grained, gravel - 30%, cobbles up to 7" - 10%.							
5									
10		Total Depth = 10' No groundwater encountered Test pit backfilled with cuttings.							
15									
20									
25									
30									
35									

PLATE A-8

Petra Geosciences, Inc.

TEST PIT LOG

Project: **North Maple Avenue and Barbee Street**			Boring No.: **T-8**
Location: **Fontana**			Elevation:
Job No.: **23-203**	Client: **Diversified Pacific Communites**		Date: **7/26/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**		Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**YOUNGER ALLUVIUM (Qya)** Silty SAND (SM): Brown, dry, fine-grained. moist.							
		Gravelly SAND (SP/GP): brown, moist, fine- to medium-grained, gravel - 30%, cobbles - 10%, boulders up to 12" - 5%. Yellowish brown, gravel - 20%, cobbles uo to 8" - 10%,.							
5									
10		Total Depth = 10' No groundwater encountered Test pit backfilled with cuttings.							
15									
20									
25									
30									
35									

PLATE A-9

Petra Geosciences, Inc.

TEST PIT LOG

Project: **North Maple Avenue and Barbee Street**		Boring No.:	**P-1**
Location: **Fontana**		Elevation:	**±1307'**
Job No.: **23-203**	Client: **Diversified Pacific Communites**	Date:	**8/24/2023**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**YOUNGER ALLUVIUM (Qya)** Sand (SP): Brown, moist, loose to medium-dense, fine- to medium-grained sand.							
		Gravelly Sand (GP-SP): Brown, moist, medium-dense, fine- to medium-grained sand, gravel and cobbles up to 4" in diameter. Increase in rock content.		11 50/0"	◪				
10		Total Depth= 10' No groundwater encountered Percolation test installed within boring utilizing 3" perforated pipe, pea gravel, and sock.				■			
15									
20									
25									
30									
35									

PLATE A-10

Petra Geosciences, Inc.

TEST PIT LOG

Project: **North Maple Avenue and Barbee Street**		Boring No.:	**P-2**
Location: **Fontana**		Elevation:	**±1309'**
Job No.: **23-203**	Client: **Diversified Pacific Communites**	Date:	**8/24/2023**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**YOUNGER ALLUVIUM (Qya)** Sand (SP): Brown, moist, loose to medium-dense, fine- to medium-grained sand.							
		Gravelly Sand (GP-SP): Brown, moist, medium-dense, fine- to medium-grained sand, gravel and cobbles up to 4" in diameter.							
5		Increase in rock content.		11 12 12	■				
10				25 17 5	■				
		Total Depth= 12' No groundwater encountered Percolation test installed within boring utilizing 3" perforated pipe, pea gravel, and sock.							
15									
20									
25									
30									
35									

PLATE A-11

Petra Geosciences, Inc.

TEST PIT LOG

Project: **North Maple Avenue and Barbee Street**		Boring No.:	**P-3**
Location: **Fontana**		Elevation:	**±1310'**
Job No.: **23-203**	Client: **Diversified Pacific Communites**	Date:	**8/24/2023**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**YOUNGER ALLUVIUM (Qya)** Sand (SP): Brown, moist, loose to medium-dense, fine- to medium-grained sand.							
		Gravelly Sand (GP-SP): Brown, moist, medium-dense, fine- to medium-grained sand, gravel and cobbles up to 4" in diameter.							
5		Increase in rock content.		15 21 21	■				
10		Total Depth= 10' No groundwater encountered Percolation test installed within boring utilizing 3" perforated pipe, pea gravel, and sock.		25 17 5	■				
15									
20									
25									
30									
35									

PLATE A-12

Petra Geosciences, Inc.

APPENDIX B

LABORATORY TEST PROCEDURES

LABORATORY DATA SUMMARY

LABORATORY TEST PROCEDURES

Soil Classification

Soils encountered within the exploratory borings were initially classified in the field in general accordance with the visual-manual procedures of the Unified Soil Classification System (ASTM D 2488). The samples were re-examined in the laboratory and the classifications reviewed and then revised where appropriate. The assigned group symbols are presented in the Boring Logs (Appendix A).

Maximum Dry Density and Optimum Moisture Content

The maximum dry density and optimum moisture content of the on-site soils were determined for selected bulk samples in accordance with current version of ASTM D 1557. The results of these tests are presented on Plate B-1.

Expansion Index

The expansion index of onsite soils was determined per ASTM D 4829. The expansion index and expansion potential are presented in Plate B-1.

Corrosivity Tests

Chemical analyses were performed on a selected sample to determine concentrations of soluble sulfate and chloride, as well as pH and resistivity. These tests were performed in accordance with California Test Method Nos. 417 (sulfate), 422 (chloride) and 643 (pH and resistivity). Test results are presented in Plate B-1.

Percent Passing No. 200 Sieve

Selected samples were run through a number 200 sieve in general accordance with the latest version of Test Method ASTM D 1140. The results of these tests are included on Plate B-1.

LABORATORY DATA SUMMARY

Laboratory Maximum Dry Density

Sample Location	Soil Type	Optimum Moisture (%)	Maximum Dry Density (pcf)
P-1 @ 0 – 4’	Silty fine- to medium-grain SAND with gravel	9.0	120.0

PER ASTM D 1557and D4718-15 (Oversize Correction of 6.8%)

Corrosivity

Sample Location	Sulfate[1] (%)	Chloride[2] (ppm)	pH[3]	Resistivity[3] (ohm-cm)
P-1 @ 0 – 4’	0.069	225	7.1	6,300

(1) PER CALIFORNIA TEST METHOD NO. 417
(2) PER CALIFORNIA TEST METHOD NO. 422
(3) PER CALIFORNIA TEST METHOD NO. 643

Expansion Index

Sample Location Depth (feet)	Soil Type	Expansion[1] Index	Expansion Potential
P-1 @ 0 – 4’	Silty fine- to medium-grain SAND with gravel	0	Very Low

(1) PER ASTM D 4829

Percent Passing No. 200 Sieve

Sample Location Depth (feet)	Soil Type	Passing No. 200 Sieve (Percent)
P-1 @ 0-4’	Silty fine- to medium-grain SAND with gravel	25.8
TP-3 @ 3-6’	silty fine- to coarse-grain SAND	4.8

(1) PER ASTM D 1140

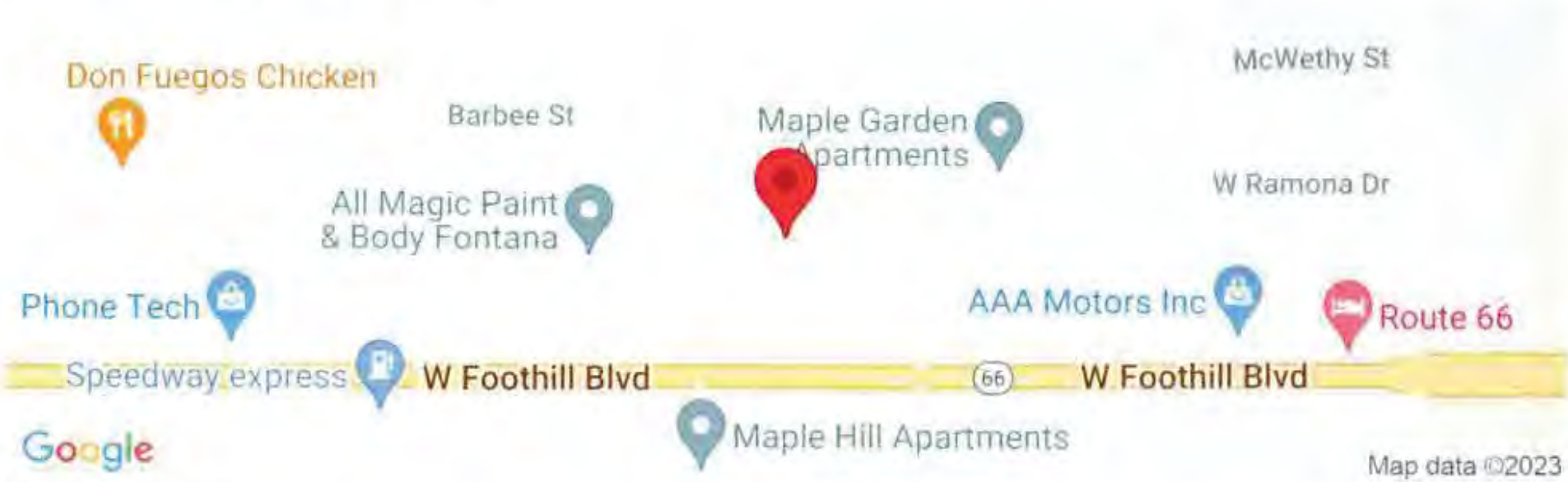
APPENDIX C

SEISMIC DESIGN PARAMETERS

OSHPD

23-203: Maple Ave., Fontana

Latitude, Longitude: 34.107729, -117.406454



Date	6/8/2023, 3:35:04 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	1.888	MCE_R ground motion. (for 0.2 second period)
S_1	0.692	MCE_R ground motion. (for 1.0s period)
S_{MS}	2.265	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.51	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category

Type	Value	Description
F_a	1.2	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.78	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.936	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	2.217	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.426	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.888	Factored deterministic acceleration value. (0.2 second)
S1RT	0.868	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.974	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
S1D	0.692	Factored deterministic acceleration value. (1.0 second)
PGAd	0.78	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.958	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.914	Mapped value of the risk coefficient at short periods
C_{R1}	0.89	Mapped value of the risk coefficient at a period of 1 s
C_V	1.478	Vertical coefficient

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APPENDIX D

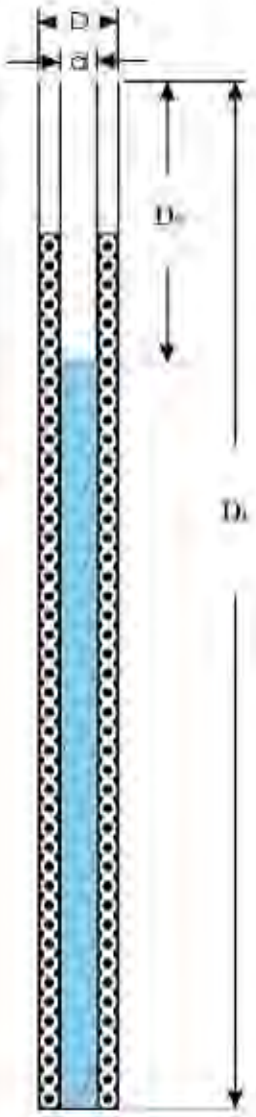
INFILTRATION TEST RESULTS

Test Number: P-1A

Shallow Percolation Test Method

Total Depth of Boring, D_t (ft):	5.2	Zone Tested: 4' -5'	
Diameter of Hole, D (in):	12	Date: 7-26-2023	
Diameter of Pipe, d (in):	3		
Agg. Correction (% Voids):	40		
Pre-soak depth (ft):	5		

Time Interval (min)	Depth to Water Surface D_w (ft)		Change in Head (in)	Perc. Rate (min/in)	Perc. Rate (gal/day/ft^2)
	1st Reading	2nd Reading			
2	4.50	5.00	6.0	0.33	421
3	4.50	5.00	6.0	0.50	281
3	4.42	5.00	7.0	0.43	308
3	4.42	5.00	7.0	0.43	308
3	4.42	5.00	7.0	0.43	308
3	4.42	5.00	7.0	0.43	308
3	4.42	5.00	7.0	0.43	308
3	4.42	5.00	7.0	0.43	308
3	4.42	5.00	7.0	0.43	308



Soil Description*: medium Gravelly Sand
* predominant materials within test zone

Percolation Rate: **0.43** **min/in**
308 **gal/day/ft^2**

Infiltration Rate: **47** **in/hr***
(Porchet Method)

where Infiltration Rate, $I_t = \Delta H\,(60r) / \Delta t\,(r + 2H_{avg})$

$r = D / 2$

$H_o = D_t - D_o$

$H_f = D_t - D_f$

$\Delta H = \Delta D = H_o - H_f$

$H_{avg} = (H_o + H_f) / 2$

*Raw Number, Does Not Include a Factor of Safety

Reference: RCFCWCD, Design Handbook for LIDBMP, dated September, 2011

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PERCOLATION TEST SUMMARY

Diversified Pacific / W. Foothill and Maple
Fontana, California

August 2023
J.N.: 23-203

Figure 2

Boring/Test Number: P-1

Total Depth of Boring, D_T (ft):	10	**Test Date:**	8/24/2023
Diameter of Hole, D (in):	8	**Tested By:**	KTM
Diameter of Casing, d (in):	3	**USCS Soil Type:**	SP/GP
Depth of Slotted Casing (ft):	5 to 10	**Depth to Groundwater (ft):**	?
Porosity of Annulus Material, *n* :	0.42	**Ground Elevation (msl ft):**	1307
Depth from Existing Ground Surface to Bottom of Prop. Inflitration System (ft):			10

SANDY SOIL CRITERIA TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔD (in.)	Change in Height of Water Greater Than or Equal to 6"? (Yes/No)*
		Initial, D_o (ft.)	Final, D_f (ft.)		
1	25	8	10	24	yes
2	25	8	10	24	yes
Standard Time Interval Between Readings (min.), [* if yes = 10, if no = 30]:					30

PERCOLATION TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔH (in.)	Percolation Rate	
		Initial, D_o (ft.)	Final, D_f (ft.)		(min/in.)	(gal/day/ft^2)
1	10	7.75	9.60	22.20	0.45	111.68
2	10	7.70	9.50	21.60	0.46	103.46
3	10	7.70	9.50	21.60	0.46	103.46
4	10	7.75	9.55	21.60	0.46	106.87
5	10	7.75	9.55	21.60	0.46	106.87
6	10	7.70	9.50	21.60	0.46	103.46

TEST RESULTS**

Inflitration Rate [Porchet Method]# (inches/hour)	Percolation Rate	
	(min/in.)	(gal/day/ft^2)
9.14	**0.46**	**103.46**

**Raw Results. Does Not Include a Factor of Safety

FACTOR OF SAFETY WORKSHEET

Factor Category[Φ]		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = (w) x (v)
A	Suitability Assessment	Soil Assessment Methods	0.25	0.25	0.0625
		Predominant Soil Texture	0.25	0.25	0.0625
		Site Soil Variability	0.25	0.25	0.0625
		Depth to Groundwater / Impervious Layer	0.25	0.25	0.0625
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			**0.25**

[Φ] Factor Category B Should Be Provided and Calculated by Project Civil Engineer

[#] Where Infiltration Rate, It = ΔH (60r) / Δt (r + 2Havg)

$r = D / 2$

$Ho = D_T - Do$

$H_f = D_T - D_f$

$\Delta H = \Delta D = H_o - H_f$

$H_{avg} = (H_o + H_f) / 2$

Reference:
SARWQCB, Technical Guidance Document Appendix VII, dated December 20, 2013

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PERCOLATION TEST SUMMARY

Maple Ave. & Foothill Blvd.
Fontana, California

PETRA GEOSCIENCES

DATE: August, 2023

J.N.: 23-202

Appendix D

Boring/Test Number: P-2

Total Depth of Boring, D_T (ft):	12	**Test Date:**	8/24/2023
Diameter of Hole, D (in):	8	**Tested By:**	KTM
Diameter of Casing, d (in):	3	**USCS Soil Type:**	SP/GP
Depth of Slotted Casing (ft):	7 to 12	**Depth to Groundwater (ft):**	?
Porosity of Annulus Material, *n* :	0.42	**Ground Elevation (msl ft):**	1309
Depth from Existing Ground Surface to Bottom of Prop. Inflitration System (ft):			10

SANDY SOIL CRITERIA TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔD (in.)	Change in Height of Water Greater Than or Equal to 6"? (Yes/No)*
		Initial, D_o (ft.)	Final, D_f (ft.)		
1	25	8.75	10.42	20.04	yes
2	25	8.84	10.33	17.88	yes
Standard Time Interval Between Readings (min.), [* if yes = 10, if no = 30]:					30

PERCOLATION TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔH (in.)	Percolation Rate	
		Initial, D_o (ft.)	Final, D_f (ft.)		(min/in.)	(gal/day/ft^2)
1	10	8.65	10.17	18.24	0.55	49.65
2	10	8.65	10.15	18.00	0.56	48.82
3	10	8.65	10.10	17.40	0.57	46.77
4	10	8.65	10.10	17.40	0.57	46.77
5	10	8.65	10.10	17.40	0.57	46.77
6	10	8.60	10.03	17.16	0.58	45.15

TEST RESULTS**

Inflitration Rate [Porchet Method]# (inches/hour)	Percolation Rate	
	(min/in.)	(gal/day/ft^2)
3.92	**0.58**	**45.15**

**Raw Results. Does Not Include a Factor of Safety

FACTOR OF SAFETY WORKSHEET

Factor Category[Φ]		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = (w) x (v)
A	Suitability Assessment	Soil Assessment Methods	0.25	0.25	0.0625
		Predominant Soil Texture	0.25	0.25	0.0625
		Site Soil Variability	0.25	0.25	0.0625
		Depth to Groundwater / Impervious Layer	0.25	0.25	0.0625
		Suitability Assessment Safety Factor, S_A = Σp			**0.25**

[Φ] Factor Category B Should Be Provided and Calculated by Project Civil Engineer

[#] Where Infiltration Rate, It = ΔH (60r) / Δt (r + 2Havg)

$r = D / 2$

$Ho = D_T - Do$

$H_f = D_T - D_f$

$\Delta H = \Delta D = H_o - H_f$

$H_{avg} = (H_o + H_f) / 2$

Reference:
SARWQCB, Technical Guidance Document Appendix VII, dated December 20, 2013

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PERCOLATION TEST SUMMARY

Maple Ave. & Foothill Blvd.
Fontana, California

PETRA GEOSCIENCES

DATE: August, 2023

J.N.: 23-202

Appendix D

Boring/Test Number: P-3

Total Depth of Boring, D_T (ft):	10	**Test Date:**	8/24/2023
Diameter of Hole, D (in):	8	**Tested By:**	KTM
Diameter of Casing, d (in):	3	**USCS Soil Type:**	SP/GP
Depth of Slotted Casing (ft):	5 to 10	**Depth to Groundwater (ft):**	?
Porosity of Annulus Material, *n* :	0.42	**Ground Elevation (msl ft):**	1311
Depth from Existing Ground Surface to Bottom of Prop. Inflitration System (ft):			10

SANDY SOIL CRITERIA TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔD (in.)	Change in Height of Water Greater Than or Equal to 6"? (Yes/No)*
		Initial, D_o (ft.)	Final, D_f (ft.)		
1	25	7.65	10	28.2	yes
2	25	7	10	36	yes
Standard Time Interval Between Readings (min.), [* if yes = 10, if no = 30]:					30

PERCOLATION TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔH (in.)	Percolation Rate	
		Initial, D_o (ft.)	Final, D_f (ft.)		(min/in.)	(gal/day/ft^2)
1	10	7.00	10.00	36.00	0.28	162.08
2	10	6.90	9.95	36.60	0.27	157.69
3	10	6.90	9.90	36.00	0.28	152.91
4	10	6.90	9.90	36.00	0.28	152.91
5	10	6.95	9.90	35.40	0.28	152.52
6	10	6.95	9.90	35.40	0.28	152.52

TEST RESULTS**

Inflitration Rate [Porchet Method]# (inches/hour)	Percolation Rate	
	(min/in.)	(gal/day/ft^2)
13.42	**0.28**	**152.52**

**Raw Results. Does Not Include a Factor of Safety

FACTOR OF SAFETY WORKSHEET

Factor Category[Φ]		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = (w) x (v)
A	Suitability Assessment	Soil Assessment Methods	0.25	0.25	0.0625
		Predominant Soil Texture	0.25	0.25	0.0625
		Site Soil Variability	0.25	0.25	0.0625
		Depth to Groundwater / Impervious Layer	0.25	0.25	0.0625
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			**0.25**

[Φ] Factor Category B Should Be Provided and Calculated by Project Civil Engineer

[#] Where Infiltration Rate, It = ΔH (60r) / Δt (r + 2Havg)

$r = D / 2$

$Ho = D_T - Do$

$H_f = D_T - D_f$

$\Delta H = \Delta D = H_o - H_f$

$H_{avg} = (H_o + H_f) / 2$

Reference:
SARWQCB, Technical Guidance Document Appendix VII, dated December 20, 2013

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PERCOLATION TEST SUMMARY

Maple Ave. & Foothill Blvd.
Fontana, California

PETRA GEOSCIENCES

DATE: August, 2023

J.N.: 23-202

Appendix D

APPENDIX E

STANDARD GRADING SPECIFICATIONS

STANDARD GRADING SPECIFICATIONS

These specifications present the usual and minimum requirements for projects on which Petra Geosciences, Inc. (Petra) is the geotechnical consultant. No deviation from these specifications will be allowed, except where specifically superseded in the preliminary geology and soils report, or in other written communication signed by the Soils Engineer and Engineering Geologist of record (Geotechnical Consultant).

I. GENERAL

A. The Geotechnical Consultant is the Owner's or Builder's representative on the project. For the purpose of these specifications, participation by the Geotechnical Consultant includes that observation performed by any person or persons employed by, and responsible to, the licensed Soils Engineer and Engineering Geologist signing the soils report.

B. The contractor should prepare and submit to the Owner and Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" and the estimated quantities of daily earthwork to be performed prior to the commencement of grading. This work plan should be reviewed by the Geotechnical Consultant to schedule personnel to perform the appropriate level of observation, mapping, and compaction testing as necessary.

C. All clearing, site preparation, or earthwork performed on the project shall be conducted by the Contractor in accordance with the recommendations presented in the geotechnical report and under the observation of the Geotechnical Consultant.

D. It is the Contractor's responsibility to prepare the ground surface to receive the fills to the satisfaction of the Geotechnical Consultant and to place, spread, mix, water, and compact the fill in accordance with the specifications of the Geotechnical Consultant. The Contractor shall also remove all material considered unsatisfactory by the Geotechnical Consultant.

E. It is the Contractor's responsibility to have suitable and sufficient compaction equipment on the job site to handle the amount of fill being placed. If necessary, excavation equipment will be shut down to permit completion of compaction to project specifications. Sufficient watering apparatus will also be provided by the Contractor, with due consideration for the fill material, rate of placement, and time of year.

F. After completion of grading a report will be submitted by the Geotechnical Consultant.

II. SITE PREPARATION

A. Clearing and Grubbing

1. All vegetation such as trees, brush, grass, roots, and deleterious material shall be disposed of offsite. This removal shall be concluded prior to placing fill.

2. Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipe lines, etc., are to be removed or treated in a manner prescribed by the Geotechnical Consultant.

III. FILL AREA PREPARATION

A. Remedial Removals/Overexcavations

1. Remedial removals, as well as overexcavation for remedial purposes, shall be evaluated by the Geotechnical Consultant. Remedial removal depths presented in the geotechnical report and shown on the geotechnical plans are estimates only. The actual extent of removal should be determined by the Geotechnical Consultant based on the conditions exposed during grading. All soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as determined by the Geotechnical Consultant.

2. Soil, alluvium, or bedrock materials determined by the Soils Engineer as being unsuitable for placement in compacted fills shall be removed from the site. Any material incorporated as a part of a compacted fill must be approved by the Geotechnical Consultant.

3. Should potentially hazardous materials be encountered, the Contractor should stop work in the affected area. An environmental consultant specializing in hazardous materials should be notified immediately for evaluation and handling of these materials prior to continuing work in the affected area.

B. Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide sufficient survey control for determining locations and elevations of processed areas, keys, and benches.

C. Processing

After the ground surface to receive fill has been declared satisfactory for support of fill by the Geotechnical Consultant, it shall be scarified to a minimum depth of 6 inches and until the ground surface is uniform and free from ruts, hollows, hummocks, or other uneven features which may prevent uniform compaction.

The scarified ground surface shall then be brought to optimum moisture, mixed as required, and compacted to a minimum relative compaction of 90 percent.

D. Subdrains

Subdrainage devices shall be constructed in compliance with the ordinances of the controlling governmental agency, and/or with the recommendations of the Geotechnical Consultant. (Typical Canyon Subdrain details are given on Plate SG-1).

E. Cut/Fill & Deep Fill/Shallow Fill Transitions

In order to provide uniform bearing conditions in cut/fill and deep fill/shallow fill transition lots, the cut and shallow fill portions of the lot should be overexcavated to the depths and the horizontal limits discussed in the approved geotechnical report and replaced with compacted fill. (Typical details are given on Plate SG-7.)

STANDARD GRADING SPECIFICATIONS

IV. COMPACTED FILL MATERIAL

A. General

Materials excavated on the property may be utilized in the fill, provided each material has been determined to be suitable by the Geotechnical Consultant. Material to be used for fill shall be essentially free of organic material and other deleterious substances. Roots, tree branches, and other matter missed during clearing shall be removed from the fill as recommended by the Geotechnical Consultant. Material that is spongy, subject to decay, or otherwise considered unsuitable shall not be used in the compacted fill.

Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

B. Oversize Materials

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 12 inches in diameter, shall be taken offsite or placed in accordance with the recommendations of the Geotechnical Consultant in areas designated as suitable for rock disposal (Typical details for Rock Disposal are given on Plate SG-4).

Rock fragments less than 12 inches in diameter may be utilized in the fill provided, they are not nested or placed in concentrated pockets; they are surrounded by compacted fine grained soil material and the distribution of rocks is approved by the Geotechnical Consultant.

C. Laboratory Testing

Representative samples of materials to be utilized as compacted fill shall be analyzed by the laboratory of the Geotechnical Consultant to determine their physical properties. If any material other than that previously tested is encountered during grading, the appropriate analysis of this material shall be conducted by the Geotechnical Consultant as soon as possible.

D. Import

If importing of fill material is required for grading, proposed import material should meet the requirements of the previous section. The import source shall be given to the Geotechnical Consultant at least 2 working days prior to importing so that appropriate tests can be performed and its suitability determined.

V. FILL PLACEMENT AND COMPACTION

A. Fill Layers

Material used in the compacting process shall be evenly spread, watered, processed, and compacted in thin lifts not to exceed 6 inches in thickness to obtain a uniformly dense layer. The fill shall be placed and compacted on a horizontal plane, unless otherwise approved by the Geotechnical Consultant.

B. Moisture Conditioning

Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly above optimum moisture content.

C. Compaction

Each layer shall be compacted to 90 percent of the maximum density in compliance with the testing method specified by the controlling governmental agency. (In general, ASTM D 1557-02, will be used.)

If compaction to a lesser percentage is authorized by the controlling governmental agency because of a specific land use or expansive soils condition, the area to received fill compacted to less than 90 percent shall either be delineated on the grading plan or appropriate reference made to the area in the soils report.

D. Failing Areas

If the moisture content or relative density varies from that required by the Geotechnical Consultant, the Contractor shall rework the fill until it is approved by the Geotechnical Consultant.

E. Benching

All fills shall be keyed and benched through all topsoil, colluvium, alluvium or creep material, into sound bedrock or firm material where the slope receiving fill exceeds a ratio of 5 horizontal to 1 vertical, in accordance with the recommendations of the Geotechnical Consultant.

VI. SLOPES

A. Fill Slopes

The contractor will be required to obtain a minimum relative compaction of 90 percent out to the finish slope face of fill slopes, buttresses, and stabilization fills. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment, or by any other procedure that produces the required compaction.

B. Side Hill Fills

The key for side hill fills shall be a minimum of 15 feet within bedrock or firm materials, unless otherwise specified in the soils report. (See detail on Plate SG-5.)

C. Fill-Over-Cut Slopes

Fill-over-cut slopes shall be properly keyed through topsoil, colluvium or creep material into rock or firm materials, and the transition shall be stripped of all soils prior to placing fill. (see detail on Plate SG-6).

D. Landscaping

All fill slopes should be planted or protected from erosion by other methods specified in the soils report.

E. Cut Slopes

1. The Geotechnical Consultant should observe all cut slopes at vertical intervals not exceeding 10 feet.

2. If any conditions not anticipated in the preliminary report such as perched water, seepage, lenticular or confined strata of a potentially adverse nature, unfavorably inclined bedding, joints or fault planes are encountered during grading, these conditions shall be evaluated by the Geotechnical Consultant, and recommendations shall be made to treat these problems (Typical details for stabilization of a portion of a cut slope are given in Plates SG-2 and SG-3.).

3. Cut slopes that face in the same direction as the prevailing drainage shall be protected from slope wash by a non-erodible interceptor swale placed at the top of the slope.

4. Unless otherwise specified in the soils and geological report, no cut slopes shall be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies.

5. Drainage terraces shall be constructed in compliance with the ordinances of controlling governmental agencies, or with the recommendations of the Geotechnical Consultant.

VII. GRADING OBSERVATION

A. General

All cleanouts, processed ground to receive fill, key excavations, subdrains, and rock disposals must be observed and approved by the Geotechnical Consultant prior to placing any fill. It shall be the Contractor's responsibility to notify the Geotechnical Consultant when such areas are ready.

B. Compaction Testing

Observation of the fill placement shall be provided by the Geotechnical Consultant during the progress of grading. Location and frequency of tests shall be at the Consultants discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations may be selected to verify adequacy of compaction levels in areas that are judged to be susceptible to inadequate compaction.

C. Frequency of Compaction Testing

In general, density tests should be made at intervals not exceeding 2 feet of fill height or every 1000 cubic yards of fill placed. This criteria will vary depending on soil conditions and the size of the job. In any event, an adequate number of field density tests shall be made to verify that the required compaction is being achieved.

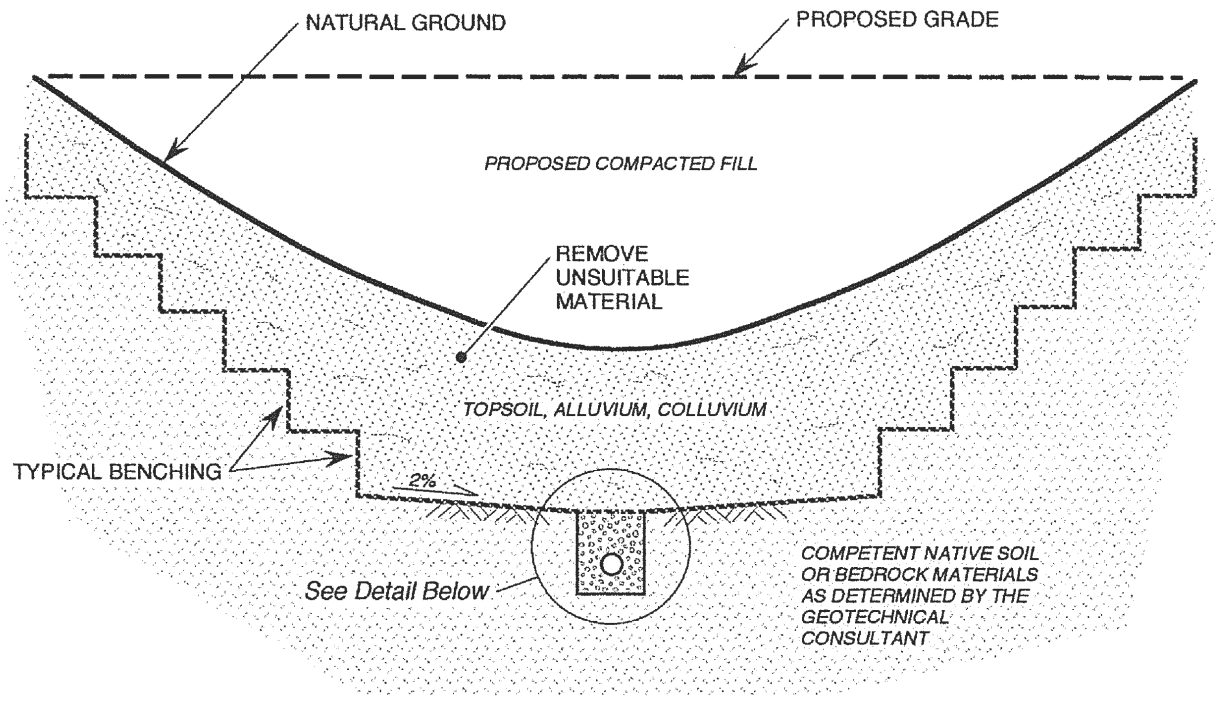
VIII. CONSTRUCTION CONSIDERATIONS

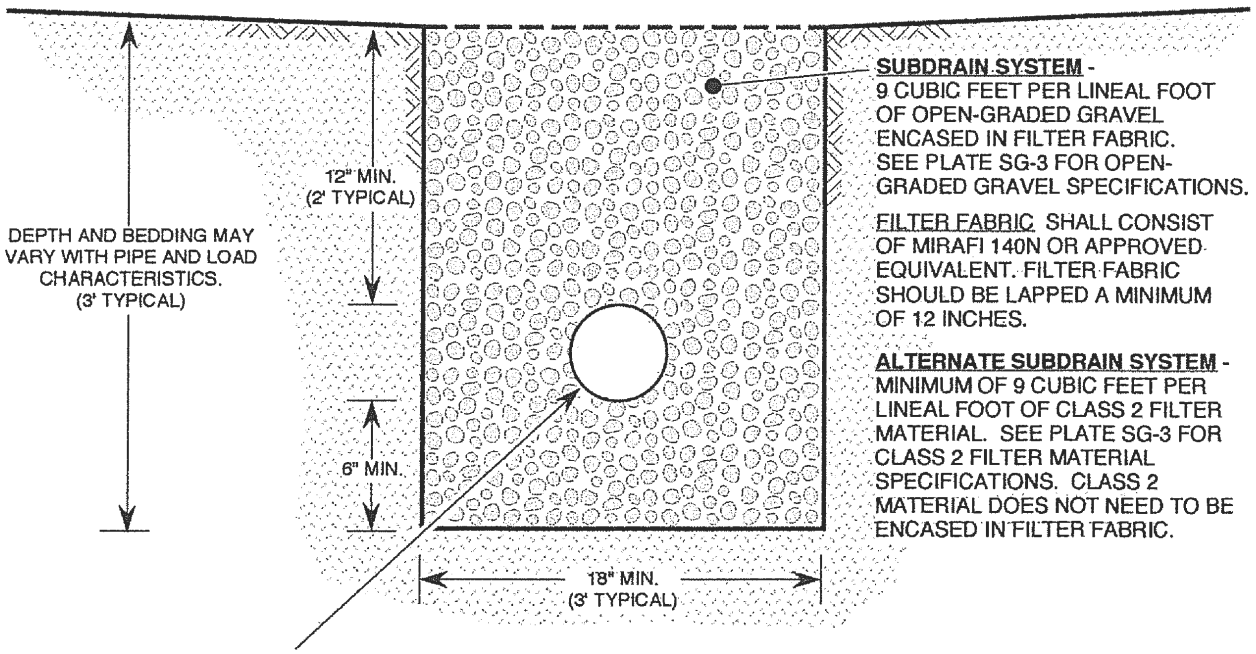
A. Erosion control measures, when necessary, shall be provided by the Contractor during grading and prior to the completion and construction of permanent drainage controls.

B. Upon completion of grading and termination of observations by the Geotechnical Consultant, no further filling or excavating, including that necessary for footings, foundations, large tree wells, retaining walls, or other features shall be performed without the approval of the Geotechnical Consultant.

C. Care shall be taken by the Contractor during final grading to preserve any berms, drainage terraces, interceptor swales, or other devices of permanent nature on or adjacent to the property.

S:\!BOILERS-WORK\REPORT INSERTS\STANDARD GRADING SPECS





SUBDRAIN SYSTEM - 9 CUBIC FEET PER LINEAL FOOT OF OPEN-GRADED GRAVEL ENCASED IN FILTER FABRIC. SEE PLATE SG-3 FOR OPEN-GRADED GRAVEL SPECIFICATIONS.

FILTER FABRIC SHALL CONSIST OF MIRAFI 140N OR APPROVED EQUIVALENT. FILTER FABRIC SHOULD BE LAPPED A MINIMUM OF 12 INCHES.

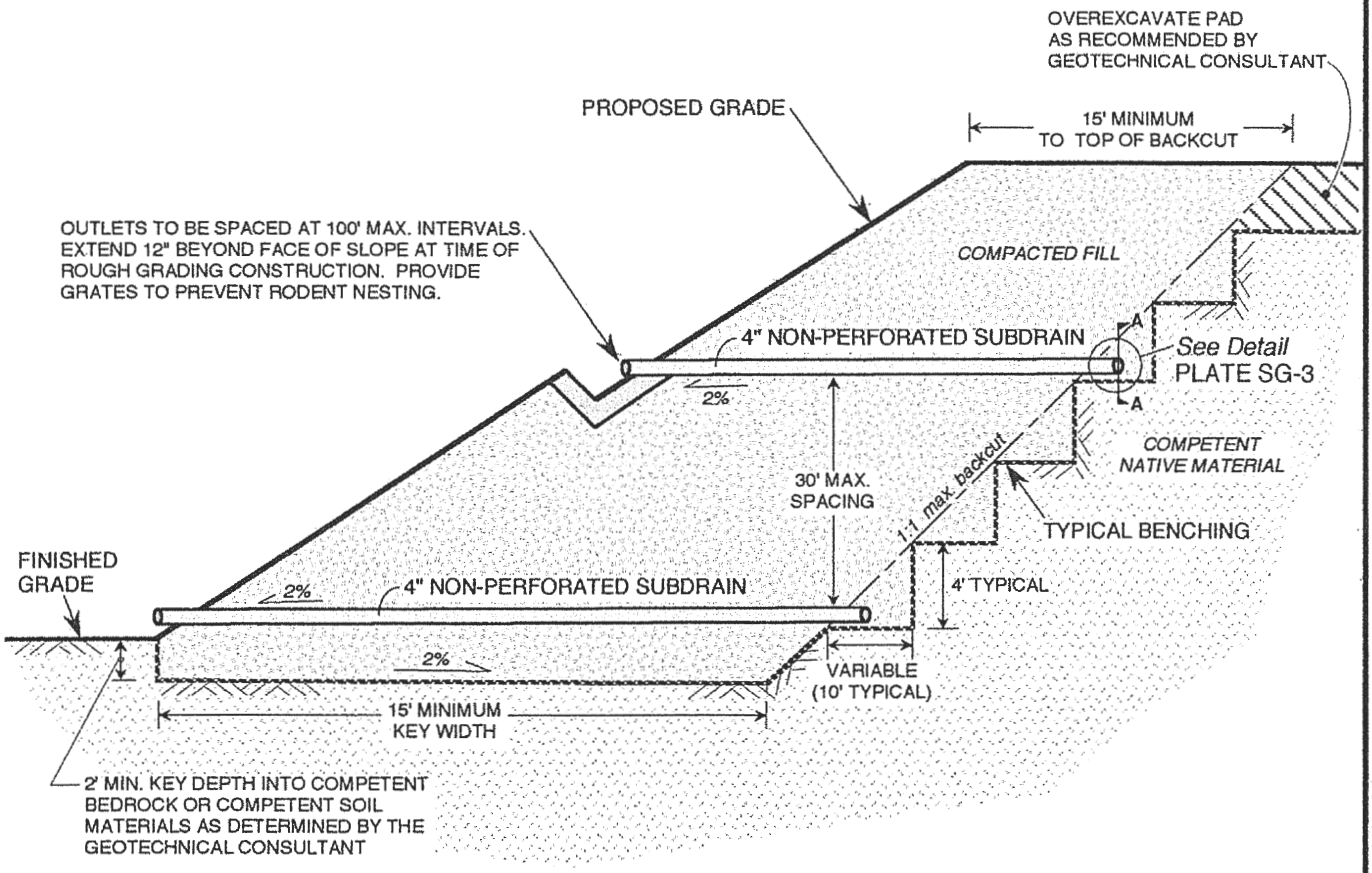
ALTERNATE SUBDRAIN SYSTEM - MINIMUM OF 9 CUBIC FEET PER LINEAL FOOT OF CLASS 2 FILTER MATERIAL. SEE PLATE SG-3 FOR CLASS 2 FILTER MATERIAL SPECIFICATIONS. CLASS 2 MATERIAL DOES NOT NEED TO BE ENCASED IN FILTER FABRIC.

MINIMUM 6-INCH DIAMETER PVC SCHEDULE 40, OR ABS SDR-35 WITH A MINIMUM OF EIGHT 1/4-INCH DIAMETER PERFORATIONS PER LINEAL FOOT IN BOTTOM HALF OF PIPE. PIPE TO BE LAID WITH PERFORATIONS FACING DOWN.

NOTES:

1. FOR CONTINUOUS RUNS IN EXCESS OF 500 FEET USE 8-INCH DIAMETER PIPE.
2. FINAL 20 FEET OF PIPE AT OUTLET SHALL BE NON-PERFORATED AND BACKFILLED WITH FINE-GRAINED MATERIAL.

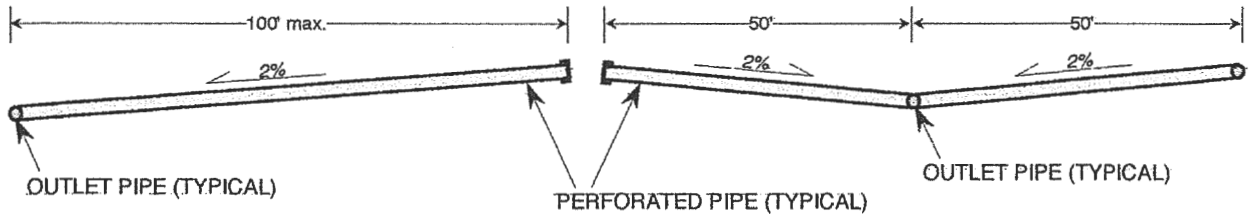
PETRA	CANYON SUBDRAIN DETAIL	PLATE SG-1



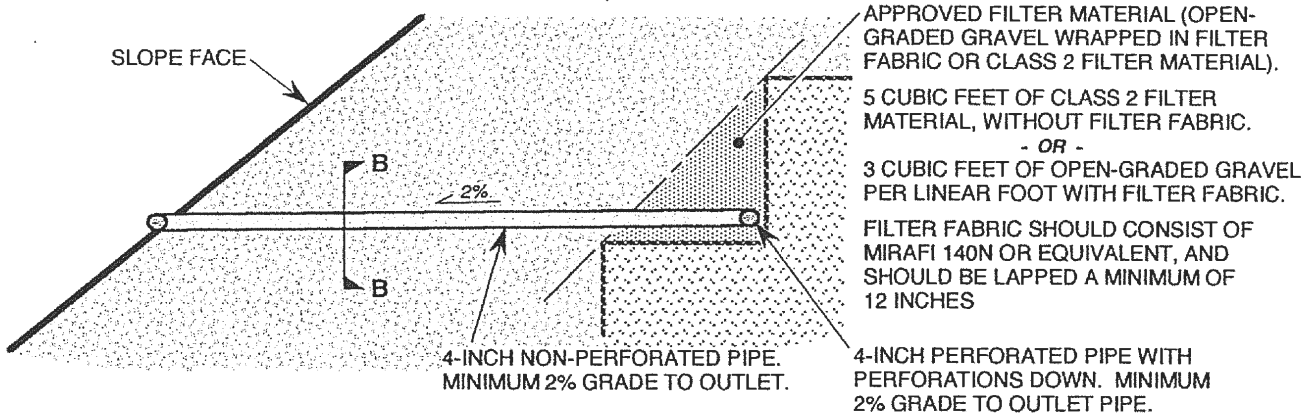
NOTES:

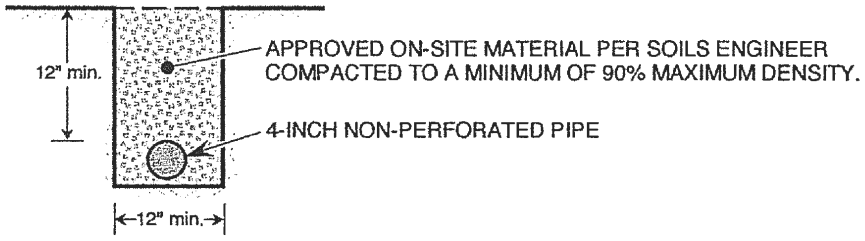
1. 30' MAXIMUM VERTICAL SPACING BETWEEN SUBDRAIN SYSTEMS.
2. 100' MAXIMUM HORIZONTAL DISTANCE BETWEEN NON-PERFORATED OUTLET PIPES. *(See Below)*
3. MINIMUM GRADIENT OF 2% FOR ALL PERFORATED AND NON-PERFORATED PIPE.

SECTION A-A (PERFORATED PIPE PROFILE)



PETRA	BUTTRESS OR STABILIZATION FILL DETAIL	PLATE SG-2





SECTION B-B (OUTLET PIPE)

PIPE SPECIFICATIONS:

1. 4-INCH MINIMUM DIAMETER, PVC SCHEDULE 40 OR ABS SDR-35.
2. FOR PERFORATED PIPE, MINIMUM 8 PERFORATIONS PER FOOT ON BOTTOM HALF OF PIPE.

FILTER MATERIAL/FABRIC SPECIFICATIONS:

OPEN-GRADED GRAVEL ENCASED IN FILTER FABRIC.
(MIRAFI 140N OR EQUIVALENT)

OPEN-GRADED GRAVEL

SIEVE SIZE	PERCENT PASSING
1 1/2-INCH	88 - 100
1-INCH	5 - 40
3/4-INCH	0 - 17
3/8-INCH	0 - 7
No. 200	0 - 3

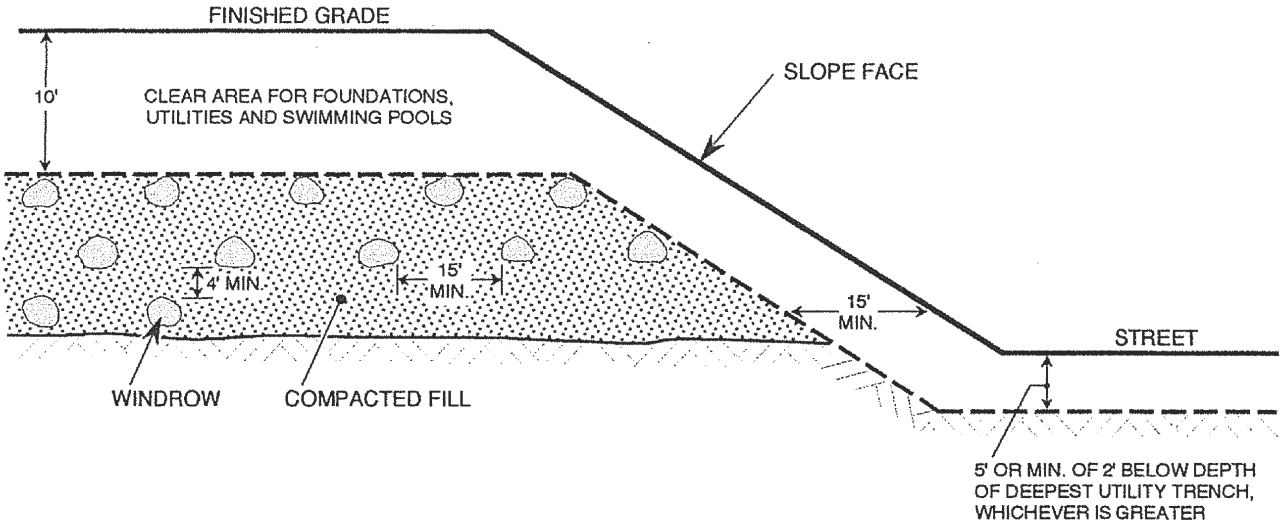
ALTERNATE:

CLASS 2 PERMEABLE FILTER MATERIAL PER CALTRANS STANDARD SPECIFICATION 68-1.025.

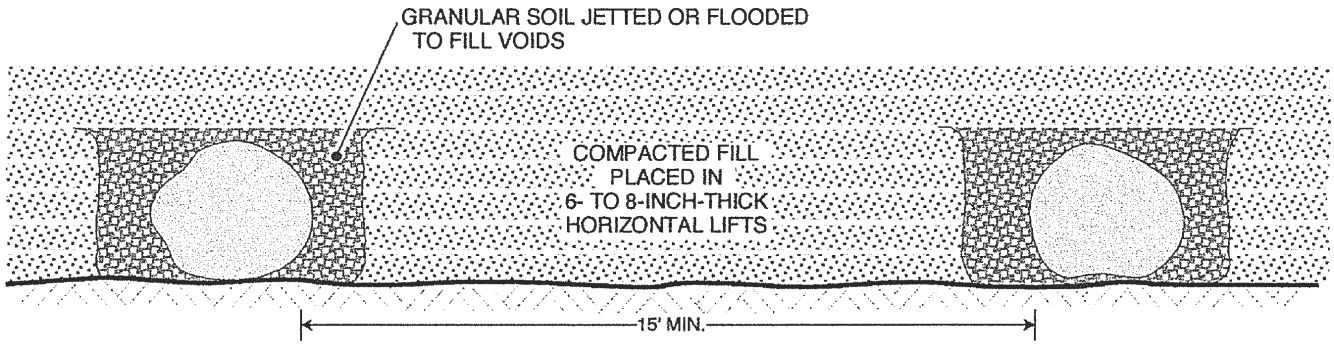
CLASS 2 FILTER MATERIAL

SIEVE SIZE	PERCENT PASSING
1-INCH	100
3/4-INCH	90 - 100
3/8-INCH	40 - 100
No. 4	25 - 40
No. 8	18 - 33
No. -30	5 - 15
No. -50	0 - 7
No. 200	0 - 3

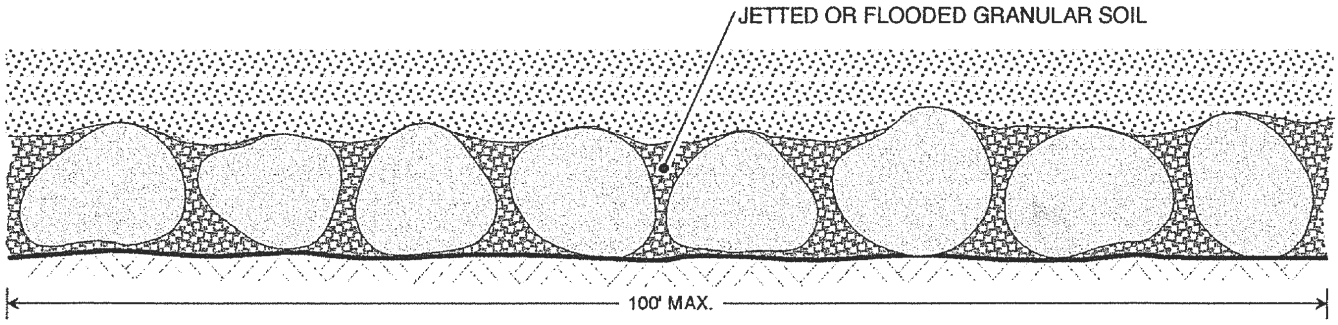
PETRA	BUTTRESS OR STABILIZATION FILL SUBDRAIN	PLATE SG-3



TYPICAL WINDROW DETAIL (END VIEW)

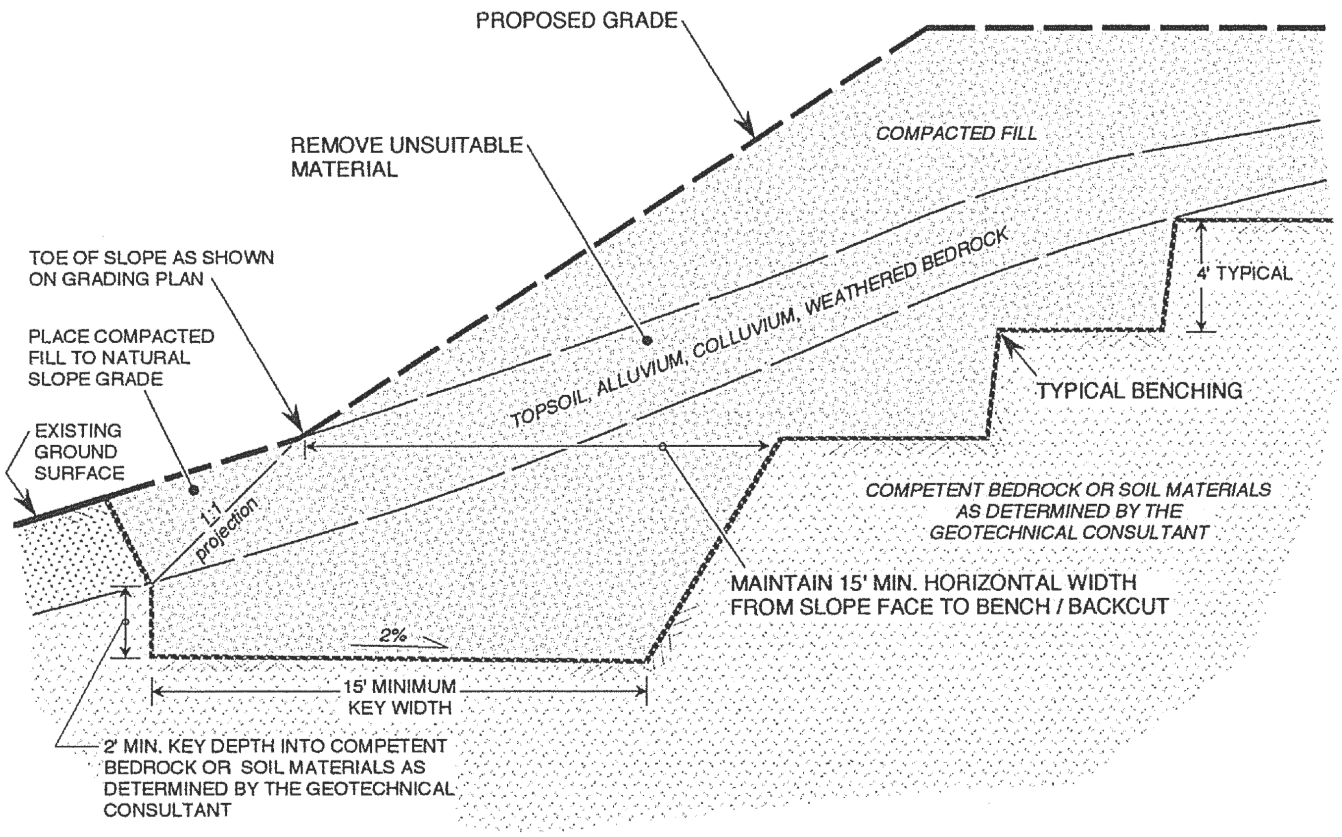


TYPICAL WINDROW DETAIL (PROFILE VIEW)



NOTE: OVERSIZE ROCK IS DEFINED AS CLASTS HAVING A MAXIMUM DIMENSION OF 12" OR LARGER

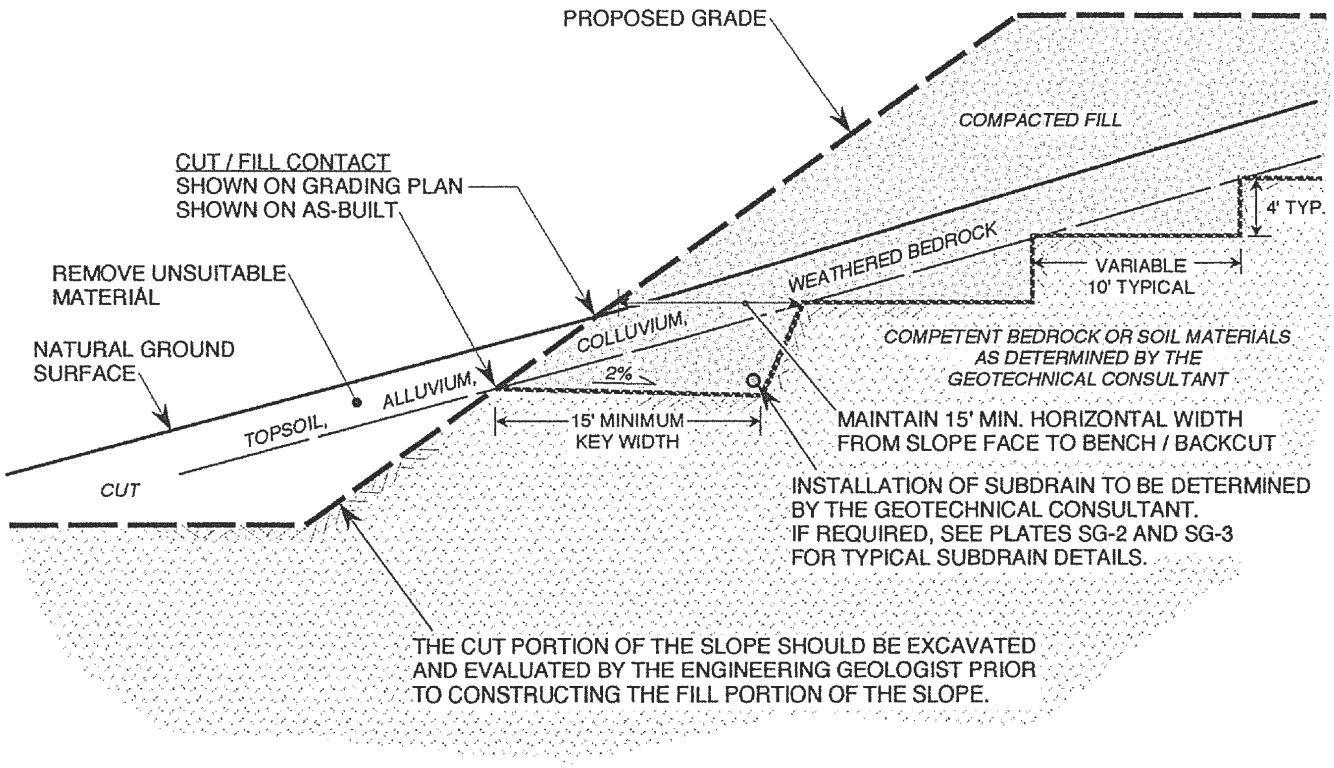
PETRA	TYPICAL ROCK DISPOSAL DETAIL	PLATE SG-4



NOTES:

1. WHERE NATURAL SLOPE GRADIENT IS 5:1 OR LESS, BENCHING IS NOT NECESSARY; HOWEVER, FILL IS NOT TO BE PLACED ON COMPRESSIBLE OR UNSUITABLE MATERIAL.
2. SOILS ENGINEER TO DETERMINE IF SUBDRAIN IS REQUIRED.

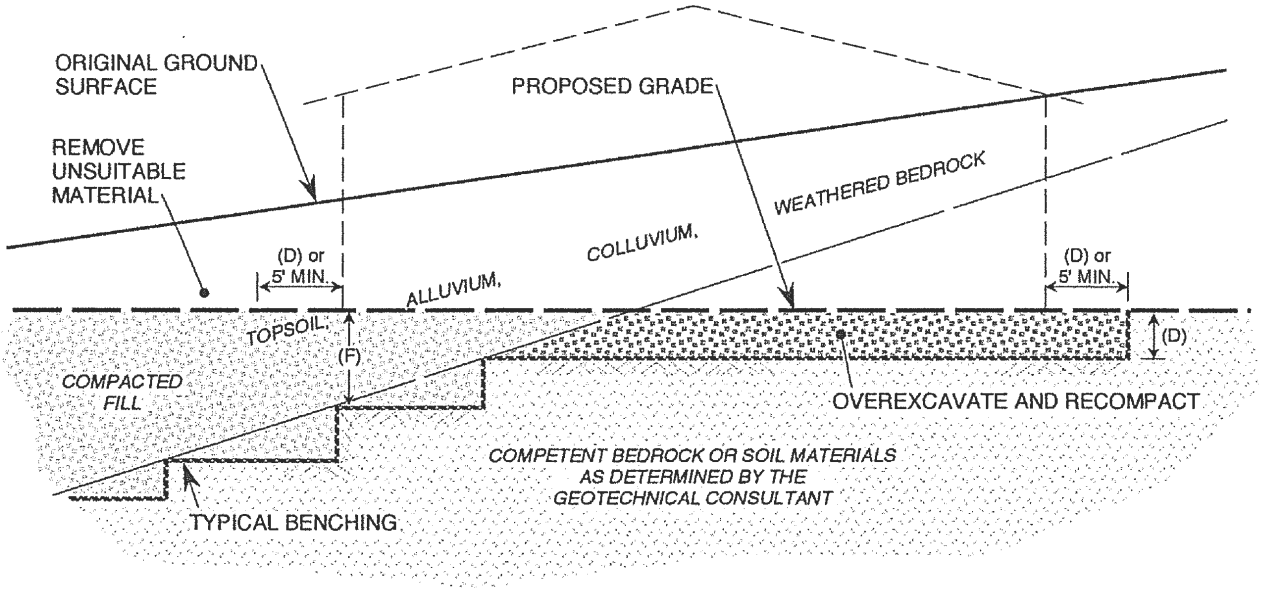
PETRA	FILL SLOPE ABOVE NATURAL SLOPE	PLATE SG-5



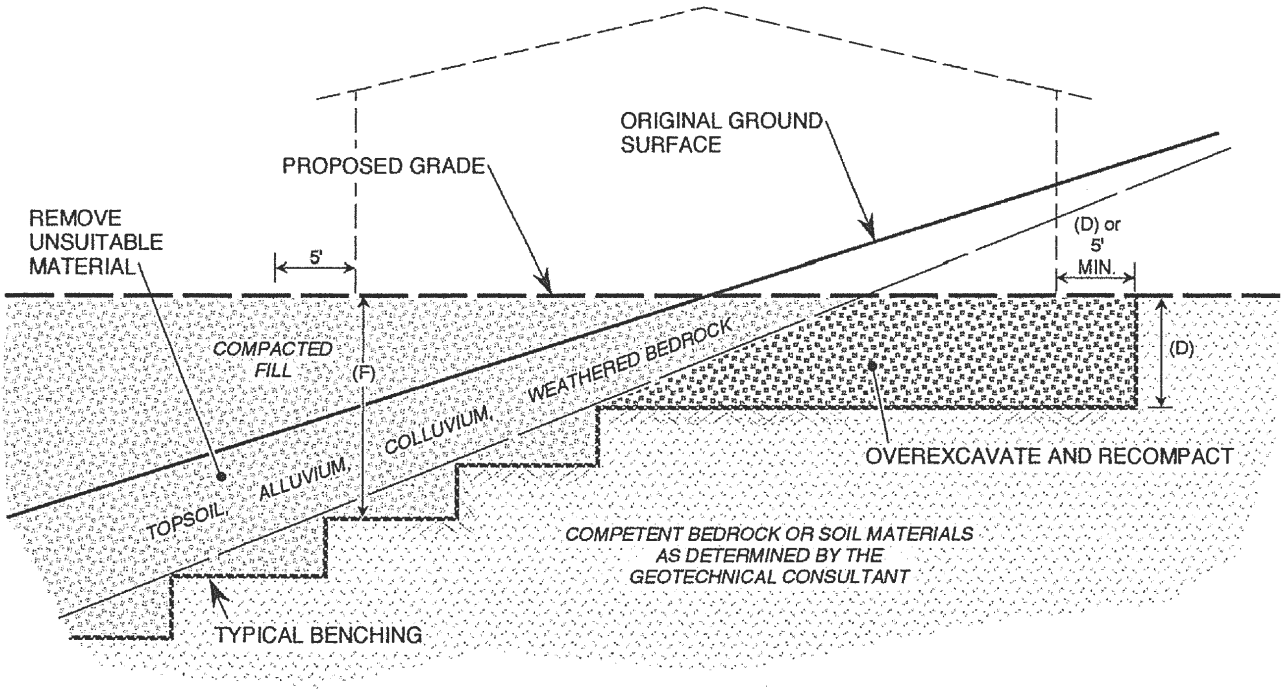
PETRA	FILL SLOPE ABOVE CUT SLOPE	PLATE SG-6

CUT LOT

UNSUITABLE MATERIAL EXPOSED IN PORTION OF CUT PAD

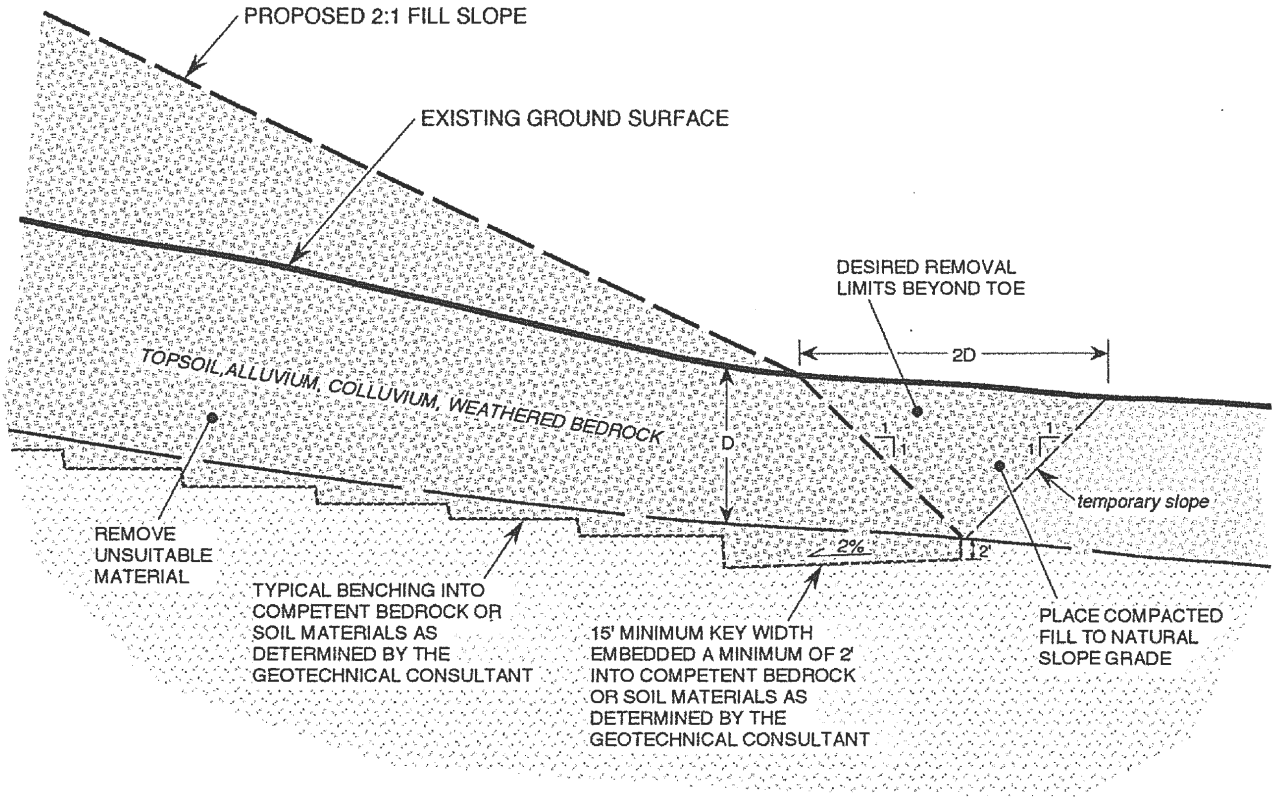


CUT-FILL TRANSITION LOT



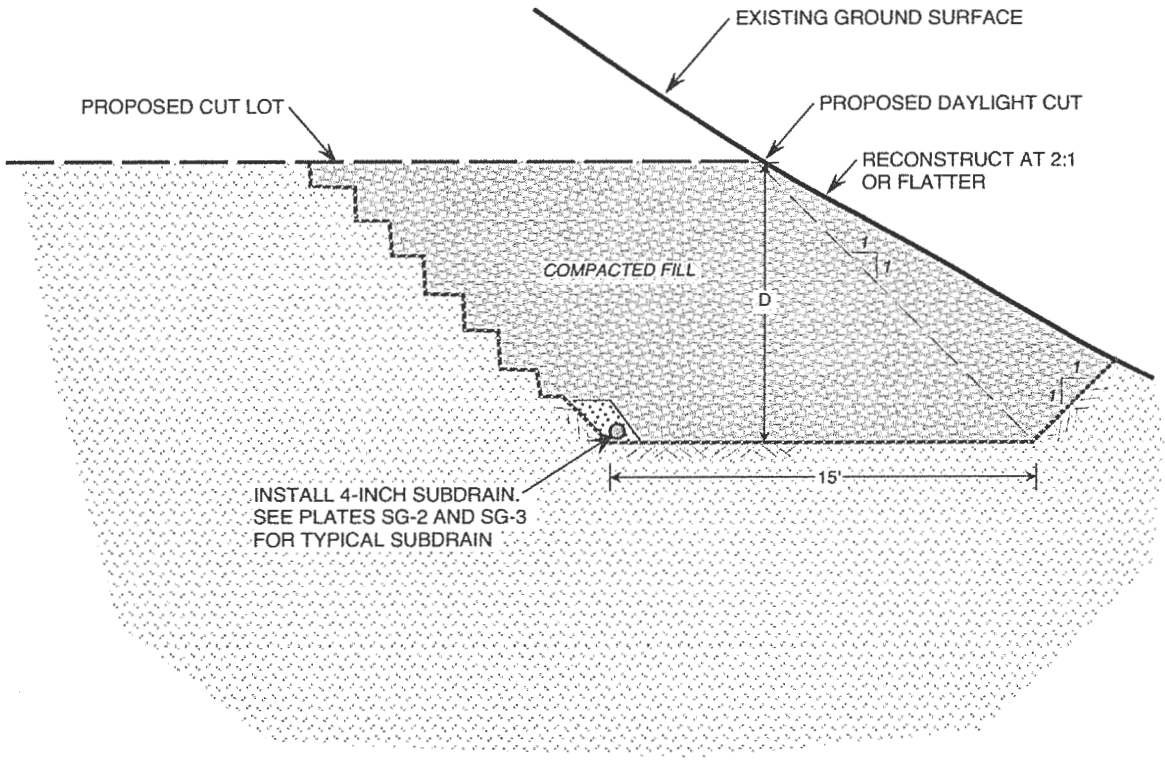
MAXIMUM FILL THICKNESS (F)	DEPTH OF OVEREXCAVATION (D)
FOOTING DEPTH TO 3 FEET	EQUAL DEPTH
3 TO 6 FEET	3 FEET
GREATER THAN 6 FEET	1/2 THE THICKNESS OF DEEPEST FILL PLACED WITHIN THE "FILL" PORTION (F) TO 15 FEET MAXIMUM

PETRA	CUT LOTS AND CUT-FILL TRANSITION LOTS	PLATE SG-7



D = RECOMMENDED DEPTH OF REMOVAL PER GEOTECHNICAL REPORT

PETRA	TYPICAL REMOVALS BEYOND TOE OF PROPOSED FILL SLOPE	PLATE SG-8



NOTE:

1. "D" SHALL BE 10 FEET MINIMUM OR AS DETERMINED BY SOILS ENGINEER.

PETRA	SHEAR KEY ON DAYLIGHT CUT LOTS	PLATE SG-9

Educational Material

Pick up after your pooch to curb pollution.

Maybe you weren't aware, but dog waste left on the ground gets into storm drains, polluting rivers, lakes and beaches.

The bacteria and risk of disease threatens the health of our kids and communities. Wherever you live in San Bernardino County, this pollution is a problem. The answer? Pick up after your dog, to help prevent pollution and protect our health. It's in your hands.

PUBLIC SERVICES
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San Bernardino County
STORMWATER PROGRAM

♻ Printed on recycled paper

STORMWATER Pollution Prevention

PAINTING

Paints, solvents, adhesives and other toxic chemicals used in painting often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these simple tips to prevent pollution and protect our health.

Water-Based Paints
Use water-based paints whenever possible. They are less toxic than oil-based paints and easier to clean up. Look for products labeled "latex" or "cleans with water."

Paint Removal
Sweep up paint stripping residue, chips and dust instead of hosing into the street and dispose of them safely at a household hazardous waste collection facility. Call (800) CLEANUP for the facility in your area.

Painting Cleanup
Never clean brushes or rinse paint containers in the street, gutter or near a storm drain. Clean water-based paints in the sink. Clean oil-based paints with thinner, which can be reused by putting it in a jar to settle out the paint particles and then pouring off the clear liquid for future use. Wrap dried paint residue in newspaper and dispose of it in the trash.

Exterior Paint Removal
When stripping or cleaning building exteriors with high-pressure water, block nearby storm drains and divert washwater onto a designated dirt area. Ask your local wastewater treatment authority if you can collect building cleaning water and discharge it to the sewer.

Recycling Paint
Recycle leftover paint at a household hazardous waste collection facility, save it for touch ups or give it to someone who can use it, like a theatre group, school, city or community organization.

To report illegal dumping or for more information on stormwater pollution prevention, call:

1 (800) CLEANUP

www.1800cleanup.org

PUBLIC SERVICES
CITY OF FONTANA

San Bernardino County STORMWATER PROGRAM

STORMWATER Pollution Prevention

HOME REPAIR & REMODELING

Paints, solvents, adhesives and other toxic substances used in home repair and remodeling often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these simple tips to prevent pollution and protect your health.

Construction Projects

Keep construction debris away from the street, gutter and storm drains. Schedule grading and excavation projects for dry weather. Cover excavated material and stockpiles of soil, sand or gravel, protected from rain, wind and runoff. Prevent erosion by planting fast-growing annual and perennial grass, which can shield and bind soil.

Recycle Household Hazardous Waste

Household cleaners, paint and other home improvement products like wallpaper and tile adhesives are too toxic to trash. Recycle them instead, at a convenient household hazardous waste collection facility. Call (800) CLEANUP for the facility in your area.

Landscaping & Gardening

Avoid applying fertilizers or pesticide near curbs and driveways, and store covered, protected from rain, wind and runoff. Try using organic or non-toxic alternatives. Reduce runoff and lower your water bill by using drip irrigation, soaker hoses or micro-spray systems. Recycle leaves instead of blowing, sweeping or raking them into the street, gutter or storm drain.

Paint Removal

Paint stripping residue, chips and dust from marine paints and paints containing lead or tributyl tin are hazardous wastes. Sweep them up instead of hosing into the street and dispose of them safely at a household hazardous waste collection facility.

Painting Cleanup

Avoid cleaning brushes or rinsing paint containers in the street, gutter or near a storm drain. Clean water-based paints in the sink. Clean oil-based paints with thinner, which you can filter and reuse. Recycle leftover paint at a household hazardous waste collection facility, save it for touch ups or give it to someone who can use it, like a theatre group, school, city or community organization.

Concrete and Masonry

Store bags of cement and plaster away from gutters and storm drains, and cover them to protect against rain, wind and runoff. Sweep or scoop up cement washout or concrete dust instead of hosing into driveways, streets, gutters or storm drains.

PUBLIC SERVICES
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To report illegal dumping or for more information on stormwater pollution prevention, call:

1 (800) CLEANUP

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

STORMWATER Pollution Prevention

HOME & GARDEN

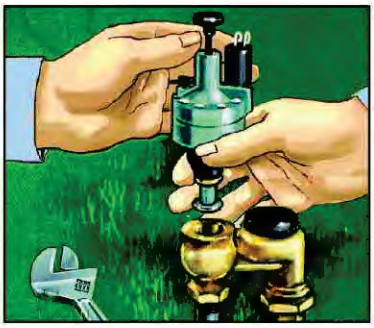
Yard waste and household toxics like paints and pesticides often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these simple tips to prevent pollution and protect your health.

Recycle Household Hazardous Waste
Household products like paint, pesticides, solvents and cleaners are too dangerous to dump and too toxic to trash. Take them to be recycled at a convenient household hazardous waste collection facility. Call (800) CLEANUP for the facility in your area.

Disposing of Yard Waste
Recycle leaves, grass clippings and other yard waste, instead of blowing, sweeping or hosing into the street. Try grasscycling, leaving grass clippings on your lawn instead of using a grass catcher. The clippings act as a natural fertilizer, and because grass is mostly water, it also irrigates your lawn, conserving water.

Use Fertilizers & Pesticides Safely
Fertilizers and pesticides are often carried into the storm drain system by sprinkler runoff. Try using organic or non-toxic alternatives. If you use chemical fertilizers or pesticides, avoid applying near curbs and driveways and never apply before a rain.

Planting in the Yard
Produce less yard waste and save water by planting low maintenance, drought-tolerant trees and shrubs. Using drip irrigation, soaker hoses or micro-spray systems for flower beds and vegetation can also help reduce your water bill and prevent runoff.



Use Water Wisely
Cut your water costs and prevent runoff by controlling the amount of water and direction of sprinklers. The average lawn needs about an inch of water a week, including rainfall, or 10 to 20 minutes of watering. A half-inch per week is enough for fall and spring. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff.

PUBLIC SERVICES
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To report illegal dumping or for more information on stormwater pollution prevention, call:

1 (800) CLEANUP

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

Fertilizer Tips to Prevent Pollution

Water that runs off your lawn and garden can carry excess fertilizer into the San Bernardino County storm drain system, and it does not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these simple tips to prevent pollution and protect your health:

PUBLIC SERVICES
CITY OF FONTANA

- Read the product label and follow the directions carefully, using only as directed.
- Avoid applying near driveways or gutters.
- Never apply fertilizer before a rain.
- Store fertilizers and chemicals in a covered area and in sealed, waterproof containers.
- Take unwanted lawn or garden chemicals to a household hazardous waste collection facility. Call (800) 253-2687.
- Use non-toxic products for your garden and lawn whenever possible.

San Bernardino County STORMWATER PROGRAM

To report illegal dumping or for more information on Stormwater pollution prevention, call:

1 (800) CLEANUP

www.1800cleanup.org

STORMWATER Pollution Prevention

FRESH CONCRETE & MORTAR APPLICATION

Cement wash, sediment, vehicle fluids, dust and hazardous debris from construction sites often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Storing Materials

Keep construction materials and debris away from the street, gutter and storm drains. Secure open bags of cement and cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.

Ordering Materials & Recycling Waste

Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. When breaking up paving, recycle the pieces at a crushing company. You can also recycle broken asphalt, concrete, wood, and cleared vegetation. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. Call (909) 386-8401 for recycling and disposal information.

During Construction

Schedule excavation and grading during dry weather. Prevent mortar and cement from entering the street and storm drains by placing erosion controls. Setup small mixers on tarps or drop cloths, for easy cleanup of debris. Never bury waste material. Recycle or dispose of it as hazardous waste.

Cleaning Up

Wash concrete dust onto designated dirt areas, not down driveways or into the street or storm drains. Wash out concrete mixers and equipment in specified washout areas, where water can flow into a containment pond. Cement washwater can be recycled by pumping it back into cement mixers for reuse. Never dispose of cement washout into driveways, streets, gutters, storm drains or drainage ditches.

PUBLIC SERVICES
CITY OF FONTANA

To report illegal dumping or for more information on stormwater pollution prevention, call:

1 (800) CLEANUP

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

STORMWATER Pollution Prevention

AUTO MAINTENANCE

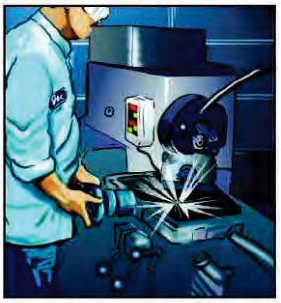
Oil, grease, anti-freeze and other toxic automotive fluids often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Cleaning Auto Parts

Scrape parts with a wire brush or use a bake oven rather than liquid cleaners. Arrange drip pans, drying racks and drain boards so that fluids are directed back into the parts washer or the fluid holding tank. Do not wash parts or equipment in a shop sink, parking lot, driveway or street.

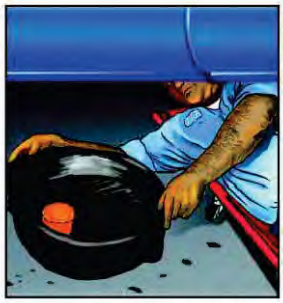
Storing Hazardous Waste

Keep your liquid waste segregated. Many fluids can be recycled via hazardous waste disposal companies if they are not mixed. Store all materials under cover with spill containment or inside to prevent contamination of rainwater runoff.



Metal Grinding and Polishing

Keep a bin under your lathe or grinder to capture metal filings. Send uncontaminated filings to a scrap metal recycler for reclamation. Store metal filings in a covered container or indoors.

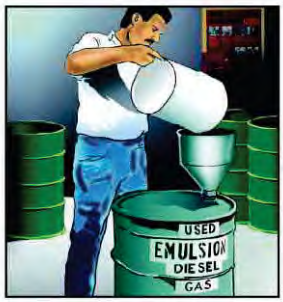


Preventing Leaks and Spills

Place drip pans underneath to capture fluids. Use absorbent cleaning agents instead of water to clean work areas.

Cleaning Spills

Use dry methods for spill cleanup (sweeping, absorbent materials). Follow your hazardous materials response plan, as filed with your local fire department or other hazardous materials authority. Be sure that all employees are aware of the plan and are capable of implementing each phase. To report serious toxic spills, call 911.



Proper Disposal of Hazardous Waste

Recycle used motor oil and oil filters, anti-freeze and other hazardous automotive fluids, batteries, tires and metal filings collected from grinding or polishing auto parts. Contact a licensed hazardous waste hauler. For more recycling information, call (909) 386-8401.

PUBLIC SERVICES
CITY OF FONTANA

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1 (800) CLEANUP

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

BMP Fact Sheets

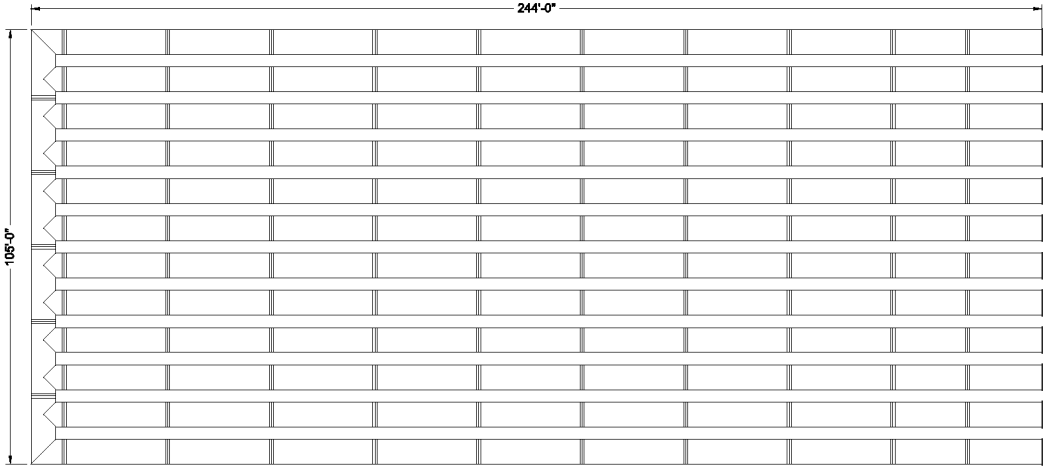
PROJECT SUMMARY

CALCULATION DETAILS
- LOADING = HS20/HS25
- APPROX. LINEAR FOOTAGE = 2,961 LF

STORAGE SUMMARY
- STORAGE VOLUME REQUIRED = 129,000 CF
- PIPE STORAGE VOLUME = 83,720 CF
- BACKFILL STORAGE VOLUME = 45,478 CF
- TOTAL STORAGE PROVIDED = 129,198 CF
- STONE VOID = 40%

PIPE DETAILS
- DIAMETER = 72"
- CORRUGATION = 5x1
- GAGE = 16
- COATING = ALT2
- WALL TYPE = PERFORATED
- BARREL SPACING = 36"

BACKFILL DETAILS
- WIDTH AT ENDS = 12"
- ABOVE PIPE = 6"
- WIDTH AT SIDES = 12"
- BELOW PIPE = 12"



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" = 30'

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CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

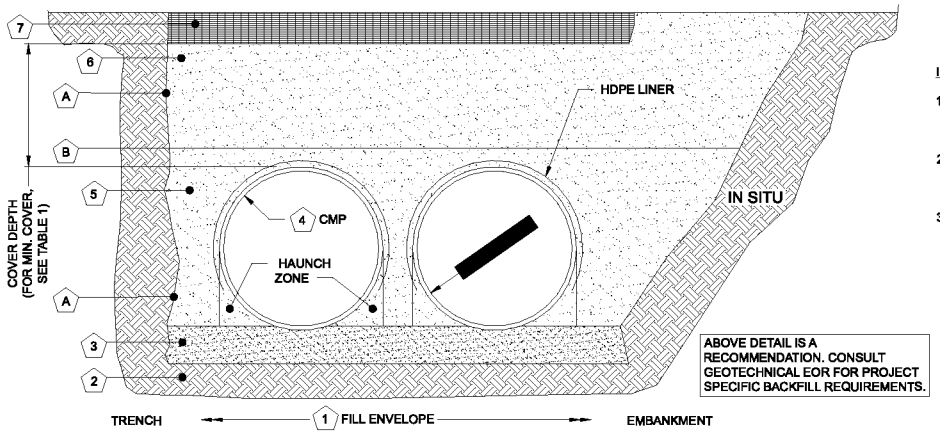
DYO46936 Pacific Communities-Maple Ave, Fontana
CMP-1 INF/DET CHAMBER SYSTEM
Fontana, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
32414	46936	7/30/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

TABLE 1:

DIAMETER, D	MIN. COVER	CORR. PROFILE
6"-10"	12"	1 1/2" x 1/4"
12"-48"	12"	2 2/3" x 1/2"
>48"-96"	12"	3" x 1", 5" x 1"
>96"	D/8	3" x 1", 5" x 1"

- STRUCTURAL BACKFILL MUST EXTEND TO LIMITS OF THE TABLE
- TOTAL HEIGHT OF COMPACTED COVER FOR CONVENTIONAL HIGHWAY LOADS IS MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT.



ABOVE DETAIL IS A RECOMMENDATION. CONSULT GEOTECHNICAL EOR FOR PROJECT SPECIFIC BACKFILL REQUIREMENTS.

MINIMUM WIDTH DEPENDS ON SITE CONDITIONS AND ENGINEERING JUDGEMENT

INSTALLATION NOTES

1. WHEN PLACING THE FIRST LIFTS OF BACKFILL IT IS IMPORTANT TO MAKE SURE THAT THE BACKFILL IS PROPERLY COMPACTED UNDER AND AROUND THE PIPE HAUNCHES.
2. OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS, AS APPROVED BY SITE ENGINEER.
3. AN HDPE MEMBRANE LINER WILL BE PLACED ON THE CROWN OF EACH PIPE TO PROVIDE AN IMPERMEABLE BARRIER AGAINST ENVIRONMENTAL CHANGES THAT MAY ADVERSELY AFFECT THE SYSTEM OVER TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL TECHNICAL DETAILS.

TABLE 2: PERFORATED STANDARD

CMP RETENTION STANDARD BACKFILL SPECIFICATIONS

	MATERIAL LOCATION	MATERIAL SPECIFICATION	DESCRIPTION	
1	FILL ENVELOPE WIDTH	PER ENGINEER OF RECORD	MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER THE PIPE. THE SUGGESTED MINIMUM TRENCH WIDTH, OR EOR RECOMMENDATION: PIPE ≤ 12": D + 16" PIPE > 12": 1.5D + 12"	MINIMUM EMBANKMENT WIDTH (IN FEET) FOR INITIAL FILL ENVELOPE: PIPE < 24": 3.0D PIPE 24" - 144": D + 4'0" PIPE > 144": D + 10'0"
2	FOUNDATION	**AASHTO 26.5.2** - PER ENGINEER OF RECORD	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 FOUNDATION BROUGHT BACK TO GRADE WITH A FILL MATERIAL APPROVED BY THE ENGINEER OF RECORD.	
3	BEDDING	**AASHTO M 43: 3, 357, 4, 467, 5, 56, 57**	ENGINEER OF RECORD TO DETERMINE IF BEDDING IS REQUIRED. PIPE MAY BE PLACED ON THE TRENCH BOTTOM OF A RELATIVELY LOOSE, NATIVE SUITABLE WELL GRADED GRANULAR MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, 2" MIN DEPTH. THE BEDDING MATERIAL MAY BE SUITABLE OPEN GRADED GRANULAR BEDDING CONFORMING TO AASHTO SOIL CLASSIFICATIONS A1, A2, OR A3 WITH MAXIMUM PARTICLE SIZE OF 3" PER AASHTO 26.3.6.1	
4	CORRUGATED METAL PIPE			
5	BACKFILL	FREE-DRAINING, ANGULAR, NATURALLY OCCURRING WASHED-STONE PER **AASHTO M 43: 3, 357, 4, 467, 5, 56, 57** OR APPROVED EQUAL *	HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION WITHOUT SOFT SPOTS. BACKFILL SHALL BE PLACED IN 8" +/- LOOSE LIFTS AND COMPACTED TO 90% STANDARD PROCTOR PER AASHTO T 99. BACKFILL SHALL BE PLACED SUCH THAT THERE IS NO MORE THAN A TWO LIFT (16") DIFFERENTIAL BETWEEN ANY OF THE PIPES AT ANY TIME DURING THE BACKFILL PROCESS. THE BACKFILL SHOULD BE ADVANCED ALONG THE LENGTH OF THE SYSTEM TO AVOID DIFFERENTIAL LOADING. WHERE CONVENTIONAL COMPACTION TESTING IS NOT PRACTICAL, THE MATERIAL SHALL BE MECHANICALLY COMPACTED UNTIL NO FURTHER YIELDING OF MATERIAL IS OBSERVED UNDER THE COMPACTOR. **IN AREAS WITH HIGH WATER TABLE FLUCTUATIONS THAT INTERACT WITH THE PIPE ZONE, CONSIDER INSTALLING A GEOTEXTILE SEPARATION LAYER TO PREVENT SOIL MIGRATION.	
6	COVER MATERIAL	UP TO MIN. COVER - **AASHTO M 145: A-1, A-2, A-3** ABOVE MIN. COVER - PER ENGINEER OF RECORD	COVER MATERIAL MAY INCLUDE NON-BITUMINOUS, GRANULAR ROADBASE MATERIAL WITHIN MIN COVER LIMITS	
7	RIGID OR FLEXIBLE PAVEMENT (IF APPLICABLE)	PER ENGINEER OF RECORD	FLEXIBLE PAVEMENT SHOULD NOT BE COUNTED AS PART OF THE FILL HEIGHT OVER THE CMP. FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS SHALL FOLLOW THE PROJECT PLANS AND SPECIFICATIONS PER THE ENGINEER OF RECORD.	
A	OPTIONAL SIDE GEOTEXTILE	NONE	GEOTEXTILE LAYER IS RECOMMENDED ON SIDES OF EXCAVATION TO PREVENT SOIL MIGRATION.	
B	GEOTEXTILE BETWEEN LAYERS	NONE	IF SOIL TYPES DIFFER AT ANY POINT ABOVE PIPE INVERT, A GEOTEXTILE LAYER IS RECOMMENDED TO BE PLACED BETWEEN THE LAYERS TO PREVENT SOIL MIGRATION.	

NOTES:
- FOR MULTIPLE BARREL INSTALLATIONS, THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE THE PIPE DIAMETER /2 BUT NO LESS THAN 12" FOR DIAMETERS <72". FOR 72" AND LARGER DIAMETERS, THE MINIMUM SPACING IS 36". CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING.
- * APPROVED REGIONAL EQUIVALENTS FOR SECTION 5 INCLUDE CA-7, MIDOT 6AA, 6A, OR 5G, PROVIDED THEY MEET THE PARTICLE SIZES INDICATED.

MANUFACTURER RECOMMENDED BACKFILL

NOT TO SCALE

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DYO46936 Pacific Communities-Maple Ave, Fontana
CMP-1 INF/DET CHAMBER SYSTEM
Fontana, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
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SHEET NO.: 1		

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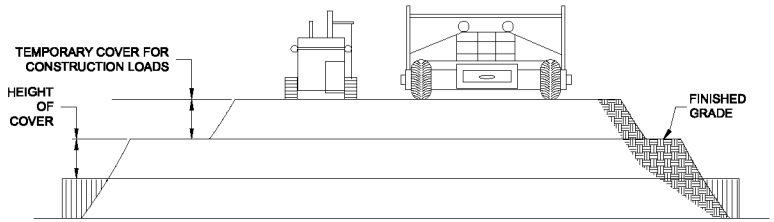


CONSTRUCTION LOADS

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
128-144	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 REQUIREMENTS OF AASHTO M-274 OR ASTM A-92.

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

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

THE ALUMINUM COILS SHALL CONFORM TO THE APPLICABLE 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.

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

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

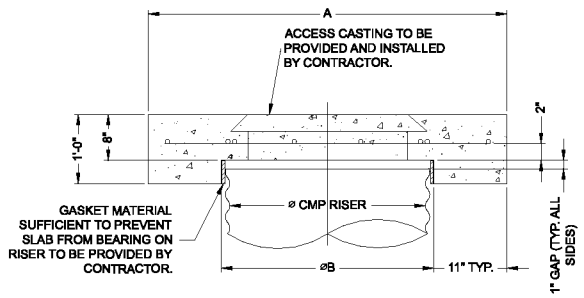
APPLICABLE POLYMER COATED: AASHTO M-245 OR ASTM A-762

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.

REQUIREMENTS
INSTALLATION
SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II DIVISION II OR ASTM A-796 (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.

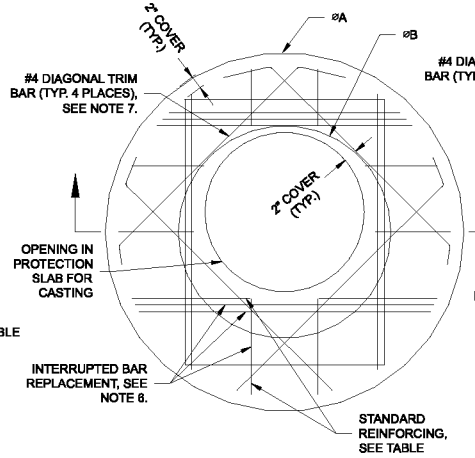
IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.



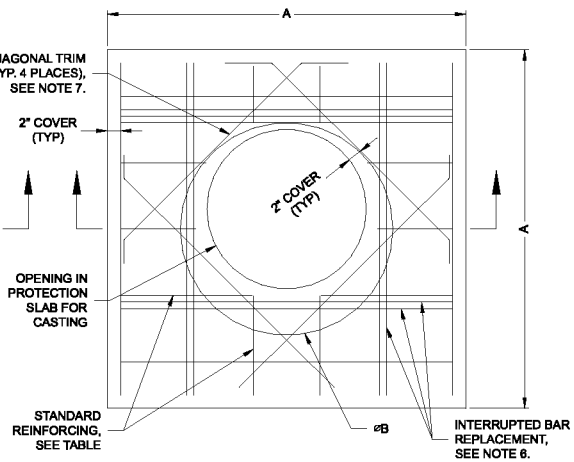
SECTION VIEW

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
46"	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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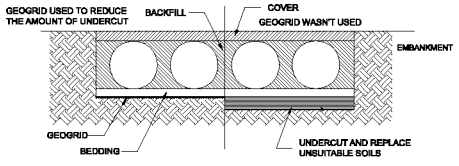
CMP DETENTION INSTALLATION GUIDE

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.

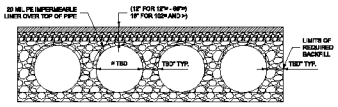


GRADE THE FOUNDATION SUBGRADE TO A UNIFORM OR SLIGHTLY SLOPING GRADE. IF THE SUBGRADE IS CLAY OR RELATIVELY NON-POROUS AND THE CONSTRUCTION SEQUENCE WILL LAST FOR AN EXTENDED PERIOD OF TIME, IT IS BEST TO SLOPE THE GRADE TO ONE END OF THE SYSTEM. THIS WILL ALLOW EXCESS WATER TO DRAIN QUICKLY, PREVENTING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

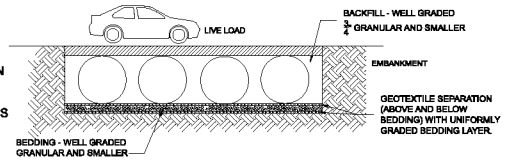
THE PROJECT'S ENGINEER OF RECORD IS TO EVALUATE WHETHER SALTING AGENTS WILL BE USED ON OR NEAR THE PROJECT SITE, AND USE HIS/HER BEST JUDGEMENT TO DETERMINE IF ANY ADDITIONAL PROTECTIVE MEASURES ARE REQUIRED. BELOW IS A TYPICAL DETAIL SHOWING THE PLACEMENT OF A GEOMEMBRANE BARRIER FOR PROJECTS WHERE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



IN-SITU TRENCH WALL

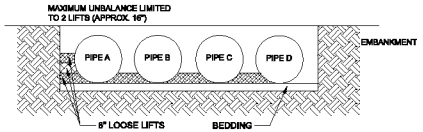
IF EXCAVATION IS REQUIRED, THE TRENCH WALL NEEDS TO BE CAPABLE OF SUPPORTING THE LOAD THAT THE PIPE SHEDS AS THE SYSTEM IS LOADED. IF SOILS ARE NOT CAPABLE OF SUPPORTING THESE LOADS, THE PIPE CAN DEFLECT. PERFORM A SIMPLE SOIL PRESSURE CHECK USING THE APPLIED LOADS TO DETERMINE THE LIMITS OF EXCAVATION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



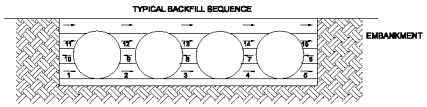
BACKFILL PLACEMENT

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

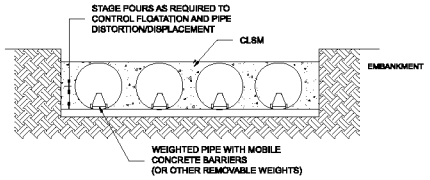


IF AASHTO T99 PROCEDURES ARE DETERMINED INFEASIBLE BY THE GEOTECHNICAL ENGINEER OF RECORD, COMPACTION IS CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE GEOTECHNICAL ENGINEER OF RECORD (OR REPRESENTATIVE THEREOF) IS SATISFIED WITH THE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

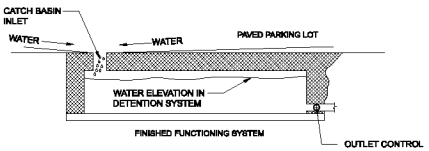


CONSTRUCTION LOADING

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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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

DYO46936 Pacific Communities-Maple Ave, Fontana
CMP-1 INF/DET CHAMBER SYSTEM
Fontana, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
32414	46936	7/30/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

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CONTECH ENGINEERED SOLUTIONS

Date: 7/30/2024
Project Name: CMP-1 INFDET CHAMBER SYSTEM - 46936 (7-30-2024 1

City / County:
State:

Designed By:
Company:
Telephone:

CMP: Underground Detention System
Storage Volume Estimation

=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

System Information		Backfill Information		Pipe & Analysis Information	
Out-to-out length (ft):	244.0	Backfill Porosity (%):	40%	System Diameter (in):	72
Out-to-out width (ft):	105.0	Depth Above Pipe (in):	6.0	Pipe Spacing (in):	36
Number of Manifolds (ea):	1.0	Depth Below Pipe (in):	12.0	Incremental Analysis (in):	2
Number of Barrels (ea):	12.0	Width At Ends (ft):	1.0	System Invert (Elevation):	0
		Width At Sides (ft):	1.0		

Storage Volume Estimation

System		Pipe		Stone		Total System		Miscellaneous	
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)
0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0%	10,528.8
0.17	0.16	0.0	0.0	1,754.8	1,754.8	1,754.8	1,754.8	0.0%	10,528.8
0.33	0.33	0.0	0.0	1,754.8	3,509.6	1,754.8	3,509.6	0.0%	10,528.8
0.50	0.50	0.0	0.0	1,754.8	5,264.4	1,754.8	5,264.4	0.0%	10,528.8
0.67	0.66	0.0	0.0	1,754.8	7,019.2	1,754.8	7,019.2	0.0%	10,528.8
0.83	0.83	0.0	0.0	1,754.8	8,774.0	1,754.8	8,774.0	0.0%	10,528.8
1.00	1.00	0.0	0.0	1,754.8	10,528.8	1,754.8	10,528.8	0.0%	10,528.8
1.17	1.16	652.5	652.5	1,493.8	12,022.6	2,146.3	12,675.1	5.1%	14,032.3
1.33	1.33	1,177.3	1,829.8	1,283.9	13,306.5	2,461.2	15,136.3	12.1%	15,412.2
1.50	1.50	1,502.5	3,332.3	1,153.8	14,460.3	2,656.3	17,792.6	18.7%	16,421.1
1.67	1.66	1,752.6	5,084.9	1,053.8	15,514.0	2,806.4	20,598.9	24.7%	17,228.8
1.83	1.83	1,957.2	7,042.1	971.9	16,486.0	2,929.1	23,528.1	29.9%	17,901.6
2.00	2.00	2,129.6	9,171.6	903.0	17,388.9	3,032.5	26,560.6	34.5%	18,474.0
2.17	2.16	2,277.1	11,448.7	844.0	18,232.9	3,121.0	29,681.6	38.6%	18,966.4
2.33	2.33	2,404.3	13,853.0	793.1	19,026.0	3,197.4	32,879.0	42.1%	19,392.0
2.50	2.50	2,514.4	16,367.4	749.0	19,775.0	3,263.4	36,142.4	45.3%	19,760.3
2.67	2.66	2,609.5	18,976.9	711.0	20,486.0	3,320.5	39,463.0	48.1%	20,077.7
2.83	2.83	2,691.2	21,668.1	678.3	21,164.3	3,369.5	42,832.5	50.6%	20,349.3
3.00	3.00	2,760.7	24,428.9	650.5	21,814.9	3,411.2	46,243.7	52.8%	20,578.8
3.17	3.16	2,818.9	27,247.8	627.2	22,442.1	3,446.2	49,689.9	54.8%	20,768.9
3.33	3.33	2,866.6	30,114.4	608.2	23,050.3	3,474.7	53,164.6	56.6%	20,921.9
3.50	3.50	2,904.1	33,018.4	593.2	23,643.4	3,497.2	56,661.9	58.3%	21,039.3
3.67	3.66	2,931.9	35,950.4	582.0	24,225.5	3,513.9	60,175.8	59.7%	21,122.4
3.83	3.83	2,950.3	38,900.7	574.7	24,800.1	3,525.0	63,700.8	61.1%	21,171.9
4.00	4.00	2,959.5	41,860.2	571.0	25,371.1	3,530.5	67,231.3	62.3%	21,188.4
4.17	4.16	2,959.5	44,819.6	571.0	25,942.1	3,530.5	70,761.8	63.3%	21,171.9
4.33	4.33	2,950.3	47,769.9	574.7	26,516.8	3,525.0	74,286.8	64.3%	21,122.4
4.50	4.50	2,931.9	50,701.9	582.0	27,098.9	3,513.9	77,800.7	65.2%	21,039.3
4.67	4.66	2,904.1	53,605.9	593.2	27,692.0	3,497.2	81,298.0	65.9%	20,921.9
4.83	4.83	2,866.6	56,472.5	608.2	28,300.2	3,474.7	84,772.7	66.6%	20,768.9
5.00	5.00	2,818.9	59,291.4	627.2	28,927.4	3,446.2	88,218.9	67.2%	20,578.8
5.17	5.16	2,760.7	62,052.2	650.5	29,577.9	3,411.2	91,630.1	67.7%	20,349.3
5.33	5.33	2,691.2	64,743.4	678.3	30,256.2	3,369.5	94,999.6	68.2%	20,077.7
5.50	5.50	2,609.5	67,352.9	711.0	30,967.2	3,320.5	98,320.1	68.5%	19,760.3
5.67	5.66	2,514.4	69,867.3	749.0	31,716.3	3,263.4	101,583.6	68.8%	19,392.0
5.83	5.83	2,404.3	72,271.6	793.1	32,509.4	3,197.4	104,781.0	69.0%	18,966.4
6.00	6.00	2,277.1	74,548.7	844.0	33,353.3	3,121.0	107,902.0	69.1%	18,474.0
6.17	6.16	2,129.6	76,678.2	903.0	34,256.3	3,032.5	110,934.5	69.1%	17,901.6
6.33	6.33	1,957.2	78,635.4	971.9	35,228.2	2,929.1	113,863.6	69.1%	17,228.8

These results are submitted to you as a guideline only, without liability on the part of CONTECH Engineered Solutions, LLC for accuracy or suitability to any particular application, and are subject to your verification.

6.50	6.50	1,752.6	80,388.0	1,053.8	36,282.0	2,806.4	116,670.0	68.9%	16,421.1
6.67	6.66	1,502.5	81,890.5	1,153.8	37,435.8	2,656.3	119,326.3	68.6%	15,412.2
6.83	6.83	1,177.3	83,067.8	1,283.9	38,719.7	2,461.2	121,787.5	68.2%	14,032.3
7.00	7.00	652.5	83,720.3	1,493.8	40,213.5	2,146.3	123,933.8	67.6%	10,528.8
7.17	7.16	0.0	83,720.3	1,754.8	41,968.3	1,754.8	125,688.6	66.6%	10,528.8
7.33	7.33	0.0	83,720.3	1,754.8	43,723.1	1,754.8	127,443.4	65.7%	10,528.8
7.50	7.50	0.0	83,720.3	1,754.8	45,477.9	1,754.8	129,198.2	64.8%	10,528.8

These results are submitted to you as a guideline only, without liability on the part of CONTECH Engineered Solutions, LLC for accuracy or suitability to any particular application, and are subject to your verification.

CONTECH®
ENGINEERED SOLUTIONS

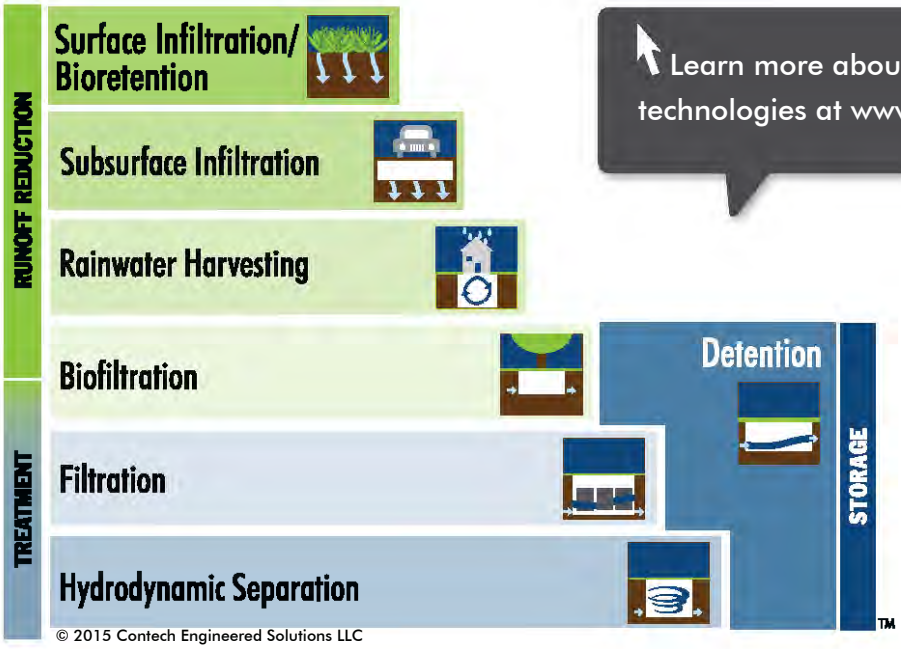
Corrugated Metal Pipe Infiltration System

Solutions Guide

Stormwater Solutions from Contech

Selecting the Right Stormwater Solution Just Got Easier...

It's simple to choose the right stormwater solution to achieve your goals with the Contech Stormwater Solutions Staircase. First, select the runoff reduction practices that are most appropriate for your site, paying particular attention to pretreatment needs. If the entire design storm cannot be retained, select a treatment best management practice (BMP) for the balance. Finally, select a detention system to address any outstanding downstream erosion.



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Learn more about all of our stormwater technologies at www.ContechES.com/stormwater

DYODS

Design Your Own Detention or Infiltration System

The Contech Design Your Own Detention System (DYODS®) tool fully automates the layout process for stormwater detention and infiltration systems and produces CAD and PDF files that can be used for creating plans and specs, and for estimating total installed costs.

To use the *Design Your Own Detention or Infiltration System* tool, visit: www.ContechES.com/dyods

Subsurface Infiltration as a Stormwater Management Strategy

The only sure way to eliminate stormwater pollution is to eliminate stormwater runoff. In recognition of this fact, Green Infrastructure and Low Impact Development based stormwater management regulations prioritizing runoff reduction have proliferated throughout the United States.

Where site conditions allow, infiltration is typically the most cost effective and reliable runoff reduction approach. In urban environments where there are competing demands for land, subsurface infiltration can provide many of the benefits of landscape based systems but without requiring dedicated land area. Infiltration systems are commonly comprised of a pretreatment component designed to remove sediment, trash, and oil, followed by plastic, metal or concrete storage units surrounded by permeable stone creating a high voids storage gallery. Infiltration systems are typically designed to support vehicular loading and to withstand lateral pressures from surrounding soil that allows the overlying land to be used for virtually any non-building application.

Subsurface infiltration meets the objectives of LID by reducing runoff with the added benefit of saving land space in urban environments.

LID benefits include runoff volume reduction, peak flow control, ground water recharge, and water quality improvement.

CMP infiltration is used at Pitzer College in Claremont, California.

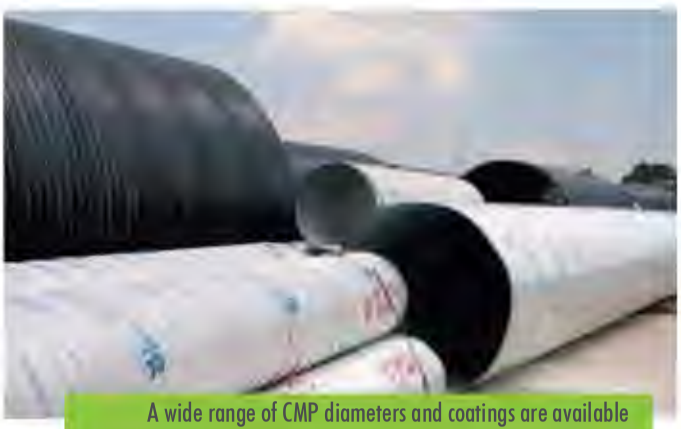
CMP – the "Go To" Material for Subsurface Infiltration

The purpose of the storage vessel is to hold stormwater runoff underground while allowing it to infiltrate the surrounding soil. For the majority of applications, corrugated metal pipe (CMP) is the "go to" material for subsurface infiltration.

- 75+ year service life guidance for certain materials/coatings in recommended environments.* Please refer to the Corrugated Metal Pipe Detention Design Guide for additional information.
- Various pipe coatings and materials are available to accommodate site-specific needs: Aluminized Steel Type 2 (ALT2), Galvanized, CORLIX® Aluminum, and Polymer Coated.
- Wide range of gages, corrugations, and shapes, in diameters 12" – 144".
- Pipe can be fully or partially perforated for infiltration, retention, or groundwater recharge applications.
- Custom access risers and manifolds provide direct access for maintenance.
- Outlet control devices can be incorporated within the system, eliminating the need for a separate structure.
- Customizable - a variety of fittings allow CMP to match most layout configurations.
- May be designed for heavy loading and high maximum cover.
- Contributes to LEED points.
- Available locally; quick turnaround time.
- The most economical installed solution.

With its low cost, a wide variety of diameters, layout configurations, and materials, no other material can match CMP's flexibility and versatility.

CMP can be laid out in configurations not achievable with other materials.



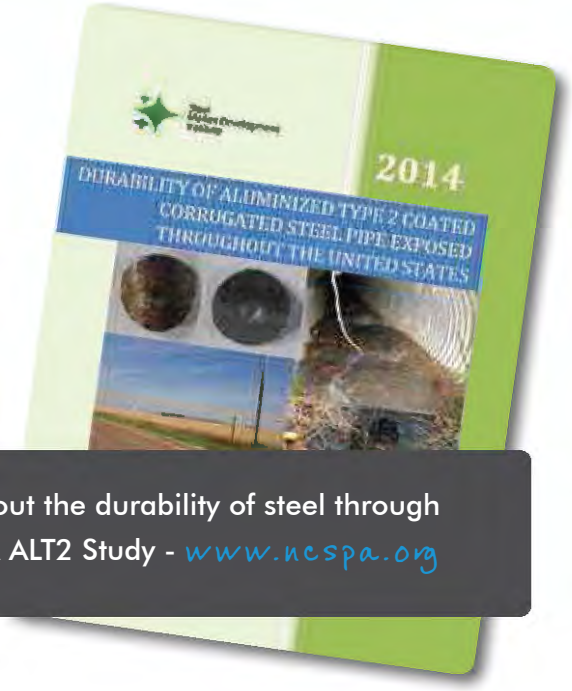
A wide range of CMP diameters and coatings are available to meet site specific needs.

* Service life guidance provided by National Corrugated Steel Pipe Association (NCSPA) and/or AK Steel Corporation. See NCSPA.org website or consult your engineer of record for additional information on service life, recommended environments and field studies on various materials and coatings. Corrosive environments, such as seawater and road/de-icing salt infiltration, and other environments with pH and resistivity outside of the recommended range may cause premature corrosion and reduce actual service life. Because site conditions vary, Contech does not guaranty or warrant service life guidance for materials and coatings.

Addressing the Question of Longevity

Some engineers are hesitant to use corrugated metal pipe (CMP) for infiltration because they have heard about CMP drainage culverts that have corroded due to abrasion. Factors affecting longevity differ between culvert and infiltration applications. Culverts experience high velocity flows carrying abrasive sediment, which can wear off galvanized coatings used in older CMP culverts. Infiltration systems are designed for storage rather than conveyance, so velocity and abrasive forces are minimized. In addition, improved CMP coatings, such as Aluminized Type 2 (ALT2), are more abrasion resistant and have demonstrated superior in-ground performance against abrasion in long-term durability studies. Field studies also have indicated that ALT2 coating may extend service life in wider pH and resistivity ranges than galvanized coatings. Confirming and maintaining recommended environmental conditions helps ensure system longevity projected by the long term studies. Finally, properly designed infiltration systems include pretreatment, flow control and a stone backfill envelope that can reduce exposure to abrasion.

CMP has a proven service life



Learn more about the durability of steel through the recent NCSPA ALT2 Study - www.ncspa.org

- National Corrugated Steel Pipe Association (NCSPA) service life guidance of 75+ years for certain materials/coatings in recommended environments.
- CMP infiltration systems can be designed to meet HS-20 or greater load requirements with proper depths of cover.
- With low flows, CMP infiltration systems have little susceptibility to abrasion inside the pipe that holds stormwater runoff.
- Various pipe coatings and materials are available to accommodate site-specific needs: Aluminized Steel Type 2 (ALT2), Galvanized, CORLIX® Aluminum, and Polymer Coated.
- CMP infiltration systems are to be surrounded by clean crushed rock to provide increased storage capacity and reduce contact with native soils. The entire system may be wrapped with fabric or liner on the sides and top to help further reduce contact with native soils.
- CMP infiltration systems may be used in wide range of recommended environments. AK Steel Corporation's field studies and technical guidance indicate 75 year service life guidance for 16 gage ALT2 for pH of 5-9 and resistivity greater than 1,500 ohm-cm and 100 year service life guidance for 16 gage ALT2 for pH of 6-8 and resistivity greater than 5,000 ohm-cm.
- Corrosive environments, such as seawater and road/de-icing salt infiltration, acidic minewater, and sanitary sewage, and other environments with pH and resistivity outside of the recommended range may cause premature corrosion and reduce actual service life.
- Infiltration systems are to be inspected and maintained in accordance with Contech's guidelines. See Corrugated Metal Pipe Detention Design Guide for additional information on CMP infiltration systems.

Learn more at www.ContechES.com/cmp-detention

Maximizing Vertical Space: Every Inch Counts

One of the most overlooked advantages of CMP is its ability to maximize vertical storage space.

Increasing the depth of a CMP infiltration system allows for more water storage in the same footprint. For example, doubling the diameter of pipe yields four times as much storage volume in the pipe. This provides a significant cost savings per cubic foot of storage. In addition, more vertical storage space means a smaller footprint, less excavation, and lower project costs.

Contech's Corrugated Metal Pipe Detention systems maximize vertical storage space.

Sizing

Round Pipe – CMP → 6-in to 144-in

Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height	Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height
12	.78	12″	78	33.2	12″
15	1.22	12″	84	38.5	12″
18	1.76	12″	90	44.2	12″
21	2.40	12″	96	50.3	12″
24	3.14	12″	102	56.8	18″
30	4.9	12″	108	63.6	18″
36	7.1	12″	114	70.9	18″
42	9.6	12″	120	78.5	18″
48	12.6	12″	126	86.6	18″
54	15.9	12″	132	95.0	18″
60	19.6	12″	138	103.9	18″
66	23.8	12″	144	113.1	18″
72	28.3	12″			

The Need for Effective Pretreatment

Infiltration systems have multiple components, and one of the most important is pretreatment. The purpose of a pretreatment device is to prolong the life of the infiltration system by removing debris and sediment that can collect on the invert and within the stone backfill voids. Pretreatment will maintain the efficiency of an infiltration system as well as extend the life cycle, therefore preventing a premature replacement. Pretreatment also offers these additional benefits:

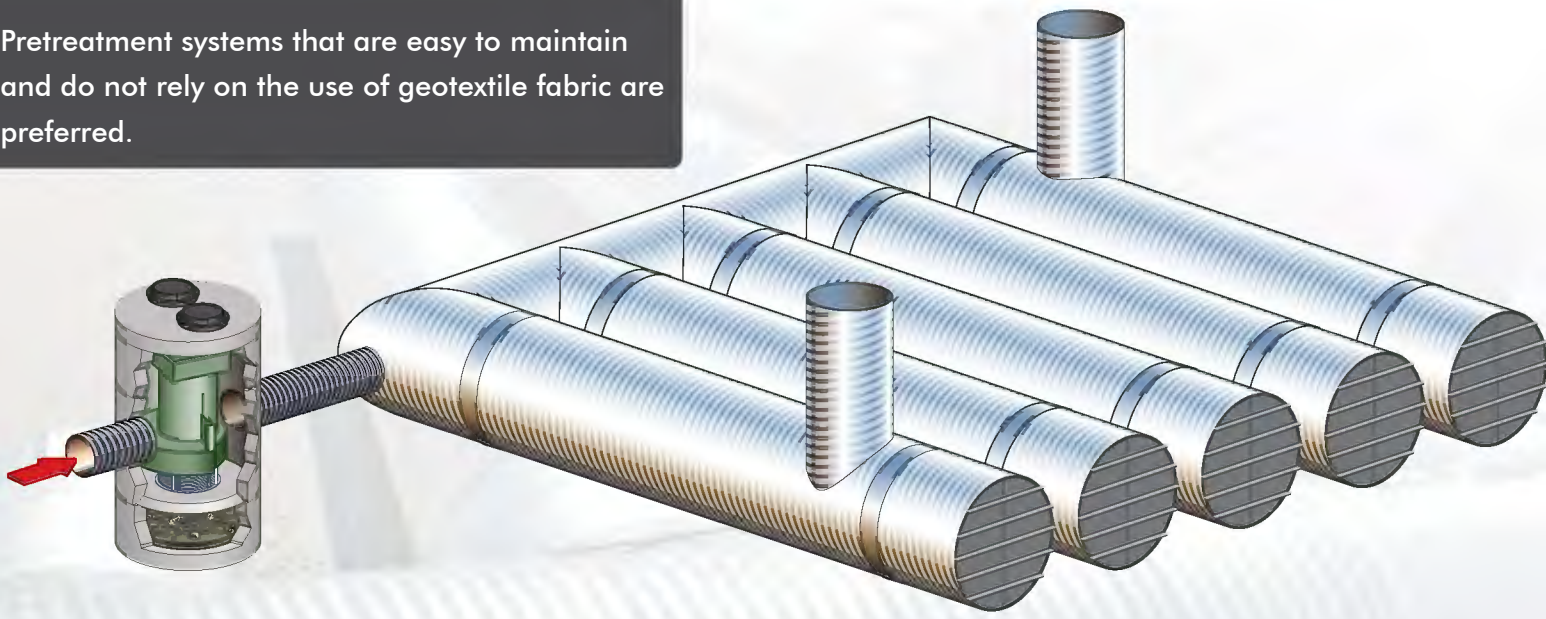
- Easier to clean and maintain compared to the infiltration system itself.
- Cost savings due to the extended service life of the system.
- Removing trash and debris protects downstream outlet control structures from clogging.

Pretreatment Design Considerations

When choosing a pretreatment system, it is important to consider the following:

- Downstream outlet control structures may require protection from a pretreatment device that screens trash and debris.
- Pretreatment system selection depends on pollutant targets. Trash, debris, and larger particles can be removed with hydrodynamic separators. Removing high percentages of fine particles and associated heavy metals and nutrients requires filtration.
- Reduced long term maintenance or replacement cost of the infiltration system can help justify pretreatment construction costs.
- Inlet and pipe layout will influence the number and type of pretreatment systems used. A combination of different systems may be appropriate for the various inlet locations and flows.

Pretreatment systems that are easy to maintain and do not rely on the use of geotextile fabric are preferred.



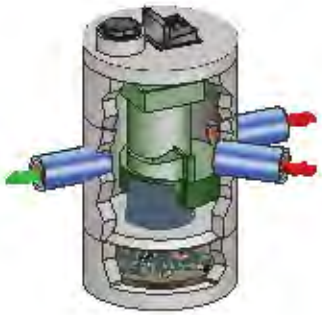
Learn more at www.ContechES.com/cmp-detention

7

Pretreatment Options

Contech offers a number of pretreatment options, all of which will extend the life of subsurface infiltration systems and improve water quality. The type of system chosen will depend on a number of factors including footprint, soil conditions, local regulations, and the desired level of pretreatment.

CDS provides direct access to cleaning, and the built-in high flow bypass weir eliminates the need for a separate bypass structure.



Hydrodynamic Separation

Hydrodynamic Separation (HDS) provides a basic level of pretreatment by capturing and retaining trash and debris, sediment, and oil from stormwater runoff.

CDS®

The CDS uses a combination of swirl concentration and indirect screening and is the only non-blocking screening technology available in an HDS system.

Filtration

Filtration provides a higher level of pretreatment and improved water quality by removing trash and debris, oil, fine solids, and dissolved pollutants such as metals, hydrocarbons, and nutrients.

Filterra® Bioretention System

Filterra is an engineered bioretention system that has been optimized for high volume/flow treatment and high pollutant removal.

The Stormwater Management StormFilter®

The StormFilter system is comprised of a structure that houses rechargeable, media-filled cartridges. The media can be customized to target site-specific pollutants.

Jellyfish® Filter

The Jellyfish filter uses membrane filtration in a compact footprint to remove a high level and a wide variety of stormwater pollutants such as fine particulates, oil, trash and debris, metals, and nutrients.

Alternative Materials for Subsurface Infiltration

There may be instances where alternative materials are needed for subsurface infiltration due to site specific needs.

Plastic Chambers

Plastic chambers are best suited to shallow depth applications; minimum cover is 18 inches, and maximum cover is 96 inches. Some benefits of chambers are:

- Chambers may be beneficial for sites with limited vertical storage.
- Lightweight and installed by hand.
- Heavy equipment is not required to set units into place.
- Centralized stocking locations for short lead times.

Concrete Structures/Vaults

Some concrete structures and vaults are best suited for high loading applications such as railroads or airports. Concrete units are also ideal in corrosive environments or areas with high salinity. Some benefits of concrete structures are:

- Wide range of spans and heights.
- Greater underground infiltration storage in a smaller footprint.
- Ample and easy maintenance access.
- Fast installation.

Project Profiles: CMP Infiltration Systems in Action

Edie and Lew Wasserman Building, UCLA

Westwood, California

- The new six-story, 100,000 square foot Edie and Lew Wasserman Building was built on a very dense site that needed to meet sustainability requirements.
- The design needed to maximize infiltration volume, match existing inverts, and work around existing utilities.
- The stormwater management systems included a CDS pretreatment system and a CMP infiltration system using 57' of 72" perforated CMP.
- Perforated CMP was selected to avoid utilities, minimize excavation, meet the City of LA LID requirements, contribute to the building's LEED certification, and to provide space for the buildings "outdoor room" and gardens.

Creative Office Space

El Segundo, California

- A stormwater infiltration solution was needed for a new group of office buildings.
- The owner wanted to maximize the use of the parking area in the urban setting.
- The site had a tight footprint and multiple utility constraints, requiring the design of five separate systems.
- A total of 860 LF of perforated CMP was installed providing of 25,265 CF of storage.
- Perforated CMP was selected for its design flexibility, cost effectiveness, and ease of installation.

City Center Regional Stormwater Facility

Mountlake Terrace, Washington

- The city of Mountlake Terrace, Washington needed a new stormwater retention facility to provide stormwater treatment and downstream flood control.
- There was limited footprint for 80,000 CF of runoff, and the system was required to be very deep, with about 15' of cover.
- Engineers designed a system consisting of a CDS pretreatment system in front of 800 linear feet of 120" diameter, perforated, aluminized type 2 CMP that allows the runoff to slowly infiltrate the surrounding soil.
- Perforated CMP was selected for its ability to accommodate the deep bury, the relatively small footprint, and cost effectiveness.

The Right Partner Can Make All the Difference

Regardless of your project's objectives and constraints, our team of stormwater design engineers, regulatory managers, and local stormwater consultants are here to provide you with expert advice and assistance. If your goal is to eliminate or detain runoff, you can rely on Contech for a wide range of subsurface infiltration, detention, and rainwater harvesting solutions. If treatment is needed, our landscape-based biofiltration or subsurface filtration designs can fit into virtually any site and can be tailored to address specific pollutants.

At every stage of your project, count on Contech to provide engineering services including:

- Regulatory guidance and permitting assistance
- Preliminary standard details and/or site specific final CAD drawings and specifications
- Low Impact Development design assistance
- Engineering calculations for hydraulics/hydrology, rainwater harvesting, and detention/retention
- Online "Design Your Own" tools
- Review of preliminary site design, feasibility screening, and layout assistance
- Value engineering – cost estimates and options analysis
- Pre-construction support, project scheduling, and contractor coordination
- Installation and construction support
- Maintenance support:
  - » Guidance manuals
  - » Demonstrations
  - » Qualified contractor identification

The result: an efficient design process, the right product, greater land space savings, and faster permitting. The entire Contech stormwater team welcomes the opportunity to work with you on your stormwater projects.

To get started, please visit www.conteches.com/localresources or call us at 800-338-1122.

Dig Deeper

Find all the information you need at www.ContechES.com, including field and laboratory test results, approvals, brochures, design guides, standard details, and specifications within the product section of our site.

Connect with Us

We're here to make your job easier – and that includes being able to get in touch with us when you need to. Go to www.ContechES.com/ConnectwithContech.

While you're there, be sure to check out our upcoming seminar schedule or request an in-house technical presentation.

Start a Project

If you are ready to begin a project, contact your local representative to get started. Or you can check out our design toolbox for all our online resources at www.ContechES.com/designtoolbox.

Links to Stormwater Tools:

To use the Land Value Calculator, visit:
www.ContechES.com/lvc
(Look under the Stormwater Management section to download the Land Value Calculator)

To use the Design Your Own Detention System tool, visit:
www.ContechES.com/dyods

To use the Design Your Own Hydrodynamic Separator tool, visit: www.ContechES.com/dyohds

To use the Rainwater Harvesting Runoff Reduction Calculator tool, visit: www.ContechES.com/rwh-calculator

To use the LID Site Planner , visit:
www.ContechES.com/LIDsiteplanner

CONTECH® ENGINEERED SOLUTIONS

COMPLETE SITE SOLUTIONS

Stormwater Solutions
Helping to satisfy stormwater management requirements on land development projects
- Stormwater Treatment
- Detention/Infiltration
- Rainwater Harvesting
- Biofiltration/Bioretention

Pipe Solutions
Meeting project needs for durability, hydraulics, corrosion resistance, and stiffness
- Corrugated Metal Pipe (CMP)
- Steel Reinforced Polyethylene (SRPE)
- High Density Polyethylene (HDPE)
- Polyvinyl Chloride (PVC)

Structures Solutions
Providing innovative options and support for crossings, culverts, and bridges
- Plate, Precast & Truss bridges
- Hard Armor
- Retaining Walls
- Tunnel Liner Plate

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FSC

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 iuclude residential, coiumercial 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 additioual 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 Landseape 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.

Roof Runoff Controls SD-11

Rain Garden

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

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

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

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

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

Dry wells and Infiltration Trenches

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

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

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

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

Pop-up Drainage Emitter

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

Foundation Planting

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

Redeveloping Existing Installations

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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.

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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 tbe 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.

Retention/Irrigation TC-12

Description

Retention/irrigation refers to the capture of stormwater runoff in a holding pond and subsequent use of the captured volume for irrigation of landscape of natural pervious areas. This technology is very effective as a stormwater quality practice in that, for the captured water quality volume, it provides virtually no discharge to receiving waters and high stormwater constituent removal efficiencies. This technology mimics natural undeveloped watershed conditions wherein the vast majority of the rainfall volume during smaller rainfall events is infiltrated through the soil profile. Their main advantage over other infiltration technologies is the use of an irrigation system to spread the runoff over a larger area for infiltration. This allows them to be used in areas with low permeability soils.

Capture of stormwater can be accomplished in almost any kind of runoff storage facility, ranging from dry, concrete-lined ponds to those with vegetated basins and permanent pools. The pump and wet well should be automated with a rainfall sensor to provide irrigation only during periods when required infiltration rates can be realized. Generally, a spray irrigation system is required to provide an adequate flow rate for distributing the water quality volume (LCRA, 1998). Collection of roof runoff for subsequent use (rainwater harvesting) also qualifies as a retention/irrigation practice.

This technology is still in its infancy and there are no published reports on its effectiveness, cost, or operational requirements. The guidelines presented below should be considered tentative until additional data are available.

California Experience

This BMP has never been implemented in California, only in the Austin, Texas area. The use there is limited to watersheds where no increase in pollutant load is allowed because of the sensitive nature of the watersheds.

Advantages

- Pollutant removal effectiveness is high, accomplished primarily by: (1) sedimentation in the primary storage facility; (2) physical filtration of particulates through the soil profile; (3) dissolved constituents uptake in the vegetative root zone by the soil-resident microbial community.

Design Considerations

- Soil for Infiltration
- Area Required
- Slope
- Environmental Side-effects

Targeted Constituents

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

Legend *(Removal Effectiveness)*

- ● Low
- ▲ Medium
- ■ High

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Trash Storage Areas SD-32

Description

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

Approach

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

Design Objectives

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

Suitable Applications

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

Design Considerations

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

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

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Other Resources

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

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

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

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

- See CASQA Stormwater Handbook BMP Fact Sheet SD-13 for additional information.

- **(S2) Design Outdoor Hazardous Material Storage Areas to Reduce Pollutant Introduction (SD-34)** - Improper storage of materials outdoors may increase the potential for toxic compounds, oil and grease, fuels, solvents, coolants, wastes, heavy metals, nutrients, suspended solids, and other pollutants to enter the MS4. Where the plan of development includes outdoor areas for storage of hazardous materials that may contribute pollutants to the MS4, the following stormwater BMPs are required:

  - Hazardous materials with the potential to contaminate urban runoff shall either be: (a) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the MS4; or (b) protected by secondary containment structures (not double wall containers) such as berms, dikes, or curbs.

  - The storage area shall be paved and sufficiently impervious to contain leaks and spills.

  - The storage area shall have a roof or awning to minimize direct precipitation and exposure, and collection of stormwater within the secondary containment area.

  - Any stormwater retained within the containment structure must not be discharged to the street or storm drain system.

  - Location(s) of installations of where these preventative measures will be employed must be included on the map or plans identifying BMPs.

  - See CASQA Stormwater Handbook Section 3.2.6 and BMP Fact Sheet SD-34 for additional information.

- **(S3) Trash Enclosures to Reduce Pollutant (CASQA BMP Handbook SD-32)** - Design trash storage areas to reduce pollutant introduction. All trash container areas shall meet the following requirements (limited exclusion: detached residential homes):

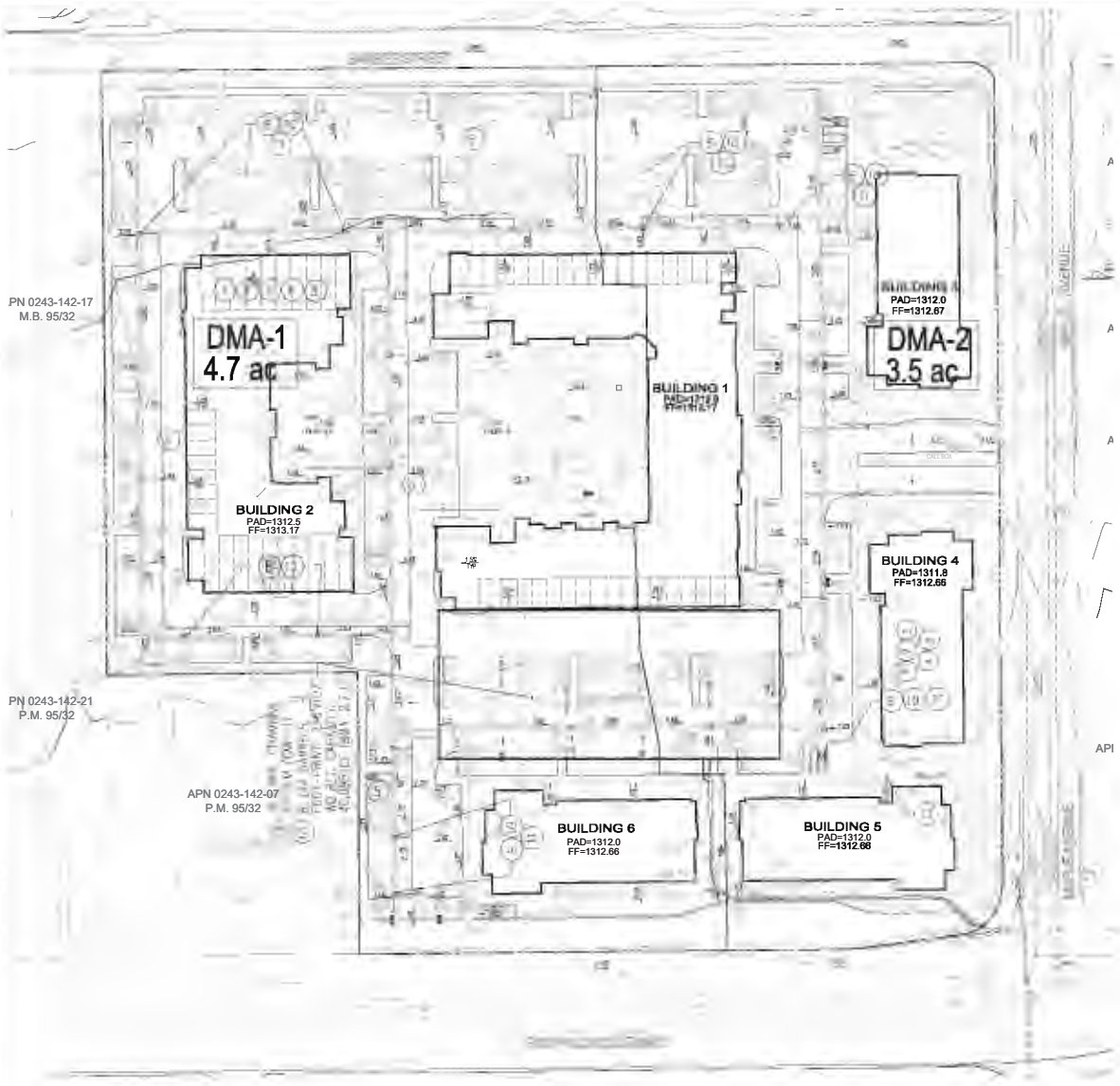
  - Paved with an impervious surface, designed not to allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements diverted around the area, screened or walled to prevent off-site transport of trash; and

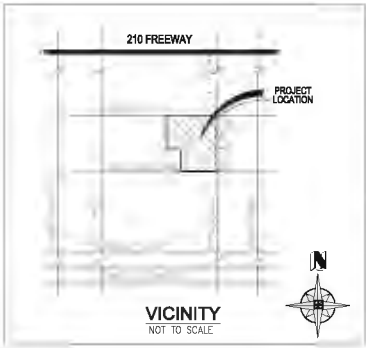
  - Provide solid roof or awning to prevent exposure to direct precipitation.

  - Connection of trash area drains to the MS4 is prohibited. See CASQA Stormwater Handbook Section 3.2.9 and BMP Fact Sheet SD-32 for additional information.

- **(S4) Use Efficient Irrigation Systems and Landscape Design (CASQA BMP Handbook SD-12)** The Water Conservation in Landscaping Act of 2006, Assembly Bill 1881 (AB 1881),

WQMP EXHIBIT





( ) DRAINAGE DIVERSION SWALE
( ) BERM/ DIVERSION
( ) INLET PROTECTION
( ) STREET SWEEPING
( ) STORM DRAIN STENCILING
( ) TRASH STORAGE AREA
( ) MATERIAL STORAGE (SEE DETAIL)
( ) WASTE MANAGEMENT
( ) SPILL KIT
( ) CONCRETE WASHOUT
( ) WATER QUALITY BASIN
( ) GRAVEL BAG BERM
( ) SANDBAG BARRIER
( ) STORM DRAIN INLET PROTECTION (SEE DETAIL)
( ) CMP (CMP BARRELS)

PERVIOUS/IMPERVIOUS AREA CALCULATIONS

DMA	AREA (SF)	PERVIOUS AREA (SF)	IMPERVIOUS AREA (SF)
DMA-1	204,732	20,480	184,252
DMA-2	152,460	15,250	137,210

BMP STATISTICS

DMA	AREA (AC)	BMP	VOLUME CAPACITY (CF)	VOLUME TREATED (CF)
DMA-1	4.7	[illegible]	22,675	40,095
DMA-2	3.5		16,886	

MITIGATION 40,095
DCV BMPs: 101%

Prepared For:
DIVERSIFIED PACIFIC COMMUNITIES

Prepared By:
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Civil Engineering · Land Surveying · Land Planning
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Fontana, California 92335
Phone (909) 356-6815

Raymond J. Allard R.C.E. 39052
Date

A.S
R.J.A

7-22-24.dwg

WQMP EXHIBIT
MAPLE & FOOTHILL
TTM. 20704

1 of 1

Rational Method Hydrology-Pre-Developed Condition
2-yr Storm Event

```
******************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
         (c) Copyright 1983-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1400

                          Analysis prepared by:



 ************************** DESCRIPTION OF STUDY **************************
* DIVERSIFIED - MAPLE AVE                                                 *
* HYDROLOGY ANALYSIS-PRE-DEVELOPED CONDITION                              *
* 2-YR STORM EVENT                                                        *
 ****************************************************************************

  FILE NAME: MAPLE.DAT
  TIME/DATE OF STUDY: 15:39 03/07/2024
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  36.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 0.6260

  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.    (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  ========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

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

******************************************************************************
  FLOW PROCESS FROM NODE      0.00 TO NODE      1.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   810.00
  ELEVATION DATA: UPSTREAM(FEET) =   1320.00  DOWNSTREAM(FEET) =   1307.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   17.477
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.312
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL POOR COVER
  "BARREN"                    A        8.20      0.67      1.000    61   17.48
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.67
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
```

```
  SUBAREA RUNOFF(CFS) =      4.77
  TOTAL AREA(ACRES) =      8.20   PEAK FLOW RATE(CFS) =      4.77
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        8.2  TC(MIN.) =     17.48
  EFFECTIVE AREA(ACRES) =      8.20  AREA-AVERAGED Fm(INCH/HR)=  0.67
  AREA-AVERAGED Fp(INCH/HR) =  0.67  AREA-AVERAGED Ap = 1.000
  PEAK FLOW RATE(CFS)   =       4.77
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Rational Method Hydrology-Developed Condition
2-yr Storm Event

```
******************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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             Ver. 23.0  Release Date: 07/01/2016  License ID 1400

                          Analysis prepared by:



 ************************** DESCRIPTION OF STUDY **************************
* DIVERSIFIED - MAPLE AVE                                                 *
* HYDROLOGY ANALYSIS-DEVELOPED CONDITION                                  *
* 2-YR STORM EVENT                                                        *
 ****************************************************************************

  FILE NAME: MAPLE.DAT
  TIME/DATE OF STUDY: 15:29 03/07/2024
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  36.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 0.6260

  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

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

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

******************************************************************************
  FLOW PROCESS FROM NODE      0.00 TO NODE      1.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   730.00
  ELEVATION DATA: UPSTREAM(FEET) =   1320.00  DOWNSTREAM(FEET) =   1307.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.552
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.885
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                  A        4.70      0.98       0.100    32    9.55
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      7.56
```

```
  TOTAL AREA(ACRES) =      4.70   PEAK FLOW RATE(CFS) =      7.56

****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      1.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.55
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.885
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        3.50      0.98     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    3.50      SUBAREA RUNOFF(CFS) =    5.63
  EFFECTIVE AREA(ACRES) =      8.20   AREA-AVERAGED Fm(INCH/HR) =  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        8.2       PEAK FLOW RATE(CFS) =      13.19

****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1307.30  DOWNSTREAM(FEET) =  1305.50
  FLOW LENGTH(FEET) =   222.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 36.000
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  11.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.56
  ESTIMATED PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.19
  PIPE TRAVEL TIME(MIN.) =   0.56    Tc(MIN.) =   10.12
  LONGEST FLOWPATH FROM NODE      0.00 TO NODE      2.00 =     952.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        8.2  TC(MIN.) =     10.12
  EFFECTIVE AREA(ACRES) =      8.20  AREA-AVERAGED Fm(INCH/HR)=  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =      13.19
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Unit Hydrograph Analysis-Pre-Developed Condition
2-yr Storm Event

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

        Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2018, Version 9.0

                Study date  03/07/24

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

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


Program License Serial Number 6484

------------------------------------------------------------------------
DIVERSIFED-MAPLE AVE
UH ANALYSIS-PRE-DEVELOPED CONDITION
2-STORM EVENT
------------------------------------------------------------------------

        Storm Event Year = 2

        Antecedent Moisture Condition = 1

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



Area averaged rainfall intensity isohyetal data:
        Sub-Area         Duration         Isohyetal
        (Ac.)             (hours)          (In)
Rainfall data for year 2
             8.20             1            0.63
------------------------------------------------------------------------
Rainfall data for year 2
             8.20             6            1.69
------------------------------------------------------------------------
Rainfall data for year 2
             8.20            24            3.14
------------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


SCS curve  SCS curve      Area      Area      Fp(Fig C6)     Ap       Fm
No.(AMCII) NO.(AMC 1)     (Ac.)     Fraction      (In/Hr)  (dec.)    (In/Hr)
 78.0       60.6           8.20       1.000      0.671     1.000     0.671

Area-averaged adjusted loss rate Fm (In/Hr) =  0.671

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

Area         Area           SCS CN     SCS CN       S      Pervious
 (Ac.)        Fract          (AMC2)     (AMC1)             Yield Fr
     8.20     1.000          78.0       60.6        6.50      0.129

Area-averaged catchment yield fraction, Y =  0.129
Area-averaged low loss fraction, Yb =  0.871
Direct entry of lag time by user
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =        8.20(Ac.)
Catchment Lag time =    0.233 hours
```

Unit interval = 5.000 minutes
Unit interval percentage of lag time = 35.7654
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.671(In/Hr)
Average low loss rate fraction (Yb) = 0.871 (decimal)
VALLEY UNDEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.232(In)
Computed peak 30-minute rainfall = 0.474(In)
Specified peak 1-hour rainfall = 0.626(In)
Computed peak 3-hour rainfall = 1.151(In)
Specified peak 6-hour rainfall = 1.690(In)
Specified peak 24-hour rainfall = 3.140(In)

Rainfall depth area reduction factors:
Using a total area of 8.20(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.232(In)
30-minute factor = 1.000 Adjusted rainfall = 0.474(In)
1-hour factor = 1.000 Adjusted rainfall = 0.626(In)
3-hour factor = 1.000 Adjusted rainfall = 1.151(In)
6-hour factor = 1.000 Adjusted rainfall = 1.690(In)
24-hour factor = 1.000 Adjusted rainfall = 3.140(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 = 99.17 (CFS))	
1	3.697	3.666
2	18.341	14.523
3	42.237	23.697
4	61.560	19.162
5	71.617	9.974
6	77.430	5.765
7	81.717	4.252
8	85.077	3.332
9	87.708	2.609
10	89.873	2.147
11	91.624	1.736
12	93.054	1.419
13	94.200	1.136
14	95.285	1.076
15	96.209	0.917
16	96.968	0.753
17	97.619	0.645
18	98.163	0.539
19	98.614	0.448
20	98.974	0.357
21	99.332	0.355
22	99.690	0.355
23	100.000	0.308

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.2316	0.2316
2	0.3056	0.0740
3	0.3594	0.0538
4	0.4032	0.0438
5	0.4409	0.0376
6	0.4742	0.0334
7	0.5044	0.0302
8	0.5321	0.0277
9	0.5577	0.0257
10	0.5817	0.0240
11	0.6044	0.0226
12	0.6258	0.0214
13	0.6542	0.0284

14	0.6816	0.0274
15	0.7082	0.0266
16	0.7340	0.0258
17	0.7591	0.0251
18	0.7835	0.0244
19	0.8074	0.0239
20	0.8307	0.0233
21	0.8535	0.0228
22	0.8758	0.0223
23	0.8976	0.0219
24	0.9191	0.0214
25	0.9401	0.0210
26	0.9608	0.0207
27	0.9811	0.0203
28	1.0011	0.0200
29	1.0208	0.0197
30	1.0402	0.0194
31	1.0592	0.0191
32	1.0781	0.0188
33	1.0966	0.0186
34	1.1149	0.0183
35	1.1330	0.0181
36	1.1508	0.0178
37	1.1684	0.0176
38	1.1858	0.0174
39	1.2030	0.0172
40	1.2200	0.0170
41	1.2369	0.0168
42	1.2535	0.0166
43	1.2699	0.0165
44	1.2862	0.0163
45	1.3024	0.0161
46	1.3183	0.0160
47	1.3341	0.0158
48	1.3498	0.0157
49	1.3653	0.0155
50	1.3807	0.0154
51	1.3959	0.0152
52	1.4110	0.0151
53	1.4260	0.0150
54	1.4409	0.0149
55	1.4556	0.0147
56	1.4702	0.0146
57	1.4847	0.0145
58	1.4991	0.0144
59	1.5133	0.0143
60	1.5275	0.0142
61	1.5416	0.0141
62	1.5555	0.0140
63	1.5694	0.0139
64	1.5831	0.0138
65	1.5968	0.0137
66	1.6104	0.0136
67	1.6239	0.0135
68	1.6373	0.0134
69	1.6506	0.0133
70	1.6638	0.0132
71	1.6769	0.0131
72	1.6900	0.0131
73	1.7004	0.0104
74	1.7108	0.0104
75	1.7211	0.0103
76	1.7313	0.0102
77	1.7414	0.0101
78	1.7515	0.0101
79	1.7615	0.0100
80	1.7714	0.0099
81	1.7813	0.0099
82	1.7911	0.0098
83	1.8008	0.0097
84	1.8105	0.0097

85	1.8201	0.0096
86	1.8296	0.0095
87	1.8391	0.0095
88	1.8485	0.0094
89	1.8579	0.0094
90	1.8672	0.0093
91	1.8764	0.0092
92	1.8856	0.0092
93	1.8947	0.0091
94	1.9038	0.0091
95	1.9128	0.0090
96	1.9218	0.0090
97	1.9307	0.0089
98	1.9396	0.0089
99	1.9484	0.0088
100	1.9572	0.0088
101	1.9659	0.0087
102	1.9746	0.0087
103	1.9832	0.0086
104	1.9918	0.0086
105	2.0003	0.0085
106	2.0088	0.0085
107	2.0173	0.0084
108	2.0257	0.0084
109	2.0340	0.0084
110	2.0423	0.0083
111	2.0506	0.0083
112	2.0589	0.0082
113	2.0670	0.0082
114	2.0752	0.0082
115	2.0833	0.0081
116	2.0914	0.0081
117	2.0994	0.0080
118	2.1074	0.0080
119	2.1154	0.0080
120	2.1233	0.0079
121	2.1312	0.0079
122	2.1391	0.0079
123	2.1469	0.0078
124	2.1547	0.0078
125	2.1624	0.0077
126	2.1701	0.0077
127	2.1778	0.0077
128	2.1855	0.0076
129	2.1931	0.0076
130	2.2006	0.0076
131	2.2082	0.0075
132	2.2157	0.0075
133	2.2232	0.0075
134	2.2307	0.0075
135	2.2381	0.0074
136	2.2455	0.0074
137	2.2528	0.0074
138	2.2602	0.0073
139	2.2675	0.0073
140	2.2747	0.0073
141	2.2820	0.0072
142	2.2892	0.0072
143	2.2964	0.0072
144	2.3036	0.0072
145	2.3107	0.0071
146	2.3178	0.0071
147	2.3249	0.0071
148	2.3319	0.0071
149	2.3390	0.0070
150	2.3460	0.0070
151	2.3529	0.0070
152	2.3599	0.0070
153	2.3668	0.0069
154	2.3737	0.0069
155	2.3806	0.0069

156	2.3875	0.0069
157	2.3943	0.0068
158	2.4011	0.0068
159	2.4079	0.0068
160	2.4146	0.0068
161	2.4214	0.0067
162	2.4281	0.0067
163	2.4347	0.0067
164	2.4414	0.0067
165	2.4481	0.0066
166	2.4547	0.0066
167	2.4613	0.0066
168	2.4678	0.0066
169	2.4744	0.0066
170	2.4809	0.0065
171	2.4874	0.0065
172	2.4939	0.0065
173	2.5004	0.0065
174	2.5068	0.0064
175	2.5133	0.0064
176	2.5197	0.0064
177	2.5261	0.0064
178	2.5324	0.0064
179	2.5388	0.0063
180	2.5451	0.0063
181	2.5514	0.0063
182	2.5577	0.0063
183	2.5640	0.0063
184	2.5702	0.0063
185	2.5765	0.0062
186	2.5827	0.0062
187	2.5889	0.0062
188	2.5951	0.0062
189	2.6012	0.0062
190	2.6074	0.0061
191	2.6135	0.0061
192	2.6196	0.0061
193	2.6257	0.0061
194	2.6317	0.0061
195	2.6378	0.0061
196	2.6438	0.0060
197	2.6499	0.0060
198	2.6559	0.0060
199	2.6618	0.0060
200	2.6678	0.0060
201	2.6738	0.0060
202	2.6797	0.0059
203	2.6856	0.0059
204	2.6915	0.0059
205	2.6974	0.0059
206	2.7033	0.0059
207	2.7091	0.0059
208	2.7150	0.0058
209	2.7208	0.0058
210	2.7266	0.0058
211	2.7324	0.0058
212	2.7382	0.0058
213	2.7440	0.0058
214	2.7497	0.0057
215	2.7554	0.0057
216	2.7612	0.0057
217	2.7669	0.0057
218	2.7726	0.0057
219	2.7782	0.0057
220	2.7839	0.0057
221	2.7895	0.0056
222	2.7952	0.0056
223	2.8008	0.0056
224	2.8064	0.0056
225	2.8120	0.0056
226	2.8176	0.0056

227	2.8231	0.0056
228	2.8287	0.0056
229	2.8342	0.0055
230	2.8398	0.0055
231	2.8453	0.0055
232	2.8508	0.0055
233	2.8562	0.0055
234	2.8617	0.0055
235	2.8672	0.0055
236	2.8726	0.0054
237	2.8781	0.0054
238	2.8835	0.0054
239	2.8889	0.0054
240	2.8943	0.0054
241	2.8997	0.0054
242	2.9050	0.0054
243	2.9104	0.0054
244	2.9157	0.0053
245	2.9211	0.0053
246	2.9264	0.0053
247	2.9317	0.0053
248	2.9370	0.0053
249	2.9423	0.0053
250	2.9476	0.0053
251	2.9528	0.0053
252	2.9581	0.0053
253	2.9633	0.0052
254	2.9685	0.0052
255	2.9738	0.0052
256	2.9790	0.0052
257	2.9842	0.0052
258	2.9893	0.0052
259	2.9945	0.0052
260	2.9997	0.0052
261	3.0048	0.0052
262	3.0100	0.0051
263	3.0151	0.0051
264	3.0202	0.0051
265	3.0253	0.0051
266	3.0304	0.0051
267	3.0355	0.0051
268	3.0406	0.0051
269	3.0456	0.0051
270	3.0507	0.0051
271	3.0557	0.0050
272	3.0608	0.0050
273	3.0658	0.0050
274	3.0708	0.0050
275	3.0758	0.0050
276	3.0808	0.0050
277	3.0858	0.0050
278	3.0908	0.0050
279	3.0957	0.0050
280	3.1007	0.0050
281	3.1056	0.0049
282	3.1106	0.0049
283	3.1155	0.0049
284	3.1204	0.0049
285	3.1253	0.0049
286	3.1302	0.0049
287	3.1351	0.0049
288	3.1400	0.0049

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0049	0.0042	0.0006
2	0.0049	0.0043	0.0006
3	0.0049	0.0043	0.0006
4	0.0049	0.0043	0.0006

5	0.0049	0.0043	0.0006
6	0.0049	0.0043	0.0006
7	0.0050	0.0043	0.0006
8	0.0050	0.0043	0.0006
9	0.0050	0.0043	0.0006
10	0.0050	0.0044	0.0006
11	0.0050	0.0044	0.0006
12	0.0050	0.0044	0.0007
13	0.0051	0.0044	0.0007
14	0.0051	0.0044	0.0007
15	0.0051	0.0044	0.0007
16	0.0051	0.0044	0.0007
17	0.0051	0.0045	0.0007
18	0.0051	0.0045	0.0007
19	0.0052	0.0045	0.0007
20	0.0052	0.0045	0.0007
21	0.0052	0.0045	0.0007
22	0.0052	0.0045	0.0007
23	0.0052	0.0045	0.0007
24	0.0052	0.0046	0.0007
25	0.0053	0.0046	0.0007
26	0.0053	0.0046	0.0007
27	0.0053	0.0046	0.0007
28	0.0053	0.0046	0.0007
29	0.0053	0.0046	0.0007
30	0.0053	0.0046	0.0007
31	0.0054	0.0047	0.0007
32	0.0054	0.0047	0.0007
33	0.0054	0.0047	0.0007
34	0.0054	0.0047	0.0007
35	0.0054	0.0047	0.0007
36	0.0054	0.0047	0.0007
37	0.0055	0.0048	0.0007
38	0.0055	0.0048	0.0007
39	0.0055	0.0048	0.0007
40	0.0055	0.0048	0.0007
41	0.0056	0.0048	0.0007
42	0.0056	0.0048	0.0007
43	0.0056	0.0049	0.0007
44	0.0056	0.0049	0.0007
45	0.0056	0.0049	0.0007
46	0.0056	0.0049	0.0007
47	0.0057	0.0049	0.0007
48	0.0057	0.0050	0.0007
49	0.0057	0.0050	0.0007
50	0.0057	0.0050	0.0007
51	0.0058	0.0050	0.0007
52	0.0058	0.0050	0.0007
53	0.0058	0.0051	0.0008
54	0.0058	0.0051	0.0008
55	0.0059	0.0051	0.0008
56	0.0059	0.0051	0.0008
57	0.0059	0.0051	0.0008
58	0.0059	0.0052	0.0008
59	0.0060	0.0052	0.0008
60	0.0060	0.0052	0.0008
61	0.0060	0.0052	0.0008
62	0.0060	0.0052	0.0008
63	0.0061	0.0053	0.0008
64	0.0061	0.0053	0.0008
65	0.0061	0.0053	0.0008
66	0.0061	0.0053	0.0008
67	0.0062	0.0054	0.0008
68	0.0062	0.0054	0.0008
69	0.0062	0.0054	0.0008
70	0.0062	0.0054	0.0008
71	0.0063	0.0055	0.0008
72	0.0063	0.0055	0.0008
73	0.0063	0.0055	0.0008
74	0.0063	0.0055	0.0008
75	0.0064	0.0056	0.0008

76	0.0064	0.0056	0.0008
77	0.0064	0.0056	0.0008
78	0.0065	0.0056	0.0008
79	0.0065	0.0057	0.0008
80	0.0065	0.0057	0.0008
81	0.0066	0.0057	0.0008
82	0.0066	0.0057	0.0009
83	0.0066	0.0058	0.0009
84	0.0067	0.0058	0.0009
85	0.0067	0.0058	0.0009
86	0.0067	0.0059	0.0009
87	0.0068	0.0059	0.0009
88	0.0068	0.0059	0.0009
89	0.0069	0.0060	0.0009
90	0.0069	0.0060	0.0009
91	0.0069	0.0060	0.0009
92	0.0070	0.0061	0.0009
93	0.0070	0.0061	0.0009
94	0.0070	0.0061	0.0009
95	0.0071	0.0062	0.0009
96	0.0071	0.0062	0.0009
97	0.0072	0.0062	0.0009
98	0.0072	0.0063	0.0009
99	0.0072	0.0063	0.0009
100	0.0073	0.0063	0.0009
101	0.0073	0.0064	0.0009
102	0.0074	0.0064	0.0010
103	0.0074	0.0065	0.0010
104	0.0075	0.0065	0.0010
105	0.0075	0.0065	0.0010
106	0.0075	0.0066	0.0010
107	0.0076	0.0066	0.0010
108	0.0076	0.0067	0.0010
109	0.0077	0.0067	0.0010
110	0.0077	0.0067	0.0010
111	0.0078	0.0068	0.0010
112	0.0079	0.0068	0.0010
113	0.0079	0.0069	0.0010
114	0.0080	0.0069	0.0010
115	0.0080	0.0070	0.0010
116	0.0081	0.0070	0.0010
117	0.0082	0.0071	0.0011
118	0.0082	0.0071	0.0011
119	0.0083	0.0072	0.0011
120	0.0083	0.0072	0.0011
121	0.0084	0.0073	0.0011
122	0.0084	0.0074	0.0011
123	0.0085	0.0074	0.0011
124	0.0086	0.0075	0.0011
125	0.0087	0.0076	0.0011
126	0.0087	0.0076	0.0011
127	0.0088	0.0077	0.0011
128	0.0089	0.0077	0.0011
129	0.0090	0.0078	0.0012
130	0.0090	0.0079	0.0012
131	0.0091	0.0080	0.0012
132	0.0092	0.0080	0.0012
133	0.0093	0.0081	0.0012
134	0.0094	0.0081	0.0012
135	0.0095	0.0083	0.0012
136	0.0095	0.0083	0.0012
137	0.0097	0.0084	0.0012
138	0.0097	0.0085	0.0013
139	0.0099	0.0086	0.0013
140	0.0099	0.0086	0.0013
141	0.0101	0.0088	0.0013
142	0.0101	0.0088	0.0013
143	0.0103	0.0090	0.0013
144	0.0104	0.0090	0.0013
145	0.0131	0.0114	0.0017
146	0.0131	0.0114	0.0017

147	0.0133	0.0116	0.0017
148	0.0134	0.0117	0.0017
149	0.0136	0.0118	0.0018
150	0.0137	0.0119	0.0018
151	0.0139	0.0121	0.0018
152	0.0140	0.0122	0.0018
153	0.0142	0.0123	0.0018
154	0.0143	0.0124	0.0018
155	0.0145	0.0126	0.0019
156	0.0146	0.0127	0.0019
157	0.0149	0.0129	0.0019
158	0.0150	0.0130	0.0019
159	0.0152	0.0133	0.0020
160	0.0154	0.0134	0.0020
161	0.0157	0.0136	0.0020
162	0.0158	0.0138	0.0020
163	0.0161	0.0140	0.0021
164	0.0163	0.0142	0.0021
165	0.0166	0.0145	0.0021
166	0.0168	0.0146	0.0022
167	0.0172	0.0150	0.0022
168	0.0174	0.0152	0.0022
169	0.0178	0.0155	0.0023
170	0.0181	0.0157	0.0023
171	0.0186	0.0162	0.0024
172	0.0188	0.0164	0.0024
173	0.0194	0.0169	0.0025
174	0.0197	0.0171	0.0025
175	0.0203	0.0177	0.0026
176	0.0207	0.0180	0.0027
177	0.0214	0.0187	0.0028
178	0.0219	0.0190	0.0028
179	0.0228	0.0198	0.0029
180	0.0233	0.0203	0.0030
181	0.0244	0.0213	0.0032
182	0.0251	0.0219	0.0032
183	0.0266	0.0232	0.0034
184	0.0274	0.0239	0.0035
185	0.0214	0.0186	0.0028
186	0.0226	0.0197	0.0029
187	0.0257	0.0224	0.0033
188	0.0277	0.0241	0.0036
189	0.0334	0.0290	0.0043
190	0.0376	0.0328	0.0049
191	0.0538	0.0469	0.0070
192	0.0740	0.0559	0.0181
193	0.2316	0.0559	0.1757
194	0.0438	0.0382	0.0057
195	0.0302	0.0263	0.0039
196	0.0240	0.0209	0.0031
197	0.0284	0.0247	0.0037
198	0.0258	0.0225	0.0033
199	0.0239	0.0208	0.0031
200	0.0223	0.0194	0.0029
201	0.0210	0.0183	0.0027
202	0.0200	0.0174	0.0026
203	0.0191	0.0166	0.0025
204	0.0183	0.0159	0.0024
205	0.0176	0.0153	0.0023
206	0.0170	0.0148	0.0022
207	0.0165	0.0143	0.0021
208	0.0160	0.0139	0.0021
209	0.0155	0.0135	0.0020
210	0.0151	0.0132	0.0020
211	0.0147	0.0128	0.0019
212	0.0144	0.0125	0.0019
213	0.0141	0.0122	0.0018
214	0.0138	0.0120	0.0018
215	0.0135	0.0117	0.0017
216	0.0132	0.0115	0.0017
217	0.0104	0.0091	0.0014

218	0.0102	0.0089	0.0013
219	0.0100	0.0087	0.0013
220	0.0098	0.0085	0.0013
221	0.0096	0.0084	0.0012
222	0.0094	0.0082	0.0012
223	0.0092	0.0080	0.0012
224	0.0091	0.0079	0.0012
225	0.0089	0.0078	0.0012
226	0.0088	0.0076	0.0011
227	0.0086	0.0075	0.0011
228	0.0085	0.0074	0.0011
229	0.0084	0.0073	0.0011
230	0.0082	0.0072	0.0011
231	0.0081	0.0071	0.0010
232	0.0080	0.0070	0.0010
233	0.0079	0.0069	0.0010
234	0.0078	0.0068	0.0010
235	0.0077	0.0067	0.0010
236	0.0076	0.0066	0.0010
237	0.0075	0.0065	0.0010
238	0.0074	0.0064	0.0010
239	0.0073	0.0064	0.0009
240	0.0072	0.0063	0.0009
241	0.0071	0.0062	0.0009
242	0.0071	0.0061	0.0009
243	0.0070	0.0061	0.0009
244	0.0069	0.0060	0.0009
245	0.0068	0.0059	0.0009
246	0.0068	0.0059	0.0009
247	0.0067	0.0058	0.0009
248	0.0066	0.0058	0.0009
249	0.0066	0.0057	0.0008
250	0.0065	0.0057	0.0008
251	0.0064	0.0056	0.0008
252	0.0064	0.0055	0.0008
253	0.0063	0.0055	0.0008
254	0.0063	0.0054	0.0008
255	0.0062	0.0054	0.0008
256	0.0061	0.0053	0.0008
257	0.0061	0.0053	0.0008
258	0.0060	0.0053	0.0008
259	0.0060	0.0052	0.0008
260	0.0059	0.0052	0.0008
261	0.0059	0.0051	0.0008
262	0.0058	0.0051	0.0008
263	0.0058	0.0050	0.0007
264	0.0057	0.0050	0.0007
265	0.0057	0.0050	0.0007
266	0.0057	0.0049	0.0007
267	0.0056	0.0049	0.0007
268	0.0056	0.0049	0.0007
269	0.0055	0.0048	0.0007
270	0.0055	0.0048	0.0007
271	0.0055	0.0048	0.0007
272	0.0054	0.0047	0.0007
273	0.0054	0.0047	0.0007
274	0.0053	0.0047	0.0007
275	0.0053	0.0046	0.0007
276	0.0053	0.0046	0.0007
277	0.0052	0.0046	0.0007
278	0.0052	0.0045	0.0007
279	0.0052	0.0045	0.0007
280	0.0051	0.0045	0.0007
281	0.0051	0.0044	0.0007
282	0.0051	0.0044	0.0007
283	0.0050	0.0044	0.0007
284	0.0050	0.0044	0.0006
285	0.0050	0.0043	0.0006
286	0.0050	0.0043	0.0006
287	0.0049	0.0043	0.0006
288	0.0049	0.0043	0.0006

```
      ----------------------------------------------------------------------
      ----------------------------------------------------------------------
      Total soil rain loss =      2.58(In)
      Total effective rainfall =      0.56(In)
      Peak flow rate in flood hydrograph =      4.78(CFS)
      ----------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        24 - H O U R    S T O R M
                     R u n o f f      H y d r o g r a p h
      ----------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      ----------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-------------------------------------------------------------------------
  0+ 5       0.0000      0.00  Q         |         |         |         |
  0+10       0.0001      0.01  Q         |         |         |         |
  0+15       0.0003      0.03  Q         |         |         |         |
  0+20       0.0005      0.04  Q         |         |         |         |
  0+25       0.0009      0.04  Q         |         |         |         |
  0+30       0.0012      0.05  Q         |         |         |         |
  0+35       0.0015      0.05  Q         |         |         |         |
  0+40       0.0019      0.05  Q         |         |         |         |
  0+45       0.0023      0.06  Q         |         |         |         |
  0+50       0.0027      0.06  Q         |         |         |         |
  0+55       0.0031      0.06  Q         |         |         |         |
  1+ 0       0.0035      0.06  Q         |         |         |         |
  1+ 5       0.0039      0.06  Q         |         |         |         |
  1+10       0.0043      0.06  Q         |         |         |         |
  1+15       0.0048      0.06  Q         |         |         |         |
  1+20       0.0052      0.06  Q         |         |         |         |
  1+25       0.0056      0.06  Q         |         |         |         |
  1+30       0.0061      0.06  Q         |         |         |         |
  1+35       0.0065      0.06  Q         |         |         |         |
  1+40       0.0070      0.06  Q         |         |         |         |
  1+45       0.0074      0.07  Q         |         |         |         |
  1+50       0.0079      0.07  Q         |         |         |         |
  1+55       0.0083      0.07  Q         |         |         |         |
  2+ 0       0.0088      0.07  Q         |         |         |         |
  2+ 5       0.0092      0.07  Q         |         |         |         |
  2+10       0.0097      0.07  QV        |         |         |         |
  2+15       0.0101      0.07  QV        |         |         |         |
  2+20       0.0106      0.07  QV        |         |         |         |
  2+25       0.0111      0.07  QV        |         |         |         |
  2+30       0.0115      0.07  QV        |         |         |         |
  2+35       0.0120      0.07  QV        |         |         |         |
  2+40       0.0125      0.07  QV        |         |         |         |
  2+45       0.0129      0.07  QV        |         |         |         |
  2+50       0.0134      0.07  QV        |         |         |         |
  2+55       0.0139      0.07  QV        |         |         |         |
  3+ 0       0.0144      0.07  QV        |         |         |         |
  3+ 5       0.0148      0.07  QV        |         |         |         |
  3+10       0.0153      0.07  QV        |         |         |         |
  3+15       0.0158      0.07  QV        |         |         |         |
  3+20       0.0163      0.07  QV        |         |         |         |
  3+25       0.0167      0.07  QV        |         |         |         |
  3+30       0.0172      0.07  QV        |         |         |         |
  3+35       0.0177      0.07  QV        |         |         |         |
  3+40       0.0182      0.07  QV        |         |         |         |
  3+45       0.0187      0.07  QV        |         |         |         |
  3+50       0.0192      0.07  Q V       |         |         |         |
  3+55       0.0197      0.07  Q V       |         |         |         |
  4+ 0       0.0202      0.07  Q V       |         |         |         |
  4+ 5       0.0207      0.07  Q V       |         |         |         |
  4+10       0.0212      0.07  Q V       |         |         |         |
  4+15       0.0217      0.07  Q V       |         |         |         |
  4+20       0.0222      0.07  Q V       |         |         |         |
  4+25       0.0227      0.07  Q V       |         |         |         |
  4+30       0.0232      0.07  Q V       |         |         |         |
  4+35       0.0237      0.07  Q V       |         |         |         |
  4+40       0.0242      0.07  Q V       |         |         |         |
```

4+45	0.0247	0.07	Q V	|	|	|	|
4+50	0.0252	0.07	Q V	|	|	|	|
4+55	0.0257	0.07	Q V	|	|	|	|
5+ 0	0.0263	0.08	Q V	|	|	|	|
5+ 5	0.0268	0.08	Q V	|	|	|	|
5+10	0.0273	0.08	Q V	|	|	|	|
5+15	0.0278	0.08	Q V	|	|	|	|
5+20	0.0284	0.08	Q V	|	|	|	|
5+25	0.0289	0.08	Q V	|	|	|	|
5+30	0.0294	0.08	Q V	|	|	|	|
5+35	0.0299	0.08	Q V	|	|	|	|
5+40	0.0305	0.08	Q V	|	|	|	|
5+45	0.0310	0.08	Q V	|	|	|	|
5+50	0.0316	0.08	Q V	|	|	|	|
5+55	0.0321	0.08	Q V	|	|	|	|
6+ 0	0.0327	0.08	Q V	|	|	|	|
6+ 5	0.0332	0.08	Q V	|	|	|	|
6+10	0.0338	0.08	Q V	|	|	|	|
6+15	0.0343	0.08	Q V	|	|	|	|
6+20	0.0349	0.08	Q V	|	|	|	|
6+25	0.0354	0.08	Q V	|	|	|	|
6+30	0.0360	0.08	Q V	|	|	|	|
6+35	0.0365	0.08	Q V	|	|	|	|
6+40	0.0371	0.08	Q V	|	|	|	|
6+45	0.0377	0.08	Q V	|	|	|	|
6+50	0.0382	0.08	Q V	|	|	|	|
6+55	0.0388	0.08	Q V	|	|	|	|
7+ 0	0.0394	0.08	Q V	|	|	|	|
7+ 5	0.0400	0.08	Q V	|	|	|	|
7+10	0.0406	0.08	Q V	|	|	|	|
7+15	0.0411	0.08	Q V	|	|	|	|
7+20	0.0417	0.09	Q V	|	|	|	|
7+25	0.0423	0.09	Q V	|	|	|	|
7+30	0.0429	0.09	Q V	|	|	|	|
7+35	0.0435	0.09	Q V	|	|	|	|
7+40	0.0441	0.09	Q V	|	|	|	|
7+45	0.0447	0.09	Q V	|	|	|	|
7+50	0.0453	0.09	Q V	|	|	|	|
7+55	0.0459	0.09	Q V	|	|	|	|
8+ 0	0.0465	0.09	Q V	|	|	|	|
8+ 5	0.0472	0.09	Q V	|	|	|	|
8+10	0.0478	0.09	Q V	|	|	|	|
8+15	0.0484	0.09	Q V	|	|	|	|
8+20	0.0490	0.09	Q V	|	|	|	|
8+25	0.0497	0.09	Q V	|	|	|	|
8+30	0.0503	0.09	Q V	|	|	|	|
8+35	0.0509	0.09	Q V	|	|	|	|
8+40	0.0516	0.09	Q V	|	|	|	|
8+45	0.0522	0.09	Q V	|	|	|	|
8+50	0.0529	0.09	Q V	|	|	|	|
8+55	0.0535	0.09	Q V	|	|	|	|
9+ 0	0.0542	0.10	Q V	|	|	|	|
9+ 5	0.0549	0.10	Q V	|	|	|	|
9+10	0.0555	0.10	Q V	|	|	|	|
9+15	0.0562	0.10	Q V	|	|	|	|
9+20	0.0569	0.10	Q V	|	|	|	|
9+25	0.0575	0.10	Q V	|	|	|	|
9+30	0.0582	0.10	Q V	|	|	|	|
9+35	0.0589	0.10	Q V	|	|	|	|
9+40	0.0596	0.10	Q V	|	|	|	|
9+45	0.0603	0.10	Q V	|	|	|	|
9+50	0.0610	0.10	Q V	|	|	|	|
9+55	0.0617	0.10	Q V	|	|	|	|
10+ 0	0.0624	0.10	Q V	|	|	|	|
10+ 5	0.0632	0.10	Q V	|	|	|	|
10+10	0.0639	0.11	Q V	|	|	|	|
10+15	0.0646	0.11	Q V	|	|	|	|
10+20	0.0653	0.11	Q V	|	|	|	|
10+25	0.0661	0.11	Q V	|	|	|	|
10+30	0.0668	0.11	Q V	|	|	|	|
10+35	0.0676	0.11	Q V	|	|	|	|

10+40	0.0683	0.11	Q V	|	|	|	|
10+45	0.0691	0.11	Q V	|	|	|	|
10+50	0.0699	0.11	Q V	|	|	|	|
10+55	0.0707	0.11	Q V	|	|	|	|
11+ 0	0.0714	0.11	Q V	|	|	|	|
11+ 5	0.0722	0.11	Q V	|	|	|	|
11+10	0.0730	0.12	Q V	|	|	|	|
11+15	0.0738	0.12	Q V	|	|	|	|
11+20	0.0746	0.12	Q V	|	|	|	|
11+25	0.0755	0.12	Q V	|	|	|	|
11+30	0.0763	0.12	Q V	|	|	|	|
11+35	0.0771	0.12	Q V	|	|	|	|
11+40	0.0780	0.12	Q V	|	|	|	|
11+45	0.0788	0.12	Q V	|	|	|	|
11+50	0.0797	0.12	Q V	|	|	|	|
11+55	0.0805	0.13	Q V	|	|	|	|
12+ 0	0.0814	0.13	Q V	|	|	|	|
12+ 5	0.0823	0.13	Q V	|	|	|	|
12+10	0.0833	0.14	Q V	|	|	|	|
12+15	0.0843	0.15	Q V	|	|	|	|
12+20	0.0853	0.15	Q V	|	|	|	|
12+25	0.0864	0.16	Q V	|	|	|	|
12+30	0.0875	0.16	Q V	|	|	|	|
12+35	0.0886	0.16	Q V	|	|	|	|
12+40	0.0898	0.17	Q V	|	|	|	|
12+45	0.0910	0.17	Q V	|	|	|	|
12+50	0.0921	0.17	Q V	|	|	|	|
12+55	0.0933	0.17	Q V	|	|	|	|
13+ 0	0.0946	0.18	Q V	|	|	|	|
13+ 5	0.0958	0.18	Q V	|	|	|	|
13+10	0.0971	0.18	Q V	|	|	|	|
13+15	0.0983	0.18	Q V	|	|	|	|
13+20	0.0996	0.19	Q V	|	|	|	|
13+25	0.1009	0.19	Q V	|	|	|	|
13+30	0.1022	0.19	Q V	|	|	|	|
13+35	0.1036	0.19	Q V	|	|	|	|
13+40	0.1049	0.20	Q V	|	|	|	|
13+45	0.1063	0.20	Q V	|	|	|	|
13+50	0.1077	0.20	Q V	|	|	|	|
13+55	0.1091	0.21	Q V	|	|	|	|
14+ 0	0.1106	0.21	Q V	|	|	|	|
14+ 5	0.1120	0.21	Q V	|	|	|	|
14+10	0.1135	0.22	Q V	|	|	|	|
14+15	0.1151	0.22	Q V	|	|	|	|
14+20	0.1166	0.22	Q V	|	|	|	|
14+25	0.1182	0.23	Q V	|	|	|	|
14+30	0.1198	0.23	Q V	|	|	|	|
14+35	0.1214	0.24	Q V	|	|	|	|
14+40	0.1231	0.24	Q V	|	|	|	|
14+45	0.1248	0.25	Q V	|	|	|	|
14+50	0.1266	0.25	Q V	|	|	|	|
14+55	0.1284	0.26	Q V	|	|	|	|
15+ 0	0.1302	0.27	Q V	|	|	|	|
15+ 5	0.1321	0.28	Q V	|	|	|	|
15+10	0.1341	0.28	Q V	|	|	|	|
15+15	0.1361	0.29	Q V	|	|	|	|
15+20	0.1382	0.30	Q V	|	|	|	|
15+25	0.1403	0.31	Q V	|	|	|	|
15+30	0.1425	0.31	Q V	|	|	|	|
15+35	0.1446	0.30	Q V	|	|	|	|
15+40	0.1467	0.30	Q V	|	|	|	|
15+45	0.1489	0.32	Q V	|	|	|	|
15+50	0.1512	0.34	Q V	|	|	|	|
15+55	0.1539	0.38	Q V	|	|	|	|
16+ 0	0.1572	0.49	Q V	|	|	|	|
16+ 5	0.1661	1.30	Q V	|	|	|	|
16+10	0.1887	3.28	Q V	|	|	|	|
16+15	0.2216	4.78	Q V	|	|	|	|
16+20	0.2483	3.87	Q V	|	|	|	|
16+25	0.2635	2.21	Q V	|	|	|	|
16+30	0.2734	1.44	Q V	|	|	|	|

16+35	0.2813	1.15	| Q |	|	| V|	|
16+40	0.2880	0.97	| Q |	|	| V	|
16+45	0.2936	0.82	| Q |	|	| V	|
16+50	0.2985	0.72	| Q |	|	| |V	|
16+55	0.3028	0.62	| Q |	|	| |V	|
17+ 0	0.3066	0.55	| Q |	|	| | V	|
17+ 5	0.3100	0.49	|Q |	|	| | V	|
17+10	0.3132	0.46	|Q |	|	| | V	|
17+15	0.3161	0.42	|Q |	|	| | V	|
17+20	0.3188	0.38	|Q |	|	| | V	|
17+25	0.3212	0.36	|Q |	|	| | V	|
17+30	0.3235	0.33	|Q |	|	| | V	|
17+35	0.3256	0.30	|Q |	|	| | V	|
17+40	0.3275	0.28	|Q |	|	| | V	|
17+45	0.3294	0.27	|Q |	|	| | V	|
17+50	0.3312	0.27	|Q |	|	| | V	|
17+55	0.3329	0.25	| Q |	|	| | V	|
18+ 0	0.3342	0.19	| Q |	|	| | V	|
18+ 5	0.3355	0.18	| Q |	|	| | V	|
18+10	0.3367	0.17	| Q |	|	| | V	|
18+15	0.3378	0.16	| Q |	|	| | V	|
18+20	0.3389	0.15	| Q |	|	| | V	|
18+25	0.3399	0.15	| Q |	|	| | V	|
18+30	0.3408	0.14	| Q |	|	| | V	|
18+35	0.3418	0.14	| Q |	|	| | V	|
18+40	0.3427	0.13	| Q |	|	| | V	|
18+45	0.3436	0.13	| Q |	|	| | V	|
18+50	0.3445	0.13	| Q |	|	| | V	|
18+55	0.3453	0.12	| Q |	|	| | V	|
19+ 0	0.3461	0.12	| Q |	|	| | V	|
19+ 5	0.3469	0.12	| Q |	|	| | V	|
19+10	0.3477	0.12	| Q |	|	| | V	|
19+15	0.3485	0.11	| Q |	|	| | V	|
19+20	0.3493	0.11	| Q |	|	| | V	|
19+25	0.3500	0.11	| Q |	|	| | V	|
19+30	0.3508	0.11	| Q |	|	| | V	|
19+35	0.3515	0.11	| Q |	|	| | V	|
19+40	0.3522	0.10	| Q |	|	| | V	|
19+45	0.3529	0.10	| Q |	|	| | V	|
19+50	0.3536	0.10	| Q |	|	| | V	|
19+55	0.3543	0.10	| Q |	|	| | V	|
20+ 0	0.3550	0.10	| Q |	|	| | V	|
20+ 5	0.3556	0.10	| Q |	|	| | V	|
20+10	0.3563	0.10	| Q |	|	| | V	|
20+15	0.3569	0.09	| Q |	|	| | V	|
20+20	0.3576	0.09	| Q |	|	| | V	|
20+25	0.3582	0.09	| Q |	|	| | V	|
20+30	0.3588	0.09	| Q |	|	| | V	|
20+35	0.3594	0.09	| Q |	|	| | V	|
20+40	0.3601	0.09	| Q |	|	| | V	|
20+45	0.3607	0.09	| Q |	|	| | V	|
20+50	0.3613	0.09	| Q |	|	| | V	|
20+55	0.3619	0.09	| Q |	|	| | V	|
21+ 0	0.3624	0.09	| Q |	|	| | V	|
21+ 5	0.3630	0.08	| Q |	|	| | V	|
21+10	0.3636	0.08	| Q |	|	| | V	|
21+15	0.3642	0.08	| Q |	|	| | V	|
21+20	0.3647	0.08	| Q |	|	| | V	|
21+25	0.3653	0.08	| Q |	|	| | V	|
21+30	0.3658	0.08	| Q |	|	| | V	|
21+35	0.3664	0.08	| Q |	|	| | V	|
21+40	0.3669	0.08	| Q |	|	| | V	|
21+45	0.3675	0.08	| Q |	|	| | V	|
21+50	0.3680	0.08	| Q |	|	| | V	|
21+55	0.3685	0.08	| Q |	|	| | V	|
22+ 0	0.3691	0.08	| Q |	|	| | V	|
22+ 5	0.3696	0.08	| Q |	|	| | V	|
22+10	0.3701	0.08	| Q |	|	| | V	|
22+15	0.3706	0.07	| Q |	|	| | V	|
22+20	0.3711	0.07	| Q |	|	| | V	|
22+25	0.3716	0.07	| Q |	|	| | V	|

22+30	0.3721	0.07	Q	|	|	|	V |
22+35	0.3726	0.07	Q	|	|	|	V |
22+40	0.3731	0.07	Q	|	|	|	V|
22+45	0.3736	0.07	Q	|	|	|	V|
22+50	0.3741	0.07	Q	|	|	|	V|
22+55	0.3746	0.07	Q	|	|	|	V|
23+ 0	0.3751	0.07	Q	|	|	|	V|
23+ 5	0.3755	0.07	Q	|	|	|	V|
23+10	0.3760	0.07	Q	|	|	|	V|
23+15	0.3765	0.07	Q	|	|	|	V|
23+20	0.3769	0.07	Q	|	|	|	V|
23+25	0.3774	0.07	Q	|	|	|	V|
23+30	0.3779	0.07	Q	|	|	|	V|
23+35	0.3783	0.07	Q	|	|	|	V|
23+40	0.3788	0.07	Q	|	|	|	V|
23+45	0.3792	0.07	Q	|	|	|	V|
23+50	0.3797	0.07	Q	|	|	|	V|
23+55	0.3801	0.06	Q	|	|	|	V|
24+ 0	0.3806	0.06	Q	|	|	|	V|
24+ 5	0.3810	0.06	Q	|	|	|	V|
24+10	0.3814	0.05	Q	|	|	|	V|
24+15	0.3816	0.04	Q	|	|	|	V|
24+20	0.3818	0.02	Q	|	|	|	V|
24+25	0.3819	0.02	Q	|	|	|	V|
24+30	0.3820	0.01	Q	|	|	|	V|
24+35	0.3821	0.01	Q	|	|	|	V|
24+40	0.3822	0.01	Q	|	|	|	V|
24+45	0.3822	0.01	Q	|	|	|	V|
24+50	0.3823	0.01	Q	|	|	|	V|
24+55	0.3823	0.01	Q	|	|	|	V|
25+ 0	0.3823	0.00	Q	|	|	|	V|
25+ 5	0.3823	0.00	Q	|	|	|	V|
25+10	0.3824	0.00	Q	|	|	|	V|
25+15	0.3824	0.00	Q	|	|	|	V|
25+20	0.3824	0.00	Q	|	|	|	V|
25+25	0.3824	0.00	Q	|	|	|	V|
25+30	0.3824	0.00	Q	|	|	|	V|
25+35	0.3824	0.00	Q	|	|	|	V|
25+40	0.3824	0.00	Q	|	|	|	V|
25+45	0.3824	0.00	Q	|	|	|	V|
25+50	0.3824	0.00	Q	|	|	|	V

Unit Hydrograph Analysis-Developed Condition
2-yr Storm Event

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

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Study date 03/07/24

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

Program License Serial Number 6484

DIVERSIFED-MAPLE AVE
UH ANALYSIS-DEVELOPED CONDITION
2-YR STORM EVENT

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		
8.20	1	0.63
Rainfall data for year 2		
8.20	6	1.69
Rainfall data for year 2		
8.20	24	3.14

++

******** 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	8.20	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
0.82	0.100	32.0	32.0	15.70	0.000
7.38	0.900	98.0	98.0	0.20	0.926

Area-averaged catchment yield fraction, Y = 0.833
Area-averaged low loss fraction, Yb = 0.167
Direct entry of lag time by user
++

Watershed area = 8.20(Ac.)
Catchment Lag time = 0.135 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 61.7284
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.098(In/Hr)
Average low loss rate fraction (Yb) = 0.167 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.232(In)
Computed peak 30-minute rainfall = 0.474(In)
Specified peak 1-hour rainfall = 0.626(In)
Computed peak 3-hour rainfall = 1.151(In)
Specified peak 6-hour rainfall = 1.690(In)
Specified peak 24-hour rainfall = 3.140(In)

Rainfall depth area reduction factors:
Using a total area of 8.20(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.232(In)
30-minute factor = 1.000 Adjusted rainfall = 0.474(In)
1-hour factor = 1.000 Adjusted rainfall = 0.626(In)
3-hour factor = 1.000 Adjusted rainfall = 1.151(In)
6-hour factor = 1.000 Adjusted rainfall = 1.690(In)
24-hour factor = 1.000 Adjusted rainfall = 3.140(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 = 99.17 (CFS))	
1	6.887	6.829
2	43.768	36.575
3	83.294	39.197
4	96.136	12.736
5	98.800	2.642
6	100.000	1.190

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.2316	0.2316
2	0.3056	0.0740
3	0.3594	0.0538
4	0.4032	0.0438
5	0.4409	0.0376
6	0.4742	0.0334
7	0.5044	0.0302
8	0.5321	0.0277
9	0.5577	0.0257
10	0.5817	0.0240
11	0.6044	0.0226
12	0.6258	0.0214
13	0.6542	0.0284
14	0.6816	0.0274
15	0.7082	0.0266
16	0.7340	0.0258
17	0.7591	0.0251
18	0.7835	0.0244
19	0.8074	0.0239
20	0.8307	0.0233
21	0.8535	0.0228
22	0.8758	0.0223
23	0.8976	0.0219
24	0.9191	0.0214
25	0.9401	0.0210
26	0.9608	0.0207
27	0.9811	0.0203
28	1.0011	0.0200

29	1.0208	0.0197
30	1.0402	0.0194
31	1.0592	0.0191
32	1.0781	0.0188
33	1.0966	0.0186
34	1.1149	0.0183
35	1.1330	0.0181
36	1.1508	0.0178
37	1.1684	0.0176
38	1.1858	0.0174
39	1.2030	0.0172
40	1.2200	0.0170
41	1.2369	0.0168
42	1.2535	0.0166
43	1.2699	0.0165
44	1.2862	0.0163
45	1.3024	0.0161
46	1.3183	0.0160
47	1.3341	0.0158
48	1.3498	0.0157
49	1.3653	0.0155
50	1.3807	0.0154
51	1.3959	0.0152
52	1.4110	0.0151
53	1.4260	0.0150
54	1.4409	0.0149
55	1.4556	0.0147
56	1.4702	0.0146
57	1.4847	0.0145
58	1.4991	0.0144
59	1.5133	0.0143
60	1.5275	0.0142
61	1.5416	0.0141
62	1.5555	0.0140
63	1.5694	0.0139
64	1.5831	0.0138
65	1.5968	0.0137
66	1.6104	0.0136
67	1.6239	0.0135
68	1.6373	0.0134
69	1.6506	0.0133
70	1.6638	0.0132
71	1.6769	0.0131
72	1.6900	0.0131
73	1.7004	0.0104
74	1.7108	0.0104
75	1.7211	0.0103
76	1.7313	0.0102
77	1.7414	0.0101
78	1.7515	0.0101
79	1.7615	0.0100
80	1.7714	0.0099
81	1.7813	0.0099
82	1.7911	0.0098
83	1.8008	0.0097
84	1.8105	0.0097
85	1.8201	0.0096
86	1.8296	0.0095
87	1.8391	0.0095
88	1.8485	0.0094
89	1.8579	0.0094
90	1.8672	0.0093
91	1.8764	0.0092
92	1.8856	0.0092
93	1.8947	0.0091
94	1.9038	0.0091
95	1.9128	0.0090
96	1.9218	0.0090
97	1.9307	0.0089
98	1.9396	0.0089
99	1.9484	0.0088

100	1.9572	0.0088
101	1.9659	0.0087
102	1.9746	0.0087
103	1.9832	0.0086
104	1.9918	0.0086
105	2.0003	0.0085
106	2.0088	0.0085
107	2.0173	0.0084
108	2.0257	0.0084
109	2.0340	0.0084
110	2.0423	0.0083
111	2.0506	0.0083
112	2.0589	0.0082
113	2.0670	0.0082
114	2.0752	0.0082
115	2.0833	0.0081
116	2.0914	0.0081
117	2.0994	0.0080
118	2.1074	0.0080
119	2.1154	0.0080
120	2.1233	0.0079
121	2.1312	0.0079
122	2.1391	0.0079
123	2.1469	0.0078
124	2.1547	0.0078
125	2.1624	0.0077
126	2.1701	0.0077
127	2.1778	0.0077
128	2.1855	0.0076
129	2.1931	0.0076
130	2.2006	0.0076
131	2.2082	0.0075
132	2.2157	0.0075
133	2.2232	0.0075
134	2.2307	0.0075
135	2.2381	0.0074
136	2.2455	0.0074
137	2.2528	0.0074
138	2.2602	0.0073
139	2.2675	0.0073
140	2.2747	0.0073
141	2.2820	0.0072
142	2.2892	0.0072
143	2.2964	0.0072
144	2.3036	0.0072
145	2.3107	0.0071
146	2.3178	0.0071
147	2.3249	0.0071
148	2.3319	0.0071
149	2.3390	0.0070
150	2.3460	0.0070
151	2.3529	0.0070
152	2.3599	0.0070
153	2.3668	0.0069
154	2.3737	0.0069
155	2.3806	0.0069
156	2.3875	0.0069
157	2.3943	0.0068
158	2.4011	0.0068
159	2.4079	0.0068
160	2.4146	0.0068
161	2.4214	0.0067
162	2.4281	0.0067
163	2.4347	0.0067
164	2.4414	0.0067
165	2.4481	0.0066
166	2.4547	0.0066
167	2.4613	0.0066
168	2.4678	0.0066
169	2.4744	0.0066
170	2.4809	0.0065

171	2.4874	0.0065
172	2.4939	0.0065
173	2.5004	0.0065
174	2.5068	0.0064
175	2.5133	0.0064
176	2.5197	0.0064
177	2.5261	0.0064
178	2.5324	0.0064
179	2.5388	0.0063
180	2.5451	0.0063
181	2.5514	0.0063
182	2.5577	0.0063
183	2.5640	0.0063
184	2.5702	0.0063
185	2.5765	0.0062
186	2.5827	0.0062
187	2.5889	0.0062
188	2.5951	0.0062
189	2.6012	0.0062
190	2.6074	0.0061
191	2.6135	0.0061
192	2.6196	0.0061
193	2.6257	0.0061
194	2.6317	0.0061
195	2.6378	0.0061
196	2.6438	0.0060
197	2.6499	0.0060
198	2.6559	0.0060
199	2.6618	0.0060
200	2.6678	0.0060
201	2.6738	0.0060
202	2.6797	0.0059
203	2.6856	0.0059
204	2.6915	0.0059
205	2.6974	0.0059
206	2.7033	0.0059
207	2.7091	0.0059
208	2.7150	0.0058
209	2.7208	0.0058
210	2.7266	0.0058
211	2.7324	0.0058
212	2.7382	0.0058
213	2.7440	0.0058
214	2.7497	0.0057
215	2.7554	0.0057
216	2.7612	0.0057
217	2.7669	0.0057
218	2.7726	0.0057
219	2.7782	0.0057
220	2.7839	0.0057
221	2.7895	0.0056
222	2.7952	0.0056
223	2.8008	0.0056
224	2.8064	0.0056
225	2.8120	0.0056
226	2.8176	0.0056
227	2.8231	0.0056
228	2.8287	0.0056
229	2.8342	0.0055
230	2.8398	0.0055
231	2.8453	0.0055
232	2.8508	0.0055
233	2.8562	0.0055
234	2.8617	0.0055
235	2.8672	0.0055
236	2.8726	0.0054
237	2.8781	0.0054
238	2.8835	0.0054
239	2.8889	0.0054
240	2.8943	0.0054
241	2.8997	0.0054

242	2.9050	0.0054
243	2.9104	0.0054
244	2.9157	0.0053
245	2.9211	0.0053
246	2.9264	0.0053
247	2.9317	0.0053
248	2.9370	0.0053
249	2.9423	0.0053
250	2.9476	0.0053
251	2.9528	0.0053
252	2.9581	0.0053
253	2.9633	0.0052
254	2.9685	0.0052
255	2.9738	0.0052
256	2.9790	0.0052
257	2.9842	0.0052
258	2.9893	0.0052
259	2.9945	0.0052
260	2.9997	0.0052
261	3.0048	0.0052
262	3.0100	0.0051
263	3.0151	0.0051
264	3.0202	0.0051
265	3.0253	0.0051
266	3.0304	0.0051
267	3.0355	0.0051
268	3.0406	0.0051
269	3.0456	0.0051
270	3.0507	0.0051
271	3.0557	0.0050
272	3.0608	0.0050
273	3.0658	0.0050
274	3.0708	0.0050
275	3.0758	0.0050
276	3.0808	0.0050
277	3.0858	0.0050
278	3.0908	0.0050
279	3.0957	0.0050
280	3.1007	0.0050
281	3.1056	0.0049
282	3.1106	0.0049
283	3.1155	0.0049
284	3.1204	0.0049
285	3.1253	0.0049
286	3.1302	0.0049
287	3.1351	0.0049
288	3.1400	0.0049

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0049	0.0008	0.0041
2	0.0049	0.0008	0.0041
3	0.0049	0.0008	0.0041
4	0.0049	0.0008	0.0041
5	0.0049	0.0008	0.0041
6	0.0049	0.0008	0.0041
7	0.0050	0.0008	0.0041
8	0.0050	0.0008	0.0041
9	0.0050	0.0008	0.0042
10	0.0050	0.0008	0.0042
11	0.0050	0.0008	0.0042
12	0.0050	0.0008	0.0042
13	0.0051	0.0008	0.0042
14	0.0051	0.0008	0.0042
15	0.0051	0.0008	0.0042
16	0.0051	0.0008	0.0042
17	0.0051	0.0009	0.0043
18	0.0051	0.0009	0.0043
19	0.0052	0.0009	0.0043

20	0.0052	0.0009	0.0043
21	0.0052	0.0009	0.0043
22	0.0052	0.0009	0.0043
23	0.0052	0.0009	0.0043
24	0.0052	0.0009	0.0044
25	0.0053	0.0009	0.0044
26	0.0053	0.0009	0.0044
27	0.0053	0.0009	0.0044
28	0.0053	0.0009	0.0044
29	0.0053	0.0009	0.0044
30	0.0053	0.0009	0.0044
31	0.0054	0.0009	0.0045
32	0.0054	0.0009	0.0045
33	0.0054	0.0009	0.0045
34	0.0054	0.0009	0.0045
35	0.0054	0.0009	0.0045
36	0.0054	0.0009	0.0045
37	0.0055	0.0009	0.0046
38	0.0055	0.0009	0.0046
39	0.0055	0.0009	0.0046
40	0.0055	0.0009	0.0046
41	0.0056	0.0009	0.0046
42	0.0056	0.0009	0.0046
43	0.0056	0.0009	0.0047
44	0.0056	0.0009	0.0047
45	0.0056	0.0009	0.0047
46	0.0056	0.0009	0.0047
47	0.0057	0.0009	0.0047
48	0.0057	0.0009	0.0047
49	0.0057	0.0010	0.0048
50	0.0057	0.0010	0.0048
51	0.0058	0.0010	0.0048
52	0.0058	0.0010	0.0048
53	0.0058	0.0010	0.0048
54	0.0058	0.0010	0.0049
55	0.0059	0.0010	0.0049
56	0.0059	0.0010	0.0049
57	0.0059	0.0010	0.0049
58	0.0059	0.0010	0.0049
59	0.0060	0.0010	0.0050
60	0.0060	0.0010	0.0050
61	0.0060	0.0010	0.0050
62	0.0060	0.0010	0.0050
63	0.0061	0.0010	0.0050
64	0.0061	0.0010	0.0051
65	0.0061	0.0010	0.0051
66	0.0061	0.0010	0.0051
67	0.0062	0.0010	0.0051
68	0.0062	0.0010	0.0051
69	0.0062	0.0010	0.0052
70	0.0062	0.0010	0.0052
71	0.0063	0.0010	0.0052
72	0.0063	0.0010	0.0052
73	0.0063	0.0011	0.0053
74	0.0063	0.0011	0.0053
75	0.0064	0.0011	0.0053
76	0.0064	0.0011	0.0053
77	0.0064	0.0011	0.0054
78	0.0065	0.0011	0.0054
79	0.0065	0.0011	0.0054
80	0.0065	0.0011	0.0054
81	0.0066	0.0011	0.0055
82	0.0066	0.0011	0.0055
83	0.0066	0.0011	0.0055
84	0.0067	0.0011	0.0056
85	0.0067	0.0011	0.0056
86	0.0067	0.0011	0.0056
87	0.0068	0.0011	0.0057
88	0.0068	0.0011	0.0057
89	0.0069	0.0011	0.0057
90	0.0069	0.0011	0.0057

91	0.0069	0.0012	0.0058
92	0.0070	0.0012	0.0058
93	0.0070	0.0012	0.0058
94	0.0070	0.0012	0.0059
95	0.0071	0.0012	0.0059
96	0.0071	0.0012	0.0059
97	0.0072	0.0012	0.0060
98	0.0072	0.0012	0.0060
99	0.0072	0.0012	0.0060
100	0.0073	0.0012	0.0061
101	0.0073	0.0012	0.0061
102	0.0074	0.0012	0.0061
103	0.0074	0.0012	0.0062
104	0.0075	0.0012	0.0062
105	0.0075	0.0013	0.0063
106	0.0075	0.0013	0.0063
107	0.0076	0.0013	0.0063
108	0.0076	0.0013	0.0064
109	0.0077	0.0013	0.0064
110	0.0077	0.0013	0.0065
111	0.0078	0.0013	0.0065
112	0.0079	0.0013	0.0065
113	0.0079	0.0013	0.0066
114	0.0080	0.0013	0.0066
115	0.0080	0.0013	0.0067
116	0.0081	0.0013	0.0067
117	0.0082	0.0014	0.0068
118	0.0082	0.0014	0.0068
119	0.0083	0.0014	0.0069
120	0.0083	0.0014	0.0069
121	0.0084	0.0014	0.0070
122	0.0084	0.0014	0.0070
123	0.0085	0.0014	0.0071
124	0.0086	0.0014	0.0072
125	0.0087	0.0014	0.0072
126	0.0087	0.0015	0.0073
127	0.0088	0.0015	0.0074
128	0.0089	0.0015	0.0074
129	0.0090	0.0015	0.0075
130	0.0090	0.0015	0.0075
131	0.0091	0.0015	0.0076
132	0.0092	0.0015	0.0077
133	0.0093	0.0015	0.0078
134	0.0094	0.0016	0.0078
135	0.0095	0.0016	0.0079
136	0.0095	0.0016	0.0079
137	0.0097	0.0016	0.0081
138	0.0097	0.0016	0.0081
139	0.0099	0.0016	0.0082
140	0.0099	0.0017	0.0083
141	0.0101	0.0017	0.0084
142	0.0101	0.0017	0.0085
143	0.0103	0.0017	0.0086
144	0.0104	0.0017	0.0086
145	0.0131	0.0022	0.0109
146	0.0131	0.0022	0.0109
147	0.0133	0.0022	0.0111
148	0.0134	0.0022	0.0112
149	0.0136	0.0023	0.0113
150	0.0137	0.0023	0.0114
151	0.0139	0.0023	0.0115
152	0.0140	0.0023	0.0116
153	0.0142	0.0024	0.0118
154	0.0143	0.0024	0.0119
155	0.0145	0.0024	0.0121
156	0.0146	0.0024	0.0122
157	0.0149	0.0025	0.0124
158	0.0150	0.0025	0.0125
159	0.0152	0.0025	0.0127
160	0.0154	0.0026	0.0128
161	0.0157	0.0026	0.0131

162	0.0158	0.0026	0.0132
163	0.0161	0.0027	0.0134
164	0.0163	0.0027	0.0136
165	0.0166	0.0028	0.0139
166	0.0168	0.0028	0.0140
167	0.0172	0.0029	0.0143
168	0.0174	0.0029	0.0145
169	0.0178	0.0030	0.0149
170	0.0181	0.0030	0.0151
171	0.0186	0.0031	0.0155
172	0.0188	0.0031	0.0157
173	0.0194	0.0032	0.0161
174	0.0197	0.0033	0.0164
175	0.0203	0.0034	0.0169
176	0.0207	0.0034	0.0172
177	0.0214	0.0036	0.0179
178	0.0219	0.0036	0.0182
179	0.0228	0.0038	0.0190
180	0.0233	0.0039	0.0194
181	0.0244	0.0041	0.0204
182	0.0251	0.0042	0.0209
183	0.0266	0.0044	0.0222
184	0.0274	0.0046	0.0229
185	0.0214	0.0036	0.0178
186	0.0226	0.0038	0.0188
187	0.0257	0.0043	0.0214
188	0.0277	0.0046	0.0231
189	0.0334	0.0056	0.0278
190	0.0376	0.0063	0.0314
191	0.0538	0.0081	0.0457
192	0.0740	0.0081	0.0658
193	0.2316	0.0081	0.2234
194	0.0438	0.0073	0.0365
195	0.0302	0.0050	0.0251
196	0.0240	0.0040	0.0200
197	0.0284	0.0047	0.0237
198	0.0258	0.0043	0.0215
199	0.0239	0.0040	0.0199
200	0.0223	0.0037	0.0186
201	0.0210	0.0035	0.0175
202	0.0200	0.0033	0.0167
203	0.0191	0.0032	0.0159
204	0.0183	0.0030	0.0153
205	0.0176	0.0029	0.0147
206	0.0170	0.0028	0.0142
207	0.0165	0.0027	0.0137
208	0.0160	0.0027	0.0133
209	0.0155	0.0026	0.0129
210	0.0151	0.0025	0.0126
211	0.0147	0.0025	0.0123
212	0.0144	0.0024	0.0120
213	0.0141	0.0023	0.0117
214	0.0138	0.0023	0.0115
215	0.0135	0.0022	0.0112
216	0.0132	0.0022	0.0110
217	0.0104	0.0017	0.0087
218	0.0102	0.0017	0.0085
219	0.0100	0.0017	0.0083
220	0.0098	0.0016	0.0082
221	0.0096	0.0016	0.0080
222	0.0094	0.0016	0.0078
223	0.0092	0.0015	0.0077
224	0.0091	0.0015	0.0076
225	0.0089	0.0015	0.0074
226	0.0088	0.0015	0.0073
227	0.0086	0.0014	0.0072
228	0.0085	0.0014	0.0071
229	0.0084	0.0014	0.0070
230	0.0082	0.0014	0.0069
231	0.0081	0.0014	0.0068
232	0.0080	0.0013	0.0067

233	0.0079	0.0013	0.0066
234	0.0078	0.0013	0.0065
235	0.0077	0.0013	0.0064
236	0.0076	0.0013	0.0063
237	0.0075	0.0012	0.0062
238	0.0074	0.0012	0.0062
239	0.0073	0.0012	0.0061
240	0.0072	0.0012	0.0060
241	0.0071	0.0012	0.0059
242	0.0071	0.0012	0.0059
243	0.0070	0.0012	0.0058
244	0.0069	0.0011	0.0058
245	0.0068	0.0011	0.0057
246	0.0068	0.0011	0.0056
247	0.0067	0.0011	0.0056
248	0.0066	0.0011	0.0055
249	0.0066	0.0011	0.0055
250	0.0065	0.0011	0.0054
251	0.0064	0.0011	0.0054
252	0.0064	0.0011	0.0053
253	0.0063	0.0011	0.0053
254	0.0063	0.0010	0.0052
255	0.0062	0.0010	0.0052
256	0.0061	0.0010	0.0051
257	0.0061	0.0010	0.0051
258	0.0060	0.0010	0.0050
259	0.0060	0.0010	0.0050
260	0.0059	0.0010	0.0049
261	0.0059	0.0010	0.0049
262	0.0058	0.0010	0.0049
263	0.0058	0.0010	0.0048
264	0.0057	0.0010	0.0048
265	0.0057	0.0010	0.0048
266	0.0057	0.0009	0.0047
267	0.0056	0.0009	0.0047
268	0.0056	0.0009	0.0046
269	0.0055	0.0009	0.0046
270	0.0055	0.0009	0.0046
271	0.0055	0.0009	0.0045
272	0.0054	0.0009	0.0045
273	0.0054	0.0009	0.0045
274	0.0053	0.0009	0.0045
275	0.0053	0.0009	0.0044
276	0.0053	0.0009	0.0044
277	0.0052	0.0009	0.0044
278	0.0052	0.0009	0.0043
279	0.0052	0.0009	0.0043
280	0.0051	0.0009	0.0043
281	0.0051	0.0009	0.0043
282	0.0051	0.0008	0.0042
283	0.0050	0.0008	0.0042
284	0.0050	0.0008	0.0042
285	0.0050	0.0008	0.0042
286	0.0050	0.0008	0.0041
287	0.0049	0.0008	0.0041
288	0.0049	0.0008	0.0041

Total soil rain loss = 0.49(In)
Total effective rainfall = 2.65(In)
Peak flow rate in flood hydrograph = 11.70(CFS)

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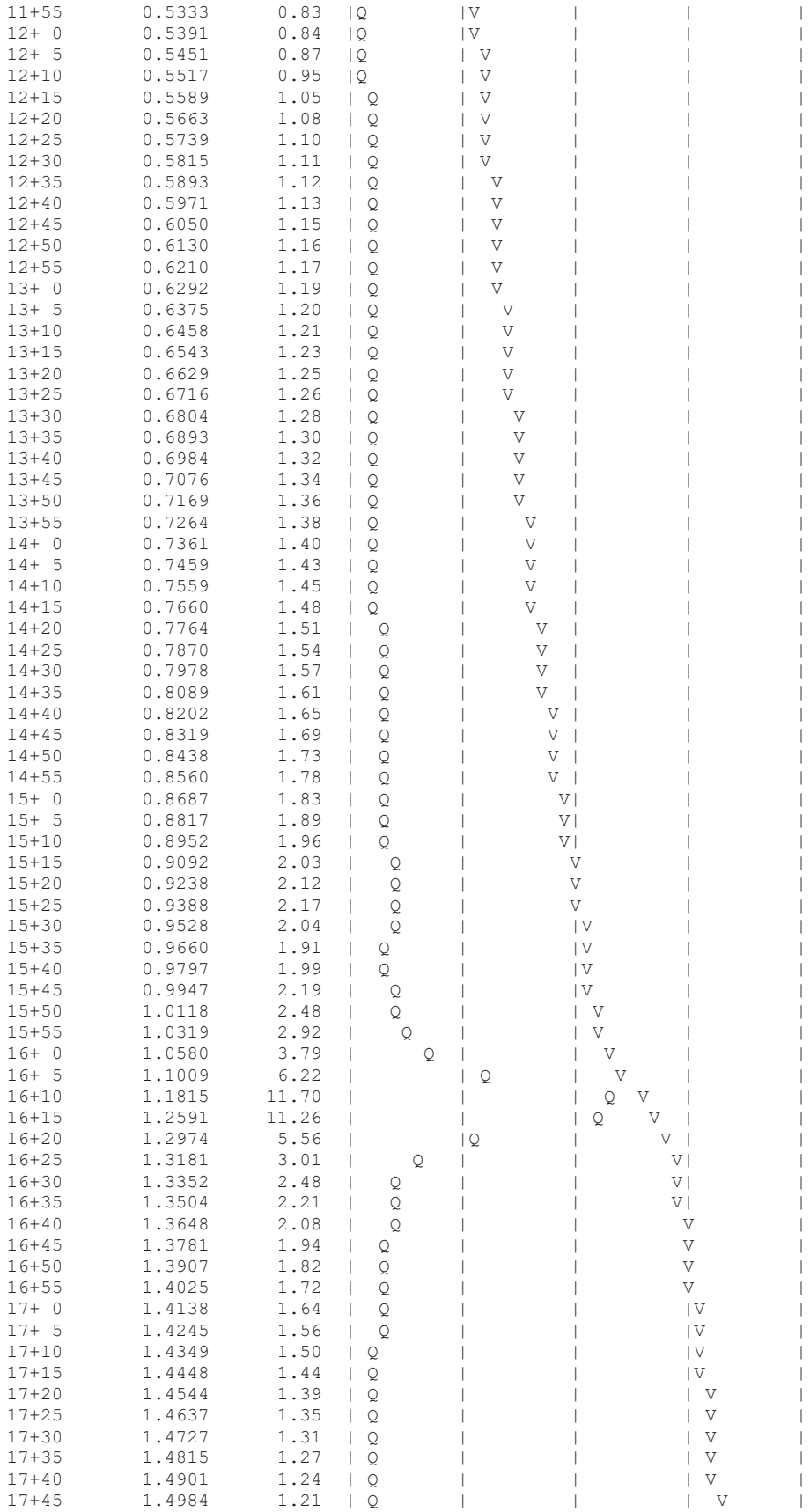
24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	5.0	10.0	15.0	20.0

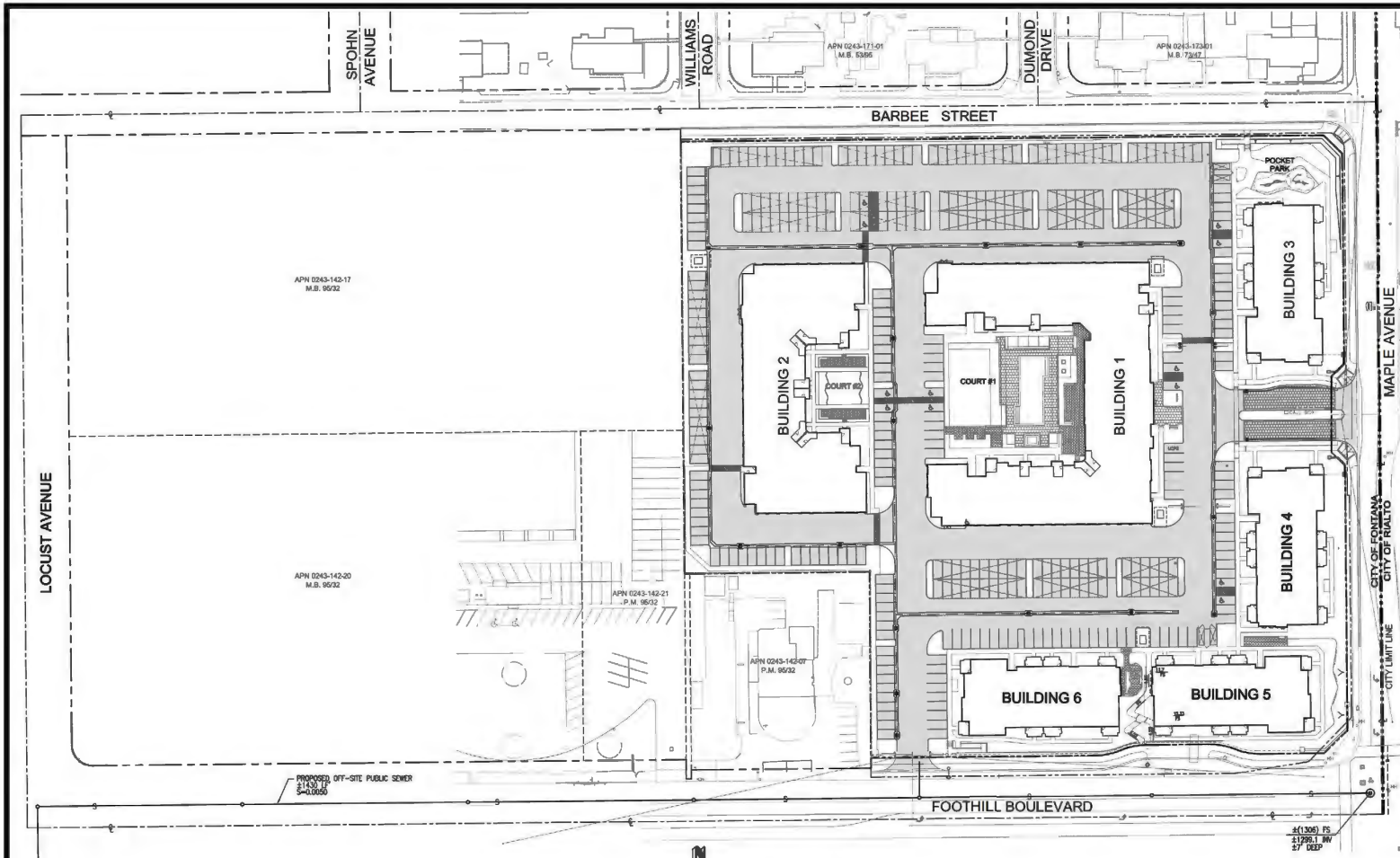
0+ 5	0.0002	0.03	Q	|	|	|	|
0+10	0.0014	0.18	Q	|	|	|	|
0+15	0.0037	0.34	Q	|	|	|	|
0+20	0.0064	0.39	Q	|	|	|	|
0+25	0.0092	0.40	Q	|	|	|	|
0+30	0.0120	0.41	Q	|	|	|	|
0+35	0.0148	0.41	Q	|	|	|	|
0+40	0.0176	0.41	Q	|	|	|	|
0+45	0.0204	0.41	Q	|	|	|	|
0+50	0.0232	0.41	Q	|	|	|	|
0+55	0.0261	0.41	Q	|	|	|	|
1+ 0	0.0289	0.41	Q	|	|	|	|
1+ 5	0.0318	0.42	Q	|	|	|	|
1+10	0.0347	0.42	Q	|	|	|	|
1+15	0.0376	0.42	Q	|	|	|	|
1+20	0.0404	0.42	Q	|	|	|	|
1+25	0.0433	0.42	Q	|	|	|	|
1+30	0.0462	0.42	QV	|	|	|	|
1+35	0.0492	0.42	QV	|	|	|	|
1+40	0.0521	0.42	QV	|	|	|	|
1+45	0.0550	0.43	QV	|	|	|	|
1+50	0.0580	0.43	QV	|	|	|	|
1+55	0.0609	0.43	QV	|	|	|	|
2+ 0	0.0639	0.43	QV	|	|	|	|
2+ 5	0.0668	0.43	QV	|	|	|	|
2+10	0.0698	0.43	QV	|	|	|	|
2+15	0.0728	0.43	QV	|	|	|	|
2+20	0.0758	0.44	QV	|	|	|	|
2+25	0.0788	0.44	QV	|	|	|	|
2+30	0.0818	0.44	QV	|	|	|	|
2+35	0.0849	0.44	QV	|	|	|	|
2+40	0.0879	0.44	QV	|	|	|	|
2+45	0.0910	0.44	Q V	|	|	|	|
2+50	0.0940	0.44	Q V	|	|	|	|
2+55	0.0971	0.45	Q V	|	|	|	|
3+ 0	0.1002	0.45	Q V	|	|	|	|
3+ 5	0.1033	0.45	Q V	|	|	|	|
3+10	0.1064	0.45	Q V	|	|	|	|
3+15	0.1095	0.45	Q V	|	|	|	|
3+20	0.1126	0.45	Q V	|	|	|	|
3+25	0.1158	0.46	Q V	|	|	|	|
3+30	0.1189	0.46	Q V	|	|	|	|
3+35	0.1221	0.46	Q V	|	|	|	|
3+40	0.1252	0.46	Q V	|	|	|	|
3+45	0.1284	0.46	Q V	|	|	|	|
3+50	0.1316	0.46	Q V	|	|	|	|
3+55	0.1348	0.47	Q V	|	|	|	|
4+ 0	0.1381	0.47	Q V	|	|	|	|
4+ 5	0.1413	0.47	Q V	|	|	|	|
4+10	0.1445	0.47	Q V	|	|	|	|
4+15	0.1478	0.47	Q V	|	|	|	|
4+20	0.1511	0.47	Q V	|	|	|	|
4+25	0.1543	0.48	Q V	|	|	|	|
4+30	0.1576	0.48	Q V	|	|	|	|
4+35	0.1609	0.48	Q V	|	|	|	|
4+40	0.1643	0.48	Q V	|	|	|	|
4+45	0.1676	0.48	Q V	|	|	|	|
4+50	0.1710	0.49	Q V	|	|	|	|
4+55	0.1743	0.49	Q V	|	|	|	|
5+ 0	0.1777	0.49	Q V	|	|	|	|
5+ 5	0.1811	0.49	Q V	|	|	|	|
5+10	0.1845	0.49	Q V	|	|	|	|
5+15	0.1879	0.50	Q V	|	|	|	|
5+20	0.1913	0.50	Q V	|	|	|	|
5+25	0.1948	0.50	|Q V	|	|	|	|
5+30	0.1982	0.50	|Q V	|	|	|	|
5+35	0.2017	0.50	|Q V	|	|	|	|
5+40	0.2052	0.51	|Q V	|	|	|	|
5+45	0.2087	0.51	|Q V	|	|	|	|
5+50	0.2122	0.51	|Q V	|	|	|	|
5+55	0.2158	0.51	|Q V	|	|	|	|

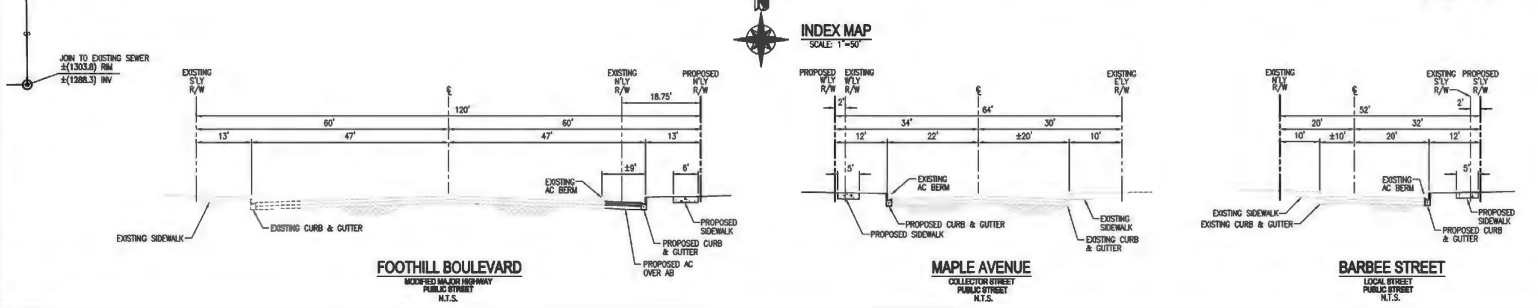
6+ 0	0.2193	0.52	|Q V	|	|	|	|
6+ 5	0.2229	0.52	|Q V	|	|	|	|
6+10	0.2265	0.52	|Q V	|	|	|	|
6+15	0.2301	0.52	|Q V	|	|	|	|
6+20	0.2337	0.53	|Q V	|	|	|	|
6+25	0.2374	0.53	|Q V	|	|	|	|
6+30	0.2410	0.53	|Q V	|	|	|	|
6+35	0.2447	0.53	|Q V	|	|	|	|
6+40	0.2484	0.54	|Q V	|	|	|	|
6+45	0.2521	0.54	|Q V	|	|	|	|
6+50	0.2558	0.54	|Q V	|	|	|	|
6+55	0.2596	0.54	|Q V	|	|	|	|
7+ 0	0.2633	0.55	|Q V	|	|	|	|
7+ 5	0.2671	0.55	|Q V	|	|	|	|
7+10	0.2709	0.55	|Q V	|	|	|	|
7+15	0.2747	0.55	|Q V	|	|	|	|
7+20	0.2786	0.56	|Q V	|	|	|	|
7+25	0.2824	0.56	|Q V	|	|	|	|
7+30	0.2863	0.56	|Q V	|	|	|	|
7+35	0.2902	0.57	|Q V	|	|	|	|
7+40	0.2941	0.57	|Q V	|	|	|	|
7+45	0.2981	0.57	|Q V	|	|	|	|
7+50	0.3021	0.58	|Q V	|	|	|	|
7+55	0.3060	0.58	|Q V	|	|	|	|
8+ 0	0.3101	0.58	|Q V	|	|	|	|
8+ 5	0.3141	0.59	|Q V	|	|	|	|
8+10	0.3181	0.59	|Q V	|	|	|	|
8+15	0.3222	0.59	|Q V	|	|	|	|
8+20	0.3263	0.60	|Q V	|	|	|	|
8+25	0.3305	0.60	|Q V	|	|	|	|
8+30	0.3346	0.60	|Q V	|	|	|	|
8+35	0.3388	0.61	|Q V	|	|	|	|
8+40	0.3430	0.61	|Q V	|	|	|	|
8+45	0.3472	0.61	|Q V	|	|	|	|
8+50	0.3515	0.62	|Q V	|	|	|	|
8+55	0.3558	0.62	|Q V	|	|	|	|
9+ 0	0.3601	0.63	|Q V	|	|	|	|
9+ 5	0.3644	0.63	|Q V	|	|	|	|
9+10	0.3688	0.63	|Q V	|	|	|	|
9+15	0.3732	0.64	|Q V	|	|	|	|
9+20	0.3776	0.64	|Q V	|	|	|	|
9+25	0.3820	0.65	|Q V	|	|	|	|
9+30	0.3865	0.65	|Q V	|	|	|	|
9+35	0.3910	0.66	|Q V	|	|	|	|
9+40	0.3956	0.66	|Q V	|	|	|	|
9+45	0.4002	0.66	|Q V	|	|	|	|
9+50	0.4048	0.67	|Q V	|	|	|	|
9+55	0.4094	0.67	|Q V|	|	|	|	|
10+ 0	0.4141	0.68	|Q V|	|	|	|	|
10+ 5	0.4188	0.68	|Q V|	|	|	|	|
10+10	0.4236	0.69	|Q V|	|	|	|	|
10+15	0.4284	0.70	|Q V|	|	|	|	|
10+20	0.4332	0.70	|Q V|	|	|	|	|
10+25	0.4381	0.71	|Q V|	|	|	|	|
10+30	0.4430	0.71	|Q V|	|	|	|	|
10+35	0.4479	0.72	|Q V|	|	|	|	|
10+40	0.4529	0.72	|Q V	|	|	|	|
10+45	0.4579	0.73	|Q V	|	|	|	|
10+50	0.4630	0.74	|Q V	|	|	|	|
10+55	0.4681	0.74	|Q V	|	|	|	|
11+ 0	0.4733	0.75	|Q V	|	|	|	|
11+ 5	0.4785	0.76	|Q V	|	|	|	|
11+10	0.4837	0.76	|Q V	|	|	|	|
11+15	0.4890	0.77	|Q V	|	|	|	|
11+20	0.4944	0.78	|Q V	|	|	|	|
11+25	0.4998	0.78	|Q |V	|	|	|	|
11+30	0.5052	0.79	|Q |V	|	|	|	|
11+35	0.5107	0.80	|Q |V	|	|	|	|
11+40	0.5163	0.81	|Q |V	|	|	|	|
11+45	0.5219	0.82	|Q |V	|	|	|	|
11+50	0.5276	0.82	|Q |V	|	|	|	|

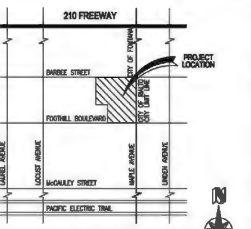


17+50	1.5065	1.18	| Q	|	|	| V	|
17+55	1.5145	1.16	| Q	|	|	| V	|
18+ 0	1.5223	1.13	| Q	|	|	| V	|
18+ 5	1.5298	1.09	| Q	|	|	| V	|
18+10	1.5367	1.00	|Q	|	|	| V	|
18+15	1.5428	0.89	|Q	|	|	| V	|
18+20	1.5487	0.85	|Q	|	|	| V	|
18+25	1.5543	0.82	|Q	|	|	| V	|
18+30	1.5599	0.81	|Q	|	|	| V	|
18+35	1.5653	0.79	|Q	|	|	| V	|
18+40	1.5706	0.77	|Q	|	|	| V	|
18+45	1.5759	0.76	|Q	|	|	| V	|
18+50	1.5810	0.75	|Q	|	|	| V	|
18+55	1.5861	0.73	|Q	|	|	| V	|
19+ 0	1.5910	0.72	|Q	|	|	| V	|
19+ 5	1.5959	0.71	|Q	|	|	| V	|
19+10	1.6008	0.70	|Q	|	|	| V	|
19+15	1.6055	0.69	|Q	|	|	| V	|
19+20	1.6102	0.68	|Q	|	|	| V	|
19+25	1.6148	0.67	|Q	|	|	| V	|
19+30	1.6193	0.66	|Q	|	|	| V	|
19+35	1.6238	0.65	|Q	|	|	| V	|
19+40	1.6282	0.64	|Q	|	|	| V	|
19+45	1.6325	0.63	|Q	|	|	| V	|
19+50	1.6368	0.62	|Q	|	|	| V	|
19+55	1.6411	0.62	|Q	|	|	| V	|
20+ 0	1.6453	0.61	|Q	|	|	| V	|
20+ 5	1.6494	0.60	|Q	|	|	| V	|
20+10	1.6535	0.59	|Q	|	|	| V	|
20+15	1.6576	0.59	|Q	|	|	| V	|
20+20	1.6616	0.58	|Q	|	|	| V	|
20+25	1.6655	0.57	|Q	|	|	| V	|
20+30	1.6694	0.57	|Q	|	|	| V	|
20+35	1.6733	0.56	|Q	|	|	| V	|
20+40	1.6772	0.56	|Q	|	|	| V	|
20+45	1.6810	0.55	|Q	|	|	| V	|
20+50	1.6847	0.55	|Q	|	|	| V	|
20+55	1.6884	0.54	|Q	|	|	| V	|
21+ 0	1.6921	0.53	|Q	|	|	| V	|
21+ 5	1.6958	0.53	|Q	|	|	| V	|
21+10	1.6994	0.52	|Q	|	|	| V	|
21+15	1.7030	0.52	|Q	|	|	| V	|
21+20	1.7065	0.52	|Q	|	|	| V	|
21+25	1.7100	0.51	|Q	|	|	| V	|
21+30	1.7135	0.51	|Q	|	|	| V	|
21+35	1.7170	0.50	|Q	|	|	| V	|
21+40	1.7204	0.50	Q	|	|	| V	|
21+45	1.7238	0.49	Q	|	|	| V	|
21+50	1.7272	0.49	Q	|	|	| V	|
21+55	1.7305	0.49	Q	|	|	| V	|
22+ 0	1.7338	0.48	Q	|	|	| V	|
22+ 5	1.7371	0.48	Q	|	|	| V	|
22+10	1.7404	0.47	Q	|	|	| V	|
22+15	1.7436	0.47	Q	|	|	| V	|
22+20	1.7468	0.47	Q	|	|	| V	|
22+25	1.7500	0.46	Q	|	|	| V	|
22+30	1.7532	0.46	Q	|	|	| V	|
22+35	1.7564	0.46	Q	|	|	| V	|
22+40	1.7595	0.45	Q	|	|	| V	|
22+45	1.7626	0.45	Q	|	|	| V	|
22+50	1.7657	0.45	Q	|	|	| V	|
22+55	1.7687	0.44	Q	|	|	| V	|
23+ 0	1.7718	0.44	Q	|	|	| V	|
23+ 5	1.7748	0.44	Q	|	|	| V	|
23+10	1.7778	0.44	Q	|	|	| V	|
23+15	1.7807	0.43	Q	|	|	| V	|
23+20	1.7837	0.43	Q	|	|	| V	|
23+25	1.7866	0.43	Q	|	|	| V	|
23+30	1.7896	0.42	Q	|	|	| V	|
23+35	1.7925	0.42	Q	|	|	| V	|
23+40	1.7953	0.42	Q	|	|	| V	|

23+45	1.7982	0.42	Q	|	|	|	V|
23+50	1.8011	0.41	Q	|	|	|	V|
23+55	1.8039	0.41	Q	|	|	|	V|
24+ 0	1.8067	0.41	Q	|	|	|	V|
24+ 5	1.8093	0.38	Q	|	|	|	V|
24+10	1.8109	0.23	Q	|	|	|	V|
24+15	1.8114	0.07	Q	|	|	|	V|
24+20	1.8115	0.02	Q	|	|	|	V|
24+25	1.8115	0.00	Q	|	|	|	V|







VICINITY
NOT TO SCALE

LEGAL DESCRIPTION:

A PORTION OF FARM LOT 425, ACCORDING TO THE MAP OF THE LANDS BELONGING TO SEMI-TROPIC LAND AND WATER COMPANY, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA AS PER PLAT THEREOF RECORDED IN BOOK 11 OF MAPS, PAGE 12, RECORDS OF SAID COUNTY

ASSESSOR'S PARCEL NO:

0243-142-01, 02, 03, 04, 05 & 06

DEVELOPER / OWNER:

DIVERSIFIED PACIFIC DEVELOPMENT GROUP
10621 CIVIC CENTER DRIVE
RANCHO CUCAMONGA, CA 91730
PH: (909) 481-1150

RAW EARTHWORK:

CUT: 44,931 CY
FILL: 47,730 CY

BENCHMARK:

BENCHMARK # E 4

ELEVATION: 1345.43 (FEET)

DESCRIBED AS: BENCHMARK DISK SET IN A RETAINING WALL OR CONCRETE LEDGE (HEADWALL) STAMPED "MF 4 1986" 0.3 MILE WEST FROM THE INTERSECTION OF CHERRY AVE AND VICTORIA ST 21 FEET NORTH OF VICTORIA ST AT THE CENTER AND ON TOP OF A CONCRETE HEADWALL. A 1-3/8 INCH BRASS DISK.

BASIS OF BEARINGS:

THE BEARINGS AND DISTANCES ARE BASED ON THE CALIFORNIA COORDINATE SYSTEM OF 1983 (CCS83) ZONE V, RELATIVE TO THE NORTH AMERICAN DATUM OF 1983 (2017.50 EPOCH) AND WERE DETERMINED BY STATIC GPS TIES TO TWO CONTINUOUS GPS STATIONS (CGPS) REFERRED TO AS "P575" AND "P612" BEARING BETWEEN BOTH STATIONS BEING NORTH 81°40'46" WEST BASED ON POSITIONS PUBLISHED IN THE CALIFORNIA SPATIAL REFERENCE CENTER. ALL DISTANCES ARE GROUND, UNLESS OTHERWISE NOTED. TO OBTAIN GRID, MULTIPLY GROUND DISTANCE BY A COMBINED FACTOR OF 0.999958411

SITE STATISTICS:

GROSS: ..... 8.43 ACRES
NET: ..... 8.13 ACRES
TOTAL DISTURBED AREA: ..... 8.43 ACRES

LEGEND

TC	TOP OF CURB ELEVATION
FS	FINISHED SURFACE ELEVATION
FG	FINISHED GRADE ELEVATION
INV.	PIPE INVERT ELEVATION
	PROPOSED SLOPE
21	LOT NUMBER
PAD=1321.0	PAD ELEVATION
HP	HIGH POINT ELEVATION
LP	LOW POINT ELEVATION
GB	GRADE BREAK
TW	TOP OF WALL ELEVATION
TF	TOP OF FOOTING ELEVATION
	PROPOSED RETAINING WALL (PER SEPARATE PLAN & PERMIT)
	TRACT BOUNDARY
TB	TOP OF BERM ELEVATION
R/W	RIGHT OF WAY
	PAD LINE
TS	TOP OF SLOPE ELEVATION
(1358.9)	EXISTING ELEVATION
	DIRECTION OF FLOW
LOS	LINE OF SIGHT
★	ADA UNIT
A / A	SECTION / SHEET LOCATION

PAM23-0073

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Perris, California 92570
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Raul J. Allard, R.C.E. 36052 — 03/26/2024
Date

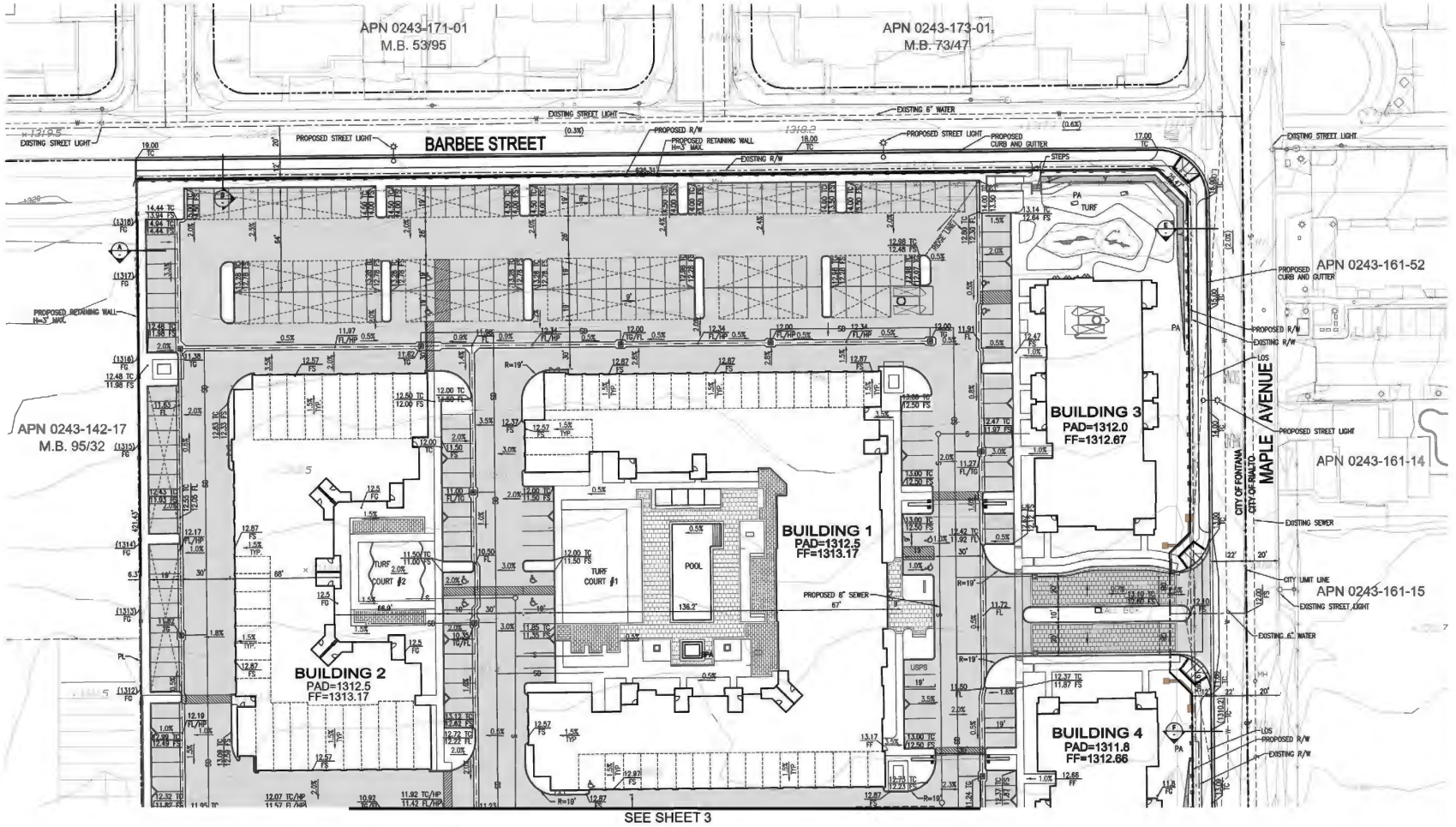
DATE: August, 2024
SCALE: 1"=50'
DRAWN: C.V.
CHECKED: R.J.A.

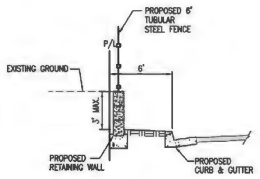
SHEET TITLE: CONCEPTUAL GRADING PLAN
PROJECT: MAPLE AND FOOTHILL
TTM 20704
CITY OF FONTANA, CALIFORNIA
JOB NO.

SHEET NO. 1 OF 3

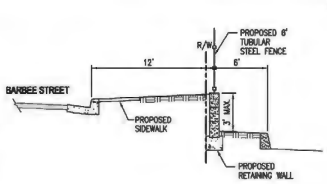
PLOT DATE: August 12, 2024 ReynoldWard

Filename: I:\Diversified Pacific Communities\Maple Fontana\ENG\3)ENTITLEMENT\CONCEPT_GRADING\CONCEPT_GRADING-1.dwg





SECTION "A"
WESTERLY PROPERTY LINE
N.T.S.



SECTION "D"
NORTHERLY PROPERTY LINE
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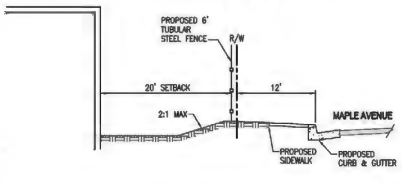

SECTION "E"
EASTERLY PROPERTY LINE
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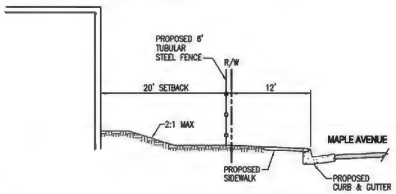
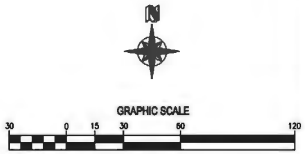


SECTION "F"
EASTERLY PROPERTY LINE
N.T.S.



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Richard J. Allard, R.C.E. 36052 — 03/26/2024 Date

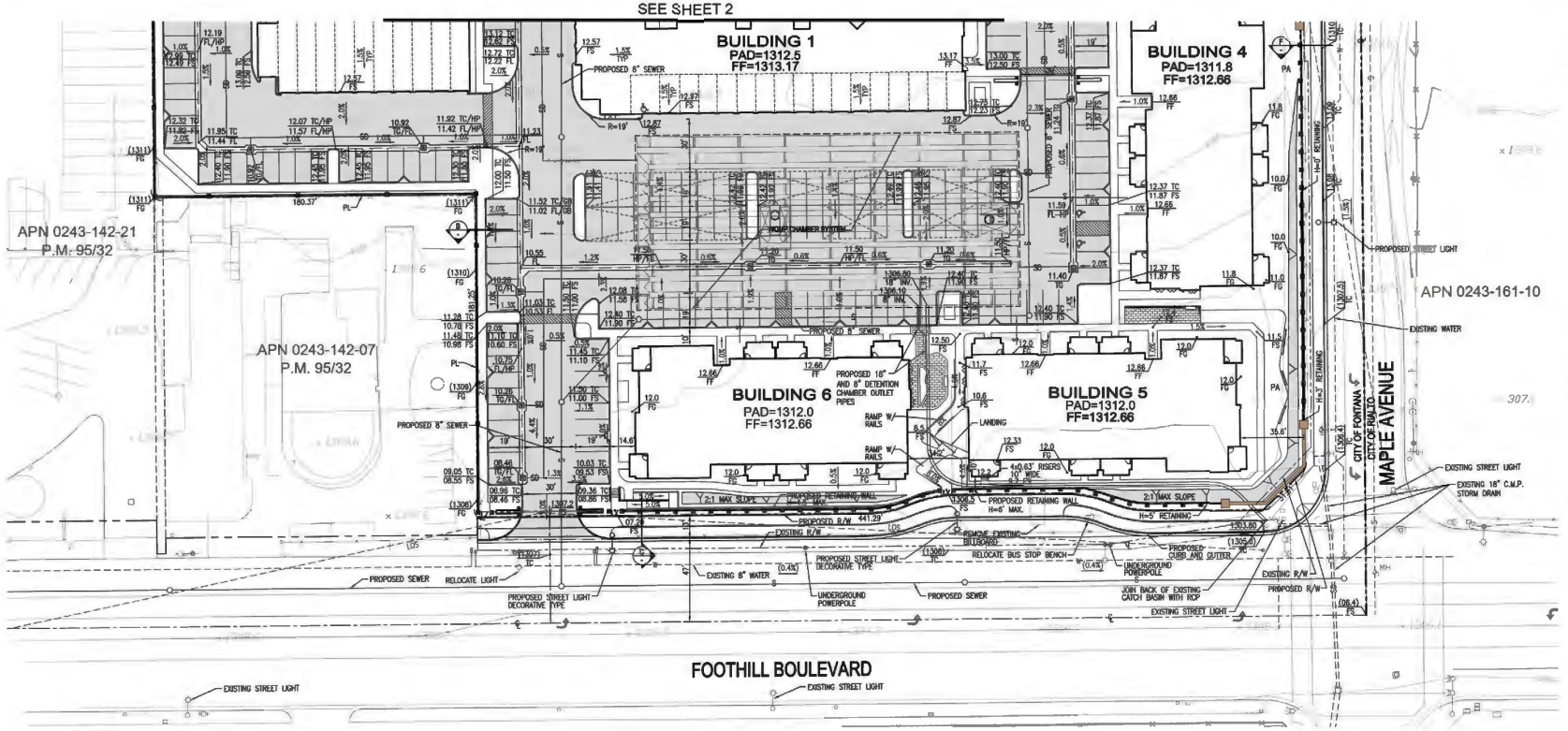
DATE: August, 2024
SCALE: 1"=30'
DRAWN: C.V.
CHECKED: R.J.A.

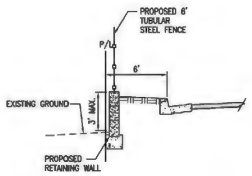
SHEET TITLE: CONCEPTUAL GRADING PLAN
PROJECT: MAPLE AND FOOTHILL
TTM 20704
CITY OF FONTANA, CALIFORNIA
JOB NO.

SHEET NO. 2 OF 3

PLOT DATE: August 12, 2024 ReynoldWard

Filename: I:\Diversified Pacific Communities\Maple Fontana\ONGOING\ENTITLEMENT\CONCEPT_GRADING\CONCEPT_GRADING-2.dwg





SECTION "B"
WESTERLY PROPERTY LINE
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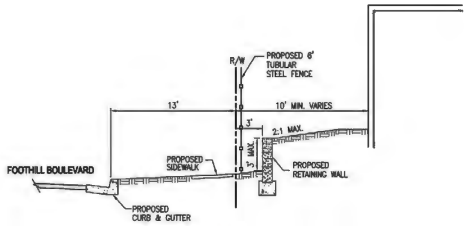
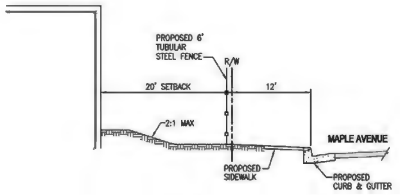


SECTION "C"
SOUTHERLY PROPERTY LINE
N.T.S.



SECTION "F"
EASTERLY PROPERTY LINE
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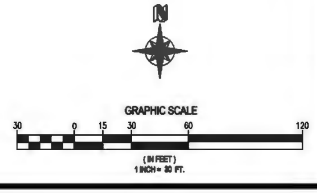

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Reginald J. Allard, R.C.E. 35552
03/28/2024
Date

DATE: August, 2024
SCALE: 1"=30'
DRAWN: C.V.
CHECKED: R.J.A.

SHEET TITLE: CONCEPTUAL GRADING PLAN
PROJECT: MAPLE AND FOOTHILL
TTM 20704
CITY OF FONTANA, CALIFORNIA
JOB NO.

SHEET NO. 3 OF 3

PLOT DATE: August 12, 2024 ReynoldWard

Filename: I:\Diversified Pacific Communities\Maple Fontana\ENG\6)ENTITLEMENT\CONCEPT_GRADING\CONCEPT_GRADING-3.dwg