
Appendix F-1

Water Quality Management Plan

Water Quality Management Plan

For:

Rialto Industrial

APN 013-218-208, 013-218-209, 013-220-204

Prepared for:

Investment Building Group

5100 Campus Dr., #300

Newport Beach, CA 92660

949-263-1111

Prepared by:

Armstrong & Brooks Consulting Engineer, Inc.

1350 E. Chase Dr

Corona, CA 92881

951-372-8400

Submittal Date:

Revision Date:

Approval Date:_____

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Investment Building Group by Armstrong & Brooks Consulting Engineers, Inc. The WQMP is intended to comply with the requirements of the City of Rialto and the NPDES Areawide Stormwater Program requiring the preparation of a WQMP. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

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

Project Data			
Permit/Application Number(s):		Grading Permit Number(s):	
Tract/Parcel Map Number(s):		Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			013-218-208, -209, 013-220-204
Owner's Signature			
Owner Name: Brian Bargemann			
Title			
Company	Investment Building Group		
Address	5100 Campus Drive, Suite 300 Newport Beach, CA 92660		
Email			
Telephone #	949-263-1111		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):		Grading Permit Number(s):	
Tract/Parcel Map Number(s):		Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			013-218-208, -209, 013-220-204

"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: Dennis Armstrong		PE Stamp Below
Title	Principal Engineer	
Company	Armstrong & Brooks Consulting Engineers, Inc.	
Address	1350 E Chase Dr. Corona, CA 92881	
Email	dennis@armstrongbrooks.com	
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Signature		
Date		

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Section 1 Discretionary Permit(s)

Form 1-1 Project Information					
Project Name		Rialto Industrial Building Project			
Project Owner Contact Name:		Brian Bargemann			
Mailing Address:	5100 Campus Drive, Suite 300 Newport Beach, California 92660	E-mail Address:		Telephone:	949-263-1111
Permit/Application Number(s):			Tract/Parcel Map Number(s):		
Additional Information/ Comments:					
Description of Project:		This project proposes two industrial buildings on a six-acre site. The buildings are approximately 71,000 sf and 47,000 sf. The development will also include standard parking, trailer parking, and landscaped area for BMPs. The site currently has an industrial building on the southerly half of the site, which will be demolished for the proposed development. The northerly half of the site is currently barren.			
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.		N/A			

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 ft ² or more of impervious surface on an already developed site	☒ New development involving the creation of 10,000 ft ² 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 ft ² or more		
☐ Hillside developments of 5,000 ft ² 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 ft ² 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 ft ² or more exposed to storm water	☐ Retail gasoline outlets that are either 5,000 ft ² or more, or have a projected average daily traffic of 100 or more vehicles per day		
☐ Non-Priority / Non-Category Project <i>May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements.</i>					
2 Project Area (ft ²):	262,140	3 Number of Dwelling Units:	N/A	4 SIC Code:	
5 Is Project going to be phased? Yes ☐ No ☒ <i>If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.</i>					
6 Does Project include roads? Yes ☐ No ☒ <i>If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)</i>					

2.2 Property Ownership/Management

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

Form 2.2-1 Property Ownership/Management

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

The property owner will be responsible for all BMP maintenance.

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 ☐	
Nutrients - Phosphorous	E ☒	N ☐	
Nutrients - Nitrogen	E ☒	N ☐	
Noxious Aquatic Plants	E ☒	N ☐	
Sediment	E ☒	N ☐	
Metals	E ☒	N ☐	
Oil and Grease	E ☒	N ☐	
Trash/Debris	E ☒	N ☐	
Pesticides / Herbicides	E ☒	N ☐	
Organic Compounds	E ☒	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

2.4 Water Quality Credits

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

Form 2.4-1 Water Quality Credits			
1 Project Types that Qualify for Water Quality Credits: <i>Select all that apply</i>			
☐ 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 % <i>(Total all credit percentages up to a maximum allowable credit of 50 percent)</i>			
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 34.072058	Longitude -117.374115	Thomas Bros Map page
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			
<pre> graph TD Outlet1[Outlet 1] Outlet2[Outlet 2] Outlet3[Outlet 3] DMAA[DMA A] DMAB[DMA B] DMAC[DMA C] DMAE[DMA D] DMAE[DMA E] DMAF[DMA F] DMAA --> Outlet1 DMAB --> Outlet1 DMAC --> Outlet2 DMAE --> Outlet2 DMAE --> Outlet3 DMAF --> Outlet3 </pre>			
Example only – modify for project specific WQMP using additional form			
Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA		
DMA A to Outlet 1	Infiltration Basin A		
DMA B to Outlet 1	Infiltration Basin B		
DMA C to Outlet 2	Infiltration Basin C		
DMA D to Outlet 2	Infiltration Basin D		
DMA E to Outlet 3	Infiltration Basin E		
DMA F to Outlet 3	Infiltration Basin F		

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft ²)	262,140			
2 Existing site impervious area (ft ²)	108,490			
3 Antecedent moisture condition <i>For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf</i>	2			
4 Hydrologic soil group <i>Refer to Watershed Mapping Tool – http://permittrack.sbcounty.gov/wap/</i>	A			
5 Longest flowpath length (ft)	980			
6 Longest flowpath slope (ft/ft)	1.65%			
7 Current land cover type(s) <i>Select from Fig C-3 of Hydrology Manual</i>	78			
8 Pre-developed pervious area condition: <i>Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating</i>	Poor			

Form 3-3 Watershed Description for Drainage Area	
Receiving waters <i>Refer to Watershed Mapping Tool -</i> http://permitrack.sbcounty.gov/wap/ <i>See "Drainage Facilities" link at this website</i>	Rialto Channel; Santa Ana River Reach 4
Applicable TMDLs <i>Refer to Local Implementation Plan</i>	None
303(d) listed impairments <i>Refer to Local Implementation Plan and Watershed Mapping Tool –</i> http://permitrack.sbcounty.gov/wap/ and State Water Resources Control Board website – http://www.waterboards.ca.gov/santaana/water_iss/ues/programs/tmdl/index.shtml	Indicator Bacteria, Copper, Lead,
Environmentally Sensitive Areas (ESA) <i>Refer to Watershed Mapping Tool –</i> http://permitrack.sbcounty.gov/wap/	None
Unlined Downstream Water Bodies <i>Refer to Watershed Mapping Tool –</i> http://permitrack.sbcounty.gov/wap/	None
Hydrologic Conditions of Concern	☐ Yes Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal ☒ No
Watershed-based BMP included in a RWQCB approved WAP	☐ Yes Attach verification of regional BMP evaluation criteria in WAP • More Effective than On-site LID • Remaining Capacity for Project DCV • Upstream of any Water of the US • Operational at Project Completion • Long-Term Maintenance Plan ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMP

4.1.1 Pollution Prevention

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

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

Form 4.1-1 Non-Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Landscape Management BMPs	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	
N6	Local Water Quality Ordinances	☒	☐	
N7	Spill Contingency Plan	☒	☐	
N8	Underground Storage Tank Compliance	☐	☒	
N9	Hazardous Materials Disclosure Compliance	☒	☐	

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	☒	☐	
N11	Litter/Debris Control Program	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☒	☐	
N14	Catch Basin Inspection Program	☒	☐	
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	
N16	Other Non-structural Measures for Public Agency Projects	☒	☐	
N17	Comply with all other applicable NPDES permits	☒	☐	

Form 4.1-2 Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☒	☐	
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	
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)	☒	☐	
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☒	☐	
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☒	☐	
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☒	☐	
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☒	☐	

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)	☒	☐	
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	
S14	Wash water control for food preparation areas	☐	☒	
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	

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 <i>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</i>
Minimize impervious areas: Yes ☒ No ☐ Explanation: Impervious area has been minimized to the feasible extent while meeting parking lot and building standards.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: Proposed BMPs will take advantage of the naturally well-draining soil on site.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: The site will continue to drain southerly. BMPs throughout the site will pick up run-off to treat and convey the flow in conditions similar to existing conditions.
Disconnect impervious areas: Yes ☒ No ☐ Explanation: Where practical, landscaped areas are included to separate impervious areas.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: There is vegetation currently on site to be protected.
Re-vegetate disturbed areas: Yes ☒ No ☐ Explanation: All pervious area, after construction is complete, will be landscaped.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: Construction entrances and staging areas will not be on proposed BMP areas.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☒ No ☐ Explanation: Swells will be used to convey run-off from impervious areas to BMPs where applicable.
Stake off areas that will be used for landscaping to minimize compaction during construction: Yes ☒ No ☐ Explanation: Construction entrances and staging areas will not be on proposed landscaping areas.

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 P₆ method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi²), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for HCOC performance criteria.

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

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA A)		
1 Project area DA 1 (ft ²): 82,177	2 Imperviousness after applying preventative site design practices (Imp%): 78%	3 Runoff Coefficient (Rc): 0.57 $R_c = 0.858(\text{Imp}\%)^{0.3} - 0.78(\text{Imp}\%)^{0.2} + 0.774(\text{Imp}\%) + 0.04$
4 Determine 1-hour rainfall depth for a 2-year return period P _{2yr-1hr} (in): 0.55 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P ₆ , Mean 6-hr Precipitation (inches): 0.81 $P_6 = \text{Item 4} * C_1$, 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): 6,207 $DCV = 1/12 * [\text{Item 1} * \text{Item 3} * \text{Item 5} * C_2]$, where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963) Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2		

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

1 Project area DA 1 (ft ²): 37,638	2 Imperviousness after applying preventative site design practices (Imp%): 86	3 Runoff Coefficient (Rc): 0.68 $R_c = 0.858(\text{Imp}\%)^{0.3} - 0.78(\text{Imp}\%)^{0.2} + 0.774(\text{Imp}\%) + 0.04$
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2\text{yr}-1\text{hr}}$ (in): 0.55 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6 , Mean 6-hr Precipitation (inches): 0.81 $P_6 = \text{Item 4} * C_1$, 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 <i>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.</i>		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft ³): 3,391 $\text{DCV} = 1/12 * [\text{Item 1} * \text{Item 3} * \text{Item 5} * C_2]$, where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963) Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2		

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

1 Project area DA 1 (ft ²): 141,677	2 Imperviousness after applying preventative site design practices (Imp%): 80	3 Runoff Coefficient (Rc): 0.60 $R_c = 0.858(\text{Imp}\%)^{0.3} - 0.78(\text{Imp}\%)^{0.2} + 0.774(\text{Imp}\%) + 0.04$
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2\text{yr}-1\text{hr}}$ (in): 0.55 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6 , Mean 6-hr Precipitation (inches): 0.81 $P_6 = \text{Item 4} * C_1$, 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 <i>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.</i>		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft ³): 11,264 $\text{DCV} = 1/12 * [\text{Item 1} * \text{Item 3} * \text{Item 5} * C_2]$, where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963) Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2		

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

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

Go to: <http://permitrack.sbcounty.gov/wap/>

If "Yes", then complete HCOC assessment of site hydrology for 2yr storm event using Forms 4.2-3 through 4.2-5 and insert results below
(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual)

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

Condition	Runoff Volume (ft ³)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	1 <i>Form 4.2-3 Item 12</i>	2 <i>Form 4.2-4 Item 13</i>	3 <i>Form 4.2-5 Item 10</i>
Post-developed	4 <i>Form 4.2-3 Item 13</i>	5 <i>Form 4.2-4 Item 14</i>	6 <i>Form 4.2-5 Item 14</i>
Difference	7 <i>Item 4 – Item 1</i>	8 <i>Item 2 – Item 5</i>	9 <i>Item 6 – Item 3</i>
Difference (as % of pre-developed)	10 % <i>Item 7 / Item 1</i>	11 % <i>Item 8 / Item 2</i>	12 % <i>Item 9 / Item 3</i>

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

Weighted Curve Number Determination for: <u>Pre-developed DA</u>	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft ² <i>sum of areas of DMA should equal area of DA</i>								
4a Curve Number (CN) <i>use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP</i>								
Weighted Curve Number Determination for: <u>Post-developed DA</u>	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft ² <i>sum of areas of DMA should equal area of DA</i>								
4b Curve Number (CN) <i>use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP</i>								
5 Pre-Developed area-weighted CN:	7 Pre-developed soil storage capacity, S (in): $S = (1000 / \text{Item 5}) - 10$				9 Initial abstraction, I _a (in): $I_a = 0.2 * \text{Item 7}$			
6 Post-Developed area-weighted CN:	8 Post-developed soil storage capacity, S (in): $S = (1000 / \text{Item 6}) - 10$				10 Initial abstraction, I _a (in): $I_a = 0.2 * \text{Item 8}$			
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): $V_{pre} = (1 / 12) * (\text{Item sum of Item 3}) * [(\text{Item 11} - \text{Item 9})^2 / ((\text{Item 11} - \text{Item 9} + \text{Item 7}))]$								
13 Post-developed Volume (ft ³): $V_{pre} = (1 / 12) * (\text{Item sum of Item 3}) * [(\text{Item 11} - \text{Item 10})^2 / ((\text{Item 11} - \text{Item 10} + \text{Item 8}))]$								
14 Volume Reduction needed to meet HCOC Requirement, (ft ³): $V_{HCOC} = (\text{Item 13} * 0.95) - \text{Item 12}$								

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

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

Variables	Pre-developed DA1 <i>Use additional forms if there are more than 4 DMA</i>				Post-developed DA1 <i>Use additional forms if there are more than 4 DMA</i>			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) <i>Use Form 3-2 Item 5 for pre-developed condition</i>								
2 Change in elevation (ft)								
3 Slope (ft/ft), $S_o = \text{Item 2} / \text{Item 1}$								
4 Land cover								
5 Initial DMA Time of Concentration (min) <i>Appendix C-1 of the TGD for WQMP</i>								
6 Length of conveyance from DMA outlet to project site outlet (ft) <i>May be zero if DMA outlet is at project site outlet</i>								
7 Cross-sectional area of channel (ft ²)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) $V_{fps} = (1.49 / \text{Item 9}) * (\text{Item 7} / \text{Item 8})^{0.67} * (\text{Item 3})^{0.5}$								
11 Travel time to outlet (min) $T_t = \text{Item 6} / (\text{Item 10} * 60)$								
12 Total time of concentration (min) $T_c = \text{Item 5} + \text{Item 11}$								
13 Pre-developed time of concentration (min): <i>Minimum of Item 12 pre-developed DMA</i>								
14 Post-developed time of concentration (min): <i>Minimum of Item 12 post-developed DMA</i>								
15 Additional time of concentration needed to meet HCOC requirement (min): $T_{C-HCOC} = (\text{Item 13} * 0.95) - \text{Item 14}$								

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

Compute peak runoff for pre- and post-developed conditions

Variables	Pre-developed DA to Project Outlet (Use additional forms if more than 3 DMA)			Post-developed DA to Project Outlet (Use additional forms if more than 3 DMA)								
	DMA A	DMA B	DMA C	DMA A	DMA B	DMA C						
1 Rainfall Intensity for storm duration equal to time of concentration $I_{peak} = 10^{(LOG \text{ Form 4.2-1 Item 4} - 0.6 LOG \text{ Form 4.2-4 Item 5} / 60)}$												
2 Drainage Area of each DMA (Acres) <i>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)</i>												
3 Ratio of pervious area to total area <i>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)</i>												
4 Pervious area infiltration rate (in/hr) <i>Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP</i>												
5 Maximum loss rate (in/hr) $F_m = \text{Item 3} * \text{Item 4}$ <i>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)</i>												
6 Peak Flow from DMA (cfs) $Q_p = \text{Item 2} * 0.9 * (\text{Item 1} - \text{Item 5})$												
7 Time of concentration adjustment factor for other DMA to site discharge point <i>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)</i>	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: $Q_p = \text{Item 6}_{DMAA} + [\text{Item 6}_{DMAB} * (\text{Item 1}_{DMAA} - \text{Item 5}_{DMAB}) / (\text{Item 1}_{DMAB} - \text{Item 5}_{DMAB}) * \text{Item 7}_{DMAA/2}] + [\text{Item 6}_{DMAC} * (\text{Item 1}_{DMAA} - \text{Item 5}_{DMAC}) / (\text{Item 1}_{DMAC} - \text{Item 5}_{DMAC}) * \text{Item 7}_{DMAA/3}]$	9 Pre-developed Q_p at T_c for DMA B: $Q_p = \text{Item 6}_{DMAB} + [\text{Item 6}_{DMAA} * (\text{Item 1}_{DMAB} - \text{Item 5}_{DMAA}) / (\text{Item 1}_{DMAA} - \text{Item 5}_{DMAA}) * \text{Item 7}_{DMAB/1}] + [\text{Item 6}_{DMAC} * (\text{Item 1}_{DMAB} - \text{Item 5}_{DMAC}) / (\text{Item 1}_{DMAC} - \text{Item 5}_{DMAC}) * \text{Item 7}_{DMAB/3}]$			10 Pre-developed Q_p at T_c for DMA C: $Q_p = \text{Item 6}_{DMAC} + [\text{Item 6}_{DMAA} * (\text{Item 1}_{DMAC} - \text{Item 5}_{DMAA}) / (\text{Item 1}_{DMAA} - \text{Item 5}_{DMAA}) * \text{Item 7}_{DMAC/1}] + [\text{Item 6}_{DMAB} * (\text{Item 1}_{DMAC} - \text{Item 5}_{DMAB}) / (\text{Item 1}_{DMAB} - \text{Item 5}_{DMAB}) * \text{Item 7}_{DMAC/2}]$								
10 Peak runoff from pre-developed condition confluence analysis (cfs): <i>Maximum of Item 8, 9, and 10 (including additional forms as needed)</i>												
11 Post-developed Q_p at T_c for DMA A: <i>Same as Item 8 for post-developed values</i>	12 Post-developed Q_p at T_c for DMA B: <i>Same as Item 9 for post-developed values</i>			13 Post-developed Q_p at T_c for DMA C: <i>Same as Item 10 for post-developed values</i>								
14 Peak runoff from post-developed condition confluence analysis (cfs): <i>Maximum of Item 11, 12, and 13 (including additional forms as needed)</i>												
15 Peak runoff reduction needed to meet HCOC Requirement (cfs): $Q_{p-HCOC} = (\text{Item 14} * 0.95) - \text{Item 10}$												

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 8 below.

⁸ Any answer from Item 4 through Item 6 is "Yes":

Yes ☐ No ☒

If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP. If no, then proceed to Item 9, below.

⁹ All answers to Item 1 through Item 6 are "No":

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) $V = \text{Item 2} * \text{Item 3} * (0.5/12)$, assuming retention of 0.5 inches of runoff			
5 Sum of retention volume achieved from impervious area dispersion (ft ³):		$V_{\text{retention}} = \text{Sum of Item 4 for all BMPs}$	
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) $V_{\text{retention}} = (\text{Item 7} * \text{Item 8}) + (\text{Item 9} * \text{Item 10} * \text{Item 11})$			
13 Runoff volume retention from on-lot infiltration (ft ³):		$V_{\text{retention}} = \text{Sum of Item 12 for all BMPs}$	

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 ☐ <i>If yes, complete Items 15-20. If no, proceed to Item 21</i>	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) <i>Use local values, typical ~ 0.1</i>			
17 Daily ET demand (ft ³ /day) <i>Item 15 * (Item 16 / 12)</i>			
18 Drawdown time (hrs) <i>Copy Item 6 in Form 4.2-1</i>			
19 Retention Volume (ft ³) <i>V_{retention} = Item 17 * (Item 18 / 24)</i>			
20 Runoff volume retention from evapotranspiration BMPs (ft ³): <i>V_{retention} = Sum of Item 19 for all BMPs</i>			
21 Implementation of Street Trees: Yes ☐ No ☐ <i>If yes, complete Items 22-25. If no, proceed to Item 26</i>	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) <i>V_{retention} = Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches</i>			
25 Runoff volume retention from street tree BMPs (ft ³): <i>V_{retention} = Sum of Item 24 for all BMPs</i>			
26 Implementation of residential rain barrel/cisterns: Yes ☐ No ☐ <i>If yes, complete Items 27-29; If no, proceed to Item 30</i>	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) <i>V_{retention} = Item 27 * 3</i>			
29 Runoff volume retention from residential rain barrels/Cisterns (ft ³): <i>V_{retention} = Sum of Item 28 for all BMPs</i>			
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs: <i>Sum of Items 5, 13, 20, 25 and 29</i>			

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 - including underground BMPs (DA A)

1 Remaining LID DCV not met by site design HSC BMP (ft ³): 6,207 $V_{unmet} = \text{Form 4.2-1 Item 7} - \text{Form 4.3-2 Item 30}$			
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 A DMA 1 BMP Type: Infiltration Trench	DA A DMA 2 BMP Type: Infiltration Trench	DA DMA BMP Type:
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	6	6	
3 Infiltration safety factor See TGD Section 5.4.2 and Appendix D	5	5	
4 Design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$	1.2	1.2	
5 Ponded water drawdown time (hr) Copy Item 6 in Form 4.2-1	48	48	
6 Maximum ponding depth (ft) BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details	5	5	
7 Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$	1.7	2	
8 Infiltrating surface area, SA_{BMP} (ft ²) the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP	1,055	1,055	
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			
10 Amended soil porosity			
11 Gravel depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details	2	2	
12 Gravel porosity	0.4	0.4	
13 Duration of storm as basin is filling (hrs) Typical ~ 3hrs	3	3	
14 Above Ground Retention Volume (ft ³) $V_{retention} = \text{Item 8} * [\text{Item 7} + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$	2,954	3,271	
15 Underground Retention Volume (ft ³) Volume determined using manufacturer's specifications and calculations			
16 Total Retention Volume from LID Infiltration BMPs: 6,225 (Sum of Items 14 and 15 for all infiltration BMP included in plan)			
17 Fraction of DCV achieved with infiltration BMP: % $\text{Retention\%} = \text{Item 16} / \text{Form 4.2-1 Item 7}$			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐ If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.			

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

1 Remaining LID DCV not met by site design HSC BMP (ft ³): 3,391 $V_{unmet} = \text{Form 4.2-1 Item 7} - \text{Form 4.3-2 Item 30}$			
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 B DMA 1 BMP Type: Infiltration Trench	DA DMA BMP Type:	DA DMA BMP Type:
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	6		
3 Infiltration safety factor See TGD Section 5.4.2 and Appendix D	5		
4 Design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$	1.2		
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	5		
7 Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$	0.5		
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	2,206		
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			
10 Amended soil porosity			
11 Gravel depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details	2		
12 Gravel porosity	0.4		
13 Duration of storm as basin is filling (hrs) Typical ~ 3hrs	3		
14 Above Ground Retention Volume (ft ³) $V_{retention} = \text{Item 8} * [\text{Item 7} + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$	3,530		
15 Underground Retention Volume (ft ³) Volume determined using manufacturer's specifications and calculations			
16 Total Retention Volume from LID Infiltration BMPs: 3,530 (Sum of Items 14 and 15 for all infiltration BMP included in plan)			
17 Fraction of DCV achieved with infiltration BMP: % $\text{Retention\%} = \text{Item 16} / \text{Form 4.2-1 Item 7}$			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐ If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.			

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

1 Remaining LID DCV not met by site design HSC BMP (ft ³): 11,264 $V_{unmet} = \text{Form 4.2-1 Item 7} - \text{Form 4.3-2 Item 30}$			
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 C DMA 1 BMP Type: Infiltration Trench	DA C DMA 2 BMP Type: Infiltration Trench	DA C DMA 3 BMP Type: Infiltration Trench
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	6	6	6
3 Infiltration safety factor See TGD Section 5.4.2 and Appendix D	5	5	5
4 Design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$	1.2	1.2	1.2
5 Ponded water drawdown time (hr) Copy Item 6 in Form 4.2-1	48	48	48
6 Maximum ponding depth (ft) BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details	5	5	5
7 Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$	2.4	1	2.3
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	888	789	1,573
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			
10 Amended soil porosity			
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	3	3	3
12 Gravel porosity	0.4	0.4	0.4
13 Duration of storm as basin is filling (hrs) Typical ~ 3hrs	3	3	3
14 Above Ground Retention Volume (ft ³) $V_{retention} = \text{Item 8} * [\text{Item 7} + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$	3,463	1,973	5,977
15 Underground Retention Volume (ft ³) Volume determined using manufacturer's specifications and calculations			
16 Total Retention Volume from LID Infiltration BMPs: 11,413 (Sum of Items 14 and 15 for all infiltration BMP included in plan)			
17 Fraction of DCV achieved with infiltration BMP: 100% $\text{Retention\%} = \text{Item 16} / \text{Form 4.2-1 Item 7}$			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐ If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.			

4.3.3 Harvest and Use BMP

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

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

Form 4.3-4 Harvest and Use BMPs (DA 1)			
1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft ³): <i>V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 - Form 4.3-3 Item 16</i>			
BMP Type(s) <i>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</i>	DA BMP Type	DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
2 Describe cistern or runoff detention facility			
3 Storage volume for proposed detention type (ft ³) <i>Volume of cistern</i>			
4 Landscaped area planned for use of harvested stormwater (ft ²)			
5 Average wet season daily irrigation demand (in/day) <i>Use local values, typical ~ 0.1 in/day</i>			
6 Daily water demand (ft ³ /day) <i>Item 4 * (Item 5 / 12)</i>			
7 Drawdown time (hrs) <i>Copy Item 6 from Form 4.2-1</i>			
8 Retention Volume (ft ³) <i>V_{retention} = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))</i>			
9 Total Retention Volume (ft ³) from Harvest and Use BMP <i>Sum of Item 8 for all harvest and use BMP included in plan</i>			
10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest & use BMPs? Yes ☐ No ☐ <i>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.</i>			

4.3.4 Biotreatment BMP

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

Use Form 4.3-5 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV w. Biotreatment computations are included as follows:

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

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)		
1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft ³): <i>Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9</i>		List pollutants of concern <i>Copy from Form 2.3-1.</i>
2 Biotreatment BMP Selected <i>(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)</i>	Volume-based biotreatment <i>Use Forms 4.3-6 and 4.3-7 to compute treated volume</i>	Flow-based biotreatment <i>Use Form 4.3-8 to compute treated volume</i>
	☐ 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): <i>Form 4.3-6 Item 15 + Form 4.3-7 Item 13</i>	4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft ³): <i>Item 1 – Item 3</i>	5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % <i>Item 4 / Item 1</i>
6 Flow-based biotreatment BMP capacity provided (cfs): <i>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)</i>		
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: ☐ <i>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.</i>		

Form 4.3-6 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type (Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
1 Pollutants addressed with BMP <i>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</i>			
2 Amended soil infiltration rate <i>Typical ~ 5.0</i>			
3 Amended soil infiltration safety factor <i>Typical ~ 2.0</i>			
4 Amended soil design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$			
5 Pondered water drawdown time (hr) <i>Copy Item 6 from Form 4.2-1</i>			
6 Maximum ponding depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
7 Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$			
8 Amended soil surface area (ft ²)			
9 Amended soil depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
10 Amended soil porosity, n			
11 Gravel depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
12 Gravel porosity, n			
13 Duration of storm as basin is filling (hrs) <i>Typical ~ 3hrs</i>			
14 Biotreated Volume (ft ³) $V_{biotreated} = \text{Item 8} * [(\text{Item 7}/2) + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$			
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: <i>Sum of Item 14 for all volume-based BMPs included in this form</i>			

Form 4.3-7 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type <i>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.</i>	DA DMA BMP Type		DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin <i>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</i>				
2 Bottom width (ft)				
3 Bottom length (ft)				
4 Bottom area (ft ²) $A_{bottom} = \text{Item 2} * \text{Item 3}$				
5 Side slope (ft/ft)				
6 Depth of storage (ft)				
7 Water surface area (ft ²) $A_{surface} = (\text{Item 2} + (2 * \text{Item 5} * \text{Item 6})) * (\text{Item 3} + (2 * \text{Item 5} * \text{Item 6}))$				
8 Storage volume (ft ³) <i>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</i> $V = \text{Item 6} / 3 * [\text{Item 4} + \text{Item 7} + (\text{Item 4} * \text{Item 7})^{0.5}]$				
9 Drawdown Time (hrs) <i>Copy Item 6 from Form 2.1</i>				
10 Outflow rate (cfs) $Q_{BMP} = (\text{Item 8}_{forebay} + \text{Item 8}_{basin}) / (\text{Item 9} * 3600)$				
11 Duration of design storm event (hrs)				
12 Biotreated Volume (ft ³) $V_{biotreated} = (\text{Item 8}_{forebay} + \text{Item 8}_{basin}) + (\text{Item 10} * \text{Item 11} * 3600)$				
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : <i>(Sum of Item 12 for all BMP included in plan)</i>				

Form 4.3-8 Flow Based Biotreatment (DA 1)

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

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	
1	Total LID DCV for the Project DA-1 (ft ³): 20,862 <i>Copy Item 7 in Form 4.2-1</i>
2	On-site retention with site design hydrologic source control LID BMP (ft ³): 0 <i>Copy Item 30 in Form 4.3-2</i>
3	On-site retention with LID infiltration BMP (ft ³): 21,168 <i>Copy Item 16 in Form 4.3-3</i>
4	On-site retention with LID harvest and use BMP (ft ³): <i>Copy Item 9 in Form 4.3-4</i>
5	On-site biotreatment with volume based biotreatment BMP (ft ³): <i>Copy Item 3 in Form 4.3-5</i>
6	Flow capacity provided by flow based biotreatment BMP (cfs): <i>Copy Item 6 in Form 4.3-5</i>
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 ☐ <i>If yes, sum of Items 2, 3, and 4 is greater than Item 1</i> - 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 ☐ <i>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</i> - 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 ☐ <i>If yes, Form 4.3-1 Items 7 and 8 were both checked yes</i>
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: ☐ <i>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, $V_{alt} = (Item\ 1 - Item\ 2 - Item\ 3 - Item\ 4 - Item\ 5) * (100 - Form\ 2.4-1\ Item\ 2)\%$</i> - 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: ☐ <i>Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed</i>

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): N/A <i>(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1</i>	2 On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft ³): <i>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</i>
3 Remaining volume for HCOC volume capture (ft ³): <i>Item 1 – Item 2</i>	4 Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft ³): <i>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)</i>
5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification ☐ <i>Attach in-stream control BMP selection and evaluation to this WQMP</i>	
6 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☐ <i>If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:</i> - Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP ☐ <i>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)</i> - 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 ☐ <i>If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:</i> - Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs ☐ <i>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)</i> - 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
Infiltration Trench	Property Owner	Stabilize eroded banks. Repair undercut and eroded areas at inflow and outflow structures. Mow as appropriate for vegetative cover species and monitor health of vegetation. Remove litter and debris from basin.	Ongoing/ As needed
Infiltration Trench	Property Owner	Check basin for sediment deposits and clean as needed	Annually

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.

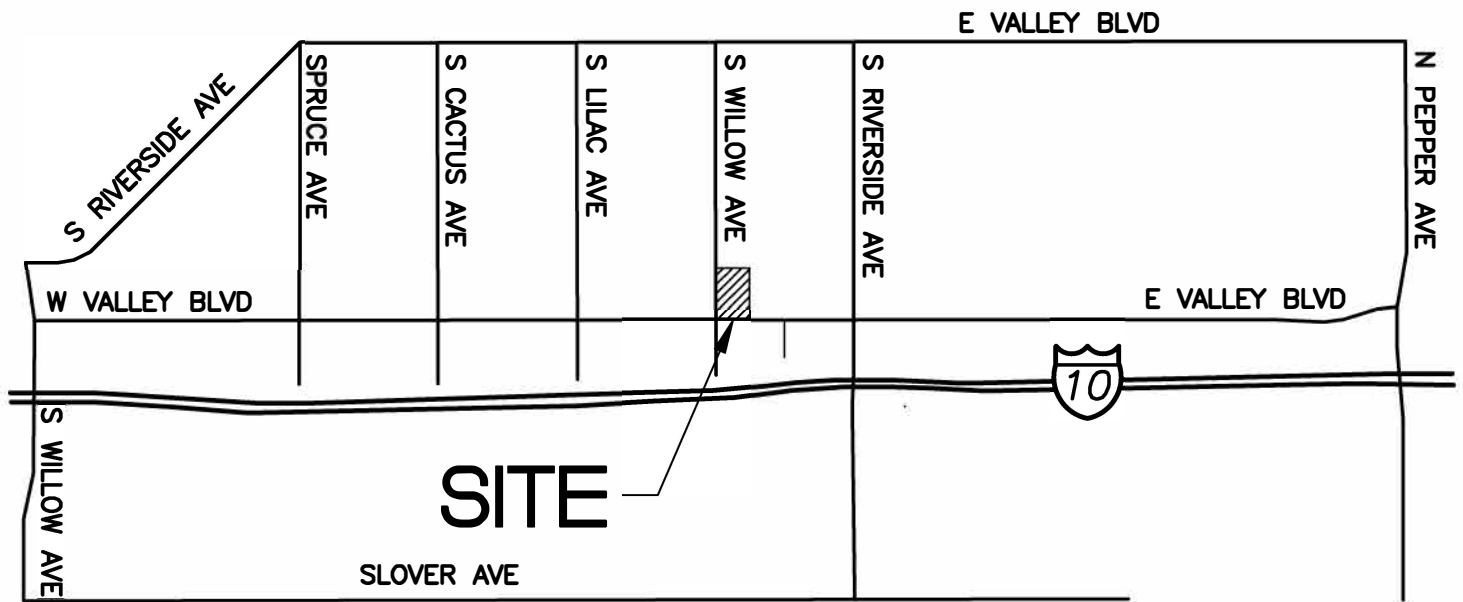
6.4 Other Supporting Documentation

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

ATTACHMENT A

Preliminary WQMP Site Plan, Vicinity Map and Location Map

VICINITY MAP

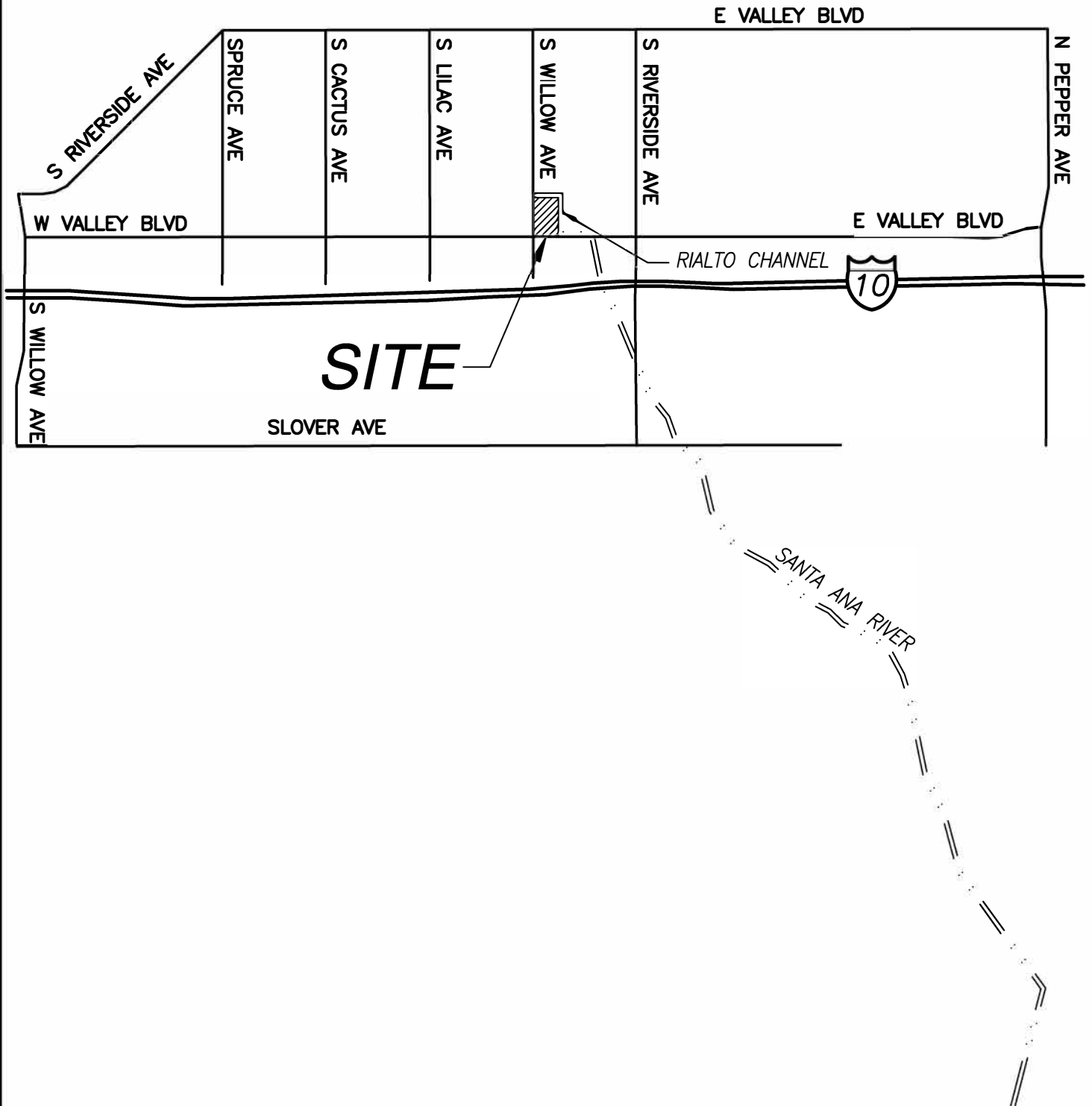


ARMSTRONG & BROOKS CONSULTING ENGINEERS

PLANNING - INFRASTRUCTURE - SITE DEVELOPMENT - WATER RESOURCES
1350 EAST CHASE DRIVE - CORONA, CA 92881
MAIL: P.O. BOX 78088 CORONA, CA 92877-998
P: 951 - 372 - 8400 F: 951 - 372 - 8430

VICINITY MAP
FOR
RIALTO INDUSTRIAL
RIALTO, CA

RECEIVING WATERS MAP



PREPARED BY:



ARMSTRONG & BROOKS CONSULTING ENGINEERS

PLANNING - INFRASTRUCTURE - SITE DEVELOPMENT - WATER RESOURCES

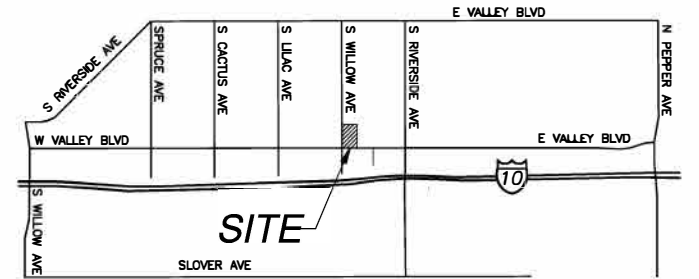
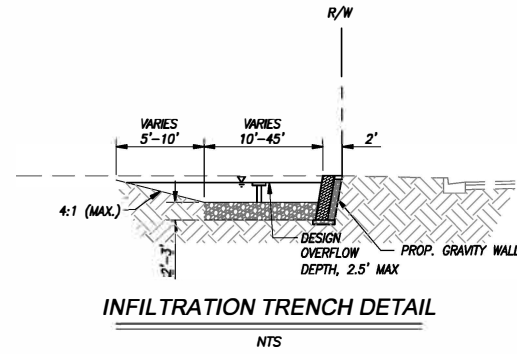
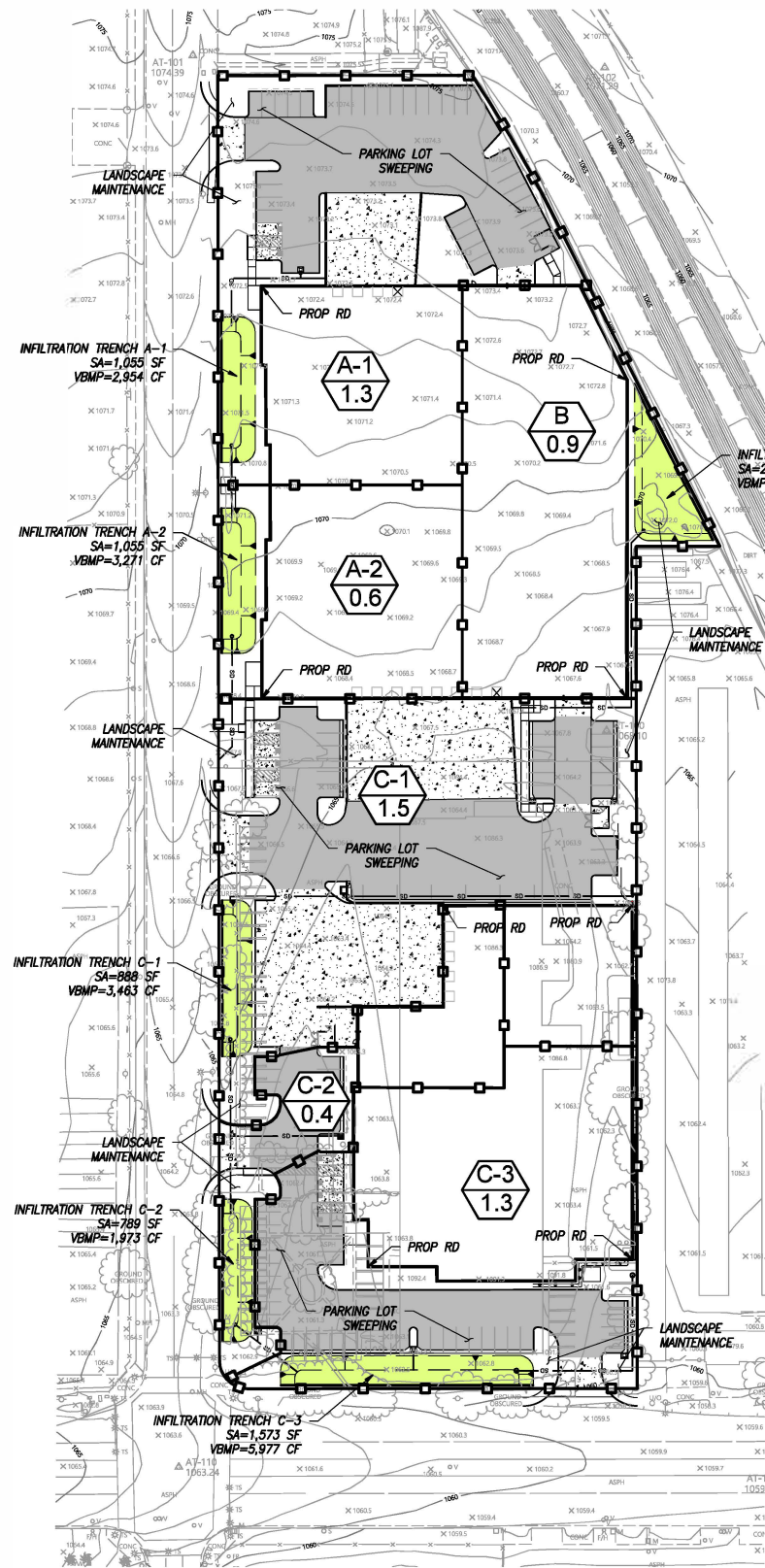
1350 EAST CHASE DRIVE - CORONA, CA 92882

P: 951 - 872 - 8400 F: 951 - 872 - 8430

RECEIVING WATERS MAP

FOR

RIALTO INDUSTRIAL
RIALTO, CA

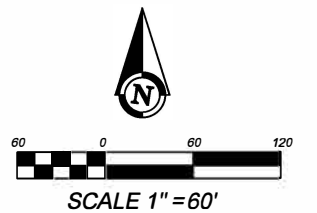


LEGEND

- FLOWLINE
- PROPERTY LINE
- R/W
- SD
- STORM DRAIN
- DRAINAGE MANAGEMENT AREA
- ACREAGE
- DMA BOUNDARY
- CENTERLINE
- AC
- PCC
- PROP. BMP

SUMMARY TABLE

DMA ID	AREA (SF)	IMP AREA (SF)	DCV (CF)	BMP VOLUME (CF)
A	82,177	64,098	6,207	6,225
B	37,638	32,369	3,391	3,530
C	141,677	113,342	11,264	11,413



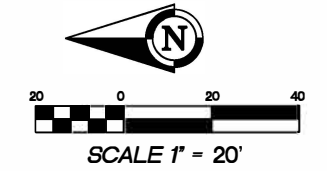
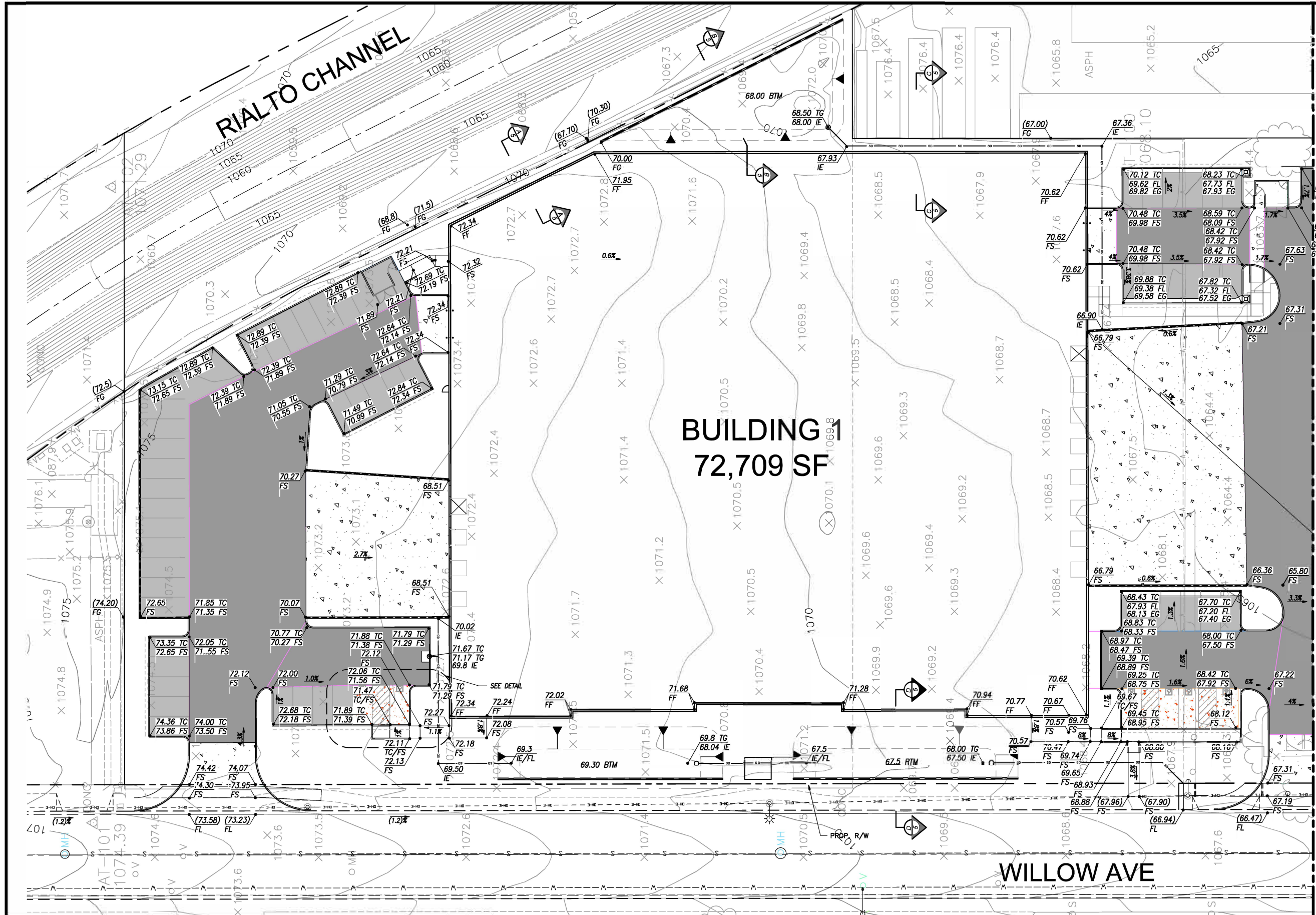
WQMP SITE PLAN FOR RIALTO INDUSTRIAL RIALTO, CA

PREPARED BY:

ARMSTRONG & BROS. CONSULTING ENGINEERS
PLANNING, ENGINEERING, AND CONSTRUCTION SERVICES
1000 S. 10TH STREET, SUITE 100, RIALTO, CA 92403
TEL: 951-509-5400 FAX: 951-509-5401

ATTACHMENT B

Construction Plans





Know what's below.
Call before you dig.

MARK	REVISIONS	APPR.	DATE

DESIGNED BY: DA DRAWN BY: QC CHECKED BY: WH

SEAL-DESIGN ENGINEER



PREPARED UNDER THE SUPERVISION OF:
DENNIS ARMSTRONG RPE C48758, EXP. 09/30/2022 DATE
RECOMMENDED FOR APPROVAL BY:
XXXXXXXXXXXXXXXXXXXXX DATE
APPROVED BY:
ROBERT G. EISENBEISZ, PUBLIC WORKS DIRECTOR/CITY ENGINEER, REC 54931 DATE



Armstrong & Brooks Consulting Engineers, Inc.
Civil Engineering - Water Resources - Surveying
1350 E. Chase Drive, Corona, CA 92881
Mail: P.O. Box 78088, Corona, CA 92887
Ph. (951) 372-8400, Fax (951) 372-8430

BENCHMARK DESCRIPTION: B.M. NO. ELEVATION=

CITY OF RIALTO
PRECISE GRADING PLANS
280 W Valley Blvd, Rialto, CA 92376

FOR: INVESTMENT BUILDING GROUP PPD No. XXXXX PLAN No. 121-1965

3
OF 5 SHEETS

BUILDING 2
45,593 SF

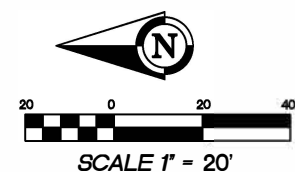
CONSTRUCTION NOTES - HARDSCAPE

1. CONSTRUCT XX" PCC OVER XX" ASPHALT BASE
2. CONSTRUCT XX" ASPHALT CONCRETE OVER XX" AGGREGATE BASE
3. CONSTRUCT XX" ASPHALT CONCRETE OVER XX" AGGREGATE BASE
4. CONSTRUCT 6" CURB
5. CONSTRUCT 6" CURB AND GUTTER
6. CONSTRUCT 3' MAX SEGMENTAL RETAINING WALL

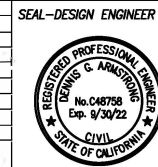
CONSTRUCTION NOTES - STORM DRAIN

1. CONSTRUCT XX" PVC STORM DRAIN
2. CONSTRUCT LANDSCAPE ATRIUM GRATE PER DETAIL ON SHEET XX
3. CONSTRUCT XX" PVC RISER PER DETAIL ON SHEET XX
4. CONSTRUCT "X" DROP INLET PER DETAIL ON SHEET XX
5. XXXXXXXX

VALLEY BLVD



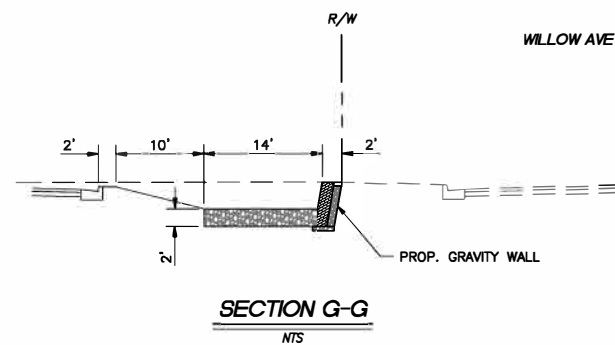
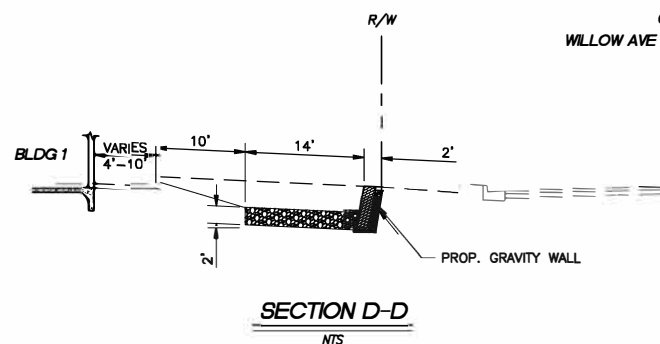
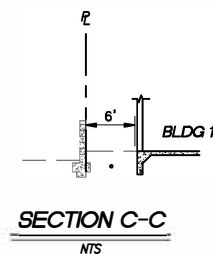
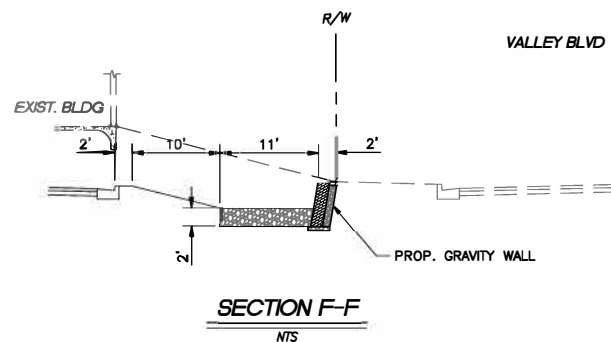
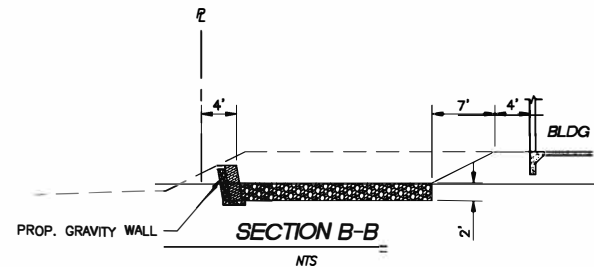
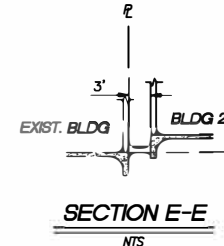
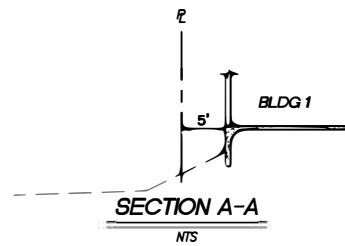
MARK	REVISIONS	APPR.	DATE
DESIGNED BY: DA	DRAWN BY: QC	CHECKED BY: WH	



PREPARED UNDER THE SUPERVISION OF:
DENNIS ARMSTRONG RPE C48758, EXP. 09/30/2022
RECOMMENDED FOR APPROVAL BY:
XXXXXXXXXXXXXXXXXXXX
APPROVED BY:
ROBERT G. EISENBEISZ, PUBLIC WORKS DIRECTOR/CITY ENGINEER, REC 54931

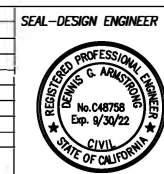
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BENCHMARK DESCRIPTION: B.M. NO. ELEVATION=

CITY OF RIALTO
PRECISE GRADING PLANS
280 W Valley Blvd, Rialto, CA 92376
FOR: INVESTMENT BUILDING GROUP PPD No. XXXXX PLAN No. 121-1965
4 OF 5 SHEETS



MARK	REVISIONS	APPR.	DATE

DESIGNED BY: DA DRAWN BY: QC CHECKED BY: WH



PREPARED UNDER THE SUPERVISION OF:
 DENNIS ARMSTRONG RPE C48758, EXP. 09/30/2022 DATE
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CITY OF RIALTO
 PRECISE GRADING PLANS
 280 W Valley Blvd, Rialto, CA 92376
 FOR: INVESTMENT BUILDING GROUP PPD No. XXXXX PLAN No. 121-1965
 5 OF 5 SHEETS

ATTACHMENT C

Property Ownership/Management Responsibilities

ATTACHMENT D

Soil Information

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

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) $p=w \times v$
A	Suitability Assessment	Soil Assessment Methods	0.25	3	0.75
		Predominant soil texture	0.25	2	0.5
		Site soil variability	0.25	1	0.25
		Depth to groundwater/ impervious layer	0.25	2	0.5
		Suitability Assessment Safety Factor, $S_A=\Sigma p$			2
B	Design	Tributary area size	0.25	2	0.5
		Level of pretreatment/expected sediment loads	0.25	2	0.5
		Redundancy	0.25	3	0.75
		Compaction during construction	0.25	3	0.75
		Design Safety Factor, $S_B=\Sigma p$			2.5

Combined Safety Factor, $STOT=S_A \times S_B$

5

Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)

Design Infiltration Rate, in/hr, $K_{DESIGN}=STOT \times K_M$

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

Geotechnical Engineering Investigation

Proposed Industrial Warehouse Development
280 W. Valley Boulevard
Rialto, California

Investment Building Group
5100 Campus Drive, Suite 300
Newport Beach, California 92660

Attn: Mr. Brian Bargemann

Project Number 22806-21
October 8, 2021

NorCal Engineering

NorCal Engineering
Soils and Geotechnical Consultants
10641 Humbolt Street Los Alamitos, CA 90720
(562) 799-9469 Fax (562) 799-9459

October 8, 2021

Project Number 22806-21

Investment Building Group
5100 Campus Drive, Suite 300
Newport Beach, California 92660

Attn: Mr. Brian Bargemann

RE: **Geotechnical Engineering Investigation** - Proposed Industrial Warehouse
Development - Located at 280 W. Valley Boulevard, in the City of Rialto,
California

Dear Mr. Bargemann:

Pursuant to your request, this firm has performed a Geotechnical Engineering Investigation for the above referenced project in accordance with your approval of our proposal dated June 23, 2021. The purpose of this investigation is to evaluate the geotechnical conditions of the subject site and to provide recommendations for the proposed industrial warehouse development.

The scope of work included the following: 1) site reconnaissance; 2) subsurface geotechnical exploration and sampling; 3) laboratory testing; 4) soil infiltration testing; 5) engineering analysis of field and laboratory data; 6) preparation of a geotechnical engineering report. It is the opinion of this firm that the proposed development is feasible from a geotechnical standpoint provided that the recommendations presented in this report are followed in the design and construction of the project.

1.0 Project Description

It is proposed to construct an industrial warehouse development consisting of two (2) buildings totaling 125,983 square feet building on the 6.47-acre subject site as shown on the attached Site Plan (Figure 1). The proposed concrete tilt-up buildings will be supported by a conventional slab-on-grade foundation systems with perimeter-spread footings and isolated interior footings. Other improvements will include asphalt and concrete pavement areas, hardscape and landscaping. This firm should have an opportunity to review plans once available to determine if any additional investigation will be necessary.

It is assumed that the proposed grading for the development will consist of minor cut and fill procedures on the order of a few feet to achieve finished grade elevations. Final building plans shall be reviewed by this firm prior to submittal for city approval to determine the need for any additional study and revised recommendations pertinent to the proposed development, if necessary.

2.0 Site Description

The property is located along the north side of West Valley Boulevard, in the City of Rialto. The generally rectangular shaped parcel is elongated in a north to south direction with topography of the relatively level property descending slightly from north to south direction on the order of a few feet. The north half of the site is currently undeveloped while the south half of the lot is occupied by an existing concrete tilt-up building with an asphalt parking lot and associated site walls, hardscape and landscape areas.

3.0 Site Exploration

The investigation consisted of the placement of nine (9) subsurface exploratory borings by a truck mounted hollow stem auger to depths ranging between 5 and 18 feet below current ground elevations. The explorations were visually classified and logged by a field engineer with locations of the subsurface explorations shown on the attached plan. The exploratory borings revealed the existing earth materials to consist of fill and natural soil. Detailed descriptions of the subsurface conditions are listed on the trench logs in Appendix A. It should be noted that the transition from one soil type to another as shown on the boring logs is approximate and may in fact be a gradual transition. The soils encountered are described as follows:

Fill: A fill soil classifying as a brown, fine to coarse grained, silty SAND with gravel, rock, occasional cobble and minor amounts of concrete and asphalt pieces was encountered across the site to depths ranging from 1 to 2½ feet below ground surface. These soils were noted to be loose and dry.

Natural: A natural undisturbed soil classifying as a brown to light brown, fine to coarse grained silty SAND with gravel, rock and occasional cobble was encountered directly beneath the upper fill soils. The grain size and amount of rock and cobble varied with depth. The native soils as encountered were observed to be medium dense and dry to damp. Borings were limited to a depth of 18 feet below the existing ground surface due to cobble.

The overall engineering characteristics of the earth material were relatively uniform with each excavation. Groundwater was not encountered to the depth of our borings and slight caving occurred in the deeper cohesionless soils. Historic high groundwater in the vicinity has been recorded greater than 100 feet below grade at nearby wells as given on the California Department of Water Resources database <http://www.water.ca.gov/waterdatalibrary/> and review of underground water maps of the Upper Santa Ana River Basin, (Carson and Matti, 1982).

4.0 Laboratory Tests

Relatively undisturbed samples of the subsurface soils were obtained to perform laboratory testing and analysis for direct shear, consolidation tests, and to determine in-place moisture/densities. These relatively undisturbed ring samples were obtained by driving a thin-walled steel sampler lined with one-inch-long brass rings with an inside diameter of 2.42 inches into the undisturbed soils. Bulk bag samples were obtained in the upper soils for expansion index tests and maximum density tests. All test results are included in Appendix B, unless otherwise noted.

4.1 **Field Moisture Content** (ASTM: D 2216) and the dry density of the ring samples were determined in the laboratory. This data is listed on the logs of explorations.

- 4.2 **Maximum Density tests** (ASTM: D 1557) were performed on typical samples of the upper soils. Results of these tests are shown on Table I.
- 4.3 **Expansion Index tests** (ASTM: D 4829) were performed on remolded samples of the upper soils to determine expansive characteristics. Results of these tests are provided on Table II.
- 4.4 **Corrosion tests** consisting of sulfate, pH, resistivity and chloride analysis to determine potential corrosive effects of soils on concrete and underground utilities. Test results are provided on Table III.
- 4.5 **R-Value test** per California Test Method 301 was performed on a representative sample, which may be anticipated to be near subgrade to determine pavement design. Results are provided within the pavement design section of the report.
- 4.6 **Direct Shear tests** (ASTM: D 3080) were performed on undisturbed and/or remolded samples of the subsurface soils. The test is performed under saturated conditions at loads of 1,000 lbs./sq.ft., 2,000 lbs./sq.ft., and 3,000 lbs./sq.ft. with results shown on Plate A.
- 4.7 **Consolidation tests** (ASTM: D 2435) were performed on undisturbed samples to determine the differential and total settlement which may be anticipated based upon the proposed loads. Water was added to the samples at a surcharge of one KSF and the settlement curves are plotted on Plates B to C.

5.0 Seismicity Evaluation

The proposed development lies outside of any Alquist Priolo Special Studies Zone and the potential for damage due to direct fault rupture is considered unlikely. The Cucamonga Fault is located approximately 12 kilometers from the site and is capable of producing a Magnitude 7.0 earthquake. Ground shaking originating from earthquakes along other active faults in the region is expected to induce lower horizontal accelerations due to smaller anticipated earthquakes and/or greater distances to other faults.

The seismic design parameters are provided below and are based on the 2019 California Building Code (CBC) Standard ASCE/SEI 7-16. The data was obtained from the American Society of Civil Engineers (ASCE) website, <https://asce7hazardtool.online/>. The ASCE 7 Hazards Report is attached in Appendix C.

Seismic Design Acceleration Parameters

Latitude	34.071
Longitude	-117.373
Site Class	D
Risk Category	II
Mapped Spectral Response Acceleration	$S_S = 1.821$ $S_1 = 0.715$
Adjusted Maximum Acceleration	$S_{MS} = 1.821$
Design Spectral Response Acceleration Parameters	$S_{DS} = 1.214$
Peak Ground Acceleration	$PGA_M = 0.847$

Use of these values is dependent on requirements of ASCE 7-16, 11-4.8, Exception 2 that requires the value of the seismic response coefficient C_s be determined by Equation 12.8.2 for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either 12.8-3 for $T_L \geq T \geq 1.5T_s$ or Equation 12.8-4 for $T > T_L$. Computations and verification of these conditions is referred to the structural engineer.

6.0 Liquefaction Evaluation

The site is expected to experience ground shaking and earthquake activity that is typical of the Southern California area. It is during severe shaking that loose, granular soils below the groundwater table can liquefy. Based on review of the *County of San Bernardino County Land Use Plan – General Plan – Geologic Hazard Overlays (2009)*, the site lies outside a zone of “Suspected Liquefaction Susceptibility”. Based on review of local groundwater maps, the depth of groundwater is in excess of 100 feet (Carson & Matti 1982). Thus, the design of the proposed construction in conformance with the latest Building Code provisions for earthquake design is expected to provide mitigation of ground shaking hazards that are typical to Southern California.

7.0 Infiltration Characteristics

Infiltration tests within the site were performed to provide preliminary infiltration rates for the purpose of planning and design of an on-site water disposal system. A truck mounted Simco 2800 Drill Rig equipped with a hollow stem auger was used to excavate the exploratory borings to depths between 5 and 10 below existing ground surface. The borings consisted of eight-inch diameter test holes. A three-inch diameter perforated PVC casing with solid end cap was installed in the borings and then surrounded with gravel materials to prevent caving.

The infiltration holes were carefully filled with clean water and refilled after two initial readings. Based upon the initial rates of infiltration at each location, test measurements were measured at selected maximum intervals thereafter. Measurements were obtained by using an electronic tape measure with 1/16-inch divisions and timed with a stopwatch. The field infiltration rate was computed using a reduction factor – R_f based on the field measurements with our calculations given in Appendix E. Based upon the results of our testing, the soils encountered in the planned on-site drainage disposal system area exhibit the following infiltration rates.

Boring/Test No.	Depth	Soil Classification	Field Infiltration Rate	Design Rate
B-1	5'	Silty SAND	21.2 in/hr	10.6 in/hr
B-2	10'	Silty SAND	13.3 in/hr	6.65 in/hr
B-3	7½'	Silty SAND	15.3 in/hr	7.65 in/hr

The correction factors CF_t , CF_v and CF_s are given below based on soils at 5 and 10 feet from our field tests.

- a) $CF_t = R_f = 8.5$, 2.25 and 2.75 were used for our three infiltration test holes.
- b) $CF_v = 1.0$ based on uniform soils encountered in two borings for infiltration tests.
- c) $CF_s = 2.0$ for long-term siltation, plugging and maintenance. The subsurface soils are likely to have some plugging and regular maintenance of storm water discharge devices is required.

Thus, the subsurface soils encountered in the proposed on-site drainage disposal system shall utilize the design infiltration rates based on a safety factor of 2.0 as required by the county standard. All systems must meet the latest county specifications and the California Regional Water Quality Control Board (CRWQCB) requirements.

It is recommended that foundations shall be setback a minimum distance of 10 feet from the drainage disposal system and the bottom of footing shall be a minimum of 10 feet from the expected zone of saturation. The boundary of the zone of saturation may be assumed to project downward from the top of the permeable portion of the disposal system at an inclination of 1 to 1 or flatter, as determined by the geotechnical engineer.

8.0 Conclusions and Recommendations

Based upon our evaluations, the proposed development is acceptable from a geotechnical engineering standpoint. By following the recommendations and guidelines set forth in our report, the structures will be safe from excessive settlements under the anticipated design loadings and conditions. The proposed development shall meet all requirements of the City Building Ordinance and will not impose any adverse effect on existing adjacent structures.

The following recommendations are based upon soil conditions encountered in our field investigation; these near-surface soil conditions could vary across the site. Variations in the soil conditions may not become evident until the commencement of grading operations for the proposed development and revised recommendations from the soils engineer may be necessary based upon the conditions encountered.

It is recommended that site inspections be performed by a representative of this firm during all grading and construction of the development to verify the findings and recommendations documented in this report. Any unusual conditions which may be encountered in the course of the project development may require the need for additional study and revised recommendations.

8.1 **Site Grading Recommendations**

Any vegetation and/or demolition debris shall be removed and hauled from proposed grading areas prior to the start of grading operations. Existing vegetation shall not be mixed or disced into the soils. Any removed soils may be reutilized as compacted fill once any deleterious material or oversized materials (in excess of eight inches) is removed. Grading operations shall be performed in accordance with the attached *Specifications for Placement of Compacted Fill*.

8.1.1 **Removal and Recomposition Recommendations**

All disturbed soils and/or fill (about 1 to 2½ feet below ground surface) shall be removed to competent native material, the exposed surface scarified to a depth of 12 inches, brought to within 2% of optimum moisture content and compacted to a minimum of 90% of the laboratory standard (ASTM: D 1557) prior to placement of any additional compacted fill soils, foundations, slabs-on-grade and pavement. The upper 12 inches of soils beneath building pad and concrete paving shall be compacted to a minimum of 95% of the laboratory standard. Grading shall extend a minimum of five horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

It is possible that isolated areas of undiscovered fill not described in this report are present on site; if found, these areas should be treated as discussed earlier. A diligent search shall also be conducted during grading operations in an effort to uncover any underground structures, irrigation or utility lines. If encountered, these structures and lines shall be either removed or properly abandoned prior to the proposed construction.

Any imported fill material should be preferably soil similar to the upper soils encountered at the subject site. All soils shall be approved by this firm prior to importing at the site and will be subjected to additional laboratory testing to assure concurrence with the recommendations stated in this report.

If placement of slabs-on-grade and pavement is not completed immediately upon completion of grading operations, additional testing and grading of the areas may be necessary prior to continuation of construction operations. Likewise, if adverse weather conditions occur which may damage the subgrade soils, additional assessment by the soils engineer as to the suitability of the supporting soils may be needed.

Care should be taken to provide or maintain adequate lateral support for all adjacent improvements and structures at all times during the grading operations and construction phase. Adequate drainage away from the structures, pavement and slopes should be provided at all times.

8.1.2 Fill Blanket Recommendations

Due to the potential for differential settlement of foundations placed on compacted fill and native materials, it is recommended that all foundations including floor slab areas be underlain by a uniform compacted fill blanket at least two feet in thickness. This fill blanket shall extend a minimum of five horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

8.2 Shrinkage and Subsidence

Results of our in-place density tests reveal that the soil shrinkage will be on the order of 5 to 10% due to excavation and recompaction, based upon the assumption that the fill is compacted to 92% of the maximum dry density per ASTM standards. Subsidence should be 0.2 feet due to earthwork operations. The volume change does not include any allowance for vegetation or organic stripping, removal of subsurface improvements, or topographic approximations. Although these values are only approximate, they represent our best estimate of lost yardage, which will likely occur during grading. If more accurate shrinkage and subsidence factors are needed, it is recommended that field testing the actual equipment and grading techniques should be conducted.

8.3 Temporary Excavations

Temporary unsurcharged excavations in the existing site materials may be made at vertical inclinations up to 3 feet in height unless cohesionless soils are encountered. In areas where soils with little or no binder are encountered, where adverse geological conditions are exposed, or where excavations are adjacent to existing structures, shoring or flatter excavations may be required. The temporary cut slope gradients given above do not preclude local raveling and sloughing. All excavations shall be made in accordance with the requirements of the soils engineer, CAL-OSHA and other public agencies having jurisdiction. Care should be taken to provide or maintain adequate lateral support for all adjacent improvements and structures at all times during the grading operations and construction phase.

8.4 **Foundation Design**

All foundations may be designed utilizing the following allowable bearing capacities for an embedded depth of 18 inches into approved engineered fill with the corresponding widths:

Allowable Bearing Capacity (psf)		
Width (feet)	Continuous Foundation	Isolated Foundation
1.5	2000	2500
2.0	2075	2575
4.0	2375	2875
6.0	2500	3000

The bearing value may be increased by 500 psf for each additional foot of depth in excess of the 18-inch minimum depth, up to a maximum of 4,000 psf. A one-third increase may be used when considering short-term loading and seismic forces. Any foundations located along property line may utilize an allowable bearing capacity of 1,500 psf and embedded into competent native soils. A representative of this firm shall inspect all foundation excavations prior to pouring concrete.

8.5 **Settlement Analysis**

Resultant pressure curves for the consolidation tests are shown on Plates B and C. Computations utilizing these curves and the recommended allowable soil bearing capacities reveal that the foundations will experience settlements on the order of $\frac{3}{4}$ inch and differential settlements of less than $\frac{1}{4}$ inch.

8.6 **Lateral Resistance**

The following values may be utilized in resisting lateral loads imposed on the structure. Requirements of the California Building Code should be adhered to when the coefficient of friction and passive pressures are combined.

Coefficient of Friction - 0.40

Equivalent Passive Fluid Pressure = 250 lbs./cu.ft.

Maximum Passive Pressure = 2,500 lbs./cu.ft.

The passive pressure recommendations are valid only for approved compacted fill soils or competent native materials.

8.7 Retaining Wall Design Parameters

Active earth pressures against retaining walls will be equal to the pressures developed by the following fluid densities. These values are for **approved granular backfill material** placed behind the walls at various ground slopes above the walls.

<u>Surface Slope of Retained Materials</u> <u>(Horizontal to Vertical)</u>	<u>Equivalent Fluid</u> <u>Density (lb./cu.ft.)</u>
Level	30
5 to 1	35
4 to 1	38
3 to 1	40
2 to 1	45

Any applicable short-term construction surcharges and seismic forces should be added to the above lateral pressure values. An equivalent fluid pressure of 45 pcf may be utilized for the restrained wall condition with a level grade behind the wall.

The seismic-induced lateral soil pressure for walls greater than 6 feet may be computed using a triangular pressure distribution with the maximum value at the top of the wall. The maximum lateral pressure of (20 pcf) H where H is the height of the retained soils above the wall footing should be used in final design of retaining walls. Sliding resistance values and passive fluid pressure values may be increased by 1/3 during short-term wind and seismic loading conditions.

All walls shall be waterproofed as needed and protected from hydrostatic pressure by a reliable permanent subdrain system. The granular backfill to be utilized immediately adjacent to retaining walls shall consist of an approved select granular soil with a sand equivalency greater than 30. This backfill zone of free draining material shall consist of a wedge beginning a minimum of one horizontal foot from the base of the wall extending upward at an inclination of no less than $\frac{3}{4}$ to 1 (horizontal to vertical).

8.8 **Slab Design**

All concrete slabs shall be a minimum of six inches in thickness in the proposed warehouse areas and four inches in office and hardscape and placed on approved subgrade soils compacted to a minimum of 95% of the laboratory standard in the upper 12 inches. Additional reinforcement requirements and an increase in thickness of the slabs-on-grade may be necessary based upon proposed loading conditions in the structures and should be evaluated further by the project engineers and/or architect.

A vapor retarder (10-mil minimum thickness) should be utilized in areas which would be sensitive to the infiltration of moisture. This retarder shall meet requirements of ASTM E 96, *Water Vapor Transmission of Materials* and ASTM E 1745, *Standard Specification for Water Vapor Retarders used in Contact with Soil or Granular Fill Under Concrete Slabs*. The vapor retarder shall be installed in accordance with procedures stated in ASTM E 1643, *Standard practice for Installation of Water Vapor Retarders used in Contact with Earth or Granular Fill Under Concrete Slabs*.

The moisture retarder may be placed directly upon compacted subgrade soils conditioned to near optimum moisture levels, although one to two inches of sand beneath the membrane is desirable. The subgrade upon which the retarder is placed shall be smooth and free of rocks, gravel or other protrusions which may damage the retarder. Use of sand above the retarder is under the purview of the structural engineer; if sand is used over the retarder, it should be placed in a dry condition.

8.9 **Pavement Section Design**

The table below provides a preliminary pavement design based upon an R-Value of 78 for the subgrade soils for the proposed pavement areas. Final pavement design may need to be based on R-Value testing of the subgrade soils near the conclusion of site grading to assure that these soils are consistent with those assumed in this preliminary design. The recommendations are based upon estimated traffic loads. Client should submit any other anticipated traffic loadings to the geotechnical engineer, if necessary, so that pavement sections may be reviewed to determine adequacy to support the proposed loadings.

Type of Traffic	Traffic Index	Asphalt (in.)	Base Material (in.)
Automobile Parking Stalls	4.0	3.0	3.0
Light Vehicle Circulation Areas	5.5	3.5	5.0
Heavy Truck Access Areas	7.0	4.0	8.0

Any concrete slab-on-grade in pavement areas shall be a minimum of six inches in thickness and may be placed on approved subgrade soils. All pavement areas shall have positive drainage toward an approved outlet from the site.

Drain lines behind curbs and/or adjacent to landscape areas should be considered by client and the appropriate design engineers to prevent water from infiltrating beneath pavement. If such infiltration occurs, damage to pavement, curbs and flow lines, especially on sites with expansive soils, may occur during the life of the project.

Any approved base material shall consist of a Class II aggregate or equivalent and should be compacted to a minimum of 95% relative compaction. All pavement materials shall conform to the requirements set forth by the City of Ontario. The base material and asphaltic concrete should be tested prior to delivery to the site and during placement to determine conformance with the project specifications. A pavement engineer shall designate the specific asphalt mix design to meet the required project specifications.

8.10 Utility Trench and Excavation Backfill

Trenches from installation of utility lines and other excavations may be backfilled with on-site soils or approved imported soils compacted to a minimum of 90% relative compaction. All utility lines shall be properly bedded with clean sand having a sand equivalency rating of 30 or more. This bedding material shall be thoroughly water jetted around the pipe structure prior to placement of compacted backfill soils.

8.11 **Corrosion Design Criteria**

Representative samples of the surficial soils, typical of the subgrade soils expected to be encountered within foundation excavations and underground utilities were tested for corrosion potential. The minimum resistivity value obtained for the samples tested is representative of an environment that may be corrosive to metals. The soil pH value was considered mildly alkaline and may not have a significant effect on soil corrosivity. Consideration should be given to corrosion protection systems for buried metal such as protective coatings, wrappings or the use of PVC where permitted by local building codes.

According to Table 4.3.1 of ACI 318 Building Code and Commentary, these contents revealed negligible sulfate concentrations. Therefore, a Type II cement according to latest CBC specifications may be utilized for building foundations at this time. It is recommended that additional sulfate tests be performed at the completion of site grading to assure that the as graded conditions are consistent with the recommendations stated in this design. Corrosion test results may be found on the attached Table III.

8.12 **Expansive Soil**

On-site soils are very low in expansion potential (EI 0-20). When soils have an expansion index (EI) of 20 or more, special attention should be given to the project design and maintenance. The attached *Expansive Soil Guidelines* should be reviewed by the engineers, architects, owner, maintenance personnel and other interested parties and considered during the design of the project and future property maintenance. Expansion test results may be found on the attached Table II.

9.0 **Closure**

The recommendations and conclusions contained in this report are based upon the soil conditions uncovered in our test excavations. No warranty of the soil condition between our excavations is implied. NorCal Engineering should be notified for possible further recommendations if unexpected to unfavorable conditions are encountered during construction phase. It is the responsibility of the owner to ensure that all information within this report is submitted to the Architect and appropriate Engineers for the project.

A preconstruction conference should be held between the developer, general contractor, grading contractor, city inspector, architect, and geotechnical engineer to clarify any questions relating to the grading operations and subsequent construction. Our representative should be present during the grading operations and construction phase to certify that such recommendations are complied within the field.

This geotechnical investigation has been conducted in a manner consistent with the level of care and skill exercised by members of our profession currently practicing under similar conditions in the Southern California area. No other warranty, expressed or implied is made.

We appreciate this opportunity to be of service to you. If you have any further questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
NORCAL ENGINEERING


Keith D. Tucker
Project Engineer
R.G.E. 841




Mike Barone
Project Manager

NorCal Engineering

SPECIFICATIONS FOR PLACEMENT OF COMPACTED FILL

Excavation

Any existing low-density soils and/or saturated soils shall be removed to competent natural soil under the inspection of the Geotechnical Engineering Firm. After the exposed surface has been cleansed of debris and/or vegetation, it shall be scarified until it is uniform in consistency, brought to the proper moisture content and compacted to a minimum of 90% relative compaction (in accordance with ASTM: D 1557).

In any area where a transition between fill and native soil or between bedrock and soil are encountered, additional excavation beneath foundations and slabs will be necessary in order to provide uniform support and avoid differential settlement of the structure.

Material for Fill

The on-site soils or approved import soils may be utilized for the compacted fill provided they are free of any deleterious materials and shall not contain any rocks, brick, asphaltic concrete, concrete or other hard materials greater than eight inches in maximum dimensions. Any import soil must be approved by the Geotechnical Engineering firm a minimum of 72 hours prior to importation of site.

Placement of Compacted Fill Soils

The approved fill soils shall be placed in layers not excess of six inches in thickness. Each lift shall be uniform in thickness and thoroughly blended. The fill soils shall be brought to within 2% of the optimum moisture content, unless otherwise specified by the Soils Engineering firm. Each lift shall be compacted to a minimum of 90% relative compaction (in accordance with ASTM: D 1557) and approved prior to the placement of the next layer of soil. Compaction tests shall be obtained at the discretion of the Geotechnical Engineering firm but to a minimum of one test for every 500 cubic yards placed and/or for every 2 feet of compacted fill placed.

The minimum relative compaction shall be obtained in accordance with accepted methods in the construction industry. The final grade of the structural areas shall be in a dense and smooth condition prior to placement of slabs-on-grade or pavement areas. No fill soils shall be placed, spread or compacted during unfavorable weather conditions. When the grading is interrupted by heavy rains, compaction operations shall not be resumed until approved by the Geotechnical Engineering firm.

Grading Observations

The controlling governmental agencies should be notified prior to commencement of any grading operations. This firm recommends that the grading operations be conducted under the observation of a Soils Engineering firm as deemed necessary. A 24-hour notice must be provided to this firm prior to the time of our initial inspection.

Observation shall include the clearing and grubbing operations to assure that all unsuitable materials have been properly removed; approve the exposed subgrade in areas to receive fill and in areas where excavation has resulted in the desired finished grade and designate areas of overexcavation; and perform field compaction tests to determine relative compaction achieved during fill placement. In addition, all foundation excavations shall be observed by the Geotechnical Engineering firm to confirm that appropriate bearing materials are present at the design grades and recommend any modifications to construct footings.

EXPANSIVE SOIL GUIDELINES

The following expansive soil guidelines are provided for your project. The intent of these guidelines is to inform you, the client, of the importance of proper design and maintenance of projects supported on expansive soils. ***You, as the owner or other interested party, should be warned that you have a duty to provide the information contained in the soil report including these guidelines to your design engineers, architects, landscapers and other design parties in order to enable them to provide a design that takes into consideration expansive soils.***

In addition, you should provide the soil report with these guidelines to any property manager, lessee, property purchaser or other interested party that will have or assume the responsibility of maintaining the development in the future.

Expansive soils are fine-grained silts and clays which are subject to swelling and contracting. The amount of this swelling and contracting is subject to the amount of fine-grained clay materials present in the soils and the amount of moisture either introduced or extracted from the soils. Expansive soils are divided into five categories ranging from “very low” to “very high”. Expansion indices are assigned to each classification and are included in the laboratory testing section of this report. *If the expansion index of the soils on your site, as stated in this report, is 21 or higher, you have expansive soils.* The classifications of expansive soils are as follows:

Classification of Expansive Soil*

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

*From Table 18A-I-B of California Building Code (1988)

When expansive soils are compacted during site grading operations, care is taken to place the materials at or slightly above optimum moisture levels and perform proper compaction operations. Any subsequent excessive wetting and/or drying of expansive soils will cause the soil materials to expand and/or contract. These actions are likely to cause distress of foundations, structures, slabs-on-grade, sidewalks and pavement over the life of the structure.

It is therefore imperative that even after construction of improvements, the moisture contents are maintained at relatively constant levels, allowing neither excessive wetting or drying of soils.

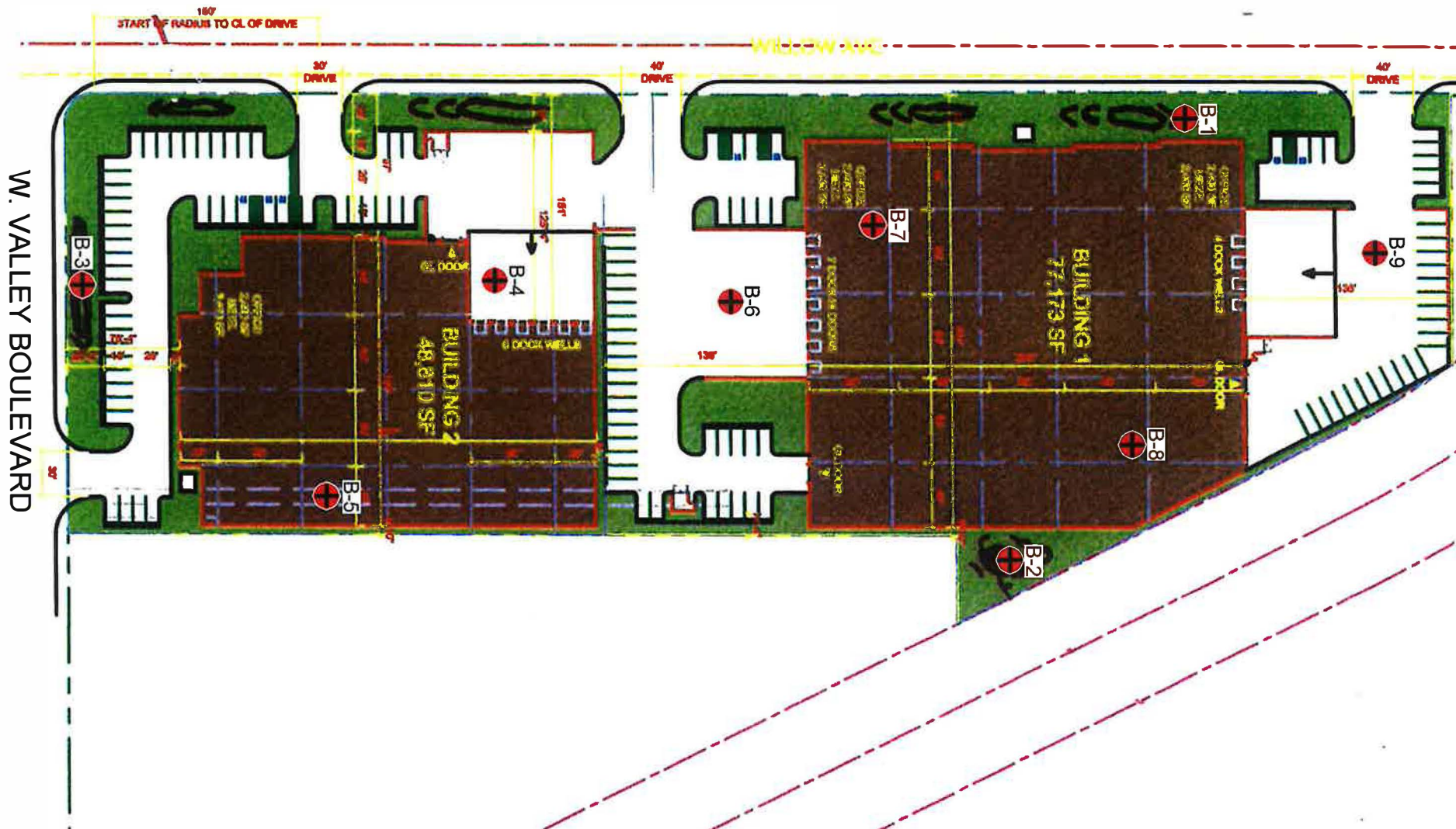
Evidence of excessive wetting of expansive soils may be seen in concrete slabs, both interior and exterior. Slabs may lift at construction joints producing a trip hazard or may crack from the pressure of soil expansion. Wet clays in foundation areas may result in lifting of the structure causing difficulty in the opening and closing of doors and windows, as well as cracking in exterior and interior wall surfaces. In extreme wetting of soils to depth, settlement of the structure may eventually result. Excessive wetting of soils in landscape areas adjacent to concrete or asphaltic pavement areas may also result in expansion of soils beneath pavement and resultant distress to the pavement surface.

Excessive drying of expansive soils is initially evidenced by cracking in the surface of the soils due to contraction. Settlement of structures and on-grade slabs may also eventually result along with problems in the operation of doors and windows.

Projects located in areas of expansive clay soils will be subject to more movement and "hairline" cracking of walls and slabs than similar projects situated on non-expansive sandy soils. There are, however, measures that developers and property owners may take to reduce the amount of movement over the life the development. The following guidelines are provided to assist you in both design and maintenance of projects on expansive soils:

- Drainage away from structures and pavement is essential to prevent excessive wetting of expansive soils. Grades should be designed to the latest building code and maintained to allow flow of irrigation and rain water to approved drainage devices or to the street. Any “ponding” of water adjacent to buildings, slabs and pavement after rains is evidence of poor drainage; the installation of drainage devices or regrading of the area may be required to assure proper drainage. Installation of rain gutters is also recommended to control the introduction of moisture next to buildings. Gutters should discharge into a drainage device or onto pavement which drains to roadways.
- Irrigation should be strictly controlled around building foundations, slabs and pavement and may need to be adjusted depending upon season. This control is essential to maintain a relatively uniform moisture content in the expansive soils and to prevent swelling and contracting. Over-watering adjacent to improvements may result in damage to those improvements. NorCal Engineering makes no specific recommendations regarding landscape irrigation schedules.
- Planting schemes for landscaping around structures and pavement should be analyzed carefully. Plants (including sod) requiring high amounts of water may result in excessive wetting of soils. Trees and large shrubs may actually extract moisture from the expansive soils, thus causing contraction of the fine-grained soils.
- Thickened edges on exterior slabs will assist in keeping excessive moisture from entering directly beneath the concrete. A six-inch thick or greater deepened edge on slabs may be considered. Underlying interior and exterior slabs with 6 to 12 inches or more of non-expansive soils and providing presaturation of the underlying clayey soils as recommended in the soil report will improve the overall performance of on-grade slabs.

- Increase the amount of steel reinforcing in concrete slabs, foundations and other structures to resist the forces of expansive soils. The precise amount of reinforcing should be determined by the appropriate design engineers and/or architects.
- Recommendations of the soil report should always be followed in the development of the project. Any recommendations regarding presaturation of the upper subgrade soils in slab areas should be performed in the field and verified by the Soil Engineer.



W. VALLEY BOULEVARD



NorCal Engineering SOILS AND GEOTECHNICAL CONSULTANTS

INVESTMENT BUILDING GROUP

PROJECT: 22806-21

DATE: OCTOBER 2021

SITE PLAN

FIGURE 1



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PROJECT: 22806-21

DATE: OCTOBER 2021

VICINITY MAP

FIGURE 2

List of Appendices **(in order of appearance)**

Appendix A – Log of Excavations

Log of Exploratory Trenches B-1 to B-9

Appendix B – Laboratory Tests

Table I – Maximum Dry Density

Table II – Expansion

Table III – Corrosion

Plate A – Direct Shear

Plates B - C - Consolidation

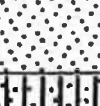
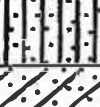
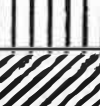
Appendix C –ASCE Seismic Hazards Report and Maps

ASCE Seismic Hazards Report

Appendix D – Soil Infiltration Data

Appendix A

Log of Excavations

MAJOR DIVISION			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINE (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

KEY:

- Indicates 2.5-inch Inside Diameter. Ring Sample.
- ☒ Indicates 2-inch OD Split Spoon Sample (SPT).
- ☐ Indicates Shelby Tube Sample.
- ▢ Indicates No Recovery.
- ▣ Indicates SPT with 140# Hammer 30 in. Drop.
- ☑ Indicates Bulk Sample.
- ▤ Indicates Small Bag Sample.
- ▥ Indicates Non-Standard
- ☒ Indicates Core Run.

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5mm) to No. 200 (0.074mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074 mm)

COMPONENT PROPORTIONS

DESCRIPTIVE TERMS	RANGE OF PROPORTION
Trace	1 - 5%
Few	5 - 10%
Little	10 - 20%
Some	20 - 35%
And	35 - 50%

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
DAMP	Some perceptible moisture; below optimum
MOIST	No visible water; near optimum moisture content
WET	Visible free water, usually soil is below water table.

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N -VALUE

COHESIONLESS SOILS		COHESIVE SOILS		
Density	N (blows/ft)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	Very Soft	0 to 2	< 250
Loose	4 to 10	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	Very Stiff	15 to 30	2000 - 4000
		Hard	over 30	> 4000

Investment Building Group
22806-21

Log of Boring B-1

Boring Location: 280 W Valley Blvd., Rialto

Date of Drilling: 9/22/2021

Groundwater Depth: None Encountered

Drilling Method: Drill Rig

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lith- ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL			1.1		
		Silty (fine to coarse grained) SAND with gravel, rock and small cobbles Brown, loose, dry					
5		NATURAL Gravelly SAND, silty with rock, occasional cobbles Brown, dense, dry to damp Boring completed at depth of 5'					
10							
15							
20							
25							
30							
35							

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Investment Building Group 22806-21			Log of Boring B-2				
Boring Location: 280 W Valley Blvd., Rialto							
Date of Drilling: 9/22/2021		Groundwater Depth: None Encountered					
Drilling Method: Drill Rig							
Hammer Weight: 140 lbs		Drop: 30"					
Surface Elevation: Not Measured							
Depth (feet)	Lith- ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL Silty (fine to coarse grained) SAND with gravel, rock, occasional concrete, asphaltic concrete Brown, loose, dry					
5		NATURAL Gravelly SAND, silty with rock, occasional cobbles Brown, dense, dry to damp Increase in grain size with depth					
10		Boring completed at depth of 10'			1.7		
15							
20							
25							
30							
35							

Investment Building Group 22806-21				Log of Boring B-3					
Boring Location: 280 W Valley Blvd., Rialto									
Date of Drilling: 9/22/2021		Groundwater Depth: None Encountered							
Drilling Method: Drill Rig									
Hammer Weight: 140 lbs		Drop: 30"							
Surface Elevation: Not Measured									
Depth (feet)	Lith- ology	Material Description	Samples		Laboratory				
			Type	Blow Counts	Moisture	Dry Density	Fines Content %		
0		2" Asphaltic Concrete		▽		2.1			
		FILL Silty (fine to coarse grained) SAND with gravel, rock and asphaltic concrete, cobbles Brown, loose, dry							
5		NATURAL Gravelly SAND, silty with rock, occasional cobbles Brown, dense, dry to damp Increase in rock and cobbles with depth Boring completed at depth of 7.5'							
10									
15									
20									
25									
30									
35									
NorCal Engineering						3			

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\22806-21.log Date: 10/8/2021

Investment Building Group 22806-21			Log of Boring B-4						
Boring Location: 280 W Valley Blvd., Rialto									
Date of Drilling: 9/22/2021		Groundwater Depth: None Encountered							
Drilling Method: Drill Rig									
Hammer Weight: 140 lbs		Drop: 30"							
Surface Elevation: Not Measured									
Depth (feet)	Lith- ology	Material Description	Samples		Laboratory				
			Type	Blow Counts	Moisture	Dry Density	Fines Content %		
0		FILL Silty (fine to coarse grained) SAND with gravel, rock and occasional cobbles B row, loose, dry		21/37					
		NATURAL Gravelly SAND, silty with rock, occasional cobbles B rowndense, dry to damp							
5		Slightly silty (medium to coarse grained) SAND with gravel, rock, occasional cobble B rowndense, dry to damp		19/31					
10		B oring completed at depth of 10'							
15									
20									
25									
30									
35									
NorCal Engineering			4						

Investment Building Group 22806-21				Log of Boring B-5				
Boring Location: 280 W Valley Blvd., Rialto								
Date of Drilling: 9/22/2021		Groundwater Depth: None Encountered						
Drilling Method: Drill Rig								
Hammer Weight: 140 lbs		Drop: 30"						
Surface Elevation: Not Measured								
Depth (feet)	Lith- ology	Material Description	Samples		Laboratory			
			Type	Blow Counts	Moisture	Dry Density	Fines Content %	
0		5" Asphaltic Concrete						
		FILL						
		Silty (fine to coarse grained) SAND with gravel, rock and occasional cobbles						
		Brown, loose, dry		█	21/28	1.5	124.9	
		NATURAL						
5		Gravelly SAND, silty with rock, occasional cobbles						
		Brown, dense, dry to damp		█	19/25	2.8	124.0	
10		Boring completed at depth of 10'						
15								
20								
25								
30								
35								
NorCal Engineering						5		

Investment Building Group 22806-21			Log of Boring B-6								
Boring Location: 280 W Valley Blvd., Rialto											
Date of Drilling: 9/22/2021								Groundwater Depth: None Encountered			
Drilling Method: Drill Rig											
Hammer Weight: 140 lbs								Drop: 30"			
Surface Elevation: Not Measured											
Depth (feet)	Lith- ology	Material Description	Type	Blow Counts	Moisture	Dry Density	Fines Content %				
0		FILL Silty (fine to coarse grained) SAND with gravel, rock and occasional cobbles Brown, loose, dry	☒								
5		NATURAL Gravelly SAND, silty with rock, occasional cobbles Brown, dense, dry to damp Boring completed at depth of 5'									
10											
15											
20											
25											
30											
35											
NorCal Engineering			6								

Investment Building Group 22806-21				Log of Boring B-7					
Boring Location: 280 W Valley Blvd., Rialto									
Date of Drilling: 9/22/2021		Groundwater Depth: None Encountered							
Drilling Method: Drill Rig									
Hammer Weight: 140 lbs		Drop: 30"							
Surface Elevation: Not Measured									
Depth (feet)	Lith- ology	Material Description	Samples		Laboratory				
			Type	Blow Counts	Moisture	Dry Density	Fines Content %		
0		FILL							
		Silty (fine to coarse grained) SAND with gravel, rock and small cobbles							
		Brown, loose, dry							
		Gravelly SAND, silty with rock, occasional cobbles							
		Brown, dense, dry to damp							
5		NATURAL							
		Slightly silty (medium to coarse grained) SAND with rock, occasional cobble							
		Increase in rock/cobble with depth							
10									
15									
18		Refusal at depth of 18' due to cobble							
20									
25									
30									
35									
NorCal Engineering				7					

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22806-21

Log of Boring B-8

Boring Location: 280 W Valley Blvd., Rialto

Date of Drilling: 9/22/2021

Groundwater Depth: None Encountered

Drilling Method: Drill Rig

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lith- ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL Silty (fine to coarse grained) SAND with gravel, rock and occasional cobbles Brown, loose, dry					
5		NATURAL Gravelly SAND, silty with rock, occasional cobbles Brown, dense, dry to damp Increase in rock/cobble with depth		14/24	1.6	130.3	
10		Boring completed at depth of 10'		14/29	1.9	128.8	
15							
20							
25							
30							
35							

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Log of Boring B-9

Boring Location: 280 W Valley Blvd., Rialto

Date of Drilling: 9/22/2021

Groundwater Depth: None Encountered

Drilling Method: Drill Rig

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lith- ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL Silty (fine to coarse grained) SAND with gravel, rock and small cobbles Brown, loose, dry					
5		NATURAL Gravelly SAND, silty with rock, occasional cobbles Brown, dense, dry to damp Slightly silty (medium to coarse grained) SAND with rock, occasional cobble Brown, dense, dry to damp					
10		Boring completed at depth of 10'					
15							
20							
25							
30							
35							

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Appendix B

Laboratory Tests

TABLE I
MAXIMUM DENSITY TESTS

Sample	Classification	Optimum Moisture (%)	Maximum Dry Density (lbs/cu.ft)
B-4 @ 2'	Gravelly Silty SAND	6.5	135.5

TABLE II
EXPANSION TESTS

Sample	Classification	Expansion Index
B-4 @ 2'	Gravelly Silty SAND	00

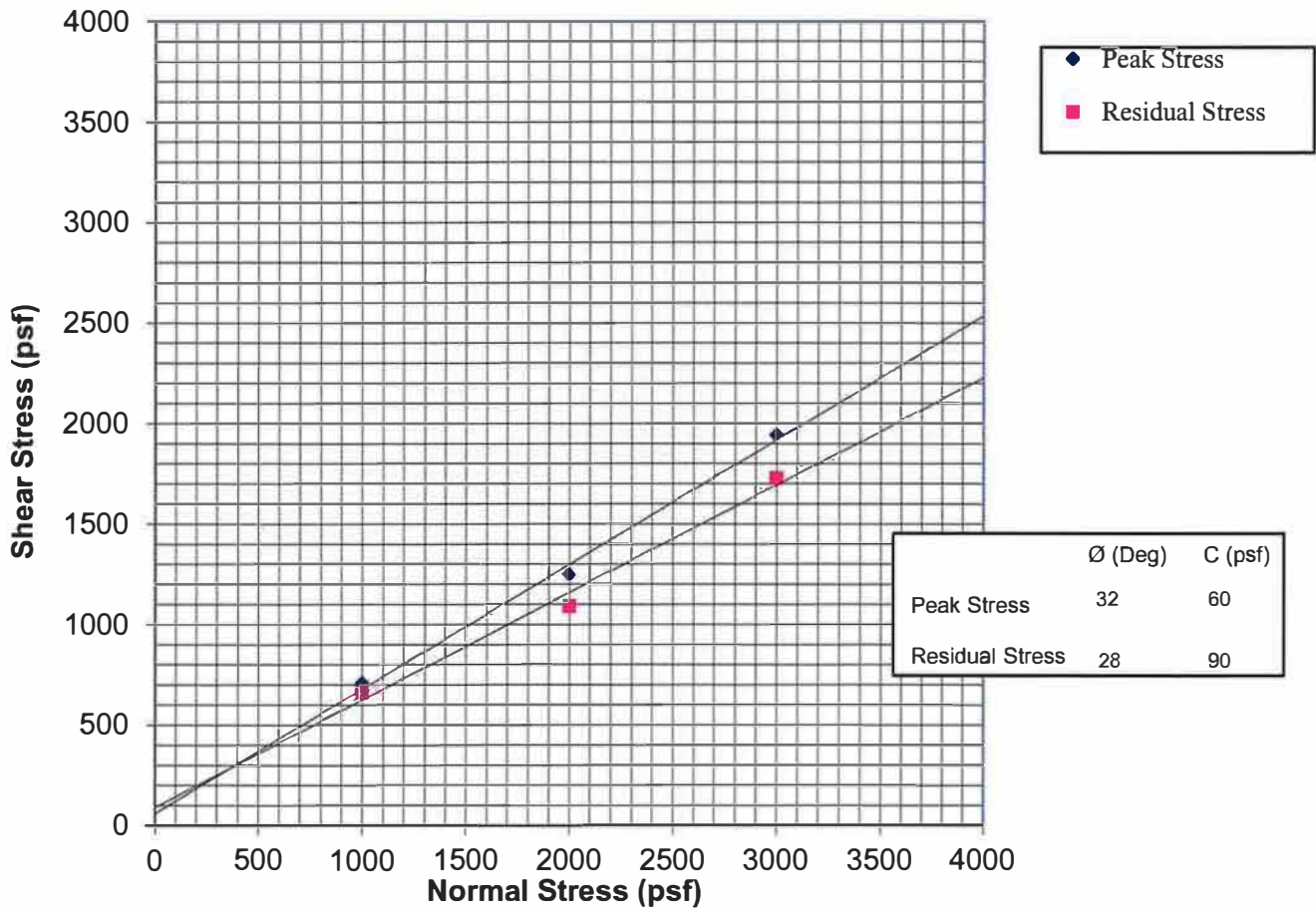
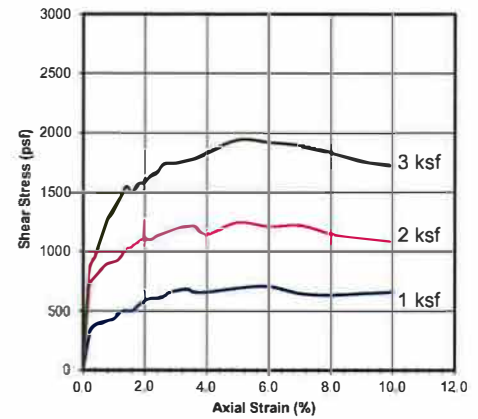
TABLE III
CORROSION TESTS

Sample	pH	Electrical Resistivity	Sulfate (%)	Chloride (ppm)
B-4 @ 1'	7.4	28,934	N.D.	154

% by weight
ppm – mg/kg
N.D. = Non-Detect

Sample No. B7@2'
 Sample Type: Undisturbed-Saturated
 Soil Description: Fine-Medium Grained Sand w/ Some Silt & small gravel

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	708	1248	1944
Displacement	(in.)	0.150	0.125	0.125
Residual Stress	(psf)	660	1092	1728
Displacement	(in.)	0.250	0.250	0.250
Initial Dry Density	(pcf)	116.4	116.4	116.4
Initial Water Content	(%)	1.3	1.3	1.3
Strain Rate	(in./min.)	0.020	0.020	0.020



NorCal Engineering
 SOILS AND GEOTECHNICAL CONSULTANTS

Investment Building Group

PROJECT NUMBER: 22806-21

DATE: 10/1/2021

DIRECT SHEAR TEST
ASTM D3080

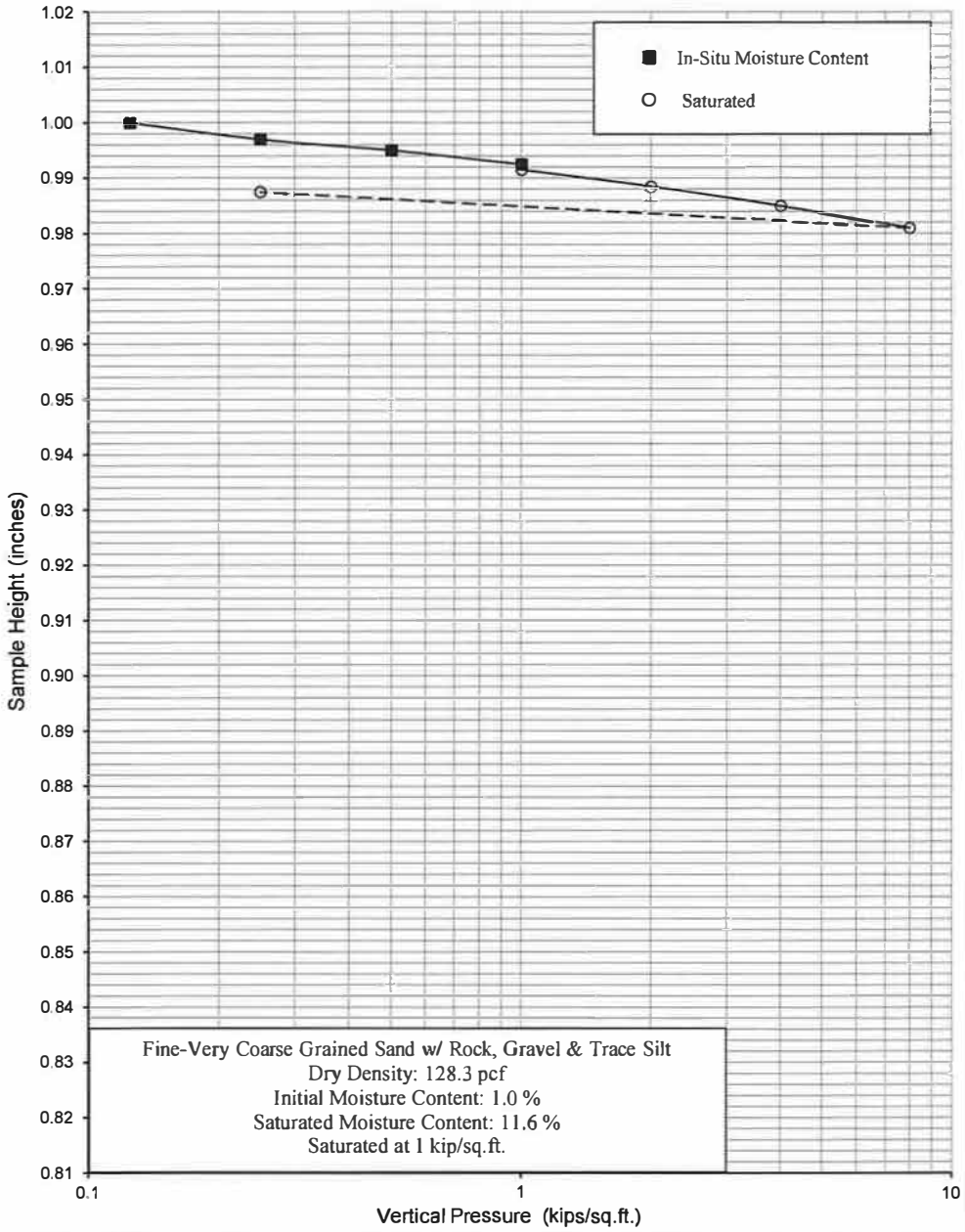
Plate A

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)	Sample No.	B4	Depth	5'	Date	10/1/2021
------------------------------------	------------------------	----------------------------	------------	----	-------	----	------	-----------

0.125	1.0000	0.0
0.25	0.9970	0.3
0.5	0.9950	0.5
1	0.9925	0.8
1	0.9915	0.8
2	0.9885	1.2
4	0.9850	1.5
8	0.9810	1.9
0.25	0.9875	1.3

Saturated

Date Tested: 9/29/2021
Sample: B4
Depth: 5'



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Investment Building Group

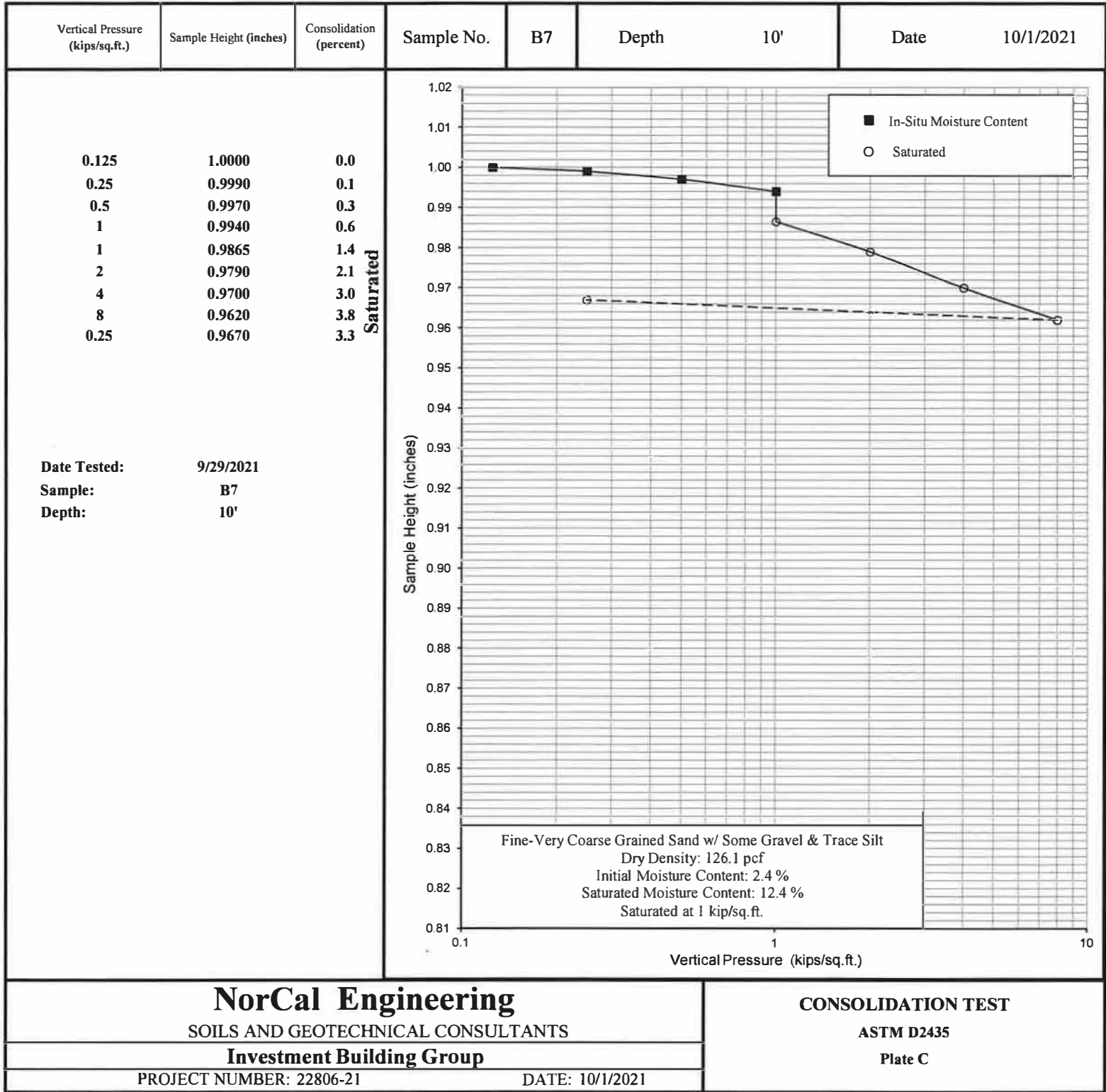
PROJECT NUMBER: 22806-21

DATE: 10/1/2021

CONSOLIDATION TEST

ASTM D2435

Plate B



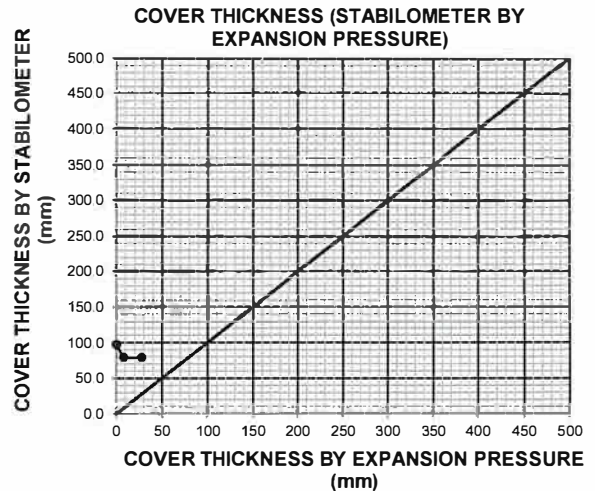
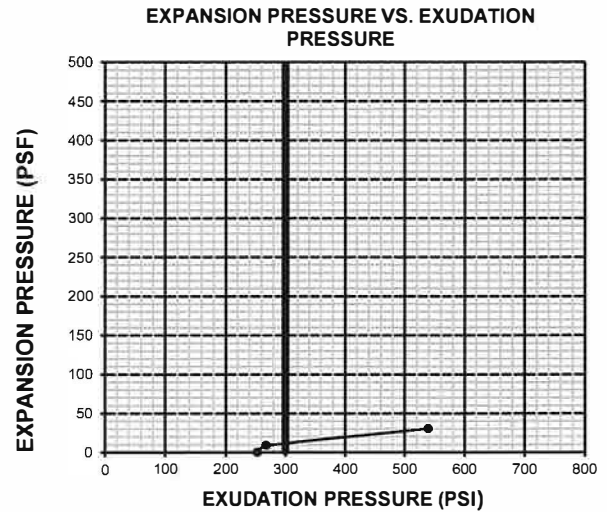
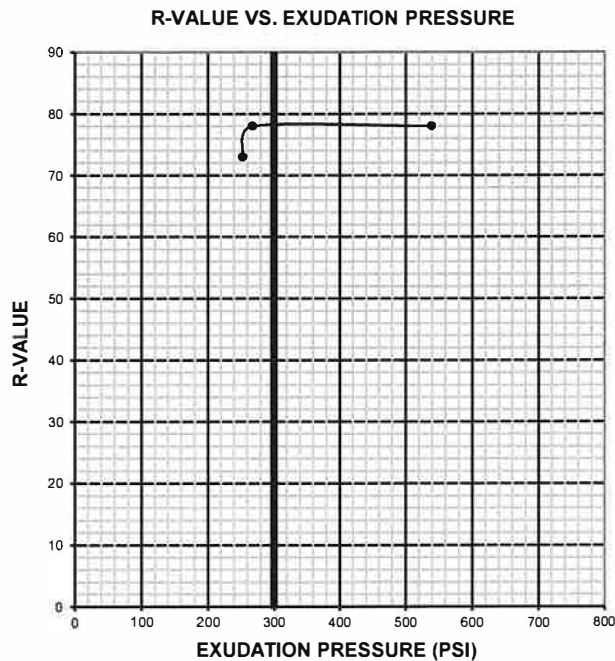


R-VALUE TEST REPORT

☒ CT-301 ☐ ASTM-D2844

PROJECT NAME:	Norcal: Investment Building Group	PROJECT NUMBER:	L-211001
SAMPLE LOCATION:	280 W Valley Boulevard, Rialto. CA	SAMPLE NUMBER:	B6
SAMPLE DESCRIPTION:	SILTY SAND (SM), brown	SAMPLE DEPTH:	1'
SAMPLED BY:	Norcal: JS 9/22/21	TESTED BY:	RC
		DATE TESTED:	10/8/2021

TEST SPECIMEN	A	B	C
MOISTURE AT COMPACTION %	7.9	8.3	8.6
WEIGHT OF SAMPLE, grams	1151	1173	1159
HEIGHT OF SAMPLE, Inches	2.57	2.68	2.62
DRY DENSITY, pcf	125.8	122.5	123.5
COMPACTOR AIR PRESSURE, psi	230	190	150
EXUDATION PRESSURE, psi	539	268	253
EXPANSION, Inches x 10exp-4	7	2	0
STABILITY Ph 2,000 lbs (160 psi)	20	20	22
TURNS DISPLACEMENT	5.07	5.10	6.03
R-VALUE UNCORRECTED	78	77	72
R-VALUE CORRECTED	78	78	73
EXPANSION PRESSURE (psf)	30.2	8.6	0.0



R-VALUE AT EQUILIBRIUM:	78
R-VALUE BY EXUDATION PRESSURE:	78
R-VALUE BY EXPANSION PRESSURE:	N.A.
EXPANSION PRESSURE AT 300 PSI EXUDATION:	10
TRAFFIC INDEX (Assumed):	5.5
GRAVEL FACTOR (Assumed):	1.5
UNIT MASS OF COVER MATERIAL, kg/m ³ (Assumed):	2100.0

Appendix C

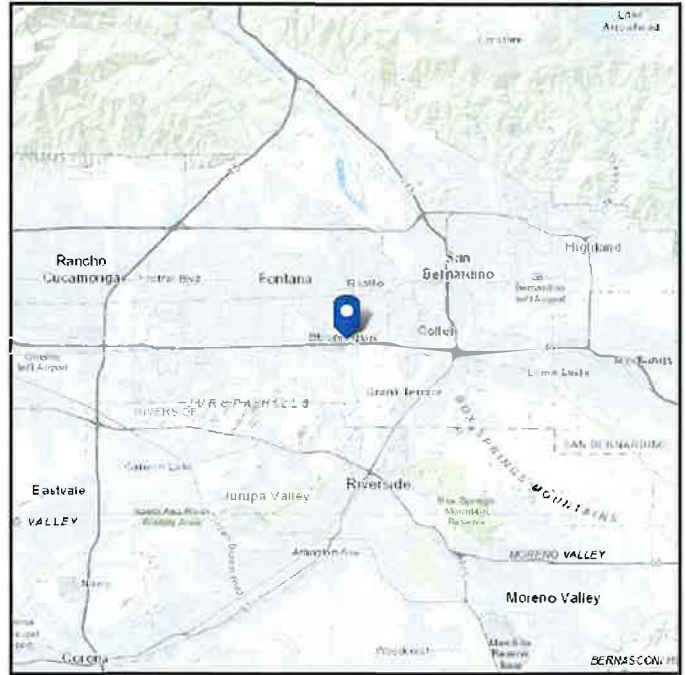
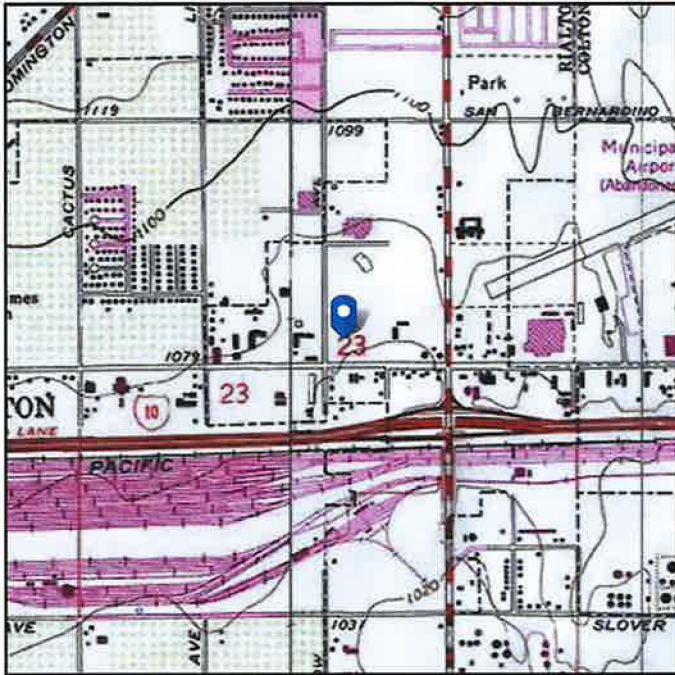
Seismic Hazards Report

ASCE 7 Hazards Report

Address:
280 W Valley Blvd
Rialto, California
92376

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Stiff Soil

Elevation: 1065.72 ft (NAVD 88)
Latitude: 34.071257
Longitude: -117.373954



Site Soil Class: D - Stiff Soil

Results:

S_s :	1.821	S_{D1} :	N/A
S_1 :	0.715	T_L :	8
F_a :	1	PGA :	0.77
F_v :	N/A	PGA _M :	0.847
S_{MS} :	1.821	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.214	C_v :	1.464

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Wed Oct 06 2021

Date Source: [USGS Seismic Design Maps](#)

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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Appendix D

Soil Infiltration Data



SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Investment Building Group	Tested By: J.S. Jr.
Project No.: 22806-21	Date Tested: 9/22/2021
Test Hole: 1	Caving:
Depth of Test Hole: 5'	Notes:
Diameter of Test Hole: 8"	Strata Peculiarities:
Date Excavated: 9/22/2021	

Sandy Soil Criteria Test

TIME	TRIAL NO.	T1	H1	H2	D
7:51	1	6	0.0	60.0	60.0
7:57					
7:57	2	9	0.0	60.0	60.0
8:06					

____ Soil Criteria

TIME	T1	TE	H1	H2	D
8:06	10	10	0.0	59.0	59.0
8:16					
8:16	10	20	0.0	57.5	57.5
8:26					
8:26	10	30	0.0	56.0	56.0
8:36					
8:36	10	40	0.0	55.0	55.0
8:46					
8:46	10	50	0.0	56.0	56.0
8:56					
8:56	10	60	0.0	53.0	53.0
9:06					
9:06	10	70	0.0	52.0	52.0
9:16					
9:16	10	80	0.0	53.0	53.0
9:26					
9:26	10	83	53.0	60.0	7.0
9:29					

T1 – Time Interval (min)
H2 – Final Water Level (in)

TE – Total Elapsed Time (min)
D – Change in H₂O Level (in)

H1 – Initial Water Level



SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Investment Building Group	Tested By: J.S. Jr.
Project No.: 22806-21	Date Tested: 9/22/2021
Test Hole: 2	Caving:
Depth of Test Hole: 10'	Notes:
Diameter of Test Hole: 8"	Strata Peculiarities:
Date Excavated: 9/22/2021	

Sandy Soil Criteria Test

TIME	TRIAL NO.	T1	H1	H2	D
8:44	1	6	0.0	120.0	120.0
8:52					
8:52	2	9	0.0	120.0	120.0
9:02					

____ Soil Criteria

TIME	T1	TE	H1	H2	D
9:02	10	10	0.0	116.0	116.0
9:12					
9:12	10	20	0.0	113.0	113.0
9:22					
9:22	10	30	0.0	113.0	113.0
9:32					
9:32	10	40	0.0	110.0	110.0
9:42					
9:42	10	50	0.0	110.0	110.0
9:52					
9:52	10	60	0.0	109.0	109.0
10:02					
10:02	10	70	0.0	109.0	109.0
10:12					
10:12	10	80	0.0	110.0	110.0
10:22					
10:22	10	90	110.0	118.0	8.0
10:32					
10:32	10	93	118.0	120.0	2.0
10:35					

T1 – Time Interval (min)
H2 – Final Water Level (in)

TE – Total Elapsed Time (min)
D – Change in H₂O Level (in)

H1 – Initial Water Level



SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Investment Building Group	Tested By: J.S. Jr.
Project No.: 22806-21	Date Tested: 9/22/2021
Test Hole: 3	Caving:
Depth of Test Hole: 7.5'	Notes:
Diameter of Test Hole: 8"	Strata Peculiarities:
Date Excavated: 9/22/2021	

Sandy Soil Criteria Test

TIME	TRIAL NO.	T1	H1	H2	D
10:46	1	11	0.0	90.0	90.0
10:57					
10:57	2	14	0.0	90.0	90.0
11:11					

____ Soil Criteria

TIME	T1	TE	H1	H2	D
11:11	10	10	0.0	83.0	83.0
11:21					
11:21	10	20	0.0	81.0	81.0
11:31					
11:31	10	30	0.0	81.0	81.0
11:41					
11:41	10	40	0.0	78.0	78.0
11:51					
11:51	10	50	0.0	77.0	77.0
12:01					
12:01	10	60	0.0	76.0	76.0
12:11					
12:11	10	70	0.0	77.0	77.0
12:21					
12:21	10	80	0.0	76.0	76.0
12:31					
12:31	10	90	76.0	85.0	9.0
12:41					
12:41	10	93	85.0	90.0	5.0
12:44					

T1 – Time Interval (min)
H2 – Final Water Level (in)

TE – Total Elapsed Time (min)
D – Change in H₂O Level (in)

H1 – Initial Water Level

SOIL INFILTRATION RATE CALCS $\Rightarrow$ Auger Boring

Location:	TH-1	TH-2	TH-3
• Depth =	5.0'	10.0'	7.5'
• Hole Dia. =	8"	8"	8"
• Drop = Δd	60"	10"	14"
• Time = Δt Interval	20 min	20 min	20 min
• Preadjusted Perc. Rate	180 in/hr	30 in/hr	42 in/hr
• Initial Water Depth = d_i	60"	10"	14"
• Reduction Factor = R_f	8.5	2.25	2.75
• INFILTRATION RATE	21.2 in/hr	13.3 in/hr	15.3 in/hr

$$\text{Infiltration Rate} = \frac{\text{Preadjusted Perc. Rate}}{\text{Reduction Factor}}$$

$$\text{Reduction Factor} = R_f = \left[\frac{2 \cdot d_i - \Delta d}{\text{Dia.}} \right] + 1$$

ATTACHMENT E

WQMP Agreement

(not needed by City of Fontana)

ATTACHMENT F

Educational Materials

3.2 INFILTRATION TRENCH

Type of BMP	LID - Infiltration
Treatment Mechanisms	Infiltration, Evapotranspiration (when vegetated), Evaporation
Maximum Drainage Area	10-acres
Other Names	None

Description

Infiltration trenches are shallow excavated areas that are filled with rock material to create a subsurface reservoir layer. The trench is sized to store the design capture volume, V_{BMP} , in the void space between the rocks. Over a period of 72 hours, the stormwater infiltrates through the bottom of the trench into the surrounding soil. Infiltration basins are highly effective in removing all targeted pollutants from stormwater runoff.

Figure 1 shows the components of an infiltration trench. The section shows the reservoir layer and observation well, which is used to monitor water depth. An overflow pipe that is used to bypass flows once the trench fills with stormwater is also shown.

Site Considerations

Location

The use of infiltration trenches may be restricted by concerns over groundwater contamination, soil permeability, and clogging at the site. See the applicable WQMP for any specific feasibility considerations for using infiltration BMPs. Where this BMP is being used, the soil beneath the basin must be thoroughly evaluated in a geotechnical report since the underlying soils are critical to the basin's long term performance. These basins may not be appropriate for the following site conditions:

- Industrial sites or locations where spills of toxic materials may occur.
- Sites with very low soil infiltration rates.
- Sites with high groundwater tables or excessively high soil infiltration rates, where pollutants can affect groundwater quality.
- Sites with unstabilized soil or construction activity upstream.
- On steeply sloping terrain.
- Infiltration trenches located in a fill condition should refer to Appendix A of this Handbook for details on special requirements/restrictions.

This BMP has a flat surface area, so it may be challenging to incorporate into steeply sloping terrain.

INFILTRATION TRENCH BMP FACT SHEET

Setbacks

Always consult your geotechnical engineer for site specific recommendations regarding setbacks for infiltration trenches. Recommended setbacks are needed to protect buildings, walls, onsite or nearby wells, streams, and tanks. Setbacks should be considered early in the design process as they affect where infiltration facilities may be placed and how deep they are allowed to be. For instance, depth setbacks can dictate fairly shallow facilities that will have a larger footprint and, in some cases, may make an infiltration trench infeasible. In that instance, another BMP must be selected.

In addition to setbacks recommended by the geotechnical engineer, infiltration trenches must be set back:

- 10 feet from the historic high groundwater mark (measured vertically from the bottom of the trench, as shown in Figure 1)
- 5 feet from bedrock or impermeable surface layer (measured vertically from the bottom of the trench, as shown in Figure 1)
- From all mature tree drip lines as indicated in Figure 1
- 100 feet horizontally from wells, tanks or springs

Setbacks to walls and foundations must be included as part of the Geotechnical Report.

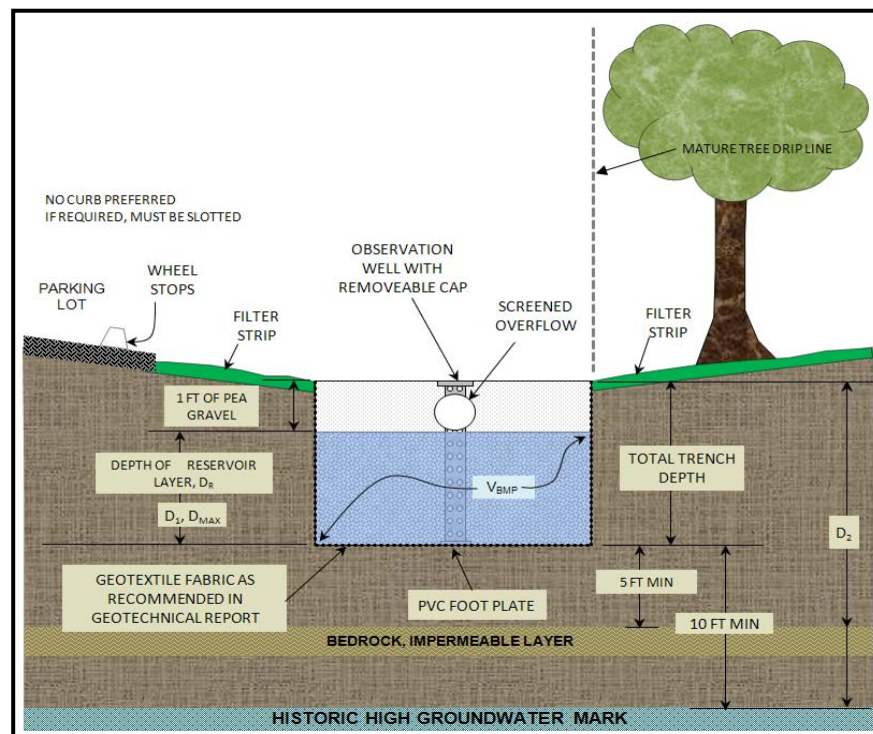


Figure 1 Section View of an Infiltration Trench

INFILTRATION TRENCH BMP FACT SHEET

Sediment Control

Infiltration BMPs have the risk of becoming plugged over time. To prevent this, sediment must be removed before stormwater enters the trench. Both sheet and concentrated flow types have requirements that should be considered in the design of an infiltration trench.

When sheet type flows approach the trench along its length (as illustrated in Figure 2), a vegetated filter strip should be placed between the trench

and the upstream drainage area. The filter strip must be a minimum of 5 feet wide and planted with grasses (preferably native) or covered with mulch.

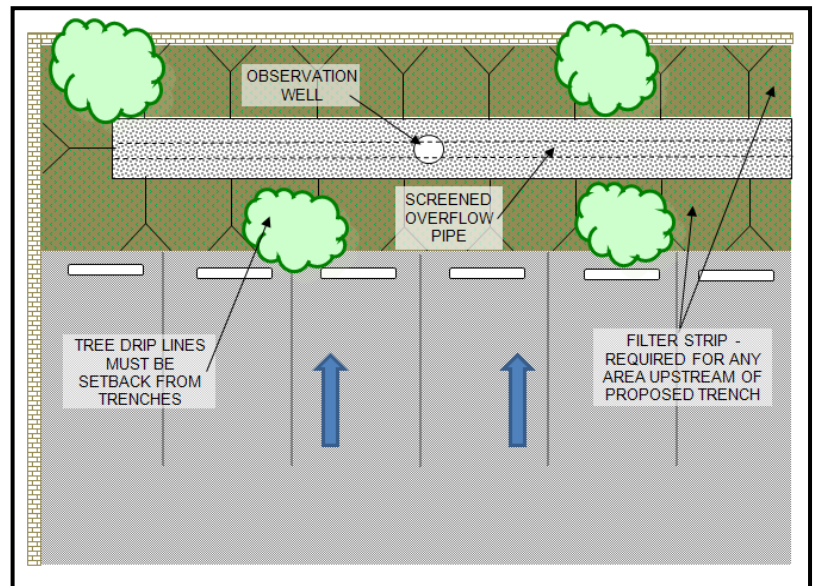


Figure 2 Plan View, Sheet Type Flows

Concentrated flows require a different approach. A 2004 Caltrans BMP Retrofit Report found that flow spreaders recommended in many water quality manuals are ineffective in distributing concentrated flows. As such, concentrated flows should either be directed toward a traditional vegetated swale (as shown on the right side of Figure 3) or to catch basin filters that can remove litter and sediment. Catch basins must discharge runoff as surface flow above the trench; they cannot outlet directly into the reservoir layer of the infiltration trench. If catch basins are used, the short and long term costs of the catch basin filters should be considered.

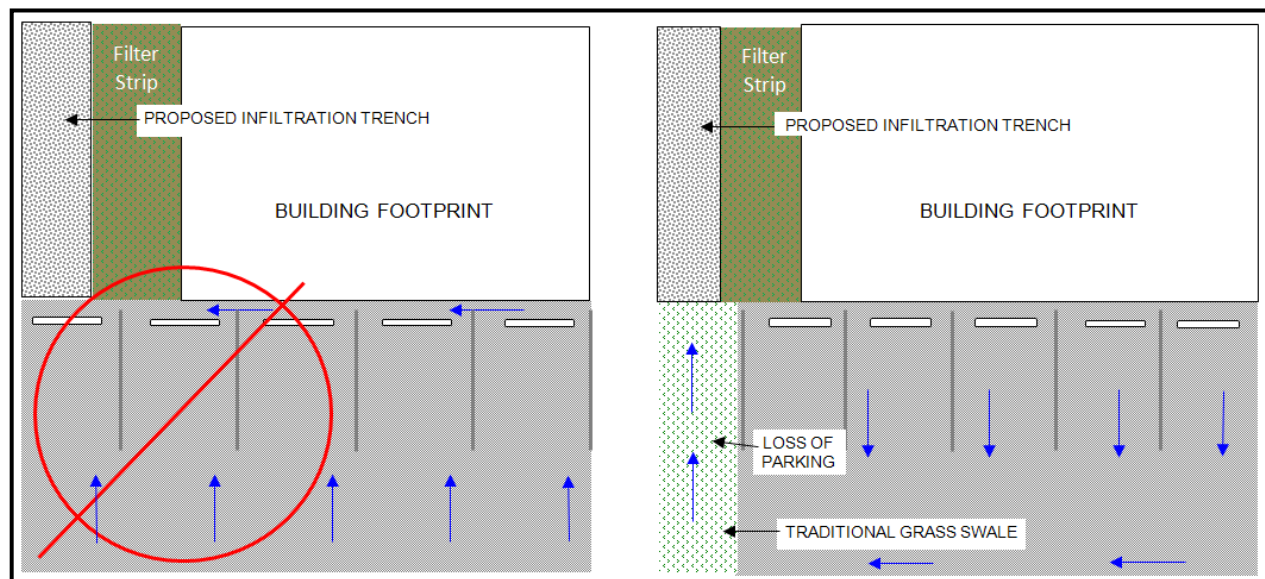


Figure 3 Plan View, Concentrated Flows

INFILTRATION TRENCH BMP FACT SHEET

Additional Considerations

Class V Status

In certain circumstances, for example, if an infiltration trench is “deeper than its widest surface dimension,” or includes an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute fluids below the surface of the ground, it would probably be considered by the EPA to be a Class V injection well. Class V injection wells are subject to regulations and reporting requirements via the Underground Injection Control (UIC) Program. To ensure that infiltration trenches are not considered Class V wells, the design procedure in this manual requires that the trench not be deeper than it is wide.

Geotechnical Report

A geotechnical report must be included for all infiltration trenches. Appendix A of this Handbook entitled “Infiltration Testing Guidelines”, details which types of infiltration tests are acceptable and how many tests or boring logs must be performed. A Geotechnical Report must be submitted in support of all infiltration trenches. Setbacks to walls and foundations must be included in the Geotechnical Report.

Observation Wells

One or more observation wells should be provided. The observation well consists of a vertical section of perforated pipe, 4 to 6 inches in diameter, installed flush with top of trench on a foot plate and have a locking, removable cap.

Overflow

An overflow route is needed to bypass storm flows larger than the V_{BMP} or in the event of clogging. Overflow systems must connect to an acceptable discharge point such as a downstream conveyance system.

Maintenance Access

Normal maintenance of an infiltration trench includes maintenance of the filter strip as well as debris and trash removal from the surface of the trench and filter strip. More substantial maintenance requiring vehicle access may be required every 5 to 10 years. Vehicular access along the length of the swale should be provided to all infiltration trenches. It is preferred that trenches be placed longitudinally along a street or adjacent to a parking lot area. These conditions have high visibility which makes it more likely that the trench will be maintained on a regular basis.

INFILTRATION TRENCH BMP FACT SHEET

Inspection and Maintenance

Schedule	Inspection and Maintenance Activity
Every two weeks, or as often as necessary to maintain a pleasant appearance	- Maintain adjacent landscaped areas. Remove clippings from landscape maintenance activities. - Remove trash & debris
3 days after Major Storm Events	- Check for surface ponding. If ponding is only above the trench, remove, wash and replace pea gravel. May be needed every 5-10 years. - Check observation well for ponding. If the trench becomes plugged, remove rock materials. Provide a fresh infiltration surface by excavating an additional 2-4 inches of soil. Replace the rock materials.

Design and Sizing Criteria

Design Parameter	Design Criteria
Design Volume	V_{BMP}
Design Drawdown time	72 hrs
Maximum Tributary Drainage Area	10 acres
Maximum Trench Depth	8.0 ft
Width to Depth Ratio	Width must be greater than depth
Reservoir Rock Material	AASHTO #3 or 57 material or a clean, washed aggregate 1 to 3-in diameter equivalent
Filter Strip Width	Minimum of 5 feet in the direction of flow for all areas draining to trench
Filter Strip Slope	Max slope = 1%
Filter Strip Materials	Mulch or grasses (non-mowed variety preferred)
Historic High Groundwater Mark	10 ft or more below bottom of trench
Bedrock/Impermeable Layer Setback	5 ft or more below bottom of trench
Tree Setbacks	Mature tree drip line must not overhang the trench
Trench Lining Material	As recommended in Geotechnical Report

INFILTRATION TRENCH BMP FACT SHEET

Infiltration Trench Design Procedure

1. Enter the area tributary to the trench, maximum drainage area is 10 acres.
2. Enter the Design Volume, V_{BMP} , determined from Section 2.1 of this Handbook.
3. Enter the site infiltration rate, found in the geotechnical report.
4. Enter the factor of safety from Table 1 of Appendix A, Infiltration Testing.
5. Determine the maximum reservoir layer depth, D_{MAX} . The value is obtained by taking the smaller of two depth equations but may never exceed 8 feet. The first depth, D_1 is related to the infiltration rate of the soil. The second depth, D_2 , is related to required setbacks to groundwater, bedrock/impermeable layer. These parameters are shown in Figure 1.

Calculate D_1 .

$$D_1 = \frac{I \left(\frac{\text{in}}{\text{hr}} \right) \times 72 \text{ (hrs)}}{12 \left(\frac{\text{in}}{\text{ft}} \right) \times n/100 \times FS}$$

Where:

- I = site infiltration rate (in/hr), found in the geotechnical report
- FS = factor of safety, refer to Appendix A - Infiltration Testing
- n = porosity of the trench material, 40%

Calculate D_2 . Enter the depth to the seasonal high groundwater and bedrock/impermeable layer measured from the finished grade. The spreadsheet checks the minimum setbacks shown in Figure 1 and selects the smallest value. The equations are listed below for those doing hand calculations.

Minimum Setbacks (includes 1 foot for pea gravel):

- = Depth to historic high groundwater mark - 11 feet
- = Depth to impermeable layer - 6 feet

D_2 is the smaller of the two values.

D_{MAX} is the smaller value of D_1 and D_2 , and must be less than or equal to 8 feet.

6. Enter the proposed reservoir layer depth, D_R . The value must be no greater than D_{MAX} .

INFILTRATION TRENCH BMP FACT SHEET

7. Find the required surface area of the trench, A_s . Once D_R is entered, the spreadsheet will calculate the corresponding depth of water and the minimum surface area of the trench.

$$Design\ d_w = D_R \times (n/100) \qquad A_s = \frac{V_{BMP}}{Design\ d_w}$$

Where:

A_s = minimum area required (ft²)

V_{BMP} = BMP storage volume (ft³)

Design d_w = Depth of water in reservoir layer (ft)

8. Enter the proposed design surface area; it must be greater than the minimum surface area.
9. Calculate the minimum trench width. This is to ensure that EPA's Class V Injection well status is not triggered. The total trench depth (shown in Figure 1) includes the upper foot where the overflow pipe is located. The minimum surface dimension is $D_R + 1$ foot.

Additional Items

The following items detailed in the preceding sections should also be addressed in the design.

- Sediment Control
- Geotechnical Report
- Observation well(s)
- Overflow

INFILTRATION TRENCH BMP FACT SHEET

Reference Material

California Stormwater Quality Association. California Stormwater BMP Handbook New Development and Redevelopment. 2003.

County of Los Angeles Department of Public Works. Stormwater BMP Best Management Practice Design and Maintenance Manual for Publicly Maintained Storm Drain Systems. Los Angeles, CA, 2009.

LandSaver Stormwater Management System. Tech Sheet - Porosity of Structural Backfill. 2006.

United States Environmental Protection Agency. Office of Water, Washington D.C. Storm Water Technology Fact Sheet Vegetated Swales. 1999.

United States Environmental Protection Agency. Office of Water. Memorandum on Clarification on Which Stormwater Infiltration Practices/technologies Have the Potential to Be Regulated as "Class V" Wells by Underground Injection Control Program. By Linda Boornazian and Steve Heare. Washington D.C., 2008.

Ventura Countywide Stormwater Quality Management Program. Land Development Guidelines Biofilter Fact Sheet. Ventura, CA, 2001.

Ventura Countywide Stormwater Quality Management Program. Technical Guidance Manual for Stormwater Quality Control Measures. Ventura, CA, 2002.